SELECTED RIVERS OF MINNESOTA

RECREATIONAL ANALYSIS

r contract with MINNESOTA CONSERVATION DEPARTMENT
ST PLANNING AND RESEARCH INC. September 1966

A SURVEY AND ANALYSIS

OF

24 RIVERS IN MINNESOTA

For the Purpose of Recommending Those Which
Should be Considered as the Minnesota Recreational River System.

Prepared By:

Midwest Planning and Research, Inc.

and

St. Paul Office of U. S. G. S.

Summer of 1966

MIDWEST PLANNING AND RESEARCH, INC.
LAND PLANNING AND URBAN RESEARCH CONSULTANTS

1005 west franklin avenue, minneapolis, minn. 55405 • 377-4000

James Hawks
Howard Dahlgren
Barbara Lukermann
Carl Dale
Dale Pollock
Thomas Blum
Robert Hall
John Darling
Bernard Steffen

November 1, 1966

Department of Conservation
Centennial Building
St. Paul, Minnesota 55101

Attention: Mr. Robert Herbst

Gentlemen:

Transmitted herewith is the report of Midwest Planning and Research, Inc. in fulfillment of its obligations to the Department of Conservation, State of Minnesota, under contract dated March 17, 1966 and numbered EC-1658.

Contract specifications called for a reconnaissance study of twenty-four rivers in Minnesota, with primary emphasis placed upon field survey of the canoeability of these rivers and determination of the feasibility and eligibility of each river being a part of an official State Recreational River System. The assignment was limited in scope, both as to time and budgeting and thus the present report is designed as a working or position paper for the Department staff and state legislation to be utilized as the basis for determining further detailed research and analysis which may be needed and along with the material provided by U.S.G.S. as a base for determining the need and control of the Minnesota Recreational River System.

Recognizing the limitations of the study, it is our firm opinion that a vast untapped reservoir of excellent recreational resource exists in these rivers; there would be no hesitation on our part to heartily recommend that a Recreational River System be established and that this pilot study and initial step toward the creation of a State River System for canoe routes be followed up by significant policy decisions and further research. The timing is propitious, the demand for canoeing facilities is swelling rapidly, and the natural resources of the State are plentiful, diverse and distributed throughout most sections of the State.

Our appreciation is here expressed again to all of those persons, agencies and associations who provided us with their time and knowledge. We would be pleased to be of any further assistance towards clarification, interpretation or discussion of recommendations included within the report.

Respectfully submitted,

J. W. Hawks
Principal Planner

JWH:ecd

FOREWORD

The present assignment under contract with the State Conservation Department is extensive, exciting and should stir the spirit of any individual who enjoys exploring the wilderness areas of Minnesota. The contract started in March of 1966 and was scheduled for completion some six months later. During these six months, the twenty-four rivers designated in the contract, having a total combined length of some 2,500 miles were investigated in the field to determine their physical characteristics and eligibility for inclusion within a State Recreational River System. The study has produced an abundance of data and an overall understanding extensive enough to provide direction and present recommendations as to what the second step should be for the future.

Much of the information contained herein was acquired from field investigation, through canoeing the various rivers, hiking and driving over portions of the area extending one mile each side of the river channel (prescribed in the contract as the Water Influence Zone). Data covering user groups, characteristics of the canoe market and physical characteristics of the natural environment were supplemented from secondary sources.

It is our opinion that the rivers of Minnesota comprise one of the largest untapped natural reserves in the Upper Midwest and that the establishment of a Minnesota Recreational River System is indeed needed. The size of the system may, by reason of use, require expansion to include additional rivers or portions of rivers. However, considering the various factors of influence, as further explained in Chapters 3 and 4, it is our recommendation that the seventeen rivers designated be the Minnesota Recreational River System at this time.

ACKNOWLEDGMENT

This report was prepared by the staff of Midwest Planning and Research, Inc. with the assistance of many persons who provided time to discuss experiences on a particular river, to provide a canoe partner on one of the numerous trips and to provide thought in one of the seminars. The following are names of persons we are indebted to: Richmond Brown, U.S.G.S., Robert Ramsted, our field director, Ken Sanders, Robert Lucas, Clyde Ryberg, Uhl Bank, Richard Edie and the many employees of the Conservation Department who provided us with secondary data and firsthand experiences.

CONCLUSIONS AND RECOMMENDATIONS

1. An estimate as to the number of canoes (12,000 - 15,000) in the State of Minnesota, the interest shown by groups from out of state, the increase in leisure time, the money to support recreational activities and the increasing demand to experience a wilderness atmosphere indicates a definite need for additional facilities.

2. Field investigation and supporting secondary data identified a great recreational resource potential in the sum of 15,000 miles of rivers in Minnesota. It is recommended that the State endorse a policy of establishing a Minnesota Recreational River System.

3. Of the 24 rivers surveyed, 13 are recommended for inclusion within the system. Included rivers are:

Big Fork	Kettle	Red Lake
Brule	Little Fork	Rum
Cloquet	Mississippi	St. Croix
Crow Wing	Pigeon	St. Louis
		Vermilion

4. Rivers not included within this recommended system are identified below with a brief description presenting reasons for the decision.

   (a) Basswood River: Located entirely in the canoe country, approximately 16 miles in length and inaccessible by vehicle, this river was not considered significant enough to remove it from the Boundary Waters Canoe Area and list as a part of the State Recreational River System.

   (b) Cannon: The flow of water is such that the river is intermittently canoeable and the degree of development along the river is of such intensity to remove it from a wilderness river consideration.

   (c) Cottonwood River: Elimination due to uncertainty of an adequate water level and at some locations an absolute lack of stream flow.

   (d) Minnesota River: The flow of water is such that the river is intermittently canoeable and the degree of development along the river is of such intensity to remove it from a wilderness river consideration.

   (e) North Fork Crow: This river has many plus qualities for local development and both Wright and Hennepin Counties are working to open the water course for canoeists. It was not included within the State System on grounds that present stream course flows through farmland with fields penetrating to the edge of the river in places leaving no trees. Ravines leading to the stream have been used and still are being used in places for dumps and urban development along the river is quite evident. The flow of water is not sufficient.

   (f) Ottertail: The flow of water is such that the river is intermittently canoeable. The development of the river with dams also makes it undesirable as a river for State-wide use.

   (g) Pine: The flow of water is insufficient.

   (h) Rainy River: This large river suffers from several handicaps which make it less than desirable for canoeing. First, its location relative to the highway and large paper mill in International Falls subjects it to heavy pollution and use by power boats. These conditions are incompatible with the objectives and purpose of the State River System. Secondly, the Rainy is competing with both the Big Fork and Little Fork Rivers in the same general location, thus inclusion can not be justified on the basis that it is the only facility available to serve regional needs. Both the Big Fork and Little Fork can provide superior resources for the same area.

(i) Root River: The flow of water is such that the river is intermittently canoeable and the channel improvement has removed much of the scenic value.

(j) Snake River: The flow of water is insufficient.

(k) Willow River: The flow of water is such that the river is intermittently canoeable and the type of soil along the river is not conducive to intense use.

5. The following objectives, or prerequisites have been considered carefully in arriving at eligibility of a river to enter the system:

1. To include rivers which normally have canoeable waters during the summer season (May 1 through September 10).
2. To include rivers requiring a variety of canoeing skills.
3. To include rivers requiring a variety of camping skills.
4. To include rivers so located as to permit a state-wide service range.
5. To include rivers which will provide a wilderness atmosphere.
6. To include rivers which have historical significance.
7. To provide rivers which can accommodate, with proper development, a large number of canoeists.
8. To include rivers which are unique for their scenic value.

6. Based on the above factors, it would be our recommendation that all water stretches eligible for canoeing, should be designated into one of three categories: (a) expert; (b) experienced; and (c) novice. This categorization relates to the skill level of the potential user, providing him with a fundamental knowledge of the demands which will be placed upon his skills as a canoeist and as a wilderness camper.

7. Based on this principle, the rivers included within the system have been rated according to the table below:

RECOMMENDED RIVER SYSTEM

NAME	NOVICED	EXPERIENCED	EXPERT
Big Fork	x	Muldoon Rapids	
Brule (Not Canoeable)			
Cloquet			x
Crow Wing	x		Spring
Kettle		Avoid Hells Gate	x
Little Fork	x	Cook to Hwy. 65	Hwy. 65 - Little Fork
Mississippi	x		
Pigeon	x	S. Fowl Lake-Ft. Charlotte	
Red Lake		St. Hilaire-Red Lake Falls	Red Lake - St. Hilaire
Rum	x	Princeton - Cambridge	
St. Croix	x		Rapids - Taylors Falls
St. Louis	x	Floodwood-Brookston	
Vermilion (Not recommended for canoeing)			

NOTE: See Figure 11 for further details on the portions of rivers included in the various classifications.

8. Some priority in assignment and development of the proposed river system is mandatory, if available funds are to be utilized expediently and demand levels are to be met in the most efficient manner. An initial priority listing has been developed for your consideration, with rivers placed in rank order and rank I allocated with top priority.

1. Little Fork (Ex. E)
2. Cloquet (Ex.)
3. Rum (N)
4. Kettle (Ex. E)
5. Big Fork (N. Ex. E)
6. Red Lake (Ex. E. N)
7. St. Louis (Ex. N)
8. St. Croix (N)
9. Crow Wing (N)
10. Mississippi (N)
11. Pigeon (Ex.)
12. Vermilion - Not Canoeable
13. Brule - Not Canoeable

9. Action recommended for the State in making the river resources available and open for public use, is primarily one of land acquisition programs. Access to the rivers for entering and leaving and for camp sites must be provided, and it would be our recommendation that the State assume the responsibility and financial burden for this. The identification and ultimate purchase of these access and camp sites should receive high priority, following a decision to proceed with a river system. However, further detailed study of each river must be undertaken in order to make a proper and accurate identification.

10. State level action in developing the Minnesota Rivers for recreation must of necessity be coordinated with many other river interests, including interests and action for flood control, erosion control, ponding for siltation, for water supply, damming for power or maintenance of navigable channels, etc. Coordination with other State agencies and departments will be vital in assuring a proper development program and avoid conflict of interest and actual conflict of purpose. It is our initial opinion that the State Planning Office currently enjoys the most advantageous position for exercising this coordination and assuring compatibility of purpose and development.

11. Responsibility of implementation of any legislative programs to proceed with a State Recreational River System would logically fall within the Department of Conservation where competent and technically trained staff are available and since this is an area of basic concern to the purpose and function of the Department.

12. Clearing of brush, etc. should occur (a) on land which is under State control, (b) on land which has been purchased to open up and assure access to a river in the System or (c) in conjunction with a local organized association. The local association should agree to assume responsibility for camp site maintenance, security, establishment of outfitters and promotion.

13. Wilderness atmosphere and its preservation is, in our opinion, a State responsibility along the rivers in the System. This is an essential attribute of the environment which must not be destroyed as canoe routes are opened up. Preservation of wilderness qualities can be achieved in many ways, running from outright land acquisition along the entire length of a river to a given depth, encouragement of adoption of local zoning laws designed to conserve the natural amenities, or the purchasing of development rights.

14. Action recommended for the State is to officially adopt those rivers classified as wilderness rivers and to take steps which will preserve this characteristic for the future.

15. Over-use and loss of recreational value is a spectre that must be carefully guarded against. Projected demand levels for use of the rivers cannot be quantified at this time since secondary source data is not available. All indications are for a tremendous surge of interest and desire to participate in the canoe market based on projected population increase of the State's population over the next 25 years, and the rapidly increasing number of young persons with backgrounds where canoeing holds a strong appeal. Increasing leisure time and promotion of the State's river resources will rapidly induce out of state visitors to also swell the ranks of the canoe market within Minnesota.

15. Available secondary data indicates that canoeing appeals strongly to the younger age groups who have college or similar educational backgrounds and are engaged in professional or technical occupations. Based on Wisconsin participation levels, Minnesota could anticipate a total for some 220,000 canoe person trips at current population levels, if the natural river resources were made available to the public in a proper manner.

16. The proposed river system contains approximately 2000 miles of waterway. With a limit of 1/2 mile between canoes and no more than six canoes per day past a given stretch, the river system has a theoretical capacity to accommodate some 9000 canoe trips per day, or 1,080,000 trips per year (120 days per year). Assuming two persons per canoe, the system could thus support a market somewhere in the neighborhood of two million persons per year. A more realistic capacity is about half this number, thus, population increase and out of state visits will begin to put pressure on the system unless careful management is exercised.

TABLE OF CONTENTS

SURVEYED RIVER MAPS

LIST OF FIGURES

Chapter 1

INTRODUCTION TO MINNESOTA'S NATURAL SETTING

Occupying a mid-continent position, Minnesota in many respects sits at a crossroads and enjoys diversity of landforms, seasonal climates and contacts with other regions. A part of its land drains north to Hudsons' Bay and Arctic waters; a part flows into the Great Lakes chain and east to the Atlantic; the source waters of the Mississippi River channel southward to the Gulf of Mexico. The Arrowhead country of the northeast, the flat Red River Valley lands, the hummocky and poorly drained moraine country of central Minnesota, the rich black prairie soils of the southwest and the hill and vale country of the southeast provide resources that man has and will use for a variety of economic and social purposes. The mid-continent position assures Minnesota a great range in temperature between the seasons, yet provides no desert regions, no excessive water supply, no territory that is impenetrable or so uncomfortable to man that there will be no demand for its ultimate use.

The cumulative result of geological and climatological processes since the last major ice age provides the State with some areas scraped bare of soil, some areas covered with a thick mantle of the glacial debris of sands, gravel and boulders--but almost everywhere a landscape with a somewhat confused natural drainage pattern. The efforts of man in recent years have been directed to controlling and managing this drainage, for farm cultivation, for urban growth, for control of erosion. Man has also been responsible for vast changes in the landscape and in many instances human action has resulted in the exploitation of the land and water, rather than in its proper utilization and conservation. The huge white pine stands of the south central part of the state and St. Croix Valley can now only be observed in preserved park lands; the north country has been cut over and virgin timber replaced with other species; the prairie sod has been cut and natural grasses replaced with cultivated grains. The landscape that is the setting for an estimated three and a half million people is thus in many areas a man-made landscape, but the State is fortunate in having a vast resource of undeveloped land and river resource that has not yet been fully utilized. The three and a half million population is expected to increase to over six million by the turn of the century and a fixed supply of land and water will have to serve not only the increased demands for economic production and recreational use for residents, but also help meet out-of-state demands for recreation. The challenge facing the State has thus two facets: how to enhance and make available the natural resources of lake, river and woods, and to know in advance what should be done to insure that future development does not lead to exploitation, over-use and conflicts of interest with other economic activities and the needs of generations still to come.

The remaining portion of this chapter will describe in more technical terms the physical forces which in large measure shape the landscape and amenity levels for the 84,068 square miles of land and water that together form the State of Minnesota.

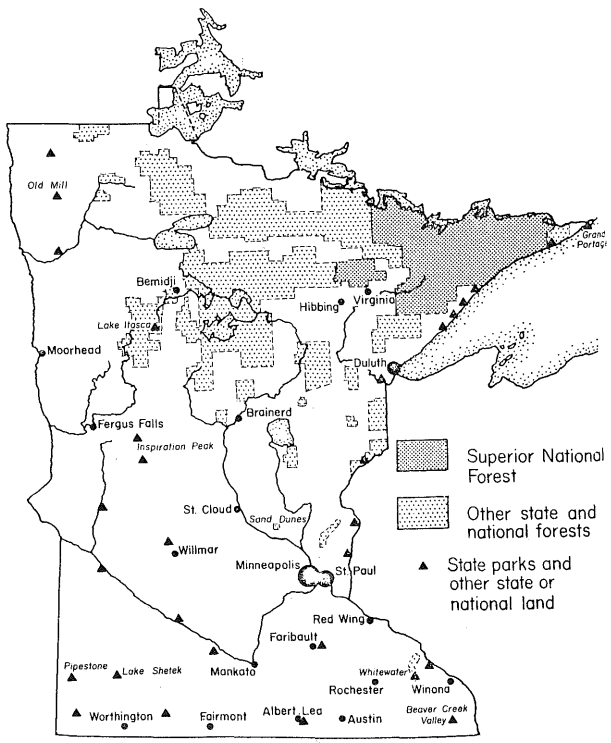


Figure 1
State and National Lands in Minnesota
Source: C-5

LANDFORMS:

Figure 2 is a generalized representation of the major landforms of the State, with five major categories; and except for the rolling plains and deep valleys of the southeast, all result from the effects of former glaciation.

The hill and lake country is glacial moraine land comprised primarily of sand, gravel and boulders. This landform type extends from the Red Lakes in the north to the southern border and includes a vast number of lakes of differing sizes, ridges of differing heights, and has been utilized by man for farming in a variety of ways. Most of the northern portions have little value for agriculture because of the combination of poor thin soils, confused drainage and swamp areas and an extremely short growing season. Toward the south, extended length of the growing season and proximity to increasing numbers of people give greater agriculture value for dairy farming. This hill and lake country is also the region in which most of the large rivers of the State have their source -- the Mississippi River near Itasca, the St. Louis flowing into Lake Superior and many tributaries of the Red River. In effect, the hill and lake country is the great watershed district of the State .

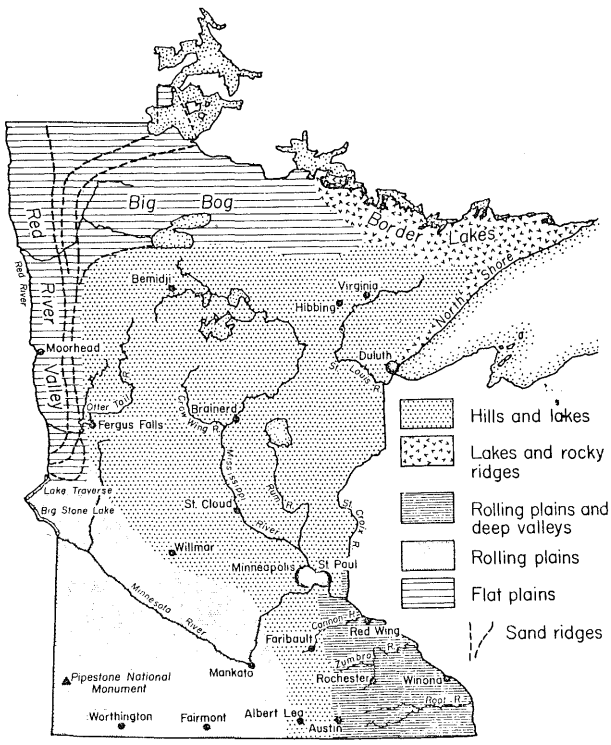
In the southwestern section of the State, the glacial moraine gives way to so called "till plains" formed of finer glacial debris including clay particles as well as sand. This is a vast rolling plain extending beyond state borders into Iowa and South Dakota, enjoying extremely fertile rich black prairie soils and prime agricultural value. Almost no rock outcropping occurs for bedrock is buried deep beneath the glacial deposits. Unlike the Red River Valley, the land is not flat, but gently rolling and in general drainage does not present the difficulties encountered both in the hill and lake country and lake bottom lands of the Red River. Within the southwest prairie lands, the great Minnesota River valley was carved by huge quantities of glacial melt waters, forming a giant valley somewhat incongruous with the volume of water now flowing along its bed. A small narrow ridge of rock outcrops in this area at Pipestone which is now a national monument area, although the outcrop barely shows up as a landform. The southwest plains are Minnesota's share of the great United States "Cornbelt" producing not only corn, but other grains, beef cattle and hog fattening. Farms are large and extremely productive in contrast with the north country described above.

The flat plain of the northwest identified as the Red River Valley and the Big Bog on Figure 2 was formerly the bottom of a huge lake, referred to as Lake Agassiz. The landscape is monotonously flat except for sand ridges which are former beach ridges of this lake. The spill water from this former lake provided the great water volumes responsible for the formation of the Minnesota River Valley. West of the sand ridges small streams drain gently into the Red River over heavy clay soils which are now cultivated for wheat, sugar beets and vegetables. This region of the State is the bonanza farmland; huge farms, highly mechanized with relatively low population densities. East of the sand ridges vast marshes and swamp occupy flat lake bottom plain, and extensive peat bogs have been formed. Water here is cool and clear but colored brownish red by chemicals from rotting plants creating yet more peat bog. Numerous small streams spill out from the bog, flowing west to color the Red River and south to color Red Lake.

The rocky ice-scoured area of the Arrowhead region in northeastern Minnesota is the result of extensive glacial erosion which stripped off the topsoil and ground down the bedrock. The landscape is rough with high forested hills and swiftly flowing streams running into the Great Lakes. Many of these rivers wind through wide deep valleys and are interrupted with high rocky waterfalls. The streams are still cutting deeply into their beds, further dissecting the landscape and cutting back gorges. Away from the north shore of Lake Superior is the Border Lakes country which Minnesota shares with Canada. These lakes differ strikingly from those of the hill and lake country since they rest on hard rock bases and are rimmed with forested and rocky ridges standing above lake levels. There are few sandy beaches that typify the resort lake areas of Park Rapids, Alexandria, Detroit Lakes, etc. The

natural beauty of the region has been preserved, providing Minnesota with one of the few truly wilderness areas of the United States. Preservation and conservation of this wilderness is not only a state concern, but also a national responsibility that has to be matched against other demands for economic return. The Border Lakes country is the canoe country of the state par excellence; it is also a canoe resource that can either be developed with proper regard for its unique qualities, or subject to development which could destroy its value.

Southeastern Minnesota has, by contrast, few lakes although it shares with the northeast a rough and stream dissected landscape. The area was affected little by the continental glaciers -- it received neither the scraping action of the north nor the dumping action of the central portions of the State The landscape has thus been developed principally through the cutting action of rivers channeling back into the hills and deep wide valleys are separated by high broad rolling upland plains. Both levels are cultivated and in early settlement and land division most owners and farmers attempted to include quarter sections of upland as well as bottom land. These high plains end abruptly at the edge of the Mississippi Valley on the eastern border of the State. A few of the deep valleys already lie in State parks -- Beaver Creek, and the Whitewater -- other equally beautiful landscapes and terrain exist outside of committed park lands.



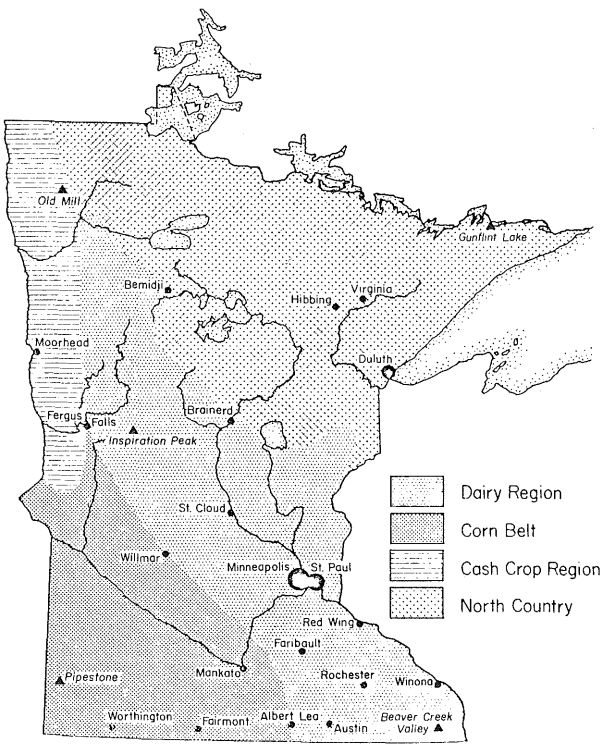


Figure 2
Topography and Farming Areas
Source: C-5

VEGETATION COVER:

The vegetation cover for the State is shown on Figures 3 and 4. The difference between the present day pattern and the original distribution of vegetation types is quite striking. The effects of clearing for agricultural purposes and extensive lumbering operations are easily seen. The extent of the pineries has been greatly reduced and much of the former area occupied by the pines is now forested with second-growth birch, poplar, aspen, spruce and tamarack. The total area occupied by hardwoods has not changed greatly but there have been extensive changes in distribution. Extensive areas of hardwoods have been cleared in southern and west-central Minnesota for agricultural purposes while at the same time, hardwoods have taken over large areas north of the Twin Cities which formerly were occupied by pines and other softwoods.

Softwoods now occupy much more extensive areas than they formerly did as a result of the logging operations which removed the greater part of the large stands of white pine. The present growth tends to be composed of smaller trees in very dense stands. Whereas coniferous trees were once the dominant species, much of the present growth consists of deciduous trees such as poplar.

The boundaries of the prairie region have not changed a great deal except in southeastern Minnesota. Here, much of the original hardwood forest was cleared for cultivation and the land has remained in prairie. While the original vegetation of this area was grass, the present vegetation cover is primarily cultivated. The trees which occur in the prairie were either planted as shelterbelts around farmsteads or grew up along river bottoms where there was an adequate water supply.

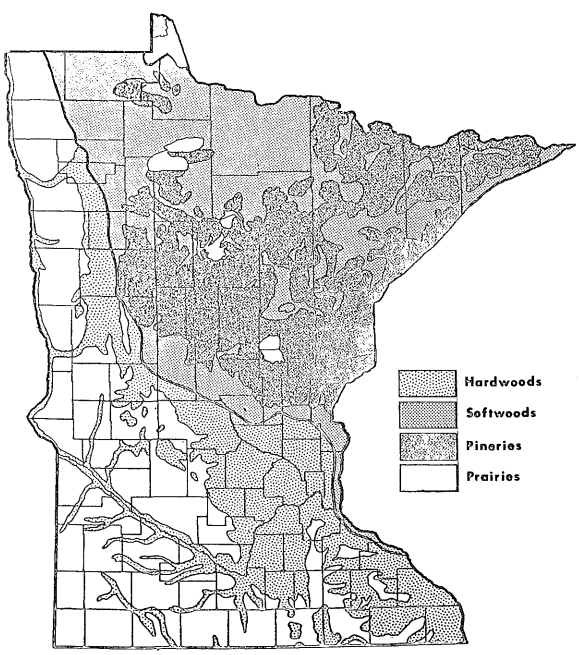


Figure 3
Original Forest Cover in Minnesota
Source: C-5

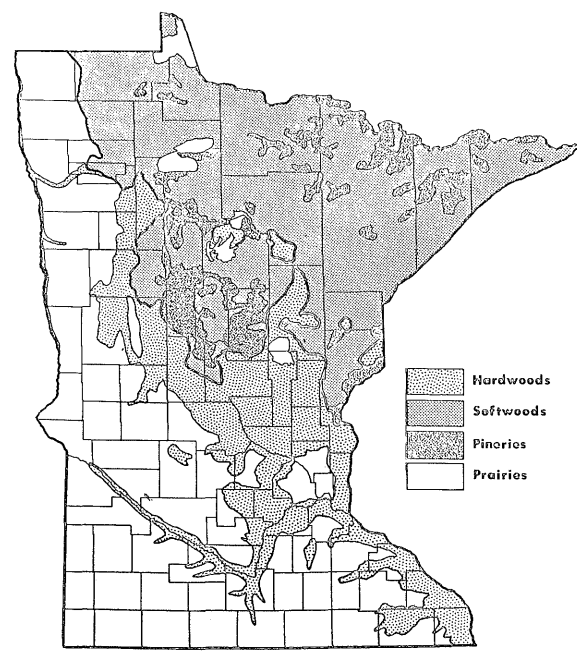


Figure 4
Present Day Forest Cover
Source: C-5

CLIMATOLOGICAL FACTORS:

The amount of rain and snow received in a given year determines water levels for that year and the next. In any rainstorm, a certain amount of water is not absorbed into the ground, thus flows along the surface and into streams. This water is called runoff and is a primary determinant of lake levels and stream flows. Figures 5 and 6 summarize precipitation and runoff patterns in Minnesota. Precipitation generally increases from north to south and from west to east, reflecting the transition from the dry plains to the more humid eastern part of the United States. Only the extreme western edge of the State receives less than 20" of rainfall in an average year.

It is natural that the areas with the highest rainfall will tend to have the highest runoff. This relationship is strengthened in Minnesota by the fact that the areas of highest precipitation are either regions of extensive rock outcroppings or very steep slopes which combine to greatly increase runoff amounts. As a result, lakes and streams in these areas are abundantly supplied with water. This abundance of water maintains lake levels and stream flows at a relatively constant level, with the result that extended periods of low flow are unlikely.

As runoff decreases, the variability of lake levels and stream flows increases. Therefore, in moving westward across the State, the likelihood of finding dry or almost dry water bodies at some time during the year increases. Seasonal fluctuations in water level thus are greatest in western Minnesota with under 4" of average annual runoff.

The temperature regime of Minnesota reflects the "continental climate" of this region, characterized by great temperature extremes and moderate precipitation. These climatic characteristics are due to Minnesota's geographical location, far inland from major oceans. The average annual temperature of the State is 42°, with the coldest month being January and the hottest, July. However, there is considerable variation across the State in any given month. The average January temperature (average between daily highs and lows) ranges from a high of 17° in the extreme southeastern corner of the State, to a low of 2° in the northwestern corner. Average July temperatures range from 59° near Grand Marais on the North Shore to 75° around Winona. The range in the annual average temperature is from 35° in northern Cook County to 46° across the southern quarter of the State.

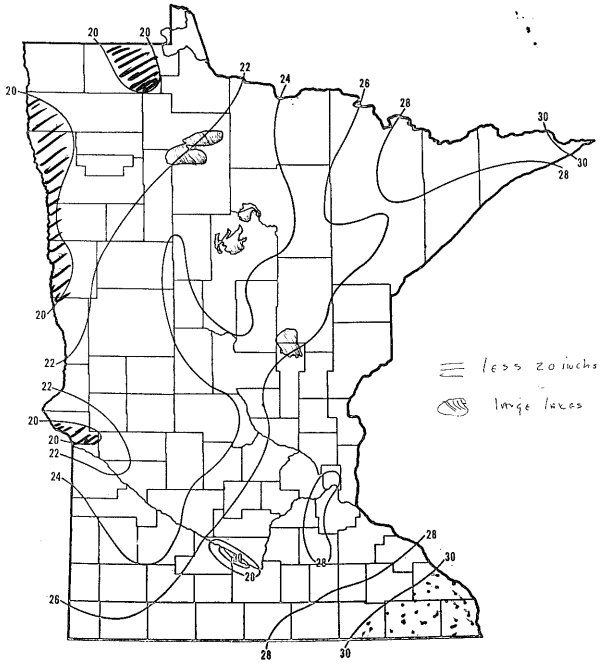


Figure 5
Annual Precipitation
Source: C-5

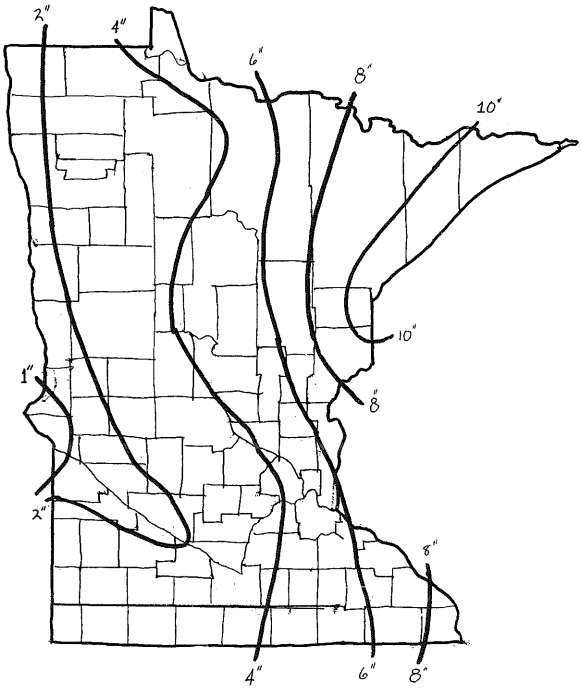
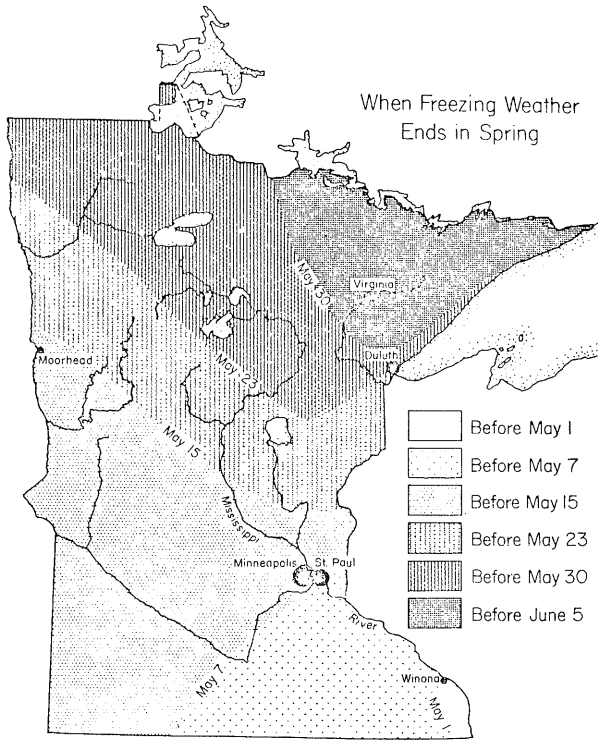
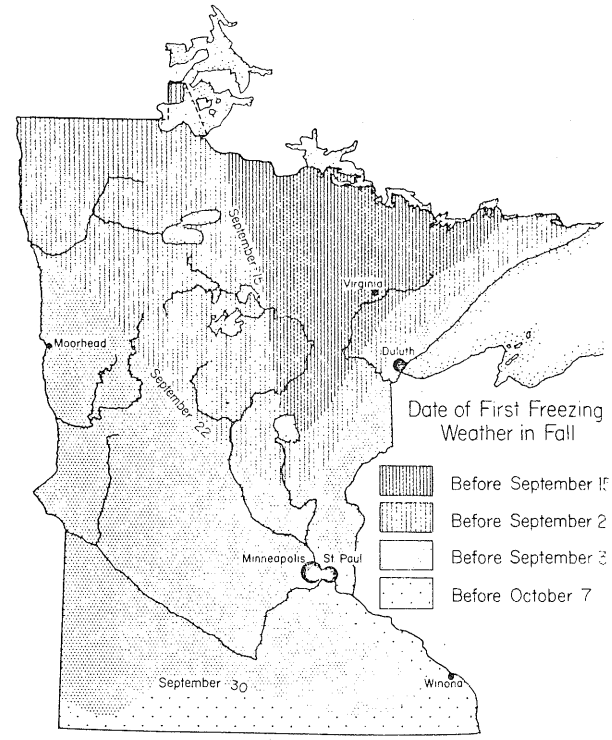
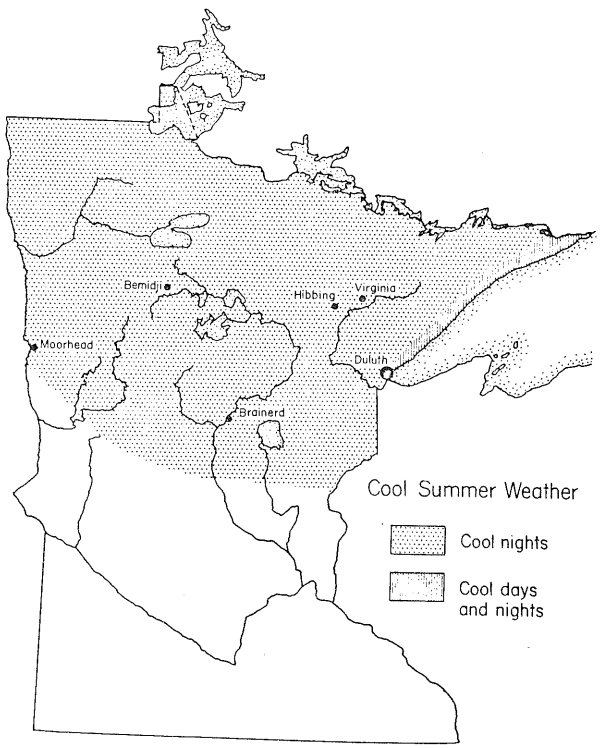


Figure 6
Annual Runoff
Source: C-5

Figure 7 summarizes the implications of climatic conditions for human use in terms of lenath of frost free







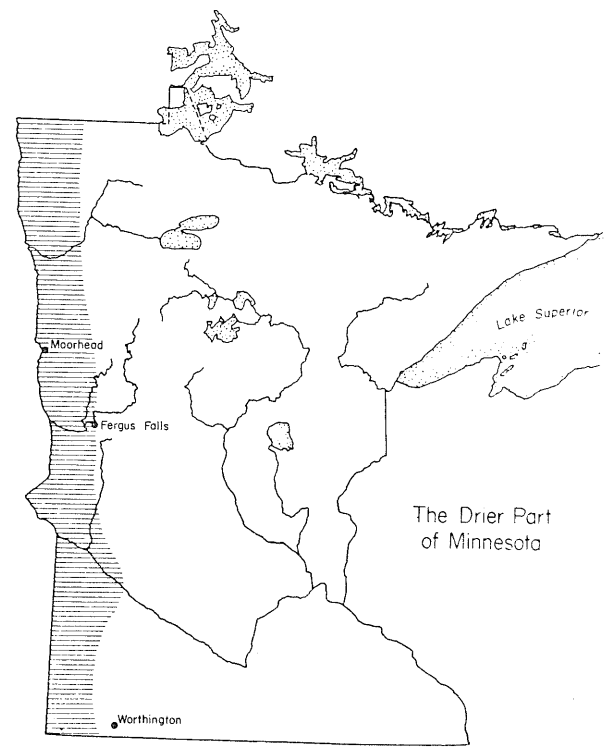


Figure 7
Climatic Conditions
Source: C-5

WATER COURSES:

The diversity of drainage patterns and river characteristics is a result of the complicated geological history of Minnesota. The characteristics of a river depend on the soils, vegetation and topography of the areas it drains. Because of the varied interrelationships among the major physical factors, there are 39 major drainage basins or watershed units within the boundaries of Minnesota. (See Figures 8 and 9) These units may be further combined into 4 major watershed areas; the majority of the State is drained by the Mississippi River and its tributaries; the North Shore is drained by numerous small streams which are located in the drainage basin of the St. Lawrence River; much of northern and western Minnesota is located in the drainage system which ultimately flows into Hudsons' Bay and the southwestern tip of the State is located in the Missouri River Drainage system.

The 39 watershed units in the State are the object of an intensive study conducted by the State of Minnesota whose purpose is to inventory the biological and geological characteristics of the rivers and their drainage basin. These detailed studies will form a basic body of knowledge which will influence decisions regarding the eventual development of each watershed unit.

Present development along the approximately 15,000 miles of rivers and streams in the State is virtually non-existent. Most of the water-oriented recreation activity in the State is centered around lakes, with rivers receiving only passing attention. This may be partially due to the state of many rivers which are polluted by industrial and municipal wastes and whose banks have become public dumping grounds. Future development of our river resources will require enforcement of existing laws and passage of new laws to insure conservation and a high development standard.

Future use of the rivers is likely to differ greatly from past uses. Originally, the rivers acted as the only means of transportation across an uncharted wilderness. First the Indians and later trappers and explorers used the rivers as highways into the interior. Later, the rivers were used for commerce as barges and steamboats plied the waterways of Minnesota. It is only recently that the public has come to view rivers as a possible source of recreation and residential amenity. The increased levels of affluence and mobility which developed after World War II, coupled with shorter work-weeks and increased leisure time have produced a boom in American recreation. This boom has created an unprecedented demand for recreational facilities which, in most cases, have been provided by public agencies. It is likely that

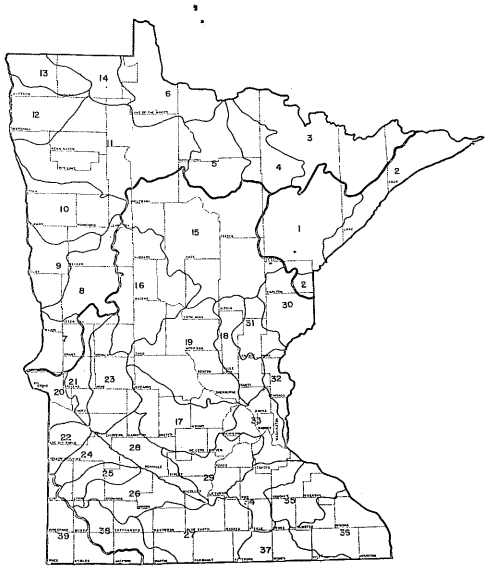


Figure 8
Watershed Units
Source: C-5

future development of recreation facilities will continue to be primarily a function of organized public action and regulation.

The rivers of Minnesota constitute an important recreational and scenic resource for the people of the State and consequently the development of these rivers and their environs should be carefully planned. Continued population growth will decrease the availability of unspoiled areas within the State unless steps are taken to insure their preservation. Nowhere is this more true than in the case of the rivers of Minnesota. The tools for acquiring and preserving areas of scenic and recreational value are numerous, but they must be used now to insure an adequate supply for future generations. Some of these tools are statewide flood plain zoning, scenic easements, outright purchase of desirable areas, State water pollution laws and so on. The tools exist, but it is the responsibility of the people of the State of Minnesota to see that they are used in an intelligent manner.

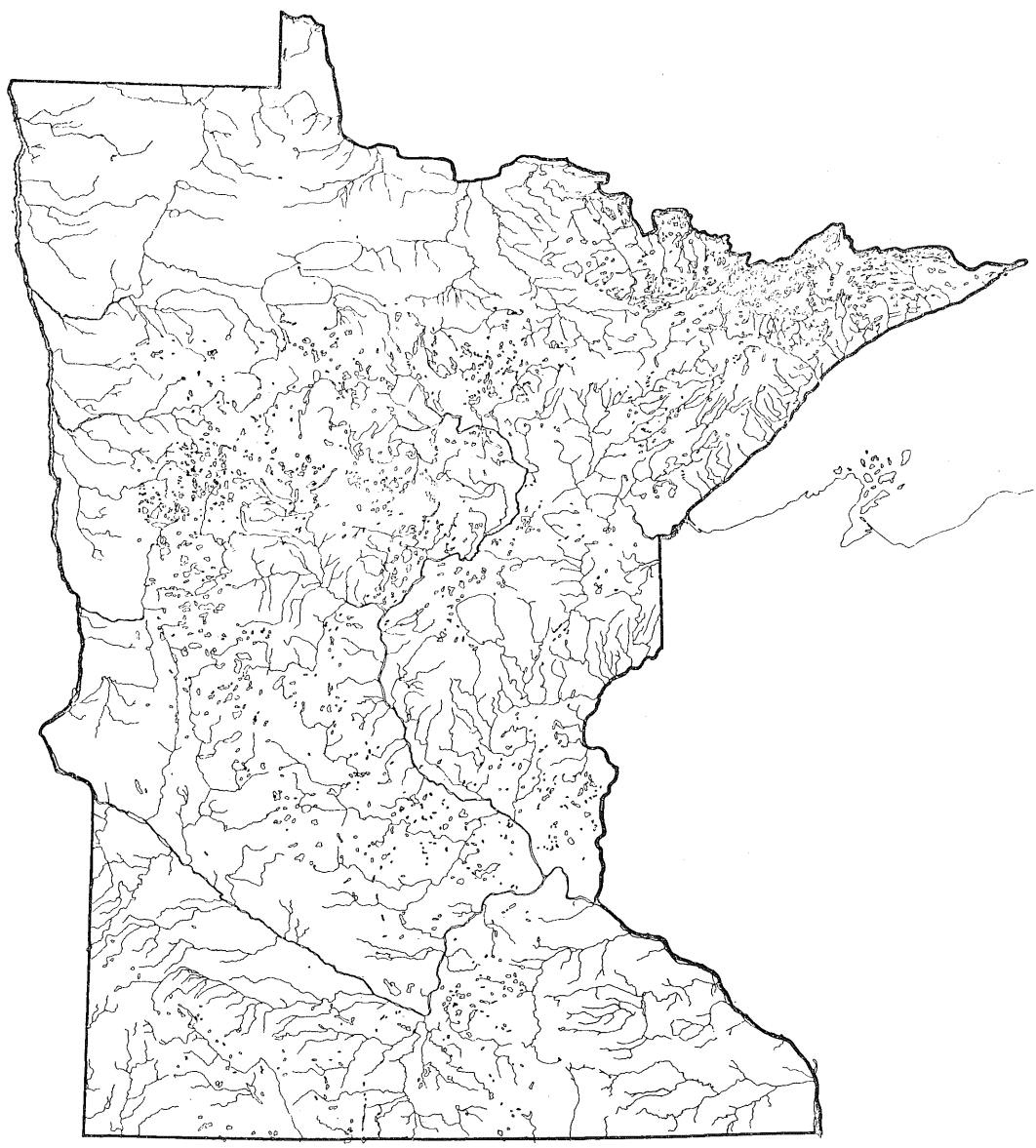


Figure 9
Minnesota's Lakes and Streams
Source: C-5

Chapter 2

USER GROUPS:

This chapter will concern itself with those groups of people who use the rivers of Minnesota. The word "use" in this connection is by necessity broad in scope; it includes not only active and direct use of the rivers, such as boating, fishing and swimming, but also passive and indirect uses, such as the use of rivers for scenic backgrounds to activities such as hiking, picnicking, horesback riding and the like. Thus, the rivers serve two primary recreational functions: one as the "raw material" for certain active types of recreation and the other as a secondary ingredient in various passive or less active recreational types.

While contract specifications call for an analysis of user groups in terms of boaters (and more specifically, canoeists) it was felt that mention should be made of other user groups and their requirements and characteristics in order to provide a more complete picture of the recreational use of Minnesota Rivers. These secondary users consist of a far larger group of people than do boaters and, if for no other reason than sheer weight of numbers, should be mentioned.

THE CANOE USER GROUP:

Two of the primary contributions of the present study are the identification of concepts which are applicable and the raising of questions which are in need of additional research prior to reaching a meaningful answer. The development of the Minnesota Recreational River System will require administrative and financial commitments on the part of the State now and in the future, thus it should be carefully analyzed and a firm foundation of knowledge presented in support of funding for development. This study includes the results of observing in the field each river once and a review of that secondary data which was possible to acquire. The study has provided an overall general understanding of the river resource, characteristics of various rivers and the abutting lands and a sufficient base to recommend a system. However, data as to current use, frequency of use and projected use for various activities is very sparce.

The contract raised a number of interesting questions for which we would like to provide answers with supporting data. The following are questions applicable to user groups:

A. How many persons participate in river canoeing and how rapidly is this number expected to grow in the future?

B. How can these persons be categorized: By social and economic characteristics? Are these characteristics likely to remain constant or are others more likely to enter the market and use the facilities?

C. Is it possible to control the rivers and prevent over-use and gradual destruction of our river recreational value?

E. Should the river resources of the State be viewed in the same fashion as local associations view the resources. Not only as recreational value, but also a potential economic resource to bring tangible economic gain to the local areas?

F. Finally, the question of compatibility of river development for recreation with other established State responsibilities for flood and erosion control, water transportation routes, farming, and also compatibility of canoe recreation with all other types of recreational desires must be further studied so that development proceeds in conjunction with all other established policies.

Trends Affecting the Size of the Canoe User Group:

(1) Increase in Population: the projected increase of Minnesota's population from 3.4 million in 1960 to over 6 million by the year 2000 is an 85% increase simply expanding the size of all age groups. The group aged between 14 years and 34 years (the bulk of the canoe market) over this same period is forecasted to grow to approximately 800,000, accounting for about 2 out of every 10 residents. Twin City metropolitan population by the year 2000 is likely to represent 2/3 of the total State's population.

Such facts as these emphasize a growing population base and an increasing urban population which will seek out recreational opportunities beyond the metropolitan limits.

(2) Increase in Mobility and Affluence: national projections call for the amount of travel to double between 1960 and 1975. Population increases, and increased ability to travel will combine to place increasing pressure on Minnesota's recreational resources. Other projections call for an increased concentration of disposable income in the hands of families earning $10,000 a year or more (one estimate places 3/4 of the total disposable income with these families by 1975). At this income level there is likely to be time and money available to have discretionary spending on leisure activities.

(3) Increase in Leisure Time and Participation in Recreational Activities: specific data is available for the State of Wisconsin, though not for Minnesota, itemizing canoe trip visits. The Wisconsin data identifies an average of some 63 canoe trips per 1000 resident population, and of these trips, 38 are made by Wisconsin residents. Using the same ratio and applying it to Minnesota, there is now a potential canoe market for 220,000 canoe trip visits in Minnesota, likely to increase to 400,000 trips by the end of the century. The potential is not being realized today, however, since the river system is not available. Participation in this recreational activity by other types of persons would make the above figures extremely conservative.

CATEGORIZATION OF THE CANOE USER GROUP:

Canoe user groups can be categorized in the following fashion: those seeking to use lakes or rivers; the skilled and unskilled; the day tripper and the person canoeing on an extended vacation trip; the individual and the group; the resident and the non-resident; the person searching for wilderness experience and the one combining canoeing with sight-seeing or general purpose vacation. In classifying rivers in Chapter 3, it is possible to separate the desires and skills of these groups and satisfactorily meet their divergent needs. The proposed classification system, however, does not cope with the problems of over-use and potential loss of the resource value, nor does it mesh the needs of canoeist with all other recreational user groups.

In developing the State's river resources it will be necessary to recognize two basic types of canoeings: (a) casual canoeing - day outings with no specific destination in mind, which is essentially a resort oriented or city lake oriented type of recreation but one which will undoubtedly veer to the State River System when facilities are made available near major urban areas; and (b) trip canoeing - which in itself can be divided into two parts: the premium sport element where wilderness and challenge from the rugged environment is a prerequisite; and group canoeing which to a lesser extent will also desire secluded waterways and move away from area of heavy use.

Information gathered in 1961 for the Boundary Waters Canoe Area* is the only local study available for documenting characteristics of the canoe user group. This study identifies the following social and economic characteristics as determining participation in canoe recreation:

1. Family Income Level above average -

2. Educational background well above average - likely to be college graduates.

3. Occupation in professional/technical skills - occupations which are "white collar" and essentially sedentary. Occupational groups demanding heavy physical activity as part of daily routine tended to search out more passive types of recreation and activities which would bring more tangible rewards, such as fishing or hunting.

4. Age and Sex - heavier participation in younger age groups, under 35 years.

5. Leisure time available.

The effect of young peoples camp and canoe experience in the Boundary Waters Canoe area was found to be significant, leading to continued participation in canoeing in later life. The national trends for a rapidly increasing professional and technical occupational structure, increased emphasis on further education and increased income and leisure time would thus lead to the conclusion that the canoe user group is likely to grow rapidly in numbers in coming years.

In 1961 25 percent of all recreational visitors to the Boundary Waters Canoe area were canoeists and almost half of these were Minnesota residents. For this specialized type of canoe experience it was also found that the 'draw' extended far beyond state lines, and more out of state persons participated in canoeing than in other types of recreational activity. Further development of Minnesota's river resources for canoe trips would lead one to speculate that between 50 percent and 66 percent of the potential trips would be generated from within the state.

PROPER USE OF RESOURCE FOR THE CANOE USER GROUP

While over-crowding and the potential incapacity to accommodate the demand remains strongly in the minds of those canoeists searching out the wilderness experience, there is nevertheless considerable evidence to demonstrate a tremendous opportunity for the State of Minnesota to make available much of the State's river courses which are now inaccessible for use, without leading to exploitation.

As an interim guide, the following can be used as a formula for determining demand levels and theoretical capacity of the river system to accommodate the demand:

Demand Level Averages: 2 persons per canoe
Daily trip distance - 15 miles maximum
One-half mile distance between canoes
6 canoes a day per water stretch

Theoretical capacity on the proposed system would be over 10,000 canoes per day although a realistic capacity would be less.

*Robert C. Lucas," Recreational Use of the Quetico-Superior Area," U.S. Forest Service Research Paper LS-8, Forest Service, U.S. Department of Agriculture, April, 1964.

SECONDARY USER GROUPS

This group of users, which we have chosen to call the "secondary" group not because of its lesser importance, but rather because of its indirect use of the river resource, constitutes a large and varied segment of the population. A partial list of this group includes campers, hikers, bird watchers, picnickers, horseback riders, and rock climbers. For most of this group, the primary use of the river is appreciation of the scenic and aesthetic qualities which the river has to offer, either as a result of geological or biological features which the river has produced or the effect the river has had on cultural features. In any case, the water course itself is not the primary element being used.

The range of attractions varies from group to group and river to river. Outing clubs, such as the Minnesota Rovers, require different things of rivers depending on the activity. For a rock climbing expedition, the obvious need is for cliffs and bluffs to climb. In most cases, such places are directly associated with rivers, such as the St. Croix Falls or the Mississippi River Bluffs. Other groups require different settings. Bird watching groups need areas which do not present terrain problems but allow easy movement. They also require relatively undisturbed wooded areas. Hiking groups prefer areas where terrain and vegetation are varied, thereby allowing a diversity of experience. Picnickers and campers prefer areas which offer a wide variety of scenic attractions and are not congested, noisy or poorly maintained. Probably the largest group is composed of persons who drive for pleasure. These people are concerned with good access to areas which present a variety of terrain and vegetation and are located within reasonable distance. Horseback riding, which is experiencing a boom in participation, would seem to be an activity well-suited for river areas. The linear character of streams lends itself to the establishment of cross-country trails for riding purposes.

Available data indicates that the following are typical characteristics of some of these secondary groups:

Group	Average Number of Persons/outing	Average length of outings	Favorite Seasons
Bird Watchers	15-20	1 day	April & May
Hikers	40-50	1 day	Fall & Spring
Horseback Riders	40-50	1 day	Fall
Outing Clubs	5-10	Varies with activity	Year Around
Rock Climbers	5-10	1 day	Fall & Spring

Source: Mailed questionnaire survey, Midwest Planning & Research, Inc.

The relative importance of these various activities on a statewide basis can be shown by the following table. All of the activities shown can, in one way or another, be related to the river resource. Obviously, not all of these activities are concentrated on Minnesota's rivers. Much of the water-oriented activity takes place on Minnesota's lakes and portions of all these activities do not relate to rivers. Nevertheless, the table indicates the existing and projected demand for these activities, part of which must be met by the rivers and streams in the State.

ESTIMATED NUMBER OF MINNESOTANS PARTICIPATING IN MAJOR OUTDOOR RECREATION ACTIVITIES, 1960 -

Activity	Persons (000)	Average Days Per Participation	Person Days (000)	Percent of Person Days
Auto Driving for Pleasure	2,526	12.7	32,080	28.8
Outdoor Swimming	1,536	15.5	23,808	21.3
Boating and Canoeing	1,161	14.9	17,299	15.5
Fishing	1,297 (1045)	10.0	12,970	11.6
Picnics	2,560	4.0	10,240	9.2
Hunting	649 (586)	8.0	5,192	4.7
Camping	512	5.7	2,918	2.6
Winter Sports	273	9.8	2,675	2.4
Hiking	580	4.4	2,552	2.3
Horseback Riding	239	7.5	1,793	1.6
TOTALS	11,333		111,527	

PROJECTED PARTICIPATION IN MAJOR OUTDOOR RECREATION ACTIVITIES BY MINNESOTANS, 1976 -

	Persons (000)	Percent Increase 1960-76	Person Days	Percent Increase 1960-76
Auto Driving for Pleasure	3,314	31	49,710	55
Outdoor Swimming	2,149	40	43,625	83
Boating and Canoeing	1,775	52	36,920	113
Fishing	1,978	52	30,650	136
Picnics	3,368	32	15,493	52
Hunting	1,057	63	13,424	158
Camping	1,032	102	10,939	276
Winter Sports	573	110	10,314	285
Hiking	845	46	4,732	85
Horseback Riding	731	206	14,839	730
TOTALS	16,822	49	230,646	107

Source: M.O.R.R.C. Report "Private Enterprise in Recreation"

CONCLUSIONS

The general unavailability of comprehensive, up-to-date information precludes the development of specific projections for any user group. The available data does indicate, however, that levels of demand for various recreational activities are likely to double by 1985. The effect of this demand level on the rivers of the State will depend, to a great extent, on the level of development and availability of specific information for each river. Probably the greatest problem to be resolved is the conflict between the needs and demands of various user groups. Some rivers are not suited for certain types of activities and development must be aimed at those groups who will benefit the most. Other rivers, however, are suited to a wide range of activities and development proposals should be cognizant of this fact. Development of these rivers exclusively for boating and canoeing may deprive other groups of the opportunity to enjoy the natural setting of the river. The placement and spacing of access points, riverside development, condition of the water and many other factors, will all determine the uses for which a given river will be best suited. Careful consideration must be given to all of the factors which will influence the use of the river in order to insure the maximum amount of enjoyment for the maximum number of people.

FISH IN SURVEYED RIVERS

River	FISH								
	Northern Pike	Walleys	Small Mouth Bass	White Bass	Rock Bass	Catfish	Trout	Muskies	Sturgeon
Basswood	X	X	X						
Big Fork									
Brule	X	X					X		
Cannon	X	X							
Cloquet	X	X							
Cottonwood	Very Little Fishing								
North Fork Crow	X								
Crow Wing	X	X			X				
Kettle	X	X	X				X		X
Little Fork		X					X	X	
Minnesota	X	X						X	
Mississippi	X	X						X	
Ottertail	X		X	X					
Pigeon		X							
Pine	X	X							
Rainy	X	X		X					X
Red Lake	X	X							
Root			X			X	X		
Rum	X	X	X						
St. Croix	X	X	X			X		X	X
St. Louis	X	X				X			
Snake	X	X	X			X			X
Vermilion	X	X						X	
Willow	X	X							

Figure 10
Fish in Surveyed Rivers
Source: Stanley Daley

Chapter 3

CLASSIFICATION OF RIVERS:

One of the assignments under the Contract is to establish a method for classifying the various rivers within the study in relation to recreational use. The 24 rivers included in the study are located from the Root River near the southern state line to the Basswood which is the boundary between United States and Canada. The type of terrain, vegetation, geological formation, depth of water, width of stream, and wilderness atmosphere are but some of the variables encountered and considered.

Classification presumes that whatever the subject matter is, that it numbers more than one. Also that a criteria has been established against which judgment may be applied. Rivers have many uses to a wide variety of interest groups and it was found that when used to satisfy one, this use was often in conflict with another. Man's use of Minnesota resources has led in many instances to heavy increases in rate of water run-off to the rivers...through tiling of land, drainage of low areas, or development of urban sites. This increased run-off has caused the flooding abutting land which at times is contrary to those who want to utilize the land. Thus, certain rivers have had the channel straightened to permit the water to flow more rapidly to the next restriction; while others have been widened or dyked to confine the water.

Other interest groups, however, do not want the water to flow from the area except under controlled conditions. Dams have been constructed to retain the water for producing hydroelectric power, to create a lake for recreational boating and swimming, to create a lake for improving the beauty through a community, to assure a flow of water to blend with the sewage plant affluent, to permit barge traffic sufficient depth, to control silting, to provide water supply for communities and irrigation and to protect fish and marine life.

Among the many persons contacted during the survey, a renewed interest in the protecting and preserving of our rivers was noticed. Comments were made about pollution control, dumping and erosion. Preservation was often mentioned but to preserve what we now have is to preserve a certain state of man's exploitation and not nature for it is unlikely that any river has escaped mans effort. Rather than preservation, I believe we should be interested in conservation. Scenic areas, wildlife areas, wilderness areas, unique natural areas and high intensity use areas should be conserved and to do so requires that something be done to protect the values we enjoy and find worth spending money to preserve. Conservation as used herein is the process of establishing controls, policies, programs and development for preserving, i.e., wilderness, canoeability, fishing, water supply, recreational facilities, etc. according to the desires of the citizens of Minnesota.

LEISURE TIME AND RECREATION:

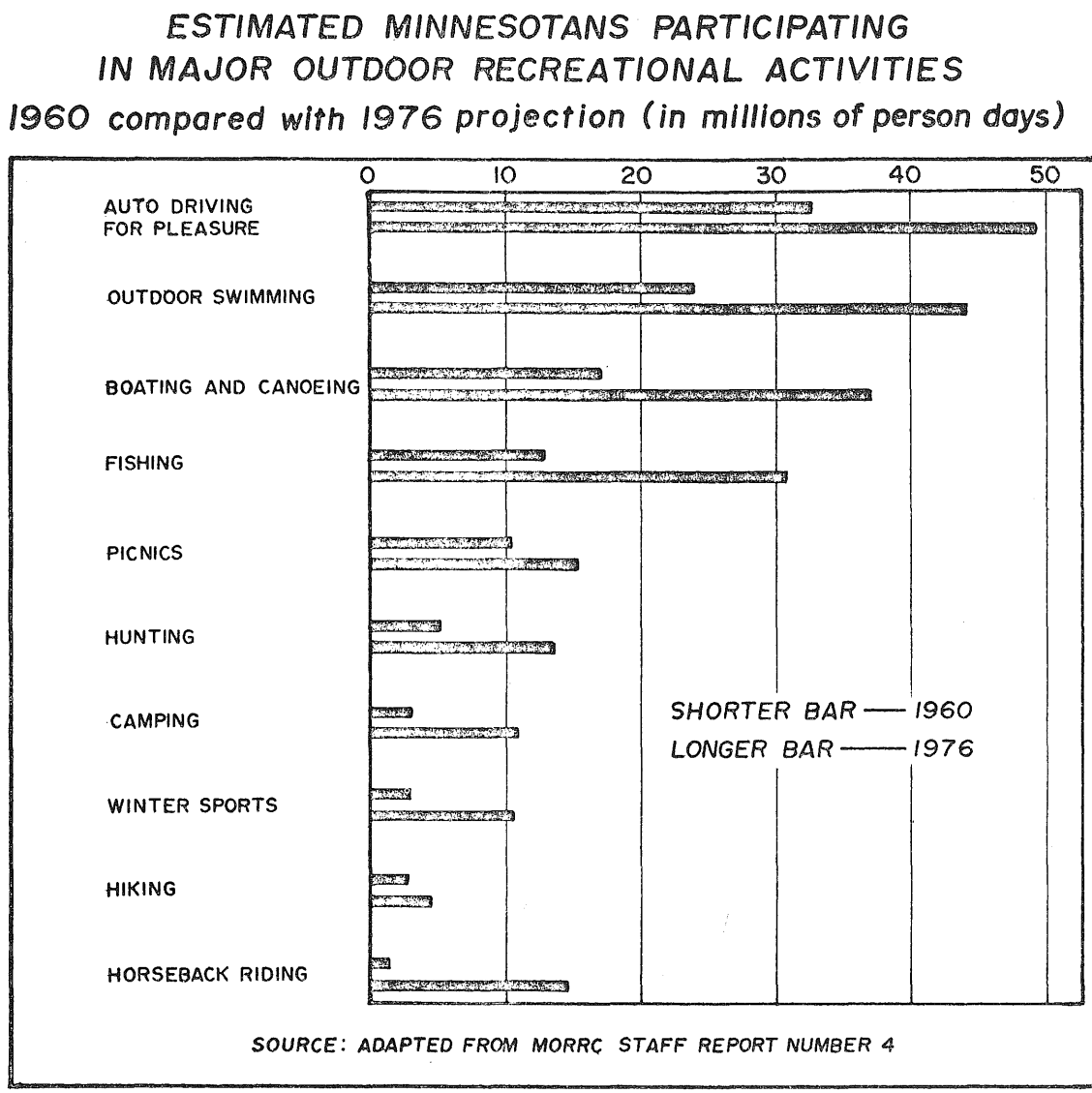
Leisure is that time which a person has after he completes his work and other essential tasks. Recreation is any activity in which one utilizes his leisure. Both leisure and recreation at the adult level are a comparatively recent development for in prior years all of the time and energies of man were required to produce the necessities of life. This uncommitted time is the subject of many articles, papers, seminars and some have referred to it as the crises of our age.

The demand for recreational opportunity is compounded by what appears to be an ever increasing population and an increasing number of leisure hours. The population to be served is composed of the local residents and the visitors or tourists. Minnesota's population alone is expected to increase 1.5 million between 1960-1985 and another 1.3 million by 2000. Each year Minnesota resorts are visited by over .5 million from out-of-state and hundreds of other out-of-state persons own cabins, frequently visit our motels, utilize our camp

grounds and enjoy Minnesota. The State is an important unit of government in providing outdoor recreational facilities and has defined its role on Page 55 of Preliminary Plan as "a provider of large-scale recreational areas of state-wide interest and importance for its citizens." To accommodate the state-wide responsibility for outdoor recreational facilities requires the support and cooperation of all levels of government plus the private and quasi-private effort.

Minnesota is well known for it's 10 - 14,000 lakes, northwoods and fishing and the 4 most popular outdoor recreational activities are so related as shown in Figure . (Page 92 of State Plan)

Minnesota has 7,232,979* acres of recreational land available. Over 6 million acres are classified as Natural Environment Areas and Outstanding Natural Areas. Much of this land is along the many rivers and streams and tends to be remote from population centers.



* Page 128 State Plan

Figure 11
Participation in Outdoor Recreation

Over 50% of the State's population is expected to be in the Twin Cities Metropolitan area by 1970, thus those rivers within the two hours service range are of extreme importance. Canoeing today in the Boundary Waters Canoe Area tends to provide a means for those who want to experience wilderness - an escape from urbanism. The demand has caused some to be concerned that the wilderness atmosphere is in danger. However, many urban dwellers are not at ease with nature and prefer to canoe in groups or where accommodations are more convenient.

OBJECTIVES OF THE CLASSIFICATION:

Within this study, classification is based upon a composite 'recreational value' of the water course for canoeing. The classification is in terms of relative human value, and the ratings designed to consider the personal safety of the potential user as well as the scenic and other physical attributes of the water course itself.

PREREQUISITES OF THE CLASSIFICATION:

The following objectives, or prerequisites have been considered carefully in arriving at eligibility of a river to enter the system:

1. To include rivers which normally have canoeable waters during the summer season (May 1 through September 10).
2. To include rivers requiring a variety of canoeing skills.
3. To include rivers requiring a variety of camping skills.
4. To include rivers so located as to permit a state-wide service range.
5. To include rivers which will provide a wilderness atmosphere.
6. To include rivers which have historical significance.
7. To provide rivers which can accommodate, with proper development, a large number of canoeists.
8. To include rivers which are unique for their scenic value.

ELIGIBILITY OF RIVERS TO BE INCLUDED IN THE SYSTEM:

Out of the 24 rivers surveyed, 13 were judges as being eligible for inclusion within the recommended State Recreation River System, either in part or in total. Those rivers excluded are identified below with brief comments as to reasons for exclusion.

(a) Basswood River: Located entirely in the canoe country, approximately 16 miles in length and inaccessible by vehicle, this river was not considered significant enough to remove it from the Boundary Waters Canoe Area and list as a part of the State Recreation River System.

(b) Cannon: The flow of water is such that the river is intermittently canoeable and the degree of development along the river is of such intensity to remove it from a wilderness river consideration.

(c) Cottonwood River: Elimination due to uncertainty of an adequate water level and at some locations an absolute lack of stream flow.

(d) Minnesota River: The flow of water is such that the river is intermittently canoeable and the degree of development along the river is of such intensity to remove it from a wilderness river consideration.

(e) North Fork Crow: This river has many plus qualities for local development and both Wright and Hennepin Counties are working to open the water course for canoeists. It was not included within the State System on grounds that present stream course flows through farmland with fields penetrating to the edge of the river in places leaving no trees. Ravines leading to the stream have been used and still are being used in places for dumps and urban development along the river is quite evident. The flow of water is not sufficient.

(f) Ottertail: The flow of water is such that the river is intermittently canoeable. The development of the river with dams also makes it undesirable as a river for state-wide use.

(g) Pine: The flow of water is insufficient.

(h) Rainy River: This large river suffers from several handicaps which make it less than desirable for canoeing. First, its location relative to the highway and large paper mill in International Falls subjects it to heavy pollution and use by power boats. These conditions are incompatible with the objectives and purpose of the State River System. Secondly, the Rainy is competing with both the Big Fork and Little Fork Rivers in the same general location, thus inclusion can not be justified on the basis that it is the only facility available to serve regional needs. Both the Big Fork and Little Fork can provide superior resources for the same area.

(i) Root River: The flow of water is such that the river is intermittently canoeable and the channel improvement has removed much of the scenic value.

(j) Snake River: The flow of water is insufficient.

(k) Willow River: The flow of water is such that the river is intermittently canoeable and the type of soil along the river is not conducive to intense use.

PRIMARY SUBCLASSIFICATION CATEGORIES:

For those rivers included within the system, a primary subclassification system has been formulated relating to; one, the natural setting of the river and two, the skill level of potential "users" of the water course.

Wilderness Category - Experiencing a wilderness atmosphere is a pleasure on which many persons place a high value and to assure its availability now and for the future requires careful conservation. Each day that the development remains possible, the preservation is in danger. Thus, we are of the opinion that considerations should be given by the State to establish a policy determining the precise wilderness area to be preserved and the method for assuming preservation.

Twenty-four rivers were surveyed and it was found that ten of the rivers had characteristics which in our opinion would qualify each to be designated as a wilderness river. The factors included to judge wilderness are as follows:

(a) Significant natural and scenic setting.
(b) Significant portions of the river which currently have little or no cultural development.
(c) Significant amount of land within the water influence zone under Federal, State or other public ownership.
(d) River and water influence zones where justification can be shown for multiple purpose use.

The designation of the certain rivers as wilderness would include the water influence zone, (a minimum distance of 660 feet each side of the channel) and the management intent of such areas would be to preserve the wilderness atmosphere. The ten rivers or portions of rivers which we believe should have a wilderness designation are as follows:

1. Big Fork
2. Brule
3. Cloquet
4. Kettle (Below Sandstone)
5. Little Fork
6. Pigeon
7. Red Lake (upper portion)
8. St. Croix (above Taylors Falls)
9. St. Louis
10. Vermilion

State Canoe River Category - The rivers considered in this category are ones which normally have canoeable water during the summer season (May 1 through September 10). Planning is an important part of a canoe trip

and those persons making up the user group require a large variety of conditions. Thus, it is our recommendation that the rivers or portions of river be classified as follows.

(1) EXPERT - Rivers classified as expert should only be canoed by those who have the skill to shoot white-water rapids, cope with fast water, or be able to camp in the wilderness.

(2) EXPERIENCED - Rivers so classified will have some rapids, some fast water and may have one or two days of wilderness.

(3) NOVICE - Rivers so classified are safe for the beginner when observing normal precautions.

NOTE: Life jackets to be worn at all times.

Big Fork
Brule
Cloquet
Crow Wing
Kettle
Little Fork
Mississippi
Pigeon
Red Lake
Rum
St. Croix
St. Louis
Vermilion

This subclassification thus rests on two principal elements of the physical environment: (a) the physical condition of the water which affect and control the personal safety of the conoeist; and (b) the degree of isolation of the water course from outside aid which demands different levels of resourcefulness and individual responsibility in taking the trip.

Both elements relate to "human" or "personal safety" of the user, rather than to absolute qualities of the natural environment in terms of scenic beauty, wildlife resource, wilderness value, etc. It is indeed recognized that classification of all rivers included within the system could be rated and classified according to each of the physical qualities identified above. It would be appropriate for such a classification to be developed by the State in later phases of the development of the Minnesota Rivers.

For this study, it was considered of primary importance to provide a classification which would enable a person, when selecting a particular route or river, to judge the demands that the river will make on his skills, abilities and expectation of recreational rewards. The final tabulation in this chapter thus identifies each river included within the State River System and the ratings that each river or stretch of river may receive according to the classification of expert, experienced or novice.

In addition to the two primary classification of rivers which together are the Minnesota Recreational River System, a number of the other rivers in the survey were found to have sufficient quality to be considered as State canoe streams. The uncertainty of water flow prevented some from being proposed as a desirable river for designation. The following rivers are recommended for designation Regional Canoe Rivers:

1. Cannon
2. Cottonwood
3. Crow
4. Minnesota (Above Mankato)
5. Mississippi (Above Grand Rapids)
6. Ottertail
7. Pine
8. Root
9. Snake
10. Willow

2544 MILE RIVER SYSTEM:

Minnesota has approximately 15,000 miles of rivers, many of which are ideal for canoeing and other types of boating. They have, however, remained dominant in relation to being considered a part of the recreational system. In 1963 the legislature did designate the St. Croix, Little Fork, Big Fork and Minnesota Rivers as official canoe route rivers. In addition, a river system of approximately 2544 miles consisting of 24 rivers was designated for study as possible canoeing and recreational boating rivers.

During the summer of 1966 each of the rivers were investigated by the U.S.G.S. personnel and by Midwest Planning and Research Inc. personnel to determine water quantity, water temperature, water quality, stream flow, stream bed conditions, characteristics of banks, location and intensity of rapids, frequency of wildlife, camp site locations, quality of vegetation, portage locations, availability of drinking water, river abuses and in general the canoeability and recreational quality.

The survey, due to the time permitted under the Contract, only permitted each river to be traveled once with the information and impressions gained being spread from early spring to late fall. A more detailed study is recommended for each river prior to adoption of a capital expenditure program. The survey did provide sufficient comparative data for recommending a desirable and acceptable recreational river system.

A number of outdoor recreational activities are adaptable to the river area and the following are recommended for consideration:

1. Rowboating
2. Motorboating
3. Sailboating
4. Canoeing
5. Swimming
6. Trail Riding
7. Skeet Shooting
8. Picnicking
9. Fishing
10. Trapping
11. Camping
12. Hunting
13. Hiking
14. Tube Floating
15. Bicycle Trails
16. Snowmobile Trails
17. Nature Study
18. Archery
19. Photography

Not all of the various recreational activities are adaptable to each river or to all parts of any one river. Rivers, due to the fluctuation of the water level must also have activities related to the time of year. This factor creates the need for a central information center where an interested person could receive a report as to water conditions similar to what has been made available to skiers as to condition of the snow. The fluctuating water level is a positive asset also for it has tended to preserve the abutting land in a wilderness character.

The survey indicated and verified that the rivers are an exciting undeveloped natural resource currently being utilized by only the heartiest of our outdoorsmen. The pools above the many dams are used for power boating, some communities have provided parks for other activities but in general the facilities available are few. Recently, associations have been developed to accommodate the canoeist and the acceptance has indicated a definite demand which now exists and will increase swiftly in the years ahead.

CLASSIFICATION CHARACTERISTICS:

The group interested in and to be accommodated as canoeist, fisherman and campers on the rivers have a wide range of canoeing skills and reasons for going canoeing. (See Chapter 2 - User Groups)
One difficult problem which must be solved by each canoeist is how to have transportation available at the point of leaving the river. A three day trip could place over 60 miles from one's car. A second problem is supply of safe drinking water. A third problem is camping skills and the fourth is canoeing skills. Those who desire to experience a river canoe trip will have a range of ability to cope with these various problems from the novice to the expert. Another factor which is important is time; it was found that the most common length of time for a trip extended 2 days.

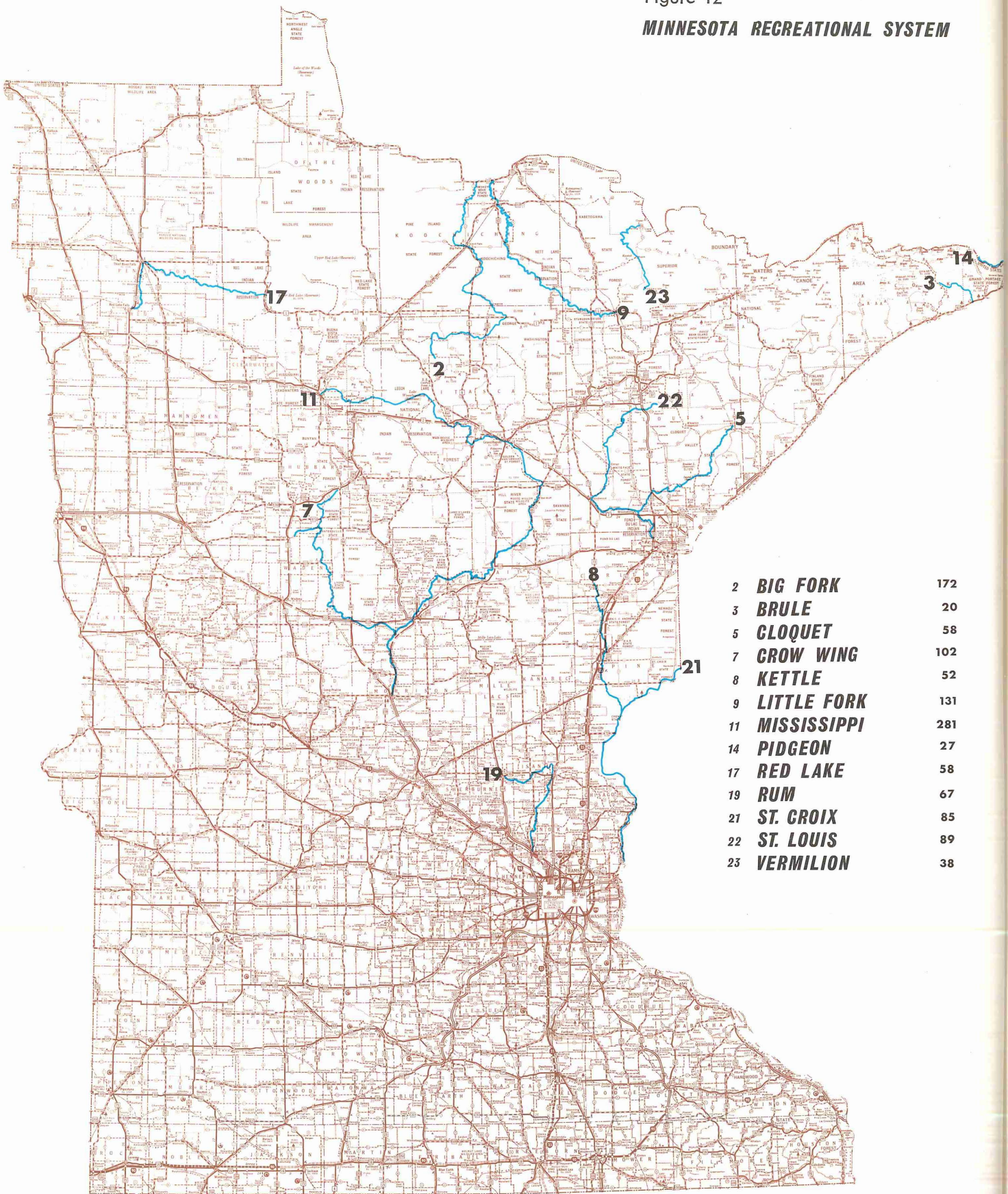
RECOMMENDED RIVER SYSTEM

NAME	NOVICED	EXPERIENCED	EXPERT
Big Fork	x	Muldoon Rapids	
Brule (Not Canoeable)			
Cloquet			x
Crow Wing	x		Spring
Kettle		(Avoid Hells Gate)	x
Little Fork	x	Cook to Hwy. 65	Hwy. 65-Little Fork
Mississippi	x		
Pigeon	x	S. Fowl Lake-Ft. Charlotte	
Red Lake		St. Hilaire-Red Lake Falls	Red Lake-St. Hilaire
Rum	x	Princeton-Cambridge	
St. Croix	x		Rapids-Taylors Falls
St. Louis	x	Floodwood-Brookston	
Vermilion (Not recommended for canoeing)			

NOTE: See Figure 11 for further details on the portions of rivers included in the various classifications.

Figure 12

MINNESOTA RECREATIONAL SYSTEM



2	BIG FORK	172
3	BRULE	20
5	CLOQUET	58
7	CROW WING	102
8	KETTLE	52
9	LITTLE FORK	131
11	MISSISSIPPI	281
14	PIDGEON	27
17	RED LAKE	58
19	RUM	67
21	ST. CROIX	85
22	ST. LOUIS	89
23	VERMILION	38

Chapter 4

PRIORITY OF RIVERS:

In Chapter 3, the method of classifying the various rivers included in this study was presented, and it was recommended that 13 of the 24 rivers assigned and included in the survey be retained in the Minnesota Recreational River System. The rivers were further classified as wilderness and canoe rivers with the latter having sub-classifications of novice, experienced, and expert. The acceptance and designation of the system can be approached as an overall policy consideration but the development of the system, acquiring land, adoption of maintenance procedure and budgeting of money requires programming and priority assignments.

The following factors were considered as the criteria for judging the various rivers for priority assignment:

(1) Wilderness - preservation and conservation of the wilderness atmosphere is important for once it has been removed, replacement is almost impossible. What is wilderness, was asked many times and the opinion appears to be related to past experience and the general day-to-day surroundings of the individual. What one sees is a major factor in formulating this opinion; thus, to maintain a controlled visual corridor along the river will conserve the visual wilderness. However, we also have the factor of noise and the occurrence of man-made noise such as produced by vehicles traveling on highways, voices, domestic farm animals, motor boats, etc., which can be, and are, distracting to many. The control of noise will require a much wider corridor to preserve the noise wilderness. Another factor of wilderness is frequency of evidence that man had penetrated the area in the past. Bridges, fences, buildings, beer cans, newly cut trees, power lines, dumps, improved channels and pipes are examples of the more frequently found non-wilderness uses. This is a much more difficult condition to guide and control, for it is related to the direct use of the river as well as the surrounding area. It is considered important, however, to provide an unoccupied wilderness within the system.

The quality of wilderness is desired, yet the search by private individuals for camp sites, cabin sites, hunting camps and trails to claim and occupy thus assuring themselves a small piece of the wilderness is gradually removing it from the scene. Our increasing population is expected to accelerate private penetration of the woods which, if wilderness is really to be preserved, places a premium on time.

(2) Scenic Setting - the various rivers within the system provide a scenic range from the prairie flatlands to high hills and rock cliffs with a trickle of water to a raging white-water rapids. The personality and mood of the individual will be the determining factor in selecting the scenic value desired for it is possible to select a quiet, slow moving river to float down where the lush green of the willows and elms along the bank form a sun-spotted shade, inviting the canoeist around another bend to a new landscape; or one might select the Kettle River from Sandstone to the St. Croix River, which is many miles of rapids and action.

(3) Proximity - in a recreation system, it is important that the facilities and the user group be carefully related time-wise. The bulk of the State's population is now in the Twin Cities Metropolitan area and the number of people and percentage of the total State's population is expected to increase. Concentrations are located throughout the State, such as Moorhead, Duluth, Pipestone, Albert Lea, Rochester, and others which should also be served by the system.

(4) User Groups Relationship to River Sub-Classifications - the summary indicated that the typical canoe outing was two days with the largest group being classified as "novices." This group also contains large numbers of young people who are dependent upon adults for transportation. Time enters the picture as a major factor for many of the trips are taken on the weekend and to program for cost, time and adult leadership requires nearby facilities.

(5) Supporting Interests - in addition to recreation, a number of other interests in river development, including erosion control, water supply, pollution control, wildlife preservation and flood control are being studied and programmed. Each of the particular agencies tend to be special purpose, which, for overall development, should be coordinated and the new State Planning Office could provide such a function.

The establishment of a priority is approached with the heretofore explanation of factors in mind and on the assumption that if one project could be undertaken, what would it be and what would be the second, etc. Access points, parking areas, camp sites, snagging, mapping, water supply and other improvements can be made whenever the money is available; however, once the wilderness has been penetrated and partially destroyed, it is almost irreplaceable. Thus, the number one priority in our opinion should be an acquisition program of land abutting the rivers or building rights along those rivers which have wilderness now. The three prime wilderness rivers are the Little Fork, the Upper Cloquet, and the Rum from Princeton to Cambridge. The reason for including the Rum is its proximity to the metropolitan area.

Enlarging the perspective judgment of priorities to include two categories: (a) development features, and (b) river characteristics in general, we recommend the following:

Development Features Priority

1. Acquire access points and provide parking sites.
2. Prepare a detailed map indicating camp sites, water supply, rapids, dams, portages, highway bridges, doctors' names and phone in river communities, and outfitters' names. Map to be available to any interested person.
3. Select and develop camp sites.
4. Improve stream conditions (create a "shoot" at old dams, snag river, construct portage paths, etc.)

River Priority Based on Overall Characteristics

1. Little Fork (Ex. E)
2. Cloquet (Ex.)
3. Rum (N)
4. Kettle (Ex. E)
5. Big Fork (N. Ex. E)
6. Red Lake (Ex. E. N)
7. St. Louis (Ex. N)
8. St. Croix (N)
9. Crow Wing (N)
10. Mississippi (N)
11. Pigeon (Ex.)
12. Vermilion - Not Canoeable
13. Brule - Not Canoeable

The 13 rivers in the above priority listing were judged from availability of water during summer season, wilderness characteristics, scenic value, proximity to population and user groups. Four of the rivers will serve the expert (Ex.), seven will serve the experienced (E), six will serve the novice (N). The apparent discrepancy between the 13 rivers listed and the 17 categories of use groups available is explained by the division of some rivers into two or more user categories. The distribution of the 13 rivers to serve the State population is not as desirable as one would like, but the availability of water during the summer season made it necessary to remove some such as the Root. However, the Regional Canoe Rivers System does provide good distribution and will provide easy access throughout the State. Parking areas, access points and camp sites should be provided along the rivers in the Regional Canoe River System.

Chapter 5

IMPROVEMENTS FOR IMMEDIATE USE:

The survey of the 24 rivers in this study documented a direct correlation between use and presence of local canoe and recreation oriented associations. The Crow Wing River, its use being promoted by Crow Wing Canoe Trail Committee, was found to be the most heavily used. Outfitters have been established to serve the canoeist and solve his transportation problem; camp sites have been developed with picnic tables, fireplaces, trash cans, parking areas, access points and drinking water provided, a brochure including a map has been prepared and promotional activities have been undertaken. In addition, trail rides have been incorporated into the recreational opportunities along the river with snowmobile trails during the winter. This effort has, according to the estimates, attracted over 5,000 persons in 1966. The Crow Wing is not alone however, for the Big Fork has the Big Fork Canoe Trail Association, the Mississippi River has Aitkin County Park Commission, and the Root River has a Canoe Trail Association; all of which are showing an annual increase in use of the river for recreation.

As previously mentioned in this report, the development of the various rivers in the Minnesota Recreational River System should be a joint effort between local interest of private enterprise and the State of Minnesota. It has also been recommended that the State assume the responsibility for acquiring access sites with parking space, camp sites and to provide development monies with development monies allocated in relation to a local operational and promotion program agreement. However, as a necessity and, I anticipate an inspirational spark, it is considered advantageous to undertake certain positive steps quickly and prior to local interest and commitment.

The Twin Cities Metropolitan area has 1.7 million persons which is increasing some 40,000 each year. An increasing number of these people desire to experience canoeing, especially over the 2 day weekend, thus improvements which will accommodate this desire are recommended. Another consideration is the demands which are being placed on the "Boundary Water Canoe Area." The emphasis throughout the Boundary Waters is wilderness which has been defined as a minimum - out-of-sight and out-of-sound of other persons. The Boundary Water area is being conserved to provide a wilderness experience, an event which is becoming more difficult each year. Many persons have expressed concern over the large number of persons, estimated at 78,000 last year, which use the area during the short season. Over 10,000 persons canoed Moose Lake in 1961 which is of such density that the wilderness atmosphere cannot exist. The typical canoe party in the Boundary Water Area averages between 4 and 5 days per trip while it was found that the 2 day trip was most prevalent on the rivers. However, it is expected that once the Recreational River System is made known and access areas are provided, some of those parties now canoeing only in the Boundary Water Area will utilize the rivers.

WILDERNESS:

The preservation of wilderness is the number one priority for it is extremely difficult to recreate, it will provide an experience which many persons indicated they preferred and enjoyed and each day of delay finds another portion of the existing wilderness reduced by development. The preservation may occur by utilizing three methods; acquire ownership, acquire building and management rights within the water influence zone and by zoning at the State level that land along those rivers within the Minnesota Recreational River System.

MAPPING:

Planning is an important part of a canoe outing and can spell the difference between a safe and happy experience and a dangerous unpleasant event. A good map should be prepared and made available indicating location of facilities and reliable distances for each river. Data can be acquired to produce such a map for each river and this is our priority two recommendation.

ACCESS:

All rivers have access at locations where bridges exist and normally one can park on the shoulder near the bridge. Some of these access points are only for the hardy due to steep banks, heavy woods, wet areas, high weeds, fences, etc. and the frequency of bridges is sometimes inconvenient. Also parking on the road for any length of time is dangerous to the traveling public and unsafe for the owner of the vehicle. Access points should be located on a parcel of land large enough to accommodate parking, picnicking, camping and protection from potential urbanism. The location of access points should be a logical starting point for a one or more day trip. It is also recommended that the person intending to park his vehicle over a period of time in one of these access locations be permitted, under an established procedure, to pick up a tag from the local sheriff or police which may be displayed and the procedure will also place the sheriff or police on notice to inspect the site.

RECOMMENDED ACCESS IMPROVEMENTS NEAR TWIN CITY METROPOLITAN AREA:

River	Location
Rum	Southwest quadrant - St. Francis Bridge
Rum	Bridge at Highway 47
St. Croix	Highway 22
St. Croix	Highway 70
Kettle	Highway 61
Kettle	Highway 48

REGIONAL SYSTEM:

Cannon	Northwest quadrant-Highway 50 Bridge
Cannon	South of Sewage Plant

ACCESS IMPROVEMENTS - "OUT STATE:"

St. Louis	Floodwood
St. Louis	Brookston
Red Lake	Red Lake Falls
Red Lake	St. Hilaire
Cloquet	Highway 52
Cloquet	Highway 274
Mississippi	Below dam at Grand Rapids

REGIONAL SYSTEM:

Root	Lanesboro
Root	Rushford

The access points as herein listed are minimum and when developed for use will permit the river to have assured access. They are located so as to provide accommodations for the various levels of canoeing skills as well as to provide geographic distribution.

Development beyond this minimum is proposed to be coordinated with local interest and willingness to provide leadership and organizational effort. Those rivers which have not been included have access points and are in position to have local interests request for cooperative development help in conjunction with the State.

CAMP SITES:

Improvements beyond mapping and minimum access are recommended to be programmed in accordance with local interest groups. However, it is recognized that technical and design assistance would be desirable and that the Conservation Department has such talent in it's employment. Thus, it is recommended that the State prepare specifications and plans for various development items such as picnic tables, fireplaces, outhouses, road access sections, etc. which may be acquired by local interest groups. The detailed plans for a site should remain a local effort but plans for the elements would be useful. The spacing of camp sites on rivers classified as "Novice" should be approximately 7 miles and some would not have vehicular access. "Experienced" classified rivers should have camp sites about 15 miles and "Expert" rivers would only have access point camp sites since development of such a river to a greater extent could remove its characteristic and cause a reclassification to "Experienced" or "Novice."

MILE MARKERS:

The subject of mile markers has been brought up a number of times on the premise that they would permit a person to identify his position on a map of the river. However, it was found that where it had been tried, the signs become the target for those persons misusing a gun and those persons who enjoy nullifying others' efforts by removing the signs or mislocating them. The misuse of guns also showed up in killing of turtles, muskrats, squirrels and shooting holes in trash cans, outhouses, etc. Serious thought should be given to prohibiting guns except during hunting season.

Mile markers should not be necessary if an adequate map is prepared which will identify natural features along the river for locational purposes.

WATER CONTROL:

Certain rivers have the water flow controlled by dams which produce hydroelectric power and the flow does not coordinate with canoeing.

One river in particular is the Cannon from Cannon Falls to Red Wing. This is a very attractive and scenic portion of the river and it is recommended that the State attempt to assure a water flow during the summer weekends.

Other improvements could be made. However, it is our opinion that a precise study of each river take place which would produce a detailed map, a land ownership record for abutting land, precise location and intensity of rapids for various volumes of water flow, location and length of portages and recommended camp site parcels prior to establishing a program for development of and funding. Another service which should be considered is a Central Information Center where a person could obtain data about the water flow conditions for a particular river similar to what is now available for ski conditions at various hills.

Chapter 6

STANDARDS OF ADMINISTRATION AND SUGGESTED ASSIGNMENT:

The broad commitment of the contract states that we are to recommend for consideration appropriate standards for the administration of the Minnesota Recreational River System and also to suggest which major department in the State of Minnesota government's framework could logically provide necessary service. To analize the framework of such a decision is a major study in its own right, however, we believe the following information in this chapter will provide direction and will be helpful in developing a decision.

The Minnesota Recreational River System as proposed will give recognized state status to 13 rivers and in so doing, some responsibility will be assumed. In 1963, under Chapter 386, Minnesota Legislature designated 4 rivers as official canoe routes. The rivers are the St. Croix, Little Fork, Big Fork and the Minnesota. Under this law, the Commissioner of Conservation has the authority to mark these routes and to enter into agreements with agencies and private landowners along the routes for development of camp sites. In addition, legislation under Section 97.48 gives the Commissioner of Conservation the authority to establish public access to the rivers and streams.

This study by Midwest Planning & Research and the U.S.G.S. Office provides a preliminary analysis and survey of 24 rivers which have potential for being added to the recreational designation as canoe rivers, wilderness trails, hiking trails, etc. Our findings, as indicated in Chapter 3, proposes that the Minnesota Recreational River System include all or parts of 13 rivers, 3 of which were previously designated by the Legislature as official canoe rivers.

It is possible to launch a canoe and enjoy wilderness and fishing in backwaters without any administration and development of a river system. The heartier individual will always find some way of achieving this recreational goal. However, the population is made up of a wide cross section of persons who do have an interest and desire to enjoy the rivers and prefer development and access of a public nature. Increased use of wilderness areas requires that decisions be made as to which roads to use, where automobiles will be parked, which camp sites will be used, where the river should be entered, where fires shall be made. Compounded individual decisions without guidance and control can quickly destroy the atmosphere that made a location desirable in the first instance. Official publication of the Minnesota Recreational River System will place many people on notice that the rivers are available and will encourage them to use the facilities. It is thus imperative that standards of development and methods of administration be developed for the system prior to such official action.

In observing the various rivers within the study as to various types of use, the frequency of use and the type of individual on the river, it was obvious that there is correlation between these factors and the intensity of development facilities for solving some of the problems which one faces when intending to use the river for recreation. Portions of rivers within the corporate limits of communities having 2,500 people or more tended to receive attention by the city or the efforts of private enterprise in providing boat landings or swimming beaches. Often the dams are located within this portion of the river creating a pool which is sufficient to accommodate power boats and where this is true it is customary to find an improved boat launching ramp. However, within the corporate limits of municipalities are found numerous instances of river bank abuses such as dumps, the remains of old piers, erosion problems and sanitary and storm water pipes discharging various degrees of polluted water. The state enabling legislation permits all communities to adopt zoning regulations, a part of which could be floodplain zonings that would tend to prevent many of the abuses although the majority of the communities have not followed this opportunity to control the river banks through their community.

The Water Pollution Commission has recently become concerned over the use of the river as a method of disposing the waste water and material, this concern should have an upgrading affect. It is difficult to judge whether communities in the future will be more serious and show an appreciation for the river as a natural asset and, in turn, take steps to control development or whether a solution should be considered at a higher level of government such as the County or the State. At this time, however, I believe conditions to be serious enough that the State should take under study the possibility of adopting state-wide floodplain zoning which would establish minimums for any community and some communities, if they adopt an ordinance which incorporates the minimum State standards, could in turn be the administer of the zoning ordinance. Otherwise it could be administered at the State level.

RIVER USE:

Each of the rivers within the survey were canoed and investigated during the spring and summer of 1966 and the findings definitely indicated that those rivers which had a Canoe Association or River Development Association, which in turn was backed up by one or more canoe outfitters, received the most use. Why this is true may be rationalized in a number of different ways such as the following:

A. One of the responsibilities of the Association is to prepare a brochure and publicize the fact that a group of individuals wants people from out of the area to canoe on their river.

B. The Associations have realized that in order to make more than a one-day trip on the rivers necessitates the locating of a camp site and camp sites have been provided.

C. One major problem facing all canoeists is what to do with the car and how to have the car available at such time as one desires to leave the river. The inconvenience of not having the car at the point where you wish to land is a part of the problem but this can be solved when two cars are included and a party of two canoes is undertaking a trip; however, the safety of parking a car in the woods for two, three or four days cannot be solved by having two cars in a canoe party. The outfitters on the most highly used rivers have solved this problem by providing a service of security to the car and transporting the automobile to your intended landing spot or picking up the canoe and bringing you back to the car.

D. One of the secrets to a successful canoe trip is planning. Plan where you want to go, how far, what to take, what not to take, and what you may anticipate along the way. On most of the rivers a map is not available to permit you to do this preliminary planning but this has been solved on most of the rivers which have an organized Association, for they do have a map and often a rather elaborate and detailed brochure. Many of the areas which have undertaken a program for accommodating those who want to use the rivers for recreational purposes have, as a basic goal, an economic improvement to the area, thus success is measured in numbers.

At this point the question must be asked as to the intent of establishing the State Recreational Rivers System and whether or not the intent can be carried out with the aid of local Associations which have economics as their driving force. Standards of development and standards of administration both must be considered in developing an answer to such a question. In addition to the positive benefits observed in the success of the Association to encourage and accommodate canoeists, there were some negative factors. Vandalism was a major concern with the following being examples of what has taken place.

* The camp site was cleared and provided with tables, fireplaces, parking area, and outhouses and, in turn to make it easier for the canoeist and to discourage indiscriminate cutting, cut fireplace wood was provided at the site. However, it was found that people would take the wood or set the entire woodpile afire thus the policy was changed to merely locating dead branches on the camp site.

* Extremely poor judgment was noticed in the use of firearms. One Association went to the trouble of locating mile markers and also indicating the camp sites with a sign since the sites

have been located somewhat back from the river so as not to cause infringement of the wilderness on the river and nearly all of the signs were found to have been shot full of holes. One old-timer was very unhappy for he indicated to us that since the river had become populated for canoeing the wildlife was disappearing, he had found turtles shot, muskrats that had been shot, and birds of various types. Misuse of firearms was serious enough that it is recommended the State consider prohibiting firearms be taken in a canoe except during hunting season.

STANDARDS FOR CONSIDERATION:

The use of the river requires access. The desirability of the river requires a natural setting. The conservation of the river requires development control and the popularity of the river appears to require local acceptance. As a means of accomplishing these various goals, it is recommended that the following procedures be given study for adoption.

a. That the State assume the responsibility of acquiring necessary access points.
b. That the State assume responsibility for preserving the wilderness characteristics of certain rivers.
c. That the State assume the responsibility for regulating cultural development within the water influence zone such as dams, power lines, timber cutting, fencing, sewage disposal plants, dumping and highway locations.
d. That the State adopt a water influence zone along those rivers in the system of at least 660 feet.
e. That the State build an access road to the camp site.
f. That the State accept the responsibility for providing safety improvements such as developing portages, signing dams and rapids, marking channels through marshland, reducing snags to acceptable conditions and preparing maps for rivers.
g. That the State adopt a policy of matching dollars with a local Community Association for the development of the access points or camp sites where the Association would be given financial credit for (a) producing a river recreational brochure, (b) conducting publicity, (c) taking care of the trash from the camp site, (d) providing police protection, and (e) assuring that outfitters will be in operation in the area with a program to solve the security of the automobile and the bringing together the canoe and the automobile of the canoeist.

ADMINISTRATIVE ASSIGNMENT:

The one department within the present structure of the State Government which currently has talent, experience, and knowhow for planning, constructing and maintaining such a facility as the Minnesota Recreational River System is the Conservation Department. The only other approach which one might take is to establish a special commission to administer and watch over the Minnesota Recreational River System and it would be necessary for such a commission to contract for the services needed or to build a staff very similar to the staff which the Conservation Department currently has.

RIVER INDEX

		MILES
1	BASSWOOD	8
2	BIG FORK	172
3	BRULE	20
4	CANNON	72
5	CLOQUET	58
6	COTTONWOOD	54
7	CROW WING	102
8	KETTLE	52
9	LITTLE FORK	131
10	MINNESOTA	262
11	MISSISSIPPI	369
12	NORTH FORK CROW	89
13	OTTERTAIL	114
14	PIDGEON	27
15	PINE	31
16	RAINY	70
17	RED LAKE	163
18	ROOT	77
19	RUM	67
20	SNAKE	76
21	ST. CROIX	120
22	ST. LOUIS	89
23	VERMILLION	38
24	WILLOW	37

CHAPTER 7

On March 25, 1966, Midwest Planning and Research, Inc. signed a contract to survey specific portions of 24 specified rivers in Minnesota. The combined length of the survey distance according to estimated distances provided by the Conservation Department was 2600 miles. The survey was to be completed, analyzed and delivered in draft form within 180 days. It is easy to see that the undertaking is of major proportions.

Various sources of maps were investigated with the hope and anticipation that the river areas had been mapped since it was necessary to have a base map which could be taken into the field for reference as well as one on which to record data. All of some rivers and portions of others were covered by the U.S.G.S. Map Service although not necessarily at the same scale. Many sources of data and maps were discovered but the only consistent base which had statewide coverage was the county maps prepared by the State Highway Department. Thus, this became our base map. Reference was made as to the length of the various rivers in the many reports reviewed, however, some difference of opinion is evident since the length of a river in "water miles" varies from report to report. We do not know the river miles between points; however, accepting the base map as drawn, we have indicated mile markers to a refined degree for purposes of indexing the river (see summary).

For purposes of indexing the rivers they have been arranged alphabetically and numbered 1 to 24. The material in the appendix is coded to these numbers.

Prior to physically surveying the various rivers by canoe, available secondary information was reviewed to inform the person responsible for the survey of points of interest, rapids, dams, etc. Field maps were provided to the accuracy possible and persons experienced in camping, canoeing and coping with the wilderness were utilized. All of the rivers were surveyed in the field, findings were recorded, photos were taken and the following text and graphics is our presentation of the findings.

RIVER CHANNEL

RIVER FLOW

MILE MARKER

A ACCESS

BRIDGE

EXISTING CAMP SITES

POSSIBLE CAMP SITES

STATE PARKS

WP WAYSIDE PARKS

POINTS OF INTEREST

HISTORICAL SITES

GENTLE RAPIDS

STEEP RAPIDS

PR PORTAGE RIGHT

PL PORTAGE LEFT

D DUMP

SD SEWAGE DISPOSAL

GS GAUGING STATION

PUBLIC OWNED LAND
(within one mile of surveyed river)

LEGEND

ROAD AND ROADWAY FEATURES

TRAIL (HIKING)
PROJECTED ROAD
PRIMITIVE ROAD
UNIMPROVED ROAD
GRADED AND DRAINED ROAD
SOIL SURFACE ROAD
GRAVEL OR STONE ROAD
BITUMINOUS ROAD
PAVED ROAD
DIVIDED HIGHWAYS
TERMINUS OF DESIGNATED ROAD
TRUNK HIGHWAY UNDER CONSTRUCTION
TRUNK HIGHWAY TRAFFIC BEING ROUTED THROUGH CONSTRUCTION ZONE — 20
ROADS IN UNINCORPORATED COMPACTS, EXTENSIONS OF LOCAL ROADS (NOT F.A.S.) WITHIN MUNICIPALITIES AND FRONTAGE ROADS
POINTS BETWEEN WHICH DISTANCES ARE MEASURED INDICATED THUS — * 6.2 *
GRADE SEPARATION (HIGHWAY—HIGHWAY)
FULL TRAFFIC INTERCHANGE
PARTIAL TRAFFIC INTERCHANGE INDICATING TRAFFIC MOVEMENT

ROAD SYSTEM DESIGNATIONS

NATIONAL INTERSTATE AND DEFENSE HIGHWAY — 35
UNITED STATES NUMBERED HIGHWAY — 65
STATE HIGHWAY SYSTEM — 18
COUNTY STATE AID HIGHWAY — 5
COUNTY ROAD — 12
COUNTY STATE AID HIGHWAY IN ADJOINING COUNTY — (24)
GREAT RIVER ROAD
FEDERAL AID INTERSTATE SYSTEM — F.A.I.
FEDERAL AID PRIMARY HIGHWAY SYSTEM — F.A.P.
FEDERAL AID SECONDARY HIGHWAY SYSTEM — F.A.S.
END OF FEDERAL AID ROUTE — F.A.S.
NATIONAL FOREST HIGHWAY — N.F.H.
NATIONAL FOREST DEVELOPMENT — N.F.D.
INDIAN SERVICE ROAD — I.S.
STATE FOREST ROAD — S.F.R.
STATE PARK ROAD — S.P.R.

RAILROADS

RAILROAD (ANY NUMBER OF TRACKS) USED BY A SINGLE OPERATING COMPANY OR BY TRAINS OF ANOTHER CARRIER UNDER TRACKAGE RIGHTS
RAILROADS IN JUXTAPOSITION (TWO OR MORE TRACKS OF SEPARATELY OPERATED COMPANIES ON ADJACENT RIGHTS OF WAY)
RAILROAD STATION
GRADE CROSSING
UNDERPASS (HIGHWAY BELOW)
OVERPASS (HIGHWAY ABOVE)

AIRWAYS

RUNWAY
MILITARY FIELD
COMMERCIAL OR MUNICIPAL FIELD
COMPLETE FACILITIES
LIMITED FACILITIES
LANDING AREA OR STRIP
AIRWAY LIGHT BEACON, GENERAL
SEAPLANE BASE, MILITARY
SEAPLANE BASE, CIVIL
RADIO RANGE STATION — R

STRUCTURES

General Symbols (over 20′ span)

HIGHWAY BRIDGE
SMALL BRIDGES CLOSELY SPACED
DRAWBRIDGE

General Symbols (300′ span and over)

GENERAL
DRAWBRIDGE
ARCH
TRUSS (W = WOOD; S = STEEL) THE WORD TOLL IS ADDED WHERE APPLICABLE

Other Structures

DAM WITH ROAD (LARGE SCALE)
DAM WITH ROAD (SMALL SCALE)
DAM WITHOUT ROAD (LARGE SCALE)
DAM WITHOUT ROAD (SMALL SCALE)
LEVEE OR DIKE
LEVEE OR DIKE (WITH ROAD)
MINOR STRUCTURES (5′ TO 20′ SPAN)
CONCRETE FORD OR DIP
FORD—ROAD ESTABLISHED

BOUNDARIES

NATIONAL OR STATE
COUNTY
CIVIL TOWNSHIP
CONGRESSIONAL TOWNSHIP (U.S. LAND)
CORPORATE LINE
SECTION LINE
INSET
NATIONAL OR STATE PARK
NATIONAL OR STATE FOREST
NATIONAL INDIAN RESERVATION
GAME REFUGE
MATCH LINE BETWEEN ADJOINING SHEETS OF THE SAME COUNTY
AIRPORT
WILDLIFE MANAGEMENT AREA (STATE)

DRAINAGE

INTERMITTENT STREAM
NARROW STREAMS
WIDE STREAMS
MARSH OR SWAMP LAND
DRAINAGE DITCH
POND OR LAKE
RESERVOIR, FLOWAGE LIMITS

NAVIGATION

BARGE LINES ON NATURAL STREAMS (SEASONAL)
SHIP LINES ON INLAND LAKES (SEASONAL)
DOCK, PIER OR LANDING
FERRY (T.F. FOR TOLL-FERRY) — T.F.
NAVIGABLE STREAM (SEASONAL)
HEAD OF NAVIGATION
DAM WITH LOCK
LAND MARK LIGHT BEACON
LIGHT HOUSE

CONSERVATION AND RECREATION

PICNIC GROUND
PLAYGROUND, BALLFIELD, ETC.
BATHING BEACH OR SWIMMING POOL
SCENIC SITE
CAMP SITE
CAMP OR LODGE
FOREST RANGER STATION
GUARD OR RANGER STATION (NOT PERMANENTLY OCCUPIED)
FISH HATCHERY
GAME PRESERVE
OBSERVATION AND LOOKOUT TOWER
PROMINENT ELEVATION
GOLF COURSE OR COUNTRY CLUB — C
GUN CLUB — GC
ATHLETIC FIELD OR AMUSEMENT PARK — A
SMALL PARK SP = STATE; CP = COUNTY; MP = MUNICIPAL; WP = WAYSIDE — WP
MONUMENT (SMALL)
DRIVE-IN THEATRE
FAIR GROUND, RACE COURSE, SPEEDWAY
PUBLIC ACCESS POINT

FARM UNITS, DWELLINGS, ETC.

FARM UNIT
DWELLING OTHER THAN FARM
ROWS OR GROUPS OF DWELLINGS CLOSELY SPACED
COMBINED DWELLING AND STORE OR SMALL BUSINESS
BARRACKS OR DORMITORIES FOR STUDENTS, WORKERS, MIGRANTS, ETC.
SEASONAL DWELLING
SEASONAL DWELLINGS CLOSELY SPACED
HOTEL
TOURIST COURT, MOTEL
CHURCH, OTHER RELIGIOUS INSTITUTIONS
FRESH AIR OR REST HOME
HOSPITAL
TOWN HALL OR COMMUNITY HALL
COUNTY FARM
CEMETERY
CHURCH WITH CEMETERY ADJACENT
TOLL HOUSE, STATE PORT OF ENTRY, OR WEIGHT STATION
GROUP OF MIXED CULTURAL FEATURES CLOSELY SPACED — 1 2 3 4
NOTE—NUMBER PLACED ADJACENT TO SYMBOL SHOWING UNITS CLOSELY SPACED INDICATES NUMBER OF EACH UNIT.
DOT TO INDICATE LOCATION OF ANY CULTURAL FEATURE SHOWN OUT OF POSITION

INDUSTRIAL

STORE OR SMALL BUSINESS ESTABLISHMENT
FACTORY OR INDUSTRIAL PLANT
SAWMILL
GROUP OF STORAGE TANKS, OIL OR GAS
SEASONAL INDUSTRY (CANNERY OR SMALL GRAIN MILL)
GRAIN ELEVATOR
BEET DUMP
STOCKYARD—LOADING PEN
GRAVEL PIT
QUARRY
MILK DEPOT, CREAMERY OR CHEESE FACTORY
NURSERY
GREENHOUSE
WAREHOUSE—GENERAL (IF GOVERNMENT, ADD STATE OR U.S.)

PUBLIC SERVICE FACILITIES

POST OFFICE
DWELLING AND POST OFFICE
DWELLING, BUSINESS AND POST OFFICE
BUSINESS AND POST OFFICE
U.S. BORDER PORT OF ENTRY
VALVE HOUSE, GAS, OIL OR WATER
GAUGING OR PUMPING STATION, GAS, OIL OR WATER
PIPE LINE, WATER — W
PIPE LINE, GAS — G
PIPE LINE, OIL — O
TRANSMISSION LINE (33KV OR OVER) — T
POWER PLANT
TRANSFORMER STATION — T
RADIO STATION (WITH CALL LETTERS)
GARBAGE OR RUBBISH DUMP — D
AUTO JUNKYARD — A
SCRAP METAL JUNKYARD — M
SEWAGE DISPOSAL PLANT — S
HIGHWAY GARAGE
HIGHWAY PATROL SUBSTATION
HIGHWAY DEPARTMENT DISTRICT OFFICE WITH PATROL STATION
HIGHWAY DEPARTMENT GENERAL OFFICE

EDUCATIONAL AND CORRECTIONAL INSTITUTIONS

SCHOOL HOUSE
CONSOLIDATED OR LARGE SCHOOL
CORRECTIONAL INSTITUTION
NOTE—VACANT CULTURAL UNITS
ABANDONED CULTURAL UNITS — A

CITY AND VILLAGE CENTERS

STATE CAPITOL
COUNTY SEAT
CITY OR VILLAGE CENTER
INCORPORATED CITY OR VILLAGE (GENERALIZED)

MISCELLANEOUS MAP FEATURES

FORT, ARMY CAMP, BARRACKS OR MILITARY POST
TRIANGULATION STATION
LOOKOUT TOWER AND TRIANGULATION STATION
LATITUDE AND LONGITUDE INTERSECTION

BASSWOOD RIVER

LOCATION:

The Basswood River is located in the Boundary Waters Canoe Area of Lake County, Minnesota and forms the boundary between the United States and Canada. Flowing east out of Basswood Lake the river tumbles over a series of small falls and rapids until it reaches Lower Basswood Falls. At the Lower Basswood Falls the river turns definitely north and flows quietly into Crooked Lake. The total length of the trip is 8.2 miles of which approximately 1.5 miles have to be portaged.

NATURAL SETTING:

Being part of the Boundary Waters Canoe Area the Basswood River has remained relatively unscathed. Banks are heavily forested with a second growth of pine forest covering them. Underlying the thin veneer of soil is the bedrock of the Laurentian Shield.

The Basswood River forms at Upper Basswood Falls. Here the canoeist can elect to take a 380 rod portage around Basswood Falls and rapids or a much shorter 70 rod portage around Upper Basswood Falls. The portages are marked and maintained as part of the Superior-Quetico Wilderness, as are all others. The decision on which portage to take must rest on the confidence and ability of the canoeist to handle the white water below Upper Basswood Falls, which ranges from moderate to heavy, depending upon water levels.

At mile 2.1 there is another stretch of white water which should be canoed by experts only. The portage of 60 rods is on the Canadian side. The total drop through this stretch of the river has been 30 feet or approximately 15 feet per mile.

Following this portage there is one mile of relatively quiet water. Wheelbarrow Falls at mile 3.5 has rapids both above and below the falls. There is a 15 foot drop in the river with a portage of 70 rods on the Canadian side. Portaging is mandatory for everyone.

Lower Basswood Falls is located slightly less than 1 mile below Wheelbarrow Falls at mile 43. A portage of 20 rods on the Canadian side is mandatory for everyone. Lower Basswood Falls is the last portage on the Basswood River. The remaining river to mile 8.2 is quiet water. The survey ended at the outlet of the Basswood River into Wednesday Bay of Crooked Lake.

EXISTING DEVELOPMENT:

Access to the Basswood River is confined to 3 primary canoe routes: (1) Fall Lake via Newton Lake and Pipestone Bay of Basswood Lake, (2) Fall Lake via the four mile truck portage and Basswood Lake, and (3) Moose Lake via Prairie portage and Basswood Lake. All three routes entail portaging. The most direct route to the Basswood River is through Fall Lake via Pipestone Bay, but all canoe parties using this route must confine their trip to the Minnesota side of the border due to the fact that it is difficult and time consuming to paddle down Basswood Lake to clear customs at Ottawa Island. The routes via the four mile portage and Prairie portage afford a canoe party with convenient access to the Canadian Customs on Ottawa Island at Prairie portage.

Canoes and supplies may be rented from several outfitters, which cater to the wishes of the canoeist. Trip planning, tow service and guide service are all available if desired.

There is no cabin development on the Basswood River. Campsites are numerous but without development, except for crude stone fireplaces and perhaps a long bench.

AMENITIES FOR RECREATION:

The Basswood River is one of the more scenic areas of the Boundary Waters Canoe Area. For this reason and also because it is a primary access route into the hinterland it is one of the more popular routes.

For centuries, ancient Indian paintings, drawn on the rock cliffs at miles 5.6, 5.7 and 5.8, have fascinated the canoeist. Voyageurs plied up and down the Basswood River on their way to the Athabascan Country or Grand Portage. They established a fort on Ottawa Island in Basswood Lake.

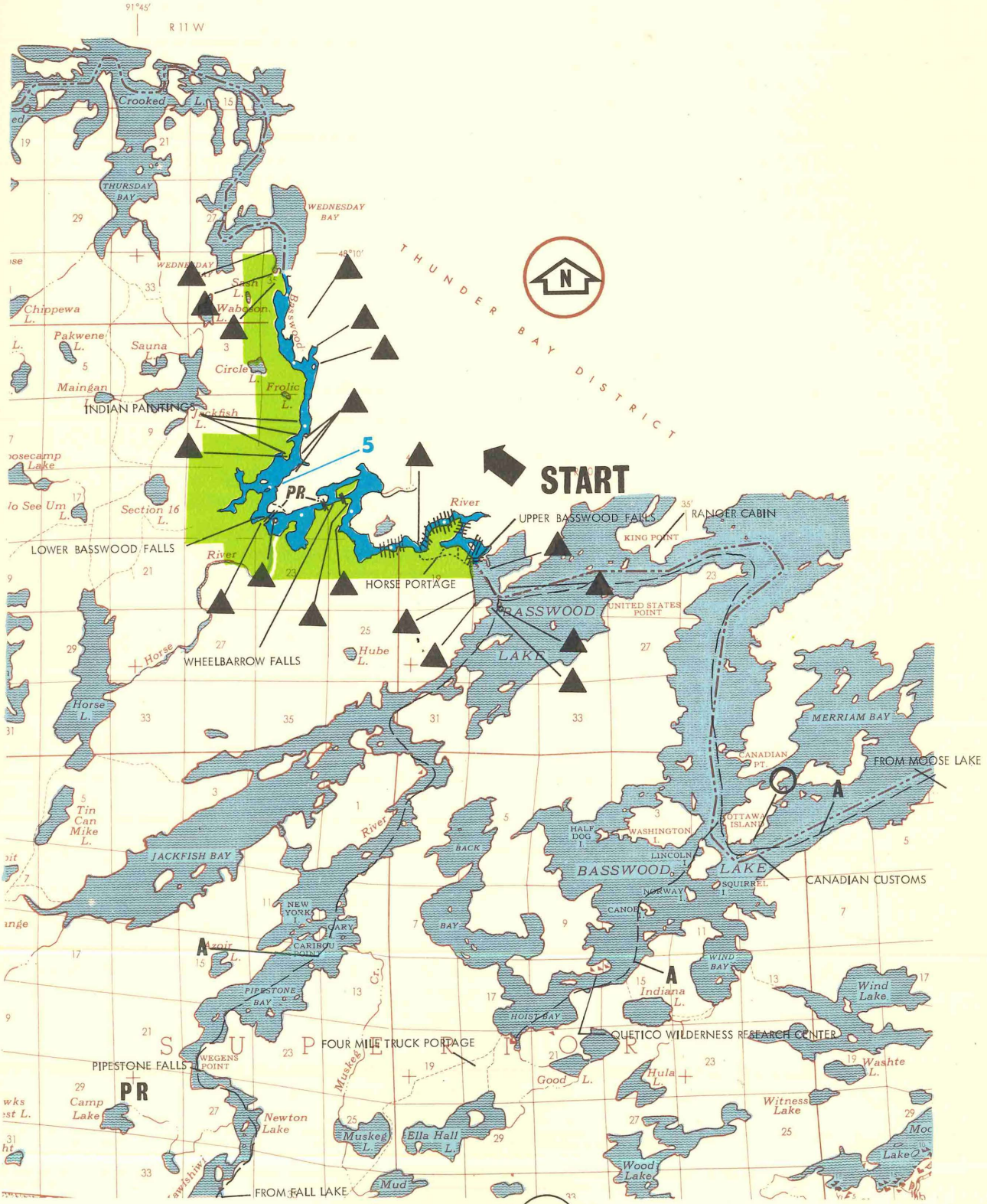
Fishing conditions are good in the Basswood River, especially up to early July. Northern pike, smallmouth bass and walleyed pike are found in the river. Deer, bear, moose and many of the smaller mammels, native to Northern Minnesota, inhabit the area around the Basswood River. Birds, especially the loon, delight the canoeists.

POTENTIAL FOR FUTURE RECREATION:

The Basswood River in being a fine stream for canoeing and a primary canoe route in the Boundary Waters Canoe Area should continue to grow in popularity as use of the Boundary Waters Canoe Area grows.

CONSIDERATIONS:

Being a minimum 3 day trip from access points, the Basswood River is more suited as a route to or from the hinterland of the Superior-Quetico wilderness. As such, it should not be treated as an official State Canoe Route but rather as a member of the larger community of fine rivers and lakes of the Boundary Waters Canoe Area.



SCALE OF STATUTE MILES

1 0 1 2 3 4

1

BASSWOOD RIVER

BIG FORK RIVER

LOCATION:

The Bowstring River rises in Jessie Lake in northern Itasca County about 15 miles north of Deer River and flows through Bowstring and Sand Lakes to Dora Lake. Here it is joined by the Popple River flowing from Squaw and Round Lakes; this is an alternate canoe route to the Big Fork River. Below Dora Lake the stream is known as the Big Fork River, although some confusion in names has long existed both above and below this point. From here the Big Fork River follows a winding course northward through timber lands until it joins the Rainy River west of International Falls. The Rainy River flows through Lake of the Woods into the Red River of the North and on into Hudson Bay.

GEOLOGY:

The source of the Big Fork River is in the sandy outwash plain (formed by action of running water as the glacier melted) of the lake region in west-central Itasca County. The river flows in a wide channel easterly from this outwash plain along the southerly edge of a "glacial till" area. The river channel narrows a few miles east of Wirt and enters the Lacustrine Basin of ancient glacial Lake Agassiz near where Itasca County Road No. 14 crosses the river. The Big Fork flows through this basin in a well defined channel for the remainder of its journey, with the exception of a rolling glacial till area near Muldoon Rapids. The river also crosses a narrow sandy beach of former Lake Agassiz near Little American Falls west of Graigville, and a morainic strip in the Big Falls area.

Glacial drift overlies the bedrock throughout the entire watershed. The upper or southern half of the watershed is characterized by a hummocky rolling surface that is genetically related to glaciers that invaded the area from the north and northeast and deposited ridges and hills of sandy, stony glacial debris known as moraines. A later glacier from the northwest overrode the stony drift and deposited a veneer of clayey glacial till that modified the topography by rounding off the hills and ridges and partially filling the depressions. Small lakes and marshes now occupy the many depressions interspersed among the hills and ridges.

Streams that rise in the morainic area of Itasca County flow northward and enter terrain on the former bed of glacial Lake Agassiz, which at one time covered practically all of the watershed in Koochiching County. In this area the original rolling surface left by the early glaciers has been modified and nearly obscured by the action of the waters of Lake Agassiz, which planed off the high areas and filled in the low areas with lake clays. The surface is monotonously flat and almost entirely swampy with the exception of occasional ridges of glacial moraines that extend upward through the swamp deposits and form islands. The largest of the ridges is called Pine Island, which extends westward from Big Falls along the Sturgeon River. Remnants of the highest beaches of Lake Agassiz extend across the watershed near the southern border of Koochiching County.

There are several major rock outcrops at various points along the river. At Little American Falls a fine mica schist occurs along the east side of the river. On the west side, a grey granitic outcrop cuts the mica schist. The bedrock at Big Falls is primarily granite with scattered mica schist. A rather large granite outcrop, about 200 feet long, occurs along the west bank of the river about fifteen miles above its mouth. Lesser granitic outcrops are found along the river in Itasca and Koochiching Counties. The Big Fork River watershed unit has a total area of 2,063 square miles and is roughly 75 miles from south to north, with an average width of about 30 miles. The main stream and many of its tributaries rise in the lake region of north-central Itasca County and follow a widely curving course to the north to its junction with Rainy River. The entire basin is one of generally low relief with a gentle slope from an elevation of about 1,450 feet at the divide which separates it from the Mississippi River basin on the south to an elevation of about 1,100 feet at the mouth.

Before it leaves Itasca County, the stream receives the waters of several tributaries from the south, which are naturally regulated by the many lakes and marshes through which they pass. Therefore, the river has an adequate supply of water all summer long.

In the lake region of northern Itasca County streamflow is regulated considerably by changes in storage in the lakes and ground water reservoirs. The glacial morainic terrain provides not only the many depressions now occupied by lakes and marshes but also a favorable environment for the infiltration of precipitation into the soil and the storage space beneath the land surface. These factors retard and reduce direct runoff to streams, thereby reducing flood stages locally and stabilizing streamflow as water is released from storage during dry periods. However, the beneficial effects of the geology in the upper basin are not of sufficient magnitude to provide appreciable regulation in the lower basin The low storage capacity and relatively impermeable characteristics of the lake clays combined with the flat topography of the lower part of the watershed are unfavorable for recharge. Much of the water available for recharge is rejected and flows directly into the stream channels as surface water runoff.

In Koochiching County the main stream and tributaries are characterized by a succession of shallow pools separated by clay and gravel bars with infrequent rapids. Therefore, the rapids in this area will be relatively easy to run since no large boulders will be present.

Streamflow records show that peak flows on the Big Fork River and its tributaries generally occur during April or in early May although flood stages occasionally persist until June as a result of relatively late warming temperatures and intense rainfall. As in other north-flowing streams, the flood waters from the melting snow in the headwaters area arrive at the lower reaches when the downstream channel is still blocked with ice. The highest flood stage and discharge of record at Big Falls shown in the tables occurred in May 1950 as a result of excessive snow accumulation during the preceding winter and heavy rains coincident with the spring breakup.

Big Fork and Big Falls, the only villages with water supply systems, both have wells in the glacial drift. Most of the domestic supplies are obtained from wells in the glacial drift although some wells have been drilled into the bedrock where supplies in the drift are not adequate. Wells drilled deeper than about 20 feet into bedrock do not encounter fractures or fissures of sufficient size or numerous enough to contribute significant quantities of water.

The hydroelectric plant constructed in 1938 at Big Falls by a power cooperative is the only known user of the available surface water supplies aside from the recreational use of the lakes and streams.

Although none of the municipalities provide sewer systems or sewage treatment facilities, stream pollution is not a general problem because the entire area is sparsely populated. Locally, pollution problems exist where raw sewage is dumped directly into a stream or lake.

HISTORY OF BIG FORK RIVER VALLEY:

The exact time that a canoe first rode the waters of the Big Fork river is not known, but no doubt the native Indians with their birchbark craft used the stream and its tributaries as a means of transportation long before the white man made his appearance some 200 years ago.

No spot on the American continent was better endowed with the fruits of nature than the Big Fork Valley Heavy stands of sugar maple covered the ridges in the Bowstring area, vast fields of wild rice were to be found on the upper reaches of the stream. Fur bearing animals of every species abounded with beaver by the thousands on every tributary, large or small. Waterfowl darkened the sun during their migrations, with moose to be had at any time in addition to caribou to vary one's diet. Heavy stands of pine lined much of the stream from source to mouth.

An early picture of the Big Fork Canoe Trail can be taken from a diary of John T. Knight, who with a companion came up the Mississippi the autumn of 1854, portaging across from Lake Winnibigoshish to Bowstring Lake probably along the route of what is now County Road 35. From here he traveled by birch bark canoe down the entire length of the stream to Rainy River.

We find that a white man with a supply of goods lived at the outlet of the lake" -- probably where Inger now is -- he continues, "the Chippewa Indians were very friendly and hospitable. Most of our nights were spent near a wigwam. When we departed, gifts of dried moose meat, wild rice and often maple sugar were pressed upon us so that we lived well through no effort of our own. Luckily we carried a goodly supply of tobacco which we doled out carefully as we traveled. We portaged around small falls"--evidently Little Falls--"and within an hour came to a Hudson Bay trading post occupied by two white men who were harvesting a supply of potatoes and vegetables against the coming winter". (This spot is still known by the old settlers as the 'Old Hudson Bay Farm' and is a short distance upstream above Highway No. 6). "Two days' travel downstream from this point we were obliged to carry around a large falls"--Big Falls--"Here we found a lone white man living in a cabin on the west bank. We saw moose every day and on two occasions bands of caribou were sighted crossing the stream." This early traveler of the Big Fork Canoe Trail returned in 1904 to spend his last years beside the stream eight miles below the village of Big Fork.

With the railroad reaching Kenora, Ontario in 1879 the Big Fork river and its tributaries for the next 30 years carried millions upon millions of feet of pine logs to the mills at Kenora and later to Spooner and Baudette. In a single season as high as 100 million feet of timber floated down the stream into Rainy River on its way to the various mills. These river men, or river pigs as they were sometimes known, were a hardy breed working 16 hours a day 7 days a week, rain or shine, at labor that present day operators wouldn't think of handling without power equipment.

In keeping with the historical aspect of the Big Fork River Canoe Trail is the starting point at Inger with its nearby Indian village. From this base on down to Dora Lake we find several Chippewa colonies where the descendents of the early day Redman still live. Here, during the wild rice harvest, the Indians still use the same campgrounds and gather the cereal by the same primitive methods as did their ancestors of centuries past.

On the west bank of the river, where the Popple joins the Big Fork, a historical plaque showing what is believed to be the first wild rice processing mill in Minnesota. Frank L. Vance settled there in the early 1890's. Quick to recognize the potential of the large wild rice acreage, he not only built the mill but also invented a reaper to harvest the valuable cereal in wholesale tonnage. After a few years of operation a ban was placed on harvesting wild rice by any mechanical means. This curtailed his output and eventually put him out of business.

On down the river the early settlers found numerous drying racks at game crossings where Indians killed and cured their meat.

About two miles south of the village of Bigfork a battle between the Sioux and the Chippewa took place in 1855 with the invading Sioux being driven out.

On the north bank of the river we find a historical marker honoring Demase Nevieux, the first permanent resident of the village of Big Fork. "Uncle Tom," as he was known, took up residence by "squatter's rights" in 1892. "Uncle Tom's" cabin was a place of hospitality and many were the travelers of the ensuing years who took advantage of his hearty invitation to stop and share his muskrat stew, broiled beaver and moose meat with sometimes an added delicacy of "headsucker soup" a favorite concoction of the old Frenchman.

About 12 miles below the village we come to the Klondike trail and landing where the trail can still be traced inland to one of the campsites of the early logging days. Remains of the old buildings and ox stables are still visible and testify to the logging methods of the old days. The title "Klondike" no doubt came about through the Alaska gold rush which was in full swing at that time.

A mile further on we enter the land of Busticogan, so-called as the one time domain of perhaps the most noted Chippewa chief of the north country. With the opening of the pine lands to the timbermen and other lands to the settlers, the government reserved an entire township as a land grant to Chief Busticogan, partly perhaps because of his standing as head of the Nett Lake Tribe and no doubt because of his faithful squaw in nursing and caring for a smallpox stricken camp in the Caldwell Brook area. On a former occasion he throttled with his bare hands a crazed Indian bent on taking the

life of the white doctor at the Hudson Bay trading post mentioned earlier. Although chief of the Nett Lake Indians, Busticogan's home wigwam stood on a ridge above the river a short mile past Highway 1. Here his old trail still leads about a quarter of a mile over the hill to a beautiful lake.

The largest falls in the river with a drop of 35 feet are to be found at Big Falls. Here the Indians gathered on the rocky ledges to make their arrow heads. An Indian mound on high ground above the Falls is ample evidence of the early red man. It was near the falls too, that Dan Campbell the first white settler squatted in 1877.

Further down stream at the strategic point where the Sturgeon River enters from the west stood another early day Hudson Bay post and fort. Many old Indian relics have been found on this historic spot.

At the confluence of the Big Fork and Rainy Rivers we find other Indian mounds adding further legend as our Big Fork Canoe Trail comes to an end.

A trip down the Big Fork Canoe Trail is a journey into the past and, for the most part, it is still a sparsely settled wilderness. If one slips quietly and leisurely down its winding course, practically every species of wild life that existed 200 years ago can still be seen. One has only to rest his paddle for moment's reflection now and then to realize what a privilege it is to travel the same route in the same manner as did the Indians, the fur traders, the loggers and the settlers of long, long ago.

GENERAL RIVER TRIP INFORMATION

The Big Fork River has been designated by the State of Minnesota as one of the four wilderness canoe routes in our state. In order that a canoeist may plan his own trip, a detailed map of the Big Fork has been drawn up in loose-leaf form covering the entire route. The cost of this map is $2.00 and may be obtained by writing to the Big Fork River, Canoe Trail, P.O. Box 256, Big Fork, Minnesota 56628.

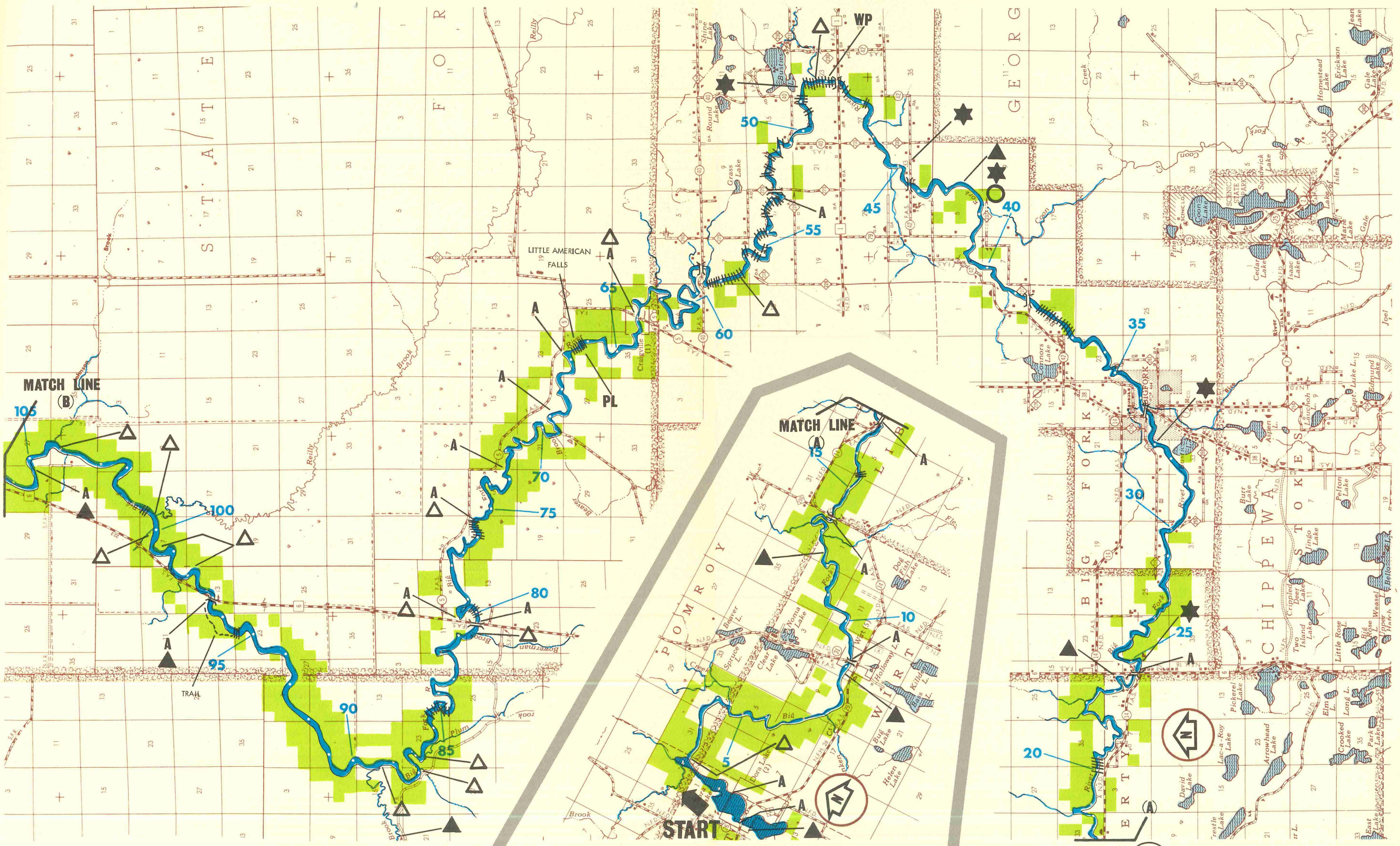
Water depth and rate of travel on the river are subject to rainfall and season of the year, therefore it is impossible to predict float time between two points in advance. Generally, however, a normal day of fishing and paddling will carry you about ten miles on the river, but outfitters and guides in the area will provide more accurate information at the time of your departure. Float trips of from four hours to two weeks are possible.

Either canoes or fourteen foot flat or semi-round bottom boats are recommended. They accommodate three people in comfort, are small enough to handle and will float high over rocks and snags. As a general rule the less skillful you are in boat handling the more sturdy should be your craft. Ordinary common sense will see you through the occasional swift but navigable rapids with a sense of exhilaration and satisfaction. There are but two portages and these are clearly marked on the map. Both are around major falls in the river.

The current is sufficient in most places to provide moderate travel speeds and a set of oars or paddles will give great personal satisfaction as you will be better able to enjoy the peace and quiet of our wilderness while seeing more wildlife because of your silent approach. Motors of over 5 h.p. are not recommended. Carry plenty of shear pins.

You should provide yourself with water for your trip or make arrangements with one of the outfitters to supply you at predetermined landings. Arrangements can be made directly with listed guides, or outfitters, to supply you with information and accommodations.

This is a wilderness trip. Campsites are largely unimproved. Work is underway to make minimum improvements on a number of the campsite areas.



2

BIG FORK RIVER

NATURAL SETTING:

The Big Fork River Survey starts at Dora Lake in the sandy outwash plain of the lake region in west central Itasca County. The river flows in a wide channel from this plain along the southeasterly edge of a glacial till area, through the Chippewa National Forest, an excellent recreation area. The river channel narrows a few miles east of Wirt and enters the Lacustrine Basin of ancient Lake Agassiz near where Itasca County Road #14 crosses the river. From here to Big Fork vast fields of wild rice line the banks; a chef's delight with fish or fowl anytime of the year. The river is only two to three feet deep, water is clean and clear. The river bottom is a mixture of sand and gravel with a large amount of plant growth in the water. Tree growth is very extensive and extremely thick on both sides of the river. Tree cover consists of mainly aspen, birch, oak and pines. Rock outcroppings left by glaciers are visable in the river occasionally.

At mile 19.6, Hucks Rapids is located. The rapids are rather easy to "run" and no difficulty should be encountered, although large boulders four and five feet in diameter are present.

After the Rice River enters the Big Fork a significant change takes place. The river banks are slightly steeper and the river a little deeper but not wider; the river picks up velocity. Undergrowth along the river is so dense it is very difficult to get out of the canoe except where animal trails lead to the river.

The small amount of farming that takes place in this area is between Big Fork and Rice Rapids. The west side is farm land and the east side is heavily wooded. Rice Rapids is slightly less than a mile long, not difficult but very exciting.

After the wayside park at State Highway # 1, the banks get noticably steeper, forming a well defined channel for the remainder of the way with the exception of a rolling glacial till area near Muldoon Rapids. The river also crosses a narrow sandy beach of former Lake Agassiz near Little American Falls and a morainic strip in the Big Falls area. There are water falls at both these areas and portages must be made.

Little American Falls is a very scenic area surrounded with excellent tree cover. A portage around the Falls on the left hand side is mandatory but not difficult. Just below the Falls is Plummer's access which could be extended to the Falls a distance of three blocks to provide an access to the river and a possible campsite.

The river has steep banks in this area with intensive tree cover consisting of both hard and soft woods. Many small spring fed brooks and streams enter the river from Little American Falls to Big Falls. The river is clearer and the bottom changes from clay to a sand and gravel bottom. Where the streams enter the river the fishing is usually very good.

Another portage is encountered at Big Falls where a morainic outcrop of rock create a rapids and a water fall of 6 to 8 feet.

Further north where the Sturgeon River joins the Big Fork, east of Big Falls, a Hudson Bay Post once stood. It is also the site of an old Indian campground and many artifacts may be found here. This is the ancient water route, via the Sturgeon and Tamarack Rivers to Red Lake - traveled by Indians of many years ago.

Another Hudson Bay Trading post was located near Keuffner's Landing further north of Big Falls.

The last stretch of the river from Big Falls to Rainy River is a very meandering stream with frequent and numerous rapids.

At the mouth of the Big Fork, on the east bank, ancient Indian burial grounds are to be found. These are under investigation at the present time by archaeologists and the area is being considered as a site for Grand Mounds State Park.

CONSIDERATIONS:

1. Access, launch sites, camping areas, portages and hiking trails be developed and undertaken at state, county, municipal and private enterprise levels.

2. That the Big Fork River Trail Map be enlarged to include a list of facilities included at each camp site and this map kept up to date. The numbering system should be changed to number from month to source.

3. Established coordination between federal, state, county and municipal governments should be continued. The state should draw up an overall plan to be administered mainly by county and municipal with some state development.

4. The area should be better publicized through brochures, films, radio, television and newspapers.

5. A study should be undertaken of tributaries of the Big Fork River to provide alternate and additional trips for people who want shorter trips and for those who like smaller rivers.

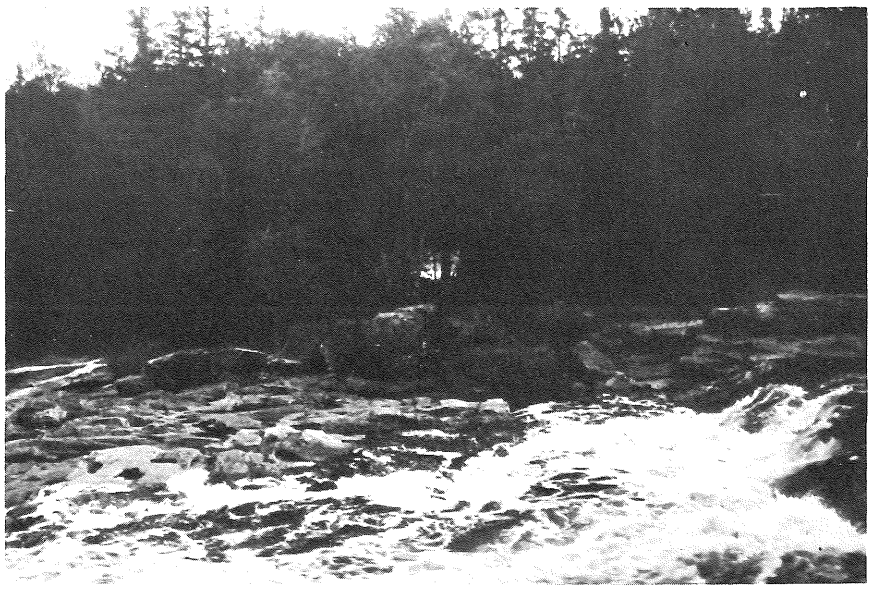
6. A biological study of the watershed should be undertaken to determine the possibility of stocking former trout streams. The possibility of stocking beavers for the purpose of storing water in tributary streams should also be studied.

7. An area wide approach to developing the Big Fork River and its watershed should be made to provide the optimum economic gain for this area.

Early section of Big Fork, mile 17, illustrating the wild rice that can be harvested.

BIG FORK RIVER:

1. Upper most reach with very beautiful conifer woods.
2. Typical scene showing beauty of upper reach.
3. American Falls with portage over rock outcrop, on the right.
4. A typical scene of cleared area below American Falls.
5. Unusual high, steep, grassy banks.
6. Paper-birch wooded area.
7. Typical scene showing ice-scour line 6 to 8 feet above river level.
8. Typical scene showing steep banks, but flat deciduous woods on inside of meander, (left) conifer woods on outside (right).



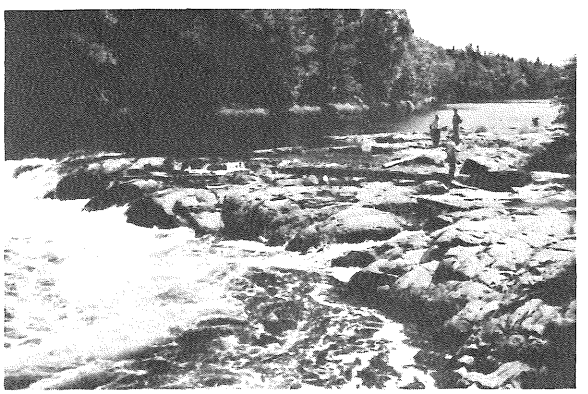
Moranic rock outcroppings forming falls at Big Falls, mile 120.

Falls created by moranic rock outcropping, mile 120.

BIG FORK RIVER

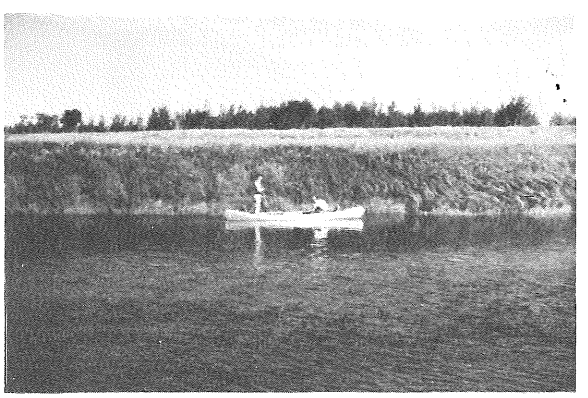
1

2



3

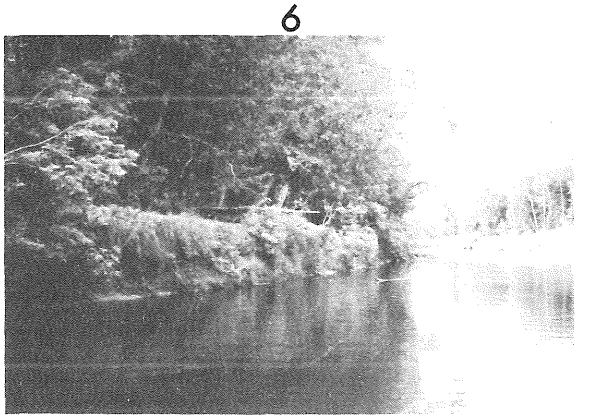
4



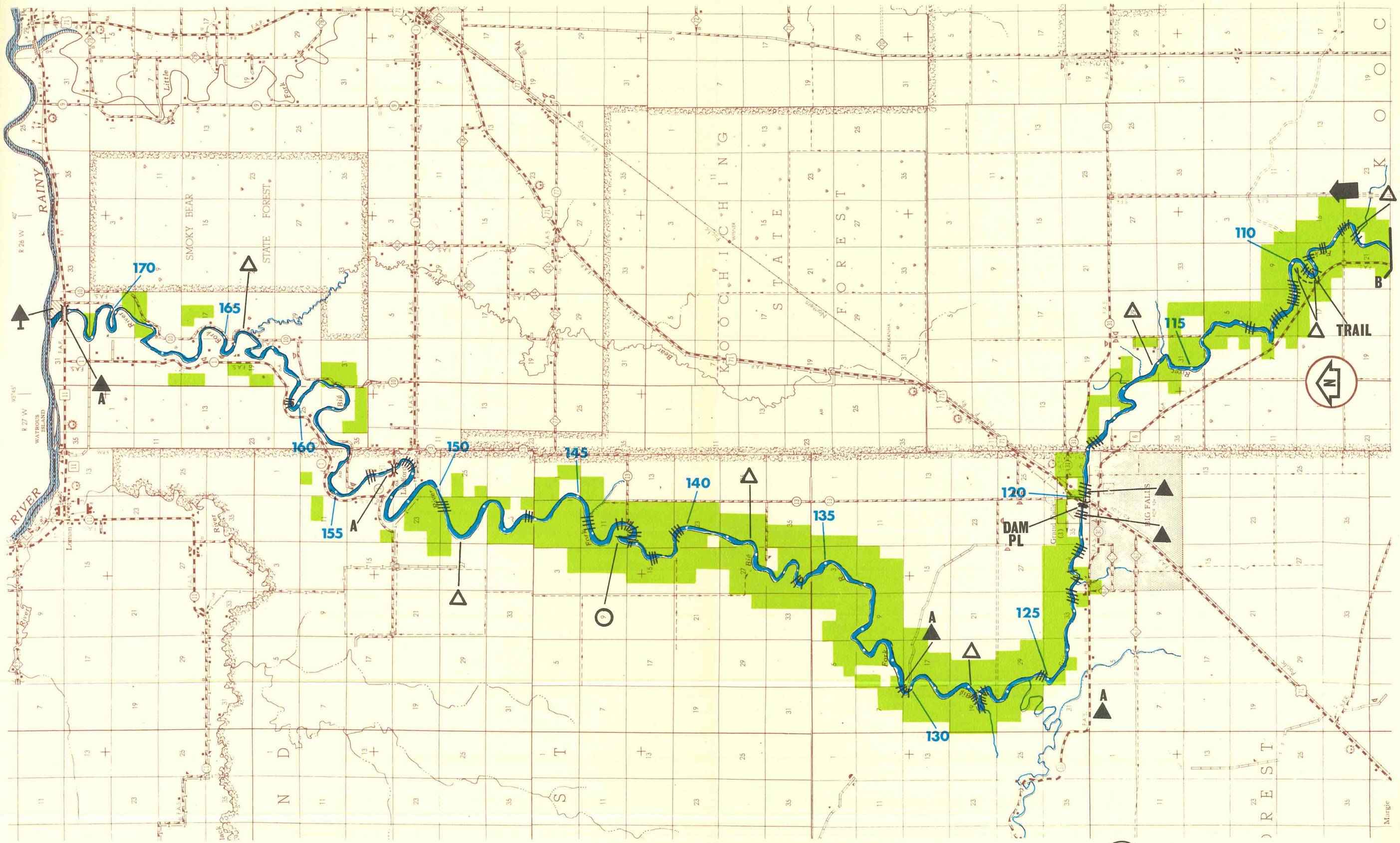
5

6

7



8



2

BIG FORK RIVER

BRULE RIVER

LOCATION:

The Brule River is located in the Arrowhead region of Minnesota in Cook County. The survey was started at the confluence of the north and south branches of the Brule River, adjacent to the famed Gunflint Trail.

At this point the Brule River flows in a southeasterly direction into Northern Light Lake. At the outlet of Northern Light Lake the Brule turns north for several miles then resumes its southeasterly flow, crosses the proposed boundary of Judge C. R. Magney State Park and plunges along a 5 mile length into Lake Superior.

GEOLOGY:

According to the Hydrologic Atlas of Minnesota, the watershed ranges in altitude from 602 feet at Lake Superior to 2,230 feet in the rock-formed Misquah Hills. Basalt, gabbro and diabase are the principal types of bedrock in the area. The gabbro and diabase rocks are intrusive into and are apparently younger than the lava flows.

During the ice age glaciers covered the area several times. The topography is a reflection of the bedrock surface assoicated with glacial deposits. The glacial deposits are especially associated in the upper reaches of the Brule. The steep slopes to Lake Superior are associated with erosion surfaces developed on the bedrock.

Ground water is derived primarily from local precipitation. Although ground water enters streams through rills or surface springs a considerable amount discharges directly into Lake Superior through water-bearing formations. Because the Brule River has a relatively small watershed district and there is very little ground water percolation, water heights in the river are dependent upon regular rainfalls. No rainfall for several weeks will cause the water level to drop considerably.

NATURAL SETTING:

The upper reaches of the Brule have a relatively slight fall. From the start of the survey to mile 12.5 the river falls 60 feet. However, from mile 12.5 to Lake Superior the river falls 760 feet. This is significant with regard to the various recreational activities.

The upper reaches described above consist of a series of rapids and pools and one large lake (Northern Light Lake). The pools are less than 3 feet deep, very weedy and are bordered by dense deciduous brush, reeds and lily pads. Deep holes of over 20 feet may be found at miles 5.6, 12.0 and below the falls on the Brule River at miles 19.5 and 20.0.

The hills surrounding the area are up to 400 feet higher than Northern Light Lake. Between the hills and extending from Northern Light Lake are dense tamarack swamps. The slopes of the hills themselves are forested primarily with poplar, jack pine and black spruce with an occasional giant white pine. Alder brush and granite outcrops complete the scene.

The lower stretch of the river, below mile 12.5, is similar to the upper reaches except that there are no large areas of swamp land. Slopes of the hills abutting the river are steeper than is the upper reaches.

PHYSICAL CHARACTER OF THE RIVER BED:

The river bed may be divided into two types: (1) The "pool type" has a soft muck bottom with associated dense weed beds, reed beds and lily pads; (2) The "rapid areas" are composed of large rounded boulders and shattered gravel, both originating from the parent rock.

EXISTING DEVELOPMENT:

Very little development exists on the Brule River. At mile 0.0 the Gunflint Trail passes over the Brule. At mile 2.9 there is a developed access and rental boats from a local resort. No cabins are located on Northern Light Lake. At mile 5.4,the outlet of Northern Light Lake, is a log dam about 1 foot high. No more development exists until a logger's cabin is reached at mile 12.6. This cabin is open to all but has no facilities; it is not visible from the river, but a jeep trail runs to it from the east. At mile 15.0 is a bridge across the river and a cabin. The jeep trail running southward is not passable due to washouts. No further development is encountered until Judge C. R. Magney State Park is entered at mile 18.2. Here there is a developed trail and picnic tables on the east bank. A State owned gravel pit is visible from the trail. The main campgrounds are on the west side of the river. State highway bridge crosses the Brule River at mile 20.5. The Naniboujou Motor Lodge and Resort on the east bank caters to the tourists at mile 21.0 the end of the survey.

AMENITIES FOR RECREATION:

The river is scenic and attractive to the canoeist. The contrast between the pools and the rapids provides an ever changing scene. Wide open areas of the upper stretches may be contrasted with the walled-in lower reaches. All is surrounded by some of Minnesota's wildest and densest woodland.

Scenic views of Lake Superior exist on rock outcrops high in the hills. The Devils Kettle and falls of the lower river are especially interesting, geologically as well as aesthetically. The Devils Kettle is a hole at the top of the upper falls about 15 feet in diameter. Water pours into it and disappears - where, nobody knows. In the C.C.C. years, green dye was poured into the Devils Kettle but never reappeared. It is theorized that the water must discharge directly into Lake Superior in the form of a spring. The fall is the best time of year to observe this scenic wonder.

Wildlife in the area is abundant. Moose, bear, deer, beaver, and porcupine can be found. Families of ducks and great blue heron were observed along the river. Partridge are in the woodland, fish inhabit the entire river. In the upper reaches (mile 0.0 to mile 12.6) are northern pike and walleyes. From mile 12.6 to Lake Superior, brook trout are the dominant fish species, and this is the stretch of river with the greatest drop. Fishing below the lower falls is popular for rainbows during the spring run. Fishing in Lake Superior for lake trout and rainbows is popular.

Wild flowers, such as water lilies, iris and daisies add color to the total scene. Raspberries, blueberries, strawberries, and thimbleberries (similar to raspberries but larger) provide a feast when in season.

POTENTIAL FOR FUTURE RECREATION:

As stated above, the Brule River is very scenic throughout its length. However, access to the river is difficult. Access on Northern Light Lake is well developed but below this point there are only two take-out spots. One is at the cabin at mile 12.6, the other at the bridge at mile 15.0. Below this point, the river is not canoeable. Low water also makes canoeing difficult.

The possibilities for hiking along the river are limited due to the dense growth of alder brush. It required the surveyors four hours to hike less than three miles over a ridge. However, on the interior there are numerous logging roads which may be used as hiking trails. Hedstrom Mills located on the Gunflint Trail has numerous logging trails on the north side of the Brule and the area is logged. The south side of the river has one logging road running parallel to the north-south stretch of the Brule River, extending from the bridge at mile 15.0 to Highway 61; however, this area has not been logged in recent years. Evidence of former occupance is revealed by abandoned sawmills and farmsteads.

At present a trail runs on the east bank of the Brule from Highway 61 to the Devils Kettle. This trail is well traveled and worth the trip. There is a proposed development of a trail which would extend north of the Devils Kettle to mile 18.2 where there would be a bridge across the river and down the west bank of the Brule. It would appear that the development of the proposed trail should be acted on. The

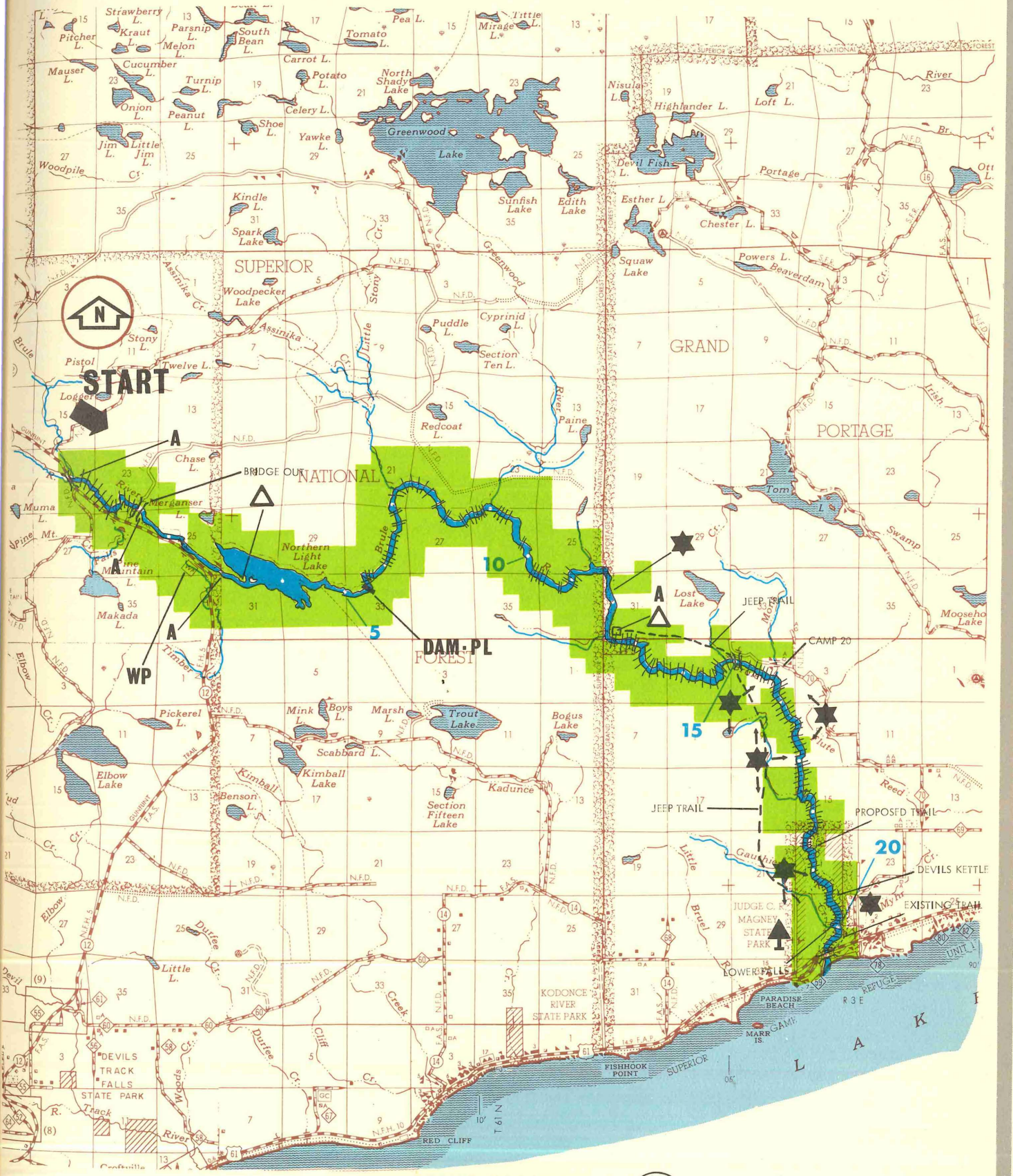
tourist reaction would give a clue to the advisability of an extended trail on the south and west side of the river, possibly to the Gunflint Trail, with full cabin development.

CONSIDERATIONS:

A detailed forest cover, wildlife, and fish survey should be made. A no-cut zone should be established on both sides of the river to allow the trees to grow. Hikers then would be able to hike through the most scenic areas, the best areas for wildlife watching and fishing all of which add to the enjoyment of hiking.

Typical stretch of rapids.

Path leading to the lower falls and Devil's Kettle.



3

BRULE RIVER

CANNON RIVER

LOCATION:

The Cannon River is the main stream of a 1,411 square mile watershed consisting of parts of six counties. The length of the Cannon, according to the Hydrologic Atlas of Minnesota, is 109.2 miles with the channel flowing through Rice, Dakota and Goodhue counties. The length of the river is somewhat in question. However, for purposes of this survey the beginning was at the bridge on Highway 13 just west of Lake Sakatah and continues to the Mississippi River some 72.5 miles to the east.

NATURAL SETTING:

The Cannon River flows from a rolling topography where the drainage pattern has not been definitely determined, thus leaving marsh land and undrained wet areas. In the area west of Faribault are located a number of relatively large lakes - Cannon Lake, Tetonka Lake and Sakatah Lake - which forms a part of the river. The banks in this area are subject to severe eroding when farmland penetrates the abutting tree cover. The river from Faribault to Northfield is 50 to 100 feet in width with a meandering channel that provides a new and interesting view with each turn. At mile 18.8 is located a dam which during late summer restricts the flow of water to the extent that the river is not canoeable. The Straight River enters the Cannon River at Faribault and from this junction the river is satisfactory. Along the river at frequent intervals are out-croppings of sandstone and limestone creating vertical cliffs and it is noticeable that the surrounding land is creating more of a valley. The banks of the river are wooded to the extent that abutting development is blocked from view except for 3 or 4 locations between Faribault and Northfield. Located at mile 35 is the Northfield sewage disposal plant and the effluent entering the river creates a discoloring. It was also noticed that for 3 or 4 miles below Faribault there were dead fish in the hundreds on the banks and caught in snags. The stream bed to Northfield is a series of pools and rapids with the rapids of such intensity to be interesting but not dangerous. Dundas, Minnesota is located at mile 31 where the remains of an old mill and dam are still in evidence. The dam creates a rapids which can be shot by carefully selecting a location.

The entrance to Northfield is a pool above the dam and on the right-hand side just past the Highway 3 bridge is a city park. The dam at Northfield is in the business district and the banks below the dam are rip-rapped for nearly a quarter of a mile creating a rather difficult and long portage.

From Northfield to Cannon Falls the river flows gently in a rather uninteresting valley with low banks and heavy woods and underbrush.

At the lower end of this portion of the river is Lake Byllesly which, due to its size, lake-shore development, frequency of power boats and lack of access, is adverse to canoeing. At the eastern end of the lake is the N.S.P. dam which is one of the highest and most difficult to portage of any experienced in the survey.

The dam is some 100 feet above the river bed and the river flow is dependent upon release water. The present schedule is to generate power during the five work days. Thus, on weekends the river from the dam to where it intersects with Highway 52 does not have sufficient flow for canoeing. Just below Highway 52 the Little Cannon enters the Cannon River.

From Cannon Falls to Red Wing the river is in a deep gorge and presents a very picturesque scene. The river from Highway 61 to the Mississippi River is a flat wandering stream. A trip down the Cannon River provides a wide range of canoeing experience and exposure to a variety of land formations. The wildlife was abundant with deer, squirrel, birds and at one location ten blue heron were in flight. The trees below Cannon Falls along the banks are scarred with ice marks some 8 to 10 feet above the river bed. The variety of trees are oak, elm, maple, birch, cedar, willow, butternut, basswood, and ash.

EXISTING DEVELOPMENT:

The variety of abutting land provides the possibility for a wide range of development. In the upper portion farms are seen along the river and cottages and houses on the lakes. The river passes through a number of communities and six dams must be encountered. A railroad parallels the river on the south side from Cannon Falls to Red Wing. The railroad is on a bluff some 30 to 50 feet above the river bed and well buffered by trees so it does not distract from the wilderness atmosphere except when a train is passing. At mile 59 on the right ride is located a camp designed to accept tents, trailers and campers. At mile 60.5 in the community of Welch there is a dam and a water-powered mill. To date, improvements to accommodate the canoeist, the boaters, fishermen, or others who might want to make recreational use of the river do not exist. On Byllesly Lake the only access available to the public is a pay park which operates a beach, boat ramp and campsites.

AMENITIES FOR RECREATION:

As heretofore stated, the Cannon River in its present condition has a number of adverse factors when viewed as a recreational facility. However, when considering the river from Faribault to Highway 61 west of Red Wing, it is one of the most interesting from standpoint of experiencing a change of topography, a demand for canoeing skill and for viewing wildlife. In addition, it is conveniently located to serve a large portion of the state's population. The spacing along the river of the three major cities divides the distance into three easily canoeable segments for those persons residing in the metropolitan area and thus can provide a major facility for those desiring an outing of only one day.

POTENTIAL FOR FUTURE RECREATION:

The Cannon River has a fine potential and it is recommended that a Canoe Trail Association be created for that area beginning at Faribault on the Straight River south of the sewage disposal plant and extending east to Highway 61 bridge, a distance of 51 miles. The river to Northfield will require no improvements although a campsite at mile 26.3 would be convenient and provisions for parking and access at the beginning are necessary. The dam at Northfield, being located in the business district does create a problem but a set of steps on the down river side of the dam along the retaining wall would eliminate the necessity of a long portage. That portion of the river to Lake Byllesly and the N.S.P. Dam needs little attention but the lake and the dam do create a major obstacle. A campsite should be provided at the east end as indicated on Map 4.

It is suggested that the first leg of the trail end above the dam and start again at Highway 52 bridge in Cannon Falls. Since the flow of water in the river is directly related to release water at the dam it is recommended that sufficient amounts to assume canoeing be released on weekends during the summer season. The river to Welch and then to Highway bridge 61 is a desirable experience. The community of Welch has a dam where a portage path should be created to the right. It also has a ski facility, a camping site and presents the picturesque setting of a mountain village. This ski facility is where the Minnesota, Mining and Manufacturing Company is experimenting with summer time skiing. The distance to Red Wing and to Cannon Falls from Welch plus the attractive setting would make it an ideal location for establishing trail rides and hiking trails. The river requires no attention to Highway 61 bridge where access and parking improvements should be made in the southwest quadrant.

CONSIDERATIONS:

The distance from the metropolitan area to Cannon Falls, to Northfield or to Faribault is such that those persons desiring a one day outing can easily make one of the legs of the river or two on a weekend. This is important in providing accommodations for this would appear to serve a large number of persons. The break in the trail from Byllesly Lake to Highway 52 is not desirable but considering the height of the dam and the condition of the river below the dam it is recommended.

The difficulty of bringing the car which was parked at the start of the trail and the canoe at the end of the trail together is always present and private initiative on the part of local outfitters should be promoted. Some interest has been shown along the Cannon River but not to the extent that a program of facilities has been established.

Dam at Cannon Falls.

Typical river around Northfield.

CANNON RIVER

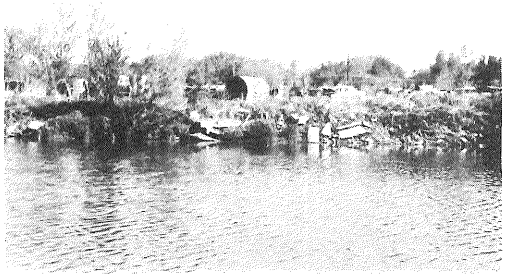
1. Sandstone cliffs below Faribault.
2. Remains of wooden dam.
3. Debris along river above Northfield.
4. Portage at Northfield.
5. Typical of area below Northfield.
6. View downstream from Byllesby Reservoir.
7. Typical of area near Welch.

8 & 9. Typical of stream near mouth.

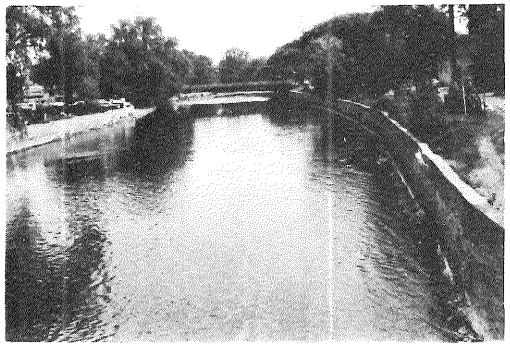
CANNON RIVER

1

2



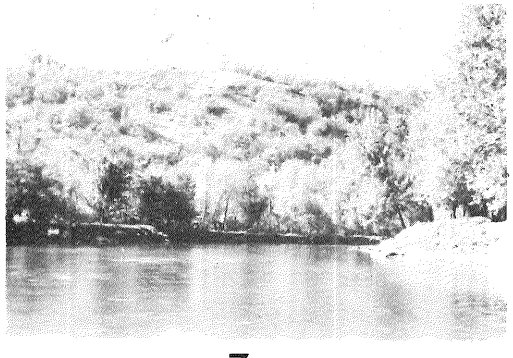
3



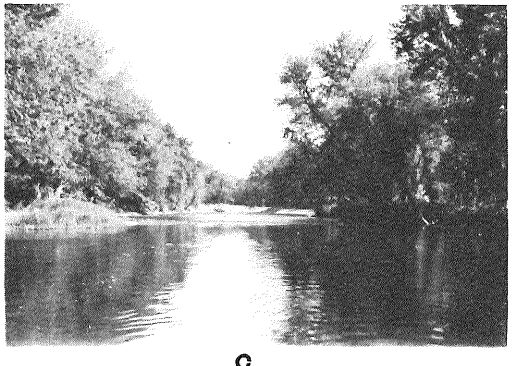
4

5

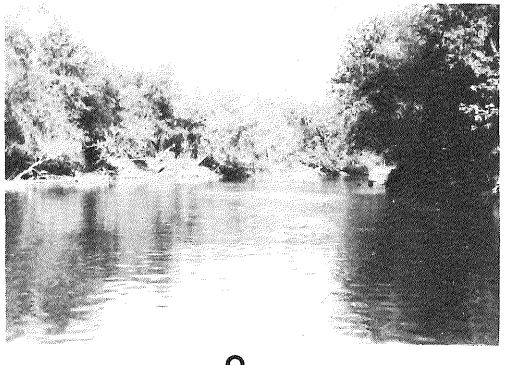
6



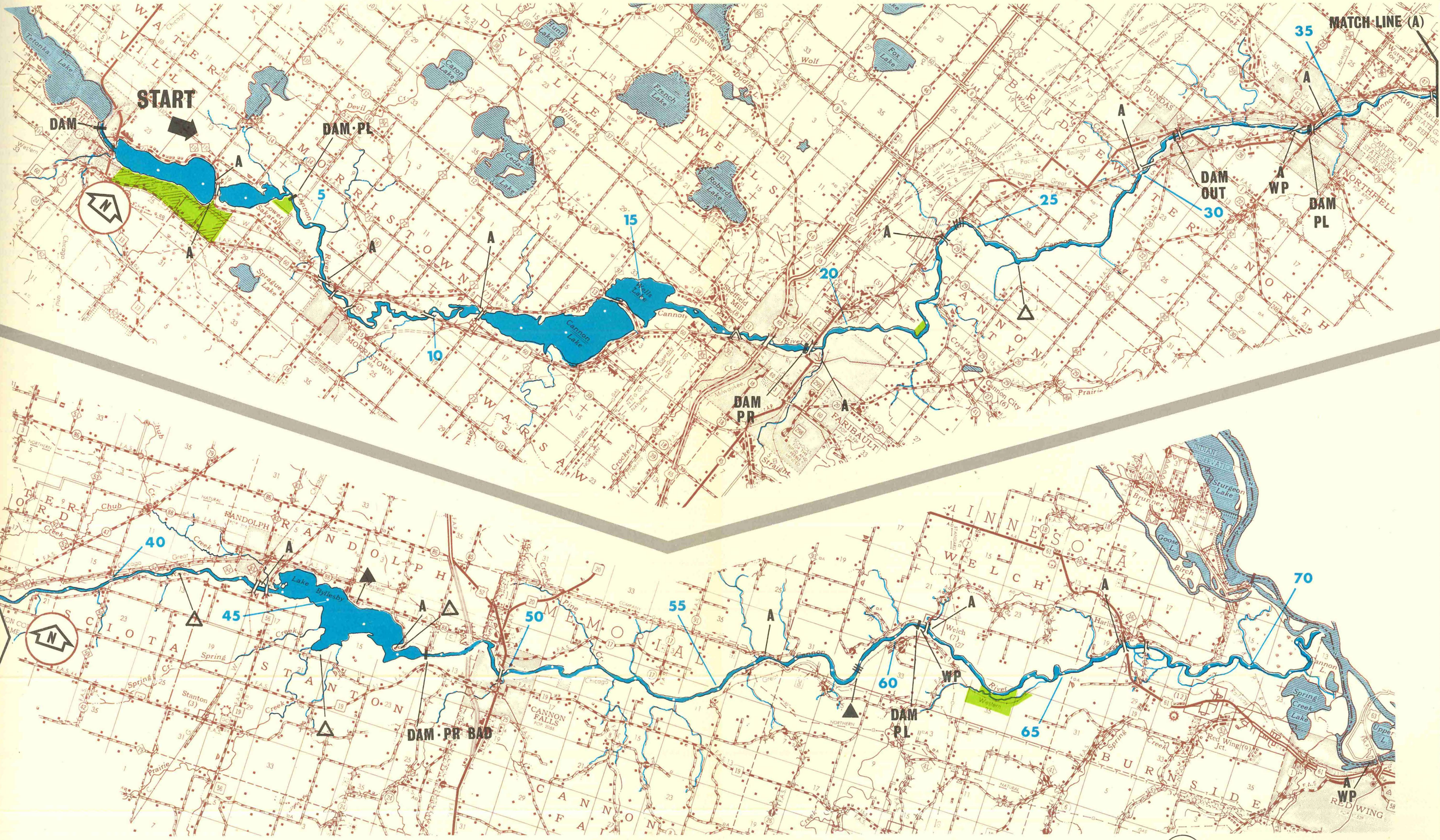
7



8



9



4

CANNON RIVER

CLOQUET RIVER

LOCATION:

The Cloquet River is located within St. Louis County, Minnesota. It is the St. Louis River's largest tributary and enters the St. Louis River just below Brookston, Minnesota. As a tributary to the St. Louis River it is completely different in its natural setting. The survey of the Cloquet River began at Brimson, Minnesota on County Road 44 and ended where the Cloquet flows into the St. Louis River directly east of Brookston, Minnesota.

NATURAL SETTING:

At mile 0.0 the starting point of the survey, the river is very narrow and shallow, the bottom consists of sand and gravel, the stream is log choked, the banks are about five feet high on both sides, covered with brush, silver maple, birch and black spruce. The narrow, log choked and shallow characteristics of the river continued to mile 4.6 where the first real rapids occur. These rapids are about 100 yards long, have a very steep grade and would not be canoeable except in high water and then only with great danger.

Below the rapids the river broadens out, the banks become lower and typical northern Minnesota marsh land appears. Banks consist of sand and gravel and are covered with brush. Away from the banks, swamps stretch out some three to five miles. Throughout the rest of this section of the river we have low domed hills with swamps in between. The hills are composed of morainic type material covered with a few norways and white pine intermixed. The swamp lands extending back from the river are not open marsh land but are rather covered with very thick underbrush and tamarack forest. The river flowing through this type of terrain characteristicly has stretches two to three miles long where the drop is small. Riffles and sandbars predominate in this area. This is followed by a rapids of approximately 100 yards long with a very steep slope and large bolders of two to three feet in diameter. There are four rapids which require "lining."[1] These are located at miles 4.6, 10.5, and 11.2.

From mile 17.0 to mile 21.0 the Cloquet River takes on a characteristic similar to the Rum River, i.e., there are natural levees composed of sand and covered with hardwood forest, such as silver maple, elm, birch, and aspen. The river meanders through this type of natural setting. There are many shallow sandbars which must be walked over. At mile 18.9 a small falls occurs which is very treacherous and should be portaged under any condition. Below the falls the river broadens out with rapids intermittent down to Lake Alden.

Lake Alden is surrounded with summer homes. People may travel up the Cloquet River to mile 19.2 depending upon water levels and the type of craft they are using. They also have access directly into Little Alden Lake which is northeast. Alden Lake is shallow, the edges are composed of wild rice, reeds and water lilies with swamps and low hills on the edge of the lake.

The Cloquet River leaves Alden Lake on the southeast corner. There is a rapids of moderate difficulty at the outlet of the lake. Below the rapids the river broadens out, riffles are intermittent and must be walked in low water. At mile 24.0 there is another major rapids. This rapids is different from the rest in that instead of being straight it meanders back and forth in a very narrow channel and with a very short radius of turn. This means that it is very difficult to canoe, even under high water conditions.

The rest of the rapids and riffles marked on the map are easily canoed except in low water when they must be walked. In between these riffles and rapids the river broadens out upward to 100 feet and becomes shallow. The rapids directly east of Island Lake Reservoir mile 25.9, are the most difficult rapids, except for the previous mentioned falls. The rapids fall around on island and directly into Island Lake Reservoir.

[1] "Lining" is the process of guiding a canoe through a rapids by controlling with ropes tied to the stern and bow by a person on each bank.

Entering Island Lake Reservoir one can look directly west at the bridge where State Highway 4 spans the river. The reach is 2 miles and could be potentially hazardous under unfavorable wind conditions. From the State Highway 4 bridge to the dam at the outlet of Island Lake Reservoir, is a reach of 4 miles and also could be treacherous under certain wind conditions. This reservoir is being maintained by Minnesota Power and Light Company and is a holding pond for their dam at Cloquet and, as such, the water fluctuations in the reservoir are high, however, pressure brought on by summer cottage development calls for a greater control of the water fluctuations.

The dam at the outlet is approximately 25 feet high, there is a portage on the left hand side which is quite steep but possible. Below the dam the Cloquet River becomes wide and deep. Banks are high on both sides until approximately mile 34.0. At mile 34.0, the banks begin to fall away with swamp areas coming in on both sides of the river. The river itself is lined with one of the finest white birch forests observed in the Rivers Survey. The birch are dense on both sides of the river and average about five inches to six inches in diameter. At mile 37.5 one comes to Hunters Lake which is directly accessible from the Cloquet River by motorboats and canoes and is heavily developed for summer cottage use. At mile 39.7 one comes to Side Lake which is also another lake directly accessible to the Cloquet and is also heavily developed for summer use. Below Side Lake the river broadens out to over 200 feet wide, small areas of open fields and swamps are interspersed with heavy forest cover to mile 42.8. Mile 42.8 is the beginning of the rapids which are relatively difficult for they have steep slopes, are narrow and the water is fast. In high water, powerboats can and do go up and down these rapids, however, due to the water fluctuations of the river caused by the dam, this is not a desirable or advisable thing to do. These rapids extend to mile 44.0.

At mile 44.8 and mile 45.5 there are two short sudden drops which could cause problems in low water. At mile 47.9 there is another rapids of almost two miles in length which is of moderate difficulty and should be taken with care. The river through this stretch follows a narrow channel with steep banks rising as much as 50 feet on both sides within a few feet of the water's edge. The banks are heavily covered with hardwoods, especially birch, however, some jack pine, black spruce and norway pines are interspersed. From this point, to the St. Louis River, intermittent rapids and pools occur with the rapids becoming progressively worse as one descends into the St. Louis River Valley. It is also the area where the shift from hardwoods to conifers is noted. Birch and aspen begin disappearing while black spruce, backed by the norway pine, come in stronger. The longest and most difficult rapids of the trip is also in this stretch, it runs from mile 54.5 directly below the County Road 46 Highway to the St. Louis River at mile 58.6. These rapids are very wide, shallow, and filled with large boulders, some greater than three feet in diameter. The slope is about ten feet per mile. This means that the rapids range from moderate to difficult depending upon the water level. The rapids extend into the St. Louis River in the shape of an alluvial fan. This is at mile 58.6, the end of the survey.

EXISTING DEVELOPMENT:

On the upper stretches of the Cloquet River from Brimson, mile 0.0, to the Island Lake Reservoir, mile 26.5, there are no bridges crossing the river. Five cabins were observed during the first 26 miles of the river proper, plus eight on Alden Lake. Island Lake Reservoir is heavily developed with summer homes. This portion of the river between the dam and mile 43 is extensively used by owners of powerboats and by fishermen. From mile 43 to the St. Louis River development is sparse with only five homes observed and five highway bridges.

AMENITIES FOR RECREATION:

The upper stretch of the Cloquet River, from Brimson down to Island Lake Reservoir, is one of the wildest stretches of stream to be surveyed under the obligations of this study. The marsh extends back from the river on both sides three to five miles, and has only a few jeep trails penetrating it. At the time of the survey, the banks of the river were covered with moose and deer tracks. According to local residents, there is a rather large moose population in the area. During the course of the survey, two moose were observed on this upper portion of the river.

Throughout this stretch of river there was a noticable absence of flies and mosquitos one learns to expect.

The contrasting nature of the pools, with marsh on both sides, reeds, red-orange sand banks, the boulder fields in the rapids, and the green lush vegetation to the clear blue sky, provided a very contrasting visual change. Island Lake Reservoir is visually pleasing; the clear blue waters, the sandy shores and wooded banks provide many camping sites and is a delightful visual change from the upper stretches of the river. Below the Island Lake dam, the river is completely different being much wider and deeper and having steep banks and high hills on both sides. The hills are covered with dense forests of white birch. The rapids are of moderate difficulty and provide the excitement which canoeists hope to experience.

In summary, the Cloquet River is one of the most interesting rivers for it provides striking visual change, it has rapids from moderate intensity to treacherous falls, wildlife is abundant and camp sites available. Access at Brookston is good.

POTENTIAL FOR FUTURE RECREATION:

The Cloquet River, because of its extreme changes in nature, is a very desirable river to include as part of the Minnesota Recreational River System. However, there are some problems which seem to be in need of attention such as (1) accessibility - for the private individual with two cars, the cars must be driven over 150 miles in order to be spotted. It is also conceivable that some of these roads would not be possible to drive at certain times of the year when water levels make the river available for canoeing; (2) the hardship of the upper river as a narrow shallow stream with steep pitches, where canoes must be lined through or canoed only under extreme danger; (3) the nature of Island Lake Reservoir in being some seven miles across, makes it somewhat treacherous for the average canoeist; (4) the nature of the river below the Island Lake Reservoir Dam to mile 41.1 being heavily developed with summer cottages and also heavily traveled by motorboats makes it undesirable for the canoeist; (5) the lower stretch of the river, from 47.8 to the confluence with St. Louis River has white water, moderate to difficult in nature, and should be attempted by experts only; (6) the rapids change in water level caused by the dam on the Island Lake Reservoir.

CONSIDERATION:

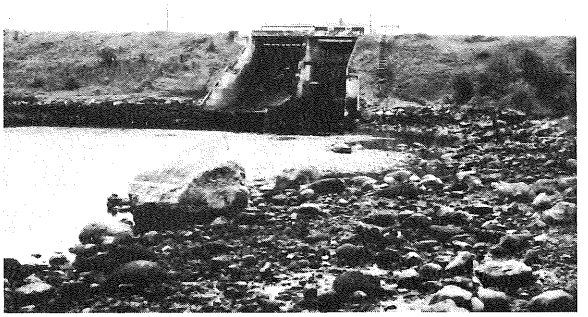
1. The Cloquet River should be considered as one of the rivers in the State System but one should be made aware of the quality this river has, so they can judge.

2. Development on this river should be limited to a few access points and camp sites . Sites for consideration are County Road 44 near Brimson, County Road 273 where the Cloquet River flows into Island Lake Reservoir, and at the County Road 15 crossing. By developing these access points the upper stretch of the river from Brimson down to Island Lake Reservoir would be a long strenuous one day trip or a restful two day trip. By developing an access at the County Road 15 crossing the Cloquet River below County Road 15 could be canoed in an easy one day trip providing the water levels were high enough. The minimizing of access points would also help keep the river in its wild state, preserving its fine qualities for the heartier who desire a wilderness experience and a test of canoe skills.

CLOQUET RIVER

1. Dam at Island Lake Reservoir. Showing 8 cu. ft. per second discharge, that only which leaks.
2. Boulder strewn, riffle area, typical of much of the river below Island Lake Reservoir.
3. Mixed forest typical throughout the entire reach of the river.
4. Typical scene.
5. Cobble and boulder, gravel banks seen throughout the length of the river.
6. One of the many gravel islands covered with deep grass.
7. Typical banks and the bridge at Burnett.
8. Downstream from bridge at Independence.

CLOQUET RIVER

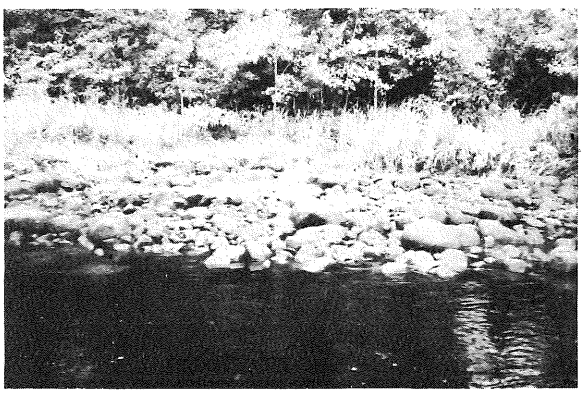


1

2

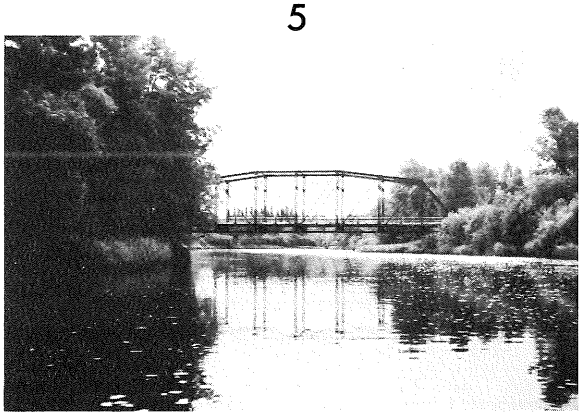
3

4



5

6



7

8

MATCH LINE (A)

DAM
PR

WP
A

START

FALLS

SCALE OF STATUTE MILES

5

CLOQUET RIVER

COTTONWOOD RIVER

LOCATION:

The Cottonwood River is located in southwest Minnesota and is the principal stream of a 1,295 square mile drainage basin. It flows through Lyon, Redwood, and Brown Counties entering the Minnesota River at New Ulm. Its length is approximately 100 miles, however, for purposes of this survey, only that portion from Sanborn to New Ulm is considered, a distance of some 54 miles.

NATURAL SETTING:

The general setting of the Cottonwood River is through rich farmland of gently rolling plains. In the northeastern portion of the river valley, the river has cut some deep gorges. The river banks tend to be bordered with a heavy tree growth of oaks, boxelders, lindens, elms, all of which provide a very colorful fall array. The stream bed consists of many boulders and shallow pools with insufficient water to provide a canoe route. The naturalistic setting of the river is very attractive but the flow is such that the river cannot be enjoyed by boating or canoeing except during selective times of the year. Access to the river is good at nearly every bridge. At mile 26 there is a parking location and park with no facilities.

EXISTING FACILITIES:

Two facilities which are developed along the river are Flandrau State Park, which has parking and camping accommodations and a city park in Springfield. A dam is under construction at the north end of the State Park (mile 52) which when completed is expected to create a lake of sufficient size to accommodate boating and swimming.

POTENTIAL FOR FUTURE RECREATION:

The Cottonwood River, which has a stream bed varying in width from 25 to 50 feet with a flow during the fall of only a few inches in depth and at certain locations 2 or 3 feet in width, is not of such quality as to be considered in the State Recreational River classification.

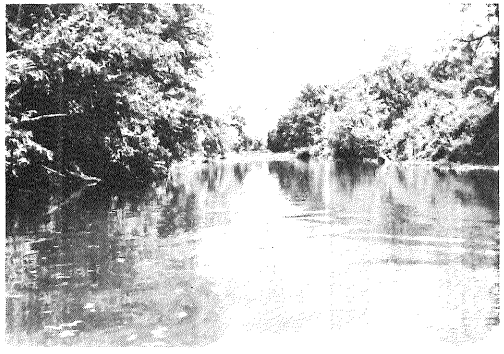
CONSIDERATIONS:

The river could be of local value should construction be undertaken to create water retention dams. Parks and campsites for vehicle-oriented travelers would be very enjoyable along the river.

COTTONWOOD RIVER

1, 2 & 3. Typical bank cover.
4. Sandstone cliff at mile 8.
5. Typical tree fall with associated debris.
6, 7 & 8. Typical of the reaches throughout the river.
9. Typical rock riffle.

COTTONWOOD RIVER



1

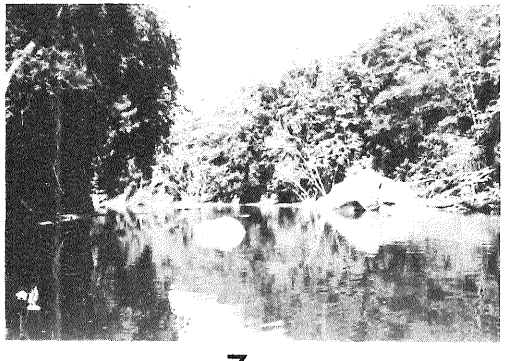
2

3

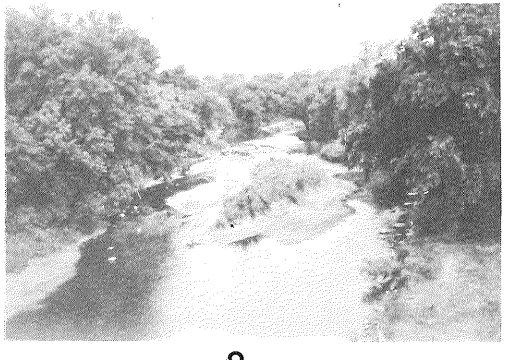
4

5

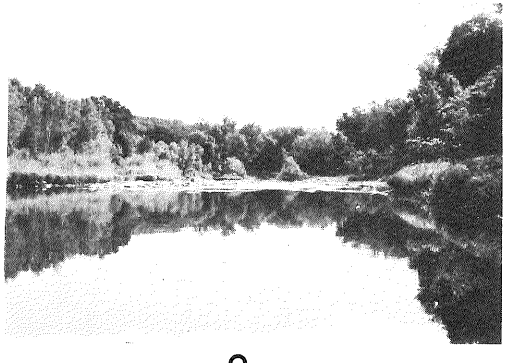
6



7



8



9

MATCH LINE (A)

START

DAM PL

DAM OUT

NEW ULM POP 12,587

SPRINGFIELD POP 2701

SANBORN POP 297

COBDEN POP 214

SLEEPY EYE

SLEEPY EYE STATE SCENIC WAYSIDE PARK

FLANDRAU STATE PARK

MILFORD STATE MONUMENT

WILDLIFE AREA

RIVER

Cottonwood River

Sleepy Eye Creek

Minnesota River

Chicago, Milwaukee, St. Paul & Pacific Railway

Western Railway

Northern Railway

Bloomike Lake

Boys Lake

Altermatt Lake

Clear Lake

Lake Cottonwood

Juni Lake

School Lake

Zanders Lake

Bachelor Lake

Gilman L.

Sleepy Eye L.

To St. George

To Nicollet

To Lafayette

5

10

15

20

25

30

35

40

45

50

WP

A

D

(A)

6

COTTONWOOD RIVER

CROW WING RIVER

LOCATION:

The Crow Wing River has its beginning in Hubbard County with a chain of 10 lakes known as the Crow Wing Lakes one through 10. From this point the river flows in a southerly direction to the Mississippi River. At the mouth of the river is located "Camp Ripley." The distance through the chain of lakes is approximately 20 miles and at this point the Shell River from Menahga, Minnesota flows into the Crow Wing. The Crow Wing River has a watershed of 3,764 square miles which is settled by approximately 35,000 persons, two-fifths of which are classified as rural residents. The principal communities along the river are Nimrod and Motley.

NATURAL SETTING:

The characteristic feature of the Crow Wing River is clean, cool, clear water flowing through relatively dense growth of trees. The water is seldom over three feet in depth and nearly always sufficient to float a canoe or boat. The penetration of the abutting woods by urban development, cabins, parks, clubs or other evidence of settlement is seldom and does not distract from the northwoods atmosphere. Most of the river is in the upland plains. The surrounding landscape tends to be gently rolling with the moraines predominantly sand and gravel. The banks of the river are sometimes steep but not high and well stabilized by trees and woody plants. Lumbering is a source of employment with oak, pine, spruce, maple , elm and poplar found in the area. Wildlife is evident with muskrats, deer, skunks, beaver off the main river, and water oriented birds. Song birds were few in number.

In general the vegetation is rich on both sides of the river and dense enough to prohibit one's view from extending into the settled area. A northwoods atmosphere is definitely present.

EXISTING DEVELOPMENT:

Of the various rivers surveyed in this study the Crow Wing was found to be the most advanced in providing accommodations for recreation utilization. The chairman of the Crow Wing Canoe Trail Committee was contacted and it was learned that the effort to develop and promote the use of the river was only four seasons old. The Canoe Trail, as locally recognized, combines the Shell River and Crow Wing River beginning at Menahga and extending to Motley some 69 miles toward the Mississippi. Thirteen camp and park sites have been developed along this route varying in size from Stigman's Mound of three-fourths of an acre to Anderson's Crossing of 113 acres. The sites are all served by a passable vehicular road which permits a wide range of trip lengths, for it is possible to enter or leave the river at any site. A map is published by the Committee telling of facilities to be found at each site, such as tables, toilets, fire places and water. A continuing program of upgrading facilities is in existence which appears to be necessary to accommodate the increasing demand. Accurate records as to the number of users is difficult to keep, however, through conversing with the three approved outfitters and reviewing the letters of inquiry it is estimated that the river accommodated 4,000 canoe man-days within the designated canoe trail.

In addition to the canoeing and boating facilities, the Crow Wing Wilderness Saddle Trail, consisting of 31 miles along the river has been developed. The trails are cleared and wind through scenic coniferous and hardwood forests. Fords and bridges permit the crossing of the river at various points.

A headquarter corral has been established at Huntersville with additional corrals at camps along the trails. These same trails and campsites are available during the winter months for snowmobile rides and received large acceptance in 1965-1966.

The development which has occurred in relation to the Crow Wing River is impressive both from a physical standpoint and from a community organization of cooperative efforts. A need is being met.

AMENITIES FOR RECREATION:

The clearness of the water in the Crow Wing River is impressive for one can count the stones on the bottom where the water is three feet deep. Swimming is recommended, which is not true in many rivers. The heavy tree cover and lack of prominent man-made facilities is peaceful and relaxing.

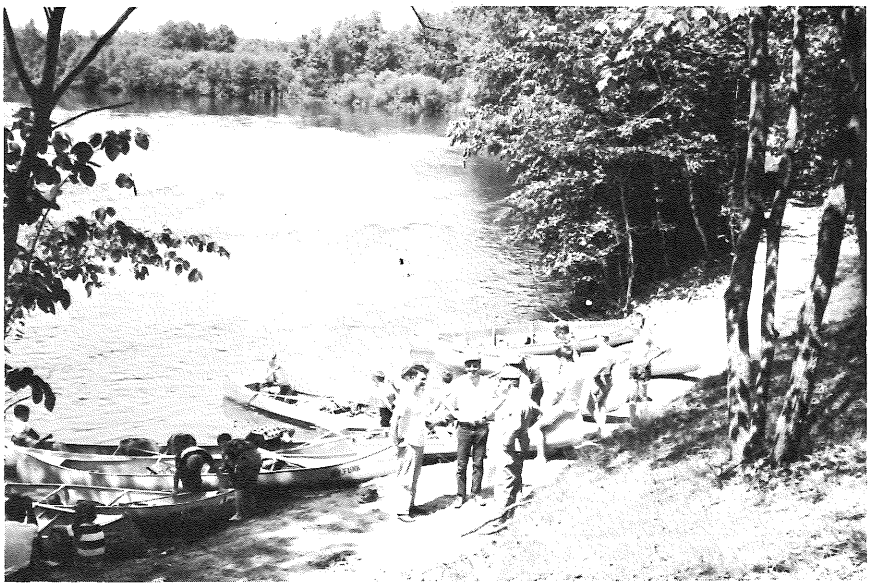
The river requires no portages and the current is strong but not dangerous which together permits easy canoeing. The wildlife is present and fishing is considered good. Thus, the amenities for enjoying an atmosphere at the other end of the pendulum from a busy urban scene are present.

POTENTIAL FOR FUTURE RECREATION:

The present development approach, considering the type and quality of the river, appears to be in the proper direction. Currently the facilities are for those persons who desire to canoe, ride a snowmobile and camp out or only experience a single day. To enlarge on this and accommodate the family which will have persons who wish to be on the family trip but do not want to canoe, fish or ride the range, facilities should be enlarged for them. A resort in Nimrod with a golf course, pool and dining room would greatly expand the range of family acceptance.

CONSIDERATIONS:

In relation to the Crow Wing, the considerations are more of refinements than basic elements. Campsite locations could be marked by a yellow post, for it was found that the wilderness of the bank was so well protected from campsite encroachments that the sites were easy to bypass. It is suggested that the canoe route to be considered, be adopted by the Crow Wing River Committee and not include the Crow Wing Lakes.



Group of Boy Scouts at Funk's Landing - Crow Wing.

CROW WING RIVER

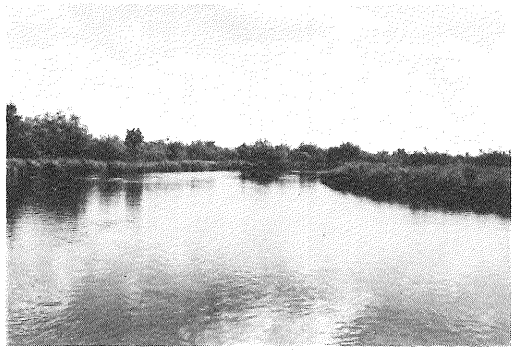
1, 2, & 3. Typical of interlake reaches.
4. Typical vegetation along entire length of the river.
5. Typical camp at mile 50.
6. View from camp.
7. Typical of marsh banks on inside of meander with high, sand banks on outside.
8. Cottingham Bridge.
9. Sylvan Dam.

Typical downstream.

CROW WING RIVER

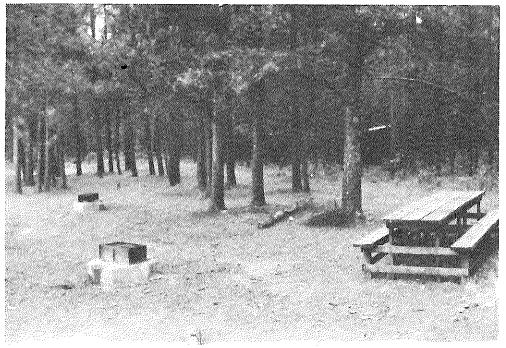
1

2

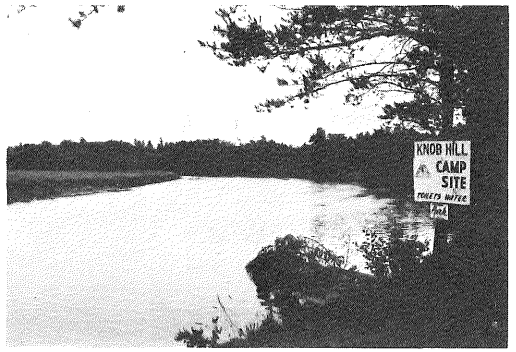


3

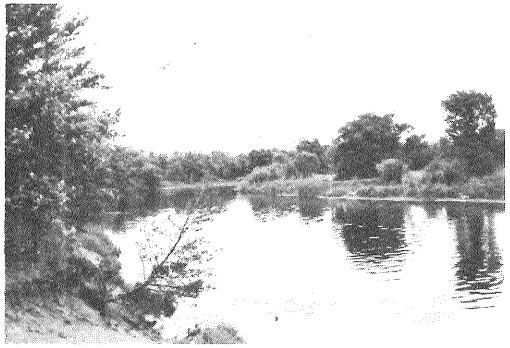
4



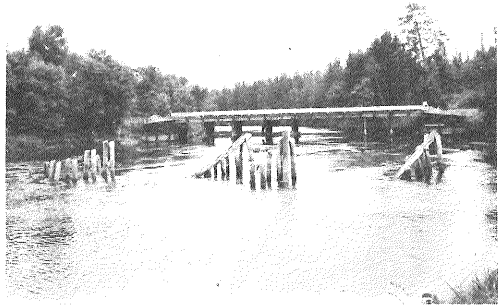
5



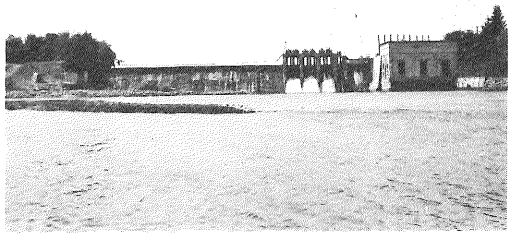
6



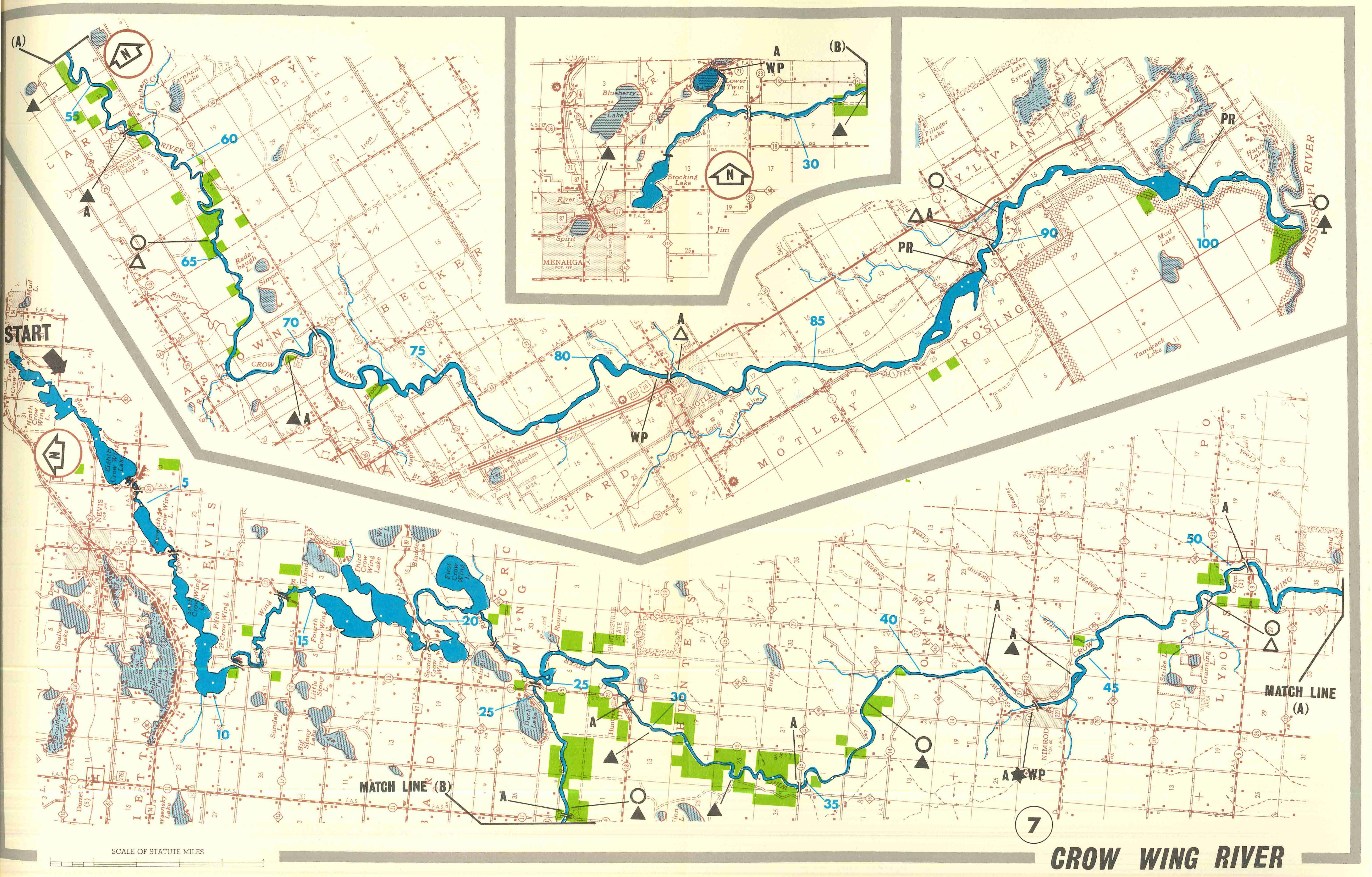
7



8



9


START
(A)
(B)
MATCH LINE (A)
MATCH LINE (B)
SCALE OF STATUTE MILES
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
100
WP
PR
A
NEVIS
NIMROD
MOTLEY
MENAHGA
MISSISSIPPI RIVER
Eighth Crow Wing Lake
Seventh Crow Wing L.
Sixth Crow Wing Lake
Fifth Crow Wing L.
Fourth Crow Wing L.
Third Crow Wing Lake
Second Crow Wing L.
First Crow Wing L.
Ninth Crow Wing L.
Belle Taine Lake
Shallow Lake
Boulder L.
Sunday L.
Big Stony Lake
Little Stony L.
Duck Lake
Palmer L.
Round L.
Bladder Lake
Island L.
Burgen L.
Strike L.
Granning L.
Blueberry Lake
Lower Twin L.
Stocking Lake
Spirit L.
Farnham Lake
Simon L.
Radabaugh L.
Mud Lake
Tamarack Lake
Pillager Lake
Lake Sylvan
Hardy Lake
Gull
HUNTERSVILLE STATE FOREST
NEVIS
WING
HUNTERS
ORTON
LYONS
LARD
BECKER
MOTLEY
ROSING
SYLVAN
CROW WING RIVER
Oylen
Hayden Brook
Long Prairie River
Shell R.
Swamp Creek
Beaver Creek
Iron Creek
Farnham Cr.
Northern Pacific Railway
Huntersville
Sylvan

CROW WING RIVER

KETTLE RIVER

LOCATION:

The Kettle River is located in east-central Minnesota. The river has its head waters in Carlton County and flows in a generally north-south direction, passing through Pine County and into the St. Croix River.

For the purposes of this study, approximately 53 miles were covered. The survey was started on the County Road 6 bridge northwest of Kettle River in Carlton County and ended at the confluence with the St. Croix River.

NATURAL SETTING:

The Kettle River flows through and over several types of surface and subsurface geology. On the northern part of the river, from mile 0 to mile 6, the river flows through an area of glacial moraine. Pools and rapids are closely spaced and do not exceed 50 yards in length. The rapids are shallow and very difficult to canoe even in high water. The banks of the river are gravel and heavily forested with small aspen and birch with an occasional stand of larger norway pine, white pine, and black spruce. The forest growth is right down to the edge of the river and encloses the river.

Starting at mile 6.9 a large open field on the left bank signifies a change in the river characteristics. The river broadens out; pools and rapids are longer (100 yards) and deeper; the rapids are more easily traversed due to the gravel type of bottom; and the banks of the river are higher and grassy but flat on top.

From mile 10 to mile 13 the river broadens out amoung islands, grass areas with low banks of sand and gravel. Distinguishing the main channel is difficult. Maple and elm are the dominant species of hardwoods, but there are a few pine visible. At mile 12.8 the Moose River joins the Kettle River and seems to contribute a great deal of water which could be the reason for the strange behavior of the Kettle River directly above.

Below the confluence with the Moose River, the Kettle River becomes entrenched and narrows down once more. Pine are intermingled with hardwoods, farmland extends down to the edge of the river. The open woods, caused by grazing, are very scenic. There are no rapids in this stretch.

From mile 21 to mile 27 the Kettle River broadens out to over 150 feet wide. Average depth is about 4 feet. The banks slope up and away from the river and are covered with pine and hardwoods. Ground water inflow was noted at mile 23. At mile 23.9 a short set of rapids with a steep pitch occurs. Running them in high water is possible. A rock outcrop stands better than 10 feet above the water on the right hand bank. There is a camp site on top of the rock outcrop. The whole area is quite scenic. Directly below mile 24, Interstate 35W crosses the river. Downstream high hills are beginning to appear. The river characteristics remain much the same until mile 28.5 within Banning State Park.

The Kettle River flows through Banning State Park in a gorge approximately 130 feet deep, which forms the Hells Gate Rapids. These rapids are about 1 mile long and consist of four major drops of about 5 feet each. There is no portage and running the rapids is very dangerous. Several lives have been lost in the rapids. The river remains entrenched for more then 100 feet until it reaches the remains of the Kettle River Dam at mile 33.0.

Below the Kettle River Dam the river passes through several short rapids of moderate difficulty and through several pools, one of which is bet ter then 20 feet deep. At mile 36.1, rapids, of about 1/2 mile in length, occur. These rapids are also of moderate difficulty.

From mile 37 to mile 46 the river once again becomes wide (over 200 feet) and placid. Flood plains develop on both sides with open hardwood forests.

At mile 46.1 the lower Kettle River Rapids begin. These rapids are moderate in difficulty and very

popular with the canoeists. They are, however, wide and shallow and cannot be run in low water. This is true of all the rapids in the Kettle River.

The St. Croix River confluence is at mile 53 and is the end of the survey.

EXISTING DEVELOPMENTS:

There are seventeen homes located along the river's edge although only 5 may be seen from the river. Two of the five are old farmsteads while the remainder are homes which have penetrated the wilderness setting. Fourteen bridges and two trestles cross the river.

There are developed access points at miles 21.0, 33.0, 40.5 and 47.0; however, access is also possible at other bridge crossings. There are no developed camp sites on the Kettle River.

Approximately 26 miles of the Kettle River are already in public ownership of one form or another. The General C.C. Andrews State Forest abuts on the east side of the river from mile 13 to mile 15.2. The undeveloped Banning State Park abuts both sides of the river from mile 24.2 to mile 30.8. The Sandstone Game Refuge abuts the east side of the river from mile 31.5 to mile 40.5. Part of this is also the Federal Correctional Institution.

Chengwatana State Forest and St. Croix State Park abut the river from mile 42.6 to mile 51. Other stretches of the river are within the municipalities of Kettle River, Rutledge and Sandstone. Finally, the State and County own small parcels of land on the river which have not been declared parks, game refuges, etc.

AMENITIES FOR RECREATION:

The Kettle River is a very scenic and interesting river. The constantly changing topography and forest cover provide an ever changing scene. The river has rapids interspaced with long pools. The rapids provide a challenge, the pools a chance of relaxation and quiet reflection.

The glacial geology of the area, as reflected in the river, also is an interest point. Moraines, glacial outwash plains, gorges, kettle holes, and caves exist along the river and are primarily the result of glacial activity.

The history of the area is rich. The remains of the lumbering activity of the 1850's and 60's, the quarrying at Banning and Sandstone, the forest fires and the development of the St. Croix State Park make the river corridor more desirable.

Wildlife within the river corridor is numerous. Deer, beaver, muskrats, herons, and hawks are all present within the river basin.

Fishing is also reported good. Walleyes, sturgeon and small mouth bass are especially good. Northern pike, red horse, suckers, and even trout (mainly in the Pine River and Willow River tributaries) are fished in the river.

POTENTIAL FOR FUTURE RECREATION:

The Kettle River is truly a fine stream. It has all of the qualities which a prime stream should have. Being off a major highway (35W), it is within range for weekend outings by the people of the major population concentrations.

The Kettle River setting is such that all river oriented recreational activities could be accommodated and the small communities, through promoting and participating, can experience a significant economic gain. The current accommodations are in need of expansion and new camp sites, parking areas and trails should be developed.

CONSIDERATIONS:

1. The Kettle River should be included as a Minnesota canoe route.

2. The route should extend from Glaisby Brook (mile 4.6) to the St. Croix River.

3. Camp sites should be developed at miles 4.6, 13.9, 23.9, with Banning State Park, Highway 48, and at mile 51.0.

4. Access points should be developed at miles 4.6 and 51.0 in addition,access points at miles 20.9, 27.0, 33.0 should be maintained.

5. A portage on the east bank around Hells Gate Rapids should be developed.

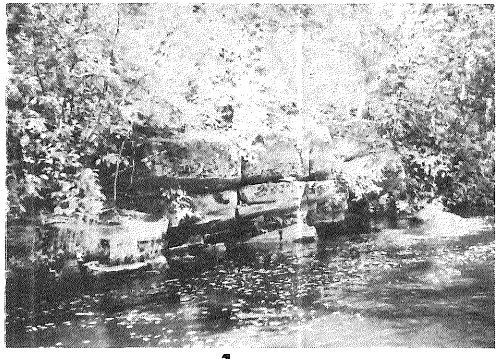
6. Consideration should be given to the development of hiking and riding (bridle) trails from the vicinity of Glaisby Brook (mile 4.6) to the St. Croix River - corrals should be provided.

Below confluence of Moose River at mile 15.0.

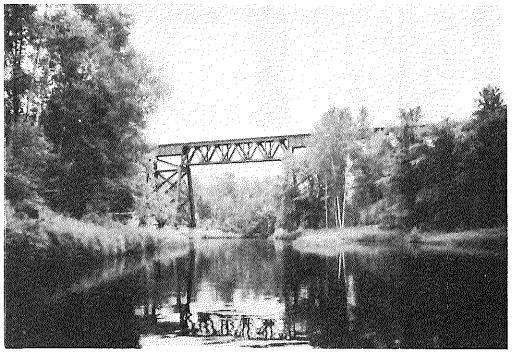
KETTLE RIVER

1. Rock outcrop in the upper reach.
2. Typical upper reach and very high railroad bridge.
3. Typical rapids of the mid and upper reaches.
4. High eroding bank of riparian farmland.
5. Typical scene, mile 35.
6. Typical scene, mile 33.
7. Lower reach above Sandstone.
8. View upstream from Sandstone bridge with railroad bridge and ore train.
9. Rapids, typical of those near the St. Croix Park area.

KETTLE RIVER



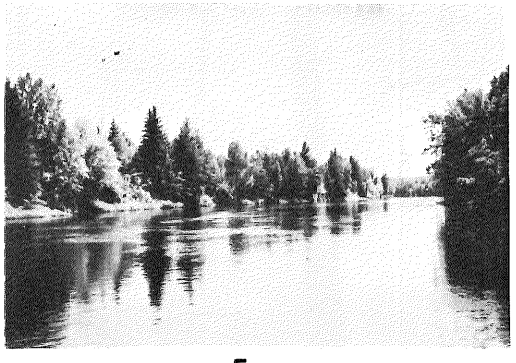
1



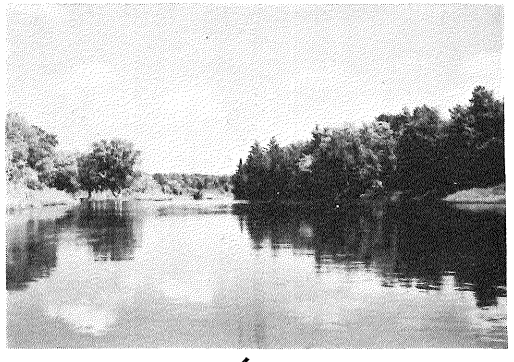
2

3

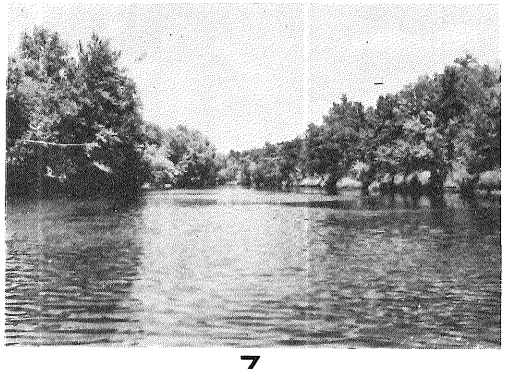
4



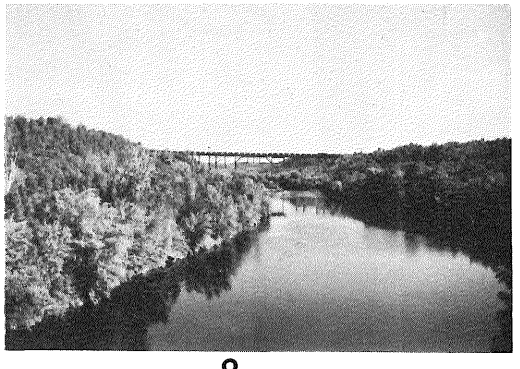
5



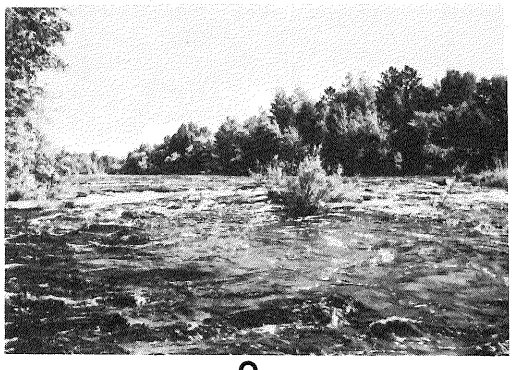
6



7

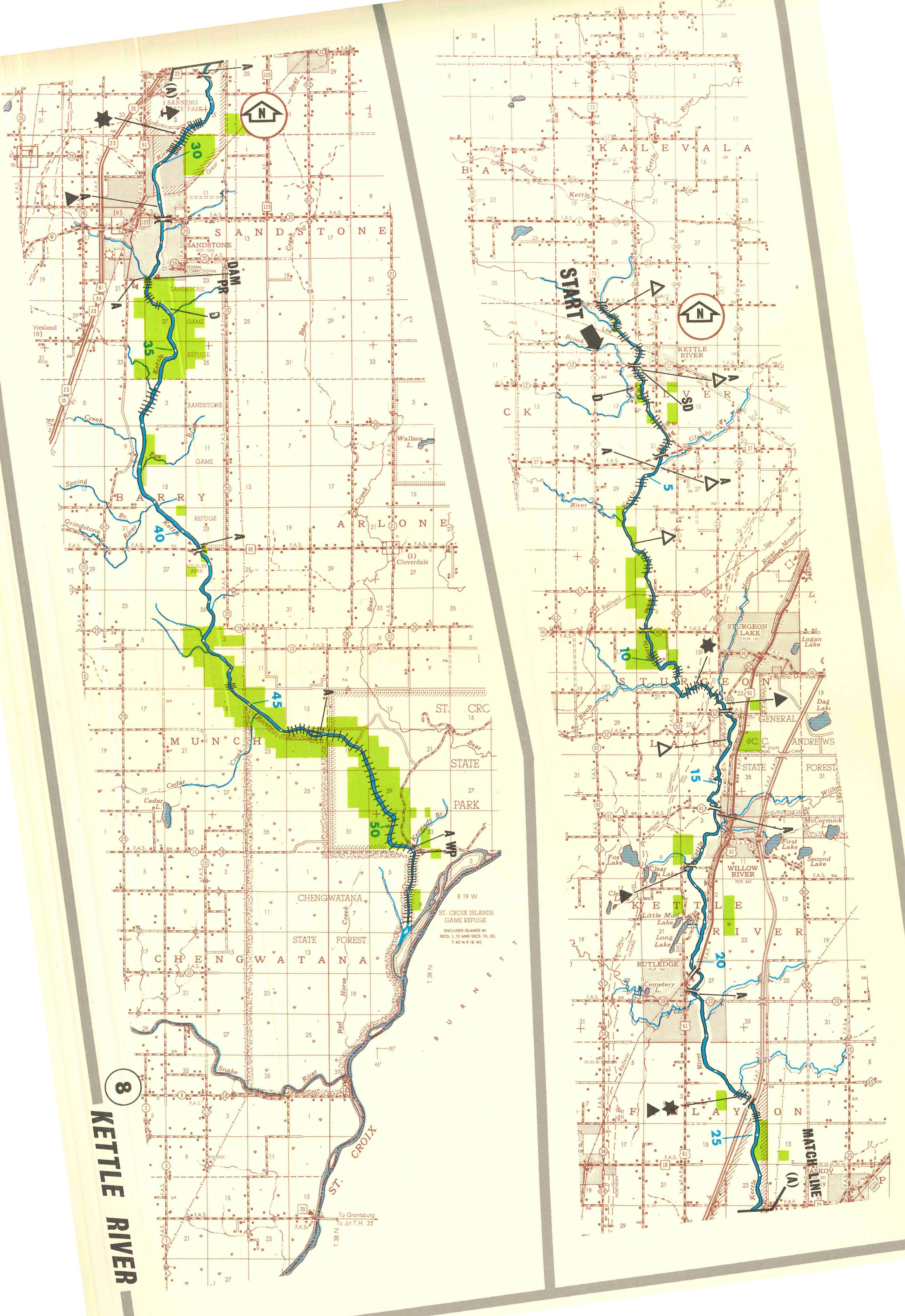


8



9

8 KETTLE RIVER



START
KALEVALA
KETTLE RIVER
STURGEON LAKE
STURGEON
GENERAL C.C. ANDREWS STATE FOREST
LAKE
WILLOW RIVER
McCormick L.
First Lake
Second Lake
Logan Lake
Dago Lake
Fox Lake
Clear Lake
Little Mud Lake
Long Lake
Cemetery L.
RUTLEDGE
KETTLE RIVER
FINLAYSON
ASKOV
MATCH LINE
BANNING STATE PARK
SANDSTONE
FEDERAL CORRECTIONAL INSTITUTION
DAM
PP
D
SANDSTONE GAME REFUGE
BARRY
ARLONE
Cloverdale
Wallace L.
WILDLIFE AREA
MUNCH
Cedar L.
ST. CROIX STATE PARK
Kennedy Br.
A WP
CHENGWATANA STATE FOREST
CHENGWATANA
ST. CROIX ISLANDS GAME REFUGE
(INCLUDES ISLANDS IN SECS. 1, 12 AND SECS. 19, 20, T 40 N R 18 W)
BURNETT
Snake River
ST. CROIX
To Grantsburg
To Jct T.H. 35
5
10
15
20
25
30
35
40
45
50

LITTLE FORK RIVER

LOCATION:

The Little Fork watershed is located in Itasca, St. Louis and Koochiching Counties. It rises in a rather flat region in St. Louis County and follows a meandering course to the northwest through eastern Koochiching County to its junction with the Rainy River about 19 miles below Little Fork, Minnesota. The watershed has a total area of 1,849 square miles, is about 80 miles long and averages 23 miles in width.

For the purposes of this report, a distance of some 132 miles from Cook, Minnesota to the Rainy River were surveyed.

NATURAL SETTING:

The upper part of the Little Fork River from Cook, Minnesota to the Silverdale Bridge at mile 37.8 is geologically associated with the glaciers which invaded from the north and northeast. A hummocky rolling surface is made up of moranic deposits and glacial drift laid over a bedrock composed largely of granitic, volcanic and metamorphic rocks.

Cook, Minnesota at mile 0.0 is a resort town primarily oriented towards Lake Vermilion. The Little Fork River meanders through town. It is about 30 feet wide, fringed with wild rice, reeds and lily pads. Banks are about 5 feet high and are composed of clay. The river can get quite shallow during the summer at which time it appears to be fed primarily by the sewage treatment plant directly to the southeast.

Outside of Little Fork, the river flows through rolling farm land. The farms are of the beef cattle and hay type, some of which have pasture land abutting the river.

The forest cover is primarily hardwoods with birch, poplar and elm being the predominant species. Jack pine, norway pine, juniper and black spruce are intermixed.

From Little Fork to mile 15.0, six bridges are crossed. The south branch of Little Fork comes in at mile 4.8 and Flint Creek comes in at mile 8.4. Together they contribute a significant volume of water such that canoeing is possible except during periods of very low flow.

Below Hananen's Falls the river has intermittent rapids, some of which should be run with care and would only be possible to run under normal water conditions. There are small falls at miles 22.0 and 34.6. Fishers Rapids is at mile 27.0.

Below the falls and rapids at mile 34.6, the Little Fork River begins meandering over the floor of Glacial Lake Aitkin. From this point downstream the number of farms near the river diminishes. In the area of the La Vallee River, a dense forest extends down to the banks. The forest extends back from the river for more than a mile with cedar trees greater than 3 feet in diameter and towering into the sky. Needles form a thick layer over the ground with ferns turning the forest floor into a green carpet. Walking through this forest is a pleasurable experience.

The river flowing through this forest has high banks composed of calcareous clay. Under these conditions it is almost impossible to get out of the canoe. If getting out is desired, steps may have to be cut into the bank. The clay is of such a nature that after hiking around on the bank for a while it is necessary to cut off the three or more inches of clay clinging to your boots with a knife. Under these conditions it is difficult to locate a campsite that is reasonably accessible and desirable.

Below the La Vallee River confluence (mile 41.3) the interesting phenomenon of vertical bank slumping with trees seem to be taking place. It appears that the river is undercutting on the outside of the bends. The clayey material is very cohesive and instead of flowing, it shears and in such a way that the trees do not fall across the river but rather fall vertically into the water.

At mile 41.0 we come to Nett Rapids which are of moderate difficulty but must be walked in low water. Nett Rapids is one of the longer rapids and wile running them, the canoeist passes into the Nett Lake Indian Reservation.

Below Nett Rapids, the ancient bed of Glacial Lake Aitkin continues to be crossed. High clay banks continue. The bends of the river are log and stump choked, with clay banks better than 30 feet high. The river is relatively narrow and deep for its volume.

Rapids begin again just outside the Indian reservation at mile 55.0. The banks and bed of the river become sandy with large boulders. The river widens out and shallows. Riffles become numerous. The forest cover changes to hardwood, especially elm with some cedar and species of pine. Occasional elm with trunks up to 4 feet in diameter tower 100 or more feet into the sky. Dense brush covers the forest floor.

Seller's Rapids at mile 61.3 is possibly the roughest rapids on the trip and should be looked over.

Flat rock at mile 63.8 is a low granite outcrop that pinches the river. It is a good spot to stop for lunch or possibly camp.

Deadmans Rapids at mile 68.4 is not as difficult as it sounds, especially in low water, however, care should be taken in running it.

At mile 75.0, the first home and farm visible from the river in the last 47 miles is approached. Another home is located at mile 75.3. Highway 65 and a ranger station are passed at mile 77.0. Wilderness again encloses the river to mile 95.0. From mile 95.0 to the town of Little Fork, homes become more numerous. Another flat rock rapids similar to but more extensive than the one at mile 63.8 is passed at mile 103.8. This is a popular area with the people of the Little Fork area. Access, camping, and swimming are all possible here.

Upper and Lower Rapids at miles 105.3 and 110.0 present more of a standing wave rather than rock dodging situation.

The town of Little Fork is entered at mile 111.0. The river is entrenched some 30 feet below Little Fork. Flooding is not usually a problem in spite of high spring runoff and a late breakup date of the rivers lower portion. The resulting ice jams cause flood stages at Little Fork 20 to30 feet above normal low water stage. The record flood of May 11, 1950, reached a stage of 37 feet at Little Fork. Highway bridges were submerged and a railroad trestle endangered but little actual damage was reported.

Below Little Fork, the river is considered a navigable stream by the U.S. Corps of Engineers. Farms again become numerous and extend to the river edge. At its confluence with the Rainy River, the Little Fork River is as wide as the Minnesota River at Bloomington but shallower.

EXISTING DEVELOPMENT:

When discussing this subject it is best to break the Little Fork into 3 parts: the upper, central and lower sections.

The upper section extends from Cook to the Highway 65 (Silverdale) Bridge at mile 38.0. This stretch of the river has numerous farms along it, some of which extend down to the rivers edge. There are also ten bridges crossing the river in this section of which 4 have access to the river from them. Except for possible camping in a wayside park at mile 13.0, there are no developed camping areas. Fine camping areas exist at Hananen's Falls for the occasional camper in the area, however, heavy use would undoubtedly bring restriction.

The central section, i.e., from the Silverdale Bridge (Highway 65) to mile 95.5 is some 57 miles long and is true wilderness. There is a camping and access area under the Silverdale Bridge, however, toilets, water, picnic tables and fire places are needed. Other than the Silverdale Bridge, there are no developed campsites for the next 57 miles (the entire central section). Decent wilderness campsites are difficult to locate because of water supply, high banks and brush problems. It is possible to camp on any of the numerous sandbars jutting into the river. However, this river is known for its rapidly changing water level, making this type of camping a dangerous sport at the least.

There are five access points to the central section. Except for two jeep type access points within the Nett Lake Indian Reservation there are no access points for 34 miles below the Silverdale Bridge. There are also no visible homes for 37 miles below the Silverdale Bridge (mile 37.8). These statistics add up to make

this one of, if not the longest stretch of wild river in the State of Minnesota.

The lower section of the Little Fork i.e. from mile 95.5 to the confluence with the Rainy River mile 132.0 again is rather heavily developed with homes and farms. As Little Fork is approached from mile 95.5 homes become more numerous. Ed Johns Sawmill is located at mile 109.0. The Little Fork River flows some two miles through the town of Little Fork, where everyday supplies may be purchased and the areas only hospital is located.

Below Little Fork, farming is once again important with some farms extending to the rivers edge.

In this 36 mile stretch of river there are three bridge crossings, two of which have access points. In addition, there are five other access points making a total of seven.

AMENITIES FOR RECREATION:

The primary charm of the Little Fork River is its wild nature. Even in the farming areas the river flows through, a sense of wilderness permeates the air. The dense forest cover and the occasional large trees lining the banks are indeed "a sight to behold."

Wildlife abounds, moose inhabit the muskeg and tamarack swamps along the river. Deer browse in the farm meadows. Beaver and muskrat may be found in some of the smaller tributaries. Ducks and other common Minnesota birds may be observed.

Fishing in the river is said to be excellent. Muskalunge and walleyes are of primary interest. However, brown trout have been caught in the Little Fork and especially its tributaries.

POTENTIAL FOR FUTURE RECREATION:

Having stated that the primary charm of the Little Fork River is its wild nature it would appear that it should be developed on these lines. Access points should be few but developed. Campsites should be of the wilderness variety except at access points where they would have full facilities.

CONSIDERATIONS:

1. The Little Fork should continue to be designated as a wilderness canoe route.

2. The canoe trail should begin near Hananen's Falls (mile 15.7) and terminate at the town of Little Fork.

3. Car camping and access points should be developed near Hananens Falls mile (15.7), Silverdale Bridge (Highway 65 mile 37.8), Highway 65 crossing (mile 77.0), Little Fork (mile 111.0) and at the Little Fork-Rainy River confluence (mile 132.0).

4. Wilderness campsites developed at intermediate points (approximately 10 miles apart) should be brushed out and have a source of water.

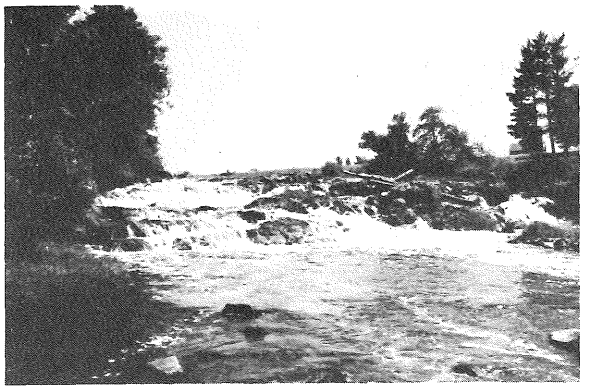
5. The two access points within the Nett Lake Indian Reservation should continue to be jeep-type access points.

LITTLE FORK RIVER

1. A 30 ft. falls at mile 116.
2. Typical rock riffle with pool above Little Fork.
3. Open area suitable for camp development.
4. Typical rock riffle.
5. Typical pool between riffles with mixed forest bank cover.
6. Typical bedrock outcrop occurring at mile 110, although navigable by canoe, it is quite dangerous.

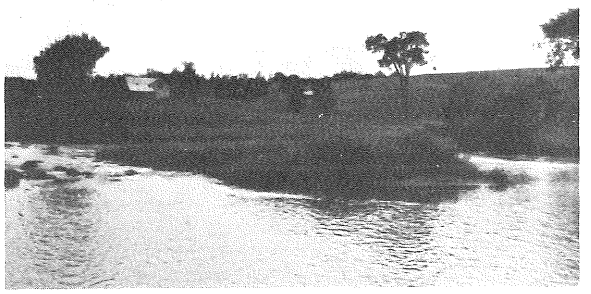
7 & 8. Typical reaches of the river with mixed forest corridors.

LITTLE FORK RIVER

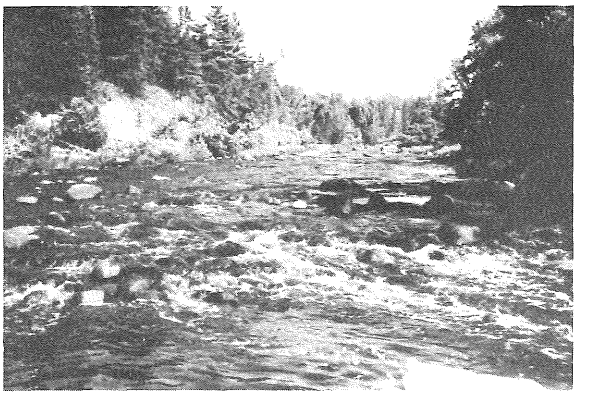


1

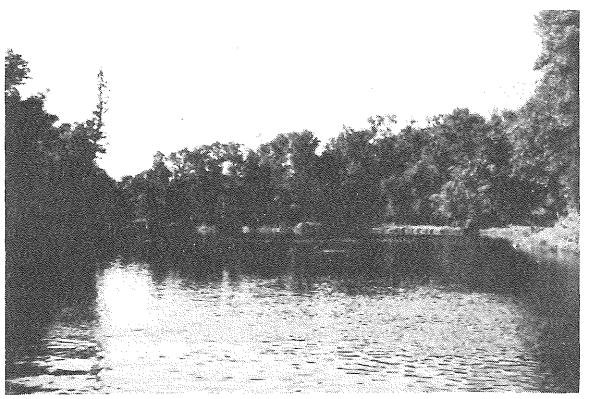
2



3



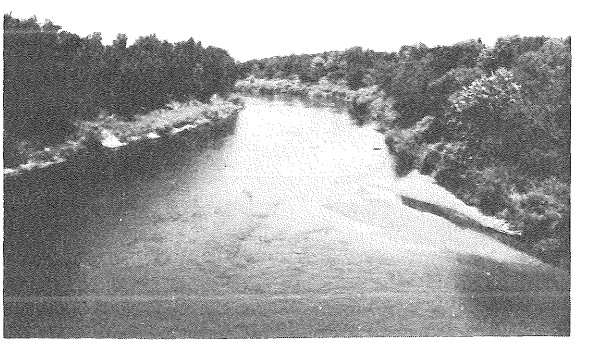
4



5

6

7



8

MATCH LINE (B)

MATCH LINE (A)

CANADA

SCALE OF STATUTE MILES

LITTLE FORK RIVER

MINNESOTA RIVER

LOCATION:

The head waters of the Minnesota River rise in the Browns Valley area on the Minnesota, South Dakota border. Within a few miles the river enters Big Stone Lake, which is also on the Minnesota, South Dakota border. Leaving Big Stone Lake at Ortonville the river begins its 330 mile flow through the State of Minnesota proper. Heading southeast the river flow is 185 miles until it reaches Mankato. In Mankato the river turns northeast, flows through Bloomington and joins the Mississippi at the Mendota Bridge. The average fall over its entire length is about .8 foot per mile. For the purposes of this report the survey began at Ortonville in Big Stone County and ended at Shakopee in Scott County. A total of 262 miles was covered.

UPPER MINNESOTA RIVER:

The Minnesota River flows through a valley, one to three miles wide and 100 to 300 feet deep. The tributary streams enter this valley through deep and rugged gorge-like valleys. The rich farmland in this watershed average nearly 200' of drift deposit. However, in the Minnesota River Valley, from Montevedio to New Ulm, the drift has eroded away to exposed precambrian granite bedrock. Around Courtland and to the south, the erodsion has exposed paleozoic bedrock consisting of dolomites and sandstone. Some 450,000 acres of land in the watershed has become producing farmland due to extensive system of drainage ditches. Even with the aid of ditches, flooding of farmland is common.

LOWER MINNESOTA RIVER:

The Lower Minnesota River, which has a length of about 115 miles from Mankato to its confluence with the Mississippi River, has a slope of less than 1 foot per mile. The river flows through a valley, one to three miles wide and 100 to 250 feet deep, which contains alluvial deposits as thick as 50 feet. The tributary streams of the Lower Minnesota River are mainly creeks about ten to thirty miles long. The tributaries have low slopes in their upper reaches; but, where they descend to the Minnesota River Valley, they have steep gradients and deeply eroded valleys. The bedrock in the watershed consists of sandstones, shales, and limestones which underlie the glacial drift deposits. Along the Minnesota River Valley the drift has been eroded, exposing rock terraces 25 to 50 feet above the alluvial bottom land. The most important natural resource of the area is its fertile soil. Additional resources of commercial value include limestone, clay, and deposits of sand and gravel. The Lower Minnesota was once a mixture of prairie and woodland, but today the area contains only a few scattered growths of hardwood trees along the river valley. The principal industries along the Lower Minnesota River Valley are related to the processing and marketing of agricultural products, chiefly feed and grain, canning plants, and dairies. Additional industries utilizing agricultural products are breweries and malting plants at Shakopee, St. Peter and Mankato, and a beet sugar plant at Chaska. Other industries in the area include the manufacture of brick and tile, quartering of building stone and the processing of silica sand by glass manufacturers.

HUMAN HISTORY:

Because the Minnesota River best reflects settlement history in Minnesota and was an important highway for the Indians and fur traders, the following is more detailed than in the other river survey reports.

Mound groups and skeleton findings, dating back 6,000 to 7,000 years, record marls living on the banks of the River Warren. Dr. Eldon Johnson, archaeologist at the University of Minnesota, says about the area near Big Stone Lake, "No single area in the State of Minnesota exhibits such a tremendous time range for archaeological sites in such a localized area. Nearly the whole record of pre-historic man in Minnesota is recorded here."

Within recorded history the Minnesota River Basin was originally Sioux territory. In the middle sixteen hundreds, the white man made early explorations into the watershed. Radisson and Grosseillers, French

fur traders, made an expedition into the west and reached the Minnesota River Valley in 1654. In 1700 Pierre LeSueur ascended the Minnesota River and established a trading post named Fort L'Huillier on the Blue Earth River. Jonathan Carver explored the Minnesota River in 1767 and traded with the Sioux. The town of Carver, Carver County and the proposed state park carry on his name. Other lesser known men followed, establishing over 20 trading posts along the Minnesota and major tributaries. In the 1820's Joseph Renville built a trading post at Lac qui Parle, now an existing state park, and built Fort Renville. Reverend Williamson and Reverend Riggs moved to Lac qui Parle in 1835 and established a mission church. By 1850 settlers from the eastern United States, Canada, and Europe had established settlements in the basin, by treaties of Traverse des Sioux, and Mendota. In July and August of 1851, the territory west of the Mississippi was open to settlers. The land was fertile and in the following thirty years settlement spread to occupy the land within the watershed.

Following the period of settlement were years of development. Commercial steam boating was inaugurated on the Minnesota River. The river had always been a focal point for Indians, early explorers, missionaries, fur traders, and the early settlers and it continued to play an important part in the development of towns and neighboring farms.

In August of 1862, the Sioux uprising began in the Minnesota Valley. It resulted in the death of about 450 settlers and an unknown number of Indians. This is an important era in the Minnesota River Valley and many of the historic sites are preserved in state parks.

As soon as Governor Ramsey heard of the outbreak he appointed Henry H. Sibley to head the counter-attack and put down the rebellion. While Sibley was trying to get a force of men together, the Indians seiged Fort Ridgely between August 20 and 22, but were driven back with heavy guns and a determined defense. Shortly after this, Major Joseph Brown led a party of men from Fort Ridgely to scout the Indian movements. On September 2, the party was attacked at Birch Coulee and were saved only by relief from Fort Ridgely. Following these defeats, the Indians began their withdrawal from the river valley, taking many women and children as prisoners. On September 18 Sibley, moving from Fort Ridgely, cut across to the south bank of the Minnesota River. On September 23 the Battle of Wood Lake was fought near the Yellow Medicine River, and the main force of the uprising was broken. Little Crow, the Sioux leader, fled westward after the battle and the plan of the Indians to take their prisoners was blocked by half-breeds, such as Gabriel Renville and Indians friendly to the white men. On September 26 at Camp Release, the Indians handed over 269 white prisoners. A military commission appointed by Sibley hastily tried almost 400 Indians and half-breeds. Of these, 303 were condemned to death, and their names were sent to President Abraham Lincoln. Lincoln was able to understand the injustices which caused the outbreak. Thus, only 38 of 303 Indians convicted were hung at Mankato on December 26, 1862. Most of the other Sioux were sent out of the State to North and South Dakota. With the coming of the railroads in the 1870's the steam boating era was over and the river was forgotten.

NATURAL SETTING:

The survey of the Minnesota River began at Ortonville, Minnesota. There is an excellent access off County Road 30, and also a potential camp site on a grassy area with cottonwood and willow trees interspersed.

From Ortonville to Marsh Lake, the river presents a jungle appearance. Trees with vines hanging down intermesh over the river like so many fingers. There are many snags in the river which require chopping through or carrying over. There are also several broken down bridges that create snag obstacles. The banks are steep and muddy. Dark and smelly woods of soft maple, cottonwood, and elm fringe the river. Basswood and ash trees are found occasionally on the higher banks. The first granite outcrop occurs at approximately mile 2. The granite outcrops continue to mile 9.5 Highway 75.

From Highway 75, mile 9.5, to Marsh Lake, mile 17.2, the banks become lower with frequent side bogs which smell stagnant. Granite outcrops, marshy pastures, and farmsteads are away but visible from the river. One farm has a hog yard running down to the river edge. As Marsh Lake is approached the river spreads out. Large areas of swamps and marsh extend away from the river and willows become the predominant type of tree. This area is a heaven for birds and other wildlife. Wood ducks, cormorants, great blue herons, little green herons, and occasionally hawks inhabit the area. Song birds are everywhere. Woodchucks and deer were also noted. Two varieties of cactus and other dry plain types of vegetation are present. Much of this stretch of stream is being proposed as a national wildlife refuge by the U. S. Depart-

ment of the Interior National Wildlife Service. A dam directly above Highway 75 capable of manipulating the water level five feet and the purchase of 10,100 acres of land are needed to bring the project to completion.

Marsh Lake is about 4.0 miles long and 1 to 1.5 miles wide. The edges are swampland. The bluffs of the Minnesota River Valley appear on the northeast and southwest. The lake is shallow and weedy and is a stopover point for the many flocks of geese, ducks and pelicans flying north or south. The Marsh Lake Dam is about 4 feet high and should be portaged.

From Marsh Lake to Lac qui Parle is a distance of two miles. The river has broadened out and is deeper. There are no tree falls to contend with in the area. Lac qui Parle is 12.0 miles long and is similar to Marsh Lake except that it is deeper and longer and appears to be more heavily used. At the southeast end of Lac qui Parle is Lac qui Parle State Park. Within the park there are endless miles of back channels which support an abundant wildlife population. Deer, beaver, muskrats, and birds such as pelicans in migration, owls, hawks, and ducks were observed. Banks are wooded with elm, basswood, soft maple, cottonwood, and willow toward the lake. Lac qui Parle Dam is directly under County State Aid Highway Bridge 13 or 33 depending upon which County you are in. The portage is excellent on both sides.

From Lac qui Parle Dam to Granite Falls the river flows in a channel from 100 to 150 feet wide. Hardwood species fringe the river. The banks of the river are approximately 5 feet high and are composed of fine silt.

At Granite Falls the river begins flowing over precambrian granite. Small rapids occur above Granite Falls at mile 63.2. Within Granite Falls lawns extend down to the river edge. The power plant off State Highway 23 abuts the river at mile 66.0. The dam in Granite Falls should be portaged 60 yards on the south bank. Below the falls there is a short rapids and then a pool about 2 miles long to Minnesota Falls at mile 67.7. At the Minnesota Falls there is a 40 yard portage on the south bank. Below Minnesota Falls to North Redwood, mile 101, the river flows through an area of granite outcrops. The banks are heavily forested with typical river hardwood, such as maple, elm, cottonwood, willow, etc. Away from the river the high granite domes are covered with cedars and oak trees. This stretch of the river is interesting from a historical, geological, and natural history point of view. There are a great many historical sites relating to the Sioux occupation of the valley, the early white settlement and Sioux uprising. The Morton Guneiss is among the oldest rock in the world, and tells a story of ages past. For the naturalist the area from mile 86.5 (County Road 19) to mile 101 (North Redwood) has much to offer. Starting below County Road 19 is a series of small rapids which present no difficulties. At mile 90.5 there are several hardwood fringed ponds on the south bank hidden in the granite outcrops. These are not connected directly with the river and must be hiked into. On the north bank kettle holes can be seen in the granite outcrops 20 to 30 feet above the river. There are also several on a rock outcrop in the middle of the river. At mile 95.0 is a massive granite dome locally known as Cedar Rock. The ecology of the rock is different from the surrounding country. Lichens come in many colors and are attached to nearly all rocks. A wide variety of moss is also evident where it is possible to gain a foothold. Where the process of reducing the rocks to smaller pieces has occurred and soil has deposited, ferns are often in existence. Flowers and bushes follow, cedar roots probe and split the rock. Beaver tail cactus with six inch lobes are present and should be watched for. The number and variety of birds seen in this section of the river is surprising. Wood ducks, great blue heron, the less common green heron, pileated woodpeckers, geese, owls, hawks, and even eagles inhabit the area. Beaver, deer, fox, and woodchucks were some of the larger animals seen. Fox snakes and plains garter snakes along with the rare blue tail skunks live here, and like to sun themselves on the rocks early in the season. In essence, this is a grand area for nosing about and observing nature.

The river changes little through its center stretches. There is endless meandering to and fro. The banks are low and current very slow, otherwise little change from unattractive mud walls with vines and roots trying to hang on. The trees covering the banks are much the same as on the Upper Minnesota, willows, cottonwood, elm, ash, river maple, and basswood, while oak, hard maple, and cedar are found on the higher hills adjacent to the river.

The banks below LeSueur are sandy and eroding almost everywhere. Because of the sand character of the banks, a constant supply of new snag trees on the outside of the curves and sandbars on the inside of the curves are produced. Most of the banks are high and prevent a view of the valley. The river is wide and deep in this stretch with no snags large enough to be a threat to canoeing. There is almost no exposed rock, and then only on the bank, such as crumbling limestone. Creeks dump gravel bars halfway across the river or more and pinch the river at low water. The wildlife along the river was typical, but not as abundant as

in the upper stretches of the Minnesota. Several wood ducks, a few owls, great blue heron, little green heron and muskrats were noted. Song birds were everywhere. Almost no one faces the murky river with house or cabin, as the river is more often thought of as a place to dump rubbish. Canoers are apt to feel they are on a liquid road. The Minnesota continues this endless meandering down to Shakopee, which is the end of this survey.

EXISTING DEVELOPMENT:

Throughout the surveyed portion of the river, i.e., from Ortonville to Shakopee the river is crossed by many bridges and railroad trestles. There are numerous access points, camp sites, historical markers and parks. These access points, camp sites, historical markers, bridges, etc. have been located on the included maps, however, for more detailed information relating to the agency or level of government responsible for the development of these access points, camp sites, historical sites, etc. MORRC Report No. 7 should be referred to.

POTENTIAL FOR FUTURE RECREATION:

In recent years increased leisure time has put an inordinate stress on all types of recreational facilities. Because of this, increasing attention has been paid to the fine recreation potential of the Minnesota River Valley. Many proposals, concerned with the Minnesota River Valley, have already been made. The three major ones, i.e., the Big Stone -Whetstone Wildlife Refuge, the proposed Minnesota River Valley Forest and the seven flood control reservoirs, proposed by the Army Corp of Engineers, have already been discussed, however, there are several proposals which relate directly to recreational planning the valley itself. Among these, are scenic drives and trails of various types.

Scenic Drives:

There are several existing and proposed parkways and scenic highways for the Minnesota Valley. The Sioux Trail as designated by Minnesota Statue Session Law, 1961, Chapter 669 provides for a scenic and historic drive from Mendota, Dakota County to Ortonville, Big Stone County. The Conservation Department, in a report entitled "The Minnesota River," 1963, has proposed a Minnesota Parkway which closely parallels the route of the Sioux Trail. The Hiawatha Pioneer Trail - the third proposal for a scenic highway system parallels and follows the foregoing route from St. Peter, Nicollet County to Granite Falls, Yellow Medicine County. The scenic Minnesota Valley Drive as projected by the State Highway Department, follows, in part, the Sioux Trail and the proposed Minnesota Parkway.

Any parkway which is developed should have more aesthetic considerations than standard highway construction. The standards include steeper grades, pleasant curves and slower speeds which will permit a meandering alignment from the panoramic views on the bluffs to the spacious green valley below. The Parkway would be an ideal connecting link between points of historic, scenic and geologic interest. The scenic views across the broad valley need to be preserved and billboard control is necessary. Also serious consideration should be given to single lane one-way parkways.

Boating and Canoeing:

Increased canoeing and the number of registered boats have emphasized the need to provide opportunity for this type of activity. The Minnesota River was one of the four rivers officially designated by the Minnesota Legislature in 1963 as a State canoe route. No appropriations were made to provide for any acquisition or development. The only barriers to navigation are the dams at Ortonville, Marsh Lake, Granite Falls, Minnesota Falls, and Lac qui Parle, however, the filtration and pollution problems, coupled with snags and high muddy banks,make much of the Minnesota River undesirable for this type of recreational activity. Also if the proposed Big Stone -Whetstone National Wildlife Refuge and the seven dams , proposed by the Army Corp of Engineers, are constructed, much of the river will become undesirable for canoeing.

The stretch of river from Lac qui Parle,mile 36,to Nbrth Redwood,mile 101,is, however, very desirable for canoeing. This is an area of scenic change, small rapids, interesting geologic structures, varied wildlife and vegetative cover. The rest of the river below New Ulm is more desirable for the larger type of craft and thus these would not be affected greatly by the presence of large reservoirs.


START
DAM·PR
WP
ORTONVILLE
ODESSA
MARSH LAKE
CORRELL
APPLETON
LOUISBURG
LAC QUI PARLE
MILAN
Chippewa
MATCH LINE (A)
(A)
DAM
LAC QUI PARLE STATE PARK
WATSON
CAMP RELEASE STATE HISTORICAL WAYSIDE PARK
Wegdahl
Stony Run Creek
DAM PR
Minnesota Falls
Hazel
Hawk
Medicine
MATCH LINE (B)
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
SCALE OF STATUTE MILES

Trails:

Trails of all types could tie together scenic views, historic sites, state parks, and other interesting areas. In many cases an easement across private property may be all that is necessary. There are an ever increasing number of adult hikers that need a safe place to travel. The Interstate Highways forbid bicycling and with the heavy traffic on State and County highways, biking is almost impossible. Along certain stretches of the river and possibly its whole length, special trails should be provided. In some cases it may be on the river bank and in other places the most logical spot may be on the parkway back slopes.

Hiking:

Walking for pleasure is second only to driving in popularity. This may be only for short distances or over hundreds of miles. On both the east and west coast there are plans for several 100 miles of hiking trails. Efficient and lighter equipment make hiking more possible for the wider range of the population instead of just the stong-back packer. These trails could be the same as the bike trails, except where a steep climb might take the hiker to a special historical spot, a cool spring, or an ideal camping spot.

Bridle Trails:

Many people have, or would like to have, horses which they could take on interesting trail rides, much the same as the boater takes his boat for a scenic cruise. Since this type of trail takes a different type of surface, than bikers or hikers, they would take a separate right-of-way, but in many cases little or no construction would be needed to make this possible. These may tie in well with dude ranches and vacation farms that are opening up in rural areas. Wilderness camp sites for the horseman should include corrals.

Camping:

All of the trails along the river, from riding to hiking, would need camping facilities. The spacing of camp sites for these activities along the 330 mile river should be somewhere between 7 to 15 miles. Any distance greater than this would eliminate all but the very hardy individuals. There would be ample opportunities to coordinate private, semi-public and public facilities. These may be tied in with group camps of all types and also picnic grounds.

Winter Sports:

Many of the hills coming down to the Minnesota River make ideal skiing and tobogganing slopes. Many of the trails would make ideal cross-country skiing or snowmobiling trails, a sport that is showing renewed interest. Ski jumping is important in winter sports in some areas and could be coordinated with interest groups.

CONSIDERATIONS:

Granted that the Minnesota River Valley poses unique scenery and was historically the path of Indian movement, trade, and white settlement and whereas the population of the counties and communities adjacent to the river comprises approximately one-half of the population of the State, the following considerations with respect to recreational needs are made.

(1) The New Federal River Basin Planning Act provides funds to encourage river basin planning on a State level. The State Planning Agency, in cooperation with the Minnesota River Basin Counties, should review how Minnesota may best participate in the benefits of the Federal River Basin Planning Program.

(2) The State should move to consummate an agreement with the Federal Government for joint control of the Minnesota River.

(3) The proposed Big Stone-Whetstone National Wildlife Refuge should be created.

(4) The Department of Conservation should complete a detailed study on the proposed Minnesota River Forest with supplemental data relating the effects of the proposed forest on fish and wildlife population and economy of the adjacent area.

(5) The Commissioner of Conservation, in cooperation with the U.S. Corps of Engineers, the State Highway Department and the various railroad companies involved should make a feasibility study of the seven proposed dams in the Minnesota River Valley. A special consideration should be given to the proposed dams near Delhi in Redwood County and Carver in Carver County to determine the gain and loss in all phases of recreation.

(6) The development of public access points, camp sites and snagging operations should not begin until plans relating to flood control reservoirs are finalized.

(7) The Commissioner of Conservation in cooperation with other governmental units and agencies should initiate and conduct studies to determine how siltation can best be reduced or eliminated; how and by whom lakes and streams can be returned to their original state of usefulness; what legislative action may be required, either State or Federal and how such actions can be financed.

(8) Those departments of the State which may be involved should undertake a joint study as to the feasibility of establishing a Minnesota River Scenic Parkway. Leisure driving is the recreational activity enjoyed by the largest number of persons and such a drive could emphasize natural setting, views, picnic sites and recreational areas.

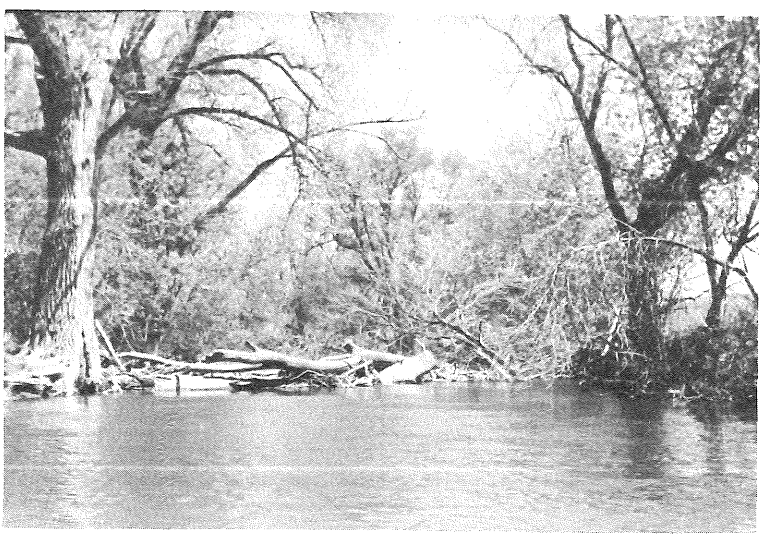
(9) Canoe Routes - A canoe route should be developed from Lac qui Parle State Park to New Ulm. The reach from Granite Falls to North Redwood is especially desirable.

(10) Bridle, bicycle and foot paths - The development of these types of trails could begin at the proposed Carver State Park and the area from Granite Falls to North Redwood. Each trail should be developed according to its own type of travel, especially with respect to grade.

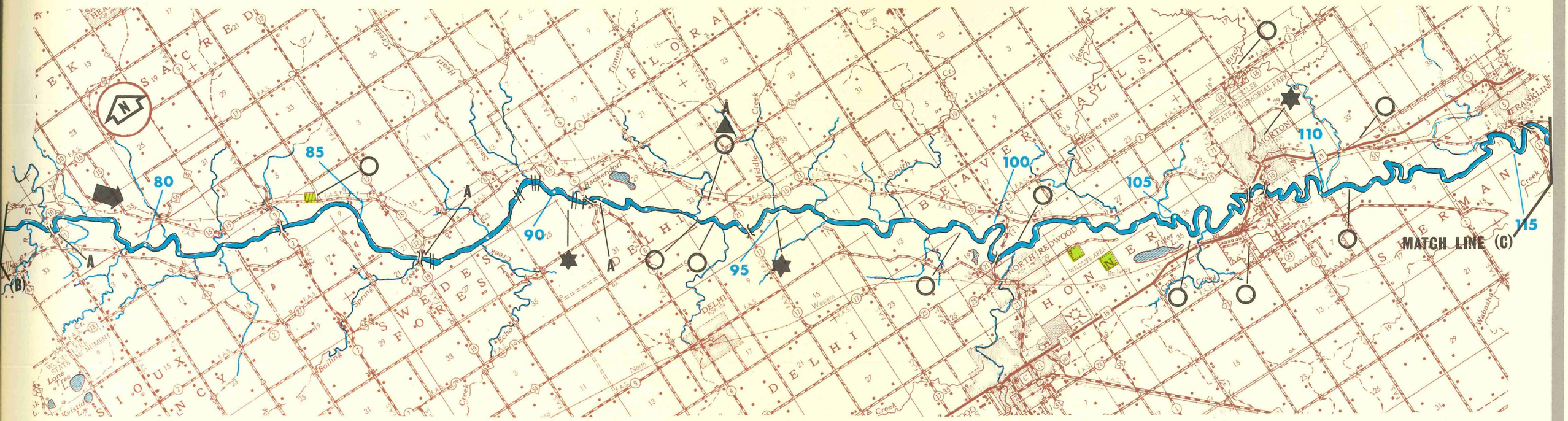
(11) Camp sites - Camp sites for these trails should be developed according to the speed of travel, thus we see that camp sites for hiking would be much closer, 5 to 10 miles, than camp sites for horseback riding or bicycling would be. These camp sites should be kept separate from the scenic drive camp sites or the Sioux Historic Trail camp sites except at major historical sites.

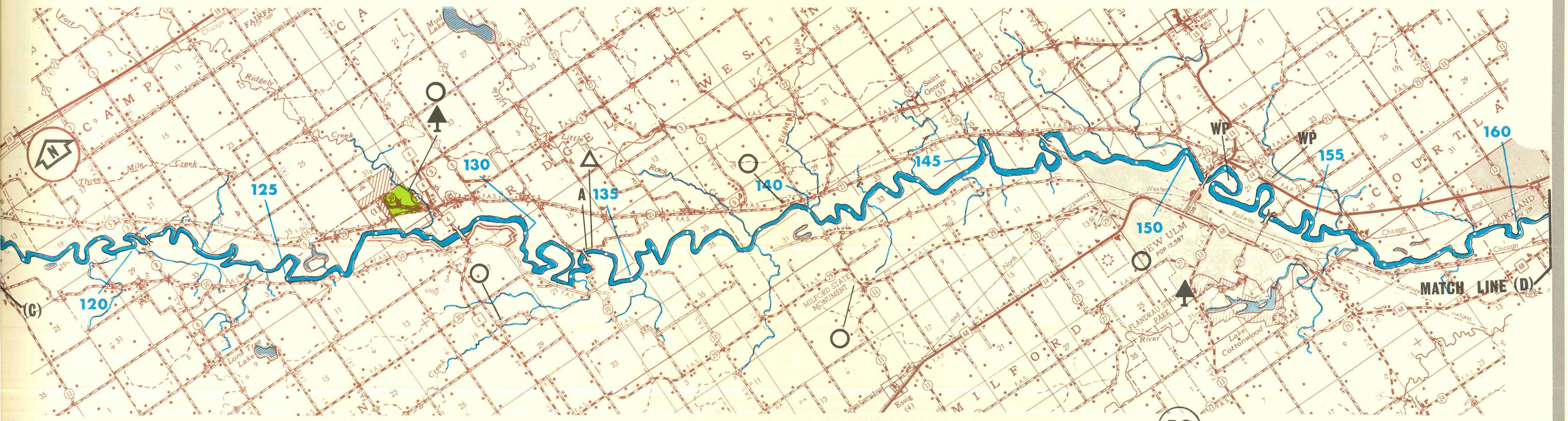
(12) Proposed Park - A large state park, similar to the proposed Carver State Park should be considered in the scenic and wildlife areas near Delhi, Minnesota in Redwood County. This park should also include many of the nearby historic sites.

(13) The Marsh Lake Reservoir should be included with the Big Stone-Whetstone National Wildlife Refuge, if possible and should be primarily wildlife oriented instead of flood control.



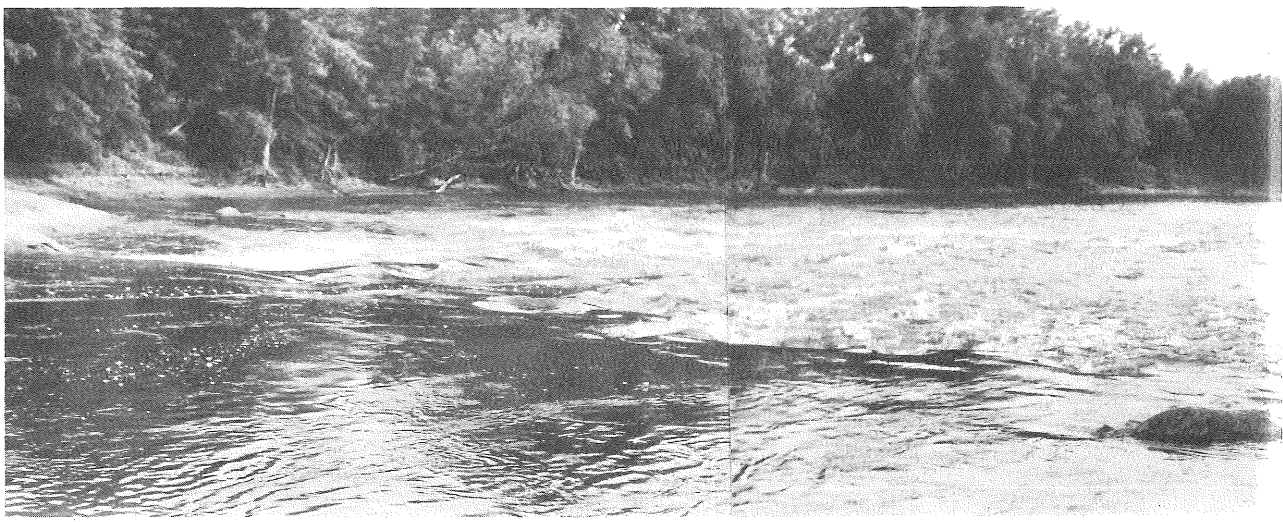
100% snag below Ortonville.





SCALE OF STATUTE MILES

1 0 1 2 3 4

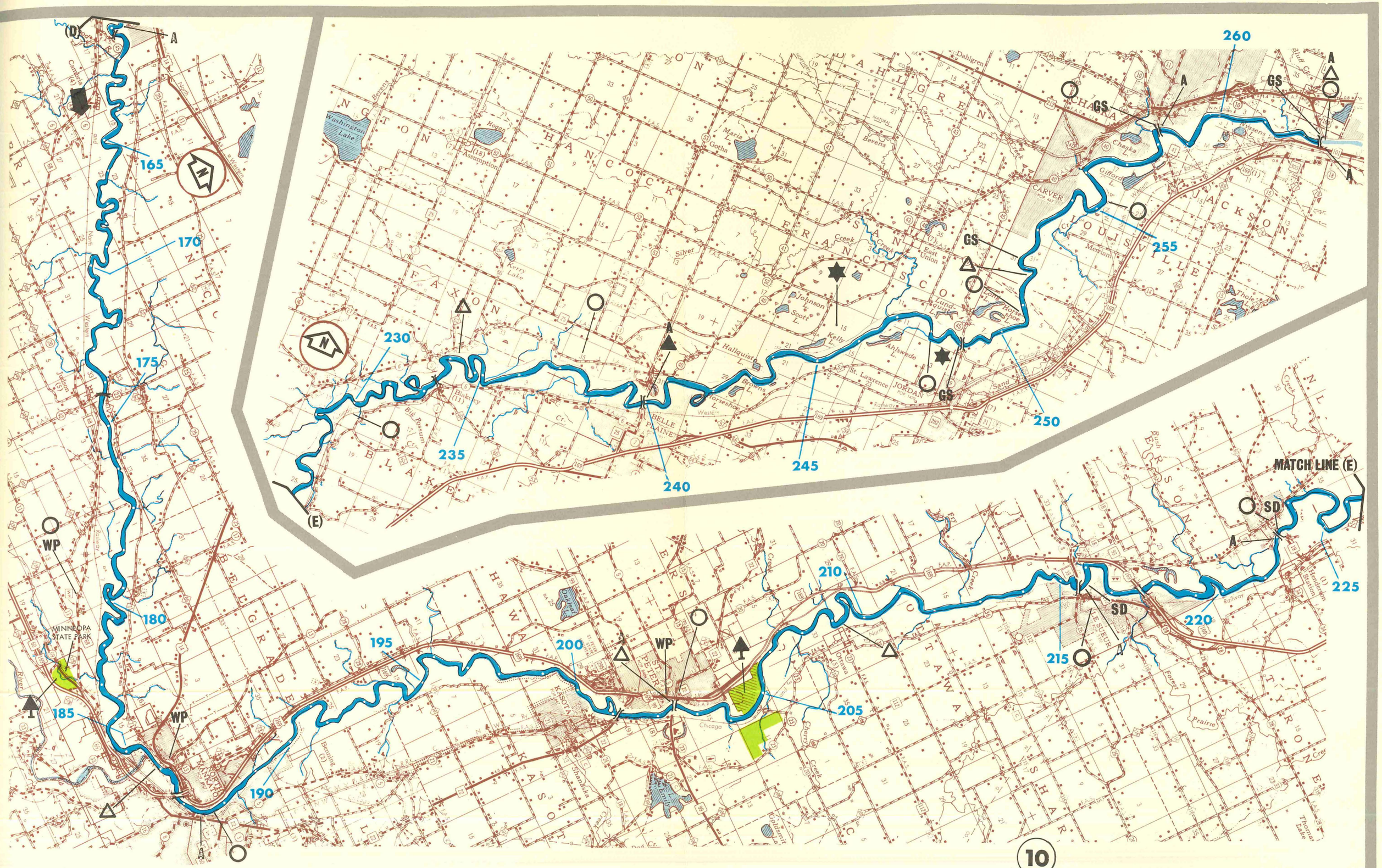


Small rapids below County Road 19, (mile 86.5).

Scenic Pond, mile 90.4.

The LeSeur Dump.

Endless meandering on lower Minnesota (near Henderson).



10

MINNESOTA RIVER

MISSISSIPPI RIVER

INTRODUCTION:

This unit embraces all of the land drained by the Mississippi River above the mouth of the Crow Wing River and has a total area of 7,068 square miles including parts of 10 counties in north-central Minnesota. From its source in Itasca Lake in Itasca State Park, the river follows a roughly circular course, flowing 376 miles to the mouth of the Crow Wing River, at which point it is only 75 miles airline distance from its source.

The area is overlain by a mantle of glacial till as much as 300 feet thick. Surface topography ranges from level to very rough, hilly areas. Elevations over most of the watershed are 1,300 to 1,500 feet, but are as high as 1,900 feet near the headwaters of the Mississippi. It is crossed by several very extensive terminal moraines, deposited by the retreating glaciers, which alternate with wide level areas of till and outwash plains.

An outstanding topographic feature of the southern part of the watershed is the broad, flat, swampy plain covering much of Aitkin County. This area was temporarily occupied by a shallow glacial lake, known as glacial Lake Aitkin, which was drained by the Mississippi River after the glaciers retreated.

Precambrian crystalline rocks which underlie the glacial drift in the watershed crop out in small areas in the eastern part of the watershed.

The Mesabi iron range extends from the northeast into the watershed near Keewatin and terminates several miles southwest of Grand Rapids. It is crossed by the Prairie and Mississippi Rivers.

Loam soils with limy clay-loam subsoils cover most of the swampy regions in the northern part of the area. Light-colored sandy soils with sand subsoils extend in an east-west belt from the vicinity of Bemidji eastward to Pokegama Lake. These sandy soils also occupy the southeastern part of Cass County and most of western Crow Wing County. Sandy loams with clay-loam subsoils are found in most of the southern part of the watershed, in eastern Crow Wing County and most of Aitkin County.

Due to the generally poor quality of the soils, agriculture has not been intensively developed. Farms are scattered and usually small. About 530,000 acres of land is in drainage enterprises, most of which are in Aitkin County.

The entire region, with the exception of the open bog areas, was originally forested and is still largely in this condition. Jack pine and hardwoods cover much of the land, with some excellent stands of white and norway pine in the heavier soils. Cutting and marketing of pulpwood and other forest products is a major factor in the economy.

About three-fourths of the Chippewa National Forest, parts of 12 state forests and the Leech Lake Indian Reservation are included within the boundaries of the unit. Itasca State Park embraces about 50 square miles of scenic wilderness at the source of the Mississippi River. The Rice Lake Federal Wildlife Refuge is located near McGregor.

NATURAL SETTING:

The survey starts in Bemidji in southern Beltrami County. The city was named for Chief Bemidji, a Chippewa whose band of 50 made their home at the southern end of Lake Bemidji.

The area was homesteaded in 1894 and soon after the lumber industry invaded the area. Within 20 years the timber in the region had all but disappeared. At one time there were 14 saw mills producing a million board feet of lumber per day.

On the channel to Cass Lake, 8 miles from Bemidji, hydroelectric power is developed by a 22 foot dam.

At the entrance to the Chippewa National Forest seven miles from the dam is the Old Red Lake Oxcart Trail running north and south. Hudson Bay Company wagons carried furs over this route from Steamboat River past Cass to the Red River Valley.

Cass Lake was named by the French fur traders as Le Haut Lac de Cedre Rouge translated: Upper Red Cedar Lake after the Chippewa word meaning "the place of the red cedars", because of the many cedar trees growing on an island in the lake. It was renamed Cass Lake by the explorer Schoolcraft, to commemorate Lewis Cass, who led an expedition through the region in 1820.

David Thompson, surveyor and geographer, records that in 1798 there was a fur-trading post here under John Sayer of the Northwest Company. On the lake shore Bishop Whipple, the first Episcopal bishop of Minnesota, founded a mission (about 1860) for the Chippewa.

Between Cass and Winnibigoshish Lakes the river flows sluggishly through flat marshy land with extensive rice beds bordering it on both sides. Its tributaries from the north, Turtle River flowing into Cass Lake and Third River flowing into Winnibigoshish, are both regulated by the many lakes through which they flow.

Winnibigoshish Lake covers an area of 114,800 acres and is 15 miles across. Crossing should not be attempted on any day when the water is not calm.

On the north eastern side of Winnibigoshish are located the Turtle and Snake Indian Mounds along the shore of Cut Foot Sioux Lake. This mound is in the shape of a turtle, about 25 feet wide by 30 feet long, with the head pointing north. Around the turtle is built a snake of proportionate size with the head and tail meeting and pointing south.

The mound's origin and interpretation are interesting. This region originally belonged to the Sioux but was coveted for its rich resources by the Chippewa. In 1748 a major battle, ending in the complete rout of the Chippewa, was fought on the spot where the mound now stands. The Sioux, jubilant and eager to commemorate the victory, built the turtle part of the mound with the head pointing north to signify that the enemy had been driven in that direction.

The defeat suffered by the Chippewa only increased their determination; they returned in the summer of 1748. In the ensuing battle, the Chippewa surrounded and massacred the Sioux to the last man and built the snake around the turtle to signify that the Sioux had been surrounded and annihilated. The head of the snake was pointed south as a warning to other Sioux tribes and as an indication of future path of Chippewa conquest.

The morning after the battle, while the Chippewa were still dividing the spoils, some of their squaws found on the lake shore an unconscious Sioux warrior whose foot was almost severed. The squaws dispatched the warrior with alacrity, and the Chippewa thereafter referred to this lake as the "Lake of the Cut Foot Sioux". The original Cut Foot Sioux Ranger Station built in 1904 on the site of an old camping ground at the head of the portage, was vacated about 1918 but is still in good condition. This portage between Little Cut Foot Sioux Lake and the Bowstring River crossed the divide and was used by the Chippewa and Sioux for generations.

This area of Winnibigoshish would make an excellent side trip both for its historical value and its four excellent campsites.

Two miles below the Leech Lake fork, the Mississippi receives an important affluent, namely, the discharge of Ball Club 1., which enters at about the middle of the S. border of Sect. 31, T. 145, R. 25, 5th M., and thus only about 4 miles due west of Deer River (town). The difference in level between this lake and the river is so slight that sometimes, when the latter is full, it backs up into the former. Ball Club is a large lake - 6 miles long, and 1 to 2 miles broad in different places, the outlet is from the lower broad end. This lake is notable because it is the usual and direct route up to Little Lake Winnibigoshish and so on, to avoid the more circuitous course of the Mississippi itself. You traverse the main axis of the lake from its outlet northwest to its head, and there make a portage of a mile or so over into Little Lake Winnibigoshish. "Ball Club", the now universal name of this body of water, is a term which translates from the French La Crosse; the names refer to the celebrated game


START
LAKE BEMIDJI
BEMIDJI
Birchmont
LAKE BEMIDJI STATE PARK
Lake Irving
SD
DAM
PR
WP
A
5
10
15
20
25
30
35
MISSISSIPPI RIVER
Stocking Lake
Goose Lake
Wolf Lake
Andrusia Lake
ALLENS BAY
CASS LAKE
Star Island
Windigo
CEDAR IS.
Pike Bay
TEN LAKE
Silver Lake
Blue Sky L.
Ten Lake
Little Lost L.
Lost Lake
Buck Lake
Luck L.
Bull-head Lake
Pug Hole Lake
McDonald L.
Pennington
INDIAN RESERVATION
Schram Lake
Mark Lake
Tower L.
Sugar Lake
Drewery Lake
OLD RED LAKE TRAIL
MATCH LINE (A)
40
45
50
55
60
65
70
75
80
85
LAKE WINNIBIGOSHISH RESERVOIR
WINNIBIGOSHISH RESERVOIR
Pigeon Dam Lake
Hale
Creek
School House Lake
Little Winnibigoshish Lake
Tamarack Lake
DAM
PL
Club Lake
Ball Club
WHITE OAK POINT INDIAN RESERVATION
White Oak Lake
Little White Oak Lake
White Lake
ZEMPLE
WAHNENA
FOREST
MUD GOOSE GAME REFUGE
Mud Lake
Rice Lake
Nushka Lake
TORREY
Vermillion River
SCHOOLCRAFT STATE PARK
Skunk Lake
Little Skunk Lake
Little Vermillion Lake
Little Drum Lake
Warburg
MATCH LINE (B)
(A)
SCALE OF STATUTE MILES
0
1
2
3
4

of ball, known as La Crosse.

After leaving Ball Club Lake the river is exceeding tortuous; its bends are, moreover, so connected with collateral channels, in part natural and in part artificial, that the stream is virtually double and incloses a series of large islands in its sinuous folds. From here the river flows in an area known as the "meadows"; these meadows are in part what Nicollet named Eagle Nest Savannah. It is absolutely flat and low marshy ground, alternating with haying fields, extending widely on both sides of the river, south and west of White Oak I. White Oak Point reaches the river in a narrow tongue of higher ground, while higher up several bends of the river abut against woodland on the south.

East of Ball Club Lake is a historic site known as White Oak Point. It was an old Indian village site and a fur trading post was built there in 1795.

South of White Oak Point 82 miles, where the Vermilion River enters the Mississippi River is Schoolcraft State Park, named after Henry Schoolcraft who on July 13, 1832 discovered the source of the Mississippi River in Lake Itasca .

East of Schoolcraft State Park 9 miles and upstream 3 1/4 miles by river, above the Pokegama (Pokeg' - ama) Falls, is the discharge of Lake Pokegama itself. This is by far the largest body of water in the vicinity, having an extreme length of 13 miles; but its form is so irregular, something like a hand with spread-out fingers, that its actual shore-line is very much greater; and a number of smaller sheets of water are dotted about it on all sides. Nicollet renders Pakegomag, "a name applied by the Chippeways to all sheets of water in the vicinity of a river."

At Pokegama Falls, now an U. S. Army Corp of Engineers dam, the river drops 15 feet over a granular quartz ridge. It was naturally one of the best known on the river in this vicinity years ago.

Kabikons Rapids as the Indians called it, is Grand Rapids, meaning Big Falls, as referred to by the early explorers. The rapids are located 4 miles southeast of Pokegama Dam. The river drops 9 feet in 80 yards.

Grand Rapids stands across the mouth of a small creek that discharges several small lakes. The historic site of Grant's Northwest Company fur trading post was located directly opposite the town of Grand Rapids. It doubtlessly stood on the first rising ground from the river probably, on the knoll that overlooks that curious expansion of land that divides the Mississippi into a pair of ponds or one small lake of hour-glass shape, across the constricted part of which the river flows.

Just south of Grand Rapids is the ghost town of La Prairie. Poor judgment was exercised in planting this hamlet on a site below the head of navigation, now commanded by Grand Rapids. Although all the buildings have been moved away, the outlines of the old streets are still visible.

Below Grand Rapids, the tributaries of the Mississippi, the Prairie and Swan Rivers enter from the north-east. Both have ample fall and swift currents. In Aitkin County the Mississippi enters the ancient bed of glacial Lake Aitkin; here it meanders widely across an alluvial plain in a broad shallow valley. Its tributaries in this section, Sandy, Willow and Rice Rivers, drain mostly level swampy land.

The Aitkin area is famous for the steamboats that provided passenger and freights service from 1870 to 1920 before the advent of autos and railroads.

MISSISSIPPI RIVER ABOVE BEMIDJI

1 & 2. Typical of marsh with bordering mixed forest.
3. Typical of shallow, fast and narrow reaches through mixed forest.
4. General view of heavy growth along stream in some marshes.
5, 6 & 7. Typical of some marsh reaches.
8. Wooded area just above Bemidji.

MISSISSIPPI RIVER

1

2

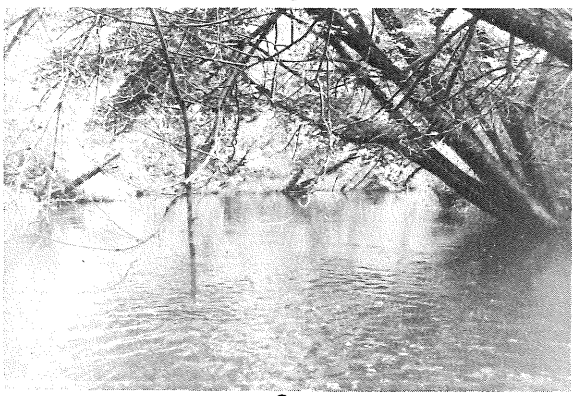
3

4

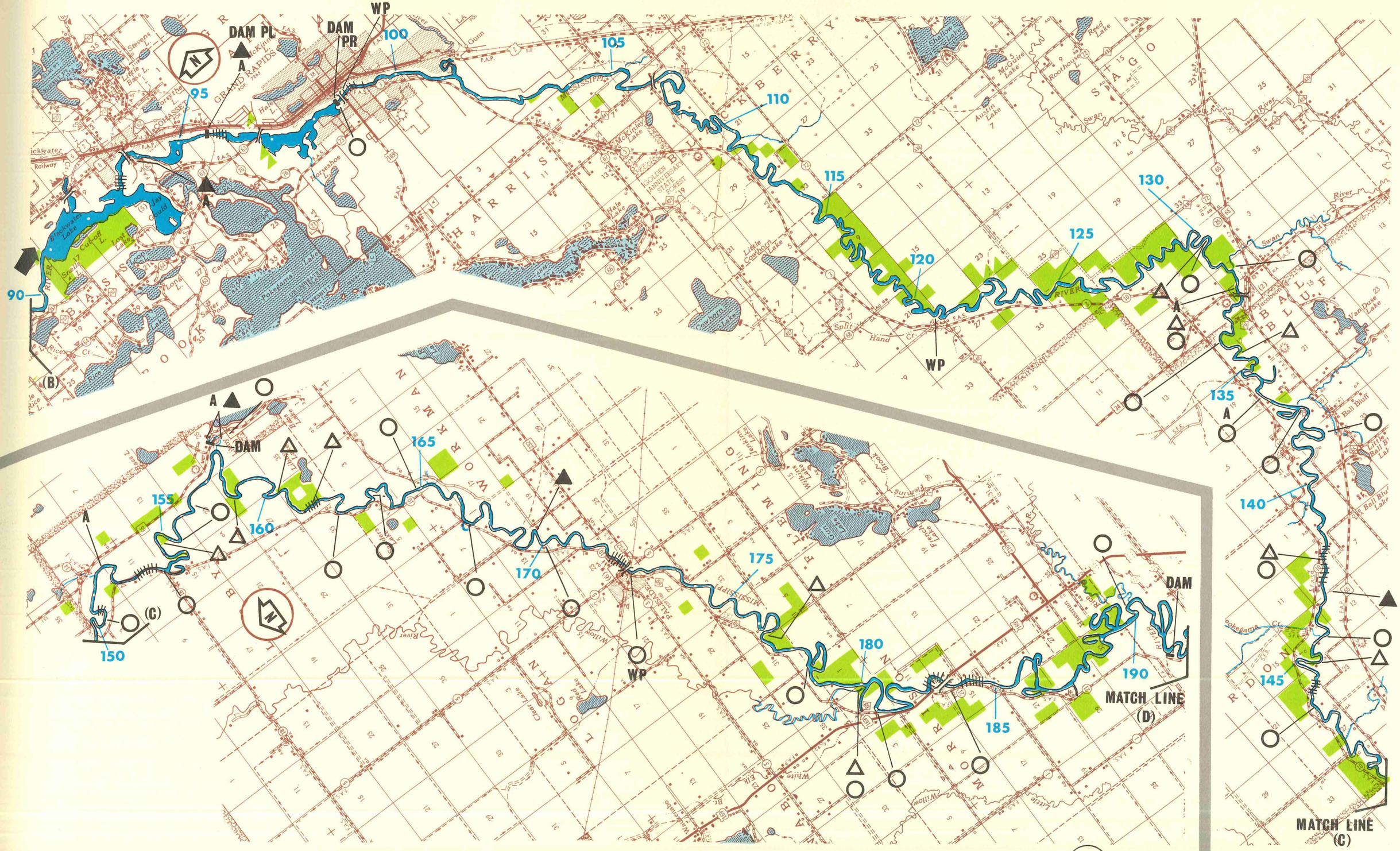
5

6

7



8



SCALE OF STATUTE MILES

11

MISSISSIPPI RIVER

RIVER BOATS THAT TRAVELED BETWEEN GRAND RAPIDS AND AITKIN:

Name	L	BW	D	Dates of Service
Pokegama	100'	24'	2'	1871-1877
Stern Wheeler, (Capt. George Houghton) Destroyed by fire winter of 1877.				
White Swan	70'	16'	3'	1878
Side Wheeler. Built in Brainerd by Alsop & Mahlum, summer & fall trips were impossible so it was dismantled and shipped to the Red River.				
City of Aitkin	120'	22'		1878-1883
In 1879 it only made five trips because of low water. Carried 120 passengers & 150 tons of freight. Sank at its dock Sept. 4, 1883 as falling water caused it to list.				
Fawn	85'	14'	3'	1882-1894
Made trip to Grand Rapids & back in one week, the last two years it was used by Weyerhauser Co. towing logs and breaking log jams. In 1894 it struck snag below Swan River and sank.				
Andy Gibson	140'	32'	2'	1883-1892
Stren Wheeler hauled 150 passengers & 100 tons of freight. It caved in many banks of the river as it was too long for the sharp bends of the river. It was purchased by the Potter Co. in 1891. It was retired in 1892 and its boiler was used in the heating system of the Potter Company.				
George Houghton	115'	21'	14"	1886-1889
Burned at its mooring 20 miles above Aitkin.				
Swan	-	-	-	1894-1898
Burned at the mouth of the Ripple River, Cap. Wm. Hay.				
Walter Taylor	50'	15'	-	1895-1897
Built by Cluff Brothers & James Tayler, Sank from over loading at the mouth of the Sandy River.				
Irene	-	-	-	1900-1908
Named in honor of Irene Hodgedon. Burned in 1901, rebuilt and sank in 1908 at Verdons Landing.				
Remnica	30'	-	-	1903
Used by a Finish settlement.				
Oriole	105'	22'	-	1907-1918
Used as a dredge boat in 1918. Was renamed the Ark and used on the Sandy Lake as a summer resort until 1941.				
Lee	-	-	-	1911-1921
Sank near Gydes mill at the Ripple River.				

Sandy Lake, Lac au Sable or de Sable of the French, is close to the river, on the left hand side and discharges into the Mississippi by a short crooked stream called Sandy Lake River, 2 miles or less in length. Here the Northwest Company house (trading post) was located on a site 1 mile south of the outlet of Sandy Lake on the west shore next to the Mississippi. An Indian village was located here in close proximity to the post. One main affluent of Sandy Lake comes in from the east and is generally known as Prairie River. Its main branch from the N.E. is now known as Savanna River; Nicollet called this West Savannah River to distinguish it from that branch of the St. Louis River which he designated East Savannah River, and accentuate the relations of the two. For it must be known that these rivers of the Mississippian basin connect so closely with certain branches of the St. Louis, in the Lake Superior basin, that they were formerly of the utmost importance as waterways between the two great systems, and as such were greatly used by the early voyageurs. The N.W. Co. house stood on the west shore of Sandy Lake next to the Mississippi. The site on the map gives its position 1 1/4 mile south of the discharge of the lake into the short thoroughfare by which this reaches the Mississippi. There are existing remains of old settlements in various positions further south. A trail from the Indian village struck the Mississippi river in the S. E. 1/4 of Sect. 4, T. 49, R. 24. When David Thompson was here in 1798, he made the fort to be lat. 46° 46' 39" N., long 93° 20' W. It was a point of commercial and even political importance long before the 1800's - it was such at the pivotal date, 1763, in the history of French-English occupancy of the Upper Mississippi. At the discharge of the lake into the Mississippi on the north side, is a small sharp point; this was the site of a post of the American Fur Co. of which Schoolcraft speaks in 1832; Palmburg was and Libby is there now.

Below Big Sandy Lake the river meanders along a terminal moraine through a broad, flat, swampy plain that was once occupied by glacial Lake Aitkin.

Below Aitkin the river channel is straight and the valley deeper, running parallel to the famous Cuyuna Iron Range.

The Pine River enters the confluence of the Mississippi 28 miles west of Aitkin and offered the voyageurs a means of communciation with Leach Lake much more direct than the course of the Mississippi. In 1805 there was a Chippewa encampment of 15 lodges where the two rivers joined.

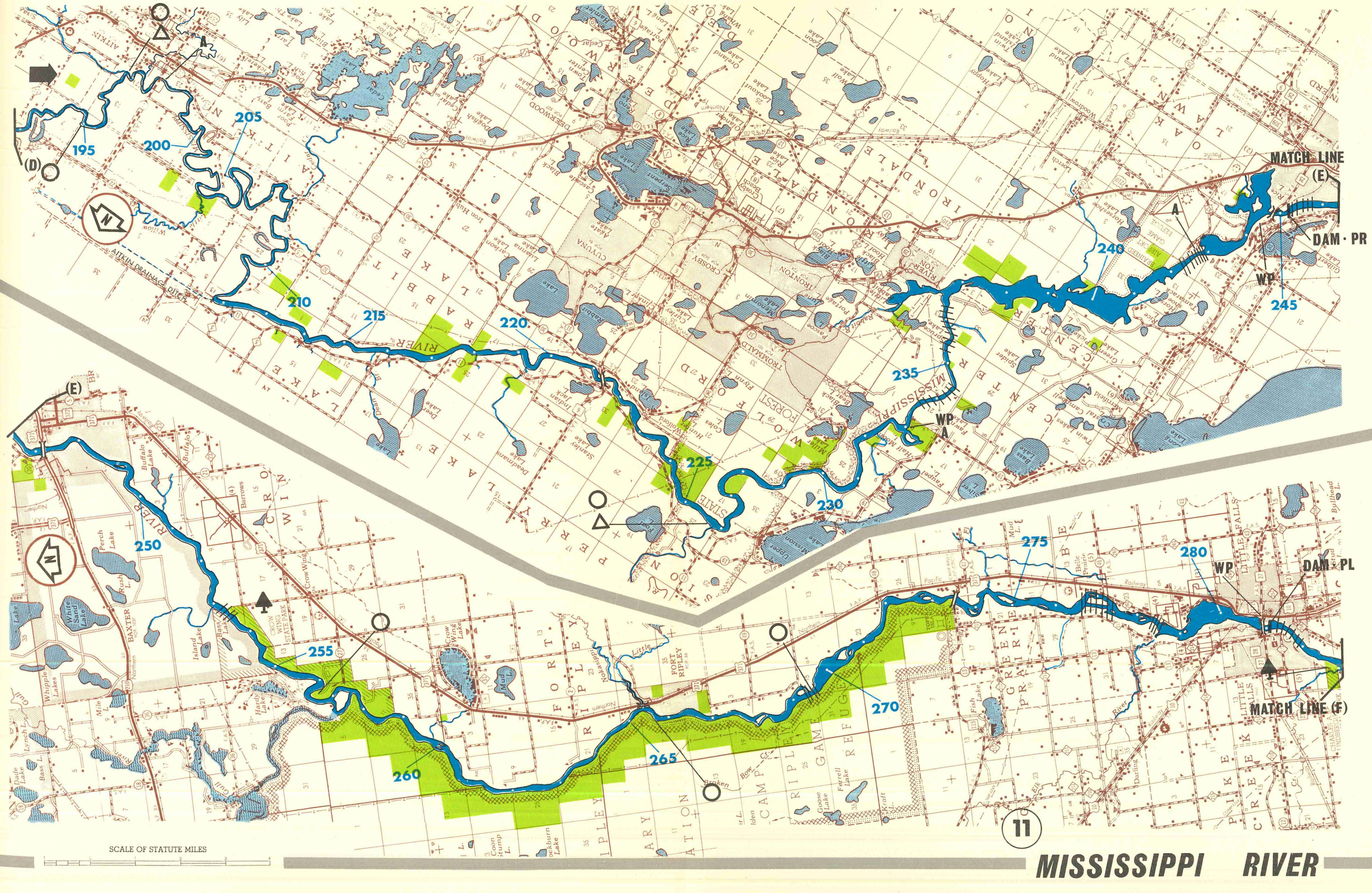
Ten miles south of Brainerd the Riviere a l' Aile de Corbeau of the French, usually shortened into R. de Corbeau, though Eng. Crow Wing River reflects the full name. This is the largest branch of the Mississippi above Little Falls. The unnumbered affluents which unite to compose the main stream head in lakes and marshes of Hubbard, Becker, Otter Tail, Wadena and Todd Counties. Having received most of its tributaries, and coursed through Wadena, the river for a short distance separates Todd from Cass Co., and then runs between Cass and Morrison to empty opposite the town of Crow Wing. Crow Wing River was important as a means of communication between the Mississippi and Red River of the North. It was navigated up to the mouth of R. des Feuilles, now Leaf River, in the southern part of Wadena Co.; thence the route was up Leaf River, and by portage into Otter Tail Lake, one of the principal sources of Red River waters. Crow Wing River was also a route to Leech Lake.

Just south of the point where the Crow Wing River enters the confluence of the Mississippi stood the old site of the town of Crow Wing. It was abandoned about 1870 when surveyors for the Northern Pacific Railroad Company specified a site on the east bank of the Mississippi River as the points where the railroad would cross the river. Brainerd was made the county seat for Crow Wing county in 1872.

The abandoned town of Crow Wing is one of the state's oldest ghost towns. This area was also an important crossing of the Red River Oxcart Trail over the Mississippi and a fur trading post dating to 1700's was located here. At one time it was the site of a Chippewa settlement. This area is now preserved in the Crow Wing State Park.

The drainage area below where the Crow Wing River enters the confluences of the Mississippi is a rolling glacial till plain with altitudes ranging from 950 to 1,100 feet. A series of interrupted morainal hills border the area forming irregular sandy hills and lake-filled hollows. Other topographic features of the area include small irregular clayey hills interspersed with the larger sandy morainal areas.

South of the Crow Wing area is the state's second oldest military post, Fort Ripley built in 1848 and occupied until July 1878. This military post established as a buffer against the Indians, was used as a


MATCH LINE (E)
DAM · PR
W.P.
A
195
200
205
210
215
220
225
230
235
240
245
WP
A
(D)
(E)
AITKIN DRAINAGE DITCH
RIVER
250
255
260
265
270
275
280
WP
DAM · PL
MATCH LINE (F)
SCALE OF STATUTE MILES
11
MISSISSIPPI RIVER

shelter for the settlers in the uprising of 1862. Of the old fort nothing remains today except the ruins of the powder magazine, the only building of stone.

Little Falls was called Painted Rocks by the French voyageurs. It served as the winter headquarters of Zebulon Pike during the winter of 1805-06 while Pike was searching for the source of the Mississippi. Its historical significance is comparable to Lewis and Clark's Fort Mandan on the Mississippi River. This area is also important as the site of Lindberg State Park.

In Sherburne County and between Pierz and Watab the glacial till is covered with dune sands reworked by glacial stream action and by wind. Altitudes in the morainal areas range from 1,150 to 1,500 feet. The Mississippi River which receives the drainage of the entire region follows a southerly course through the center of the watershed and flows through a broad valley partially filled with glacial outwash plains of sand and gravel. The outwash deposits also extend along the lower reaches of the numerous tributary streams which drain the upland areas of the watershed.

In the northern and western parts Precambrian crystalline rocks underlie the glacial drift except for small areas where remnants of Cretaceous rocks lie beneath the glacial drift of the western area. In the southeastern part of the basin Paleozoic sandstone, limestone, and shale underlie the glacial drift deposits. Bedrock crops out at the surface along many of the stream valleys in the eastern part of the watershed, especially in the area between Watab and Sauk Rapids, in the form of granite knobs as much as 100 feet above the surrounding plain areas.

Watab named after the Watab River that enters the Mississippi just south of the town was an old Indian trading post before it was organized in 1858. This little river was formerly important as the most tangible part of the shadowy Sioux-Chippewa boundary of 1825. Watab is the Chippewa word for the long slender roots of both the tamarack and jack pine, which were dug, split and used as threads by the Indians in sewing their birchbark canoes. Both trees grow on or near the lower part of the Watab River.

At Sartell, the Indian boundary established by the Prairie du Chien Treaty of 1825 crosses the Mississippi River. By this treaty Sioux Indians were restricted to the territory south of this mythical line, while that north of it was designated as Chippewa country.

Sauk Rapids, 96.1 miles (1,008 alt., 2,656 pop.) is on the site chosen by the Sac Indians as a refuge after they had been driven from Wisconsin for their raids on the white settlers.

When Sauk Rapids became the northern terminal of the Northern Pacific and Great Northern Railways, it assumed importance as the junction of rail and ox-cart traffic. The foundation of an old sawmill on the river front is all that is left of the town's boom days, for the cyclone of 1886 leveled the entire city.

The section of the river from Sartell through St. Cloud is very urban in character with many houses, factories and businesses reaching the banks that line the river.

Before the settlement of St. Cloud the immediate vicinity was first Sioux territory, but the Chippewa who drove out the Sioux centered their activities around Mille Lacs, to the north. In the forties, one of the fur trails from the Red River country met the Mississippi at St. Cloud, and here the teamsters, happy at reaching this important milestone on their long haul to Mendota, forded the stream, rested their tired oxen, and built their campfires under the shelter of the bluffs, appeased their hunger. with pemmican and their spirits with roistering songs and robust stories.

The first stage line was operated through the region in 1851, and in 1859 the route was extended a considerable distance up the Mississippi, and later to the north and westward through the Sauk Valley to the Red River country. The stages brought the mails upon which the people depended almost entirely for their communication with the outside world. With the coming of the railroad from Minneapolis in 1866, the stage extensions assumed additional importance but were gradually discontinued after 1871 when the railroad reached the western boundary of the State.

The geographical position of St. Cloud, near what was then the head of upper Mississippi River traffic, brought it into prominence in the fifties and sixties as an outfitting post for the fur trade. A vast tonnage of furs from the territory west and north was loaded upon steamboats here, after they had

discharged cargoes mainly of supplies for the wilderness forts and for the distant Canadian posts of the Hudson Bay Company. The goods were carried inland by trains of one hundred or more ox and pony carts that came and went in a steady flow, week after week. The last regular steamboat trip was made up the river in 1874. By that time the railroads had absorbed the traffic.

Elk River is the seat of Sherburne County. The town and the river, which enters the Mississippi at this point, were both named for the herds of elk found here by Pike. The first house in Elk River, a trading post, was erected in 1848 by the French trader and guide, Pierre Bottineau. It stood on a bluff just east of the bridge across the Elk River on U.S. 10. Just south of Elk River is the Oliver Hudson Kelley Homestead. Significant as the birthplace of organized agriculture in the United States, O. H. Kelley founded the National Grange. His pioneer farm, including house, barm, corn crib, dating from 1870 are located here. At one time the Red River Oxcart Trail traversed this site.

Visible to the north and east of the Mississippi is the triangular area known as the Anoka SandPlain, covering about 858 square miles. Part of this area is now set aside as the Sand Dunes State Forest and Game Refuge. This plain probably was produced by the lowering of the water table which resulted from the down-cutting of the river. When the plant cover disappeared, it left the dry surface sand exposed to the erosive southwest wind. In many places the fine sand has been blown into well-defined dunes, some of which reach a height of 20 feet.

Dayton Station, an abandoned railroad-junction town, formerly an Indian trading post, was platted in 1852 as Itasca but was later overshadowed by Dayton across the river. Near Dayton Station the Crow River flows into the Mississippi. Geologists have ascertained that the Crow once was the bed of the preglacial St. Croix, which proceeded from its upper reaches through the vicinity of Pine City, Dayton, and Rockford to the Mississippi. During an interglacial period, the river in this bed flowed southwest, but a lobe of ice pushing into the valley changed the direction and shunted the river into its present course far to the east.

Pond Lilies grow thickly in the shallow water along the slow-moving streams and in stagnant ponds beside the highway. Ginseng, a medicinal herb found in the woods, became a source of income and tided over many a settler's family through bad years.

The area around Anoka is interspersed with groves of native timber and is traversed by the Rum and Sunrise Rivers, tributaries of the Mississippi. The Rum River is one of Minnesota's most famous streams. Father Hennepin, Jonathan Carver, and Sieur du Luth traversed its water, and many others followed them. It was a favorite highway for the fur-traders settlement on the old Red River Oxcart Trail and bore the first pine logs cut in the State.

POTENTIALS FOR RECREATION:

SCENIC DRIVES:

The Mississippi Valley Parkway authorized by Congress in 1954 should be improved and a special scenic parkway developed paralleling the river its entire length in Minnesota.

Special consideration should be given to the aestheticsof the parkway including steeper grades, pleasant curves, slower speeds and scenic wayside park areas. The parkway could provide an ideal link between points of historic, scenic and geological interest.

BOATING:

Increased boating in Minnesota has emphasized the need to provide opportunity for recreation in the area. A possible water parkway similiar to a motor parkway might be provided making double use of the historic, scenic and geological interest areas.


(F)
285
DAM
290
295
300
305
310
DAM · PR
MATCH LINE (G)
315
WP
(G)
WP
DAM · PR
320
325
330
335
340
345
A
A
350
MATCH LINE (H)
CLEARWATER RIVER
SCALE OF STATUTE MILES
1 0 1 2 3 4

PARKS:

Two State Parks, Crow Wing and Charles A. Lindberg offer good recreational areas.

The Chippewa National Forest offers one of finest recreational areas in the country with its miles of clear northern water, excellent stands of pines, and abundance of wild life. The Chippewa area is rich in the history of the Indians and early voyageurs.

The Mississippi River played a very significant part in the development of the State. It formed an avenue of commerce for the Indians and fur traders and the early explorers, almost without exception either entered or left the region by way of this river.

AMENITIES FOR RECREATION:

The Mississippi River from Bemidji to Grand Rapids traverses four dams and two extremely large lakes. Between the dam and lakes the river flows very slow comparable to water flow through swamp land. The river doesn't offer much in the way of canoeing but more in the way of fishing.

From Grand Rapids to Brainerd the river flows over a gravel moraine into a huge swamp basin and past the Cuyuna Iron Range. The river is wide, rather sluggish in nature. The scenery in the Iron Range is exciting but the rest of the area monotonous due to the large expanse of swamp area.

The River from Brainerd to Anoka through an area of rolling glacial till plain interrupted by morainal hills, farming, sandy hills and lake filled hollows. Numerous towns, among them Little Falls, Sauk Rapids, St. Cloud, Monticello, Elk River, Dayton, and Anoka prevent the river from having a wild or semi-wild feeling. The river falls on the average only 3 feet per mile and greatest falls occur at the four dams.

Due to the large size of the river, the many large lakes it flows through and its extreme length, the river is recommended for motor boat traffic only and canoeing be limited to the smaller rivers.

The Mississippi River provides excellent fishing and this potential should be investigated.

CONSIDERATIONS:

Develop new and existing parks to include access, water supply, sanitary facilities, interpretative markers and additional facilities as needed.

Develop a program to adequately preserve, mark and interpret major historic sites.

Establish a scenic parkway in connection with the Great River Road and the proposed Mississippi Valley Parkway.

Expand the wayside rest areas along the Mississippi River.

Preservation of natural areas along the river.

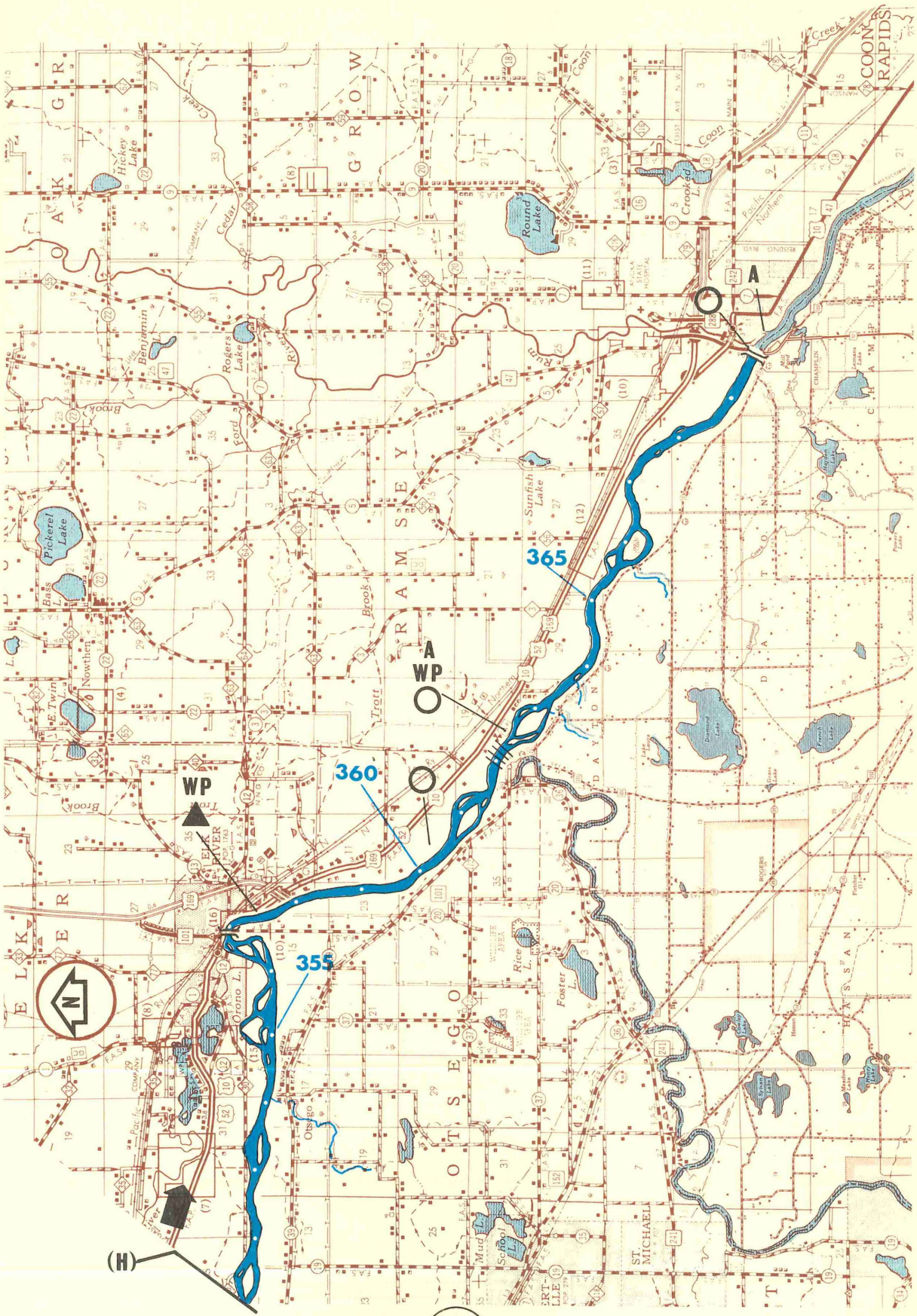
Sewage treatment along the river be brought to an acceptable level.

Water level between Lake Bemidji and the Ottertail Power Company Dam be increased to a reasonable level.

The possibilities of studying these rivers:

Turtle River near Cass Lake
Third River near Winnibigoshish Lake
Prairie River near Grand Rapids
Swan River near Jacobsen
Platte River near Royalton
Sauk River near Sauk Rapids
Clearwater River near Clearwater

For their potential as alternate canoe routes to the Mississippi River.



11

MISSISSIPPI RIVER

NORTH FORK CROW RIVER

LOCATION:

The North Fork of the Crow River rises in southeastern Pope County and follows a general southeasterly course for about 175 miles through Stearns, Meeker, and Wright Counties to its junction with the South Fork about 1 1/2 miles south of Rockford. From Rockford the Crow River forms the county boundaries between Wright and Hennepin Counties until it empties itself into the Mississippi River at Dayton, Minnesota.

NATURAL SETTING:

The North Fork flows in a well defined channel in a valley from 40 to 50 feet below the adjacent land surface. Channel slopes are fairly uniform and average, 2.9 feet per mile in the upper 100 miles and 1.6 feet per mile in the lower 75 miles which is a very gradual slope.

The northern half of the watershed consists of low morainic hills and interspersed glacial till plains with altitudes ranging from 1,200 to 1,300 feet. Glacial out-wash, sand and gravel cover much of the valley of the North Fork from its source to Paynesville. Throughout the rest of the area, gray to brownish-gray soils derived from limy, clayey loam still predominates except for areas of dark-colored, well-drained loams which cover the surface in Central Meeker County.

The fertile soil of the area is its principal resource accounting for its large amount of crop and dairy farming. The eastern part was once a thick hardwood forest, a part of the "Big Woods," but very little of this area is forested at the present time.

Water in the Crow River watershed is derived largely from local precipitation. Recharge in shallow aquifers generally occurs during the spring breakup and in deeper aquifers several weeks or months later, depending on the thickness and permability of overlying formations. Minor amounts of recharge may result from summer precipitation under favorable conditions.

Mean annual runoff for the North Fork basin for the 31 years of record is 3.0 inches. In comparison with most other Minnesota streams, this low runoff can be attributed to high evaporation and transpiration from numerous lakes and potholes in the basin.

Flood damage along the North Fork has been reported above Koronis Lake in the vicinity of Paynesville, and on the lower 40 miles of the stream. Flooding does occur every spring but it has been confined largely to wooded pasture land and some cultivated land.

All but four of the municipalities with sewage systems discharging effluent into surface waters have sewage treatment facilities and accordingly stream pollution problems have been ameliorted.

RIVER SURVEY:

The trip starts 45-50 miles downstream from the beginning of the North Fork of the Crow River on State Highway #22 in Meeker County. The river is narrow and fast moving, farms dot the landscape adding a sense of ruralness rather than wilderness to the air. The water is free moving, clear and clean. The banks are of a grayish loam which covers the whole area. Access and a campground are possible here, as to date nothing has been developed in this area.

The land is low rolling pasture land with intermittent areas of tree cover. Elm and willow grow in the rocky soil abutting the river with ash, oak and poplar growing away from the banks. The river is shallow with large rocks protruding from the water. The bottom is a combination of sand and gravel with a small rapids - mostly a collection of rocks to break the surface of the river.

A mile or so farther, County Highway #35 passes over the river. This area is predominately farm land with the river carving a 5 to 10 foot crevice through it. Oak and willow trees line the shallow water as it winds past meadow lands.

At County Highway #4, about 32 miles downstream, the river travels through a slough and back-wash area, which in its own way, is rather scenic and offers the canoeist a visual change in scenery. There were sunfish and catfish in this general area.

At Albright County Highway #5 crosses the North Fork about 34 miles from our point of departure. The area is rather quiet and serene, and very beautiful outside of the town. No access at the present time due to the steep banks and large amount of undergrowth. The water is extremely clear and the sandy bottom is everywhere present. Every so often a dead tree will be seen hanging over the water or partly submerged making it necessary to canoe around the protrusion.

A significant change occurs just one mile further downstream where another bridge crosses the river, here on both sides of the river are dumps which surround the houses and invade the river. Trash and scrap appliances, garbage and even old automobiles force themselves upon the river causing pollution, eye sores and to literally nauseate the area. Here the water begins to take on a tone of brown that it will not relinquish the rest of its journey to the Mississippi River. The land is quite flat pasture, meadow land and some swamp areas with a lot of dover along the banks, bushes mixed with oak, elm, and willow trees.

Forty-five miles downstream County Highway #9 crosses the river. Steep banks and heavy growth along the banks add to the beauty but do not hinder access. Ducks were sighted here, presumably tame. Trees, aspen, elm, and willow reach out over the river almost as if to cover it as a green archway.

State Highway #25 crosses the North Fork 50 miles downstream. Access and campsite possible on the northeast side of the bridge in a wooded area. The river is wider, somewhat deeper and a silt brown shade. The banks are shallow and composed of dark-colored clay and loam mixture.

Just before we reach the North Fork-South Fork junction of the Crow River, numerous rocks of varied size are present in the shallow brown water of the river. The river in general is shallow and wide, filled with all sorts of debris.

A significant change takes place at Rockford, 60 miles downstream from where the survey started, the North Fork and the South Fork have merged into the Crow River. The river is much wider and only slightly deeper than either of its tributaries, tree-lined and quite scenic as it enters the town. Access at the State Highway #55 bridge is quite steep and poorly developed. In town it is possible to park an automobile along the edge of the road and enter the river on the east side of the County Road #18 bridge.

The flow of the river at this location is very adequate, however, the urban scenery is primarily the rear of older inexpensive homes, many of which have been used to accumulate sheds, old cars, and board fences. The banks along this location tend to be gentle with a growth of elms and willow trees. Some fifteen minutes downstream, the land is being farmed on the east and the depth of the abutting trees is approximately 25-50 feet. Paralleling both sides of the river is a highway or road providing a good access to the river. The stream is very gentle although the banks have evidence of persons dumping trash and cans into the ravines along the edge of the river. Some thirty minutes downstream on the east side of the river is located a house with the foundation within three feet of the actual water and the yard of this house has a number of old cars giving the appearance of clutter. Along the river is noticable many birds - one heron was seen, yellow canaries, robins, orioles, red-winged blackbirds and many other varieties. Also squirrels were seen in the abutting trees. The elevation of the land above the river was approximately 4-6 feet and in certain locations the river was not tree-lined and evidence did exist of erosion. On the east side of the river approximately three miles out of Rockford is a gentle bank which slopes up to a road approximately 300 to 400 feet from the river which would make a very good location for a camp site. Just south of Hanover is a bridge under construction and at Hanover is the dam which does require caution that you begin a portage no closer than one-hundred feet from the dam. On the east side is undeveloped property where you can take the canoe out and portage some 500 to 800 feet downstream around the dam and a rocky area directly below the dam. The bank on the west side is privately developed and the bank is very difficult to pull a canoe out, and in order to portage around the dam at this location it is necessary to travel around the Hanover Mill which at one time was powered by water. The Mill was in operation until the 1965 flood which was severe enough to cause the owner to decide not to re-open.

Access to the Crow River at Hanover is by the mill, parking was good but access to the river was difficult because of steep banks. There was a lot of trash and debris in the water in this general area. The river is rather rough here but is a good example of the way it behaves on its journey to the Mississippi River.

There is a county camp site outside of Hanover, approximately 1 mile, providing fireplaces, picnic tables, water, and outdoor toilets. The general area is well kept-up and also accessible from the road. Access at this point could be provided easily.

The tree cover in this area is dense and extends along both sides, mostly oak, willow and cottonwoods, sheltering the river and providing a very pleasing visual experience.

A few more miles down river gravel sand bars extend into the river where it widens out and slows down. Flood marks with ice scour on trees from spring time flooding is visible. This particular part of the river from mile 75 to mile 80 is interesting, exciting and a visually pleasing segment to travel.

About 10 miles down river from Rockford, just outside of St. Michael, a high bluff is encountered on the west side of the river, on top of the bluff State Highway #241 parallels the river. Homes are also visible in this vicinity.

Below Highway 241 the river widens but is still fairly shallow. You notice intermittently between tree cover, farm land extending away from the river providing a rich base for both crops and farm animals. Tree cover depth in this area is deep enough so visually you can't see through the natural cover. Ice scour is noticeable on trees 4 to 6 feet above present water level.

At Berning Mill a portage has to be made along the right hand side of the river around the dam that supplied power to the Berning Mill when it was in operation. The portage is very good and only 75 yards long. When portaging the old mill, paddle wheels, and spillways are visible. A project to restore the mill to its original condition would make it a worthwhile historical site. On the portage side of the river there is a picnic ground which provides a place to eat and a view of the mill.

The rest of the trip from Berning Mill on down the river is slow moving and wide but not deep. This area is mostly flat farm land. Periodically there is a rapids where the river narrows and flows over a rocky bottom then it will widen out and slow down again. There is an access point just before State Highway No. 152 crosses the river. A very good access point where people camp overnight and launch boats and canoes. The soil is sandy and there is good cover around the camping area. No facilities, such as toilets, water and tables are provided for the camper but these facilities could be easily built and maintained.

The many rapids encountered indicates the type of river bottom in this area, sand, gravel and rocks primarily. If you were to use a motor you would have to be extremely careful because the water is very shallow along the entire river.

Just before entering Dayton a camp ground and picnic grounds are visible on the right side of the river. River access is not developed but could easily be accomplished. Acess from State Highway No. 101 is good and parking is available for those who use the area.

After leaving the camp ground and rounding a bend in the river there is a very picturesque scene of the church steeple raising above the trees in Dayton. Further down river the State Highway No. 101 bridge crosses the Crow River. Here is a private access to the river but no public access. After the highway bridge the shallow Crow River is engulfed by the wide expanses of the Mississippi River ending the Crow River water survey.

EXISTING DEVELOPMENT:

The general development along the whole route of the North Fork of the Crow River is farm land, used for crops and dairy cattle with some herds of beef cattle. At 16 miles just before Kingston is located a town dump away from the river. Twenty-five miles downstream just below French Lake is located a national cemetery. A gravel pit is located at mile 29. Three miles further south is located a gun club. Mile 33 is the site of a gravel pit and shortly thereafter at mile 35, along both sides of the river, is a large dump and junk yard. Throughout this area of the river are numerous sand and gravel operations.

There are dams located at miles 70, 76, and 82, also at mile 82 is located old Berning Mill, now used as a flour mill. There are located along the 90 miles of the Crow River 35 highway bridges in use, two abandoned bridges and one railroad bridge.

AMENITIES FOR RECREATION:

The river throughout its entire length is bounded by low rolling farm land interspread with small and large areas of tree growth and swamp land. The river is very shallow throughout its length all summer long. Wildlife consists of spotting a deer or a blue heron once in awhile. The catfish is the only fish that lives naturally in this river. There are no camping facilities along the river except between Rockford and Dayton.

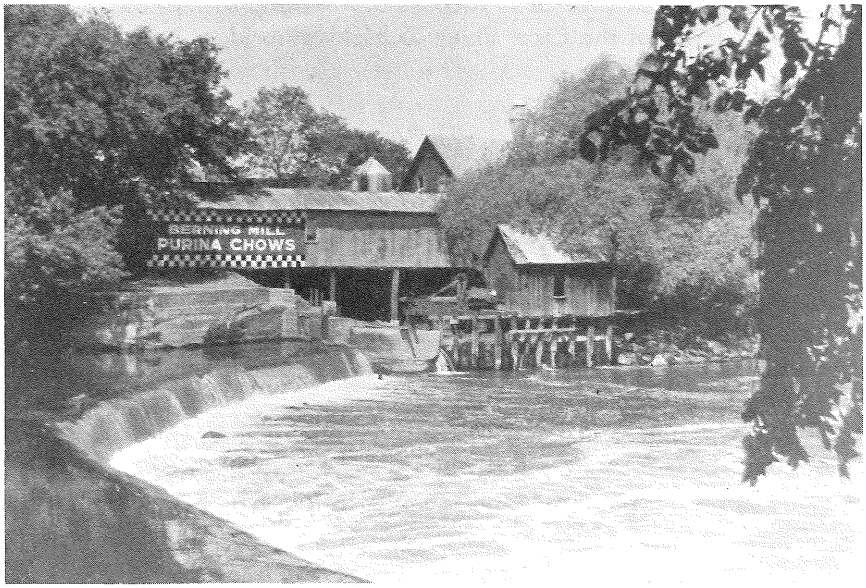
From Forest City to Albright and from Rockford to Dayton are the areas that offer the greatest possibilities for recreation. They are the most scenic and offer the optimum diversity along this river. The Rockford-Dayton area is easily accessible to the metropolitan population, although it is by no means wild, it offers a potential for easy canoeing and a weekend of recreation not far from a population center.

CONSIDERATIONS:

This river is not a wilderness river but its proximity to the Twin Cities make it one which should be given further considerations. The purchase of park land by both Hennepin and Wright Counties will make it accessible and hiking, bicycling and riding trails could be a major function.

Boating and canoeing for weekend outings when the water flow is sufficient should be considered.

Crow River winding its way through part of the fertile farmland in this area, mile 17.



The power house, mill wheels and spillways are still intact at Berning Mill, mile 82.

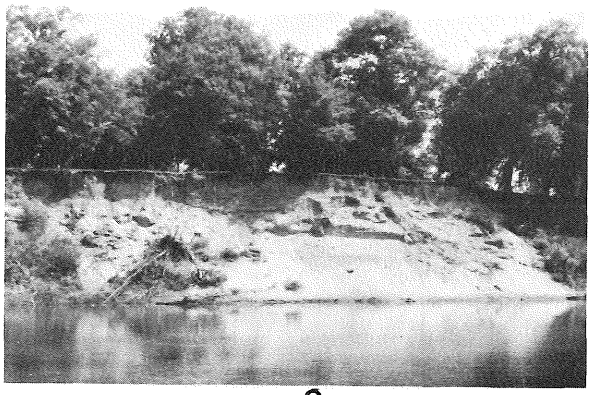
A rocky area of the Crow River, mile 86.

NORTH FORK CROW RIVER

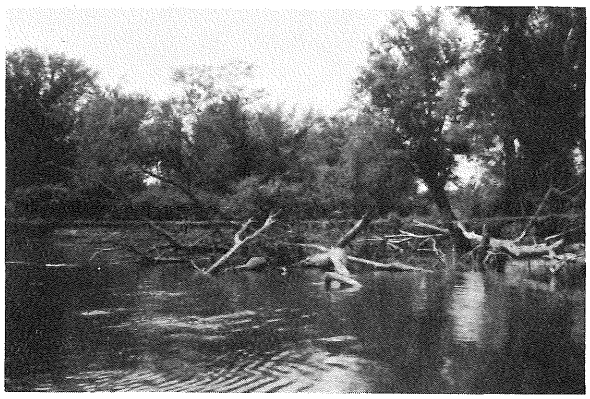
1. Typical of a few reaches of conifers on high sandy banks.
2. Bank erosion at mile 2.
3. Flood debris, typical of reaches above Rockford.
4 & 5. Typical of many reaches below Rockford.
6. View downstream from Hanover Dam.
7 & 8. Typical scenes below Rockford.

CROW RIVER

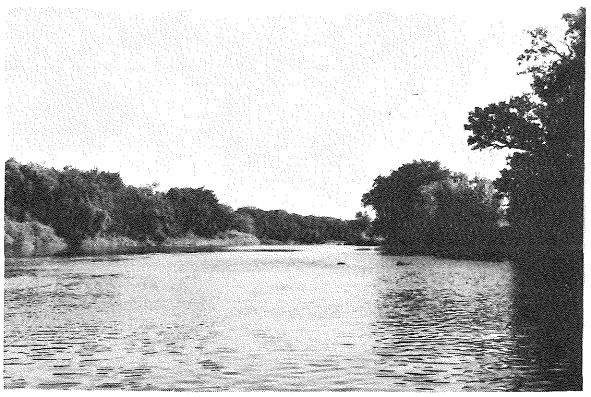
1



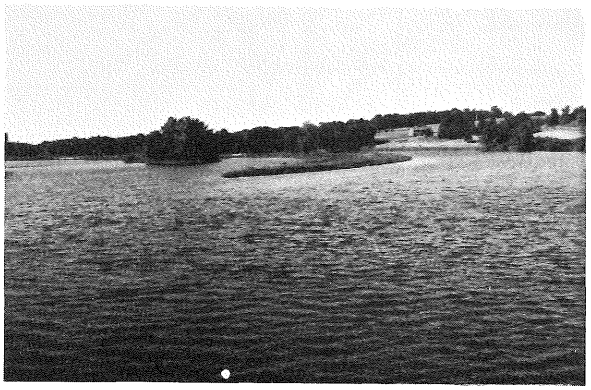
2



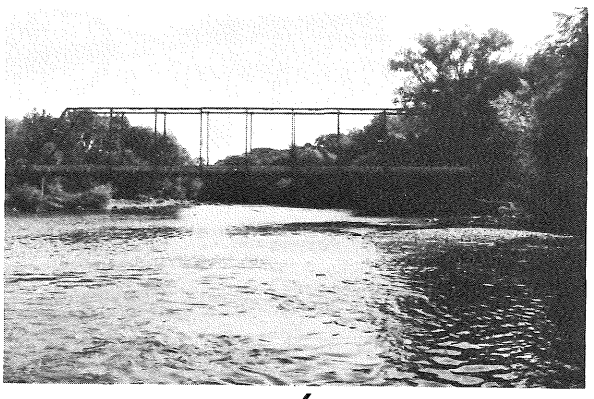
3



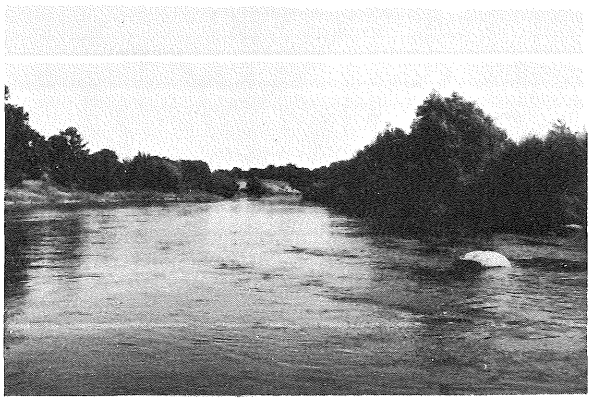
4



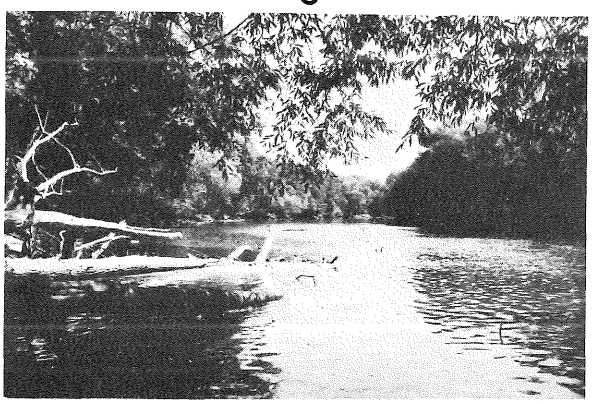
5



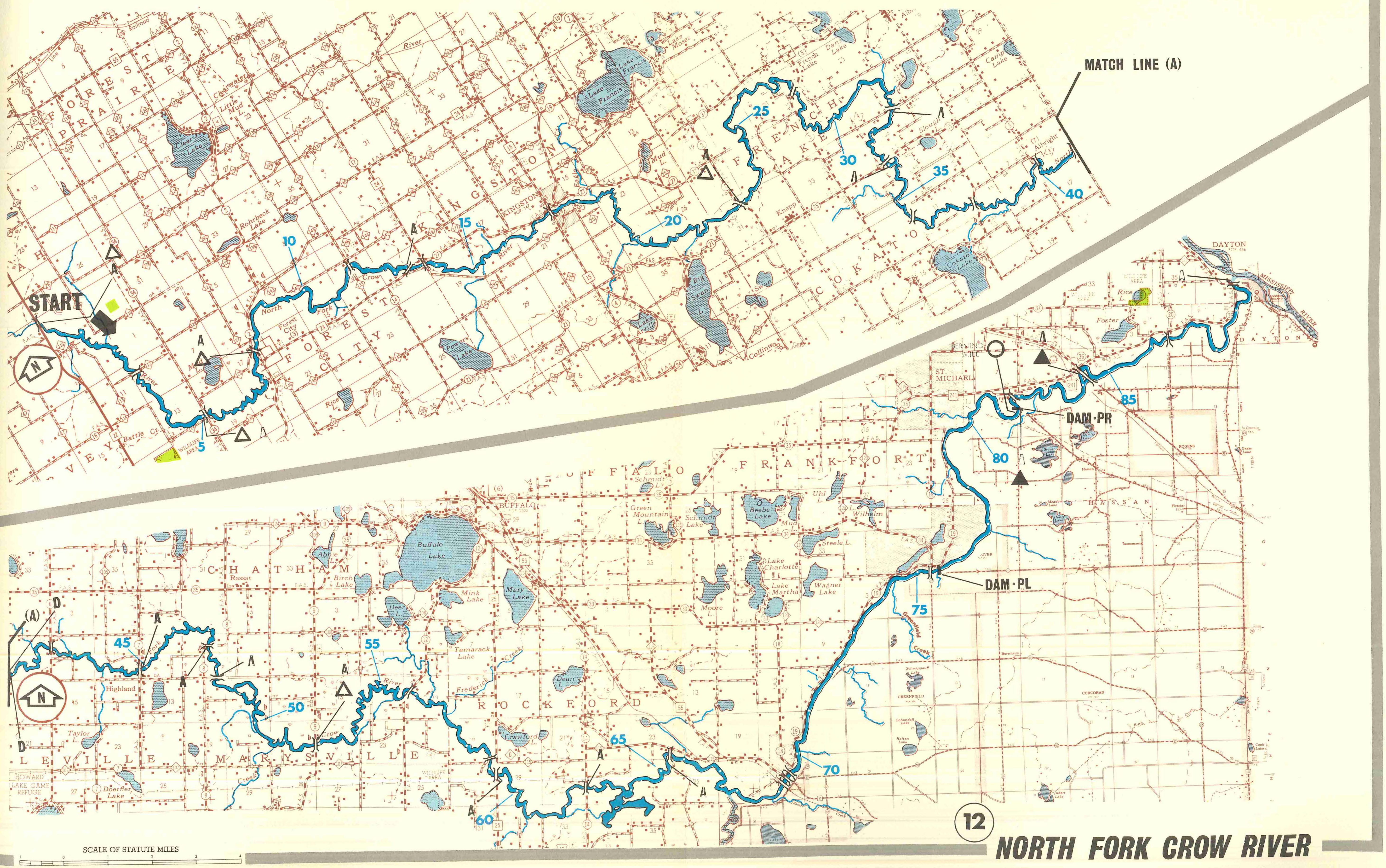
6



7



8



12

NORTH FORK CROW RIVER

OTTER TAIL RIVER

LOCATION:

The Otter Tail River rises in a hilly region in the southwest corner of Clearwater County and flows southward through a series of lakes until it reaches Otter Tail Lake where it turns and flows west to its junction with the Bois De Sioux River to form the Red River of the North at Breckenridge. The watershed unit has an area of 1,922 square miles and includes parts of Becker, Clearwater, Otter Tail and Wilkin Counties. West of Fergus Falls the watershed has flat topography. This area is a lowland plain covered with lake clays and silts derived from glacial Lake Agassiz. From the vicinity of Fergus Falls eastward the area has rolling topography consisting of a series of morainal hills with interspersed glacial till and outwash plains containing numerous lakes and depressions. Between the rolling upland plain and the flat lowland plain is a series of beach ridges representing the recessional shoreline of the glacial lake. Altitudes range from 960 to 1,000 feet in the lowland lake plain and from 1,150 to 1,600 feet in the morainic upland plain.

Cretaceous sedimentary rocks form the bedrock of an area extending 6 to 8 miles east of the mouth of Otter Tail River but have not been found throughout the remainder of the watershed where the known bedrock consists of Precambrian crystalline rocks which underlie the glacial deposit at depths of 150 to 500 feet.

The Otter Tail River has three major tributaries, Pelican, Dead, and Toad Rivers which have drainage areas of 518, 148, and 122 miles, respectively.

The river is one of the best naturally regulated streams in Minnesota because of the numerous lakes in the drainage basin. The more than 400 meandered lakes and 700 nonmeandered lakes in the watershed constitute nearly 15 percent of the total area. In addition, about 6 percent of the watershed area, mainly in the rolling upland area, consists of swamps and marshes.

Lake storage augmented by water released from ground water storage is sufficient to stabilize streamflow during years of normal precipitation. During long periods of insufficient rainfall the evaporation rate from the lake surfaces is higher than normal, and ground water discharge into streams and lakes is low, thereby creating periods of deficient streamflow.

NATURAL SETTING:

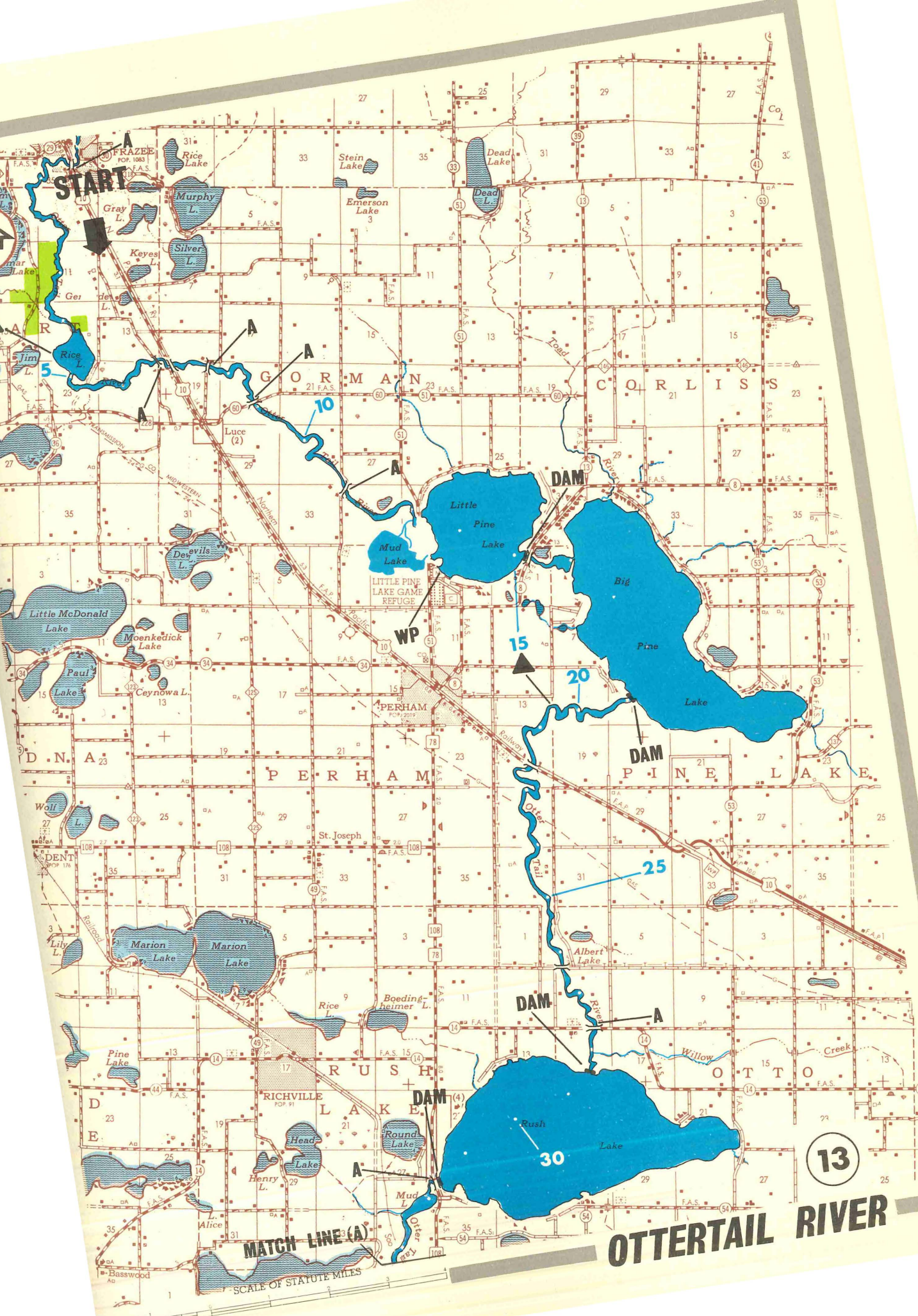
The cities of Fergus Falls and Breckenridge utilize surface water from the Otter Tail River for their municipal supply. The remaining municipalities have wells in the glacial drift.

There are five hydroelectric plants owned and operated by the Otter Tail Power Company now in operation on the Otter Tail River. Three of the hydroelectric plants, the Dayton Hollow, Hoot Lake and Wright stations, are located at Fergus Falls. The Pisgah station is located on the Otter Tail River about 8 miles south of Fergus Falls and the Friburg plant is located at the mouth of Taplin Gorge about 20 miles north of Fergus Falls. The dam at the Hoot Lake station develops the greatest head of any of the stations, 70 feet. There have also been numerous other small water power installations on both the Otter Tail and Pelican Rivers used mainly for milling purposes. All of these have been discontinued and some of the dams have been removed. Surface water is utilized in stream power generation at Detroit Lakes and at Hoot Lake where it is augmented by the hydroelectric power development.

There are more than 50 dams at the outlets of lakes and in the streams in the watershed. Many of these dams were sponsored by the state and constructed by federal relief agencies during the 1930's. Most of the dams are utilized for maintaining lake levels and for recreational purposes.

All of the municipalities in the watershed with sewer systems have sewage treatment plants.

For the purposes of reducing flood damage and of providing regulated low flow releases for communities on the Red River of the North, certain improvements have been made in recent years on the lower portion of the Otter Tail River. The Orwell Dam and Reservoir project, located about 15 miles downstream from Fergus Falls, was completed by the U. S. Corps of Engineers in 1953. The dam is 47 feet high and 1,355 feet long and impounds water over an area of 1,110 acres at normal pool elevation of 1,070 feet. The reservoir has a capacity of 14,100 acre-feet at normal pool elevation. About 1,000 acre-feet is


START
A
FRAZEE
POP. 1083
Rice Lake
Stein Lake
Dead Lake
Murphy L.
Gray L.
Emerson Lake
Dead L.
Keyes L.
Silver L.
Jim L.
Rice L.
5
10
15
20
25
30
GORMAN
CORLISS
Luce (2)
Little Pine Lake
Mud Lake
DAM
WP
LITTLE PINE LAKE GAME REFUGE
Big Pine Lake
Little McDonald Lake
Moenkedick Lake
Paul Lake
Ceynowa L.
PERHAM
POP. 2019
DENT
POP. 176
St. Joseph
Wolf L.
Lily L.
Marion Lake
Rice L.
Boedingheimer L.
Albert Lake
Pine Lake
RICHVILLE
POP. 91
Head Lake
Henry L.
Round Lake
Mud L.
Rush Lake
Willow Creek
Otter Tail River
Railroad
Northern Pacific Railway
MATCH LINE (A)
Basswood
SCALE OF STATUTE MILES
13
OTTERTAIL RIVER

normally reserved for emergency water supply use and for the benefit of wildlife, the rest of the capacity being available for storing floodwaters.

Improvement of the channel of the Otter Tail River for a distance of 11.4 miles above Breckenridge was completed by the Corps of Engineers in 1954. This project was designed to reduce flooding of agricultural lands which has occurred frequently in this area, to provide a better outlet for local drainage, and to reduce losses from evaporation in the delivery of water released from the Orwell reservoir. The Wilkin County Drainage and Conservancy District was established in 1950 to provide the local cooperation required by the federal government for certain projects. In 1953 the custody of the state dam and reservoir in the Otter Tail River just above the city of Breckenridge was transferred to that city for use as a water storage reservoir. All the land except for the dam site has been given to the State of Minnesota, Department of Conservation for wildlife conservation purposes, and for public recreation.

From its source to the vicinity of Perham the Otter Tail River valley is one-fourth to one-half mile wide and 50 to 100 feet deep except for an area of four miles through Height of Land Lake which is nearly three miles wide. In the next 40 miles the valley is about 15 feet deep and reaches a width of about 3 miles in Rush and Otter Tail Lakes. From Otter Tail Lake to a point 15 miles west of Fergus Falls the valley is generally less than half a mile wide and as deep as 130 feet. The river flows through a wide shallow channel in a broad flat plain until in the lower 8 miles of its course it enters a distinct valley about 400 feet wide and 10 feet deep.

The average fall of the Otter Tail River over its entire length of 200 miles is about 3 feet per mile. The lowest stream gradient of less than 0.5 foot per mile occurs in the reach between Pine and Otter Tail Lakes, whereas the highest gradient of nearly 12 feet per mile occurs over a reach of 5 miles below Height of Land Lake.

SURVEY:

The Otter Tail River rises in a hilly region in the southwest corner of Clearwater County approximately 30 miles north of Frazee. The survey begins at the U.S. Highway #10 bridge in Frazee. The launch site is good and the water flow and quality are both excellent. Weed beds in the river are quite thick leaving only a small channel through which to navigate. The river banks consist of marsh, marginal, and wood lands. Tree cover consist of willow and a few ash trees. Many short turns in the early part allow you to surprise great blue herons and the many ducks that inhabit this weedy area of the river. There is little sign of civilization which adds a wilderness feeling.

At about four miles the river valley widens until it gets lost in a luxuriant wild rice marsh. The channel is not evident in a few places making the paddling difficult until the marsh ends at Rice Lake. The exit from Rice Lake is on the far southwest corner. The water is clear but weed cover is extensive along both shores and the bottom, numerous northerns and bass inhabit the channel. There are many bog trees located in the marshes in this general area alternating with some farm country until you reach Little Pine Lake. Just past County Highway #51 bridge is a municipal park located in the Little Pine Lake Game Refuge.

The outlet dam at Little Pine Lake is canoeable and the channel winds its way through a marsh area leading to Big Pine Lake. There is a outlet dam at the exit of the Otter Tail River from Big Pine Lake which can be canoed. The water in this area is very cloudy and is covered with green algae for the next five or six miles in this marsh area. The river after leaving Big Pine Lake meanders its way southward to Rush Lake and at the southwest corner or the exit point of Rush Lake is a private campground. The river bends sharply below the campgrounds and has a tree and marsh fringe for a few miles. Then it opens up again to farm land and roads are visible giving the area a semi-wilderness feeling. In this area are tamarack bogs with oak trees inhabiting the higher land interspersed with some willow and cottonwoods. The Otter Tail River after leaving Rush Lake enters Otter Tail Lake on the north side. The lake is 8 miles long and at the outlet on the southwest corner is a controlled dam that can be canoed. At the outlet of Otter Tail Lake the water is clear and the river is wide and deep. From here to Deer Lake the area alternates with open woods, mainly basswood, elm with some oak trees inhabiting the higher ground, and marsh land. The river flows through Deer Lake and East Lost Lake and flows out in a strong wide and deep channel from East Lost Lake. The banks open onto fields with rice

marshes and interspersed with wood land areas. Near Phelps Mill is a dam which should be approached with caution since there are no guards on the dam itself. The Phelps Mill is being restored by the county and a county park is being constructed in and around the dam. The water quality below Phelps Mill is excellent with a sandy bottom and some marsh areas along the sides. A large beaver house is located on the left side of the river. In the Red Lake area of the Otter Tail River there are many species of birds to be found in theriver marshes and wood areas along the banks.

West of County Highway #43 are several springs heavy in mineral content running audibly into the river. This area might provide some possibilities for very nice campsites. Weed beds scum up the river on the upper end of the pool above the Otter Tail power dam. Just west of the County Highway #3 bridge is a wayside park providing a good campsite in this area. At the bridge there is a small store where supplies may be acquired. Further west on the Red River Lake, as this wide stretch of the river is called, there are several areas where possible campsites might be constructed and maintained. About 20 miles north of Fergus Falls the Friburg Power Plant is located at the mouth of Taplin Gorge. The dam is rather high and to avoid uncertain conditions of the rapids in the spillway, a portage of several hundred yards down around the powerhouse outlet, on the right hand side, where water is ample, the portage should be made. Below the dam the river appears dredged and has lost its natural character. The river water is clear flowing over a sandy bottom with steep high banks along both sides, lined with many high willow and cottonwood trees. The dredged portion ends about 4 miles below the power dam and the river widens into a marsh and wild rice area. The country is extremely open and no trees are visible until the area of the next dam about 3 miles away.

Most of the river is diverted underground to the dam at Hoot Lake where it develops a head of 70 feet to supply power to the Fergus Falls area. By following the course of the river about a fourth of a mile from the dam, a good campsite is located on the right hand side. This area along the natural course of the river is rather wild and is quite wooded. Many deer may be seen in this area in the early morning. A portion of the area near Wall Lake is farmed extensively and a wilderness feeling is lost until we pass this area. After the creek from Wall Lake enters the Otter Tail River the woods become more prominent again, a few natural springs flow into the river and the first real rapids of the area begin to challenge your skill as a canoeist. In the last half of the river there are some old dams that have been washed out over the years and offer an exciting thrill to run. There are possible camp sites in this area. In Fergus Falls at the first power plant a canoe should be lined over the small dam. There are also two more dams located in town that pose problems to navigation. Below Fergus Falls, the quality of the river and water drop very fast in scenic value. Two miles below the Oarwell area the wooded area ends, the rapids end and the valley flattens out. Farming is quite extensive in this area and much garbage and trash is expelled by the farmers into the river, since it is easier to throw it into the water than to carry it off to a dump. Each farm has a frings residue of dirty water with numerous snags and litter in the river. The fishing is very poor with only carp inhabiting this area due to the large amount of pollution.

The 2 mile stretch between the two dams at the north and south end of the Oarwell reservoir offer the most exciting or natural scenery below Fergus Falls. Since this is a wildlife management area, managed by the Department of Conservation, wildlife is abundant in this area and deer may be seen both in the morning and the evening. The closer towards Breckenridge the Otter Tail River gets, the dirtier and more polluted it becomes, finally empting its remains into the Red River of the North as it is known after the Otter Tail and the Bois de Sioux Rivers join.

AMENITIES FOR RECREATION:

The first section of the river is mostly swamp land or low flat land filled with many marsh areas of wild rice and natural swamp vegetation. The next segment consisting of Little Pine Lake, Big Pine Lake, Rush Lake and Otter Tail Lake seems to be more conducive to motor boat travel since these lakes are rather large for canoeing. The area of the river from Fergus Falls to Breckenridge is a flat, monotonous farming plain consisting of dirty water and polluted areas which would not be recommended since it offers no wild or natural feeling to the canoeist.

POTENTIALS FOR RECREATION:

Possibly the area from the controlled dam at Otter Tail Lake on the southwest corner to the first dam at Fergus Falls can be developed into a canoe route since the boy scouts and YMCA groups from the western part of Minnesota and eastern North Dakota use the river for recreation purposes.

CONSIDERATIONS

1. A thorough study be made from Otter Tail Lake to Fergus Falls to determine whether expenditures for development in this area will be justified.

2. If feasible, small campsites should be constructed and maintained in this area.

3. A detailed map should be made so that navigation through the swamp area, especially in the Otter Tail Lake region, can be made easy without getting lost.

4. Historical important sites should be investigated and marked for the canoer and for anyone else who may be traveling through this area and interested in the early history of Western Minnesota.

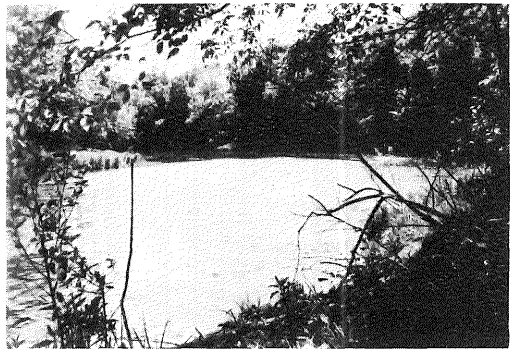
5. Other rivers in the area might be studied to determine if they would offer a greater natural experience to the canoer rather than the Otter Tail River.

Section of Ottertail River before Rush Lake at mile 26.0.

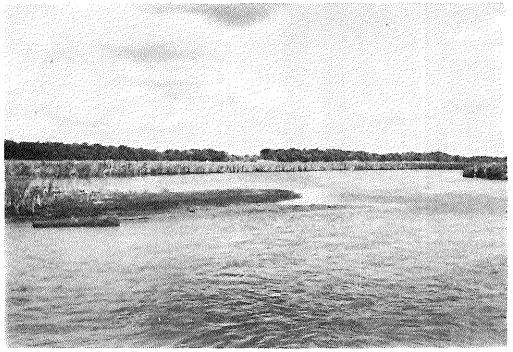
OTTERTAIL RIVER

1. Typical forest cover near Detroit Lakes.
2. Outlet of Rice Lake.
3, & 4. Typical areas for camping, near Mud Lake.
5, & 6. Typical bank vegetation throughout the length of the river above Orwell Dam.
7, 8, & 9. Typical reaches of the river above Fergus Falls.

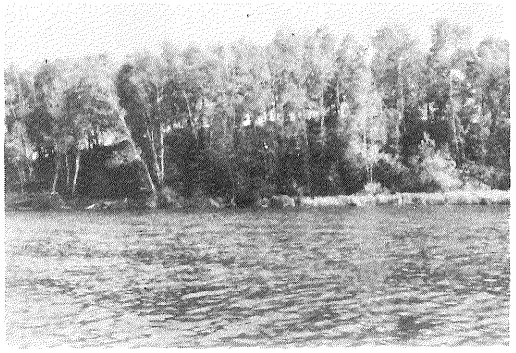
OTTERTAIL RIVER



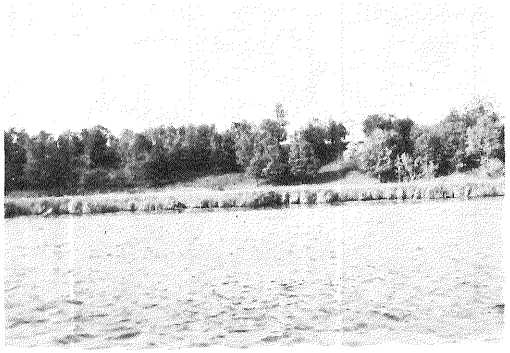
1



2

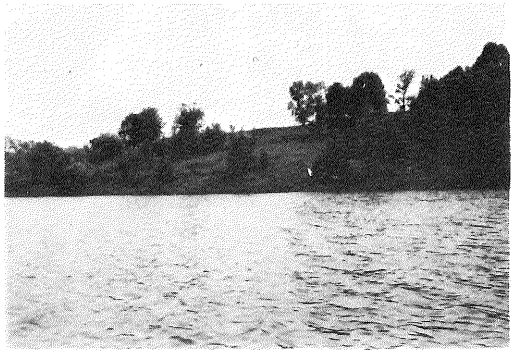


3



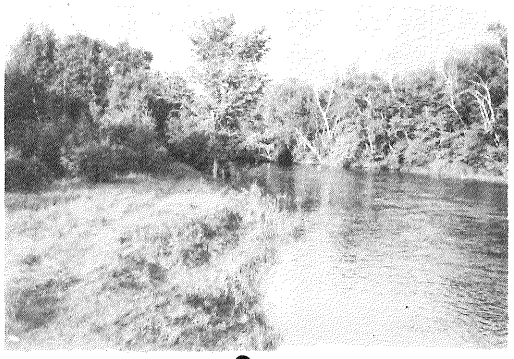
4

5



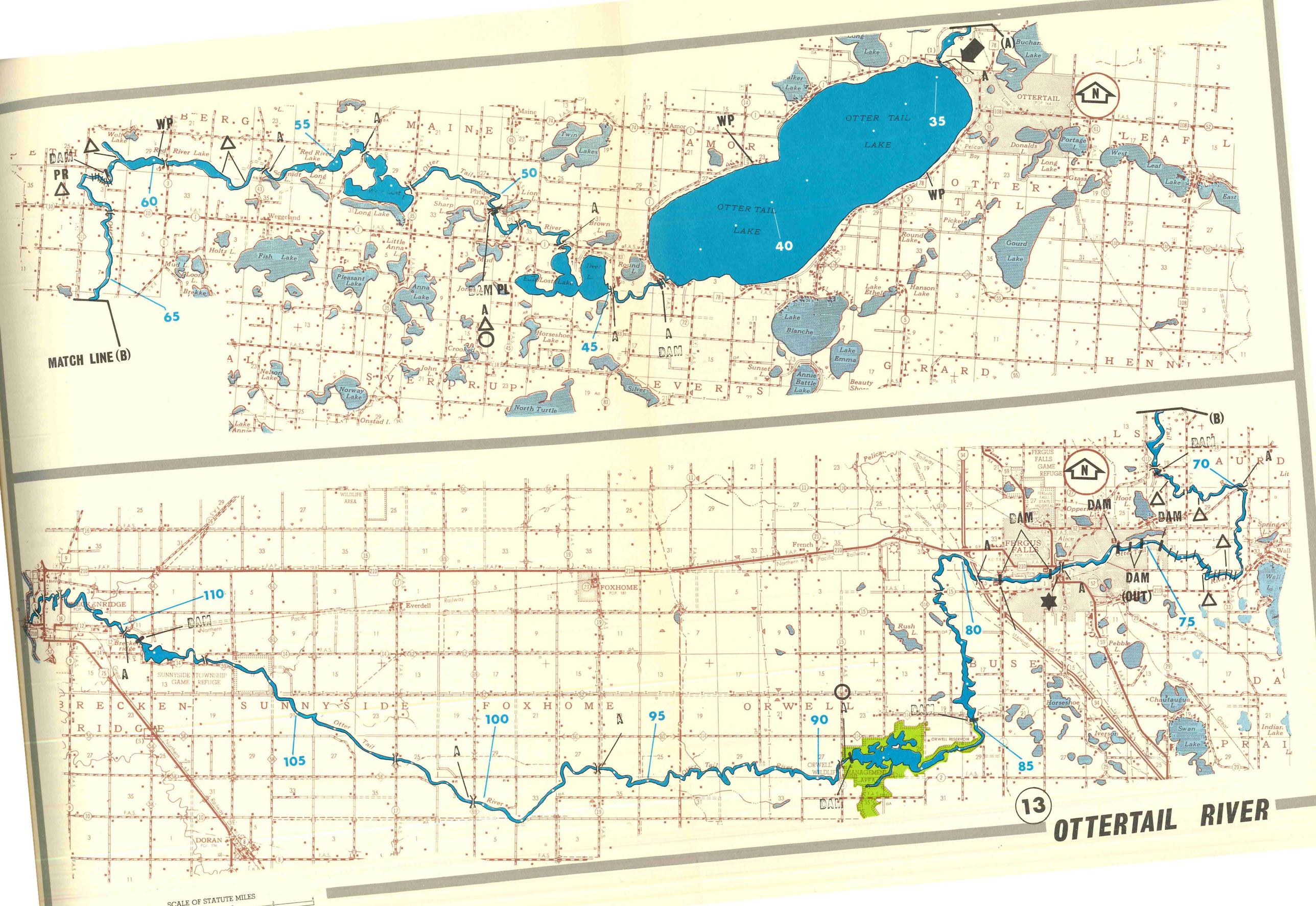
6

7



8

9



SCALE OF STATUTE MILES

PIGEON RIVER

LOCATION:

The Pigeon River defines the boundary between Cook County, Minnesota and Canada. Starting at South Fowl Lake the Pigeon River flows east 28 miles through the rugged Sawtooth Mountain range to Lake Superior.

NATURAL SETTING:

Access to South Fowl Lake is possible by two access routes; one is via John Lake and the Pine River; the other is via a jeep trail that runs off the Arrowhead Trail or McFarland Road, as it is locally known. Starting at the dam at the outlet of South Fowl Lake, Fowl portage of approximately 1.5 miles must be taken on the north or left bank. Below the rapids there is a short stretch of quiet water. Banks are marshy and muskeg extends away from the river. The hills in the distance are covered with poplar, jack pine, black spruce and alder brush.

At mile 2.0 there is a short rapids which presents no great difficulty. Below this to mile 3.3 the marshy type of topography becomes dominant. At mile 3.3 a cabin on the north bank of the river signifies the start of another rapids and a portage on the north bank. Below the rapids at mile 4.3 the river is narrow and fast. English Rapids begin at mile 4.9 with a portage on the north bank. The Swamp River comes in on the south bank at mile 5.6 and seems to add a significant volume of water.

The Pigeon River, to mile 9.9 is again quiet but fast. Marsh extends back 1/2 mile from the river. Hills up to 250 feet high project out of the swamp. Cliffs, high in the hills, are visible from the river. Partridge Falls at mile 9.9 has a portage on the north bank. A cabin is located at the end of the portage on the north bank.

From mile 10.0 the Pigeon River is fast and narrow; however, there are no portages around the rapids. At mile 11.5 Fort Charlotte is passed on the east bank which is one end of the Grand Portage. The Grand Portage Trail or the "great carrying place" was the traditional route of the voyageurs from the Great Lakes to the interior of the continent.

The Pigeon River below Fort Charlotte is canoeable to mile 12.1 (The Great Cascades). Here, the Pigeon River begins its final plunge into Lake Superior. It is difficult to get into the river from the Great Cascades to Lake Superior. A jeep trail runs along the Pigeon River on the Canadian side; however, dense alder brush prohibits all but the most hardy individuals from seeing the river.

At mile 16.0 to mile 17.1 there is a rather severe stretch of rapids and small waterfalls. At mile 18.0 begins the Dalles of the Pigeon River which culminate in a very narrow gorge called the Tunnel. The Tunnel is interesting in that it appears to result from erosion through an intrusive dike for which the region is famous.

Below the Tunnel to mile 26.5 the Pigeon River is fast and has a great deal of white water. Horn Rapids is at mile 22.1. Middle Falls is at mile 24.6. Another gorge similar to the Tunnel, except that it is straight, exists at mile 25.5. At mile 26.5 is the end of the white water and one of the most spectacular sites in the area. Pigeon Falls, or "the High Falls of the Pigeon" as it is also known, is the highest falls in Minnesota.

Below Pigeon Falls to mile 27.6 (Lake Superior) the river is placid - large boats can ply up the river. There is a logging boom at mile 27.1.

EXISTING DEVELOPMENT:

There is very little man-made development on the Pigeon River other than the control dam at the outlet of the Pigeon River or South Fowl Lake. In addition, there are four cabins on the river which are open

for anyone's use at mile 3.0, 8.5, 10.0 and 12.3. Basic supplies may be obtained at the town of Pigeon River. There are two highways crossing the river. Highway 89 crosses at the town of Pigeon River, while Highway 61 crosses below the High Falls where the U. S. and Canadian customs are located on Highway 61 at the border.

AMENITIES FOR RECREATION:

The Pigeon River is famed primarily because it was the route of voyageurs into the Athabascan Territory. It was this route, which led over the Grand Portage "Trail" and through the present international boundary waters to Lac La Croix and then into Rainy Lake, that the French, and later British and Canadian traders, most frequently passed from the waters of Lake Superior to the fur country.

Each spring, when streams and lakes were free from ice, fur gathered during the winter was pressed, packed and loaded into brigades of canoes destined for Grand Portage. As furs were moving down from the north, trade goods from warehouses at Montreal and Lachine were being packed into "pieces" of 90 pounds each and loaded into Montreal canoes, destined for the great carrying place. After weeks of paddling and portaging, the brigades converged on Grand Portage and for two weeks there took place the annual exchange of goods and furs. After the season's trading and accounting, the men from Montreal returned eastward and those from the north country wended their way back to wilderness outposts.

Another interesting segment of the Pigeon River's history is concerned with the boundary settlement. In 1822 the lakes and rivers forming the boundary between present Minnesota and Canadian Province of Ontario were carefully explored and mapped by surveyors of a joint American and British commission provided for by the Treaty of Ghent. The object of the survey was to provide for a base upon which a boundary line, acceptable to both Great Britain and the United States, could be drawn.

When the commissioners held their final meeting in 1827, the envoy of Great Britain offered to accept the Pigeon River as the boundary, if the line were drawn through the portages, including the Grand Portage. When this was rejected, he offered to accept the river as the boundary if the portages could be used freely by both countries. This was also turned down by the United States, yet when the boundary controversy was finally settled by the Webster-Ashburton Treaty of 1842, it was on these terms. This treaty is still in force, thus citizens of both countries may use the waterways and the Grand Portage freely.

In addition to the historical background of the Pigeon River the geology of the Grand Portage area is most interesting. The mountainous ridges, points, and islands owe their existence mainly to the massive and resistant rocks formed from molten material poured out on the surface or forced into pre-existing rocks between layers or along fractures, erosion by streams, and by the great glaciers which occupied the Superior basin and carved out the topography, which has been only slightly modified by post glacial erosion.

POTENTIAL FOR FUTURE RECREATION:

The historical background, geologic features and scenic values of the Pigeon River give it some prime recreational assets which other rivers do not have. The great circle route around Lake Superior is popular and is becoming more so each year of its existence. This will bring a great deal of recreation oriented people into the Grand Portage area. In addition, since this was the primary route of the voyageurs, a possible tie-up with the Superior-Quetico wilderness would bring additional traffic from and to the Boundary Waters Canoe Area.

The river from Fort Charlotte to Lake Superior is not generally considered canoeable, however, it is the most scenic stretch. To facilitate access into this area a trail should be developed. The trail could begin on the Arrowhead Trail and follow the ridges, escarpments, edges of the swamps and the Pigeon River in the lower sections.

CONSIDERATIONS:

1. A possible B. W. C. A. - Pigeon River link-up should be studied.
2. Development of a trail along the lower stretches of the Pigeon River should be contemplated.

C A N A D A

O N T A R I O

THUNDER BAY DISTRICT

14

PIGEON RIVER

PINE RIVER

LOCATION:

The Pine River is primarily located in Cass and Crow Wing Counties. Throughout its 32 miles the river flows in an easterly and then southerly direction as a direct tributary of the Mississippi River. The survey includes that portion of the river from the City of Pine River to the confluence of the Pine River and Mississippi River in Crow Wing County.

NATURAL SETTING:

The first 10 miles of the river flow through an area of mixed hardwoods and conifers with birch, elm, jack pine and norway pine the predominant species. This forest cover is interspersed with farmland which in some cases abuts the river bank.

At mile 8 the river enters the Whitefish chain of lake, which continue to the Federal Dam at the outlet of the Pine River at Cross Lake--about mile 17. The lake is heavily built up with resorts and summer homes. It also exhibits all the dangers of a large lake and has a north-south reach of 3 miles and east-west reach of over 6 miles.

Below Cross Lake the river becomes more wild. The forest cover is dense and there are no farms or cottage development except between Cross Lake and Pine Lake. This stretch of the river flows through a deep valley similar to that area above Whitefish Lake. However, below Pine Lake the river broadens out into a marshy area which extends to essentially the end of the surveyed portion of the river.

RIVER BED AND BANKS:

The bed and banks of the river are primarily of sand and gravel. Where rapids occur large boulders up to three feet in diameter predominate. None of these rapids are difficult to canoe. In the lower stretches below Pine Lake in the marshy areas fine sediments occur. Except in some of the deeper pools the average depth is about three feet.

EXISTING DEVELOPMENT:

The first mile of the Pine River surveyed was composed of year-around homes with lawns extending down to the river edge. At mile 0.5 the only junk yard (auto) observed occurs. The river is crossed by 11 bridges, two of which are rail trestles. Cables hung across the river occur at miles 4.1, 17.3 and 19.3. All are hung about 5 feet above the river bottom and could be potentially hazardous in high water. The major cottage development occurs from the City of Pine River throughout the Whitefish chain of lakes to Pine Lake. Below Pine Lake there is no observable development. Access points occur at side roads and bridge crossings (see mile markers). Two camp sites are in the process of development. The Cross Lake Dam camp site is being developed by the Army Corps of Engineers and was extremely crowded on the 4th of July weekend. This isthe only camp ground access on the Whitefish Chain to our knowledge. Northwest Paper Company is also developing a camp site at mile 28.4. At the present, there are no facilities.

AMENITIES FOR RECREATION:

The river throughout its entire length is scenic. The interspersion of hardwoods, conifers, farmland, and marsh provides a continuing visual change. The shore line changes from low slopes to high sand and gravel banks. The river itself changes constantly from rapids to meanders, marshes, pools and lakes. Each change is a visual delight. The water of the river is so clear that fish watching is possible; such species as northern pike, walleye and rock bass were observed. Fishing for these species is also excellent. Wildlife is abundant with deer, beaver, muskrat and great blue heron observed. Wild flowers such as roses and iris color the scene.

In essence this is a beautiful stream and well worth canoeing. But, it is also a delicate stream. The clearness of the water makes trash very visible. Any walking on the sand banks can start erosion. The hordes of flies and mosquitoes are very unpleasant. Finally the 9 miles across the Whitefish Chain are potentially hazardous.

POTENTIAL FOR FUTURE RECREATION:

With proper development the Pine River could become a real treat for the average canoeist. None of the rapids are difficult but water fluctuations are such that prior knowledge of the water levels are a must, especially with respect to the Cross Lake Dam. Camp sites established along the way would protect the banks of the river elsewhere. Some method of protecting the banks at these camp sites must be devised. Protection of the river bed is also a must and could be the most difficult problem to control. However, the nearness to the major metropolitan areas (within 3 hours driving time) makes the river available to most of the State's people on weekends.

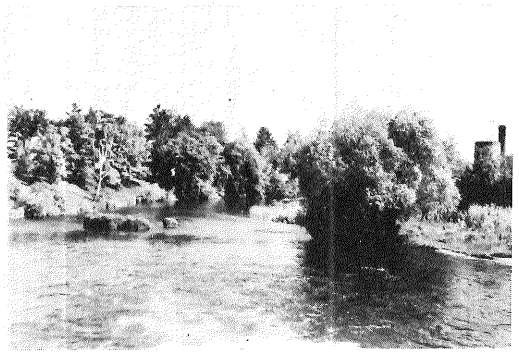
CONSIDERATIONS:

This river should not be included in a State program of canoe trail, however, the development of minimum camp sites and access points should be undertaken.

PINE RIVER

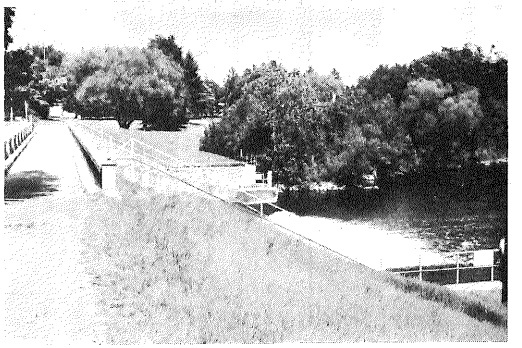
1. Downstream from the bridge at the town of Pine River.
2. Highway crossing bridge in area above Whitefish Lake.
3. Dam controlling level of Whitefish Lake. In the background is the portage that must be taken from far left to the center of the wooded area at the right.
4. Typical scene and county road bridge below Whitefish reservoir.
5. Typical scene.
6. Early morning mist rising from the warm river.
7. Conifer woods.
8. Area of moderate use showing heavy damage to weak sandbanks, caused by a disturbance of cover and subsequent erosion.
9. Near Cross Lake.
10. Camp site and far shore of Whitefish Lake viewed from island esker.
11. Camp site in pine woods below Cross Lake.
12. Typical of lower reaches.
13. Typical of lower reaches.

PINE RIVER

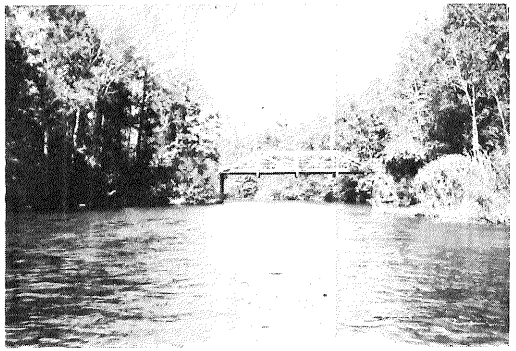


1

2



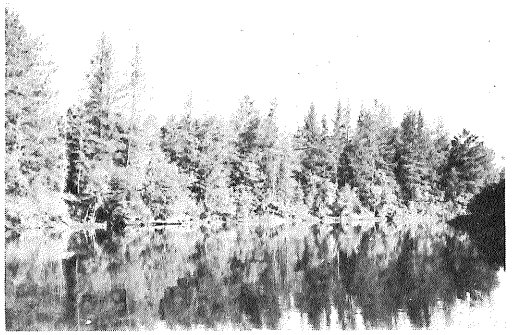
3



4

5

6



7

8

9

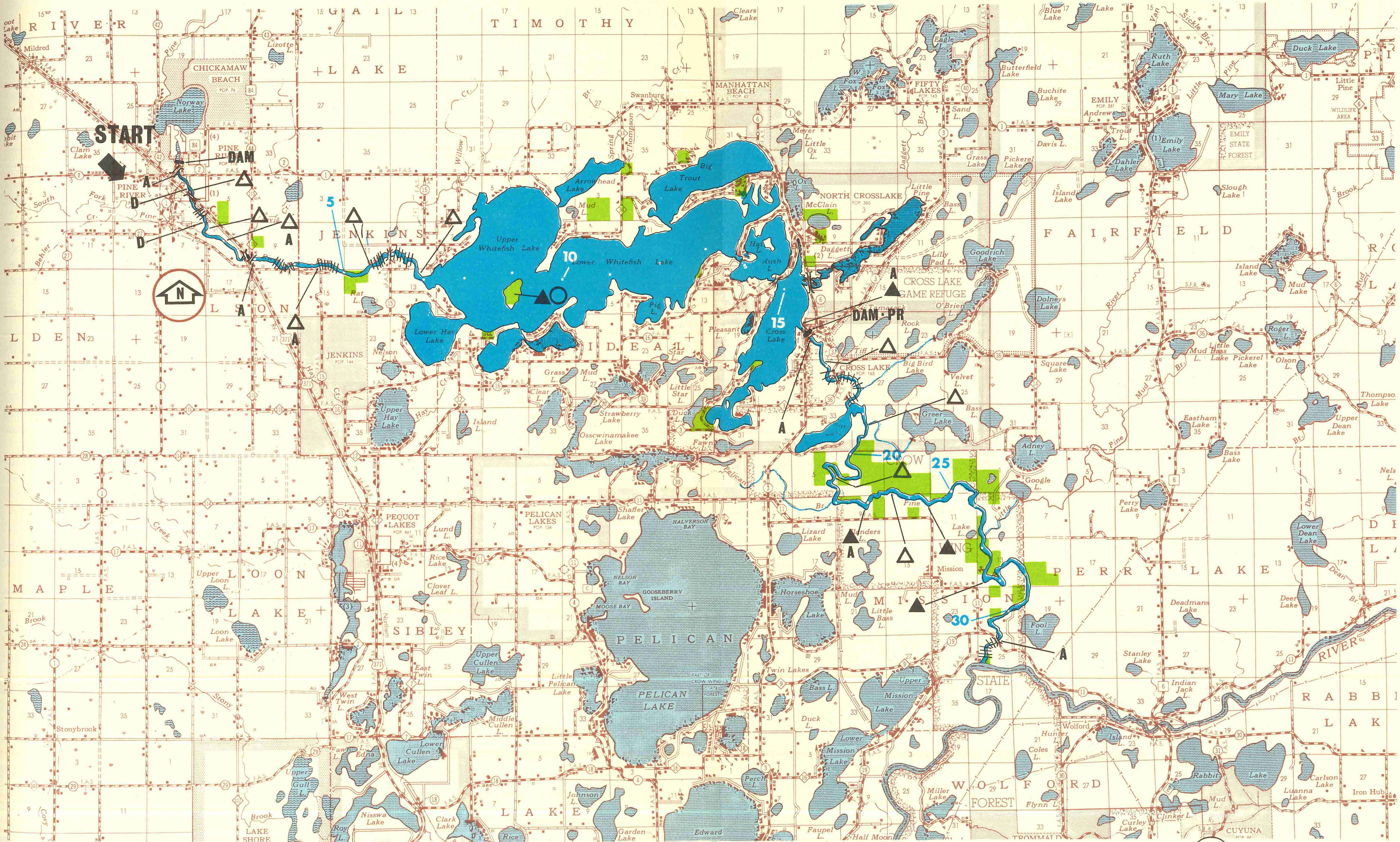
PINE RIVER

10

12

11

13



SCALE OF STATUTE MILES

PINE RIVER

LOCATION:

At the Rainy Lake outlet once stood a twenty-four foot cascade called variously the Cauldron and Koochiching Falls. Now at the head of this rapids stands the Basin Cascade hydroelectric dam, dwarfed on both sides by the mills it feeds with power. Here the Rainy River, water highway of early day explorers and voyageurs begins its 86 mile journey westward from Rainy Lake at International Falls to Lake of the Woods, north of Baudette. Located in northern Koochiching and Lake of the Woods Counties, the river forms the international boundary between Minnesota and Ontario, Canada.

NATURAL SETTING:

The eastern area of the Rainy River is composed of glacial drift, generally stony and composed largely of granitic, volcanic and metamorphic rocks derived from the bed rock in northeastern Minnesota and Ontario, Canada. The western area was invaded from the north by glaciers depositing ridges and hills of sand, stony glacial debris know as moraines. A later glacier from the northwest over-rode the stony drift and deposited a veneer of clayey glacial till that modified the topography by rounding off the hills and ridges and partially the depressions. The Rainy River forms a surface boundary between two geological phenomena, the one being the great Laurentian Shield - the rough granite country of bluffs and swift streams and water falls - the other being flat loamy land left to the west and south when glacial Lake Agassiz receded.

High flows in the streams frequently occur during the spring snow melt and occasionally in the summer after intense storms but the narrow deep valleys of Rainy River and its tributary streams generally contain the high flows so that flooding is not serious on valley floors. Low flow in the streams frequently occur during the late summer and winter, but stream flow is never extremely low because of the large drainage area and the excellent natural and artificial regulation of the basin.

The river drains a 20,850 square-mile area which includes the Little Fork, Big Fork, Black, and Rapids Rivers in Minnesota. The La Vallee, Sturgeon, and Pinewood Rivers in Canada along with the Rainy Lake reservoir discharge their drainage into Lake of the Woods.

The three main municipalities along the Rainy River, International Falls, Fort Frances, and Baudette all have primary sewage treatment plants and proposals for secondary sewage treatment plants have been made.

Rainy River water is now a splotchy green-brown, and an American-Canadian Commission reported last year that the river was polluted to the point where it was a health hazard.

About 60 tons of lime sludge-calcium carbonate is dumped into the river daily, along with another 57 tons of bark, bleach plant wastes, diluted "sulphate liquor," and sewage, by the paper mills at International Falls and Fort Frances, according to testimony.

Matts of sawdust, bark, and sludge can be seen floating down the river resembling tiny islands. Banks of the Rainy River are covered with sponge matts of saw dust and bark so thick that the earth underneath them sometimes is not visible.

RIVER SURVEY:

The Rainy River was used as a water highway for the voyageurs into the wilderness areas of Minnesota and Canada. At one time all four major fur trading companies had passed in the vicinity of Fort Frances - International Falls. Located on the Canadian side of the river were the French Post, the Northwest Company Post, and the Hudson Bay Company Post. The American Fur Company Post was located at International Falls. The river survey begins at this point where the voyageurs stopped to trade their furs. Below the dam the river spreads out to a wide 300 feet resembling a long lake. The banks of the river slope gradually at first then ascend rather steeply until they reach a height of between 40 to 50 feet above the water.

After the reaches of International Falls have subsided, farms begin to dot the landscape reaching down to the waters edge on the Canadian side, and setting on top of the embankments almost out of sight on the Minnesota side.

About 12 miles from the dam the Little Fork River joins the Rainy forming a large wide expanse of water. Access and camp sites are available where the State Highway No. 11 bridge crosses the Little Fork River. State Highway No. 11 parallels the river throughout its entire length so nobody is very far from other people.

A mixture of hard woods and soft woods grow intermittently in this area along the banks. Aspen, birch, poplar, black spruce and jack pine grow along the river, while tamarack and cedar inhabit the swamps that drain into the river.

The proposed Grand Mounds State Park is located where the Big Fork River flows into the Rainy River. Serving two rivers and having historic importance, this is an excellent site for a state park.

Access to both Big Fork and Rainy Rivers is located at present on Boise-Cascade land next to State Highway No. 11 bridge over the Big Fork River. A concrete turn-around is provided and there is an open meadow where camping is permitted. Two miles from the bridge the heavily wooded Watrous Island is located. This island has the potential for being an excellent camp site for motorboat recreationalists.

Little over 30 miles away from the starting point are two towns, Indus on the American side, which is not visible from the river, and Emo on the Canadian side. Emo is a very picturesque town sitting on top of a hill overlooking the Rainy River.

Approximately 34 miles down river is Manitou Rapids bounded on both sides by rock shelves. The current increases rapidly near the rapids and forms between one and two foot standing waves, but is short and generally not dangerous. Hudson Bay Company and Northwest Company both had fur trading posts located here and the stone cellars are still visible on the Canadian side.

Long Sault Rapids are located 5 miles from Manitou Rapids and offer an exciting mile and a half of intermittent white water which is easy to run. Just below the rapids, County Highway No. 86 ends at the river and makes an excellent access point. A good fishing spot is located at the end of the rapids.

From this point at Long Sault Rapids until the river reaches Lake of the Woods, the river elevation drops only 2 feet in the 38 miles. The river is quite slow and stagnant adding to the pollution of the river and the municipality of Baudette.

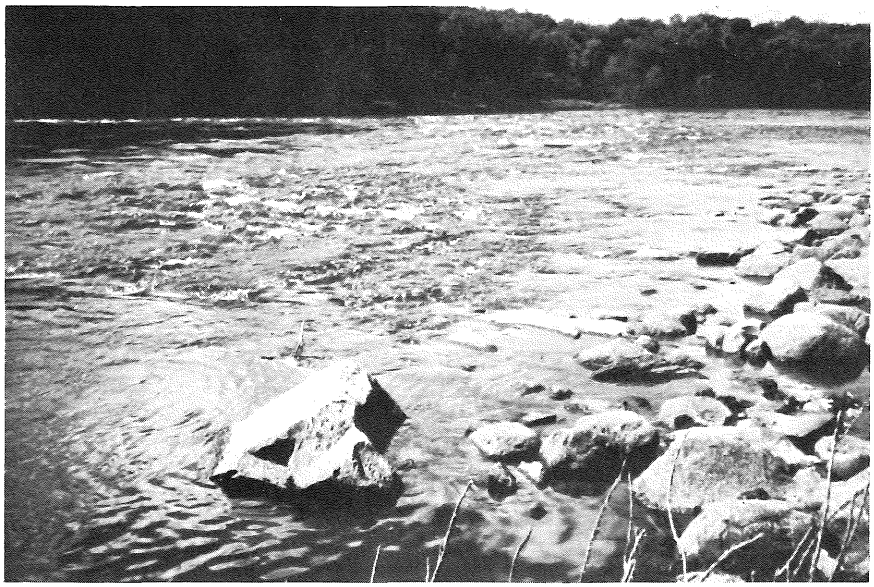
At Clementson where the Rapid River enters the Rainy River there are two very scenic wayside park areas with picnic tables and trash containers provided, but no water. From here to Baudette the area is quite civilized.

AMENITIES FOR RECREATION:

The Rainy River is wide, deep, and slow moving (1 to 3 miles per hour); and it is comparable to a large long lake, slow and monotonous. The river is too wide and the area too developed to be of any significance as a canoe trail. The river is too big, too monotonous and too void of the wilderness feeling to offer any spirit or interest to the canoers.

POTENTIAL FOR RECREATION:

Houseboat and motorboat travel and camping could be promoted especially if Grand Mounds State Park were developed. The State Park offers a historic site, a good geographic location being at the mouth of the Big Fork River which makes an excellent access point from State Highway No. 11. Also, there are no other state parks along this river or in this general area. Fishing should improve with the elimination of the waste products by the paper mills at International Falls. Walleye, northerns, bass and sturgeon do inhabit the waters of this river.



Long Sault Rapids, Rainy River, mile 41.

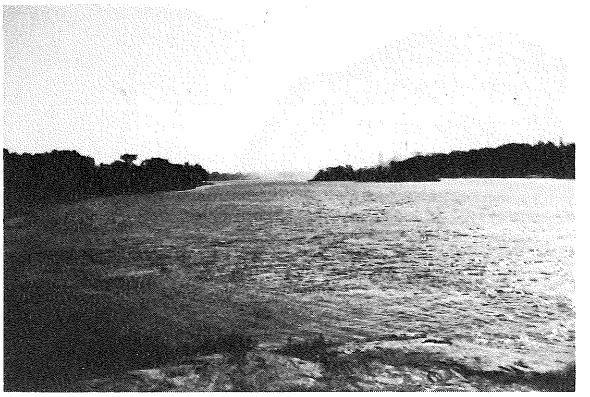
Typical portion of Rainy River, mile 50.

RAINY RIVER

1, & 2. Views downstream and upstream below International Falls.
3. Typical access.
4,5, & 6. Typical of the bank vegetation between International Falls and the mouth of the Big Fork River.

RAINEY RIVER

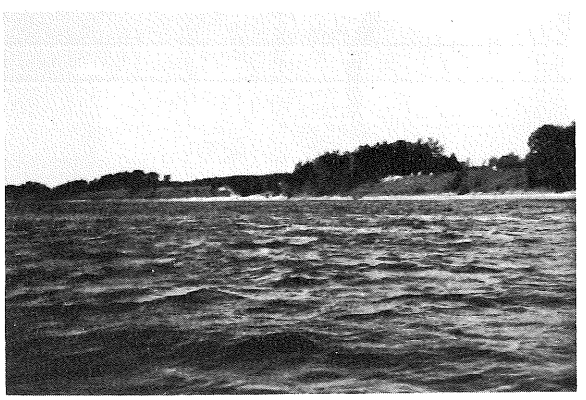
1



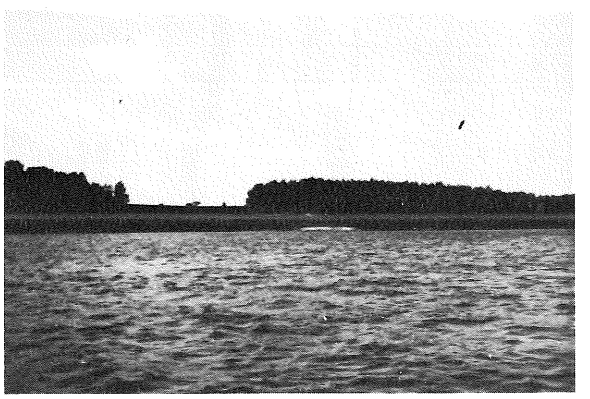
2

3

4



5



6

SCALE OF STATUTE MILES

1 0 1 2 3 4

16

RAINY RIVER

RED LAKE RIVER

LOCATION:

The area of this watershed unit is 5,988 square miles, and the unit consists of all of Red Lake County and parts of six others - Koochiching, Beltrami, Clearwater, Marshall, Pennington and Polk - in northwestern Minnesota. The main stem of the Red Lake River is 196 miles long. The river runs in a westerly direction from Lower Red Lake, in the Red Lake Indian Reservation to East Grand Forks where it enters the Red River of the North.

NATURAL SETTING:

The land forms and topography of the Red Lake River watershed are directly related to glacial history of the area. Most of the area, that is the lower or western part of the watershed, is in the basin of glacial Lake Agassiz. It is a smooth, level, nearly featureless plain interrupted by low parallel north-south ridges which represent the recessional beaches of Lake Agassiz. Part of an extensive swamp occupies this plain in Beltrami County north and west of Red Lake.

The upper or southeastern part of the watershed is an area of morainic hills with poorly established drainage systems and numerous small lakes. The morainic hills rise from 20 to 60 feet above the surrounding undulating topography.

Soils of glacial lake bed origin are particularly suitable for agriculture where they can be effectively drained, accordingly the economy of the basin is predominantly agricultural.

In the upper or eastern part of the Red Lake River watershed, small rivers drain northward from the timbered moraine into Red Lake, the source of the Red Lake River. The Red Lake River flows west from Lower Red Lake for about 70 miles to Thief River Falls where the Thief River joins it from the north. Lost, Hill and Poplar Rivers in the central and western part of the area merge with the Clearwater River and join the Red Lake River at Red Lake Falls.

From Red Lake to its junction with the Red River of the north near East Grand Forks, the Red Lake River falls 378 feet. From Lower Red Lake to Thief River Falls the fall is only 74 feet, but from here to Red Lake Falls it falls 140 feet in a stretch of 29 miles. From Red Lake Falls to Crookston it falls 110 feet and the last 76 miles the drop is only 54 feet.

Floods occur most frequently in March, April and May. Damage to agricultural lands from spring floods is ordinarily low due to the frozen condition of the ground. Less frequent but more damaging floods have occurred in June and July. Most of the damage to agricultural lands occurs in the upper reaches of the Red Lake, Thief and Clearwater Rivers. Downstream, where the river has formed a valley well below the surrounding uplands, the waters of all but the most severe floods are confined to the channels or to the lowlands immediately adjacent to the channel. Annual floods, however, cause considerable inconvenience and some damage to highways, bridges and cities.

Years of educational work and the frequent recurrence of emergency conditions finally led to the adoption of a comprehensive plan prepared by the U.S. Corps of Engineers in 1943. Construction was completed, with the cooperation of the Red Lake Drainage and Conservancy District, in 1956. The project included modification of the control structure at the outlet of Red Lake and straightening and deepening the channel of the Red Lake River. The project will reduce flooding from the river and will provide adequate water supplies for all the communities downstream as well as water for dilution of sewage effluent.

The source of municipal water supply of the three largest cities in the watershed - Crookston, Thief River Falls and East Grand Forks - is the Red Lake River. Other smaller municipalities have found adequate ground water supplies in sand and gravel aquifers in glacial drift, in glacial lake beds or in sandy beds at the base of the Cretaceous.

Hydroelectric power was developed at a number of points on the Red Lake River many years ago; the power plants are still in operation at Red Lake Falls and Thief River Falls.

The survey begins at the control dam on Lower Red Lake where the Red Lake River begins its meandering course westward for 190 miles to the confluence of the Red River of the North. The access and launch site at the control dam are excellent although improvements might be made. From the control dam on the Lower Red Lake through the first 10 miles of the river, there is an interesting segment of marsh land. Dredging has been done and is now in progress on the first three miles. Dredging has been completed from the 10 mile mark to over halfway to Thief River Falls. In this area, coniferous trees grow along the banks of the Lower Red Lake and on the distant sides of the marsh but not on the banks of the river itself. Aspen predominates through the reservation with ash and oak on the higher ground. Many species of water plants, white and yellow water lilies, wild rice, cat tails and many kinds of algae thrive in the water and along the banks. The current in this area is fairly good and the sandy clay bottom can be seen through four to five feet of clear water. Black birds, snipe, wrens, mud hens, gulls, great blue herons and many ducks with young inhabit the marsh in the area.

The only obstruction to the main channel in this area are dense weed patches along the side and a few logger heads. The second dam offers a chance to stretch your legs since it must be portaged over loose rock on the right hand side. Access to this point is good via an Indian service road. A campsite could be set up here in the woods adjacent to the road - tribal council willing. From the second dam to approximately four miles beyond High Landing, the original character of the river can only be approximated since dredging has been carried out in the entire area. Grass covers the dirt on either or both sides of the long straight stretches that have been dredged. The current in this area is free-moving, picking up dirt here and there, and the water becomes increasingly cloudy. This area would be recommended for motor boat enthusiasts since the stream offers no obstructions from here all the way to Thief River Falls.

Canoe access is good at all bridges from here to the State Highway No. 1 bridge at Thief River Falls. Since this area has so many long stretches that have been dredged, the feeling is of canoeing down a ditch and not of being in the wilderness or semi-wilderness area. At four miles below High Landing the dredging stops and we have a friendly meandering stream through prosperous farming area. Tall slough grass and willows share the low banks with some open field views in between wooded areas. The area is rather pleasant except where sheep have grazed along the banks leaving the banks vulnerable to erosion. Many ducks, a few herons and an occasional owl can be observed in this area. Muskrats and beaver work can also be seen. The trees run in the deciduous family - elms, basswood, aspen and a few birch, oak and ash grow on the higher banks. There is a well designed bathing beach in Thief River Falls where the Red Lake River and the Thief River join. On the opposite shore, dredging and other work is going on to add more space for swimming and recreation. The launch site in town is excellent. It is in a park-like setting and has paved ramps and three floating docks. Shopping for food in the town is very convenient since it is just across the road from the campgrounds. Three blocks above the power dam in Thief River Falls on the railroad bridge is a sign stating "stay away." A canoe can be paddled to a convenient spot just above the dam and a portage is available on the left hand side. The slope is very steep and rough and no pathway is provided. About a quarter of a mile from the dam there is a park on the right hand side. Access is good and water is available for anyone.

The river runs in a deeper channel below town and signs of spring break-up are evident along the banks. There are more trees in this area which are mostly hardwoods with only a few aspen. The river is a little dirtier in this area, but the current is good and should clean it up. A mile and 1/2 above St. Hilaire is a good area for a possible campsite facing east with a nice wooded area. It slopes easily from the banks of the river.

Below St. Hilaire, the banks of the river get higher and are almost completely wooded all the way to Red Lake Falls. From St. Hilaire to Red Lake Falls, the river drops 110 feet in 17 miles. The rapids increase in frequency and gradient in this area. The flow of water is ample and the quality is good in this stretch of the river. No dangerous rapids occur except a chute at the washed-out dam above Red Lake Falls, although the dam or its remnants can be run on the right hand side. The water in the rapids is quite shallow and pools run only to 5 feet deep. Campsite possibilities in this area are ample, sometimes beside audible rapids, other times on high ground surrounded

RED LAKE RIVER

MATCH LINE (B)

MATCH LINE (A)

START

DAM

DAM OUT

DAM PR

DAM PL

SCALE OF STATUTE MILES

0 1 2 3 4

17

by trees. A few miles above Red Lake Falls we encounter the first of many huge slump areas where whole hillsides have slid into the river with trees and everything else still intact. Interesting layers of the old bedding of Lake Agassiz can be observed in the banks of the Red Lake River for those who are interested in geology and the natural sciences. The Clearwater River runs through the Town of Red Lake Falls and joins the confluences of the Red Lake River. There is an access point here in the park and a possible campsite might be constructed across the river from this park. A city dump is located a few blocks upstream on the Clearwater River. Rapids again occur below the town and end about a mile or two above Huot which is the site of Old Crossing Treaty State Historical Wayside Park. Old Crossing was the site of the Treaty of 1863, paving the way for settlement of the Red River Valley. Also an important Red River Oxcart Crossing, the access at this park is good and could possibly make a termination point for those who want to canoe just the rapids from Thief River Falls to Old Crossing. Below Old Crossing the river begins to widen out and gravel bars, rocks, and lots of snags are present. These gravel bars offer possible campsites for the canoeist, especially around Gentilly River. About four miles below the entrance of the creek is another washed out dam. The drop is about three feet and should be portaged since there are numerous unseen objects - iron, pipes and various debris - in the water that could easily damage a canoe. In Crookston, there is a city park convenient to both downtown and the river. A city swimming pool is located between this park and the downtown area. After passing under numerous bridges in Crookston, you approach a dam with no warning at all. Portage is on the left hand side and it is steep up and steep down with loose rocks on both sides. It would be best to end the trip in Crookston since the water and the banks are muddy from here until Grand Forks. The trees in this area are largely cottonwoods -- many of them dead and still standing at odd angles due to the great amount of slumping of the banks into the river. There are many snag piles in the river and many times may leave only a small channel which to maneuver through. The survey ends where the Red Lake River enters the confluence of the Red River of the North.

AMENITIES FOR RECREATION:

The first segment of the river from Lower Red Lake to Thief River Falls is rather long, monotonous stretch of rolling prairie land and swamp area that has been dredged and offers very little in the way of scenic beauty. The area from Huot to East Grand Forks, is rather swampy with the slumping banks, the greenish water, many snags in the river and the pollution that has taken place in this area. There are virtually no camping areas from Crookston until Grand Forks.

POTENTIAL FOR RECREATION:

The stretch of the river from Thief River Falls to Huot with the Old Crossing Treaty State Historical Wayside Park offers the most scenic area and almost all of the rapids along the river. Water is available just below Thief River Falls and at Red Lake Falls. There are possible campsites at mile 64.5 between Thief River Falls and St. Hilaire and at mile 74 between St Hilaire and Red Lake Falls and a campsite is available, of course, at Old Crossing State Park. This area is almost totally enclosed with trees.

CONSIDERATIONS:

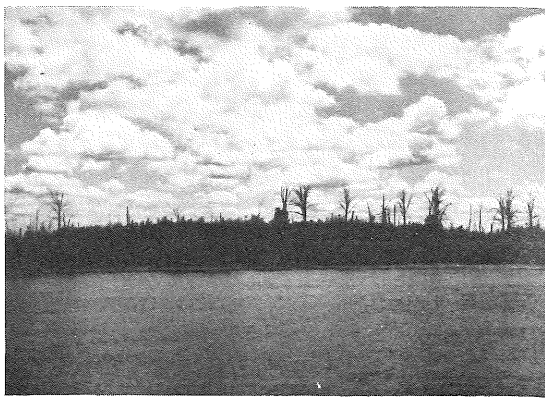
1. The campsite at Thief River Falls be improved and enlarged.
2. A campsite on the west side of the river at mile 64.5 and an access provided from State Highway No. 32.
3. A possible campsite to be constructed at mile 74 and access be provided again via State Highway No. 32.
4. That the dump on the Clearwater River in Red Lake Falls be cleaned up and the pollution from this dump eliminated.
5. An access and possibly a campsite be provided where the Clearwater River enters a confluence of the Red Lake River.
6. The trip ends (or should end) at Old Crossing Treaty State Historical Wayside Park and access and campgrounds be provided here for those who wish to make the trip.

Typical section of River below Crookston.

RED LAKE RIVER

1. Area below Red Lake outlet at mile 185.
2. Reach above weir at mile 175.
3. Typical bank in upper reach at mile 170.
4. Scene at mile 170.
5. Reach below High Landing at mile 152.
6. Reach above Thief River Falls in the backwater of the dam at mile 125.
7. The very attractive suburban banks of the city of Thief River Falls.
8. Slumping banks above Red Lake Falls commonly observed in lower reaches at mile 94.
9. Above Red Lake Falls. Note boulders randomly strewn in the river.
10. View of, eye sore, washed-out dam at Red Lake Falls. Mile 93.
11. High till cliffs at mile 92.
12. Confluence of the Red Lake River and the Clearwater River at mile 89 (rear). The Red Lake River is a gray-green color, the Clearwater River, well named, is practically clear.
13. High eroded till cliffs at mile 88.
14. View of boat launching ramp and dock at the very attractive Thief River Falls Park.
15. Tailwater area of dam at Thief River Falls showing rather difficult portage.
16. Wooded area and banks. The low area to the left is an earlier abandoned channel of the Red Lake River.

1



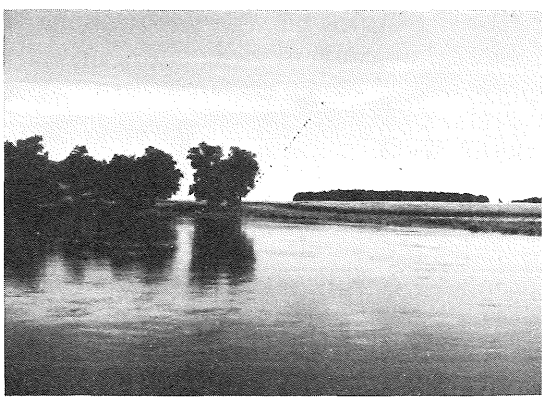
2

3

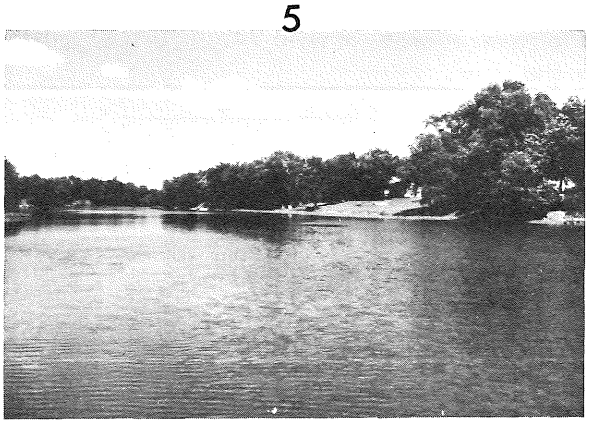
RED LAKE RIVER

4

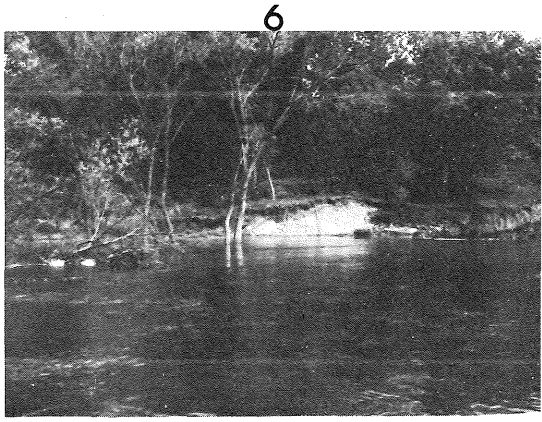
5



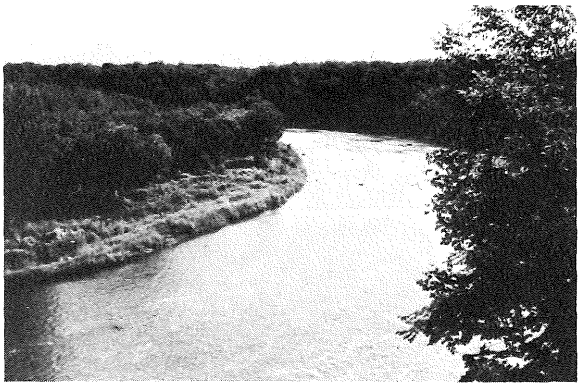
6



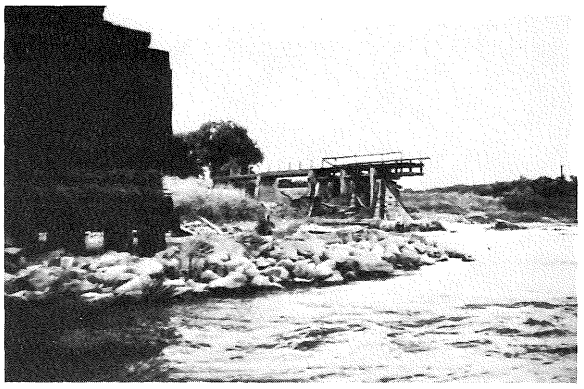
7



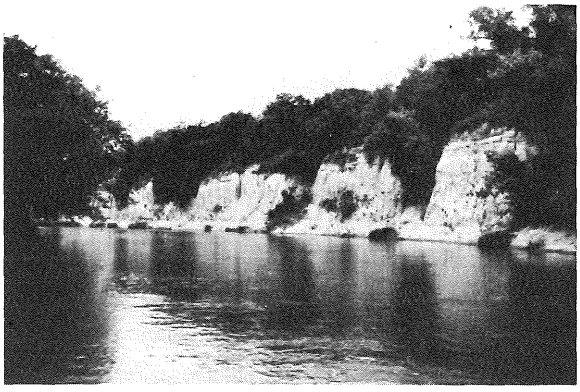
8



9

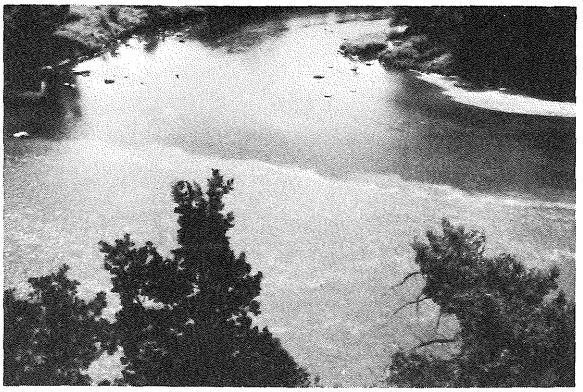


10

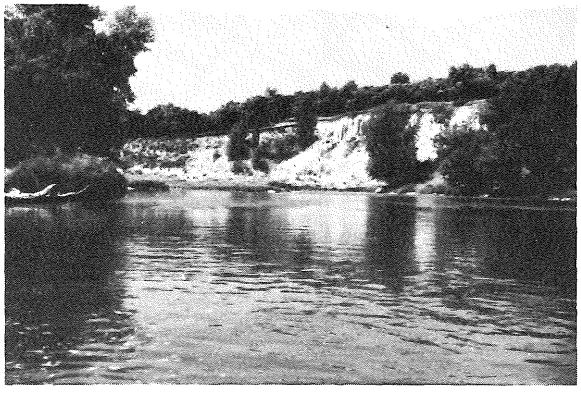


11

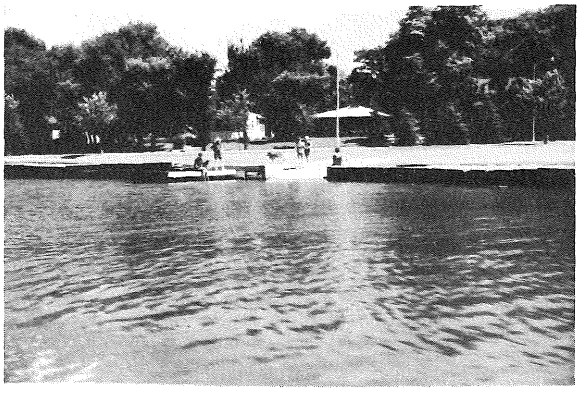
RED LAKE RIVER



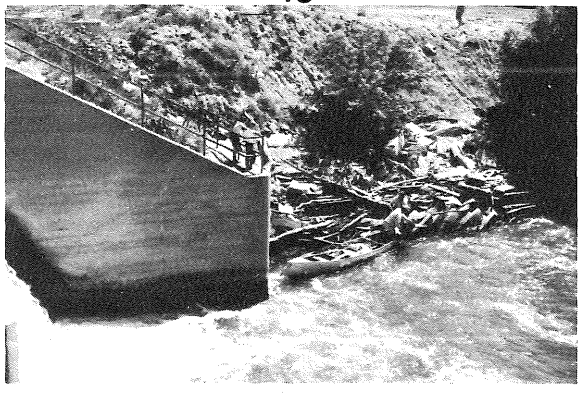
12



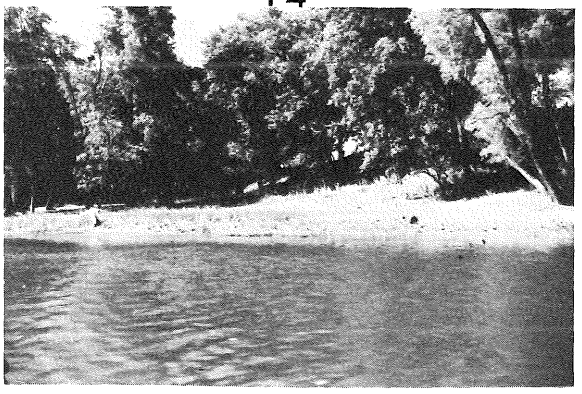
13



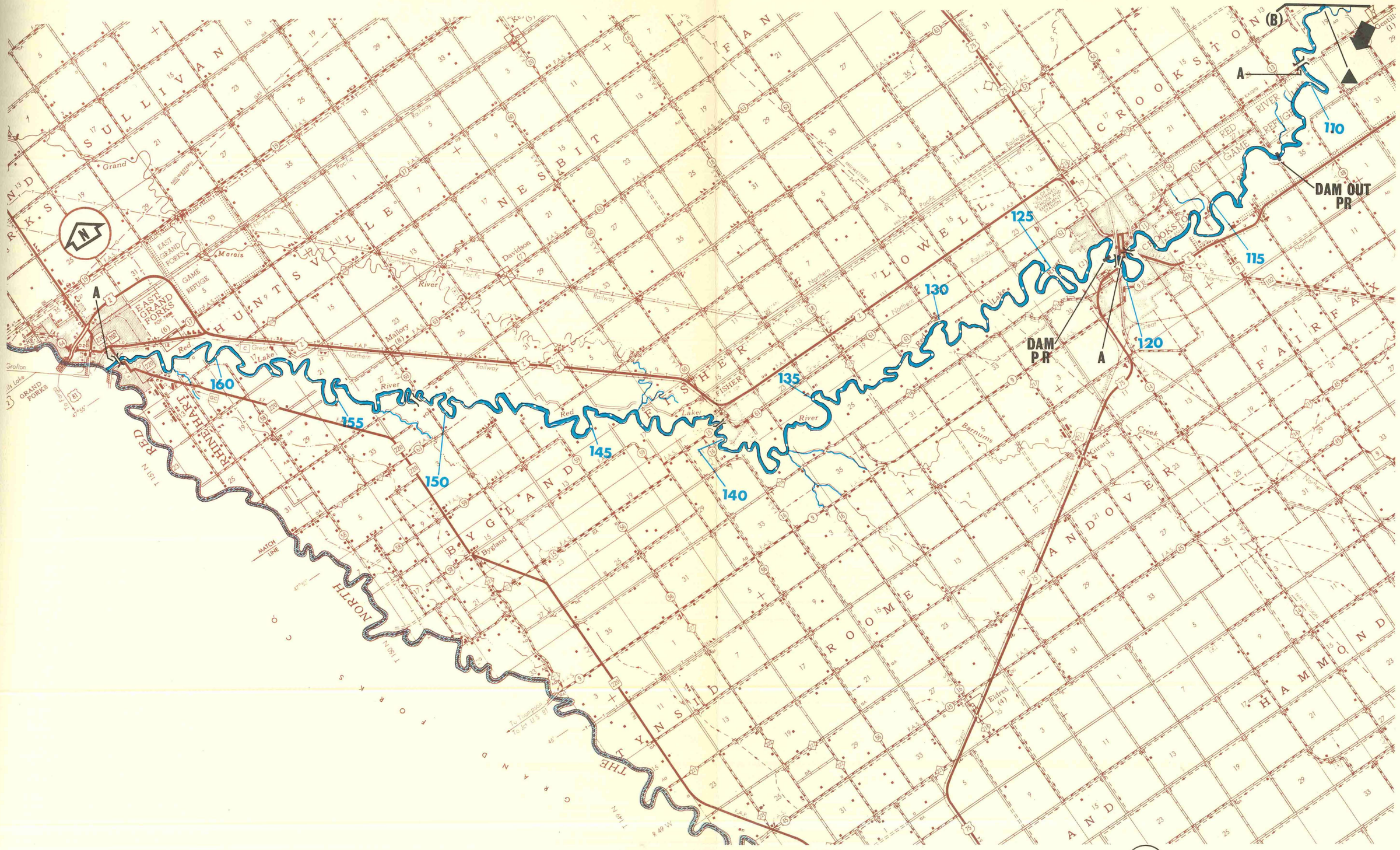
14



15



16


(B)
A
110
DAM OUT PR
125
115
130
DAM PR
A
120
135
140
145
150
155
160
SULLIVAN
NESBIT
LOWELL
CROOKSTON
FAIRFAX
BYGLAND
ROOME
ANDOVER
HAMMOND
RED LAKE RIVER
GAME REFUGE
EAST GRAND FORKS
GRAND FORKS
Grand Marais
Red Lake River
Mallory
Davidson
Girard
Eldred
Bygland
MATCH LINE
NORTH
SCALE OF STATUTE MILES

ROOT RIVER

LOCATION:

The Root River is located in Mower, Fillmore and Houston Counties in southeast Minnesota and has a watershed of some 2,568 square miles. Just below Chatfield the Root River divides into a north and south branch. This survey starts on the north branch at the bridge on Highway 74. From this point the river flows east some 82 miles as a direct tributary to the Mississippi River.

NATURAL SETTING:

The upper reaches of the river flow east through a wide shallow valley of clay glacial drift which overlies bedrock. However, from approximately Chatfield the channel has cut deep into the bedrock creating at times vertical cliffs of exposed limestone, dolomite sandstone and shale. The abutting highlands along the river near Lanesboro, Rushford and Hokah are as much as 450-500 feet above the river bed. The characteristics of the river to Rushford are meandering, a series of pools and rapids and hearty wood banks and hills. The high bluffs and continuous change of direction brings into view an everchanging panoramic of nature. The drainage pattern of the area is well defined and this has led to serious flooding during early spring. The river from Rushford to the Mississippi tends to flow in a direct manner and along this route, levies have been constructed and channel improvements undertaken. This improvement to the flowage has caused fast water, but the removal of obstructures has reduced the frequency of rapids and the severeness to a condition of gentleness. The widening of the channel has also removed the abutting tree growth which produces the effect of a river in the plains. However, the high hills forming the valley and the heavily wooded area along the river does present interesting and enjoyable surroundings.

At mile 17.5 as one rounds a curve in the river, a high rock cliff, known as pilot mound, is directly downstream. It presents a very spectacular view. Continuing to mile 24.5 is the location of an old dam which was used in conjunction with a hydro plant that was located near mile 26.5. A pipe was used to divert the water across the narrow neck of the bow in the river. Further downstream at Hokah is a community which at one time was a major industrial center with a population of over 3 times what it is today. Just east of Highway 26 bridge is located a museum. Hokah at one time contained a round house, a cooperage works, a flour mill , a creamery and some 2500 people.

EXISTING DEVELOPMENT:

The Root River in the early spring has a large flow and is considered locally as dangerous and not canoeable. During the remainder of the year the river is a very enjoyable receational asset to the area. The Root River Canoe Trail Association has been organized to publicize and promote development and use of the river by local residents and those from beyond. That portion of the river included within the trail by the association and also by the survey is from Chatfield to Highway 26 bridge east of Hokah, a distance of 80 miles. This effort is less than 3 years old, thus facilities for camping, gaining access and being outfitted remain in the improving stage. Publicly owned campsites do not exist although camping is permitted at two sites. Access can be gained at a number of locations. One outfitter stated that his demand for canoes has doubled each year with 1966 expected to be 300 canoe teams. Facilities for re-uniting the canoeist with his car are also being accommodated. This has in other locations proven to be a major problem.

Indication of development is visible along the river as one passes a farm house or small community, although the frequency is small and the general atmosphere is that of a small mountain stream.

AMENITIES FOR RECREATION:

The topography in and around the Root River Valley is one of deep valleys and steep slopes that produce a very pleasant atmosphere. Trail riding, scramble-bikes, hiking as well as canoeing would be a challenge in this area of green hills and shadow filled valleys. The upper portion of the river provides a continuous change of scenery, contains enough fast water and rapids to make it interesting, is lined with woods penetrated now and then by a rock outcropping and in general is one of the most scenic rivers in the state. Wildlife is present in the form of deer, squirrels, beavers, muskrats, turtles, and many birds. Along the river are many potential campsites which are accessible, high enough to entice a wind and remain dry and have either a sandy or rock base. The depths of the river is seldom

over 3 feet but pools do exist which according to local residents provide good fishing. The lower portion of the river presents a different atmosphere due partially to man-made improvements in realigning the channel and rebuilding the banks and levees. Again potential campsites are abundant with a few exceptions where the river has cut into topsoil leaving steep and muddy loam banks. The banks are difficult to climb and the brush is very thick. From Rushford to Highway 26, the river is paralleled by Highway 16 varying from directly abutting to one mile away. Thus, it is an easy situation to provide camp access.

POTENTIAL FOR FUTURE RECREATION:

The Root River Valley has a great potential for a variety of recreational uses, some of which are river oriented and others which will merely take advantage of the interesting and attractive foot hill atmosphere. This opinion is stated partially due to the location of the river in proximity to population centers such as Rochester, Austin, La Crosse, Decorah and Waterloo.

Trail type activities such as bridle clubs, snowmobiles, hiking, scramble bikes, canoeing, are increasing in popularity and facilities are needed to accommodate this demand. Large acreage activities such as golf courses, archery courses and ranges, skiing, hunting, rifle ranges, skeet ranges are also in demand. The general topography of this area removes much of the land from farming while also making it attractive for recreational activities. Improvements of access to the river and availability of campsites are needed. The various communities appear to have developed an interest in aiding such development but it is questionable as to their financial ability to build water retention and control devices to assure an adequate flow.

CONSIDERATIONS:

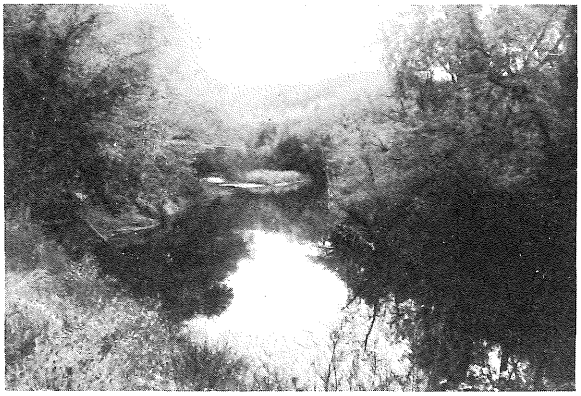
1. The location of the Root River within the State makes it important as a facility to serve a large portion of the population. The experience which it can offer in canoeing skill, exposure to nature and attractive scenery is well worth preserving and promoting.

2. Campsites are needed, access points with parking facilities are needed and having accomplished this, it is anticipated that the use will greatly increase.

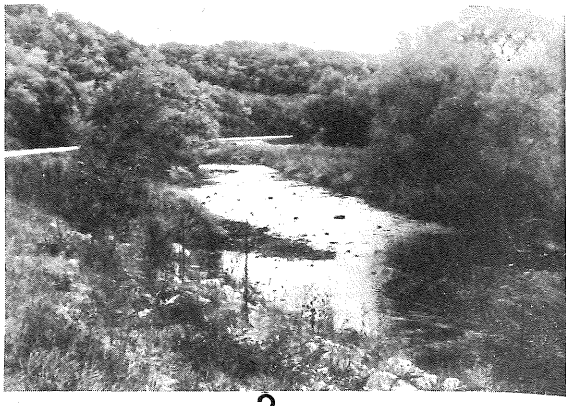
ROOT RIVER

1. Typical reach of the river below Lanesboro.
2. Typical shallow riffles in upper reaches near Lanesboro.
3, 4, & 5. Typical of reaches of pools and riffles.
6. Access to river above Rushford.
7. View from bridge at Peterson.
8. Typical reach of river with heavy growth of vegetation on banks.

ROOT RIVER

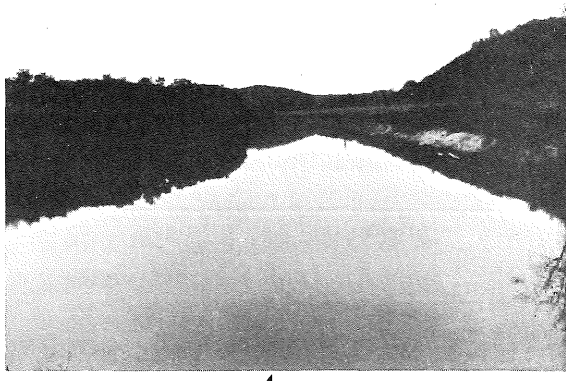


1



2

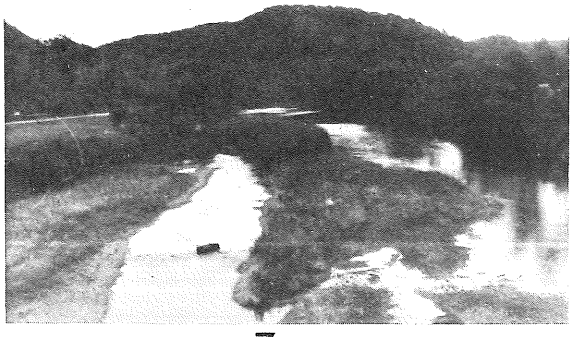
3



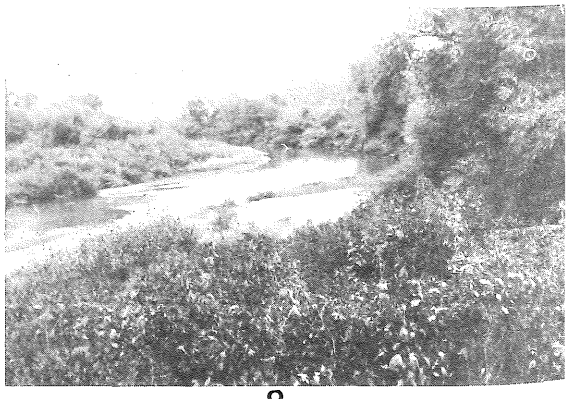
4

5

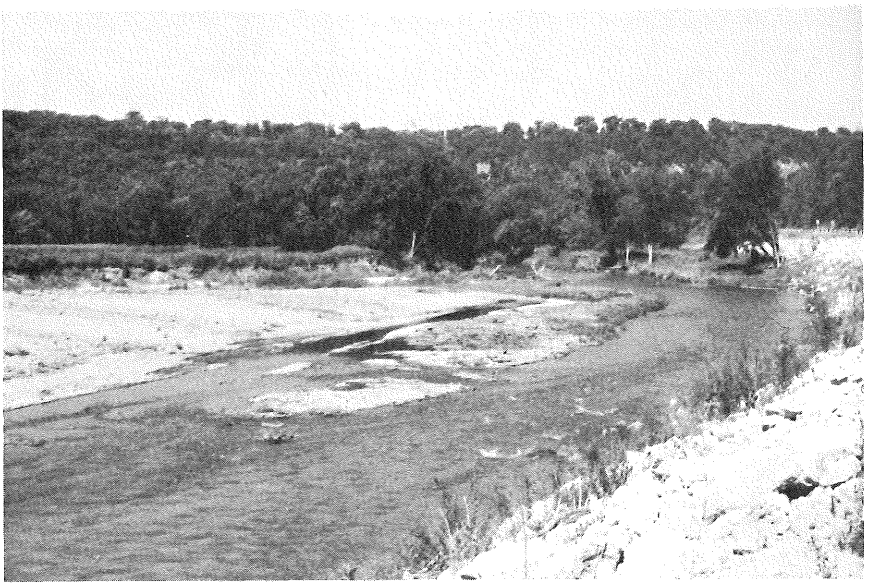
6



7

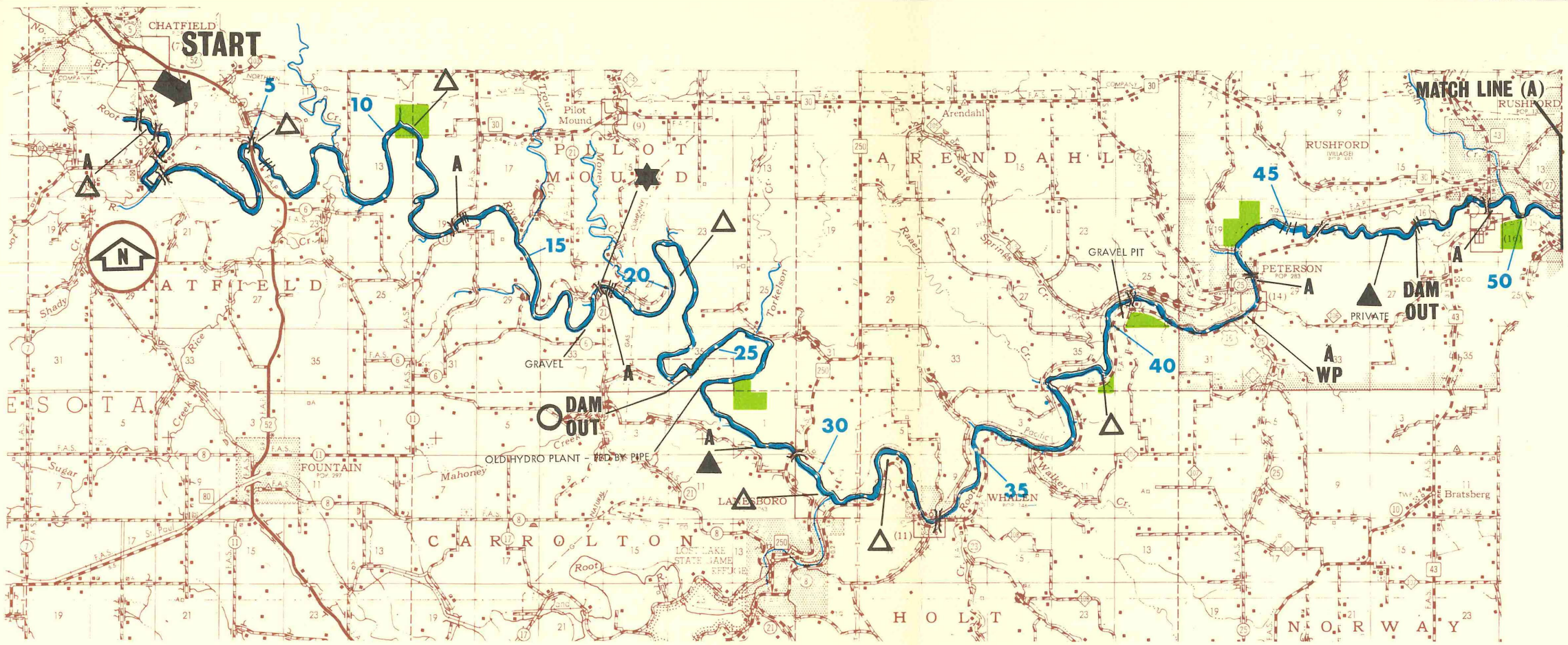


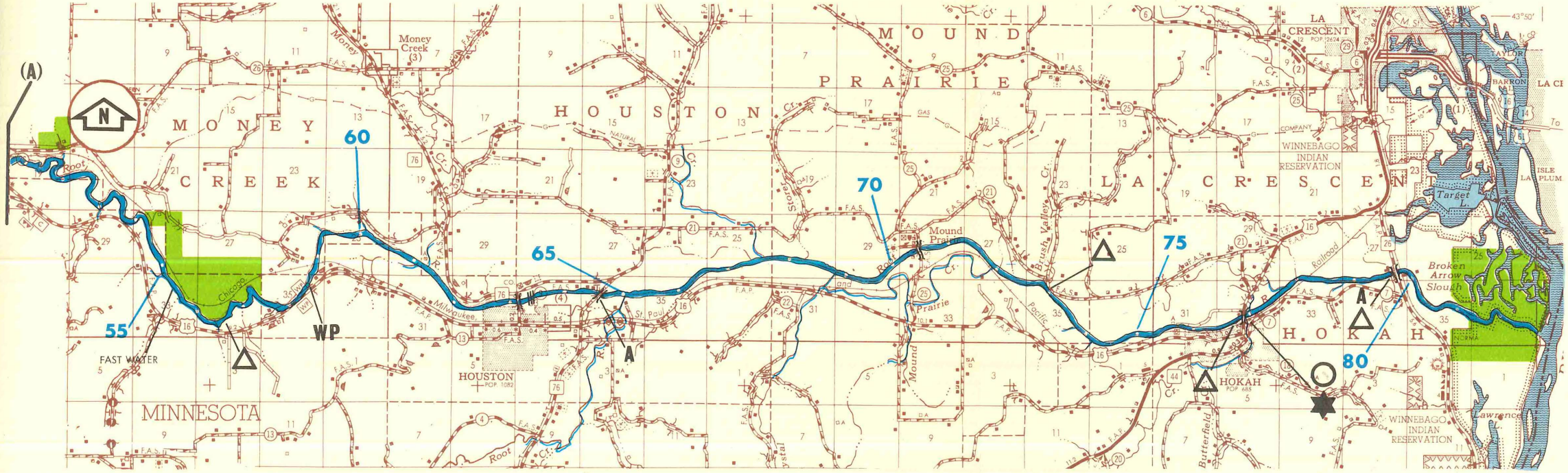
8



Below Houston.

Mound Prairie Bridge.





SCALE OF STATUTE MILES

RUM RIVER

LOCATION:

The Rum River is located in Mille Lacs, Isanti and Anoka Counties and has a watershed of some 1552 square miles. Throughout its length of 140 miles, the river flows in a southerly direction as a tributary of the Mississippi River. The survey did not extend the entire length, but covered that portion from Highway 95 in Princeton to the landing in Anoka County Fairgrounds, a distance of some 67 miles.

NATURAL SETTING:

The first 32 miles flows through a shallow valley which is a part of an undulating glacial till plain. Along this valley abutting the river are numerous marshes and evidence of flooding. The adjacent land has a dense cover of primarily second growth trees and underbrush where the land is out of the flood plain. The variety of trees are birch, elm, oak, willow, cottonwood, soft maple and some coniferous. The river channel as it searches for the grade, is almost entirely a series of turns and bows with the width varying from 20 to 100 feet. Such an alignment provides a continuously changing perspective and introduces the element of the unknown - what is around the bend?

The river from Cambridge to Anoka flows through a valley with higher and more confining topography in a more direct course. The adjacent land remains heavily wooded, and the variety of trees are the same but the proportions have changed to favor the elm, oak, maple and ash. The width of the channel tends to be 50 to 60 feet until the influence of the pool behind the Anoka dam, where the river is 200 - 300 feet wide. This part of the river has a number of islands, farm land projects to the banks at a few intermittent locations and the banks have been invaded by homes, camps and cottages. The development is evident but to date is not abusive or extensive to the point that the northwood atmosphere is lost.

RIVER BED AND BANKS:

The upper portion of the river has shallow banks which permits the water to extend into the adjacent wooded area. Where banks are in evidence, they are steep and unstable. The channel between Princeton and Cambridge was 100% snagged 8 times, necessitating pulling the canoe over the trees due to the marsh on either side.

The lower portion of the river has banks varying from low grassy slopes to high hills to sand cliffs as one nears Anoka. Many attractive landing sites are available. The rate of flow and depth of water were good in both the upper and lower portions of the river.

EXISTING DEVELOPMENT:

The first mile of river passes through Princeton which has dumped fill and junk over the bank to reclaim land for extension of the commercial area. The next 32 miles is primarily wilderness with prime evidence of man's effort being the 4 bridges and 2 farm houses which come into view. At mile 19, which is the bridge over highway 1, is an access landing in the southeast quadrant. East along highway 1 approximately one-half miles is located a grocery store and a motor fuel station. Continuing down-river to Cambridge just beyond the bridge at highway 64 is located on the east bank a city park with a picnic area, rest rooms and drinking water. Evidence still remains at this site of an early dam.

The river from Cambridge to Anoka has cottages, permanent homes and farm land which may be seen from the river although the frequency is such that the overall effect is heavily wooded. At Highway 24 in St. Francis are the remains of a dam and early bridge. This construction creates a rapids which is only canoeable during high water. The Anoka County Fairgrounds and a County Park are located on the west bank at mile 67. Water, a boat ramp and picnic facilities are available. Just below this site is the Anoka Dam.

AMENITIES FOR RECREATION:

The Rum River presents a varying experience in scenery from a shallow valley to high sand banks. The upper portion permits one to retreat into an area where nature is in command, the bird population is high and lends a musical atmosphere. The fallen trees are an inconvenience,but they also add to the overall natural setting. Wildlife is present with turtles, squirrels, herons, muskrats, skunks and deer seen along the banks. Wild flowers bring color to the scene and the water is moving at the rate to make easy canoeing and of such depth that portages are unnecessary except at St. Francis.

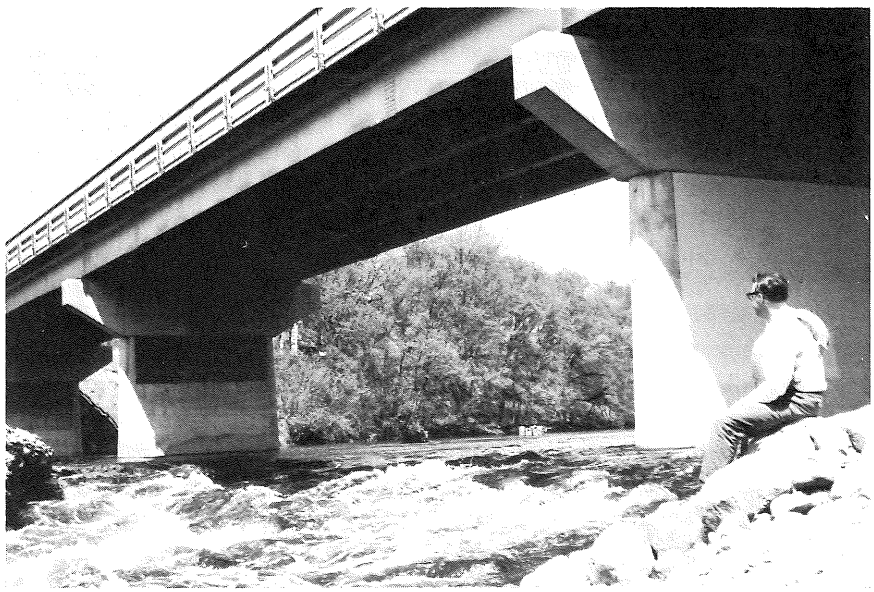
POTENTIAL FOR FUTURE RECREATION:

The nearness of the Rum River to a large portion of the states population and the variety of experience which it can offer make it an important river to consider. The distance from Princeton to Anoka can be covered in 3 days which appears to be a desirable period of time for those who canoe in rivers. The land along the banks is sufficiently undeveloped and large parcels of land could be acquired without disturbing a large number of occupants. In addition to canoeing and boating, the land along the river would provide interesting riding trails, hiking trails, bicycle trails and campsites for those persons arriving by automobile. The area above Cambridge, however, is wilderness and this type of surroundings is becoming more difficult to experience each year and having such an area close to the metropolitan area should be recognized and preserved.

CONSIDERATIONS:

This river should be included in a state program of canoe trails and the lower portion considered as a recreational river for accommodating other "trail type" activities. Campsites should be provided at Cambridge, Isanti and St. Francis; parking at Princeton, Cambridge, Isanti, St. Francis and Anoka and a "chute" should be provided at the St. Francis Dam.

One of numerous snags above Cambridge on Rum.



Old dam at St. Francis on the Rum.

RUM RIVER

1. Typical of the area below Princeton.
2. Flooded woods in area below Princeton.
3. Typical riparian farmland.
4. Typical semi-fallen tree area, predominantly maple, between Princeton and Cambridge.
5. Tree fall area.
6. Sandbanks often seen in the stretch above Cambridge.
7. Typical grazed woods.
8. Eroding banks, common on the outside of meanders.
9. Typical of the reaches of the river above and below Cambridge.

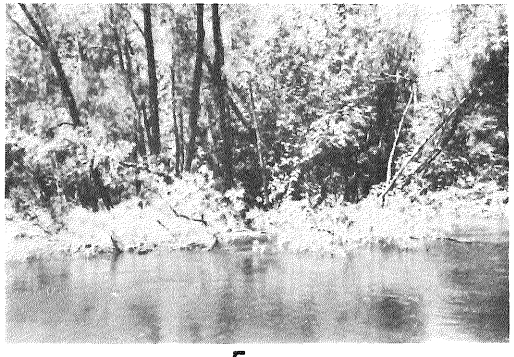
RUM RIVER

1

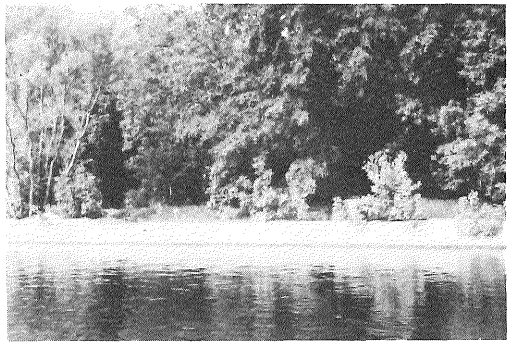
2

3

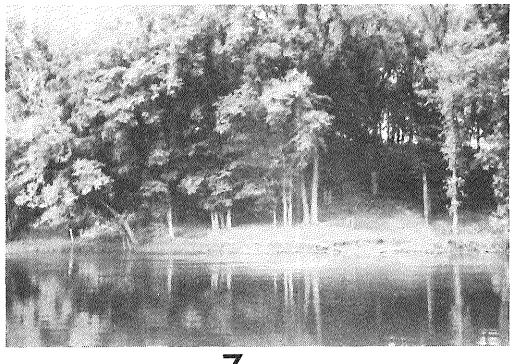
4



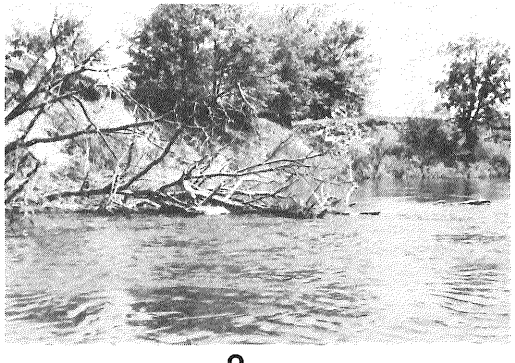
5



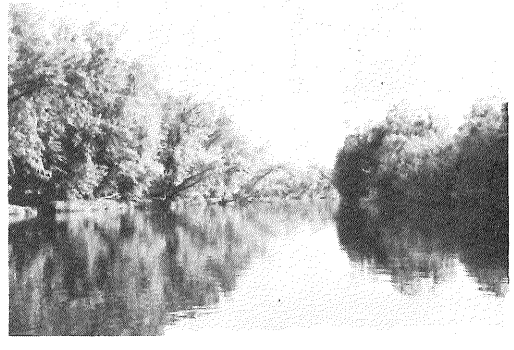
6



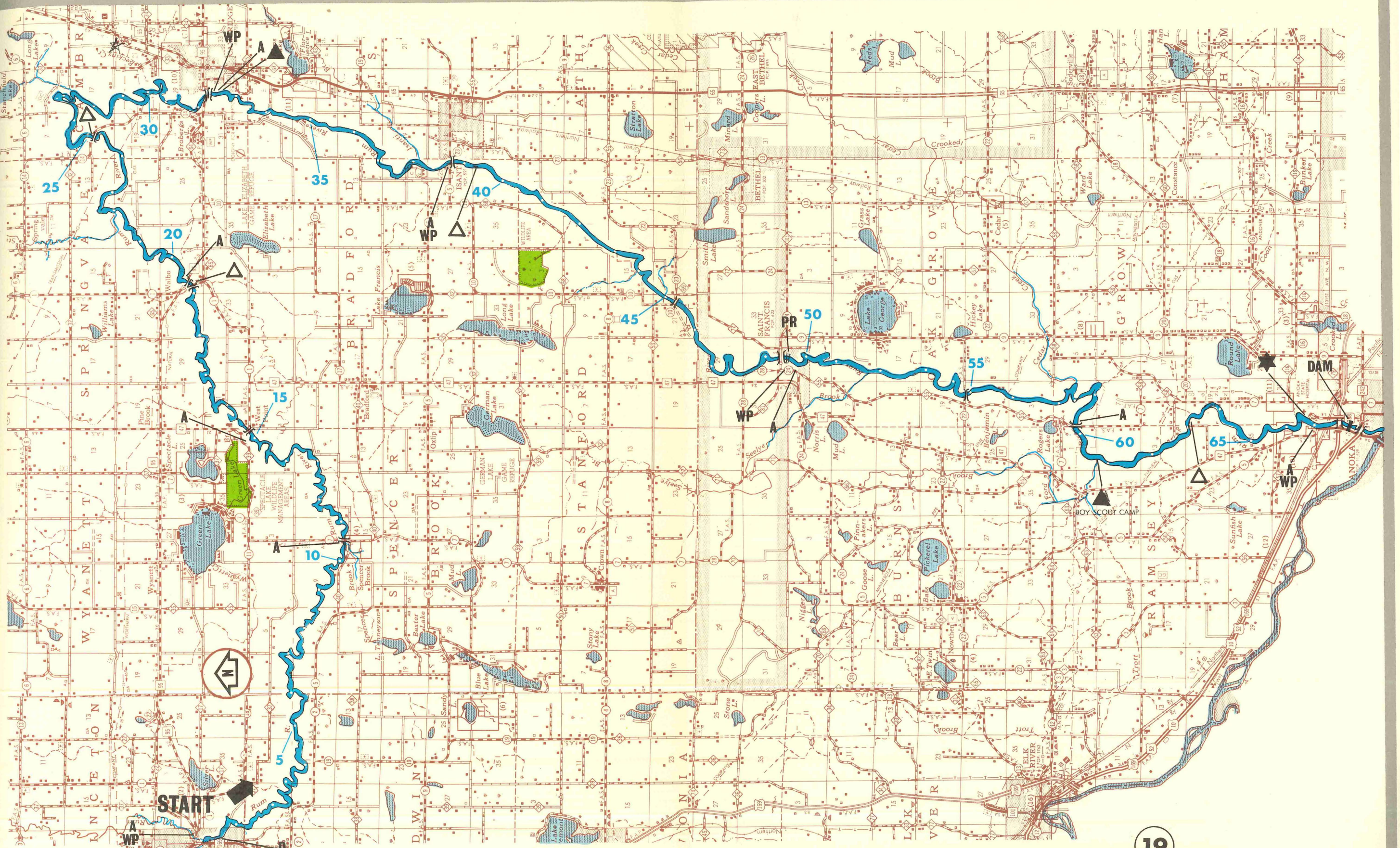
7



8



9


START
DAM
BOY SCOUT CAMP
WP
A
PR
D
5
10
15
20
25
30
35
40
45
50
55
60
65
SAINT FRANCIS POP 623
BETHEL POP 302
ELK RIVER POP 7763
Rum River
Lake Francis
Green Lake
Elizabeth Lake
Long Lake
German Lake
Mud L.
Crooked Creek
Cedar Creek
Seelye Brook
Trott Brook
Spencer Brook
Stony Lake
Blue Lake
Sandy L.
Stone L.
Pickerel Lake
Round Lake
Rogers Lake
Sunfish Lake
Bunker Lake
Ward Lake
Constance
Hickey Lake
Grass Lake
Sandshore L.
Minard L.
Coopers L.
Stratton Lake
Smith Lake
Norris L.
Pinn-akers
Goose L.
Bear L.
E. Twin
Nowthen
Lake Lucy
Lake Fremont
SPECTACLE LAKE WILDLIFE MANAGEMENT AREA
ELIZABETH LAKE GAME REFUGE
GERMAN LAKE GAME REFUGE
WILDLIFE AREA
ANOKA STATE HOSPITAL
SCALE OF STATUTE MILES

19 RUM RIVER

LOCATION:

The Snake River originates six miles north of McGrath in Aitkin County where two headwater streams join. Below this junction it meanders southward through a wide, shallow valley for a distance of 54 miles and then turns eastward and flows 36 miles to enter the St. Croix River in Pine County east of Pine City. Below Cross Lake, through which the river flows, the valley becomes deeper and narrow and the stream swifter. In this lower stretch of 12 miles the river drops 136 feet.

The earliest name of the Snake River was Portage River. The Chippewa Indians who inhabited the area near the mouth of the river renamed it Kanabig, meaning "snake," after their bitter enemies, the Sioux, who lived up river and whom they later displaced. "Kanabig" is a variant of "Kanabec", the name of the county. The Groundhouse River, one of the tributaries, is named from the earth lodges of the Mandian Indians, relatives of the Sioux who once inhabited this area (Upham, 1920). The watershed was originally densely forested. Logging started in 1837 and continued at a steady pace after 1847. In the 1880's it reached its peak after which it waned rapidly. Some of the best white pine stands in the nation were found here. Brunswick was the first town in the watershed and was a logging headquarters for operations along the Snake River in 1858 (Owen, 1852).

NATURAL SETTING:

The Snake River watershed of 1,040 square miles includes most of Kanabec, and parts of Aitkin, Mille Lacs, Pine, Isanti, and Chisago Counties. It is described in the Minnesota Hydrological Atlas (Minnesota Conservation Department, 1959) as follows: "The watershed is a relatively flat glacial till plain crossed by several east-west morainal belts. The moraines are mainly undulating areas of hills and depressions. Elevations in the watershed range from about 1,360 feet in the northern morainal hills to 890 feet near the mouth of the Snake River."

"The greatest relief in the southern part of the watershed occurs near Mora in a series of sharp, narrow eskers, or ridges of glacial drift. Much of the watershed, especially in the flat till plain region, is covered with bogs and swamps which lie in old, partly-filled, glacial river valleys. A small area between Braham and Grasston is covered with lake clays of glacial Lake Grantsburg. The watershed originally had excellent stands of white pine forest. At present much pulpwood and other timber products are cut in the northern part of the area. Parts of the White Pine, Rum River, and Chengwatana State Forests, and the McGrath State Game Refuge are within the watershed."

"Agriculture, particularly dairy farming, is the dominant occupation in the watershed, and processing of dairy and other agricultural products are the principal industy."

"The watershed contains about 40 lakes and numerous marshes and bogs. Pokegama and Cross Lakes, the largest lakes with areas of 1,500 and 1,316 acres respectively, are located in the southern part of the watershed."

The slightly undulating surface is of red glacial till on the Archaean granite, gneisses, and schists in the upper part of the basin, and on Cambrian sandstones and limestones in the southeastern part. There are rock outcrops at several points along the upper stretch of the river, notably at the upper and lower falls in northern Kanabec County. At the upper falls which are two-thirds of a mile below the mouth of Cowans Brook, there are granite outcrops on both banks which form vertical cliffs for a distance of 165 feet. Here the river drops about 3 feet. At the lower falls, which are located a short distance farther downstream, the river drops 20 feet in a distance of three-fourths of a mile. The upper part of the watershed is flat with much swampy land (Ralph and Follansbee, 1912).

Above Cross Lake the river banks are low and the valley little eroded but between this lake and the mouth there are bluffs along the stream from 40 to 100 feet high. The eroded bases of the bluffs are of coarse-grained sandstone of gray and iron-rust color in which layering has been exposed by weathering. In the sandstone there are pebbles here and there, mostly of quartz or quarzite (Winchell and Upham, 1888).

AMENITIES FOR RECREATION:

Severe bank erosion was observed at various points along the river. Poor river bank conservation practices such as clearing the banks of vegetation is usually responsible for this. Trees, shrubs, and grasses on the river banks help prevent damaging silt from washing into the stream if the adjacent land is eroding. They also hold the soil in place and thus prevent stream bank erosion. In addition stream bank vegetation plays an important role in providing shelter and food for fish.

Along the Snake River, eroding banks should be stabilized by planting trees and shrubs. Fencing should be done along eroding areas which are pastured. Garbage dumps from adjacent farms were occasionally present on the river banks, especially between Pine City and Grasston. This practice is in violation of the anti-litter law found in Minnesota Statutes 1961, Section 616.163, Subdivision 1, which is enforceable by the local sheriff. Pollution from these dumps can be detrimental to plant and animal life in the river.

If the present plans for the proposed restoration of the dam below Cross Lake are followed, fish passage upstream over the dam will be possible only during the spring high water stage. The construction of a fish passage device in the dam is being considered to insure re-establishment of fish populations above the dam from the St. Croix River in case of severe widespread winterkills.

The restoration of the dam should have some beneficial effects on fish populations above the dam. With the additional depth (two feet) chances of winterkill should be lessened in Cross Lake and the portion of river between Cross and Pokegama Lakes. Also, additional northern pike spawning area may be created.

POTENTIAL FOR RECREATION:

Fishing and Boating - Considerable fishing is done in the river near Pine City. Other areas of the river have excellent fishing potential, but are not utilized because of few public accesses, and a general lack of knowledge of the fishing potential. There is a boat livery with row boats and canoes for rent on the river at Pine City. Much use of the river is also made by boats which are moored in Cross and Pokegama Lakes. Some winter angling and darkhouse spearing is done at various locations in the river. During the winter of 1963-64 as many as 5 darkhouses were present at one time in the Big Eddy Pool above Grasston.

Canoeing - During the spring and early summer the six lower sectors of the river are canoeable. Later in the summer the river becomes quite shallow and canoeing is quite difficult between McGrath and Mora, and between Pine City and the St. Croix River. The river is canoeable all summer between Mora and Pine City.

Hiking and Camping - During the survey many excellent potential campsites and hiking areas were observed. Some of the more scenic locations are downstream from McGrath near the Snake River Falls area, and downstream from Pine City where the terrain is hilly and where there are many large bluffs. Presently, most of the hiking and camping is between Pine City and the river's mouth.

The Snake River is potentially one of the most scenic and exciting rivers covered in this survey. Especially from McGrath to Mora and from Pine City to the St. Croix. The McGrath area has an abundance of wild life being in a very remote area as far as people and access points are concerned. The lower end area is almost continuous rapids, not difficult but very exciting.

CONSIDERATIONS:

1. That the river not be developed as a wild river, since it is only canoeable in the spring and early summer.
2. That the river be advertised as a white water canoe route from Pine City to the St. Croix, as a short one-day trip. The trip should be made only in spring and early summer.
3. That a public access be secured at the mouth of the Snake in connection with County Road 18 or with a state forest road in the Chengwatana State Forest. Also a campground should be constructed in connection with the access.
4. A hiking trail constructed along the lower end possible in the Chengwatana State Forest Area.

Stream bottom types are mostly inorganic ranging from sand to boulder and ledge rock. Boulders and rubble occur in rapids and along shorelines exposed to swift current. At the Snake River Falls and also at mile 36.5 boulder and bedrock predominate. Soft organic muds are present in the large shallow, expanded area above Pine City at mile 63.

SURVEY DATA:

The Snake River originates six miles north of McGrath in Aitkin County where two small headwater tributaries, an east branch and a west branch, join. The adjacent watershed and valley consist of level land which is covered by brush, second growth hardwood forest, and considerable bog. Predominant trees in the area are black spruce, white cedar, tamarack, balsam fir, aspen, birch, and some maple and ash.

From McGrath to the County Road 82 bridge, the river gradually widens to a maximum of 85 feet, and also becomes deeper. Long stretches of rapids with ensuing small pools are common. In the lower portion of the sector the river cascades over an upper and lower Snake River Falls with intervening rapids where the granite crops out along the river. A drop of 30 feet in one mile occurs here, and at various points the river narrows in width to 20 feet where it flows between walls of granite. The range in width in this sector is 20 to 85 feet, and the depth range is 1 to 5 feet. A drop of 159 feet in 31.1 miles for a gradient of 12.14 feet per mile is present in this sector. Located between C.S.H.S. 3 bridge near Warman and County Road 82 bridge near Woodland. The wide river valley is heavily forested and little farming is done on the adjacent watershed. Watershed cover types consist predominantly of birch, aspen, scrub oak, maple, ash, elm, and some black spruce, tamarack, and white pine. There is much brushland.

The physical characteristics of this sector are very similar to the preceding sector. Many series of rapids and pools of varying sizes are present, the largest pools being the Buck Hill Pool at Mile 20.0 and the Bean Dam Pool at Mile 16.0. Rock remnants of the Old Beam Logging Company Dam still hold a three-foot head of water creating a large pool above the dam. A winding southwest course is followed from C.S.H.S 3 bridge to C.S.H.S. 6 bridge at Mora. This sector of the river is characterized by many series of rapids and small pools. In 14.5 miles the river drops 78 feet for an average gradient of 5.38 feet per mile. The width of the river varies from 30 to 100 feet, and the maximum depth varies from 1 to 8 feet. Its deepest point (8 feet) was found at Mile 33.

Between Mora and Grasston the direction of the river gradually changes from a south to east direction. A few small rapids and pools are present in this sector, but most of it is of long stretches of sandy-bottomed shallows. The widest and deepest portions are both located at mile 48.3, a stretch locally called the "Big Eddy". At this location the river bends sharply from east to south and back east again forming a large back-water. Here the maximum width found was 150 feet and the maximum depth 10 feet. Stream gradient in this sector is slight, only 0.49 foot per mile. Most wooded areas are adjacent to the river.

From Grasston to C.S.A.H. 9 bridge below Cross Lake the river follows a meandering course northeastward past the south end of Pokegama Lake and through the south end of Cross Lake. The widest point of this sector (600 feet) is located just upstream from Pine City at mile 63.3 and the deepest point (12 feet) is located at mile 57.6, an area locally called "Bears Ear." There is a very sharp bend in the river at this point. This portion of the river lies in a wide level valley which consists almost entirely of agricultural land. The forested portions consist mainly of maple, basswood, aspen, oak, ash, elm, and scattered conifers. Submerged aquatic vegetation was abundant in the wide, shallow portion of this sector above Pine City. Some of the more common species were flatstem pondweed, river pondweed, bushy pondweed, sago pondweed, coontail, and water milfoil.

The river gradually narrows from 190 feet at the C.S.A.H. 9 bridge to 25 feet at its mouth. Excepting the 2-mile-long pool at mile 70.2, this sector consists entirely of rapids with ensuing small pools. The deepest point in the entire river (20 feet) is found at mile 69.5. There are several sharp bends and about a dozen gradual changes of direction in the river channel. The stream bed drops 124 feet in 12 miles for an average gradient of 10.3 feet per mile. The valley is quite narrow and primarily in forest land. Maple, ash, oak, basswood, aspen, and pine trees are most common in the watershed and valley. The lower 2.5 miles of the river flows through the Chengwatana State Forest.

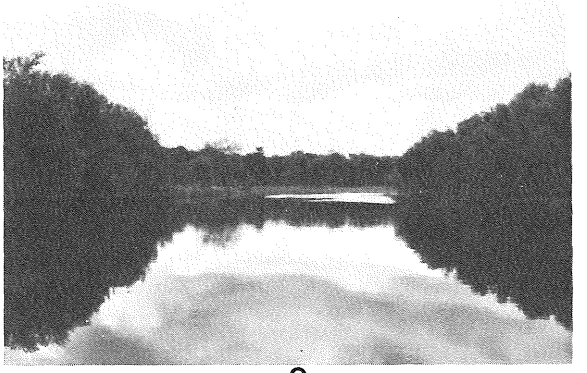
Snake River east at Pine City.

Rice patty wet area on Snake River.

SNAKE RIVER

1. View downstream from Highway 65 bridge north of Mora.
2, 3 & 4. Typical of the river above Pine City.
5. Typical scene of aquatic growth below Pine City.
6. Typical of the river downstream from Pine City.
7. Typical rock riffles downstream from Pine City.
8. Typical bank cover at Pine City.

1

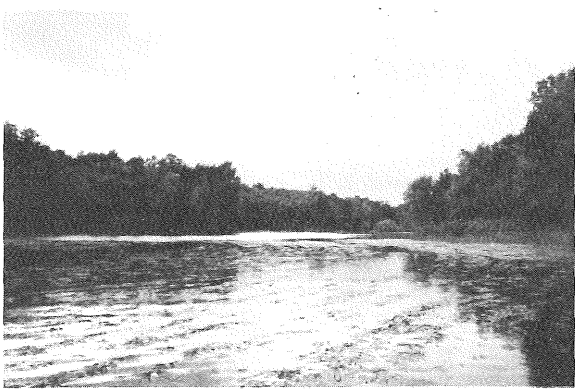


2

3

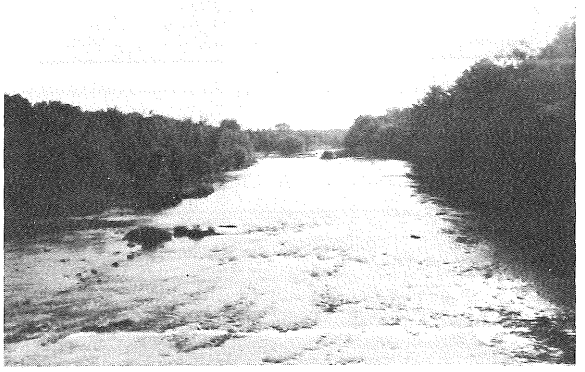
SNAKE RIVER

4

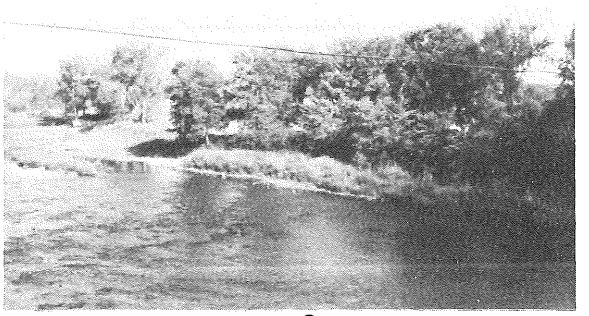


5

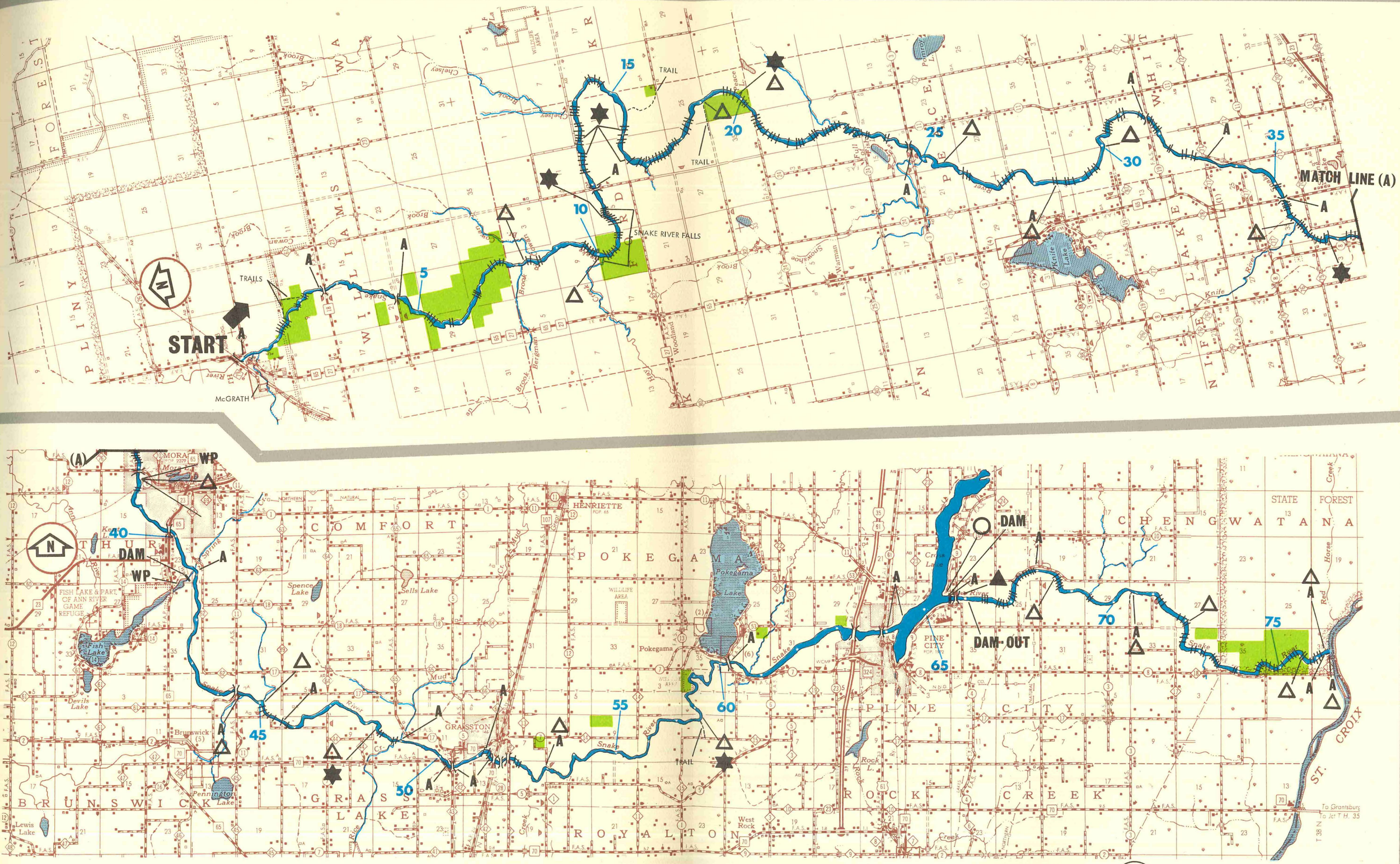
6



7



8



20

SNAKE RIVER

The MORRC Staff Report #11, "Recreational Use of the St. Croix River," is well done, pertinent and agrees with our findings. Consequently, the following information, for the greater part, has been adopted from it.

LOCATION:

The St. Croix River rises at Solon Springs, Wisconsin and flows 164 miles southwesterly and then southerly to the Mississippi River at Prescott, Wisconsin. The total fall is 340 feet or 2.9 feet per mile. The upper portion of the St. Croix River is entirely within Wisconsin, however, at Danbury, Wisconsin the St. Croix River forms the boundary line between Minnesota and Wisconsin for the remaining 120 miles of the river. Within Minnesota it abuts Pine, Chisago and Washington Counties.

The surveyed portion of the river is 120 miles from Danbury, Wisconsin to Prescott, Wisconsin.

NATURAL SETTING:

The St. Croix River is 164 miles long. Between the Danbury and the Kettle River Rapids, several streams and rivers join the St. Croix River. In this portion the river has a relatively straight channel which ranges from 190 to 500 feet wide with maximum depths varying from two to eight feet. The river in this area has an average gradient of 1.7 feet per mile and a velocity of 1.6 feet per second. The valley is more sharply defined. In places the high banks adjoin the river channel. Along the remainder of the channel, low islands and bottom lands are found.

At the Kettle River Rapids the gradient increases to 8.3 feet per mile; the river divides into two parts and it is joined by the relatively large Kettle River at the lower end of the rapids. In this section the stream course is more precise, the two main channels are relatively narrow. Immediate stream banks are 8 to 20 feet high with occasional sandstone outcrops.

Below the Kettle River Rapids the river has a width varying from 300 to 1,200 feet, an average gradient of about 1.2 feet per mile, and a maximum depth range of 2 to 10 feet. Banks range from 8 to 15 feet high and the valley becomes increasingly well defined. The physical characteristics of the St. Croix River from the above rapids downstream to the hydroelectric impoundment at St. Croix Falls are quite similar, except that below the outlet of the Sunrise River the river flows through the area which was once impounded by a low head earth and timber dam called the Nevers Dam. When in use, the Nevers Dam could hold a 13 foot head of water and created a pool about 11 miles long. This reservoir initially was used to sluice logs over the latter dam, and most recently used as an auxiliary water storage reservoir for the power dam. The Nevers Dam was heavily damaged by high water in 1951 and 1952 and was entirely removed in 1955.

A 60 foot high hydroelectric dam at St. Croix Falls impounds water in a pool which extends ten miles upstream from the town of St. Croix Falls, and partially fills a narrow valley that is about a half mile wide. The lower end of the narrow valley is the beginning of a narrow, rock gorge called the St. Croix Dalles. The river gradient in this area approximates eight feet per mile for one mile downstream from the above dam.

The next 22 miles of the St. Croix River (from the Dalles downstream to Lake St. Croix) has an average gradient of only 0.7 feet per mile. In this lower stretch, below the St. Croix Dalles, the river flows through a wider valley to Lake St. Croix. Here the river is split into many channels and backwater areas. At the lower end of this area the river becomes Lake St. Croix, a large river-like reservoir created by the natural bar at its junction with the larger Mississippi River and influenced by navigational dams located on the latter river.

The waterscape in all sections is of relatively mature second growth forest. The timbered swamps and islands are covered with mixed deciduous trees such as silver maple, elm, ash, with an understory composed of sapling reproduction, elder, pincherry, raspberry, and rank vegetation. An occasional area of white cedar, tamarack, and spruce associated with willows and alder occurs on this lowland in the upper reaches of the river. Lowland soils are generally fertile. On the higher

ground on the valley walls where the soil is lighter, picturesque white and red pine are commonly mixed with upland hardwoods such as basswood, oaks, sugar maple, paper birch, and aspen.

Widely scattered tracts of hayland or farmland occur below Highway 70, some of which are being converted back to forest land. A scattering of cabins occurs in the lower two areas but their presence do not degrade the woodland river scene.

Heavily forested cover is found on the bottomland, the islands, and the valley walls and benches. The variety of water, fast moving and white, quiet and flat add much to the total experience of being on the river. The overall impression is not one of total wilderness, but one of a fine resource that is nearly so.

The bottom of the St. Croix, due to igneous rock outcrops, tends to be a shallow stream with mostly an inorganic type bottom ranging from sand to boulder and ledge rock.

The main stream bottom is largely composed of sand. Boulder and rubble occur at the smaller rapids and along shorelines exposed to swift current. Boulder and exposed bedrock predominate in the Dalles and Kettle Rapids areas of the St. Croix. Soft organic muds are found in the St. Croix Falls reservoir, but are not common in the shoal waters.

HISTORY:

The basin of the St. Croix River was the hunting, fishing, and gathering ground for various cultures of the American Indian. It was an area seemingly plentiful in supply of fish, birds, game and wild rice.

Many prehistoric mounds, village locations, campsites, and burial grounds have been catalogued but little excavation has been completed, and the story on the ancient inhabitants of the St. Croix Valley is incomplete. Evidence now available justifies dating habitation back to at least 1000 B.C.

At one period in time this was the home of the Sioux (Dakota). This was also a period of aggressive westward movement of the Chippewa and conflict with the Fox Indians.

The Chippewa held an advantage by their early contact with the French and the acquisition of firearms. As they expanded their hunting grounds for more fur for trade, they extended their proclaimed boundaries to encompass most of the St. Croix basin. For years, this was a no-man's-land with battle after battle being fought. These fights and battles were numerous, but major conflicts occurred at Stillwater, Lake St. Croix near its outlet into the Mississippi and at St. Croix Falls portage.

During this period of Indian strife, the St. Croix and other tributary rivers became fur trading and exploration routes between the Mississippi River and Lake Superior and rivers to the east and west.

This Indian conflict did not deter the fur traders as they continued to establish posts and trade in the St. Croix basin. It was not until the French Traders who resided among the Chippewa established a post in 1694 among the Dakotas near the mouth of the St. Croix River, that there was a brief time of peace.

This was the period of French domination and of Chippewa expansion and conflict with the Dakota. In the middle 1700's the French fur traders found themselves in competition with the English traders. Conflict between these nations eliminated French control of the area with French cession of Canada to England in the treaty of 1763.

Strife continued in the fur trade among those individuals of both French and English descent. Thus, the St. Croix basin was involved in the conflict between the Northwest Company of Montreal, the XY Company and individual traders.

Thomas Conner in his diary related the story of his establishment of a post on the Snake River for the Northwest Company during the winter of 1804-05 and his competition with the XY Company who had

a post on the Kettle River. (See MORRC report "Historic Sites in Minnesota").

But the British were soon excluded from the scene. Tom Conner and men like him found themselves working for John Jacob Astor and the American Fur Company. This company then continued to control the fur trade in the St. Croix basin.

At a grand conference on August 19, 1825, the Chippewa and Sioux established a boundary line from the Chippewa River across the St. Croix River at the "Standing Cedars" just south of Osceola, Wisconsin.

The United States also had its expeditions into the St. Croix basin with the exploratory trip of Henry Rowe Schoolcraft on the St. Croix. He was accompanied by Lt. James Allen, U. S. Infantry. Records were kept of the bands of Indians camped along the river and the trading posts on the Yellow River and Snake River.

A treaty in 1837 gave the United States all lands east of the Mississippi to near the head of the St. Croix and Chippewa Rivers except for those reservation lands which were established.

In 1838, settlement began along the St. Croix River. Some of the first settlers were farmers, but this was the beginning of the lumber industry in the basin. The first commercially productive sawmill was erected in Marine Mills, now Marine on St. Croix, in 1839. Logging started in the southern part of the basin along the streams and progressed inland and northward. For the next 80 years, this was the era of the lumber jack and logging camps, as trees were cut and hauled to the rivers to be floated down stream.

Along the St. Croix, St. Johns Landing, now in St. Croix State Park, became a well known stopping place.

Peak lumber production in Wisconsin and Minnesota was in 1899. By 1920 the big logging boom was tapering off.

Along the St. Croix River, most of the town development has taken place below the twin cities of Taylors Falls, Minnesota and St. Croix Falls, Wisconsin. In this lower stretch we also find historic sites and scenic beauty.

Below the Northern States Power Dam at St. Croix Falls lie the Dalles of St. Croix with its steep rock walls and interesting geological formations. The Interstate Park now preserves much of this natural area. Below this area, in the vicinity of Osceola, are located the "Standing Cedars", the boundary line of the Chippewa and the Dakota.

On this lower portion of the river are also located Marine on St. Croix, and site of the first commercial sawmill in Minnesota; Boomsite Park, where millions of logs were sorted according to ownership, scaled or measured and rafted to down river mills. During its existence over fifteen and a half billion feet of logs went through this boom with the last log going through on June 12, 1914.

Stillwater was the great lumber supply depot and jumping off place for the lumberjacks. It was also here during late 1848 that the first steps were taken to form the Territory of Minnesota.

Lake St. Croix was formed by the sediment bar across its entrance into the Mississippi River. Here the waters of the St. Croix and its tributaries merge with the flow of the Mississippi and thus to the ocean as the history of the St. Croix and its tributaries merge with the flow of history of the North American Continent.

HISTORICAL GEOLOGY:

The geological story of the St. Croix drainage basin is a complex interrelated sequence of major geologic events which have changed, added to, and subtracted from the land.

Approximately one million years ago, the Pleistocene Period began. At that time climatic changes caused winters to lengthen in the northern part of the continent and the snowfall to increase and not melt during the short cool summers. Great masses of ice accumulated over the years in the Hudson Bay region to form a continental glacier. The glacier moved south during the various stages and was divided into major lobes or tongues by irregularities in the landscape.

Glacial tongues were thus guided down through the St. Croix drainage basin. The basin was gouged and scraped by the glacier which removed and carried this material southward. The material removed was subsequently replaced by deposits from outwash streams which drained the glacier or directly from the glacier when it retreated northward. These deposits occur today as an unconsolidated mantle of gravel, sand, clay, and silt which overlie solid bedrock. In some places flood waters created huge temporary lakes which later dried up leaving sandy plains.

The St. Croix Valley was formed in two stages by water from two such glacial lakes. The lower valley, below the cities of Taylors Falls and St. Croix Falls, was made first. This section was carved out by water from glacial Lake Grantsburg which spread over the land from Grantsburg, Wisconsin, westward into east central Minnesota. As the ice melted this lake rose until it finally spilled over its banks at a point near Taylors Falls and St. Croix Falls. There the water streamed southward, carving the lower St. Croix Valley to the Mississippi. Later, when the level of the lake fell, this river ceased to flow. Then, in the course of many centuries, glacial Lake Grantsburg dried up, leaving a sandy plain.

As the Superior lobe of the great ice mass retreated, glacial Lake Nemadji was formed by water ponded between the retreating ice front and a divide of the southwestern corner of Lake Superior. This lake drained through an outlet discharging into the Kettle River and the St. Croix River. Lake Nemadji later connected with glacial Lake Brule which drained into the St. Croix from Lake Duluth. The major outlet for these waters became the St. Croix drainage basin. As the glacier retreated, sediment was carried away by outwash streams and ultimately deposited along their course. With each episode of advance and retreat by the glacier, new deposits in the form of terraces were developed. As the continental glacier melted and decreased in weight and size, the earth's crust was relieved of a tremendous pressure. This pressure release caused the crust to rise and was accompanied by further retreat of the glacier. The result was that the St. Croix River no longer drained ancient Lake Duluth but split to form two river valleys, the south flowing St. Croix and the north flowing Brule.

Today, outcrops of Upper Keeweenawan sandstone and Cambrian sandstone may be seen along the river between Taylors Falls and the St. Croix Flowage near Gordon, Wisconsin, but mostpredominant in this area are the unconsolidated glacial sands, clays, silts, and gravels. Harder rock of the Middle Keweenawan flow, can also be seen at the rapids along this entire stretch. Most of the surface features such as glacial terraces, moraines and smaller glacial features are not apparent along most of the study stretch because of the heavy vegetative cover and difficulty of ascertaining features from the river itself.

Near Taylors Falls, Minnesota, approaching the lower end of the St. Croix basin is the gorge called the St. Croix Dalles which the river has patiently cut and which exposed up to ten layers of lava rock mantled by deposits formed during threeseparate glacial episodes. These sheer rock surfaces and unusual rock potholes are striking geologic features.

EXISTING DEVELOPMENT:

A total of seven highways cross the surveyed portion of the St. Croix River. These are U. S. Highways 10, 12 and 8, State Highways 243, 70 and 48 and County Road 23.

Access to the St. Croix:

In general, access is good.

START

MATCH LINE (A)

PRIVATE

PRIVATE

TRAILS

PRIVATE

WP

DAM PR

WP

MATCH LINE (B)

21

SCALE OF STATUTE MILES

ST. CROIX RIVER

Between the mouth of the St. Croix River and Stillwater, there are a number of public access points provided by private parties and local communities capable of handling large boats for which this reach of the river is suited. Canoeists can locate numerous sites for launching their craft. The Conservation Department has ignored public access needs of the Lower St. Croix.

In the reach above Stillwater, large and small craft may be launched at several improved access points.

In general, access points above Stillwater are adequate. In fact, additional access points would impair the wilderness-like value of the streams. A detailed study would indicate that certain new access points might be developed to string out canoe parties while other sites are not shut down.

Navigation:

A nine foot deep channel is maintained from Prescott to Stillwater and a three foot channel from Stillwater to Taylors Falls. The U.S. Coast Guard maintains navigational markings.

Pollution:

The St. Croix River, including Lake St. Croix, according to the Joint Federal-State Task Force report, is relatively clean. A bottom organism study indicates that stream water quality is essentially good. Bayport has an activated sludge treatment plant. Stillwater has a primary sewage treatment plant. (See sections on Federal and State agencies).

Ownership Pattern:

Much of the land bordering the river is owned by Northern States Power Company or by either state or county governments. The large blocks of public and Northern States Power Company holdings have resulted in the present state of river preservation. The ownership pattern also offers an ideal opportunity for continued management in the public interest. Prospects for obtaining positive control of the waterscape through fee purchase, easements, legislation, or other means are excellent.

NorthernStates Power Company representatives were consulted by the federal government in the course of the Wild River study and both states also have been in touch with the Company on related matters. The Wild River Study Team reports that the Company is ready to review its landholdings, in the light of new technology, and dispose of the non-operating properties (properties not bordering power-generating reservoirs). It may even favor selling operating properties if the Company can retain flowage rights. The Company will give priority to public agencies if disposal is decided on, according to Company representatives.

The Company has approximately 32 cottage leases on the nonoperating lands and 10 on the operating property above St. Croix Falls. The leases vary from cottage, tent, and camping permits to pasture rights. A few odd tracts are cultivated. In general, the terms provide for renewing each year. Termination clauses vary from 60 days to six months. The current policy on the part of NSP is to enter into new lease arrangements for cottages where they will not be inconsistent with their desire to maintain the wilderness character of the river.

Of the 21 miles of St. Croix River frontage in St. Croix State Park all but 7.5 miles is under lease from Northern State Power Company. All of the 3 mile frontage within the Chengwatana State Forest, Minnesota, and 6 of the 9 miles of frontage within the St. Croix State Forest, Minnesota are under lease from Northern States.

POTENTIAL FOR FUTURE RECREATION:

Demand:

At this time there is very little documented data on the extent of recreational use of the St. Croix.

Any casual inspection of the lower St. Croix River, marinas, beaches and public access during the summer months will illustrate the heavy recreational use by metropolitan area residents. Fishing, canoeing, houseboating, water skiing, motor boating and pleasure boating operate out of fifteen marinas or launching areas. The only figures available on use of the river above Taylors Falls is the St. Croix State Park attendance and the MORRC boat users analysis.

However, it is apparent that a detailed analysis of the present and future recreational demand is necessary before intelligent projections of additional recreational needs can be made.

With a population projection in the metropolitan area of 4 million by the year 2000, the St. Croix is an eventual playground for at least 50% of the population of the state.

Current attendance and projections for future use of the three state parks along the river are indicative of the recreational potential of the river.

Park	Day Visitors	1961 Campers	MORRC Campers Projected 1976
St. Croix	35,780	9.1	17.3
Interstate	246,720	13.50	25.5
O'Brien	61,340	7.2	13.5

Boating:

The only figures available are from MORRC's boat owners survey during the summer of 1963. Dr. John Borchert states that 4,378 boat owners launched their crafts in 1963, and he projects an increase of 55% to 6,800 by 1975.

River Islands:

There are within the river banks of the St. Croix, many islands which have not been surveyed and are part of the public domain.

Minnesota's Conservation Department officials have made a quick inventory of unsurveyed islands in the St. Croix River from Prescott to the point where the river leaves the state, 2.5 miles west of Riverside, Wisconsin. They estimate that there are 95 such islands. Included in the group are 18 islands in the area immediately north of Stillwater consisting of 98.10 acres. These islands were surveyed by the Bureau of Land Management, U. S. Department of the Interior in 1961. Disposition of these islands have been held up pending recommendations of the Wild Rivers Study Team.

No accurate study has been made to determine accurately the number of islands, their ownership, or value. In some instances, patents may have been issued. In other cases the states may claim title under the Swamplands Act. In any event, these small island tracts are an important part of the ecological and aesthetic character of both river systems and if a wild rivers preservation program is recommended, the islands will provide an important public nucleus.

Fishing:

The St. Croix River provides the sportsman with unusual fishing opportunities in a wild forest bordered stream interspersed with fast white water, deep pools, and long flat stretches. Fly fishing for small mouth black bass has given the river a nationwide reputation. Sturgeon and the numerous channel catfish provide a diversity of fishing.

The largest resident of the aquatic environment in the river system is the rock sturgeon which reaches a weight near 200 pounds.

Another specialized type of angling in the system is for the channel catfish.

The walleyed pike population in the river is not outstanding but is considered to be good.

Many other species are found in the St. Croix. These include northern pike, rock bass and perch, white bass and sauger. A list of fish found in the system is contained in Investigational Report No. 239 prepared by the Minnesota and Wisconsin Conservation Departments.

Wildlife:

The mixed conifer-hardwood forests interspersed with small swamps and farm openings adjacent to the St. Croix-Namekagon system support an abundance of wildlife including big game, upland game, waterfowl, and upland and aquatic fur bearers.

White-tailed deer are the most numerous game animal ranging from 1-40 per square mile. St. Croix State Park periodically has an over-abundance of these animals and requires special harvest regulations.

Black bear are found in the forest cover; however, they are not nearly as common as the deer along with an occasional moose.

Upland birds found in the coverts include ruffed grouse, sharptailed grouse, woodcock, and pheasants. All of the study area has a good distribution of these birds, except pheasants which are common along the southern edge of the forest fringe.

Cottontails, snowshoe hare, raccoon, squirrel, and fox hunting occupy a relatively smaller portion of the hunter's time because of the attractive game bird and big game.

The river system does not provide a large amount of prime waterfowl habitat. Waterfowl production is limited, and hunting pressure is light. Species commonly found here are mallards, wood duck, black ducks, ringnecked ducks, and blue winged teal.

Fur bearers present include mink, otter, muskrat, beaver, weasel, raccoon, coyote, and red and gray fox. Coyote and gray and red fox furs are not in high demand. They are hunted for bounties or for enjoyment by people who like to run dogs for these animals. There is also some interest in raccoon hunting with dogs in the bottomlands along the stream courses.

In considering the St.Croix's potential it is advisable to separate the river into three sections.

The upper St. Croix from Danbury to St.Croix Falls is wide and shallow and in general unsuitable for powered craft with the possible exception of float boats. Banks are heavily forested with an occasional summer home. This portion of the stream might be characterized as having a wild atmosphere.

The center section of the St. Croix River i.e. from St. Croix Falls to Stillwater is split into many channels and back-water areas. Banks are still heavily forested but summer homes increase in number. Outboard motorboats become increasingly evident as Lake St. Croix is approached. The stretch of the river from St. Croix Falls to William O'Brien State Park or Marine of St. Croix is especially popular with canoeists as a one day run.

The lower portion of the St. Croix River from Stillwater to Prescott, Wisconsin is actually what is known as Lake St. Croix. Six towns on the Minnesota side lie on the shores of Lake St. Croix. Heavy industries (N.S.P. Generating Station, for example) are moving into the area and a large amount of traffic is contemplated in the future. Outboard motorboats, inboards, and heavy cruisers ply up and down the lake. The increasing amounts of this type of recreation on the St. Croix generally reflect increases across the nation.

CONSIDERATIONS:

The St. Croix River seems to be developing and the above stated natural lines which should be strengthened. With this in mind, the following considerations are made:

1. The Lake Central Wild Rivers Task Force recommendations for "Wild River" status for the upper St. Croix should be supported. Such designation, however, should recognize the State and local units of government as partners with the Federal Government in development and land acquisition.

2. The Wild River Study team recommendations for matching federal fund on a 65 per cent basis on the upper St. Croix, with an additional 10 per cent bonus for an interstate unified and coordinated plan, should be encouraged.

3. The State should recognize the recreational potential of the lower St. Croix by encouraging the local units of government and the county to undertake planning, land acquisition and development with grants-in-aid from the federal funds and appropriations from the Minnesota Resource account. (see MORRC reports, "Planning in Minnesota," and "Grants in Aid.")

4. The Comprehensive Planning section of the Department of Conservation should undertake immediately a detailed recreation plan for the entire St. Croix River area in cooperation with the local units of government, the federal agencies and the proposed new Minnesota-Wisconsin Boundary Waters Compact Commission.

5. The Conservation Department, through joint action by the Game and Fish and Parks Division, should be encouraged to lay out a long-range public access program in cooperation with the local units of government for the entire St. Croix River.

6. The counties, in cooperation with the local units of government along the St. Croix River, should be encouraged to undertake joint comprehensive planning to present to the state and federal government the wishes of the local citizens regarding the proper development of the river.

7. The counties, villages and townships along the St. Croix should be encouraged to adopt zoning ordinances, to restrict development on flood plains, to protect and enhance property values, etc. compatible with the recreational use of the St. Croix.

8. The State should move to obtain those islands now in public domain and survey these islands from the point of view of ownership, proper development, etc.

9. The State should enter into definite long-range programs for the preservation of privately-held lands, and for a scheduled acquisition program of easement and fee title.

10. The Department of Conservation through the Parks Division could consider the development of multiple use trails along the entire St. Croix River but especially along the upper portion.

(B)

MATCH LINE (C)

75 80 85 90 95 100 105

WISCONSIN

ST. CROIX RIVER

(C)

110 115 120

MINNESOTA

ST. CROIX RIVER

SCALE OF STATUTE MILES

ST. CROIX RIVER

LOCATION:

That portion of the St. Louis River which was included within the survey is located entirely within St. Louis County, Minnesota. The river begins at Seven Beaver Lake and follows a generally southwest course paralleling the Iron Range cities of Aurora, Bewalirk and Virginia. South of Virginia the St. Louis River turnes south and flows to Floodwood. At Floodwood the St. Louis River changes direction and flows southeast to Cloquet, Duluth and into Lake Superior. The total river length is 160 miles from its source at Seven Beaver Lake to Lake Superior and in this distance it falls 1,065 feet.

NATURAL SETTING:

The survey started directly west of Highway 53 bridge. Access is being developed here by the Ford Fairlane Taconite Plant which has a dam downstream at mile 4.8. From the starting point mile 0.0 to the Ford Fairlane dam at mile 4.8 the river flows through an area which is densely wooded, with black spruce, norway pine and jack pine being the predominant species. The river itself is narrow and quite deep, averaging about 6 to 7 feet deep and about 50 feet wide. The water is very black in color. As one approaches the dam the heavy forested areas thin out into some open fields fringed by daisies, banks are farther away and a small floodplain has developed. The trees along the edges of the river have all been cut. Whether this is due to the construction of the dam is unknown, however the cutting has caused bank slumping which has caused an erosion problem and tends to spoil the scenic value. The river itself does not broaden out but does become deeper. The dam, just recently completed, has a very large area around it which is desolate of trees and desperately needs landscaping. There is a portage on the right hand side; caution must be used due to the mud into which a man can sink up to his knees.

The dam at this point in the river marks a significant change in the river setting. The dam has a drop of about 20 feet. The river coming out of the dam is much narrower than above. The rapids and pool system is predominant and are approximately 100 yards in length and 2 feet in depth. These rapids would have to be walked in low water. The drop throughout this stretch of river is about 25 feet per mile. The river is very entrenched, high banks on both the right and the left, pastures are intermittent with heavily wooded forest primarily of black spruce, jack pine and norway pine mixed with some hardwood, such as birch and aspen occupying most of the banks.

At mile 12.0 there is another significant change in the river. The river begins meandering and travels a distance of about 3 miles downstream moving only 1/2 mile closer to Lake Superior. There are a large number of cottages developed along the convex side while on the concave there is farmland and open fields. These, however, are not observable for the most part from the river.

At mile 17 the river leaves this meandering nature and heads southwest once again. The river becomes increasingly entrenched, the banks are 20 feet high on both sides, the river is narrow and deep and the edges of the banks are turning more to hardwoods such as oak, elm, silver maple. Away from the river abondoned farms and active farms can be seen when one walks the top of the bank. Throughout this stretch of the river there are three rapids at miles 20.5, 23.8 and 29.5, however, none of these rapids are of dangerous intensity. The most difficult of these rapids is the last one at mile 29.5.

At mile 30.8 the Swan River joins the St. Louis River. The river broadens out and becomes deeper while still being entrenched in high banks. The fall of the river in this area is only 1.3 feet per mile, thus there are no rapids and motors can be used. The banks are primarily covered with hardwood mixed with pine. Pasture lands are intermittent within this forest. Away from the river large swamps occur. These swamps have been drained, or are in the process of being drained for agricultural pursuits.

At mile 46.3 there is a boulder field which will produce the roughest rapids of the trip at certain water levels. This boulder field is about 1/3 of a mile long and is easily navigated. At mile 48.6 the White Face River enters, this river contributes a significant volume of water and was mentioned as a possible canoe route by Warden Gawboy of Meadow Lands. At the confluence of the rivers, the St. Louis broadens out to over 300 feet, pasture lands are intermittent with forest covered areas. County Road 29 follows the river throughout this stretch as far as Floodwood. At Floodwood the Floodwood River and the Savana River which has been famed for its portage route into the Mississippi drainage basin come into the

St. Louis River. Bedrock outcroppings begin to occur along this area, and consequently the river has been unable to erode vertically and has a wide and shallow cross-section. Local residents state that this stretch of the river has water fluctuations up to 20 feet.

Below Floodwood to mile 63.0 the river contains intermittent rapids and pools. These rapids have no average length nor do the pools, however, they can be described as wide and shallow boulder fields, with some of the boulders being greater than 3 feet in diameter. In high water these rapids would be of moderate difficulty, however, for the most part they present no problem. The river once again, becomes heavily forested on both sides. It is no longer as entrenced as it was before, but the banks slope away gradually for 1/2 mile or more. At mile 59.3 the river narrows down to less than 70 feet, and becomes quite shallow through this area. It is likely that in high water this would be a rugged sluiceway. Directly below this the longest rapids of the trip occur. These rapids are approximately 1 mile in length, and are composed of shallow boulder fields. Two small rapids exist at miles 62.1, and 62.9. These rapids are short, but do, however, have quite a steep drop as compared with the rest.

Above Brookston, the river becomes wider, 300 feet or so, and generally navigable. At Brookston, the wide, placid, waters extending full view downstream gives the appearance that the rest of the down stream trip might be slow and dull. But one should not disembark here, for the best is yet to come. From the area near the confluence with the Cloquet River to two miles above the town of Cloquet, there are many sets of large, and sometimes long, boulder-rapids, attractive, navigable, and fairly fast even though the river is very wide. Some boulders in this area and the reach above Brookston are ten and twenty feet in daimeter. Near Cloquet, the waters are again calm and deep, for here a pool is formed by the dam at Cloquet.

EXISTING DEVELOPMENT:

Throughout the portion of the river surveyed approximately 89 miles, there are 13 highway bridges crossing the river and 3 railroad tressals. There are approximately 35 homes and farms within 1/8 mile of the river, however, most of these are not visible from the river. The most heavily developed portion of the river occur at mile 37 to mile 42 and again from mile 47 to mile 56. The first of these areas are approximately 15 homes within 1/8 mile of the river, however, again most of these homes are not visible from the river itself. The second area has Highway 29 immediately adjacent to it. This highway is visible from the river in places. The 10 homes along the stretch of the river are, for the most part, visible. Floodwood, Minnesota lies directly on the river at mile 55. This is a small town primarily agriculturally oriented. Floodwood has been dumping raw sewage about 1/4 mile upstream on the Floodwood River, the right hand bank. The city has a park on the northeast corner of the County Road 8 bridge, off Federal Highway 2 on the Savana River. The existing marker commemorates the Savana River portage into the Mississippi River drainage. There is also a privately owned dump on the west side of the river just as Floodwood is entered. Brookston within the reservation has an access at mile 73.1. There to the St. Louis River on Highway 31 is a city park on Stony Brook about one mile above the St. Louis River. However, the city park is difficult to get to from the St. Louis River due to intervening rapids on Stony Brook.

There are 12 access points in the surveyed portion of the river, however, only two have been developed. These are at Brookston and Cloquet. The Ford Fairlane Plant is developing one near Highway 53 and should have it done by the fall of 1966. This will be an access and campground with a parking area. There is also a good access point in Floodwood, this is at the city park.

Access in Floodwood is also possible at the Highway 73 bridge on the Floodwood River. On the river there were two dumps found. One was above the Ford Fairlane Dam on a creek at mile 2.2. The other was a private dump at mile 48.9 in Floodwood. Except for these two, there was no noticeable dumping except for a junk auto at mile 15.0. There are two resorts on the St. Louis River, one in Floodwood called Tina's Catfish Landing and one near Paupores at mile 65. These resorts are primarily for catfish fishing which the river is apparently quite well known for.

The only developed camp sites on the river occur at the Ford Fairlane Plant, mile 0.0; Floodwood, both the city park and the historic wayside park; at Brookston off the St. Louis River on Stony Brook and in Cloquet at the end of the Survey mile 89.0.

AMENITIES FOR RECREATION:

The St. Louis River is one of the more picturesque rivers that was surveyed. In the upper reaches the forest consisting of jack pine, black spruce and norway pine is one of the nicer stands of forest growth which have been observed.

In the middle stretches of the river hardwoods such as elm, silver maple, birch, popular and aspen are interspersed with farmland. One of the larger deer herds in the State grazes in this area. This of course presents an opportunity to observe wild life, especially deer. Below Floodwood the river broadens out and forms flood plains. These flood plains are marshy and are inhabited by great blue heron and some moose and deer.

The riverbed runs the whole gamut from fine silt to large boulders. In the areas of fine silt the cohesiveness of the bed and banks cause the river to erode vertically instead of laterally, thus we find many deep pools which are excellant for fishing, especially catfish.

In the upper reaches the gravel bars and sand vars create riffles, which provide a never ending challenge and an always changing scene. The larger rapids and boulder fields are much more dangerous and provide a challenge to the more hearty canoeist. In general, however, the rapids can be run by all but inexperienced canoeists except in high waters. The wild life along the river runs more to big game such as deer and moose rather than the smaller game that one might expect to find, such as beaver and muskrat. The bird life along the river was not significant, owls and herons were observed quite frequently, but other than these, few were observed. Wild flowers were almost lacking, although there were some areas of wild roses and daisies and iris. Ducks on the river were few. Fishing is popular, walleyes, norther pike and especially catfish are found in the river. Tina's Resort in Floodwood and the resort near Paupores mile 65 are primarily catfish oriented resorts. People from Iowa and Missouri come to the St. Louis River every summer to fish for catfish. Some also own their own cabins along the river. The catfish run upwards to 15 pounds with seven and eight pounders being common.

POTENTIAL FOR FUTURE RECREATION:

This river is one of the more scenic and undeveloped rivers that exist close to a metropolitan center. The river, being primarily a gentle stream, except in high water would be welcomed by the family-type canoeists. The excellent fishing along the river is also a drawing point for out-of-state residents. The excellent deer hunting and grouse hunting also provide an additional incentive for local and out-of-state hunters.

CONSIDERATION:

1. That the St. Louis River be considered in an overall development plan for the State of Minnesota.
2. That the St. Louis River be surveyed as a potential canoe route from south of Aurora to Cloquet.
3. That camp sites be developed in both the wilderness and access type atmosphere.
4. That the county and local levels take responsibility to help in developing the river and in maintaining it.
5. That this canoe route be a 5 and 7 day canoe trip.
6. That Floodwood, Minnesota attemp to alleviate the pollution problem.

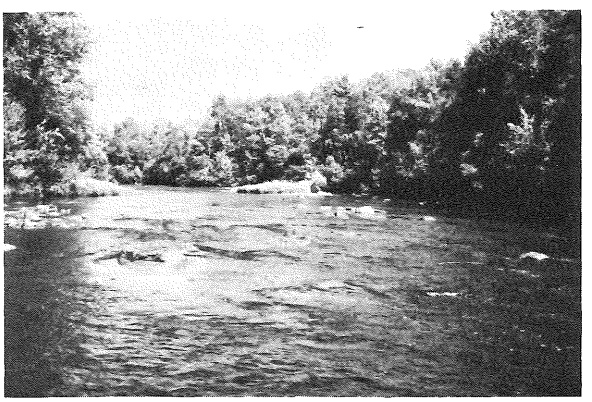
ST. LOUIS RIVER

1. Typical of upper reach showing small gravel bar on the right and large boulder in the center of the stream. Note mixed forest, predominantly conifer.
2. Typical of upper reach. Note gravel and boulder banks on the left, grassy boulder island on the right.
3. Typical boulder riffle area.
4. High, heavily grazed bank beneath deciduous woods, typical of farming area in mid-reaches.
5. Beautiful conifer forest area.
6. View upstream of one-half of the unique rubber-bag-gate dam of the Eveleth Taconite Company. Portage must be taken over boulders on the left.
7. Typical of area above Forbes.
8. Close-up of well sorted, well rounded, boulder gravel banks. Typical of much of the St. Louis River.

ST. LOUIS RIVER

1

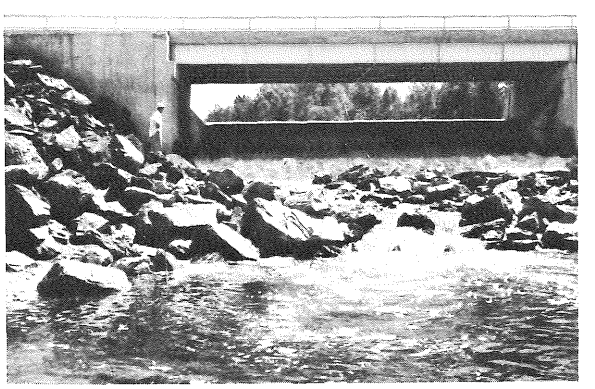
2



3

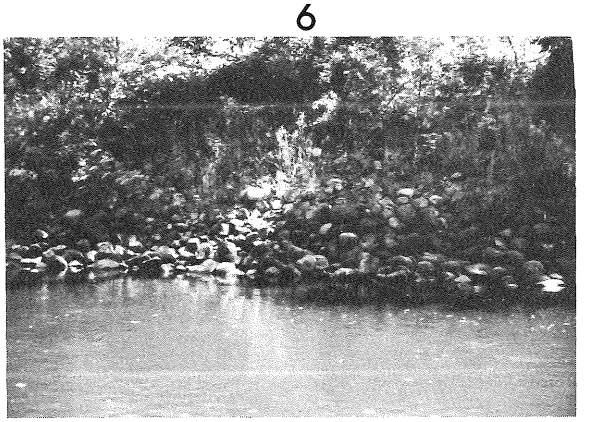
4

5

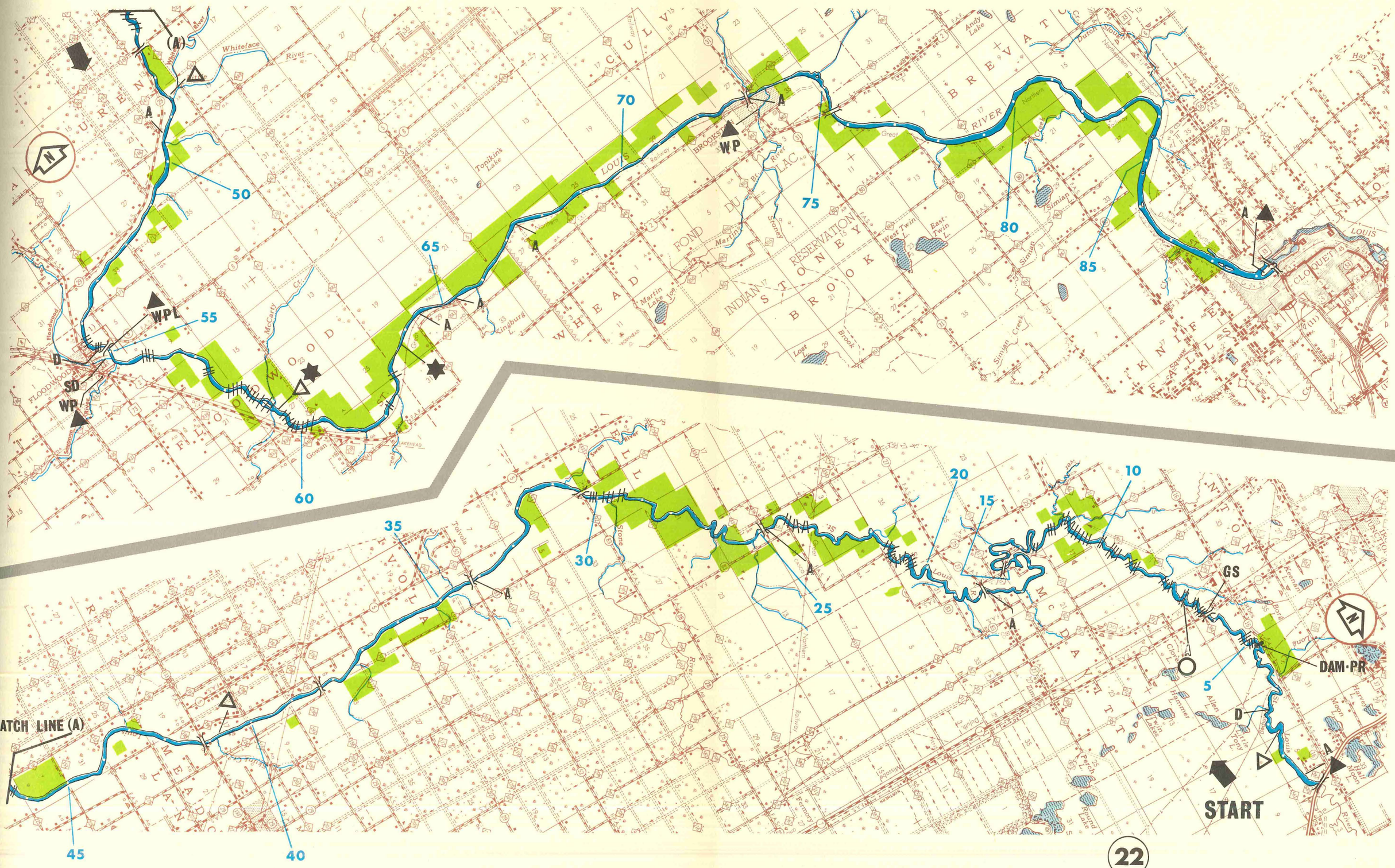


6

7



8



22 ST. LOUIS RIVER

VERMILION RIVER

LOCATION:

The Vermilion River is located in northern St. Louis County, Minnesota. It flows out of Vermilion Lake and into Crane Lake at the American Customs. Because of this, it is part of the International Waters and is governed as such. The survey began at the Vermilion Lake Dam and ended at the American Customs on Crane Lake.

NATURAL SETTING:

The dam at Vermilion Lake is very low and is actually installed to raise the water level one foot. The rapids below the Dam are very difficult, and regardless of water depth should not be attempted. The portage on the west bank about 100 rods long should be used. There is also another marked portage on the east about the same length. The Vermilion Lake Lodge has installed an access which comes out below the rapids where there is a dock and some boats which may be rented. The pool below the rapids is shallow and weedy. The edges are composed of rice beds and lilypads. The banks slope away very gradually and are forested with hardwoods, mainly birch and aspen.

At mile 0.5 there is a marked portage 80 rods in length. The portage is on the west bank with a camp site at the beginning. These rapids have three major pitches and are difficult. The equipment should be portaged around and then the canoe may be run through when the water is high enough. Below the rapids there is another long pool which is similar to the others.

At mile 2.0, there is a four foot drop and a short portage on the east bank. The portage goes directly through a camp site which has been cleared and has white pine with 18" diameter trunks. Equipment must be portaged in high water and it is possible to run the canoe over on the right hand side. Below the falls, the pool-type of natural setting continues until mile 2.6 where another set of rapids of 60 rods in length occurs. These rapids are similar to the ones above in that portage of equipment around the right hand side is possible and marked. The canoe can be run through when the water is high.

Below the rapids what is actually a lake begins. The lake is seven miles long and is similar to the pools above except that it is much larger. Coming into this lake, it widens out to about 400 feet and then narrows down at mile 5.0 to about 200 feet wide. Beyond mile 5.0 the lake begins to broaden out to its maximum width of about 1/2 mile. The next rapids marked on the Superior-Quetico Map is a 40 rod portage; however, these rapids are actually 340 rods or better in length. The portage on the right hand bank is unmarked and is very poorly developed and rough. The rapids should not be attempted because Table Rock Falls is the first obstacle encountered. These Falls are 20 feet high and dangerous. A sign marker should be placed here. Some canoeists take out on the west bank where there are some boats and portage down County Road 24 and put in below. There are three more rapids below this gorge at miles 12, 13, and 14. Below these rapids the pool arrangement begins again for another 7 miles. At mile 21 there is another rapids with a portage of 60 rods on the east bank. This can be run in high water or walked in low. The portage is not marked.

Directly below the rapids at mile 23 there is an old rail bed. The abutments may be seen from the river. The pool arrangement begins again at this point, similar to above and is about 13 miles long to mile 34 where there is another portage of 40 rods. This pool also takes on lake-like characteristics, and at mile 30 the river is nearly one mile wide. The portage is of 40 rods and similar to the others in that it can be run in high water or walked. The portage is not marked. Then at mile 35.0 there is another portage of 30 rods and this is also unmarked. There is a pool until mile 37.3 where there is a 240 rod portage on the west bank. The rapids has a falls of about 25 feet in it and should not be attempted under any circumstances. The portage goes around a gorge where the river falls into Crane Lake. Located at mile 39.0 is the American Customs and the inlet into Crane Lake. This is the end of the survey.

EXISTING DEVELOPMENT:

At mile 0.0 is the Vermilion Lake Dam, which is really just a sluiceway about 1 foot high. There is also a lodge which has cabins, swimming pool, tennis courts, and swimming beach. The owner of the lodge has

put in an access which runs off County Road 24 and comes out below the rapids. Access points exist at miles 9.9, 15.1, 30.0, 32.2 and 39.

At Buyck mile 15.0, County Road 24 crosses the river. Boundary water permits are available and a beer parlor exists here. Also, a farm exists on the east bank directly below the river bridge and homes are on the west bank. On the southeast corner of the bridge there is an access with parking spaces and room to launch a boat.

The American Customs and a resort are located on Crane Lake. Other than the above mentioned cabins, the town of Buyck and the County Road 24 crossing, there are no other developments. In former times the voyageurs used the river (via the St. Louis River) on their trek to Lake of the Woods and the far north. A fur trading post was established at mile 38.5. The Vermilion River is a scenic river. The first three rapids mentioned are all beautiful. Portages are really trails running through the woods and are well worth hiking. The woods on the sides are mainly of pine and are also scenic. The lakes allow the canoeist to look out, whereas the rapids give a more intimate association with the land.

The swamps are said to be inhabited by moose, deer, beaver and muskrats. The fishing in the river is not considered to be good, but there are walleyes, northern pike and muskellunge. Birds spotted were great-blue heron, goldeneye ducks, redwing blackbird and bald eagle nest at mile 1.0. The bald eagle nest was on the right hand bank, high in a birch tree. About four to six feet across and about four feet deep. The male and female bald eagles were both using the nest at the time of this survey.

The river, even though it was scenic, has some drawbacks. The major one is the fact that the pools are so long as to tire out the canoeist and the rapids have such a steep drop for the most part that they must be portaged. Included in this 39 mile trip are two portages close to a mile long. Both are very rugged. There are also a great many summer homes on the river -- about 15. Because of the nature of the rapids and the pools, the canoeist gets very tired. He must paddle four or five miles over dead, weedy water and then portage.

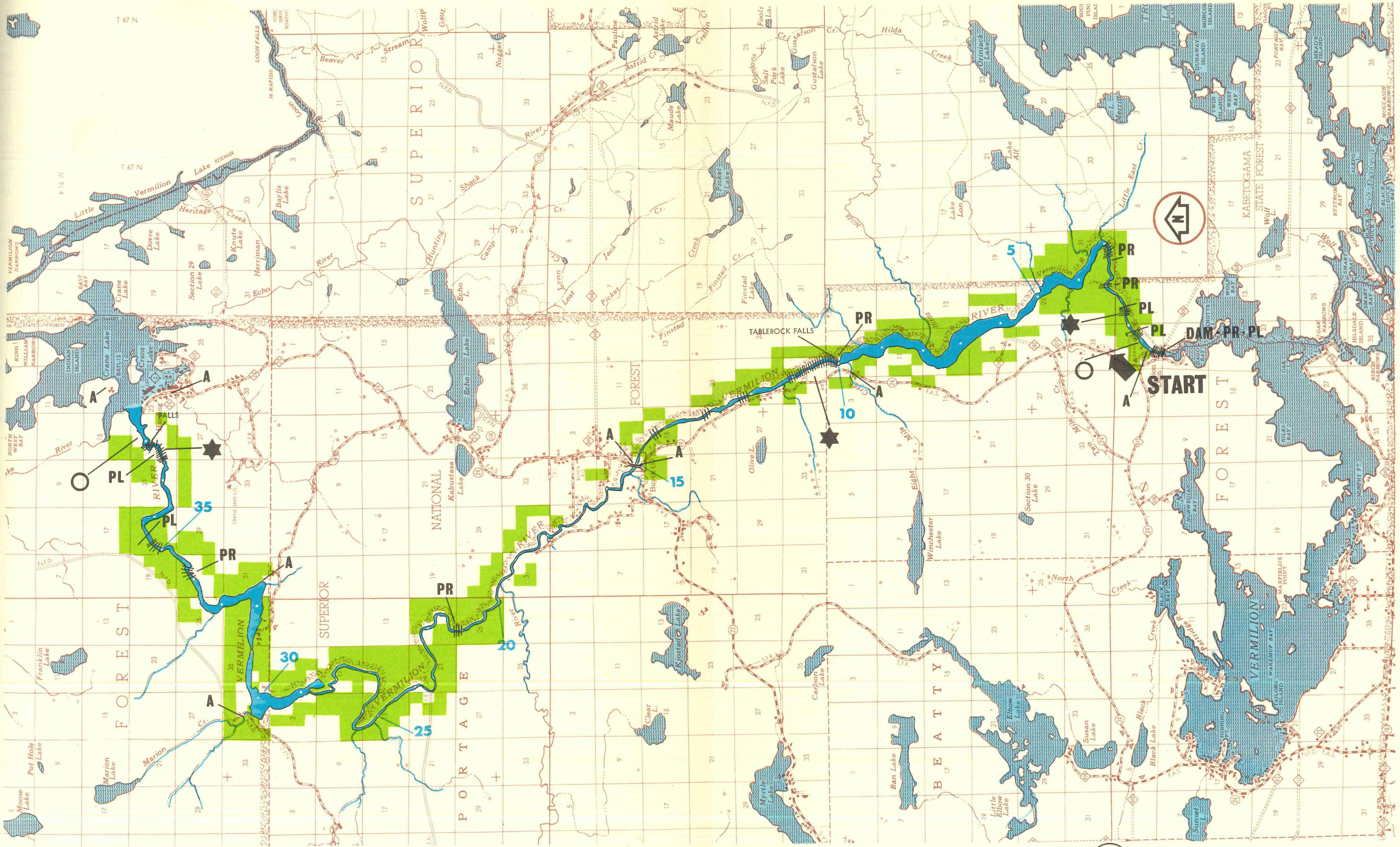
POTENTIAL FOR RECREATION:

The Vermilion River, even though it is scenic, is not worth the effort. For this reason, it is not recommended for development. However, from Buyck on down, is a popular canoe route into the Superior-Quetico region. One camp located on Pelican Lake (15 miles west) keeps canoes at Buyck for this purpose.

CONSIDERATIONS:

1. Developing and marking camp sites and portages from Buyck to the mouth of the river.

2. Developing a wayside park or camp site at Table Rock Falls (mile 10.0).



SCALE OF STATUTE MILES

1 0 1 2 3 4

WILLOW RIVER

LOCATION:

The Willow River is located in northern Aitkin County. The survey began at the Highway 169 bridge in Haypoint and ended at the confluence with the Mississippi River. A total of 38 miles were covered. Formerly the river made a hook starting at Haypoint to the northeast and then to the southwest. However, in 1910 a ditch was cut across the hook making the river flow in a southeasterly and then a southwesterly direction.

NATURAL SETTING:

The characteristic features of the Willow River are reflected in the surface geology and topography. The Willow flows through the sandy and loam alluvial plain of Glacial Lake Aitkin; thus the slope of the river is slight with no portages necessary. The banks are wooded with a mixture of hardwoods and conifers measuring up to 16 inches in diameter. The sandy loam banks are easily eroded which permit the abutting trees to become unstable and fall into the river. During the survey it was necessary to cope with 10 snagged in locations by pulling the canoe over or around the trees.

Below the confluence with the Moose River (mile 3.1) to the end of the ditching (mile 8.5) the river flows through a marshy area. High banks and tall marsh grass makes the stretch visually dull.

From mile 8.5 where the ditching ends to the confluence with the Mississippi, the river broadens out between 70 and 100 feet. Natural and abandoned farm meadows are interspersed with hardwoods and conifers. Hardwoods such as willow, silver maple, elm, oak and birch are dominant.

In general, the tree depth extends several hundred feet to several miles. The region is marginal for agricultural use. Houses are rare. Isolation from city life-even rural life-can be enjoyed on the Willow.

EXISTING DEVELOPMENT:

Seven bridges cross the Willow River. The most primitive area is from Haypoint (mile 0.0) to the County Road 5 bridge north of Palisade (mile 2.6). This stretch is crossed by only 1 bridge. However, two abandoned bridges occur just west of the Moose River confluence at miles 2.6 and 2.8. There is also an old farm dump at mile 3.5.

Homes along the river are non-existent except near bridge crossings.

The proprietor of a general store (tavern, gas, groceries) is considering a canoe livery and possibly a camp ground in Haypoint. The only developed access is at the County Road 3 bridge (mile 32.1) where there is a developed picnic area. However access is possible at all of the bridge crossings.

AMENITIES FOR RECREATION:

Wildlife is abundant along the Willow River with numerous families of ducks, large snapping turtles, deer, great blue heron and eagles noted.

Persons spoken to along the river claim it is excellent for walleyes, northern pike, red horse and pan fishing. However, deer flies and mosquitoes are terrible and present a serious problem.

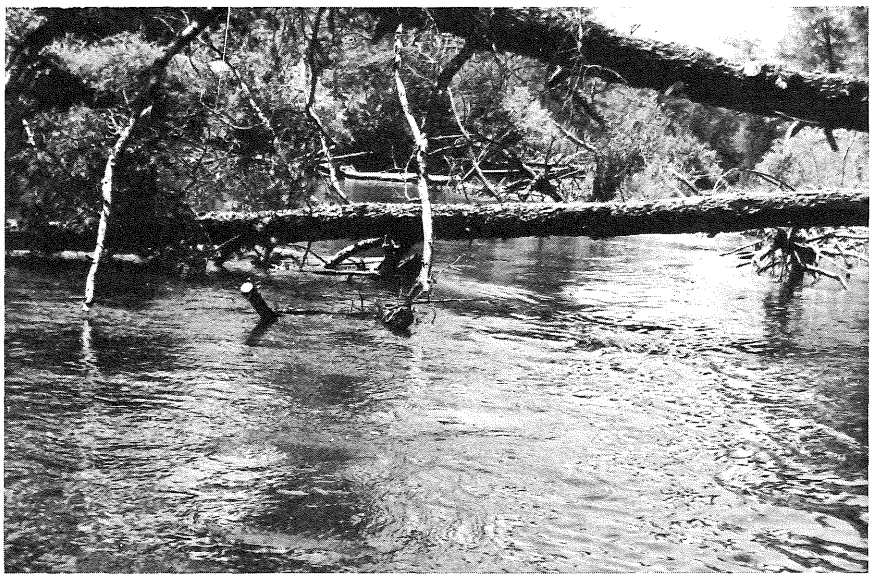
The river, having no portages (providing the downfalls are removed) and a moderate current can be easily traveled in two days.

POTENTIAL FOR FUTURE RECREATION:

The Willow River is typical of many other northern Minnesota rivers which meander and have low banks, marsh and hardwood. It is a gentle river but due to the type of soil, will not support heavy use without the danger of erosion. According to area Forester Kitzrow, the Willow River is floated from Shovel Lake but it is not recommended except by an occasional user.

CONSIDERATIONS:

The Willow River should be developed on a minimum access and camp site basis with annual cleaning of the ditched portion.



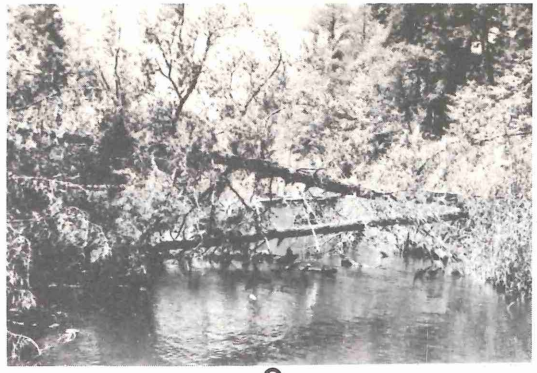
Downfall below Moose River confluence, mile 3.1.

WILLOW RIVER

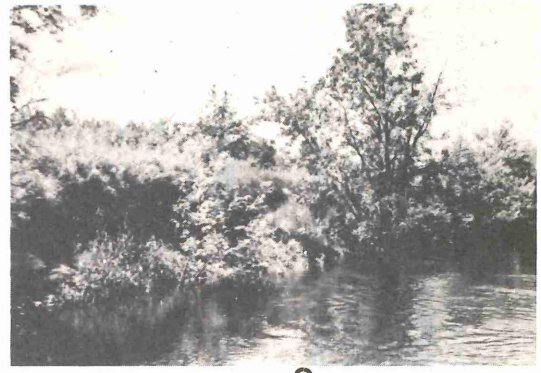
1. Downstream from Highway 169 bridge at Haypoint. Mile 34.5.
2. Typical tree fall at mile 30.0 .
3. Typical bank at mile 26.
4. Typical scene and one of several bridge remains at mile 25.
5. Log and debris jam across river at mile 20.5.
6. Bridge with debris jam beneath at mile 16.
7. Typical scene at mile 20.0.
8. One of few open riparian farm areas at mile 11.5.
9. Typical of lower reach at mile 5.9.

WILLOW RIVER

1



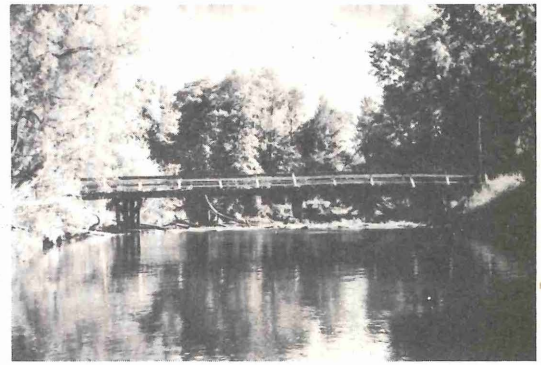
2



3

4

5

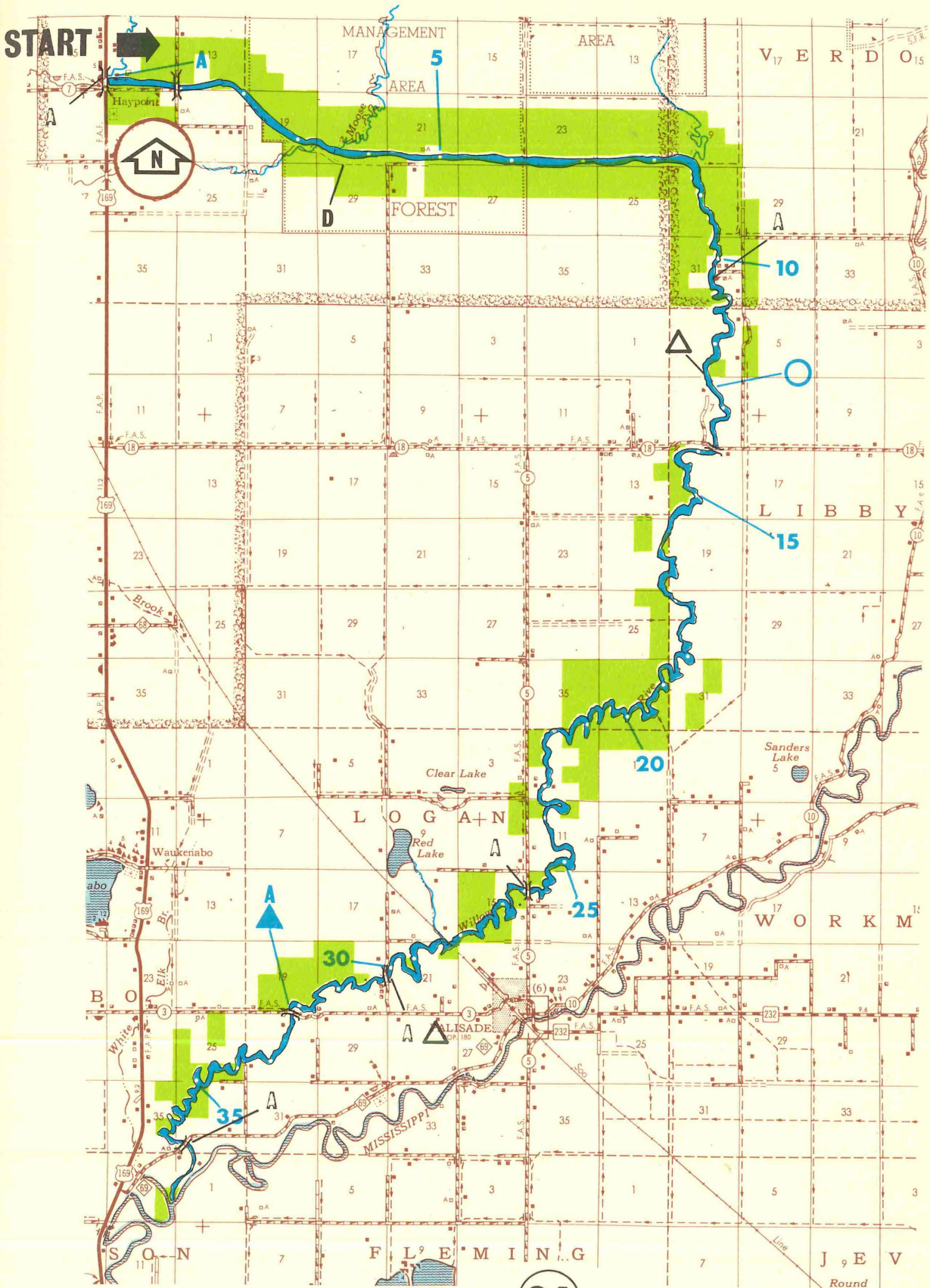


6

7

8

9



SCALE OF STATUTE MILES

24

WILLOW RIVER

PERIODICALS A

1. Grand Marais Chamber of Commerce, Come-See Review, Vol. 9 No. 1, June, 1966.

2. Kennedy, Roger G., "History in our Homes", Picture Magazine, Minneapolis Tribune, June 19, 1966.

3. Kennedy, Roger G., "Houses in Former Lumber Towns Retain their New England Character", Picture Magazine, Minneapolis Tribune, July 10, 1966.

4. Minnesota Department of Conservation, The Conservation Volunteer, Vol. 29 No. 167, May-June, 1966.

5. National Wildlife Federation, Conservation News, Vol. 31 No. 12, June 15, 1966.

6. "Pollution of the Rainy", The Baudette Region, August. 10, 1966.

7. Rapoport, Ron, "Retracing a Historic Fur Trade Route, The Minneapolis Star, May 29, 1964.

8. Saska, George, "Big Fork River to be Mapped", Minnesota Tourist Travel Notes, Volume 4, No. 1, April, 1966.

9. "Savanna Portage Comes Back to Life", Picture Magazine, Minneapolis Tribune, June 21, 1964.

10. Schaefer, Edward, "Antipollution Laws Called Ineffective", Minneapolis Star, August 12, 1966.

11. "Wild Rivers that the Senate Would Save", U.S. News and World Report, January 31, 1966.

BROCHURES B

1. Big Fork River Canoe Trail Association, Big Fork River Canoe Trail.

2. Brainerd-Paul Bunyan Vacationland Association, Brainerd-Paul Bunyan Vacationland.

3. Cook County Civic Council, The Tip of the Arrowhead in Minnesota.

4. Department of the Interior, the Bureau of Outdoor Recreation, Questions and Answers on Federal Outdoor Recreation Fees, 1965.

5. Division of Publicity, Department of Business Development, Let's Go Camping in Minnesota, 1965

6. Forest Industries Information Committee, Harvesting Minnesota's Tallest Crop: The Growing Value of Minnesota Forests.

7. Forest Service, U.S. Department of Agriculture, Boundary Waters Canoe Area-Superior National Forest.

8. Forest Service, U.S. Department of Agriculture, North Central Region, National Forest Recreation Sites, 1962.

9. Humble Oil and Refining Company, Wild Rivers.

10. Kandiyohi County, Minnesota's Little Crow Lake Region, 1965.

11. Louisiana Tourist Development Commission, Follow the Great River Road-Canada to the Gulf, 1966.

12. Michigan Tourist Council and Michigan Department of Conservation, Michigan Canoe Trails.

13. Supplement to Twin City Suburb Newspapers, Minnesota Vacation Fun Guide, 1966.

14. U.S. Army Corps of Engineers, Reservoirs at the Mississippi Headwaters.

15. United States Department of the Interior, National Park Service, Grand Portage, 1965.

16. United States Department of the Interior, National Park Service, Ozark National Scenic Riverways.

17. Winona Chamber of Commerce, Have Fun in Winona, Minnesota.

REPORTS C

1. Aitkin County Park Commission, The Mighty Mississippi-Recreational Boat Guide Through Aitkin County, 1966.

2. Bell, Robert W., William A. Heffelfinger and Elbert B. Johnson, Economic Study of the Proposed Buffalo National River, 1963.

3. Big Falls Commercial Club, Big Fork River Float Trip Map, 1966.

4. Bureau of Outdoor Recreation, United States Department of the Interior, A Report on the Proposed Allagash National Riverway, 1963.

5. Borchert, John R., Minnesota's Changing Georgraphy, 1959. Atlas of Minn. Agriculture, 1958.

6. Corps of Engineers, Department of the Army, Civil Works Projects, Recreation.

7. Department of Agriculture and the Department of the Interior, Wild Rivers, 1965.

8. Department of Conservation, Division of Forestry, Primitive State Forest Campgrounds, 1966.

9. Department of the Interior, Bureau of Outdoor Recreation, Regulations Pertaining to Assignment of Responsibilities, User Fee Criteria and Standards, and Designation of Areas-Issued in Connection with the Land and Water Conservation Fund Act of 1965, 1965.

10. Department of Iron Range Resources and Rehabilitation, Land Ownership, 1963-65, depending on county.

11. Forest Service, U.S. Department of Agriculture, The Program of Management for a Wild River and Its Country-The Eleven Point in Missouri, 1966.

12. Geological Survey Bulletin 3, by G. E. Hendrickson, Michigan's Au Sable River-Today and Tomorrow, 1966.

13. Herbst, Robert L., Our Rivers-A Major Recreational Resource, 1966.

14. Harding, Colonel Leslie B., Studies of Water Resources Problems in the Minnesota River Basin by the Corps of Engineers, 1966.

15. Hearings before the Committee on Interior and Insular Affairs of the United States Senate, Wild Rivers System-St. Croix Waterway, 1965.

16. Humrickhouse, A. B., Root River Canoe Trail, not copyrighted, 1965.

17. Lodge, Donald E., The Development of Outdoor Recreation in the Upper Midwest, 1964.

18. Lucas, Robert C., Recreational Use of the Quetico-Superior Area, 1964.

19. Lucas, Robert C., The Status of Recreation Research Related to Users, 1963.

20. Lucas, Robert C., Trendsin Use of the Boundary Waters Canoe Area and the National Wilderness Use Picture, 1964.

21. Metropolitan Planning Commission, Exerpts from Joint Program Alternatives, Paper 4, 1966.

22. Minnesota Conservation Department, Division of Game and Fish, by Donald C. Reedstrom, A Biological Reconnaissance of the Snake River, 1964.

23. Minnesota Department of Conservation, Division of Game and Fish, by Donald C. Reedstrom, A Biological Survey of the Shell River Watershed, Becker, Hubbard, Ottertail, and Wadena, Counties, 1965.

24. Minnesota Department of Conservation, Division of Game and Fish, Research and Planning Section, Fish and Wildlife Surveys Unit, Detailed Report on the Dry Weather Creek, Watershed-Chippewa and Swift Counties, 1961.

25. Minnesota Department of Conservation, Division of Game and Fish, Minnesota Game Management Policy, 1963.

26. Minnesota Department of Conservation, Minnesota Outdoor Recreation-Present and Future, 1965.

27. Minnesota Department of Conservation, The Minnesota River Report, 1964.

28. Minnesota Outdoor Recreation Resources Commission, Recreational Use of the St. Croix River, 1965.

29. Minnesota Outdoor Recreation Resources Commission, Staff Report Number 1, Users Fees, 1963.

30. Minnesota Outdoor Recreation Resources Commission, Staff Report Number 7, The Minnesota River Valley, 1963.

31. Minnesota Outdoor Recreation Resources Commission, Staff Report Number 9, Recreational Use of Rivers and Streams in Minnesota, 1965.

32. Minnesota Outdoor Recreation Resources Commission Report Number 12, Parks and Recreation in Minnesota , 1965.

33. Minnesota Recreation Association, Minnesota Recreation and Park Laws, 1958.

34. Minnesota River Recreation Development Association, Report on the Minnesota River for the 1963 Legislature, 1963.

35. Minnesota River Recreation Development Association, Inc., Minnesota River from its Mouth at the Mississippi River to New Ulm, 1963.

36. Office of Iron Range Resources and Rehabilitation, Timber Resources of Minnesota-Aitkin County, 1961, 1964.

37. Office of Iron Range Resources and Rehabilitation, Vasilevsky, Alexander and Robert N. Stone, Timber Resources of Minnesota Central Pine Unit, 1961, 1965.

38. Office of Iron Range Resources and Rehabilitation, Timber Resources of Minnesota-Crow Wing County, 1961, 1964.

39. Office of Iron Range Resources and Rehabilitation, Timber Resources of Minnesota-Itasca County, 1961, published 1964.

40. Outdoor Recreation Resources Review Commission, Directory of State Outdoor Recreation Administration, 1962.

41. Outdoor Recreation Resources Review Commission, Land Aquisition for Outdoor Recreation-Analysis of Selected Legal Problems, 1962.

42. Outdoor Recreation Resources Review Commission, Open Space Action, 1962.

43. Outdoor Recreation Resources Review Commission, Paying for Recreation Facilities, 1962.

44. Outdoor Recreation Resources Review Commission, Projections to the Years 1976 and 2000: Economic Growth, Population, Labor Force and Leisure, and Transportation, 1962.

45. Peekna, Andres and Richard Snellgrove, Guide to White Water in Wisconsin, 1965.

46. Quimby, Mildred, Upper Mississippi Harbor Guide, 1966.

47. 1963 Rivers Survey, Report No. 1, by Clyde N. Ryberg, St. Croix River, 1963.

48. 1963 Rivers Survey, Report No. 2, by Clyde N. Ryberg, Little Fork River, 1963.

49. 1963 Rivers Survey, Report Number 3, by Clyde N. Ryberg, Big Fork River, 1963.

50. 1963 Rivers Survey, Report Number 4, by Clyde N. Ryberg, Minnesota River, 1963.

51. State of Minnesota, Department of Conservation, Division of Waters, The St. Louis River Watershed Unit, 1964.

52. State of Wisconsin Department of Resource Development, Recreation in Wisconsin, 1962.

53. Snyder, Richard E., Trends in the Sporting Goods Market, 1961.

54. The Wildland Research Center, Report to the Outdoor Recreation Resources Review Commission, Wilderness and Recreation-A Report on Resources, Values, and Problems, 1962.

55. U.S. Army Engineer Division, North Central, Upper Mississippi River: A Comprehensive Basin Study of Water and Land Resources, 1965.

56. United States Department of Agriculture, Forest Service, Superior National Forest-Supplemental Specifications to the Trails Handbook For Portage Maintenance, 1960.

57. United States Department of the Interior and the Bureau of Outdoor Recreation, Guides to Outdoor Recreation Areas and Facilities, 1966.

58. United States Department of the Interior, Fish and Wildlife Service, Big Stone Lake-Whetstone River Project Modifications, Minnesota and South Dakota, 1960.

59. United States Department of Interior, National Park Service, A Proposal: Ozark Rivers National Monument, 1960.

60. United States Department of the Interior, National Park Service, Appendix: A Proposal Ozark Rivers National Monument, 1960.

61. United States Department of the Interior, National Park Service, Field Investigation Report, Suggested Buffalo National River, Arkansas, 1963.

62. Vieth, Philip, Root River Canoe Trail, not copyrighted, 1965.

63. Wisconsin Conservation Department, Wisconsin Water Trails.

The Department of Geological Survey, St. Paul Office, is under contract to survey the same 24 rivers as shown on the index map. The content of the survey charge is geology, hydrology data and water chemistry, all of which is very important when judging the priority of a river to be designated as a part of a State System. The following material represents the analysis, data and findings of the survey.

RECONNAISSANCE OF SELECTED RIVERS OF MINNESOTA

Introduction

"Water is probably the greatest of all our recreational attractions. River systems and their shore environments are major recreational resources, yet at the present time they are (mostly) uninventoried and unclassified . . . The nation is rapidly developing and utilizing it's tremendous outdoor recreational resource, especially that part of the resource that is water oriented, without knowing the total scope of the resource, the rate at which it is being developed, the characteristics of how it can be classified, rated and evaluated, preserved and improved." (Craighead and Craighead, 1962).

Since the above words were published in 1962, the nation has, through the consideration of the "Wild Rivers" bill in the U.S. Congress begun to evaluate, classify, and protect certain of our nation's major rivers. Minnesota also has wisely begun taking steps toward the classification, evaluation, preservation, and improvement of its recreational rivers. The first step is a hydrologic reconnaissance of the rivers, of which this is a report as requested by the Minnesota Department of Conservation. From this reconnaissance, certain rivers of high potential have been selected and given priority rating for which further study is proposed to enable proper understanding and management of those rivers.

Research

A river is a dynamic part of nature. The forces that have resulted in the present day river are still active; the river is downcutting and/or filling, meanders are shifting laterally and downstream, bottom sediments are shifting, chemical load is varying in character and quantity, and the velocity and discharge are changing. These changes occur on daily and shorter term bases as well as gradually over the years and must be examined and evaluated in order to understand the river and it's part in the total ecology and utilization of resources in Minnesota.

A major part of man's effort to change nature has resulted in side effects that outweigh the benefits of the initial effort. These side effects almost universally were not foreseen. For example; flood plain protection by dikes and levees not only have not decreased flood damage but the alteration of the rivers has caused shifting of channels. Banks that were relatively stable for centuries, have eroded back hundreds of feet is a single flood as a result of upstream "beneficial" channel alteration. Change in forest cover, bank vegetation, and dam management or dam construction, increase downstream erosion and changes the entire character of the river. Only in recent years have the forces that control rivers been examined closely. Full application of present day knowledge and study of these forces in operation is the next step in proper utilization of those rivers briefly examined in this study.

A complete river study must, due to the interdependence of so many factors, involve a wide range of disciplines and considerations. Herein is briefly summarized factors that we feel essential to a comprehensive river study program.

The PHYSICAL SETTING of the river concerns the geographic location, size, shape, and bottom and bank characteristics. Accurate MAPPING of the setting is important so that the description and other information may be properly communicated to the planners and users. Some areas have good coverage by U.S.G.S. topographic maps for use as base maps. Others are inadequately mapped and will require mapping through use of air photos and field reconnaissance.

Detailed study of the WATER FLOW throughout the river, its variation with time and climatic conditions, and its relation to geology, ground-water movement, and channel morphology will permit understanding of the various conditions that exist, and permit

understanding of the various conditions that exist, and permit prediction of when, where, and what conditions may exist in the future. This is of value to planners and scientists as well as to the boaters and canoeists in terms of NAVIGIBILITY.

The QUALITY of the water and its part in the overall ecology, relationship to ground water, geology, and climatic changes must be known in order to understand the balance of nature in each reach of each river. This balance might easily be disturbed through improper use and development with a resulting disasterous change in the character of the river. The GEOLOGY has dominant influence on the chemical quality, the general morphology of the river, and the ecology of the area. It is also related closely to the aesthetic quality of the river. Knowledge of the geology is of value, therefore in both management and development programs and also in giving the user further information so that he may better know and appreciate the environment through which he passes. Interrelated with the above are factors of stream morphology such as slope, bottom material, and channel shape. Presence and influence of dams and other water control structures, as well as the GENERAL USES and land ownership of the river corridor must also be known and understood. Of non-recreational use the most prominant is power production through the use of the energy in the form of hydraulic head created by dams. Many of these are relics having been abandoned as they became uneconomical. Maintenance of reservoir levels by dam control is in common practice. Rivers are also utilized extensively for waste removal for municipalities, industry, and individuals. One of the heaviest recreational uses is boating, usually by canoe in Minnesota waters. Hiking, hunting, fishing, camping, photography, and nature study are some of the other recreational uses. It is significant also that the river shelters the major concentration of wildlife within the drainage basin.

AESTHETIC APPEAL is a factor that may vary considerably among individuals. The user commonly desires some type of natural beauty whether it is a pine woods, maple forest, or swamp area full of bird life. To a degree, peace and solitude is also a measure of the rivers appeal. In order to more objectively record and transmit this illusive factor to interested persons the extensive use of photographs should be employed. The predominant character of a river is usually very different than the typical scene observed from the bridge crossings.

The study should also include work in full cooperation with the Division of Game and Fish, Forests, Parks and Lands and Minerals in order to complete the understanding of the ECOLOGY of the river. Appropriate ACCESSIBILITY needs to be known and controlled. An area must be reasonably accessible to the intended user, yet over accessibility can crowd and destroy both the degree of solitude and aesthetic appeal.

The role that the river has played in the HISTORY of Minnesota can be both of value in understanding changes that have occurred and of considerable interest and educational value to the user.

Specifically we request a program which will result in the expansion of the data and interpretations furnished by this study, so that each of the high priority rivers will have information available that will be suitable for management and for enhancement of the appreciation of the rivers by the public.

Preservation of the rivers of a wilderness or semi-wilderness character for recreation in a manner such that as little as possible of the natural system is disturbed while still permitting access and use can also be of high value to science and education. Such rivers when studied, under natural and unregulated conditions especially, can lead us to a better understanding of other rivers by providing a natural laboratory in which long-term changes and controls can be observed and interpreted. This knowledge can then be applied to the management of other rivers. Through the use of nature trails, displays and exhibits adjacent to the river, reports, maps and films made available to the public, the river becomes a valuable tool in education in the natural sciences and serves to encourage conservation and preservation of the river and other natural resources by future generations.

Result of Reconnaissance

The aforementioned factors were studied in as much detail as time and money permitted. Appropriate past records were summarized manually and by computer and presented in graphical and tabular form. U. S. Geological Survey personnel in heavily loaded 20-foot aluminum canoes traveled down most of the rivers. On these reconnaissance trips, measurements, descriptive data, photos, slides, and motion pictures were taken. The presented report form of these data is as follows:

1. A BASE MAP of each river on scale-stable mylar "green-lines" from Army Map Service 1:250,000 scale maps. Color separation plates for the rivers and lakes (blue), forest cover (green), and highways and political features (red and black combined) are available at the USGS offices in St. Paul. They are stored there until time of use due to bulk and to reduce handling to a minimum. This and the index map describe geographically, the PHYSICAL SETTING.

2. Profiles of each river channel further describing the physical setting, useful in interpretation of history, relation to geology, navigation, general character.

3. A HYDROLOGY sheet and a duration hydrograph plotted from summary of computer data. These present in graphic form the hydrologic data presently available for each river.

4. GEOLOGY sheet with geologic map of each river valley and brief description of the geology as known and observed.

5. WATER QUALITY sheet presenting data summaries in graphical and tabular form, indicating character and variation of quality and amount of data available.

6. A sheet or two of PHOTOGRAPHS selected from a collection of more than one photo per mile for each reach of river covered on the reconnaissance trips. Selected to portray typical character, aesthetic quality, and significant locations rather than to impress with the beauty spots only. A separate sheet of brief captions also accompanies the photos.

7. A set of 35 mm COLORED SLIDES of scenes on selected rivers.

8. A 30 minute silent 16 mm color MOTION PICTURE. (Presently in final stages of production). The film shows selected scenes taken along five rivers of differing character covered during the summer's reconnaissance.

9. Overall PROJECT SUMMARY with recommendations for further study including priority list of river, and introductions and explanations of the separate report sheets, of which this is a part.

Priority Ranking of Rivers for Further Study and Protection

1.	Big Fork	See following pages
2.	Little Fork	See following pages
3.	St. Croix	See following pages
4.	St. Louis	See following pages
5.	Cloquet	High quality river with limitations due to navigability
6.	Kettle Red Lake	High quality rivers, segments of which are of especial value

7.	Brule Pigeon Vermillion	High wilderness quality but limited navigability
8.	Mississippi River above Bemidji Crow Wing	Medium quality rivers with some wilderness value
9.	Snake Otter Tail Pine	Medium quality rivers with limitations due to navigability
10.	Rum Mississippi below Bemidji Rainy Root Cannon Minnesota above Mankato Cottonwood Willow	Lower quality rivers. Limitations due to navigability for all but Rum, Mississippi, and Rainy.

The BIG FORK RIVER is a semi-wilderness river ranking top priority for protection capable of limited increase in use and in need of scientific study. It is relatively unspoiled, passes through beautiful forest, both mixed and predominantly spruce. It has an abundance of wildlife, several public camping facilities, and many areas very suitable for "wilderness camping." The major part of the river now lies within areas of public ownership. A variety of waters from quiet pools to roaring falls are spaced along its pleasurable reaches. It is generally safe for even inexperienced canoeists. There are several good access points, public campgrounds, yet the areas between are very desirably inaccessible. The town of Big Falls is not directly on, nor detracting from, the river, yet lies conveniently near the middle of the usually traveled reach. There are rock outcrops and other geologic phenomena that can be observed. The water is clear, amber-colored, warm, and very pleasant for boating and swimming. The geomorphology shows indication of being of great interest, highly correlated to the vegetation, and indicates that unusual changes in channel shape and location have taken place within recent time. It meanders in such a way that users can be spaced only a fraction of a mile apart and yet be unaware of each other.

The LITTLE FORK RIVER is a wilderness river of the highest quality. Of all of the rivers in the state it and the Big Fork most nearly include all of the qualities that are desirable in natural and relatively remote rivers. The water is clear to amber in color and contains little sediment. It is cool during the summer but not dangerously cold. The bottom is sand and gravel with some large boulders and cobbles. Numerous rapids are interspersed with pool areas permitting a varied canoeing experience. Several of the falls are such that they cannot be run at any stage and must be portaged, however, the portage routes are over rock and add to the enjoyment of the trip rather than detract. The flow is normally not so great as to be unsafe for inexperienced canoeists but is adequate during the major part of the year for travel in most reaches. During lowest flows, excessive portaging may be required in the upper reaches.

In many reaches of the channel numerous bedrock exposures both along the banks and on the bottom in rapids areas enhance the appearance of the river. Mixed conifers combined with the ice-scoured, grass-covered banks, the boulder banks, and the scattered cobbles and boulders in the streams gives an unusual far north beauty. The shape of the channel and the configuration of meanders in the river reflect the interesting geologic history of the area. Particularly unique may be the effect of earth rebound, a rise in the land surface resulting from withdrawal of the ice sheets. Access and camping facilities are good now and camping sites are available for an increased use of the river. Fishing, hunting and nature study opportunities would appear to be exceptionally good.

The SAINT CROIX RIVER above Taylor's Falls is a semi-wild erness river of considerable beauty and variety. It is of special value due to its location convenient to the Twin Cities. Portions of it are already bordering a park, the St. Croix State Park. It has clean waters, good potential camping areas outside the park and public campgrounds in the park. Long stretches of quiet water and a reach of many consecutive rapids vary the river experience of the traveler from meditation to excitement. It is certainly worthy of immediate protection against any regulation and commercial or private development. At the present time some changes in bank ecology are changing long established patterns of river morphology. Being a state boundary river, a much needed study program becomes a special case and has been proposed as a separate cooperative program with Wisconsin through the Boundary Waters Commission.

The SAINT LOUIS RIVER is a semi-wilderness river of variety, beauty, and interest. The upper reach from Hwy. 53 to the Eveleth Taconite dam is very navigable and of particular beauty with clear conifer forest, sandy banks, and excellent camping opportunity.

Below the dam the river though less navigable is attractive with geologic scenery varying from boulder and cobble bars and riffles, to outstanding exposures of gray and brown, banded, possibly varved, clay deposits from the bottom of old Glacial Lake Upham. Meanders are so close that at times the downstream corridor is readily apparent adjacent to that in which one is traveling, yet above Floodwood the river is remarkably straight for many miles. It then swings southwest along the old lake beach. The lower reach is up to 300 feet wide and varies from a placid lake-like appearance at Brookston and Cloquet to sets of consecutive white-water, boulder rapids.

The quantity, high degree of sorting, and roundness of the boulder deposits is very unusual. Ice-breaker islands above Cloquet and logging eye-bolts on the boulders are of historic interest. Clams and their trails on the clean sand bottoms, the amber-colored water, ducks, deer, heron, logs buried beneath forests, beautiful fall foliage, springs, and huge glacial transported boulders are among the other interesting sights along the river.

Development on the banks is slight even at Floodwood and Burnette. Some industrial development exists at Cloquet but is not detractive. The access public park there is of very high quality. Other access areas are not developed but are suitable in number and spacing. The river is within easy reach of Duluth and Grand Rapids, and of reasonable proximity to the Twin Cities. Its location, semi-wilderness character, variety of sights and attractions make this a river deserving prime consideration for study and protection.

THUS, WE URGE IMMEDIATE ACTION FOR PROTECTION AND PRESERVATION OF THESE FOUR BEAUTIFUL AND USEFUL RIVERS AND REQUEST A PROGRAM OF FURTHER INTENSIVE STUDY THAT WILL SERVE TO GUIDE THEIR FUTURE MANAGEMENT AND SERVE AS A MEANS OF PROVIDING BASIC UNDERSTANDING OF THE FINEST RIVERS IN MINNESOTA.

Comment

Every river in the study is worthy of whatever protection seems feasible, for usually there are reaches of a mile or more that are usable for boating during the summer months by local residents. And if nothing else, they are of value just to casually observe or to fish in for an hour or so. All the rivers that were studied are deteriorating now. Areas of good access that are favorite fishing spots are littered with shiney, non-rusting aluminum, beer cans and corrision-proof plastic containers, as well as paper, dead fish, and other trash. Where access paths exist, the banks are often eroded, and frequently excessively littered. Cabin development has decreased tree cover, increased erosion and pollution. The extent of these effects cannot be evaluated from the data now available. No matter how far back from civilization one gets on any of the rivers, one finds broken glass, beer cans, or other litter. In the more populated areas, especially at bridges, everything from antique autos to dead pigs were observed in the river. The philosophy seems to be that once thrown into the river, the item is gone forever and little thought is given of the damage done to the river itself. Enforced laws and public education are two of the first corrective steps needed.

One of the problems encountered on the canoe trips, especially in the northern rivers, is the tremendous deer fly and mosquito population that exist usually after the first week in July until the first frost. Any promotion of these rivers for use by people not familiar with the problem could have disasterous results if they are not cautioned to come suitably prepared.

Any proposal for development of a river and encouragement of further recreational use by humans will also have to provide for protection, maintenance, use-regulations and enforcement thereof, or the exact factors by which the river was judged will be destroyed by that use. The Crow Wing is an example of problems encountered in promotion programs that are not also funded for maintenance and protection.

INTRODUCTIONS AND EXPLANATIONS OF

THE INDIVIDUAL DATA SHEETS

Index Map and Scale Explanation

The index maps and the accompanying scale are for use with the maps of each river on scale-stable mylar with color separation negatives from the U.S.G.S. 1:250,000 topographic maps provided by the U.S.G.S. as part of this project.

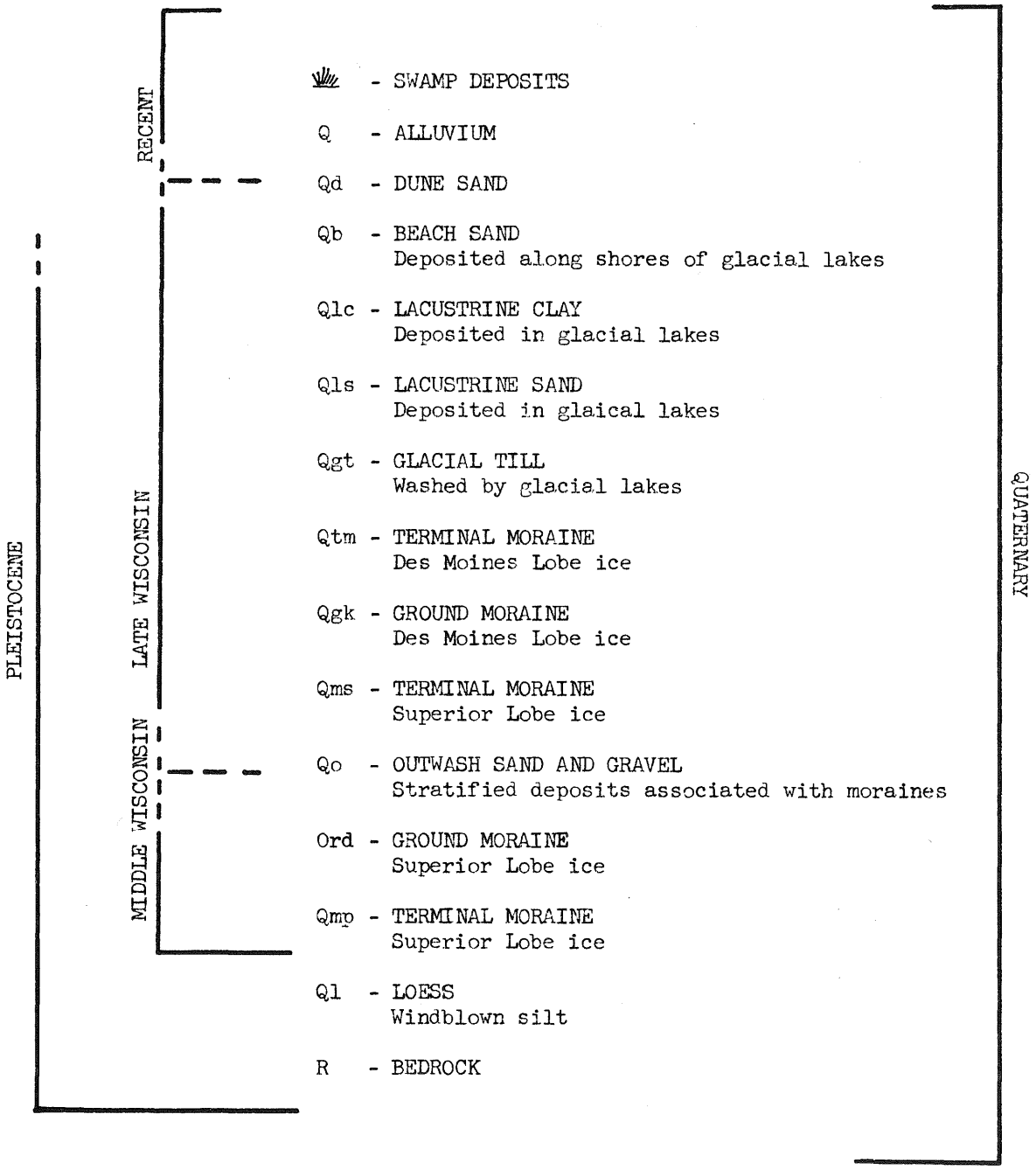
Geology Introduction

Some of the oldest rocks in North America crop out in Minnesota. The Precambrian Knife Lake group and Animikie group granite and gneiss that underlie much of northern Minnesota is now known to be about 2.5 million years old. Exposures of these rocks can be seen in the Little Fork, Big Fork, upper Snake, and Vermilion Rivers. The younger Precambrian granite exposed in the upper Rum, and the middle Minnesota, was formed about 1.1 billion years ago. The volcanic flows and diabase found in the channel of the Kettle, Snake, and St. Croix are also approximately 1.1 billion years old. The Hinckley sandstone, 0.6 billion years old, best exposed along the Kettle River, and the underlying Fond du Lac sandstone are the oldest sedimentary rocks in the state.

A series of sandstone and limestone units spanning time from Cambrian to Cretaceous were deposited on these ancient rocks by shallow seas that at one time covered Minnesota. The 400 million year old Cambrian age sandstone and limestone rock units of the St. Croix group are best seen in the St. Croix River downstream from the Dalles and in the valley of the Root River. Younger rock formations of Ordovician age (350 million years old) are exposed in the Cannon and upper part of the Root River including the Prairie du Chien, St. Peter, Platteville, and Glenwood sandstone and limestone formations. The youngest bedrock exposed in the rivers of Minnesota is sandstone, sand and clay of Cretaceous age, about 90 million years old, found just above the granite in the Minnesota River valley. This unit forms the bedrock unit throughout most of south-central and western Minnesota.

Glacial drift, rock material deposited as a direct result of glacier ice advancing over Minnesota, covers nearly the entire state. These glacial deposits make up the valley walls and channel banks in most reaches of the state's rivers. The glacial ice advanced as shown in figure 1. Although glaciation occurred over a period of one million years, the most recent glaciation is the one which had the greatest effect on the present shape of the river valleys of Minnesota. This is called the WISCONSIN glaciation. In Minnesota it is now subdivided according to advance and retreat of the major ice lobes or tongues that flowed south out of Canada and east out of Lake Superior. The DES MOINES LOBE advanced two times, the BEMIS phase 14,000 years ago, and the MANKATO phase 13,000 years ago. LAKE AGASSIZ, associated with the Des Moines Lobe existed at two phases, the more extensive 11,740 years ago, the second stage 9,000 to 7,000 years ago.

EXPLANATION
SURFICIAL GEOLGIC MAP



Sublobes of the Des Moines Lobe made major changes in the drainage of the state. Particularly, the GRANTSBURG SUBLOBE which controlled drainage of the St. Croix, Kettle, Snake, and Rum Rivers. This advance occurred 12,700 to 11,800 years ago.

The ST. LOUIS SUBLOBE, advancing through the St. Louis River basin, reached a maximum about 11,000 years ago. The ice advancing out of the Lake Superior Basin called the SUPERIOR LOBE reached its maximum in the ST. CROIX PHASE about 13,000 years ago when it deposited the ST. CROIX MORAINE west of the St. Croix River.

GLACIAL LAKE DULUTH which drained down the St. Croix River existed at about the same time as the second stage of Glacial Lake Agassiz, some 9,000 to 7,000 years ago.

The rock materials in glaciers are carried predominantly in the lower part of the ice. The deposition of the rock material carried takes place in many forms. The most common deposit is TILL, a heterogeneous mixture of clay, silt, sand, pebbles, cobbles, and boulders. This till is deposited as GROUND MORAINE, a flat featureless cover over the existing landscape (like icing over a lumpy cake). In places the till is plastered onto the surface in a series of low elongated parallel hills called DRUMLINS. TERMINAL END MORAINE is a piling up of the till that takes place when the forward motion of the glacial ice is just equal to the rate of melting. The ice carries rock material up to a fixed line and drops it there as the ice melts.

Because there is such a large amount of water near the end of a glacier where the ice is melting the water forms into major streams that flow along the side of the ice, off the end, or tongue, or even in and under the ice through tunnels. This "melt water" washes away clay and silt but leaves larger particles of stratified sand, gravel, and boulders. These deposits are generally called ICE CONTACT OUTWASH deposits.

The outwash may be in the form of a broad plain, a terrace, or a mound. Where the outwash is deposited in an ice tunnel and the present form is a long sinuous steep-sided ridge it is called an ESKER. An island in Whitefish Lake on the Pine River route and boulder ridges in the upper Rum were formed in this way.

Hydrology, Introduction and Explanation

The amount of flow in a stream is a critical factor in determining its potential use for recreation. The factors that determine navigability of a stream include channel size, shape, gradient and barriers as well as flow. Sufficient channel width is, generally, not a problem except where it may be related to tree fall. More often channels are too wide, allowing the water to spread out to a very shallow depth. Both stream width and depth are variable and, therefore, are not known in detail. Often with increasing stream width, there is a decrease in depth and an increase in gradient.

A summary of stream stages and velocities are shown on the HYDROLOGY page. They do not exactly represent any given point along the river. More exact locations of riffles or other generally shallow and fast flowing reaches of a stream can sometimes be obtained from the profile of the stream.

The duration hydrograph gives a summary of streamflow and navigability. Because the discharges of streams have been recorded for sometime, the variation in flow can be statistically predicted. No duration hydrograph could be obtained for those streams for which there was less than 19 years of record. The directly related stream discharge and stage is used as an index to navigability. The discharge is given in cubic feet per second, cfs; the gage height, in feet. Gage height, measured to an arbitrary datum should not be misinterpreted as being the depth of the water.

To predict navigation, the probable flows during a period are first found by following down from the date location at the top of the graph to either the 20%, 50%, or 80% time lines. Based on these probable flows, a range in the number of portages to be

expected can be determined from the number of portages scale.

For comparison of streams according to navigability, the hydrograph characteristics such as the range in discharge between the 20% and 80% time lines, the average discharge, and the variability through the year, should be considered.

The recession curve can be used for short term predictions. Knowing the river stage at a certain time, it is possible to follow the recession curve to the unknown gage height a given number of days in the future. This new gage height can then be used with the duration hydrograph to determine probable navigability at the future time.

Water Quality Introduction

The water quality, herein primarily limited to physical chemistry, has direct relationships with ecology and therefore, also, the aesthetic and recreational value of a river.

We are often asked what is "good" water or "bad" water, or to qualify a quantitative description of a water sample. This is difficult, if not impossible to do. First let us limit the discussion primarily to our field of responsibility, physical chemistry, neglecting bacterial and other organic "pollution." For each water type and fluctuation range, there exists both fauna and flora, including man, that can dwell within or otherwise utilize the water and its dissolved and included ingredients. Extremes exist from the plankton that dwell in the reaches of the hot, geyser-discharge waters of Yellowstone National Park to the waters frozen in glaciers; from salt lakes to mountain freshets more "pure" than public drinking water. A parrot fish commonly associated with tropical oceanic coral reef environment could not survive in a Northern Minnesota stream anymore than a rainbow trout could survive in a south sea lagoon. Some niches are well enough defined that plants may be used as good indicators of water-quality. Other plants and creatures, such as man, can utilize a very wide range of water types. Therefore, before we can qualify a water as "good," "bad," "desirable," "adequate," or other, we must ask for what and for whom. Is it for supporting life (sport fish, flowers, etc), for not supporting life (algae blooms, seaweed), drinking, swimming, or what? By consulting an ecologist it may be possible to determine if the water in question may possibly meet with the selected criteria.

It must be kept in mind that the water's quality is not the controlling factor in an ecologic system, though it strongly effects that system. The other members of the system will in turn, alter the water's quality. It would take at least a book-length report to describe, even in generalities, the interrelationship of the physical chemistry of waters and those ecologic conditions which might be considered desirable. Further, for all controls that are known there are many more that are not, for the system is complex with many inter-dependent variables. However, the following paragraphs give some specific examples of relationships pertinent to waters of Minnesota.

Calcium, magnesium, and bicarbonate in solution are related to the free carbon dioxide (CO_2) in the water and its pH and therefore effect and are effected by aquatic plant life. Some species of plants are typical of hard carbonate waters such as Potomogeton pectinatus (sago pondweed) and P. Richardsonni (clasping leaf pondweed) and will also tolerate high sulfate concentration. Many other typical hard water species such as Zizania aquatica (wild rice) are not found in large stands where water exceeds 10 ppm (0.2 EPM) sulfate. Calcium and magnesium also effect the amount of copper sulphate ($CuSO_4$) required for dosage in control of "nuisance" algae blooms. Moyle (1945a) has shown that in Minnesota lakes several species, especially Najas marina (bushy pondweed), Rupia occidentalis (wigeon grass), and Scirpus palustria (bullrush), are generally limited to waters with a sulfate content greater than 50 ppm (1 EPM) and grow best in areas with greater than 200 ppm (4 EPM) sulfate present.

The nutrients, nitrogen and phosphorus, represent a major portion of the fertility of a stream, contributing heavily to both phytoplankton and larger aquatics' growth which in turn will effect faunal conditions. The size and structure of a fish population may well reflect the chemistry of water and the factors which control that chemistry. Temperature, dissolved oxygen, and turbidity are very closely related to each other and impose limits on fish population as well as other fauna and flora. It has also been found that mollusca populations are proportional to the total dissolved solids in the waters (Shoup 1943), and that chlorides will control certain diatom populations.

The following chart is a sample of the type of information that can be applied in interpreting the quality data. By comparing the range on the dissolved oxygen plots to the range acceptable to a selected fish species, one can predict the suitability of the water for a given specie of fish.

THRESHOLDS OF DISSOLVED OXYGEN FOR FISH

	SUMMER		WINTER	
Species	Lowest observed concentration at which fish survived for 24 hours	Highest observed concentration at which fish were killed in 24 hours	Lowest observed concentration at which fish survived for 48 hours	Highest observed concentration at which fish were killed in 48 hours
Pike	6.0 ppm	3.1 ppm	3.1 ppm	2.3 ppm
Black bass	5.5 ppm	3.1 ppm	4.7 ppm	2.3 ppm
Black crappie	5.5 ppm	4.2 ppm	1.5 ppm	1.4 ppm
Common sunfish	4.2 ppm	3.1 ppm	1.4 ppm	0.8 ppm
Yellow perch	4.2 ppm	3.1 ppm	4.7 ppm	1.5 ppm
Sunfish	3.3 ppm	3.1 ppm	3.5 ppm	0.8 ppm
Blk. bullhead	3.3 ppm	2.9 ppm	1.1 ppm	0.3 ppm
Median values	4.2 ppm	3.1 ppm	3.1 ppm	1.4 ppm

(McKee and Wolf, 1963)

The rock units, the forestation, and soils of the drainage area will also be reflected in the water's quality.

Summary of Water Quality

In the following data and descriptive pages of each river of the study, quality data is presented in what is the most efficient form for those who will utilize it in management of the rivers. Interpretation of each sheet is far beyond the scope of this report for reasons explained on the previous pages, but the waters investigated may be somewhat qualified as follows.

No extremes injurious to most life, such as acid-mine-drainage waters were found.

None are saline, in fact almost all the constituents fall below 10 EPM concentration and are fresh, relatively soft, waters. The rivers are warm, often exceeding 80 degrees F. in summer and vary from clear to translucent amber to somewhat turbid. The solutes, temperature, oxygen content, turbidity and apparent lack of serious organic pollutants are all such that the rivers will support a very wide variety of aquatic plant life, from beautiful lillies to microscopic algae and a variety of fishes, insects, mollusca, and other fauna.

Explanation of Water Quality Sheet

The graphs shown on the water quality sheets are summaries of most of the physical chemistry data presently available, and indicate the type of water and quality variability.

The semi-log "EPM-(meq/l)" plots of the concentration of major ions in the water enclose by line pairs, the points from analyses at a given station. This shows the general type of water and the known ranges of major ion concentration. Most data are from regular or miscellaneous USGS sample stations. The units, equivalents per million, EPM, (milliequivalents *per liter, meq/l, within limits of these data) as the name implies, bears a direct relationship to the number, rather than the weight, of ions in solution with a factor included to allow for combining capabilities or equivalent reactive amounts. This system permits easier chemical comparison and balancing of the quantities of ions in solution.

The "downstream variation" plot illustrates the change in quality at a given time as the water progresses downstream. The data are from USGS field analyses performed as part of this project during the summer of 1965. Downstream conductivity was also measured during USGS river reconnaissance trips in the summer of 1966.

The dissolved oxygen-temperature-turbidity graphs show the correlation between the three parameters. The data upon which the graphs are based are from published records of the Minnesota Department of Health. In addition, 10 temperature recorders were placed by the USGS in selected rivers for the summer of 1966. Data summary from those continuous-chart records is under the heading "Summer Temperature Data."

Phosphorous values summarized from Minnesota Department of Health published data are also presented in tabular form.

Abbreviations Used on the Water Quality Sheet

Ca	-	calcium cation
Mg	-	magnesium cation
Na	-	sodium cation
K	-	potassium cation
HCO_3	-	bicarbonate anionic radical
SO_4	-	sulfate anionic radical
Cl	-	chloride anion
NO_3	-	nitrate anionic radical
cond.	-	conductivity, ability to pass electric current, expressed in:
umho/cm	-	micro-mhos per centimeter with reference to standard cell
D.O.	-	dissolved oxygen

* One milliequivalent is the atomic or formula weight in milligrams (mg.) divided by the electron charge or valence per unit formula; or the weight on mg. of the substance reacting with one millimole of hydrogen ion (H+) or $\frac{1}{2}$ millimole of oxygen (O).

J.T.U. - Jackson turbidity units, a standard measure of light transmittance, "0" being clear, "30" being turbid enough that one would not be able to distinguish the point source of light from a flashlight in two feet of water.

E.P.M. - equivalents per million (see explanation page)

meq/l - milliequivalents per liter (see explanation page)

ppm - parts per million by weight

REFERENCES

GENERAL:

Craighead, Frank C., Craighead, John J., 1962, River systems, recreational classification, inventory and evaluation. Naturalist, v. 13:2.

GEOLOGY:

Goldich, et al, 1961, The Precambrian geology and geochonology of Minnesota, Minn. Geol. Survey, Bull. 41, 193 p.

Leverett, Frank, 1932, Quaternary geology of Minnesota and parts of adjacent states., U.S. Geol. Survey Prof. Paper 161, 149 p.

Winchell, N. H., Upham, Warren, et al, 1884-1889, Geology of Minnesota: Minn. Geol. Nat. Hist. Survey, Final Rept., v. 1 (1888), v. 2 (1888), v. 4 (1889).

Wright, H. E., Jr., 1956, Glacial sequence in eastern Minnesota: Geol. Soc. Am. Guidebook, Pls. meeting, Univ. of Minn., Mpls.

Minnesota Geological Survey, 1966, Geologic Map of Minnesota, St. Paul sheet, University of Minnesota, Minneapolis.

QUALITY:

Hutchinson, G. Evelyn, 1957, A tretise on limnology.

Makenthan, K. M., William, I. M., Porges, R., 1964. Limnological aspects of recreational lakes, U. S. Public Health Service publication 1167.

Moyle, J. B., 1945, Some factors influencing the distribution of aquatic plants in Minnesota, Am. Midl. Nat. v. 34:2.

_____, 1956, Relationships between the chemistry of Minnesota surface waters and wildlife management. Journal of Wildlife Management 20:3.

Shoup, C. S., 1943, Distribution of fresh-water gastropods in relation to total alkalinity of streams. Nautilas 56:130, 134.

Williams, L. G., 1964, Possible relationships between Plankton-Diaton species numbers and water-quality estimates. Ecology 45:4.

_____, 1962, Plankton population dynamics. U.S. Public Health Service Publication 663, suppl. 2, (reprint 1963).

McKee and Wolf, 1963, Water quality criteria. The Resources Agency of California, State Water Quality Control Board, Publication No. 3-A.

DESCRIPTIONS AND DATA SUMMARIES BY RIVER

BIG FORK RIVER

A reconnaissance, by canoe, was made July 16, 17, 18, and 19, 1966 between Craigsville and the mouth of the Big Fork River by U.S.G.S. observers. Navigability in the entire portion was generally excellent. The Little American Falls, two miles below Craigsville and Big Falls at Big Falls, Minnesota had to be portaged. No other portaging was required. The reach downstream from Big Falls to the Sturgeon River was shallower than the reach above, and requires a relatively larger flow for satisfactory canoeing, particularly if the canoe is heavily loaded.

The Big Fork River lies in the basin of Glacial Lake Agassiz and accordingly, has a relatively flat gradient throughout its length. Rapids are caused where bedrock crops out. Generally this is the underlying granite. The exposures are very attractive and the portages are scenic and as exciting as other parts of the trip. The banks are largely grass covered with a mixed conifer and deciduous forest background. There is little evidence of man's influence on the river through most of its length. Some abandoned farms and two operating farms impinge on the river for short reaches, but do not have a significant effect on the total aesthetic appeal of the river. Camping sites are plentiful, although during much of the summer, mosquitoes and flies will be a problem at any camping site unless there is a high wind and the site is in the open. In general, one has to pull the loaded canoe up the steep grass slopes to the campsite and undergo some problems in unloading along these banks before camping.

The quality of the water is excellent. It is translucent, but amber in color, due to the organic acids derived from boglands adjacent to the river. The bottom is generally of clean sand and gravel with some large boulders. Very little algae is present and tree fall is minimum.

There is a great deal of wildlife along the river. More than 100 deer were observed during the trip. In addition, beaver, muskrat and many birds were seen. Ducks were abundant throughout the length of the river and it is reputed that fishing is excellent. The thick grass banks are incredibly effective shelter for all types of game and fowl.

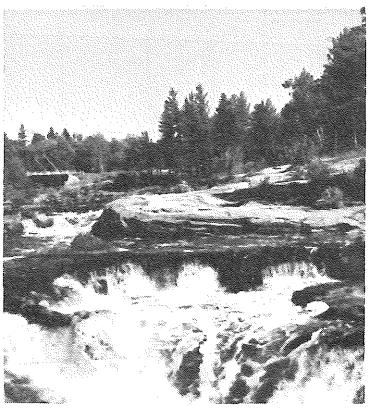
Access to the river is appropriate through a series of State campgrounds, which have been established at evenly spaced distances, plus several bridge crossings and towns. Additional access points would probably decrease the aesthetic appeal of the river and would seem to be totally unnecessary.

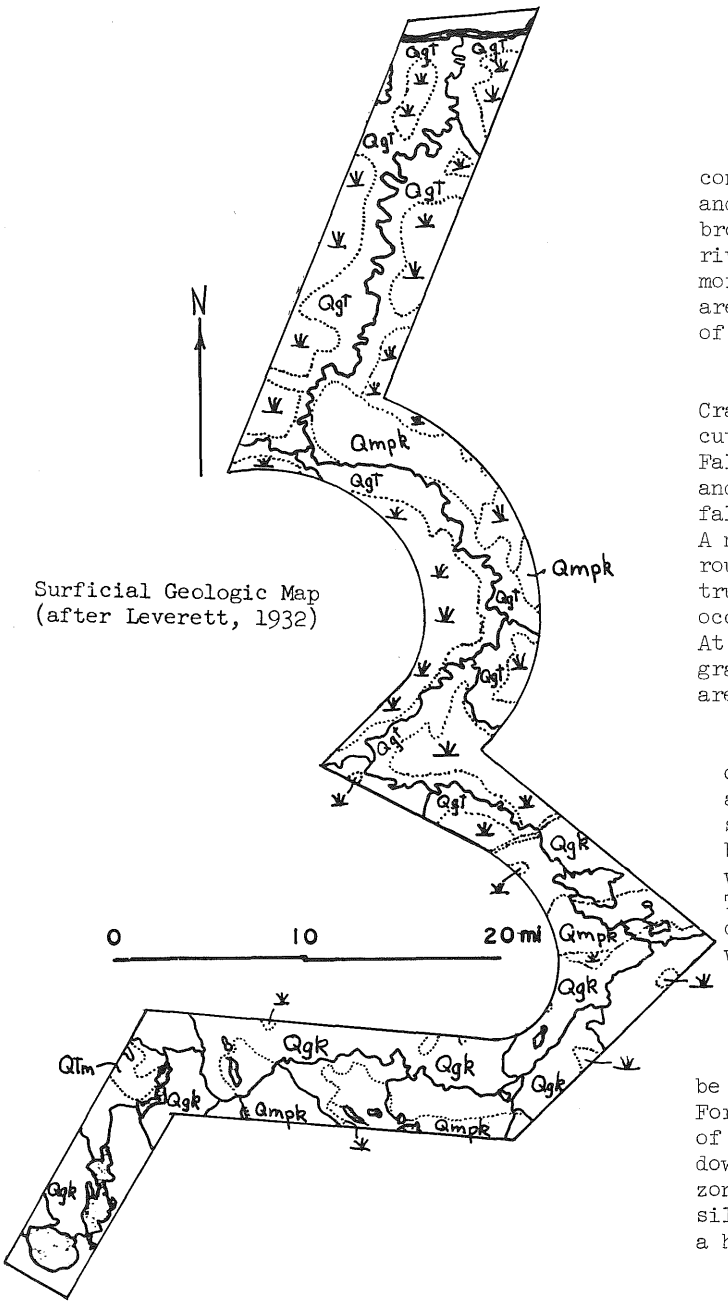
The Big Fork is certainly one of the finest rivers in Minnesota for recreational use, if not the finest. It is one of the outstanding rivers in the United States. Not only is the quality of the canoeing exceptional, but the quality of the water, the aesthetic appeal of the vegetation and the banks are excellent. Geology is interesting both from the standpoint of its having been a part of Glacial Lake Agassiz and from the exposures of igneous rocks, particularly granite and diabase in the areas of rapids. The morphology of the stream is particularly interesting because it represents an effect of ice scour and of erosion which is better developed than in any other known stream in the state. It is recommended that the Big Fork River be given prime consideration for additional investigations both to permit intelligent management of this natural resource and to utilize it as an educational tool with which to help the general public to recognize both the majesty and fragile nature of such a river.

GEOLOGY

BIG FORK RIVER

The Big Fork valley occupies a part of the northeastern extent of Glacial Lake Agassiz within Minnesota. Glaciers covered the area with deposits of glacial till and this surface was later washed to a smooth plain by the waters of Lake Agassiz. In only a few places has the Big Fork River eroded through the glacial deposits and exposed the massive bedrock, granite, gneiss, and schist which underlies the glacial till throughout the valley. The stream gradient is relatively uniform, changing only at rapids where the resistant bedrock checks the erosion of the glacial drift upstream.





Surficial Geologic Map
(after Leverett, 1932)

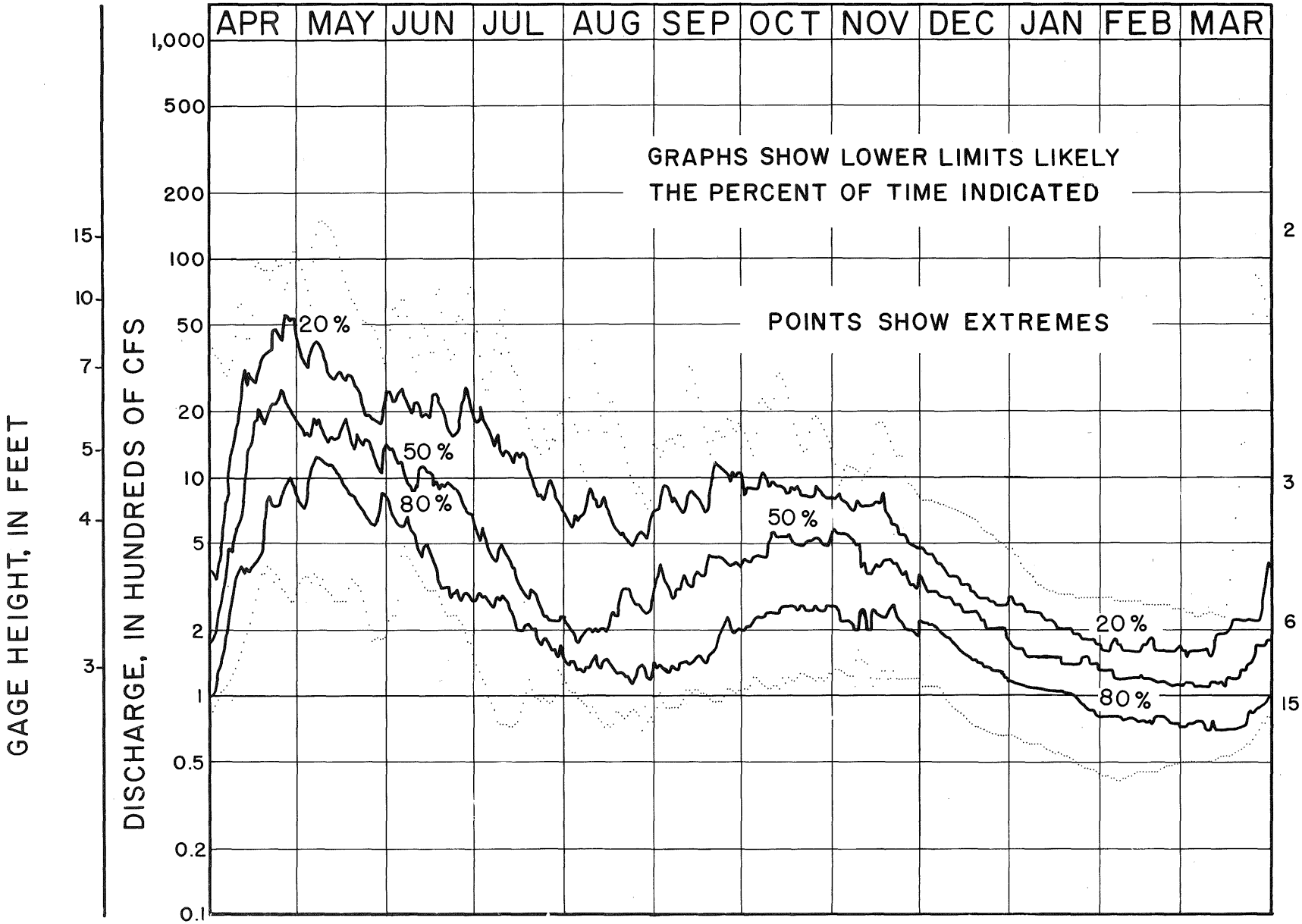
The greater part of the river banks consist of glacial till--unsorted silt, sand, and gravel. Where the younger moraines of brown drift from the Rainy Lobe impinge on the river, the relief is greater and the soil is more sandy. This sand area results in large areas of coniferous trees, whereas the areas of till support a deciduous vegetation.

At Little American Falls, 2 miles below Craigville, an exposure of mica schist is cut by two small veins of granite. At Big Falls, the rock is mica schist, granite gneiss, and granite which is cut at the head of the falls by a diabase dike about 20 feet wide. A mile and a half below Sturgeon River is a rounded outcrop of gray mica schist that protrudes from the water. A similar exposure occurs about 30 miles above the river's mouth. At river mile 15 there is a large exposure of granite on the west bank. Locally, garnets are abundant in this rock.

The Big Fork has been downcutting throughout its lower reach where long gentle slopes are formed on the inside of meanders and steeper slopes on the outside of the meander bends. The gentle slopes are mantled with washed soil and support mixed stands of timber. The steep outside banks are largely well drained sandy soil and large red pines and white pines are dominant.

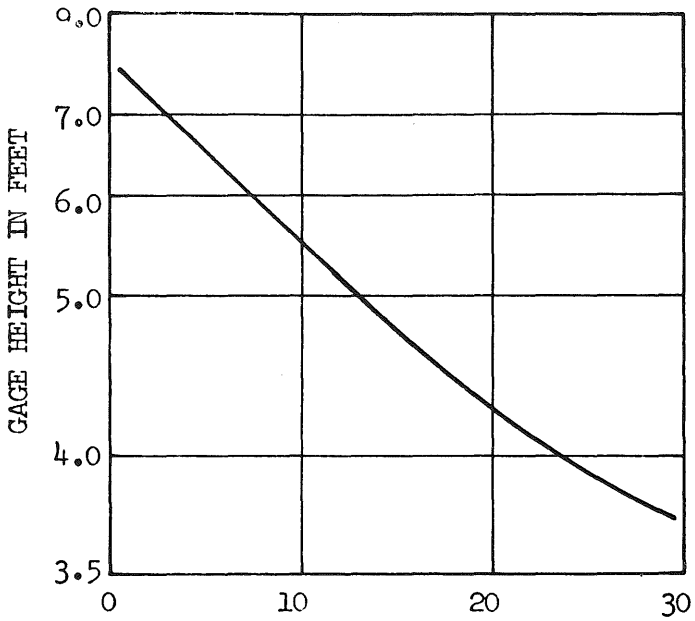
The spectacular effect of ice scour can be seen very well in the channel of the Big Fork. The high grassy banks are kept clear of large vegetation by the force of ice moving downstream each spring. This grassy buffer zone between the forest and the river prevents silt from washing into the river and serves as a habitat for game.

BIG FORK RIVER AT BIG FALLS



DURATION HYDROGRAPH FOR THE WATER YEARS OF 1943-1961

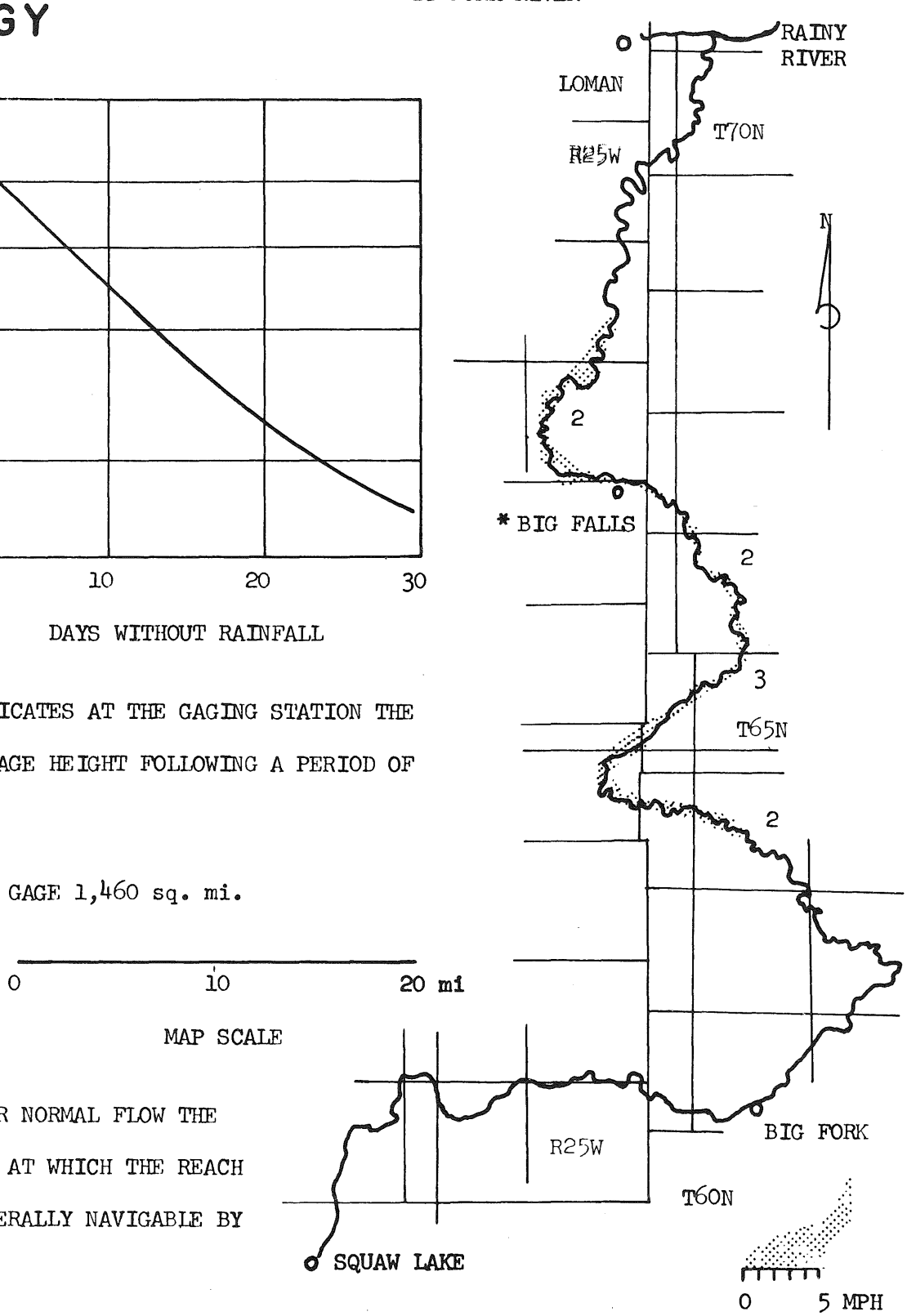
HYDROLOGY



RECESSION CURVE INDICATES AT THE GAGING STATION THE NORMAL DECLINE IN GAGE HEIGHT FOLLOWING A PERIOD OF RAIN

DRAINAGE AREA ABOVE GAGE 1,460 sq. mi.

BIG FORK RIVER



NUMBERS INDICATE FOR NORMAL FLOW THE MINIMUM GAGE HEIGHT AT WHICH THE REACH OF THE RIVER IS GENERALLY NAVIGABLE BY CANOE

DIURNAL FLUCTUATION BELOW BIG FALLS MAKES THE RIVER UNNAVIGABLE DURING PERIODS OF LOW FLOW REGULATION

* GAGING STATION LOCATION

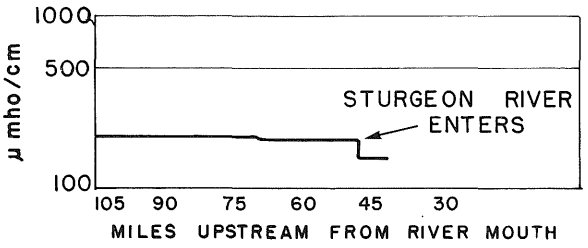
WIDTH OF STREAM INDICATES THE VELOCITY OF FLOW AT A GAGE HEIGHT OF 2 FT AT THE GAGING STATION

WATER QUALITY

BIG FORK RIVER

WATER TEMPERATURE
SUMMER 1966
STATION: BIG FALLS
DATES: JUN 2 – AUG 5
MAX. 12-HOUR ΔT = 4°
AVG. 12-HOUR ΔT = 1.2 °
MAX. 5-DAY ΔT = 15°
BEGINNING DATE: AUG 5
DAYS EXCEEDING 80°F: 12

DOWNSTREAM VARIATION IN CONDUCTIVITY
JULY 7,8,9, 1966



CANNON RIVER

Reconnaissance by canoe was made May 5, 6, 26 and 27, 1966 between Waterville and the mouth by U.S.G.S. observers.

Navigation is marginal with many riffles. Dams are the only hazards to navigation. Portages at the several dams are difficult. Regulation at Cannon Falls makes the stream below un-navigable at times. Tree fall is prevalent but does not prevent navigation.

There are many exposures of sedimentary rock along the river. The banks are mostly composed of silt or clay with some sand beaches. The width of the stream varied from 40 feet to 150 feet. The stream has an agricultural setting, but the banks are mostly pasture and woodlands. As is typical of most of the rivers, the ungrazed banks are brushy and weedy. The mixed forest is made up of conifers along the valley walls with hardwoods along the stream. Camping sites are available mainly in the grazed pasture areas. Rubbish piles are evident along or in the river.

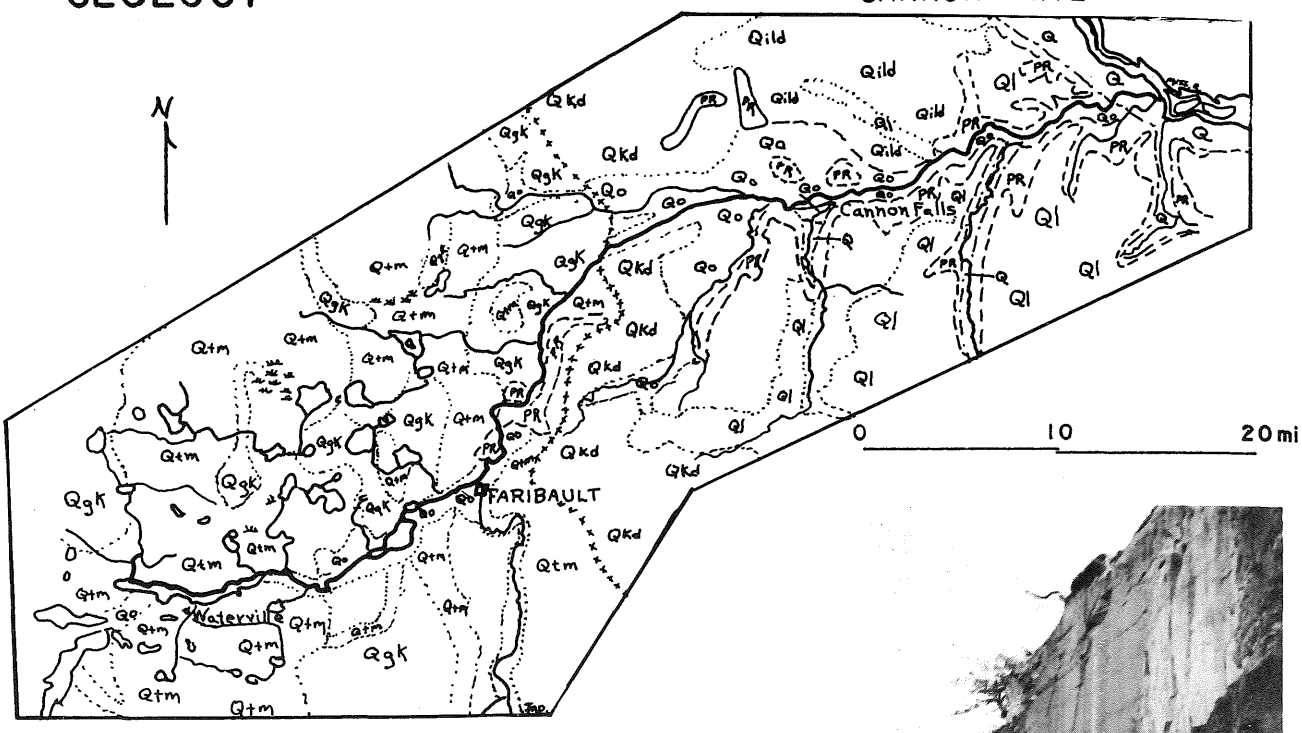
The stream is turbid, due to feeding carp and erosion. Foam floats on the water. The bottom material in most of the river is a fine sand to coarse gravel. The portion of the stream downstream from Cannon Falls has a more aesthetic appeal because of the greater amount of woodlands.

Abundant blue heron and a nesting ground were observed above Cannon Lake. Ducks and carp can be seen throughout the length of river.

Access is suitable but not developed along the river. The stream is recommended as a stream for local use with some development.

GEOLOGY

CANNON RIVER



Surficial Geologic Map
(after Leverett, 1932)

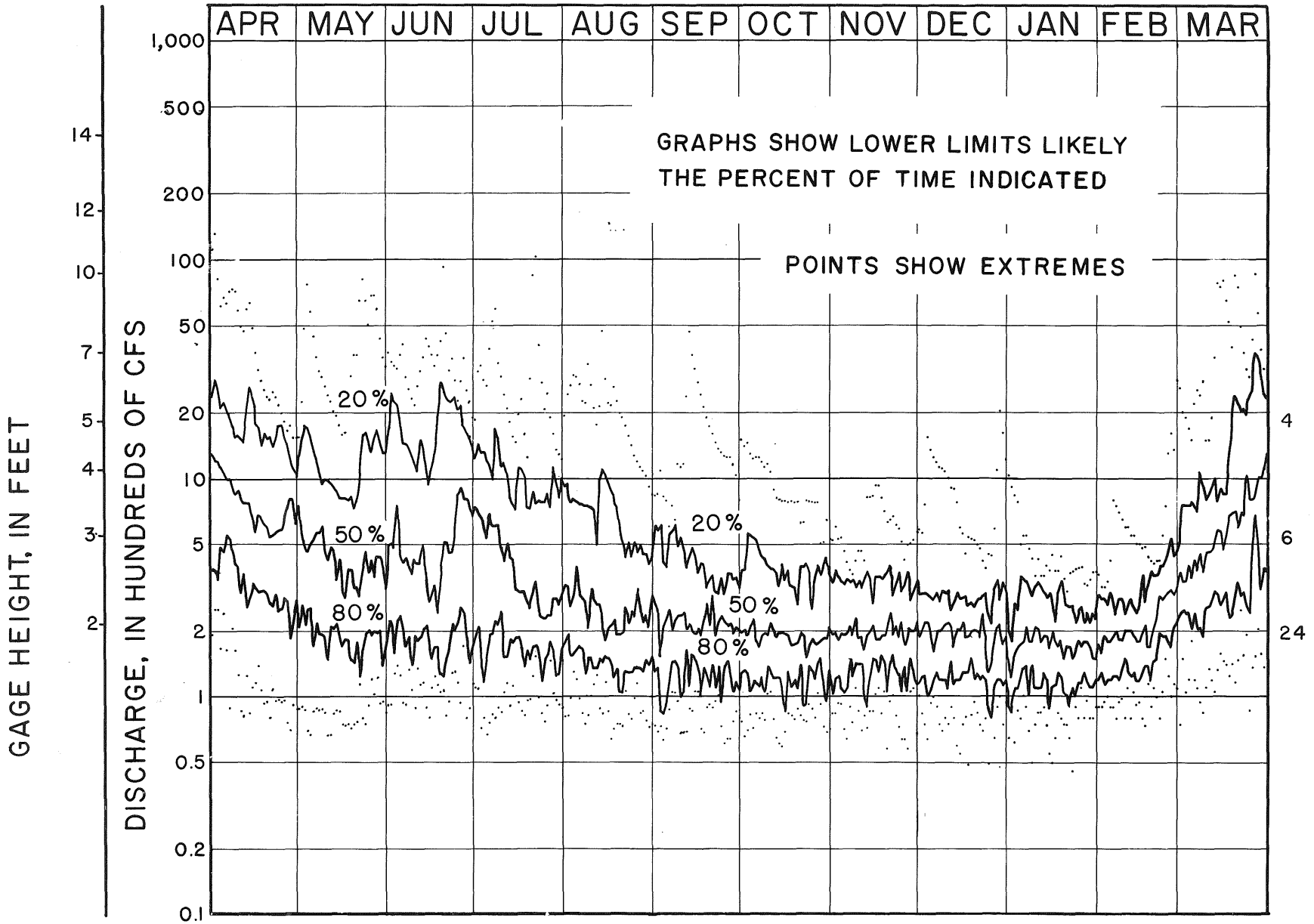
The upper part of the Cannon River, from Waterville downstream, flows over rocks of the St. Peter Sandstone formation. Limestone and dolomite of the Platteville and Glenwood formations are exposed on the east side of upper Sakatah Lake. The shores from the middle of Sakatah Lake east to the middle Lower Sakatah Lake are bounded by rocks of the Prairie du Chien Formation, two units of dolomite with a thin sandstone between. Through the east end of the lake and downstream nearly to the headwaters of Cannon Lake, the river flows again through St. Peter Sandstone. Magnificent vertical sandstone cliffs bound the river through parts of this reach. Erosion at river level undercuts the cliffs and huge slabs of sandstone spall off periodically leaving a smooth vertical plane and drop into the river. The photograph shows one of these vertical cliffs of St. Peter Sandstone.

Downstream from Faribault, St. Peter Sandstone is exposed for about seven miles. Where the river cuts below the sandstone into dolomite (similar to limestone, but a calcium-magnesium carbonate rock) it enters the Prairie du Chien Formation. Most of the remainder of the trip the exposed bedrock near the river consists of the dolomite-sandstone-dolomite sequence of the Prairie du Chien. About six miles above the mouth, the channel cuts into the Jordan Sandstone; however, alluvial fill in this section obscures some exposures.

The Cannon is particularly interesting geologically, not only because it has exposed on its banks Cambrian and Ordovician Age rocks, but also because it traverses the eastern limit of Wisconsin Glaciation, the edge of the Des Moines Lobe ice.

West of Faribault the bedrock surface is mottled with Glacial deposits of the Des Moines Lobe. East of Faribault to Northfield, the Cannon flows on outwash sand and gravel and the rocks are well exposed. Locally, exposures of the older Kansan ice sheet deposits can be seen in this reach of the river.

CANNON RIVER AT WELCH



GAGE HEIGHT, IN FEET

DISCHARGE, IN HUNDREDS OF CFS

NUMBER OF PORTAGES

DURATION HYDROGRAPH FOR THE WATER YEARS OF 1943-1961

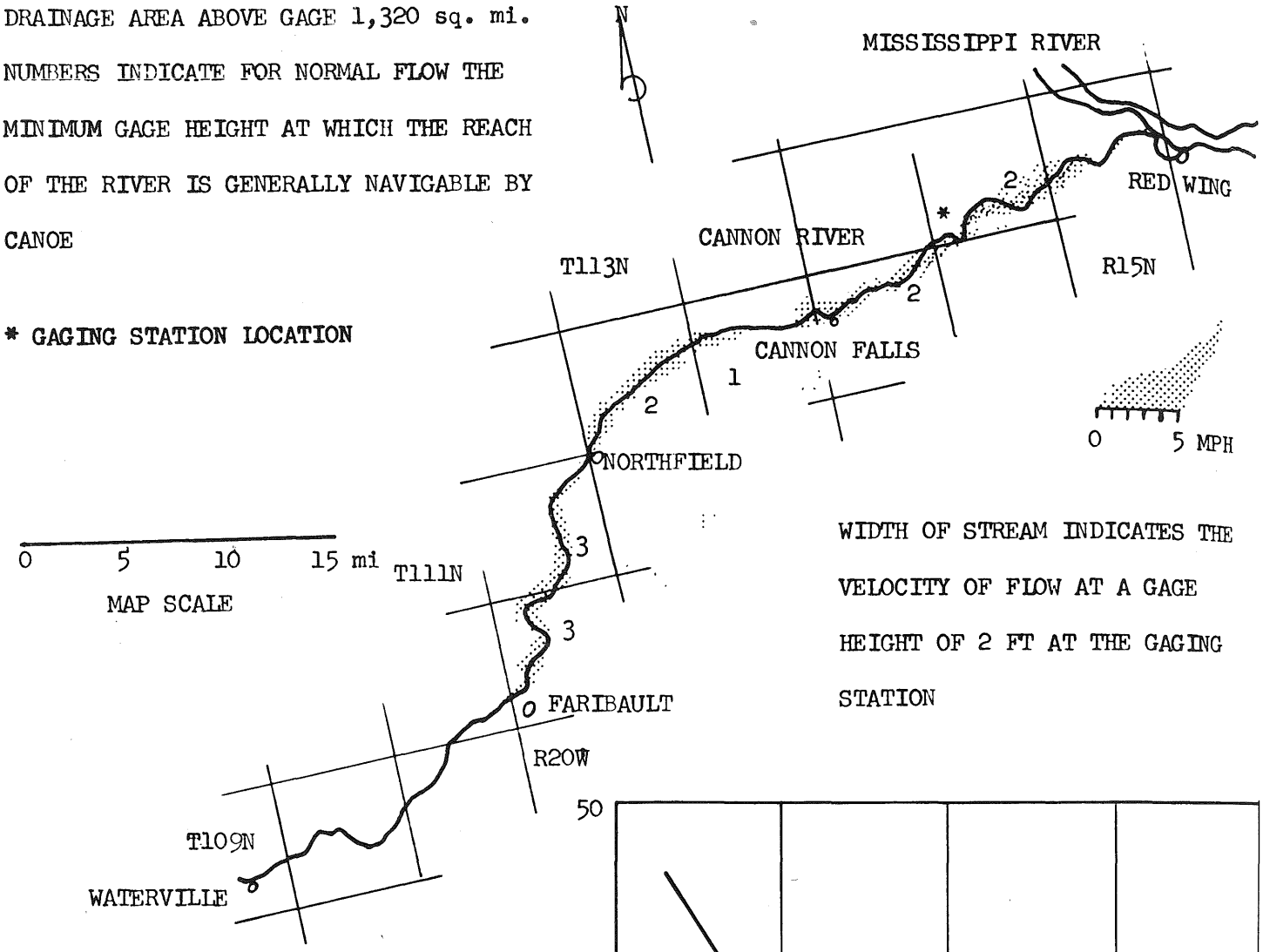
HYDROLOGY

DRAINAGE AREA ABOVE GAGE 1,320 sq. mi.

NUMBERS INDICATE FOR NORMAL FLOW THE MINIMUM GAGE HEIGHT AT WHICH THE REACH OF THE RIVER IS GENERALLY NAVIGABLE BY CANOE

* GAGING STATION LOCATION

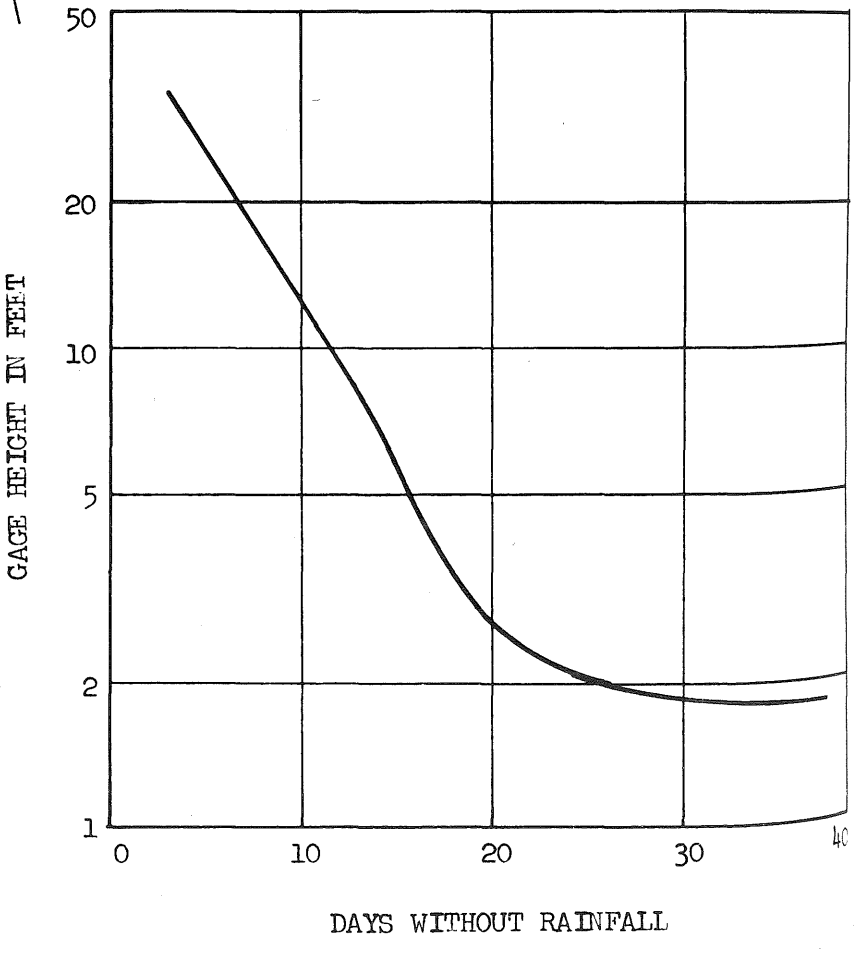
CANNON RIVER



WIDTH OF STREAM INDICATES THE VELOCITY OF FLOW AT A GAGE HEIGHT OF 2 FT AT THE GAGING STATION

RECESSION CURVE INDICATES AT THE GAGING STATION THE NORMAL DECLINE IN GAGE HEIGHT FOLLOWING A PERIOD OF RAIN

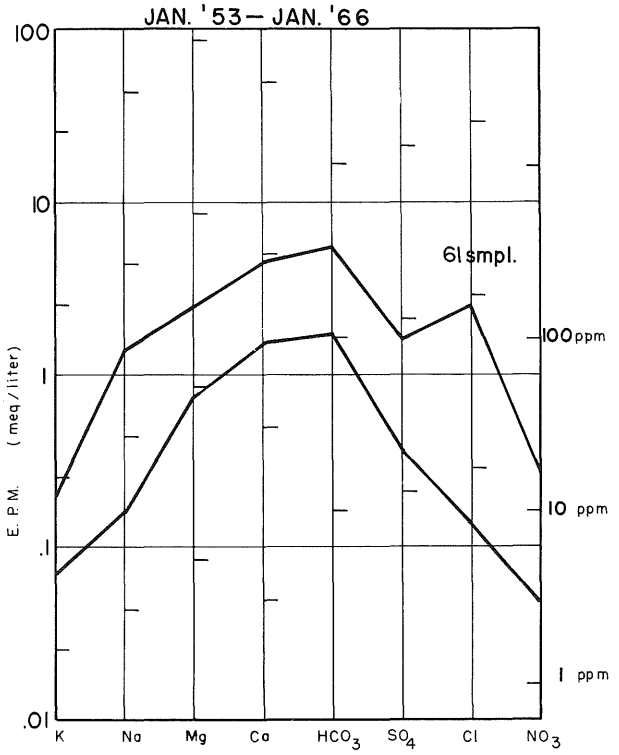
DIURNAL FLUCTUATION BELOW CANNON FALLS MAKES THE RIVER UNNAVIGABLE DURING PERIODS OF LOW FLOW REGULATION



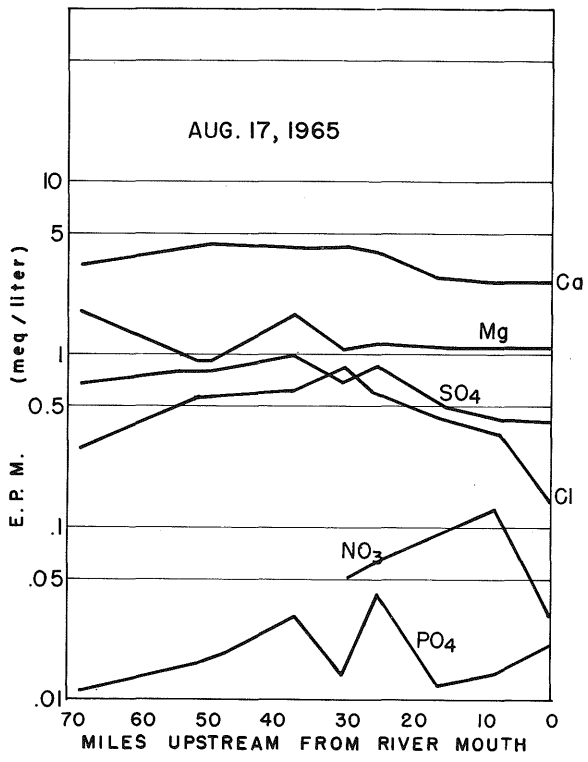
WATER QUALITY

CANNON RIVER

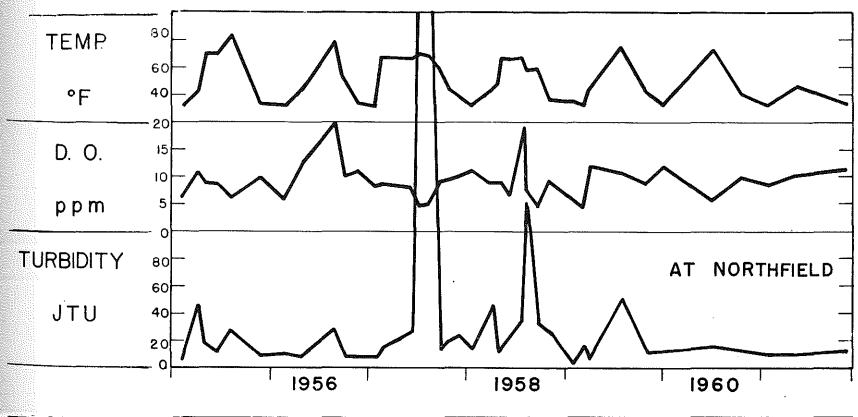
RANGE OF CONCENTRATION OF MAJOR IONS IN 50 SAMPLES TAKEN AT MILE 14
JAN. '53 – JAN. '66

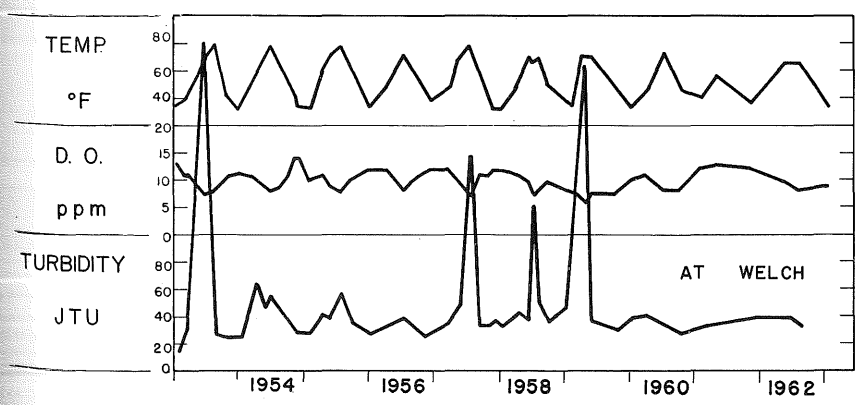


DOWNSTREAM VARIATION IN QUALITY



FACTORS OF HIGH CONCERN TO ECOLOGY





WATER TEMPERATURE
SUMMER 1966
STATION: WELCH
DATES: JUN 28 – AUG 27
MAX. 12-HOUR ΔT = 8°
AVG. 12-HOUR ΔT = 4.5°
MAX. 5-DAY ΔT = 16°
BEGINNING DATE: AUG 18
DAYS EXCEEDING 80°F: 10

NUTRIENT
PHOSPHORUS, ppm

HI	LO	AVG	SAMPLES
.97	.06	.39	8

AT WELCH

1958-1959
1962-1963

CLOQUET RIVER

Reconnaissance was made of the Cloquet River from the dam at Island Lake reservoir to the confluence with the St. Louis River, August 9 and 10, 1966 by U.S.G.S. observers.

Island Lake reservoir is itself, an attractive recreation area, though the banks have many cabins and some commercial establishments on them. It is accessible both from the dam and by County Road 4, north from Duluth which crosses the center of the reservoir. At the time that the reconnaissance trip was made, only eight cubic feet per second of water were being discharged through the dam, yet there was enough water from ground water effluent and tributaries to permit canoeing. The previous week the discharge was 800 cubic feet per second, a 100 fold difference in water discharge. River users should check with the operators before embarking on a trip. Precipitation in the area had been as much as four inches previous to the reconnaissance trip which had made the tributary contribution higher than normally would be encountered. There were many gravel and sandbar riffles, two of which had to be waded, and many navigable rapids through boulders. Boulder bars are not as prominent or consistent as on the St. Louis River. The rapid area at the mouth of the Cloquet had been observed the previous week while traveling the St. Louis. At that time it had appeared to be rather wild, possibly treacherous to the inexperienced canoeist. At the time of this trip, however, the stage of the St. Louis had risen approximately two feet and flooded out those rapids completely.

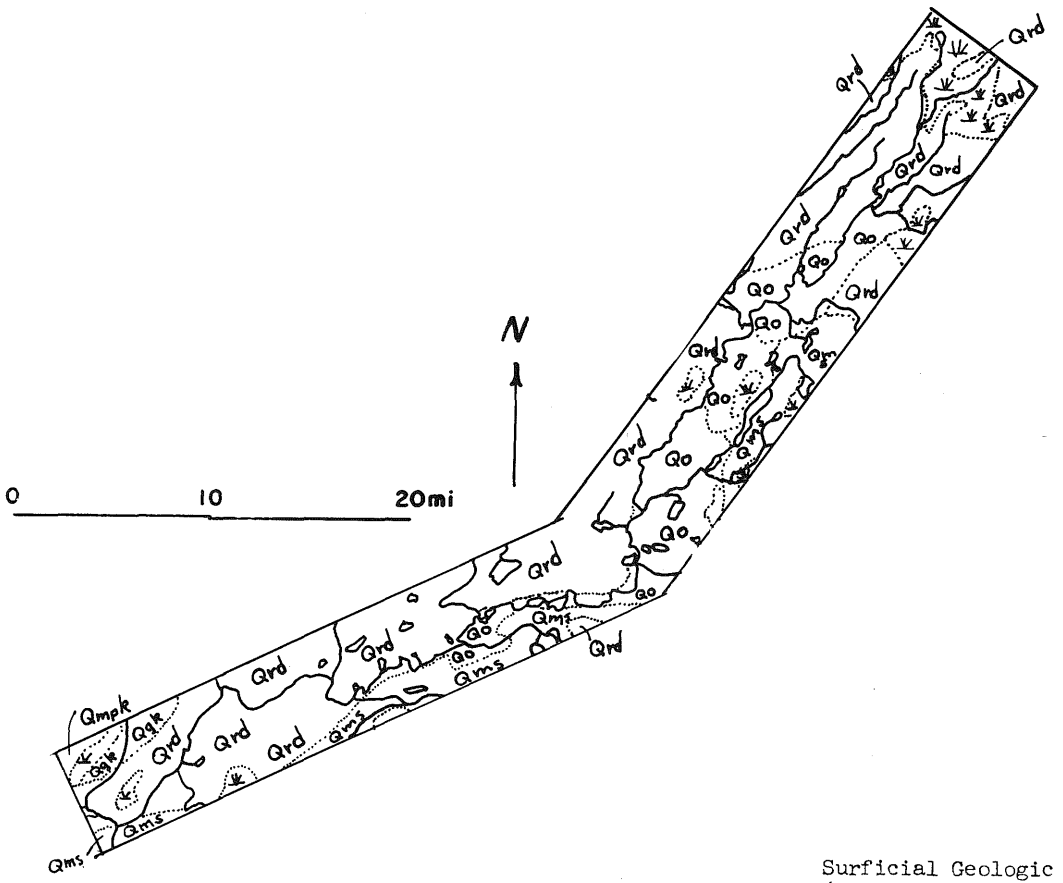
Banks are generally low along the river with mixed forest of both conifer and deciduous trees, the latter predominating in the lower reach. The river bottom is clean and varies from coarse sands to boulder gravels. It is attractive, the water quite clean, turbidity was about 30 JTU, and chemically pure for river water. Carboxylic acids give it an amber color, typical of rivers draining northern bog areas. Campsites, due to the low banks and quite dense underbrush, are not plentiful, though a few good places were spotted.

Accessibility is poor. There are bridges at Burnett and Independence, a road to the dam, and some scattered cabins along the way. Disembarkation can be made at Brookston, one and three fourths mile upstream or at U. S. Highway 2, about one mile downstream from the mouth on the St. Louis. Both have good access.

An interesting trip would be to come down the Cloquet from the Island Lake reservoir dam to the St. Louis River, and down the St. Louis to the town of Cloquet. This would present a variety of scenery, river magnitudes, and rapids. The end point has excellent facilities as described in the St. Louis report, and the two points of access are connected by good road and reasonably short driving time.

GEOLOGY

CLOQUET RIVER

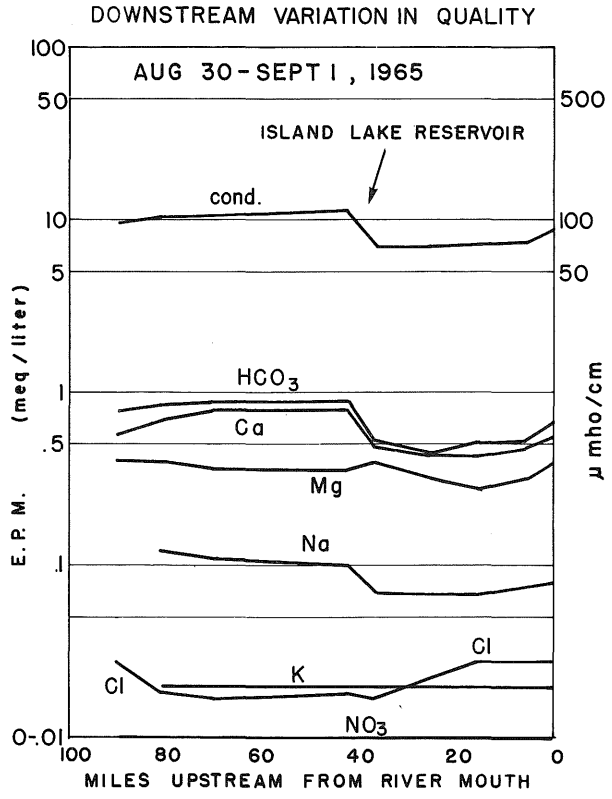


Surficial Geologic Map
(after Leverett, 1932)

Glacial ice moving westward out of Lake Superior terminated at the Highland Moraine which forms the east side of the Cloquet River valley. To the west and north, low elongate till mounds (drumlins), deposited by Des Moines Lobe ice, border the valley. In general, the river banks are reddish glacial till, and sand and gravel. The falls and rapids above Island Lake reservoir are caused by resistant beds of Gabbro, and are large enough to necessitate a portaging during normal summer flow. Below Island Lake reservoir, the river contains no rapids until it reaches the drumlin field in the center of T52N, R16W. Here the drumlins cause a series of rapids which are followed by more areas of very slow water. A mile upstream from Independence, the gradient of the Cloquet is first affected by the more deeply entrenched St. Louis River. The final 11 mile reach to the St. Louis contains numerous rapids past small islands and scattered boulders with a particularly steep drop in the last mile.

WATER QUALITY

CLOQUET RIVER



note correlation between conductivity and ion concentrations, permitting estimation of quality change.

WATER TEMPERATURE
SUMMER 1966
STATION: ABOVE IS. LK. RES.
DATES: JUN 2- AUG 22
MAX. 12-HOUR ΔT = 8°
AVG. 12-HOUR ΔT = 3.4°
MAX. 5-DAY ΔT = 18°
BEGINNING DATE: JUL 21
DAYS EXCEEDING 80°F: 4

WATER TEMPERATURE
SUMMER 1966
STATION: INDEPENDENCE
DATES: JUN 2 — AUG 22
MAX. 12-HOUR ΔT = 7°
AVG. 12-HOUR ΔT = 2.9°
MAX. 5-DAY ΔT = 14°
BEGINNING DATE: AUG 4
DAYS EXCEEDING 80°F: 0

WATER TEMPERATURE
SUMMER 1966
STATION: BELOW IS. LK. RES.
DATES: JUN 2- AUG 22
MAX. 12-HOUR ΔT = 8°
AVG. 12-HOUR ΔT = 1.1°
MAX. 5-DAY ΔT = 13°
BEGINNING DATE: AUG 4
DAYS EXCEEDING 80°F: 3

HYDROLOGY

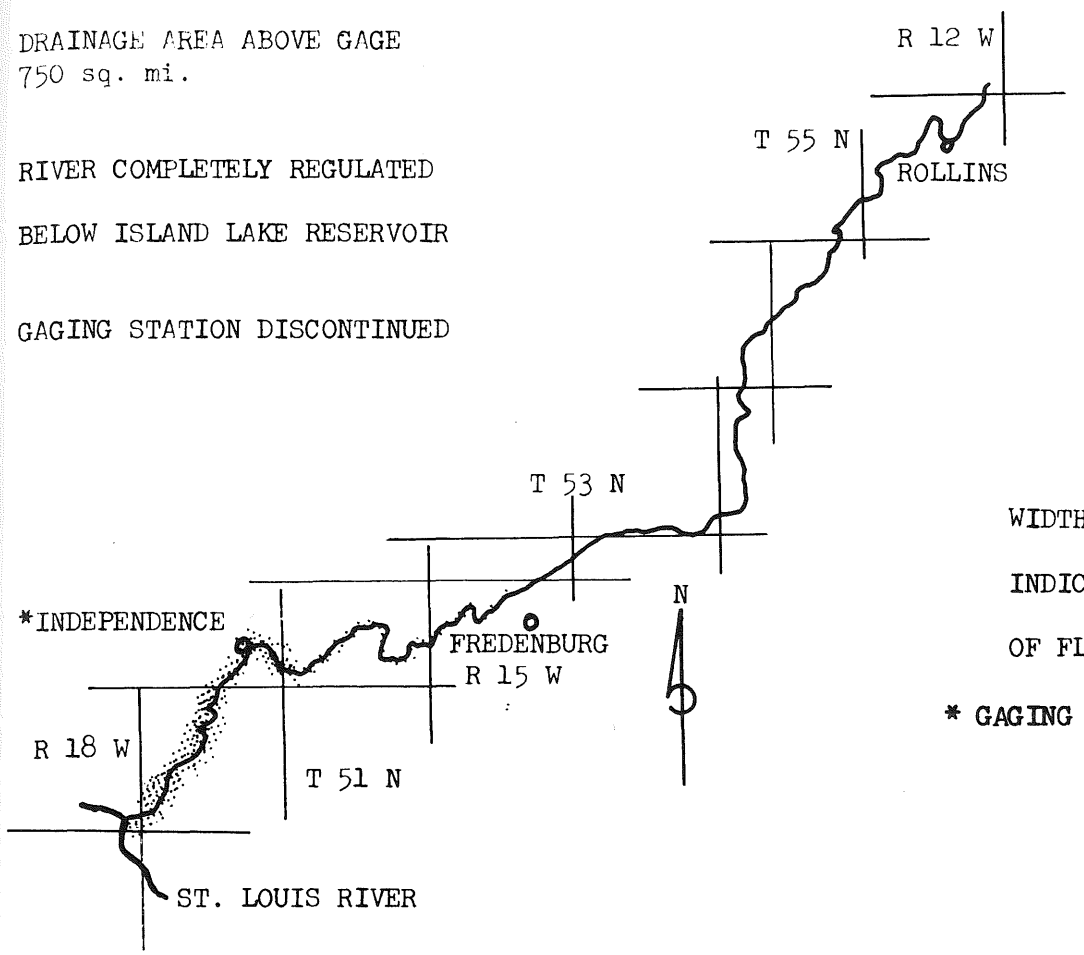
CLOQUET RIVER

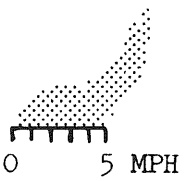
DRAINAGE AREA ABOVE GAGE
750 sq. mi.

RIVER COMPLETELY REGULATED

BELOW ISLAND LAKE RESERVOIR

GAGING STATION DISCONTINUED



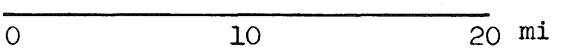


WIDTH OF STREAM

INDICATES VELOCITY

OF FLOW OF STREAM

*** GAGING STATION LOCATION**



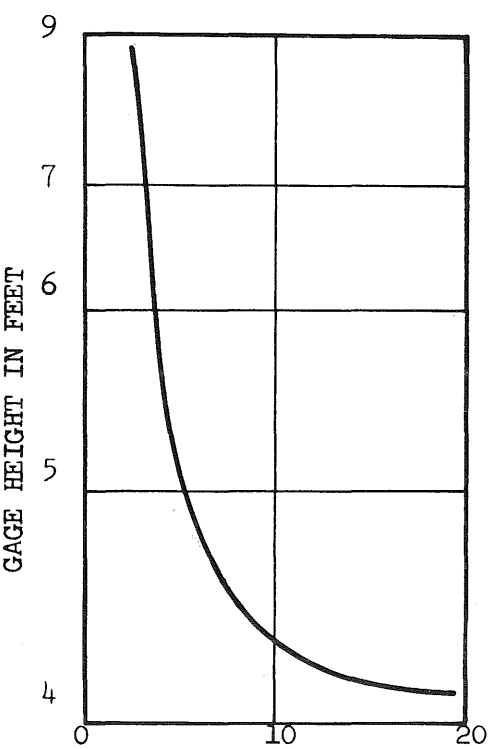
MAP SCALE

RECESSION CURVE INDICATES

AT THE GAGING STATION THE

NORMAL DECLINE IN GAGE HEIGHT

FOLLOWING A PERIOD OF RAIN



COTTONWOOD RIVER

Reconnaissance by canoe was made June 15, 16, and 17, 1966 between Sanborn Memorial Park and the mouth by U.S.G.S. observers.

The river, in general, is not navigable except during high water. The many tree falls and rock riffles make it a difficult stream to canoe.

The river has an agricultural setting. The areas along the river which are not pastured or cultivated are overgrown with willows, weeds or brush. The pastured areas which make up an estimated 30 percent of the bank vegetative cover are good camping areas and are usually accessible from the river. The banks are generally covered with a silt sediment. Private trash piles are very numerous.

The water is very turbid and had foam floating on it. The water temperature averaged 72 degrees fahrenheit. The bottom was covered with clay or silt mud except in the riffles which were sand and gravel. Very little wildlife was seen.

Accesses to the river occur every three to eight miles. The river is not recommended for more than local use.

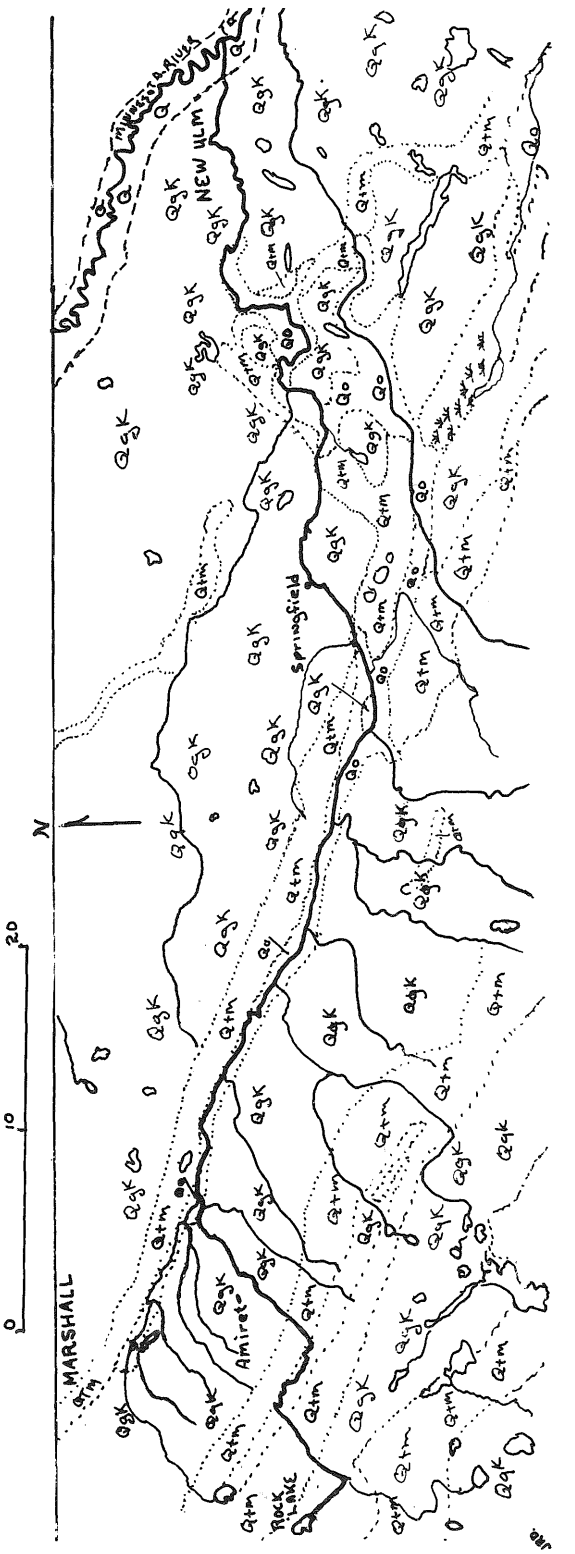
GEOLOGY

COTTONWOOD RIVER

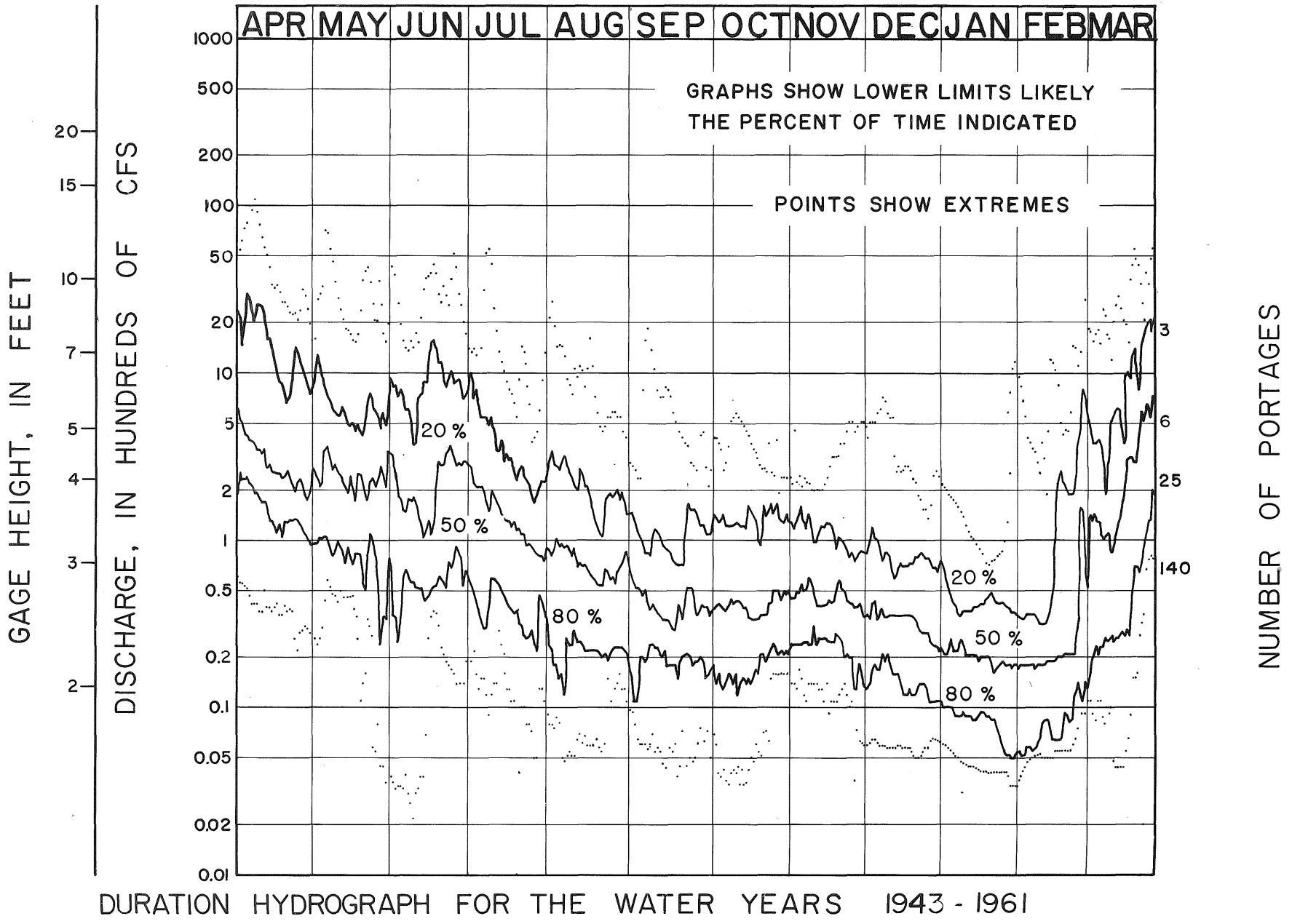
The Cottonwood River follows a course determined by land features resulting from glaciation in southwestern Minnesota. The upper reach of the river trends generally northeastward from its source at Rock Lake following the general slope of the land from the edge of the high Coteau des Prairies to the southwest. Where the river crosses the Gary moraine of the Late Wisconsin Des Moines Lobe ice sheet, it is diverted southeast parallel to the moraine.

Near the edge of Lyon County, about 10 miles downstream from Amiret, the Cottonwood encounters the southern edge of the Canby moraine and turns southeast a second time. From here to its junction with the Minnesota River, the Cottonwood flows generally along the southern edge of the Marshall moraine.

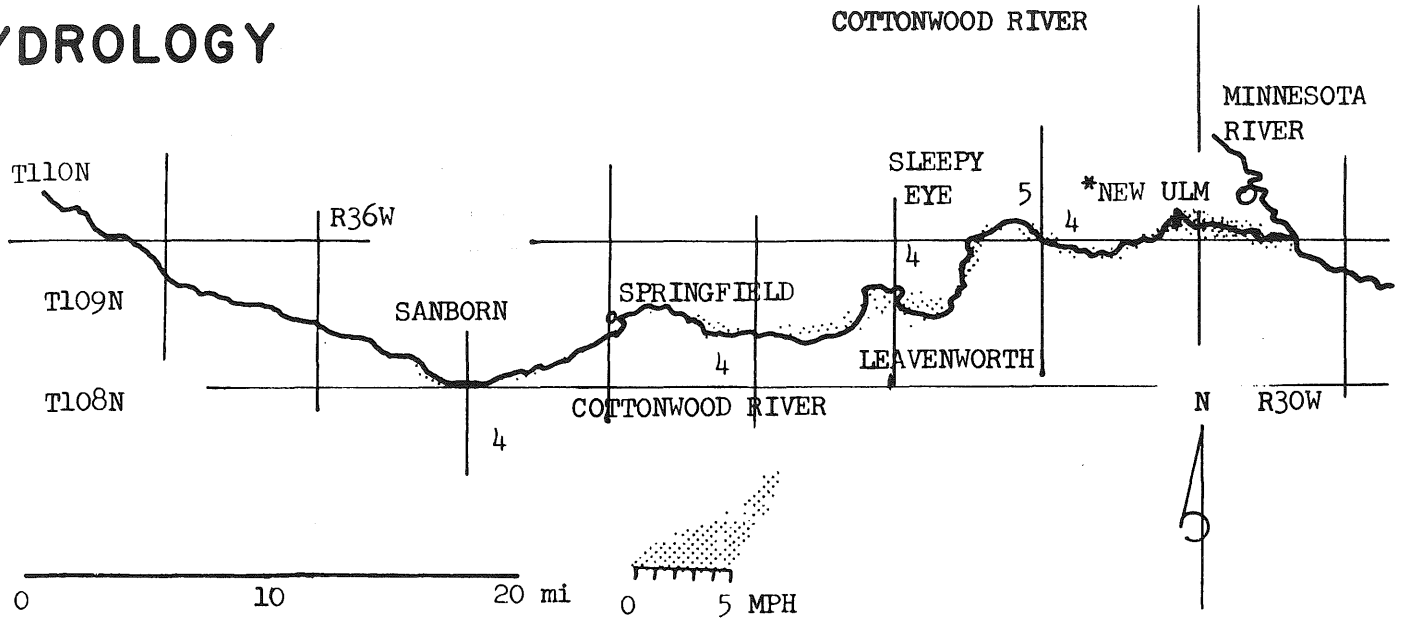
As is characteristic with streams tributary to the Minnesota River, the channel steepens sharply about 15 miles from its mouth. This is probably the result of downcutting to adjust its channel to the Minnesota River which was deeply eroded by water draining from Glacial Lake Agassiz which occupied the Red River lowland. In this reach, the valley walls are high and steep. Excellent exposures of the sandy outwash material associated with the moraines can be seen.



Surficial Geologic Map
(after Leverett, 1932)


COTTONWOOD RIVER NEAR NEW ULM
APR MAY JUN JUL AUG SEP OCT NOV DEC JAN FEB MAR
GRAPHS SHOW LOWER LIMITS LIKELY
THE PERCENT OF TIME INDICATED
POINTS SHOW EXTREMES
20 %
50 %
80 %
20 %
50 %
80 %
GAGE HEIGHT, IN FEET
DISCHARGE, IN HUNDREDS OF CFS
NUMBER OF PORTAGES
1000
500
200
100
50
20
10
5
2
1
0.5
0.2
0.1
0.05
0.02
0.01
20
15
10
7
5
4
3
2
3
6
25
140
DURATION HYDROGRAPH FOR THE WATER YEARS 1943 - 1961

HYDROLOGY



MAP SCALE

RAINAGE AREA ABOVE GAGE 1,280 sq. mi.

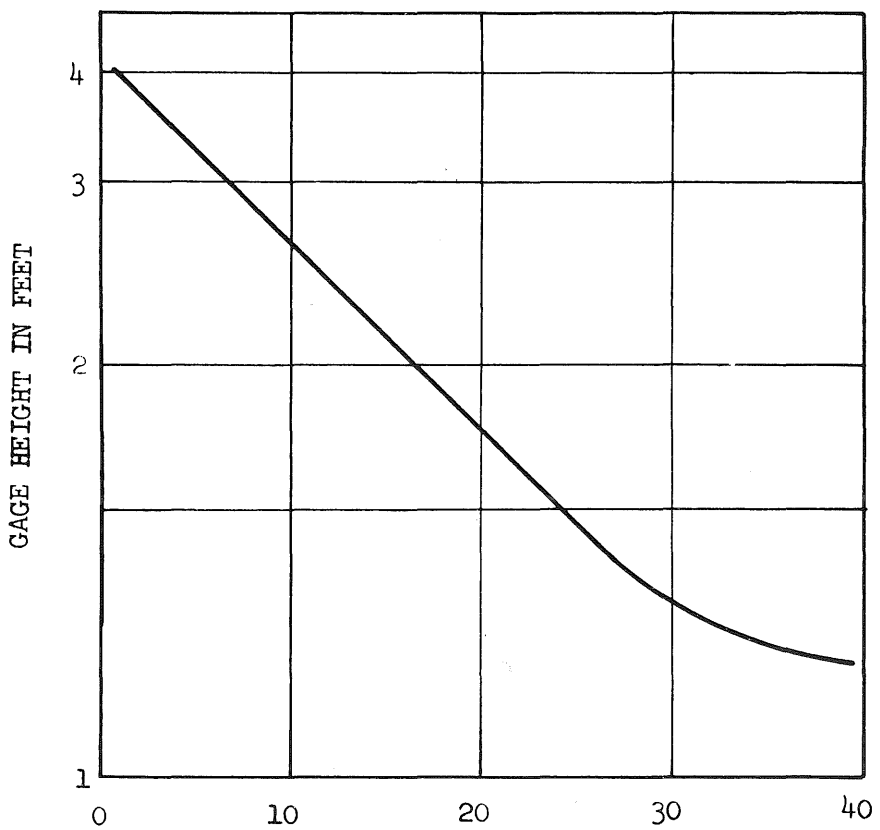
UMBERS INDICATE FOR NORMAL FLOW THE MINIMUM GAGE EIGHT AT WHICH THE REACH OF THE RIVER IS GENERALLY AVIGABLE BY CANOE

ECESSION CURVE INDICATES AT HE GAGING STATION THE NORMAL ECLINE IN GAGE HEIGHT FOLLOWING PERIOD OF RAIN

HERE IS SOME REGULATION BY HE DAM AT COTTONWOOD LAKE

WIDTH OF STREAM INDICATES THE VELOCITY OF FLOW AT A GAGE HEIGHT OF 2 FT AT THE GAGING STATION

*** GAGING STATION LOCATION**



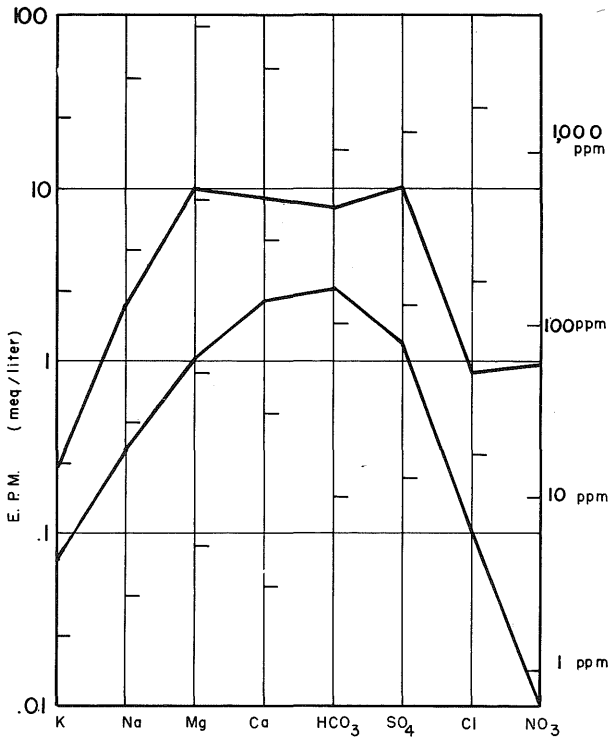
WATER QUALITY

COTTONWOOD RIVER

AT NEW ULM

RANGE OF CONCENTRATION OF MAJOR IONS IN 51 SAMPLES TAKEN AT MILE 2

MARCH '57– MARCH '66



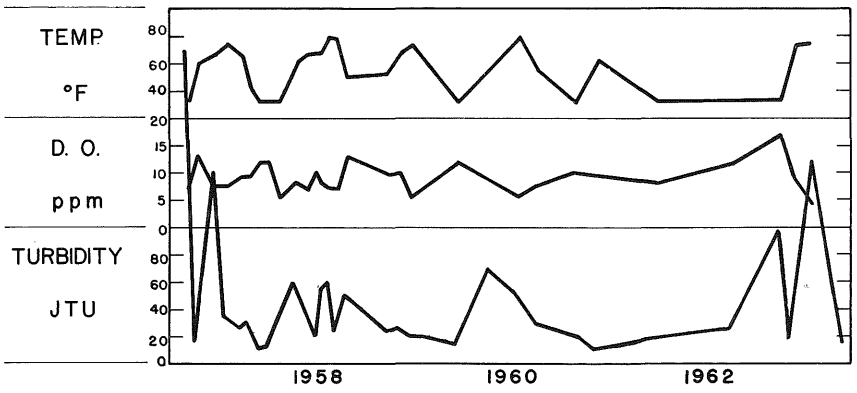
NUTRIENT

PHOSPHORUS, ppm

HI	LO	AVG	SAMPLES
.88	.12	.32	11

1958-1959
1962-1963

FACTORS OF HIGH CONCERN TO ECOLOGY



CROW WING RIVER

Reconnaissance by canoe was made June 19, 20, 21 and 22, 1966 between the Crow Wing Lake and the mouth by U.S.G.S. observers.

It was possible to use a motorboat on most of the river. No natural barriers to navigation were encountered except very shallow water at the river's mouth. Portages are necessary around the dams. Some riffles were encountered.

The river has a semi-wilderness setting; some agricultural and summer home development is evident. Banks are mostly sandy, 0 to 15 feet high, with a mixed conifer and deciduous forest. Some are low and marshy or brush covered. Good developed camping spots with fireplaces, picnic tables, water, and toilets are available along the river above Motley, with many more spots available for camp development. The water in the upper one-quarter reach of the stream was clear enough that the sand and boulder bottom could be seen through two feet of water. On the lower reaches, the bottom could be seen only in the shallow areas where it was covered with algae.

Water temperature varied from 70 degrees to 75 degrees fahrenheit. The river ranged from 20 to 175 feet wide with an approximate average width of 75 feet.

Numerous fish, turtles and ducks were seen; also a deer and several muskrats.

Accesses are generally six hours of canoeing apart.

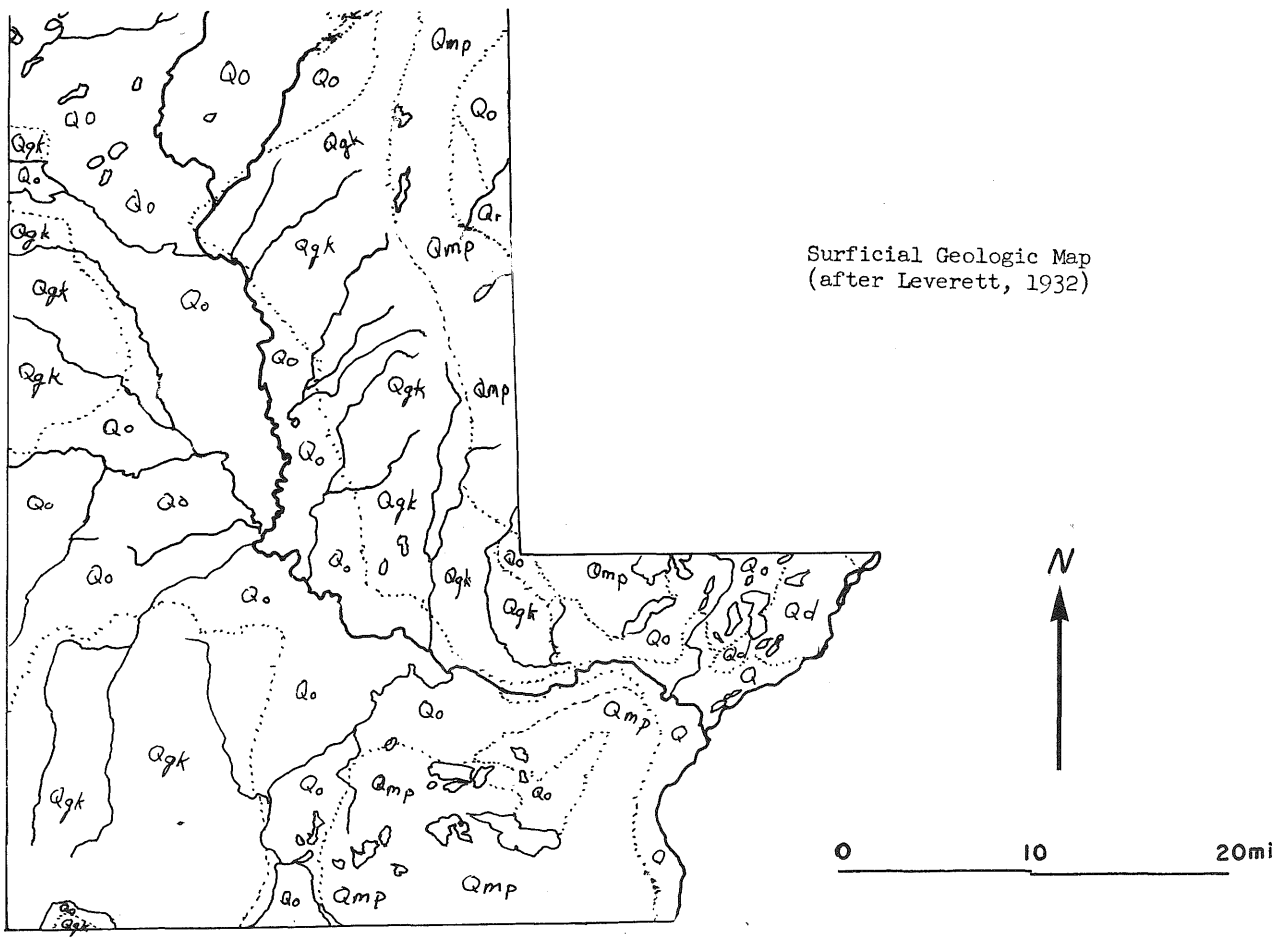
Although not an exceptional river, it has an aesthetic appeal and would make a good family recreational stream of statewide value.

GEOLOGY

CROW WING RIVER

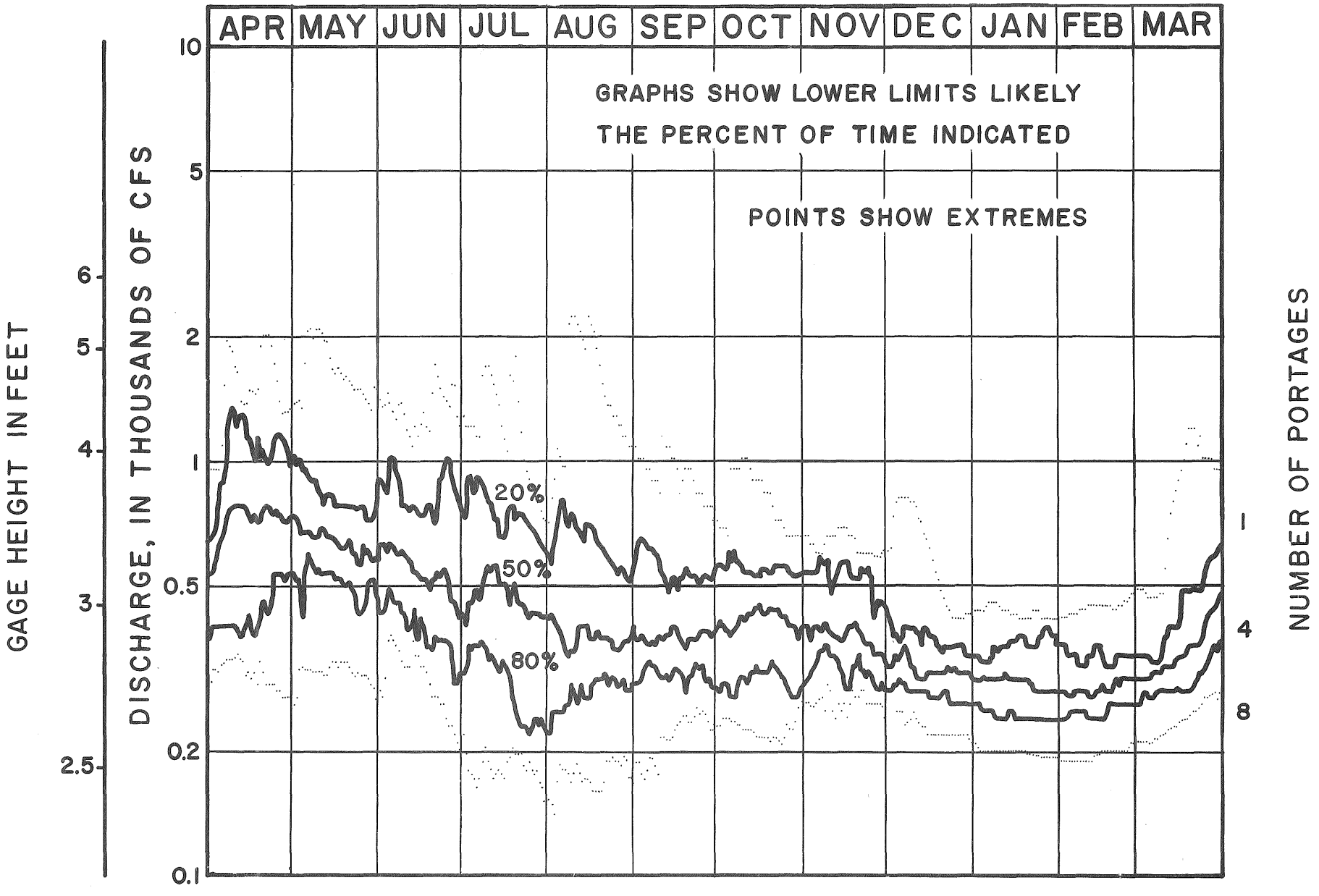
The advancing glacier, during Middle Wisconsin time, blocked the drainage of the Crow Wing River near Pillager. The resulting lake, Glacial Lake Wadena, covered a large part of Wadena County. Sand and gravel outwash was deposited in the lake and at a later period glacial streams deposited additional outwash in the area. The entire area slopes southward about 2 feet per mile, and the present Crow Wing River generally follows this slope. About 12 miles west of Pillager it swings west toward the Mississippi, following a slightly steeper gradient.

The entire length of the Crow Wing River flows on glacial drift--the underlying granite bedrock is nowhere exposed. The generally adequate low flow reflects the large amount of ground water recharge to the stream that takes place from the permeable sand and gravel deposits. The great volume of water that can be stored in these sand and gravel deposits also tends to decrease high flows.



Surficial Geologic Map
(after Leverett, 1932)

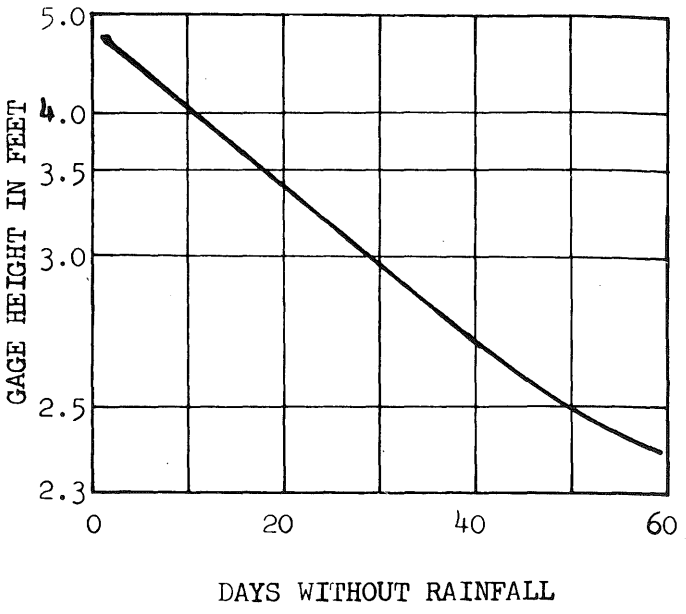
CROW WING RIVER AT NIMROD

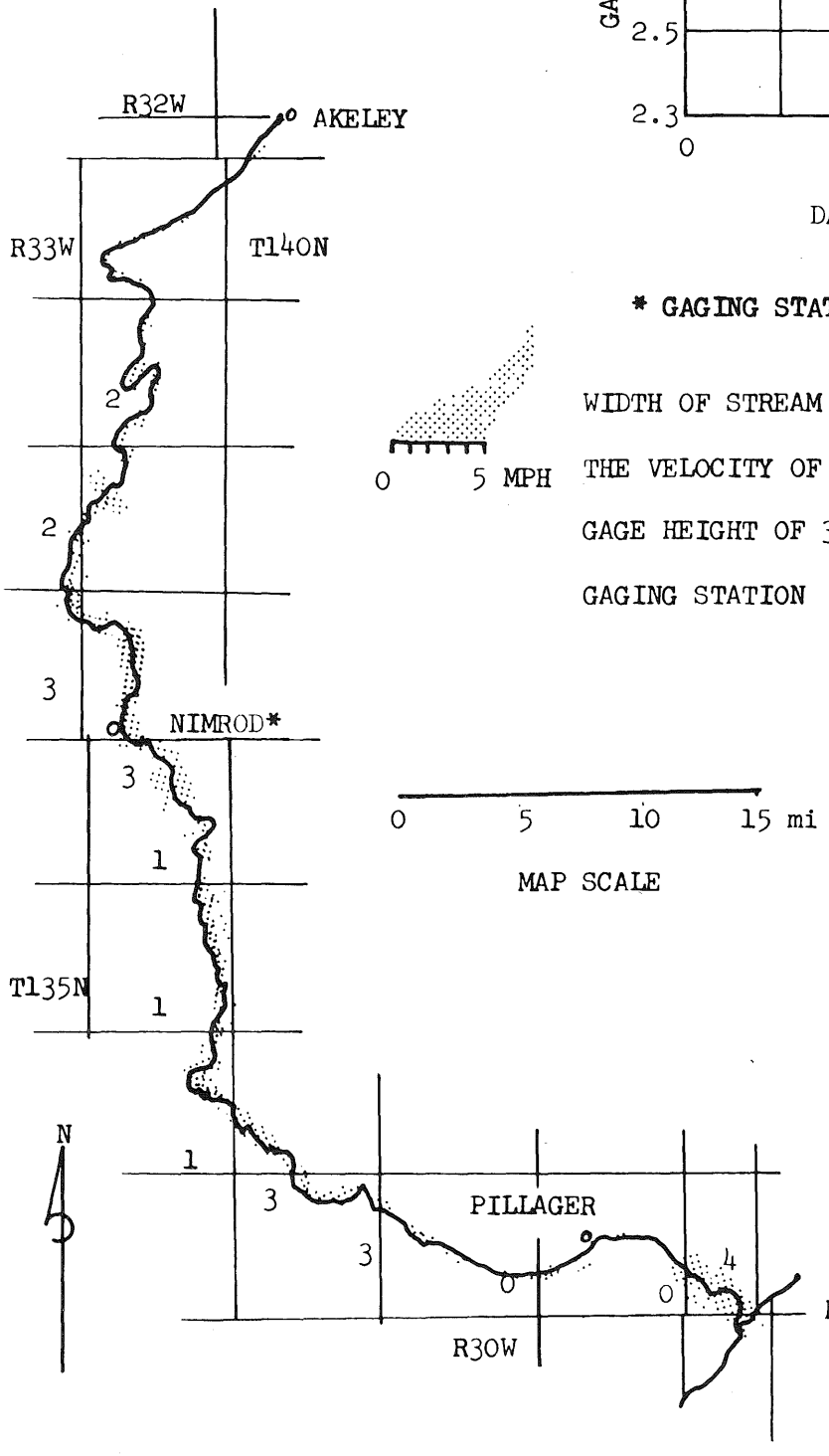


DURATION HYDROGRAPH FOR THE WATER YEARS OF 1943-1961

HYDROLOGY

RECESSION CURVE INDICATES AT THE GAGING STATION THE NORMAL DECLINE IN GAGE HEIGHT FOLLOWING A PERIOD OF RAIN





* GAGING STATION LOCATION

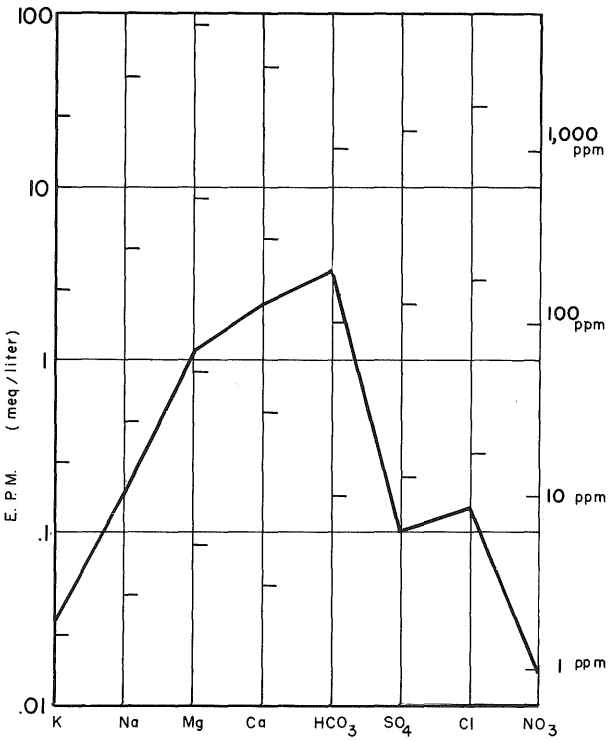
WIDTH OF STREAM INDICATES THE VELOCITY OF FLOW AT A GAGE HEIGHT OF 3 FT AT THE GAGING STATION

DRAINAGE AREA ABOVE GAGE 1,010 sq. mi. NUMBERS INDICATE FOR NORMAL FLOW THE MINIMUM GAGE HEIGHT AT WHICH THE REACH OF THE RIVER IS GENERALLY NAVIGABLE BY CANOE

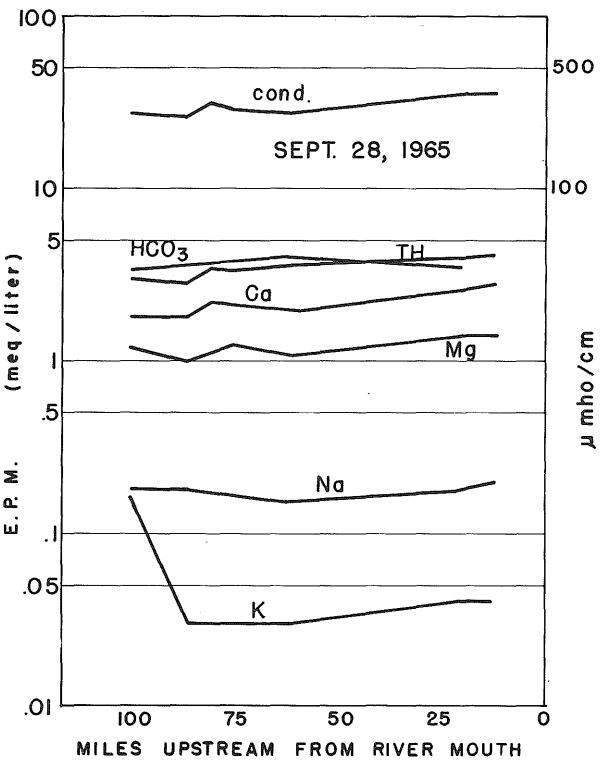
WATER QUALITY

CROW WING RIVER

CONCENTRATION OF MAJOR IONS IN 1 SAMPLE AT NIMROD



DOWNSTREAM VARIATION IN QUALITY



note correlation between conductivity and ion concentrations, permitting estimation of quality change.

WATER TEMPERATURE
SUMMER 1966

STATION: MOTLEY
DATES: JUN 3 – AUG 30
MAX. 12-HOUR ΔT = 7°
AVG. 12-HOUR ΔT = 2.9°
MAX. 5-DAY ΔT = 14°
BEGINNING DATE: AUG 18
DAYS EXCEEDING 80°F: 29

KETTLE RIVER

Reconnaissance was made by canoe from Hwy. 73 to Hwy. 23 and from the dam at Sandstone to St. Croix State Park just above the mouth on June 27, 28, 29 by a USGS observer.

The upper part of the river to the junction with the Moose River was attractive, with many riffle areas and some rock exposures, but was not fully navigable even at this stage. (The gage at Glaisby Brook read 3.30). Quite often you have to wade and drag the canoe. At the usual lower stage the trip would require extensive portaging. The channel is as narrow as thirty feet in some places. There is some tree fall but not so much that it is a hazard to navigation. Quite a few points of reasonable access exist at the bridges. Rapids and white-water areas continue to Hwy. 23 above Sandstone where the hand-painted gage read $2\frac{1}{2}$. The area at Banning where there is a narrow chute in the sandstone was not taken for it is generally not navigable at that stage. It should be left to experienced canoeists only when there is enough water to pass it, generally in the spring. Many lives have been lost in this area for the water in the spring when high and passable is cold and renders the swamped canoeist helpless in minutes. A ledge with undertow also has trapped many.

Access below the dam at Sandstone is good. From here down, the river is wide, often to 200 feet, some pools are over 20 feet deep, and there are many riffle and rapid areas that were, for the most part, navigable at this stage. (The gage at the dam read 870.4 feet). The last part of the river, that below Hwy. 48, where the gradient steepens is very appealing with a series of white-water rapids. One may disembark at Kennedy Brook in the state park where there is automobile access. Fine camping and supply facilities in the park are about 10 miles from this point. For a longer trip one may continue to the junction with the St. Croix and down the St. Croix to one of the access points along it.

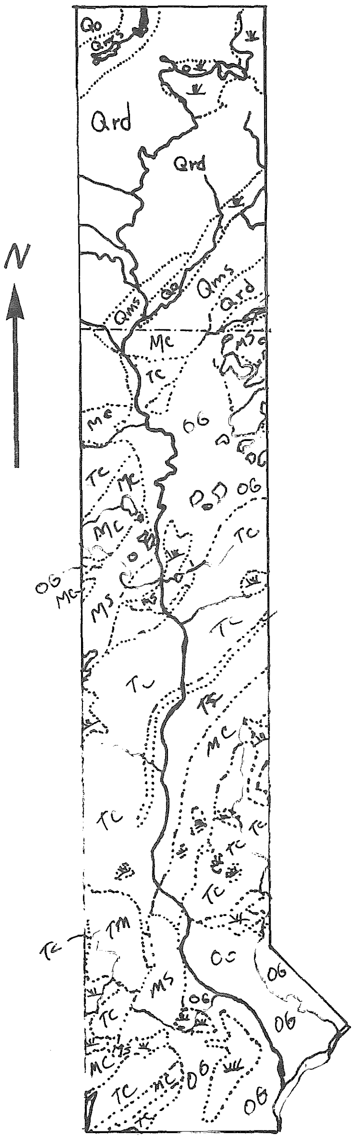
The banks along the Kettle are quite variable and interesting. In the upper reaches, phyllite rock (see photo) and diabase trap rock outcrops can be seen. Where the river flows through a moraine area the banks are gravel, locally containing large boulders. Below this, banks may vary from low and grassy, to high, steep, and sandy. Below the dam at Sandstone many striking outcrops of sandstone can be observed as steep, even undercut, banks. Above Hwy. 48 gravelly low banks predominate but at the state park, basement rock again forms steep cliffs, the most impressive being the diabase rock cliffs at the "Scenic Vista" in the park trail. Occasional conifers grow along the banks, more so in the upper reaches and the park, but hardwoods predominate, mainly maple, oak, ash and some birch. Downstream silver maple predominates.

The color of the water is amber, and even the foam at the rapids has some yellow tint to it. Some filamentous algae was growing on the rocks but over the river as a whole the algae was sparse. Some lemna (duckweed) was floating in the upper reaches but most of it was believed to have come from Moose Lake and similar areas. The bottom is mostly sand to gravel and relatively clean. Numerous ducks and their young were observed, also a few deer near the park.

Several fishermen were encountered on the trip but none had any catch. The Kettle is a river of considerable beauty and some variability in scenery. The areas above Sandstone are generally difficult to navigate unless the water is high. The Banning rapids are used by some but not recommended. They are dangerous when high water makes them navigable and generally cannot be run at lower stages. Below Sandstone the river is large and the trip slow but in places quite attractive. Below Hwy. 48 to the St. Croix it is particularly attractive with many areas of white water and rapids with standing waves of a foot or more. The condition of these rapids can be observed from the "Scenic Vista" and "Big Eddy" areas of the park. The lower reach of the river is a very exciting and beautiful trip for the canoeist and also has potential with very little clearing for a family hiking trail mostly within already established park boundaries. Further study on the navigability, changeability and safety of the stream are recommended. The river is within easy reach of Twin City residents but promotion should be with caution as parts of the river though very attractive are not safe for the average canoeist.

GEOLOGY

KETTLE RIVER



The Kettle River during glacial time, served as an outlet for Glacial Lake St. Louis. The large volumes of water that flowed from the lake cut the steep cliffs of Hinckley Sandstone that are characteristic of the river. The photo shows an exposure of Hinckley Sandstone 4 miles upstream from the Highway 23 bridge. This sculptured mass of stone was eroded to its present shape by the discharging floodwaters of Glacial Lake St. Louis.

Resistant beds of cemented sand in the Hinckley Sandstone form rapids and falls in the upper part of the river, particularly just below the Highway 23 crossing. Upstream from Rutledge, the Kettle flows on glacial drift. The banks are generally low and show sections of till deposited from ice that moved southwest out of the Lake Superior basin.

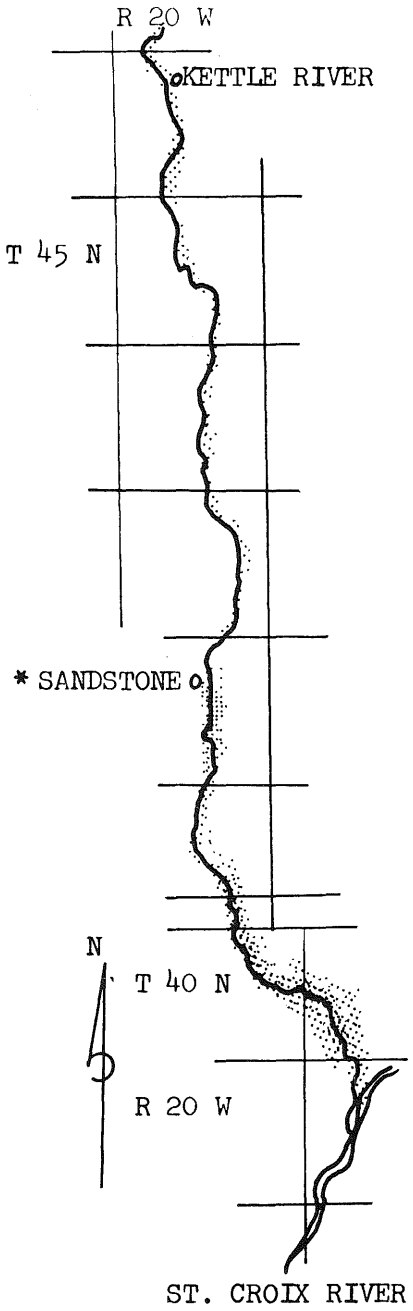
Below Rutledge, however, the Kettle flows largely on the Hinckley Sandstone except for two short reaches below Hinckley and the lower 5 miles through St. Croix State Park.

In these latter reaches, the river flows through ancient deposits of copper-bearing "trap" rock and conglomerate. The rock is decomposed diabase of a dull red or dark rusty color. Some chlorite and veins of calcite are present. The calcite occurs in joints, at places up to 10 feet in length. Copper claims were once staked in this area and free copper nuggets may still be found.

Downcutting of the river bed is slowed by this diabase rock and as a result, the gradient of the channel is abruptly steepened where the deposits are first crossed. This steep gradient, in part a result of downcutting by the St. Croix River, continues to the mouth of the Kettle. The upper change in slope at mile 28 results from resistant beds in the Hinckley Sandstone.

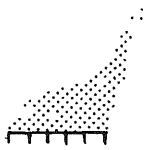
HYDROLOGY

KETTLE RIVER

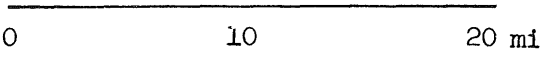


DRAINAGE AREA ABOVE GAGE
825 sq. mi.

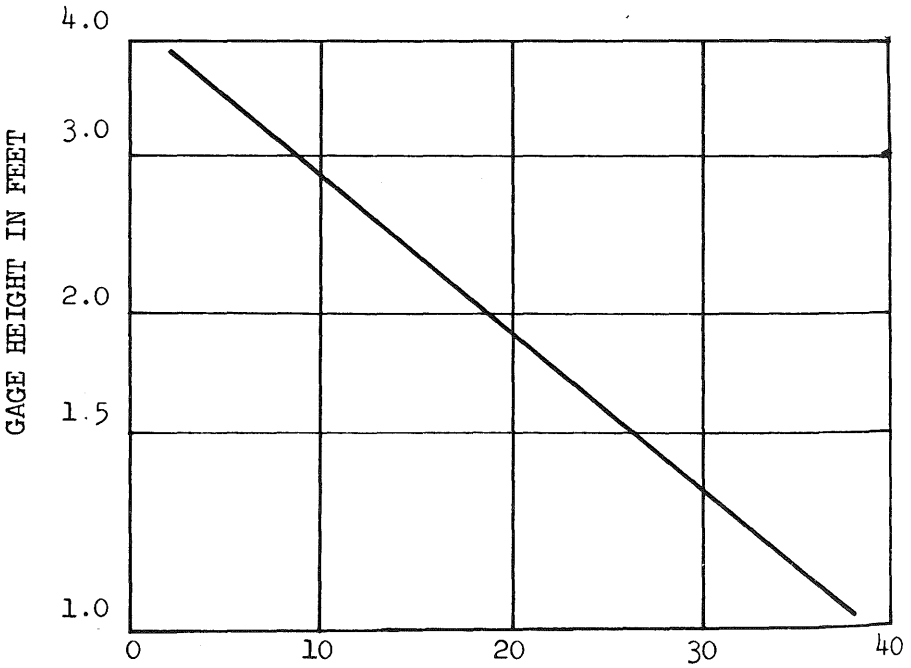
RECESSION CURVE INDICATES AT THE GAGING STATION THE NORMAL DECLINE IN GAGE HEIGHT FOLLOWING A PERIOD OF RAIN



WIDTH OF STREAM INDICATES VELOCITY OF FLOW

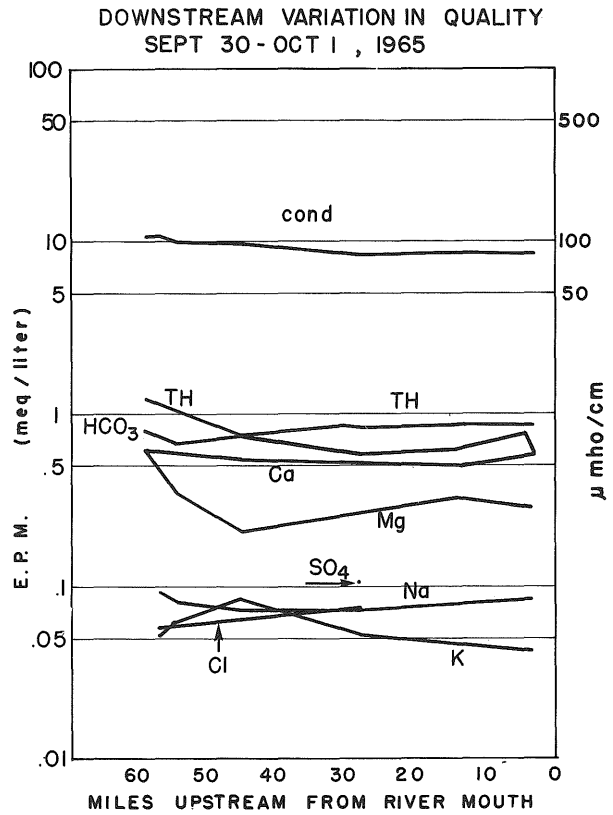


MAP SCALE



GAGING STATION DISCONTINUED

*GAGING STATION LOCATION



WATER TEMPERATURE
SUMMER 1966

STATION: HIGHWAY 48
DATES: JUN 29 - AUG 23
MAX. 12-HOUR ΔT = 8°
AVG. 12-HOUR ΔT = 1.9°
MAX. 5-DAY ΔT = 15°
BEGINNING DATE: AUG 6
DAYS EXCEEDING 80°F: 18

LITTLE FORK RIVER

Reconnaissance by canoe was made July 12, 13, 14 and 15, 1966 between Linden Grove and the mouth by U.S.G.S. observers.

Many riffles and rapids form long, easily navigable pools above Little Fork. The riffles or rapids could be quite dangerous even in low water because they are fast and have very deep pools below them. Many of the rapids are formed by bedrock outcrops. Four of the rapids should be portaged even in low water. The till which overlies the bedrock is also exposed in many of the sloughs. Width varies from 40 to 125 feet.

The portion below Little Fork is navigable except at very low stage. There are no riffles in this reach. The river averages 160 feet wide.

Banks ranged from 2 to 10 feet high. Most are till except where bedrock has been exposed. Approximately 3 percent of the banks are open, ungrazed, and grazed meadows which make excellent camping sites. The forest contains poplar, maple, elm, and oak hardwoods and pine and spruce. The banks along the forested areas are heavy with undergrowth.

The several abandoned farms could be developed into excellent parks and/or camping areas without destroying the wilderness environment or overdeveloping the area. Other camping areas are available along the river, but good ones are not spaced within a days canoeing.

There was no foam or evidence of pollution. The color is amber, typical of the northern Minnesota streams. Water temperature averaged 80 degrees fahrenheit. The bottom material is generally silt or clay, except in the riffles, where it is rock.

Ducks and deer were seen.

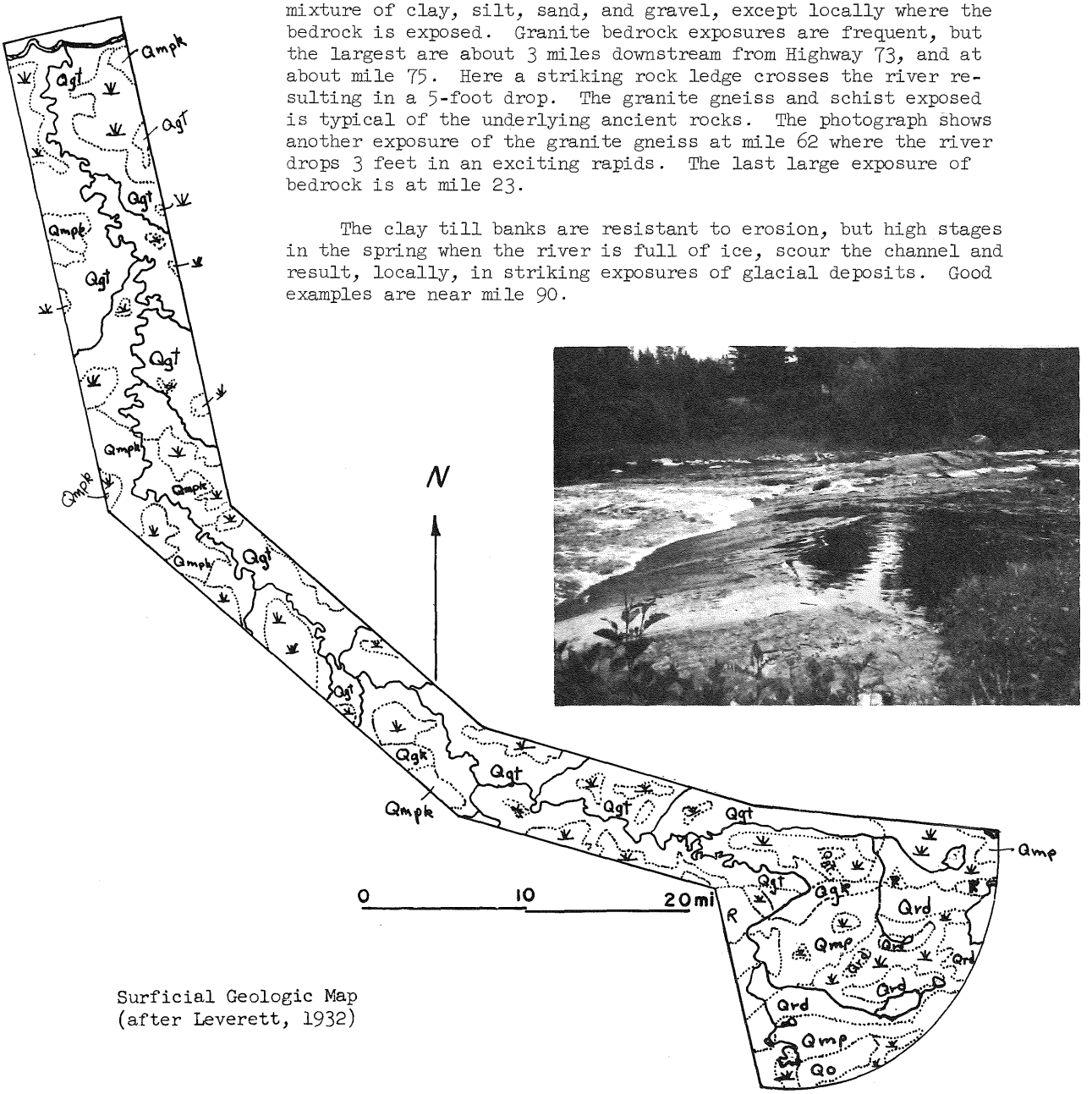
Access, generally steep, weedy or brushy, is limited, but is sufficient for a two-day canoe trip.

The river is in high quality wilderness environment above Little Fork. It should be studied in more detail, so that it could be more completely assessed as to safety, desirability, and development needs.

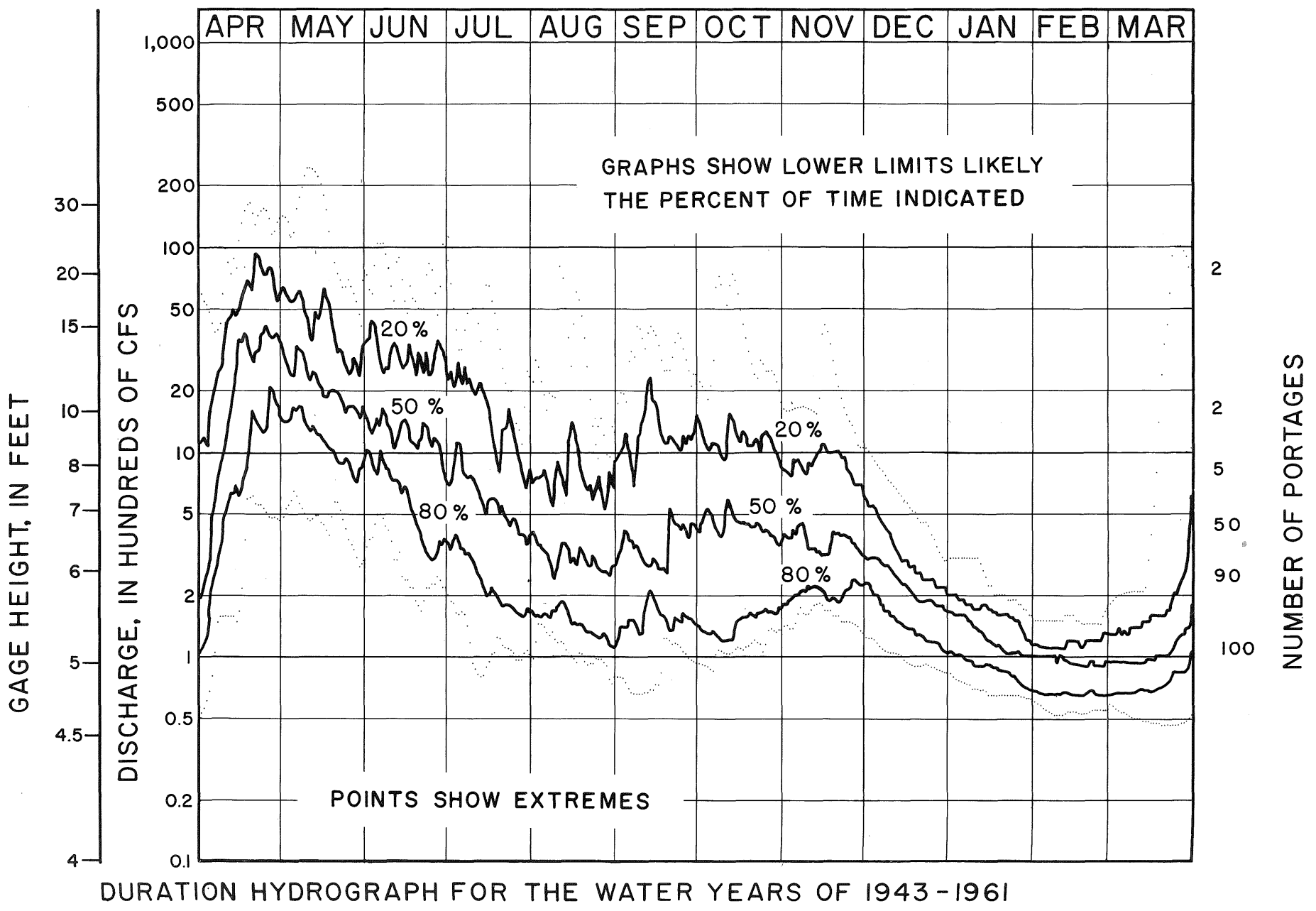
The headwaters of the Little Fork River lie along the highest beaches of Glacial Lake Agassiz. Occupying a position in the northeast part of this ancient lake basin, the river flows northwest and north, largely on lake-washed glacial till. The valley is generally cut only a few feet below the surrounding area and rapid downcutting is prevented by numerous bedrock ledges. The river follows a gently meandering course throughout most of its length, but from mile 35 downstream to Little Fork, it has developed very sinuous meanders, (probably from low slope or initial irregularities in the surface of the glacial drift). The river gradient is controlled by granite underlying each drop as shown on the profile and finally by the Rainy River to which the last 15 miles are smoothly graded.

The banks are commonly light and dark gray glacial till, a mixture of clay, silt, sand, and gravel, except locally where the bedrock is exposed. Granite bedrock exposures are frequent, but the largest are about 3 miles downstream from Highway 73, and at about mile 75. Here a striking rock ledge crosses the river resulting in a 5-foot drop. The granite gneiss and schist exposed is typical of the underlying ancient rocks. The photograph shows another exposure of the granite gneiss at mile 62 where the river drops 3 feet in an exciting rapids. The last large exposure of bedrock is at mile 23.

The clay till banks are resistant to erosion, but high stages in the spring when the river is full of ice, scour the channel and result, locally, in striking exposures of glacial deposits. Good examples are near mile 90.

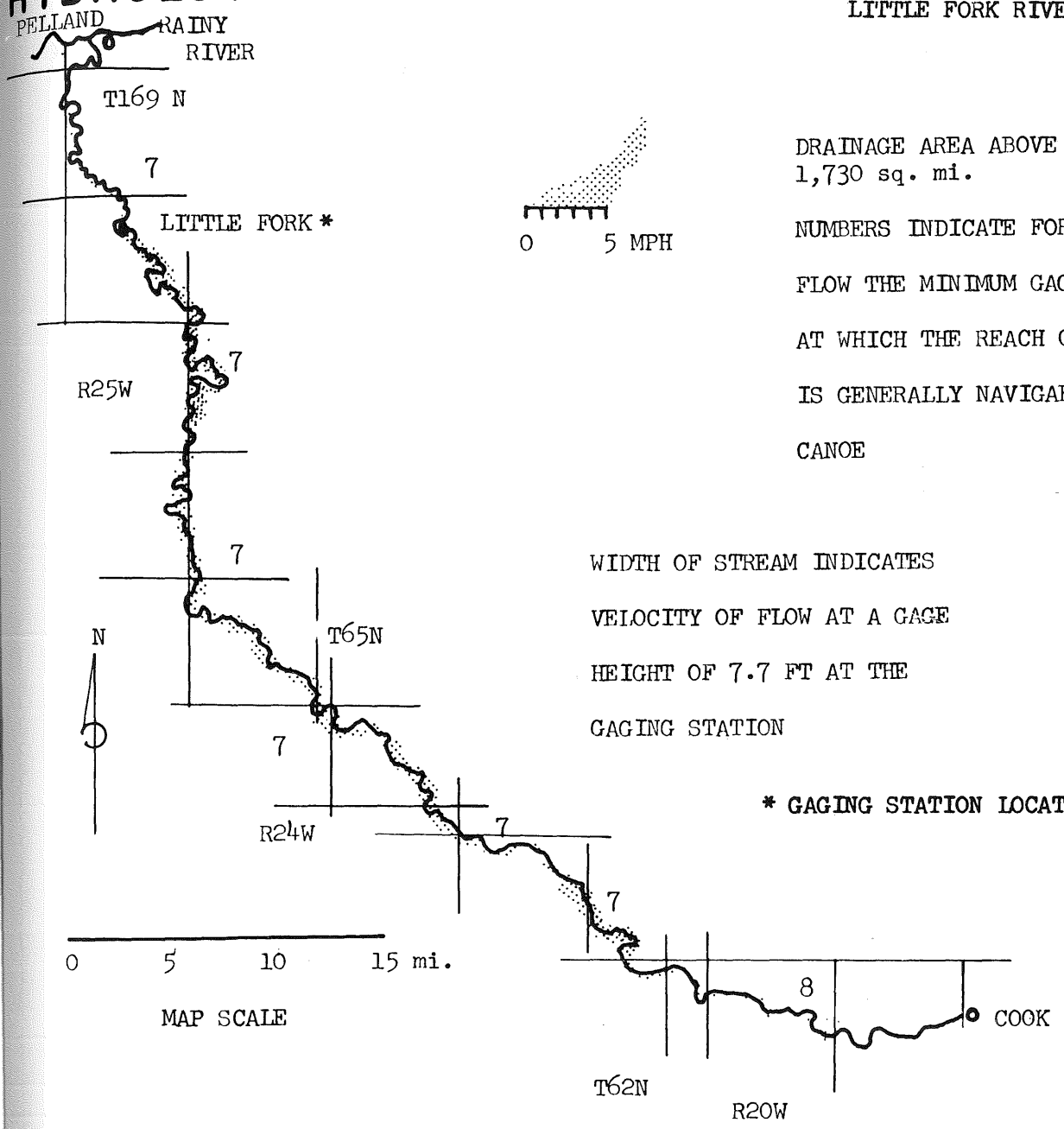


Surficial Geologic Map
(after Leverett, 1932)


LITTLE FORK RIVER AT LITTLE FORK
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
JAN
FEB
MAR
1,000
500
200
100
50
20
10
5
2
1
0.5
0.2
0.1
GRAPHS SHOW LOWER LIMITS LIKELY
THE PERCENT OF TIME INDICATED
20 %
50 %
80 %
20 %
50 %
80 %
POINTS SHOW EXTREMES
GAGE HEIGHT, IN FEET
30
20
15
10
8
7
6
5
4.5
4
DISCHARGE, IN HUNDREDS OF CFS
NUMBER OF PORTAGES
2
2
5
50
90
100
DURATION HYDROGRAPH FOR THE WATER YEARS OF 1943-1961

HYDROLOGY

LITTLE FORK RIVER

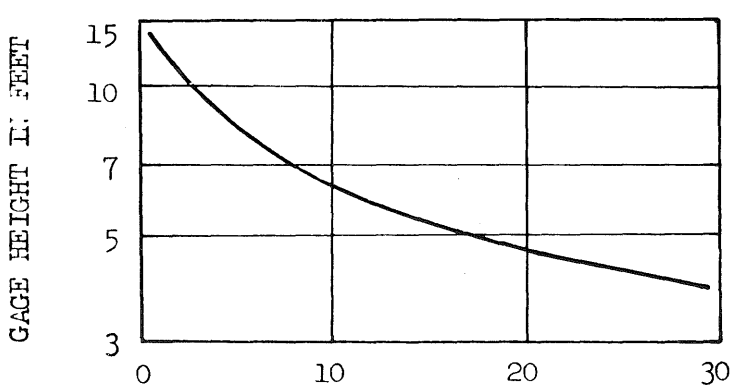


DRAINAGE AREA ABOVE GAGE
1,730 sq. mi.

NUMBERS INDICATE FOR NORMAL FLOW THE MINIMUM GAGE HEIGHT AT WHICH THE REACH OF RIVER IS GENERALLY NAVIGABLE BY CANOE

WIDTH OF STREAM INDICATES VELOCITY OF FLOW AT A GAGE HEIGHT OF 7.7 FT AT THE GAGING STATION

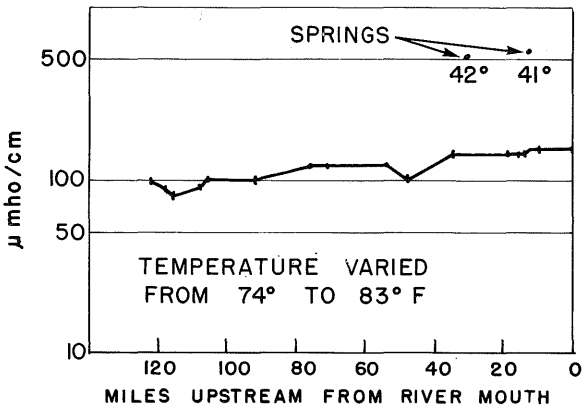
*** GAGING STATION LOCATION**



RECESSION CURVE INDICATES AT THE GAGING STATION THE NORMAL DECLINE IN GAGE HEIGHT FOLLOWING A PERIOD OF RAIN

DOWNSTREAM VARIATION IN CONDUCTIVITY

JULY 12-15, 1966



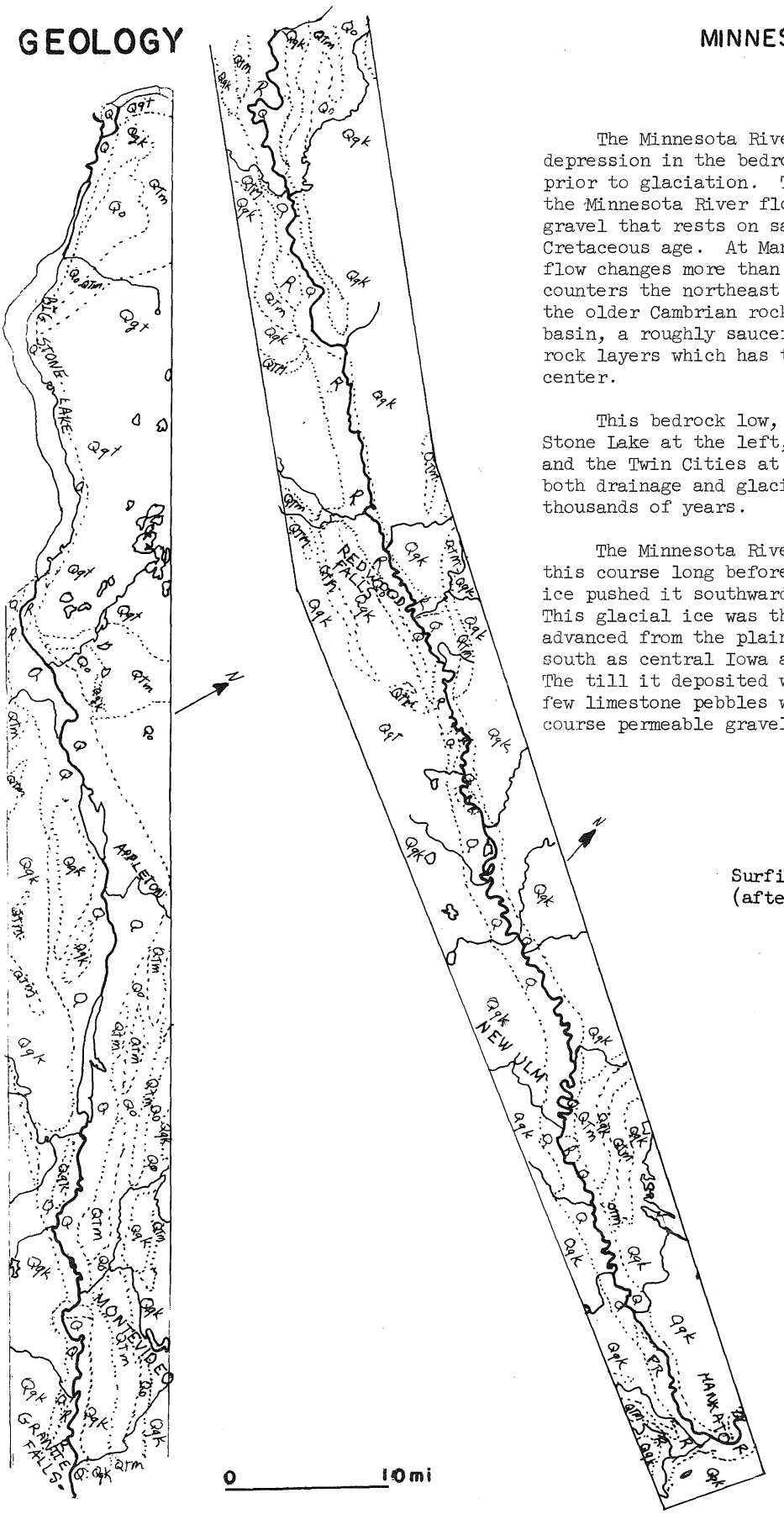
GEOLOGY

MINNESOTA RIVER I

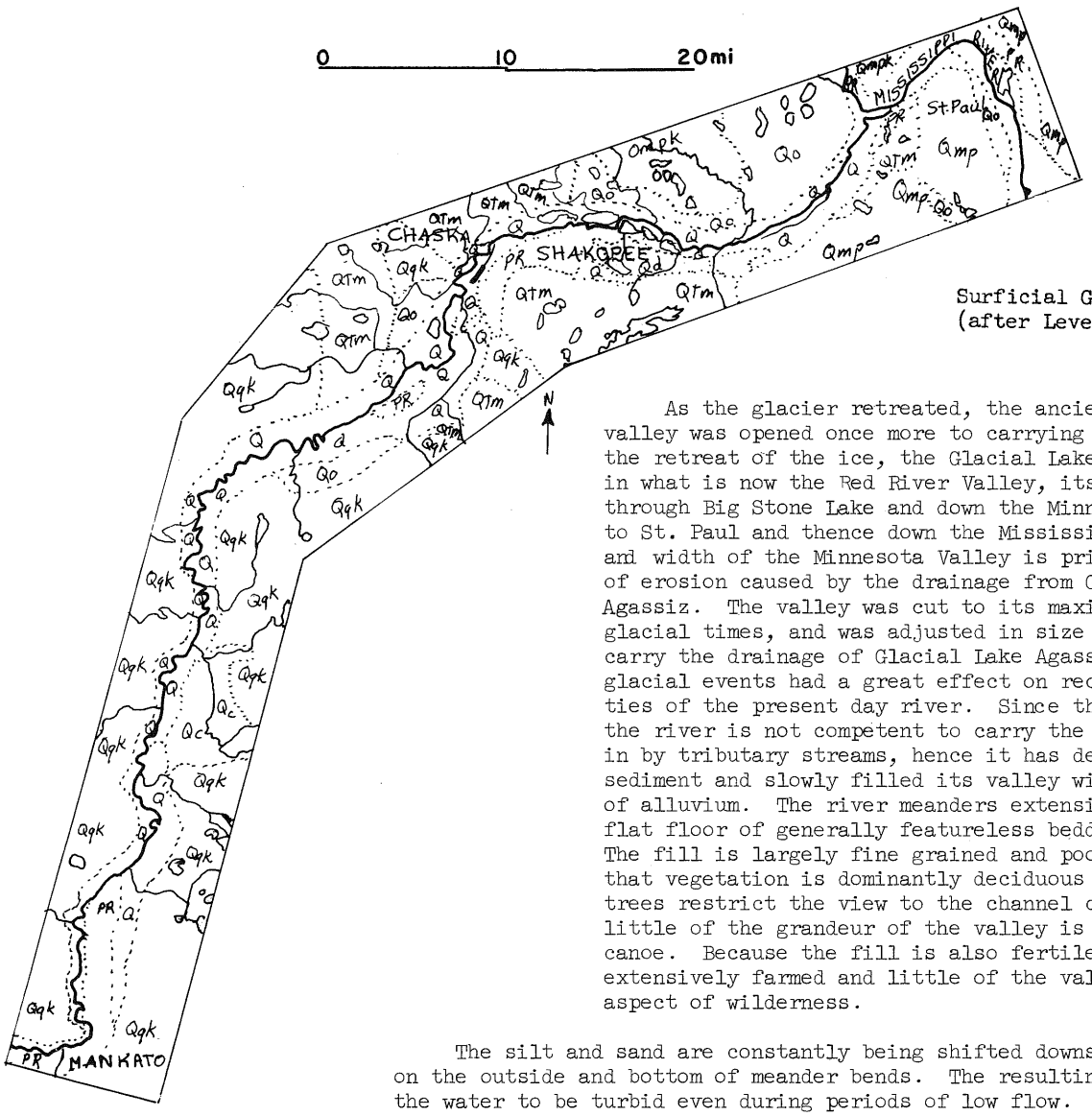
The Minnesota River valley lies in a depression in the bedrock surface that existed prior to glaciation. Through most of the reach the Minnesota River flows on alluvial sand and gravel that rests on sandstone and shale of Cretaceous age. At Mankato the direction of flow changes more than 90 degrees as it encounters the northeast down the dip slope of the older Cambrian rocks into the Twin City basin, a roughly saucer shapped structure of rock layers which has the Twin Cities as its center.

This bedrock low, a lopsided V with Big Stone Lake at the left, Mankato at the center, and the Twin Cities at the right, has controlled both drainage and glacial ice movements for thousands of years.

The Minnesota River must have followed this course long before the advance of glacial ice pushed it southward out of its channel. This glacial ice was the huge Des Moines Lobe that advanced from the plains of Manitoba as far south as central Iowa about 14,000 years ago. The till it deposited was largely clay with a few limestone pebbles with relatively little course permeable gravel.



Surficial Geologic Map
(after Leverett, 1932)



Surficial Geologic Map
(after Leverett, 1932)

As the glacier retreated, the ancient Minnesota valley was opened once more to carrying water. During the retreat of the ice, the Glacial Lake Agassiz formed in what is now the Red River Valley, its outlet was through Big Stone Lake and down the Minnesota Valley to St. Paul and thence down the Mississippi. The depth and width of the Minnesota Valley is primarily a result of erosion caused by the drainage from Glacial Lake Agassiz. The valley was cut to its maximum depth during glacial times, and was adjusted in size and gradient to carry the drainage of Glacial Lake Agassiz. These glacial events had a great effect on recreational qualities of the present day river. Since the lake drained, the river is not competent to carry the sediment brought in by tributary streams, hence it has deposited this sediment and slowly filled its valley with about 50 feet of alluvium. The river meanders extensively in this flat floor of generally featureless bedded silt and sand. The fill is largely fine grained and poorly drained so that vegetation is dominantly deciduous trees. These trees restrict the view to the channel corridor so that little of the grandeur of the valley is visible from a canoe. Because the fill is also fertile, the valley is extensively farmed and little of the valley retains any aspect of wilderness.

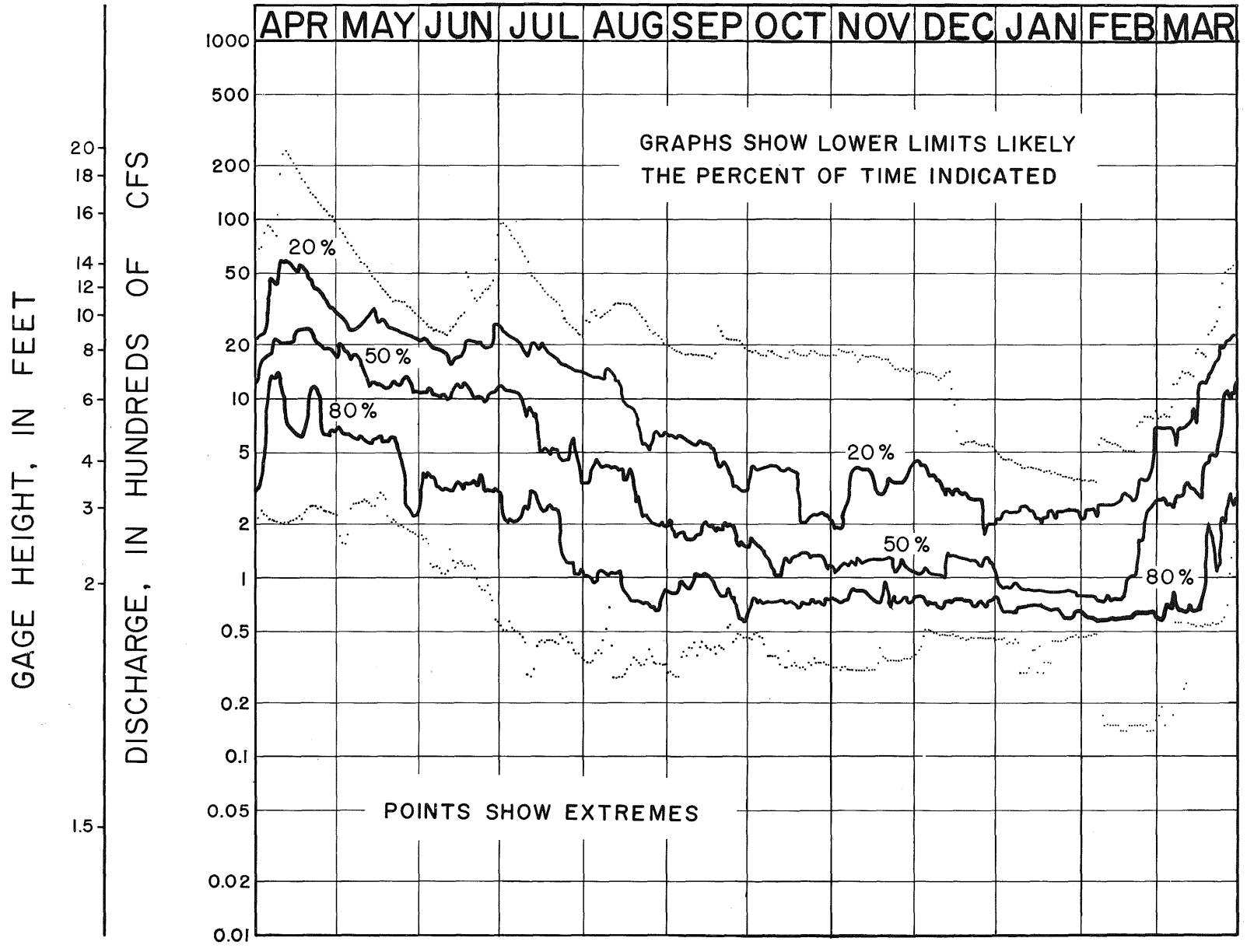
The silt and sand are constantly being shifted downstream by erosion on the outside and bottom of meander bends. The resulting load causes the water to be turbid even during periods of low flow.

The glacial deposits in the Minnesota Valley are clay till of the Des Moines Lobe as previously noted. This till is relatively impermeable; it transmits water very slowly from high areas to low areas. As a result, the groundwater discharge through summer flow (since summer flow is largely from groundwater discharge), high temperature water, and water low is dissolved mineral matter. Further, as so little water runs into the groundwater reservoir, most precipitation runs over the surface and discharges to streams as overland flow. The rate of movement of water over the surface is rapid. It reaches tributary streams soon after precipitation starts; it runs rapidly down the steep tributary valleys that drop into the deeply eroded Minnesota River; and it causes rapid increases in flow in the Minnesota.

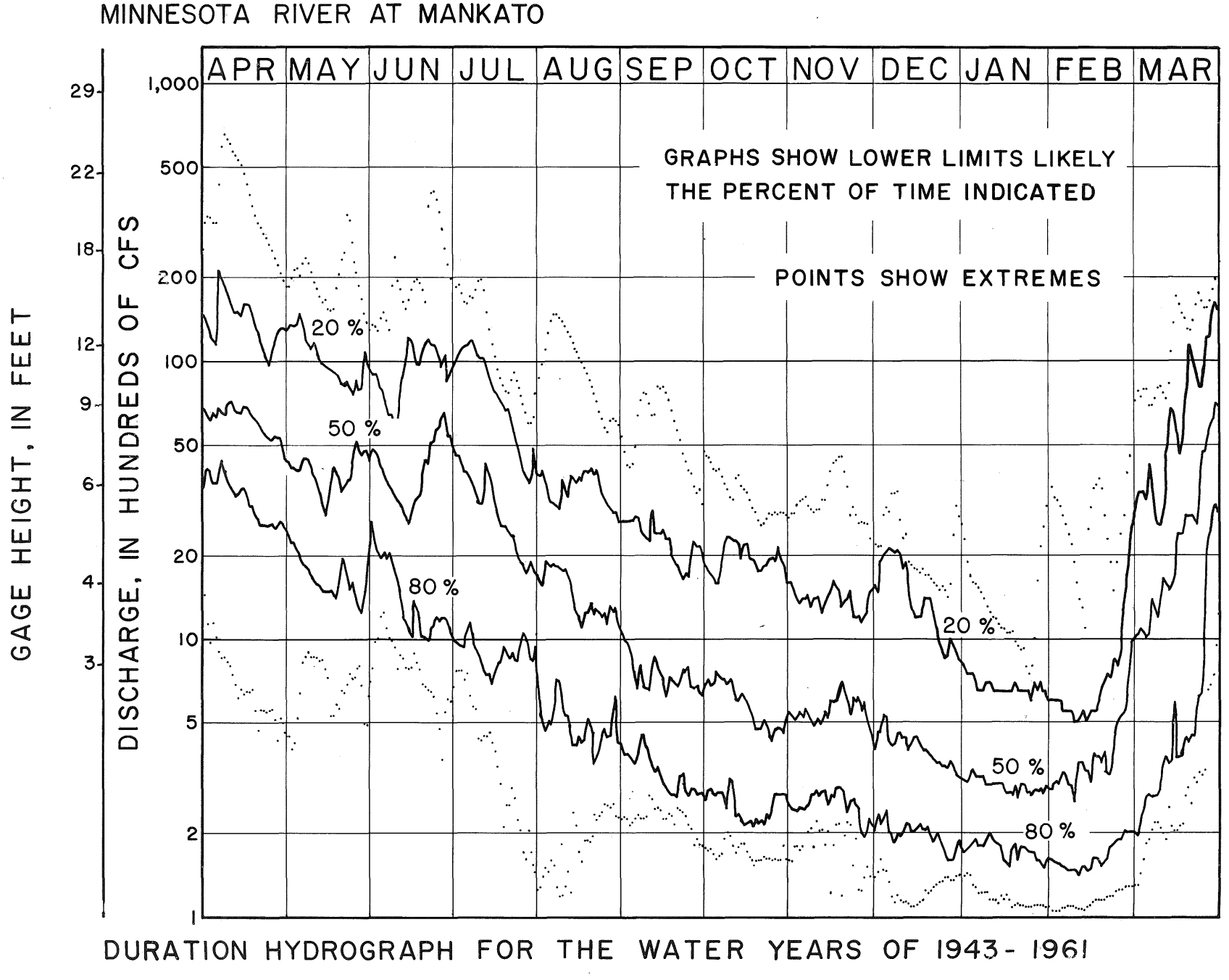
Thus, the Minnesota is a very "flashy" stream; a series of nearly stagnant muddy pools in late summer, a roaring muddy torrent after heavy rains.

The most scenic reaches are near Granite Falls where granite bedrock is exposed in the valley. The rock is extensively queried for buildings and monuments and is considered one of the finest in the world. It is Precambrian in age, about 1.1 billion years old.

MINNESOTA RIVER AT MONTEVIDEO

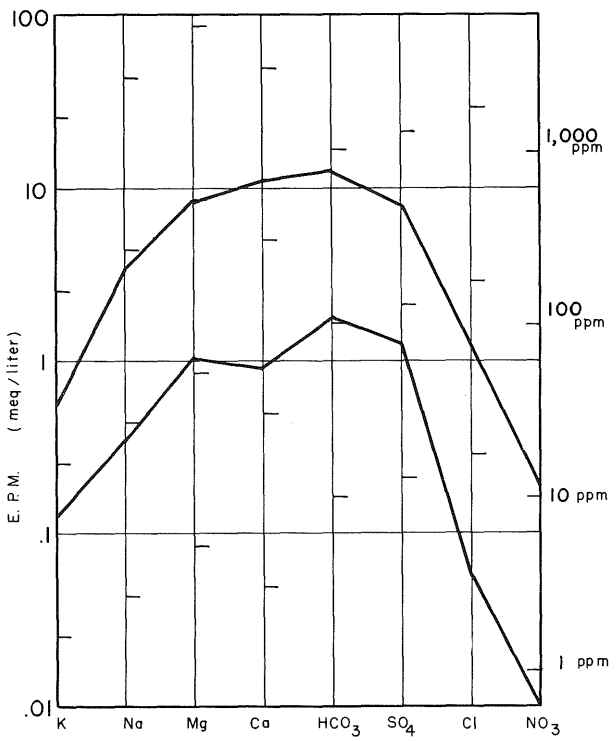


DURATION HYDROGRAPH FOR THE WATER YEARS 1943 - 1961

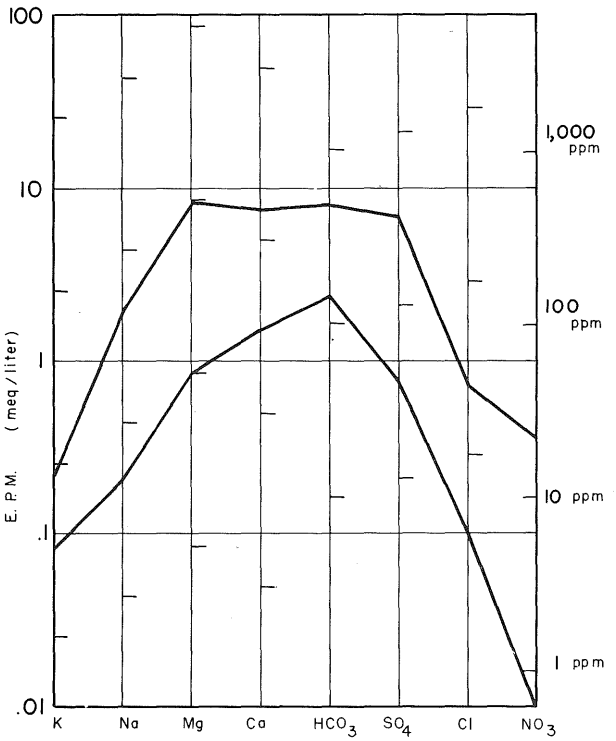

MINNESOTA RIVER AT MANKATO
APR MAY JUN JUL AUG SEP OCT NOV DEC JAN FEB MAR
GRAPHS SHOW LOWER LIMITS LIKELY
THE PERCENT OF TIME INDICATED
POINTS SHOW EXTREMES
20 %
50 %
80 %
20 %
50 %
80 %
GAGE HEIGHT, IN FEET
29
22
18
12
9
6
4
3
DISCHARGE, IN HUNDREDS OF CFS
1,000
500
200
100
50
20
10
5
2
1
DURATION HYDROGRAPH FOR THE WATER YEARS OF 1943 - 1961

RANGE OF CONCENTRATION OF MAJOR IONS

145 SAMPLES TAKEN AT MONTEVIDEO
JUNE 1962 – JUNE 1966



44 SAMPLES TAKEN AT MANKATO
OCT. 1960 – OCT. 1966



UPPER MISSISSIPPI RIVER

Reconnaissance by canoe was made August 31 and September 1, 1966 between the source, Lake Itasca, and Lake Winnibigoshish by U.S.G.S. observers.

Except for a short time in the spring of the year, there probably would not be sufficient water in the river above Bemidji for easy navigation. Tree fall and marsh-plant growth are a problem in this reach. With moderate use, most of the tree fall could be cleared and perhaps a channel opened through the marsh growth. The shallow riffles would still require wading much of the summer season. The beaver dams which were found usually had an opening through which the canoe could float. Below Bemidji the river is navigable. There are several dams which have to be portaged.

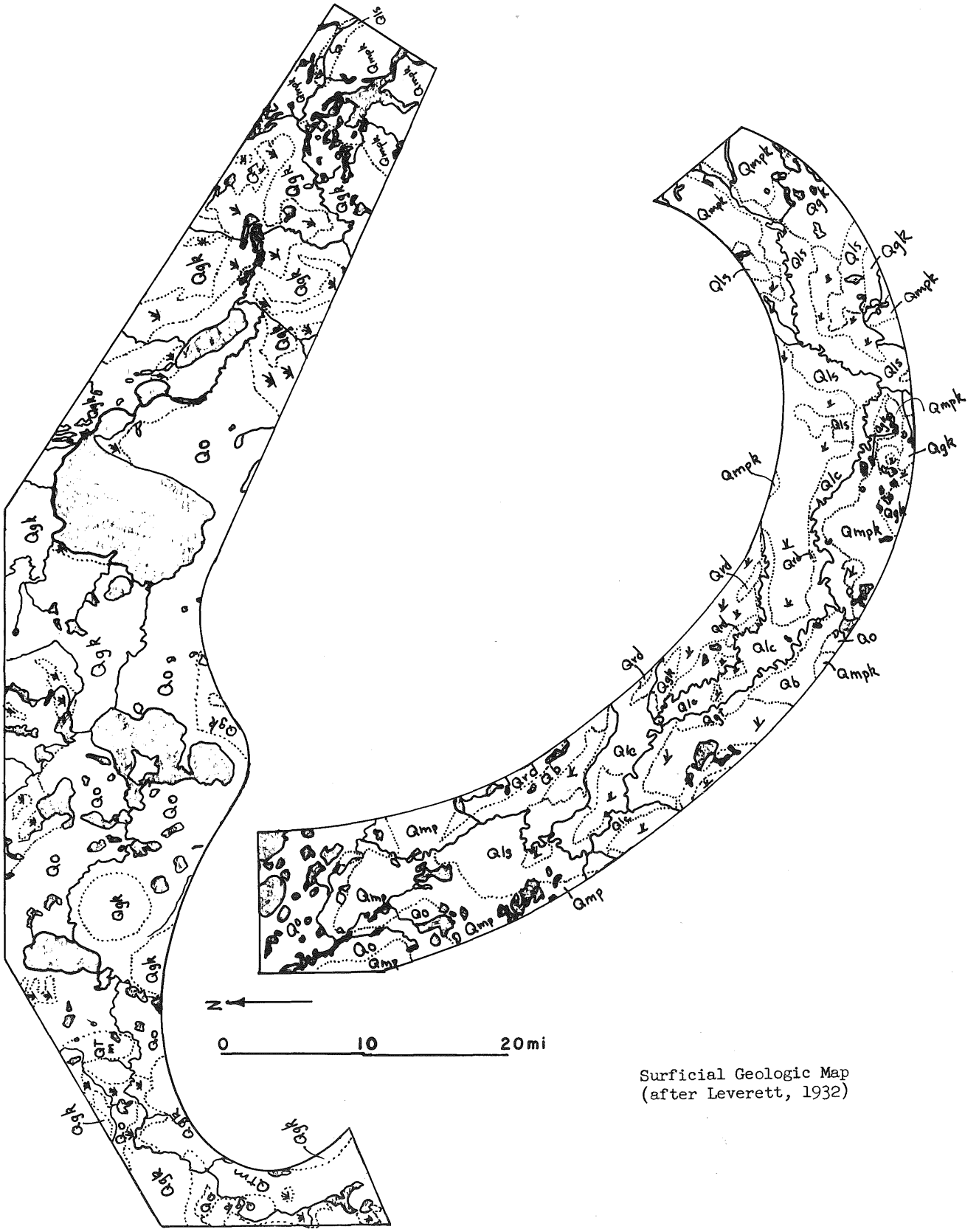
The setting of the river is very much a wilderness. Approximately 70 percent of the distance, the river flows through marsh. There is enough forest mixed in with the reaches of marsh so that good camping sites are not more than six hours of canoeing apart. The banks are usually sandy and the forests of a mixed type. The river varies from 20 to 200 feet in width and the banks from 0 to 10 feet high.

The water is exceptionally clear and clean and not until the influence of civilization at Bemidji is reached is its aesthetic appeal destroyed. The water temperature averaged about 70 degrees fahrenheit. The predominant bottom material was sand or cobbles.

Many ducks, one deer and muskrat were seen. According to local residents, the beaver population has been eliminated by trapping.

There are a few, but adequate accesses to the river spaced within a half a day's canoeing of each other.

Because of the river's importance in the history of America and its wilderness character, it is worthy of further study and development. The navigability is a limiting factor.

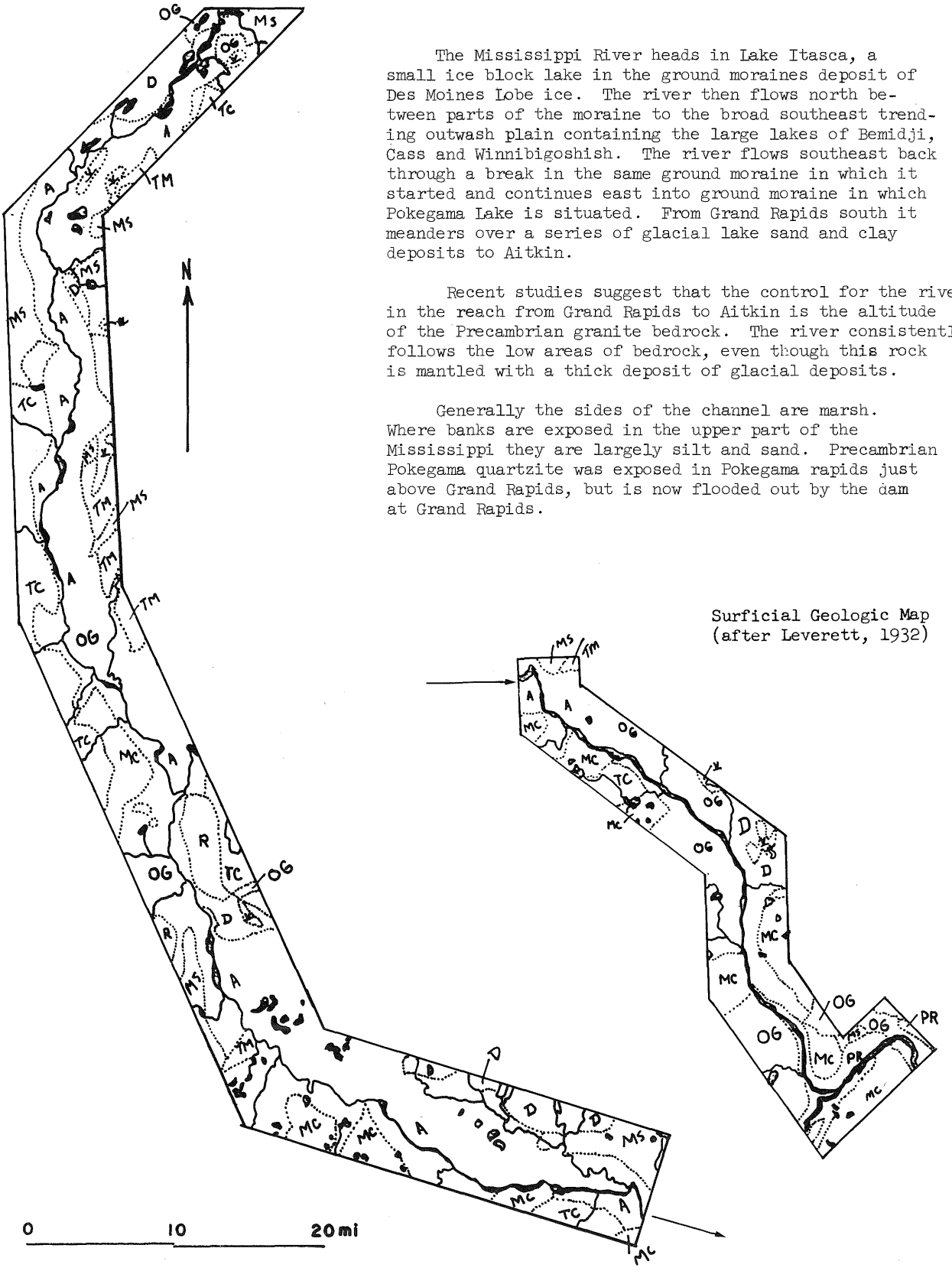


Surficial Geologic Map
(after Leverett, 1932)

The Mississippi River heads in Lake Itasca, a small ice block lake in the ground moraines deposit of Des Moines Lobe ice. The river then flows north between parts of the moraine to the broad southeast trending outwash plain containing the large lakes of Bemidji, Cass and Winnibigoshish. The river flows southeast back through a break in the same ground moraine in which it started and continues east into ground moraine in which Pokegama Lake is situated. From Grand Rapids south it meanders over a series of glacial lake sand and clay deposits to Aitkin.

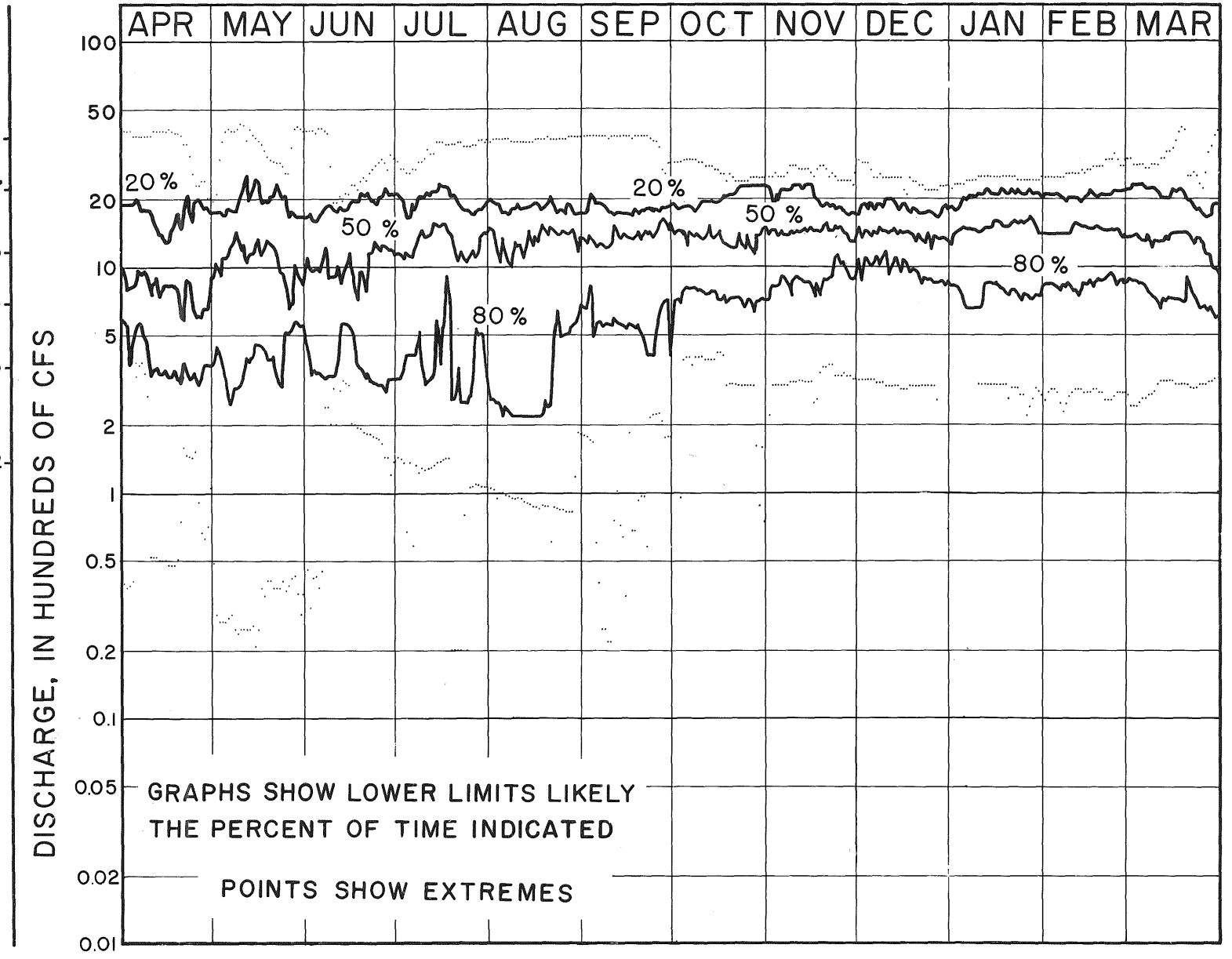
Recent studies suggest that the control for the river in the reach from Grand Rapids to Aitkin is the altitude of the Precambrian granite bedrock. The river consistently follows the low areas of bedrock, even though this rock is mantled with a thick deposit of glacial deposits.

Generally the sides of the channel are marsh. Where banks are exposed in the upper part of the Mississippi they are largely silt and sand. Precambrian Pokegama quartzite was exposed in Pokegama rapids just above Grand Rapids, but is now flooded out by the dam at Grand Rapids.



Surficial Geologic Map
(after Leverett, 1932)

MISSISSIPPI RIVER AT GRAND RAPIDS



GAGE HEIGHT, IN FEET

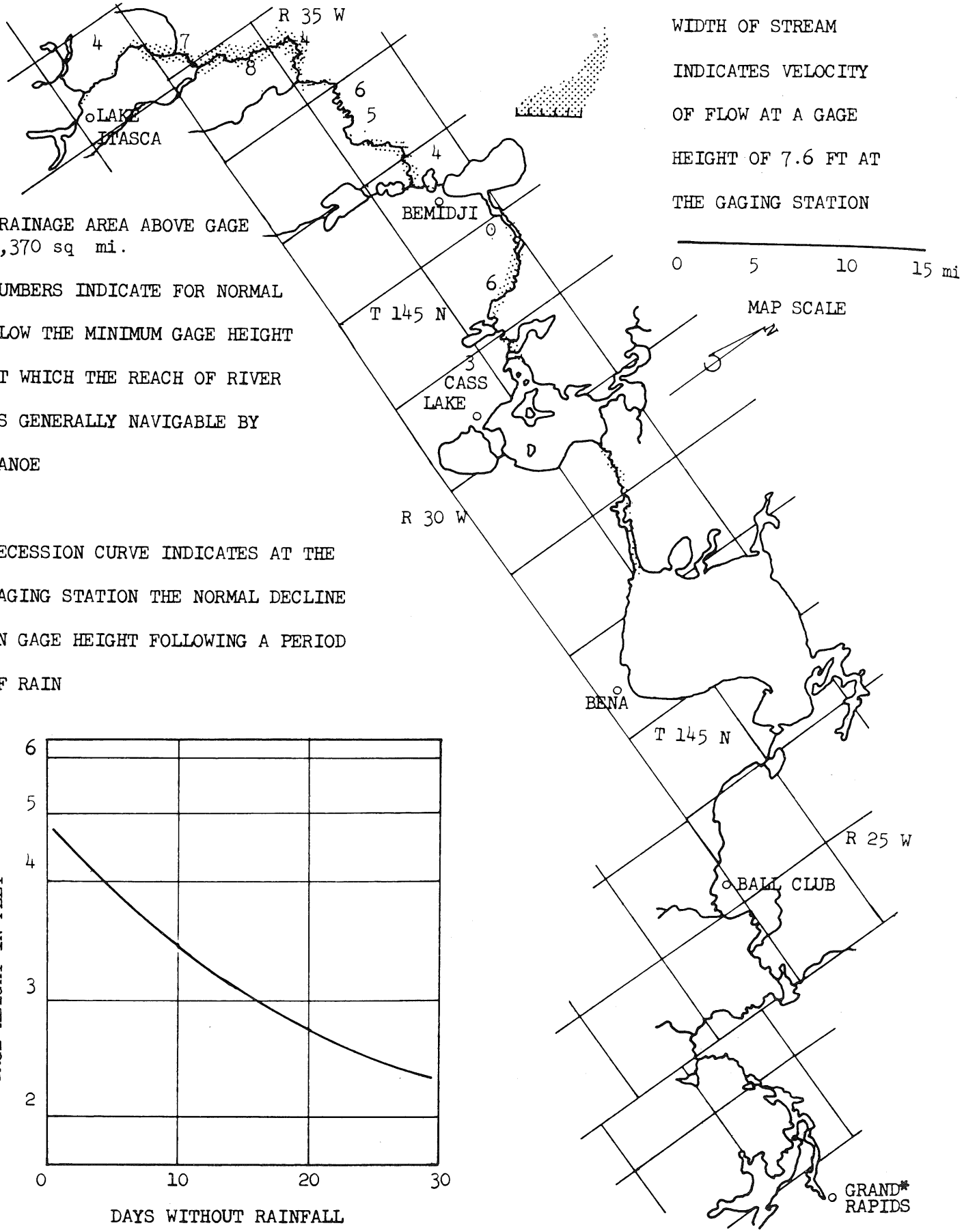
DISCHARGE, IN HUNDREDS OF CFS

NUMBER OF PORTAGES

DURATION HYDROGRAPH FOR THE WATER YEARS OF 1943 - 1961

HYDROLOGY

MISSISSIPPI RIVER



DRAINAGE AREA ABOVE GAGE 3,370 sq mi.

NUMBERS INDICATE FOR NORMAL FLOW THE MINIMUM GAGE HEIGHT AT WHICH THE REACH OF RIVER IS GENERALLY NAVIGABLE BY CANOE

RECESSION CURVE INDICATES AT THE GAGING STATION THE NORMAL DECLINE IN GAGE HEIGHT FOLLOWING A PERIOD OF RAIN

FLOW REGULATED BY MANY LAKES

*** GAGING STATION LOCATION**

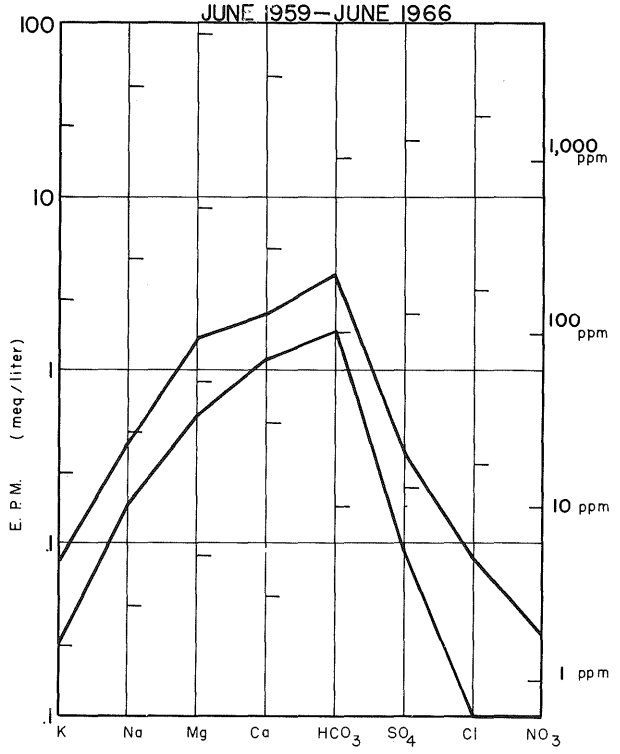
WATER QUALITY

MISSISSIPPI RIVER

RANGE OF CONCENTRATION OF MAJOR IONS

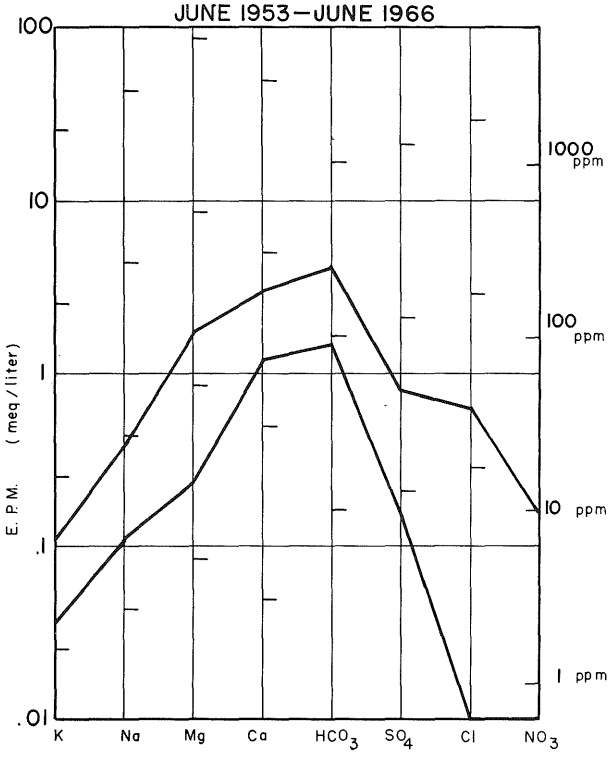
43 SAMPLES TAKEN AT GRAND RAPIDS

JUNE 1959—JUNE 1966

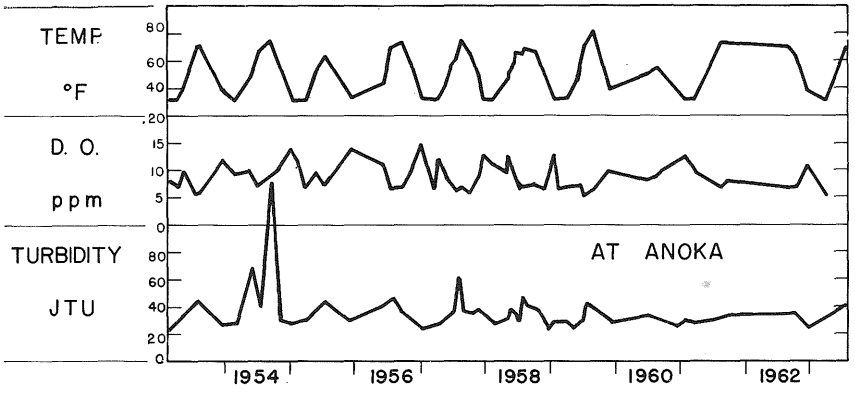


150 SAMPLES TAKEN AT ANOKA

JUNE 1953—JUNE 1966



FACTORS OF HIGH CONCERN TO ECOLOGY



NUTRIENT			
PHOSPHORUS, ppm			
HI	LO	AVG	SAMPLES
.25	.04	.12	15

AT ANOKA

1958-1959
1962-1963

CROW RIVER

Reconnaissance by canoe was made August 24 and 25, 1966 between State Highway #25 and the mouth, by U.S.G.S. observers.

Navigation was satisfactory but stage was above the summer average. Many riffles were crossed. Tree fall was present but did not hamper navigation. Fences were a problem and a hazard in the portion of the river above Rockford, where the stream width varied from 20 to 100 ft. Below Rockford, the stream varied from 75 to 175 ft in width. There are no dangerous stretches of fast water. The two dams have to be portaged and their approaches should be marked.

The stream flows through an agricultural setting with only one marsh area approaching wilderness. The banks are generally lined with a hardwood forest for 20 to 50 ft back from the river where there is usually cultivated farmland. There are some conifers along the river. Many of the grazed pastures present would make good camping spots. The banks are usually very brushy and weedy, except where grazed, and are either a till or sandy loam. In many places livestock have destroyed all grass vegetation on them. Trash piles were found at eight sites along the river.

The water was very turbid throughout the rivers length, in part due to active feeding of carp. Some foam was on the surface of the water. Bottom material was clay to sand. The temperature was 66°F.

The only wildlife observed was two herons and a few ducks. In several places beaver and muskrat signs were noted.

Access is available in a sufficient number of places but many need improvement as they are weedy, fenced or have very steep banks. There is one park at about mile 15. The old mill and dam at Benning Mill is quite interesting. A wooden fly wheel and two wooden drive pulleys are yet in excellent condition.

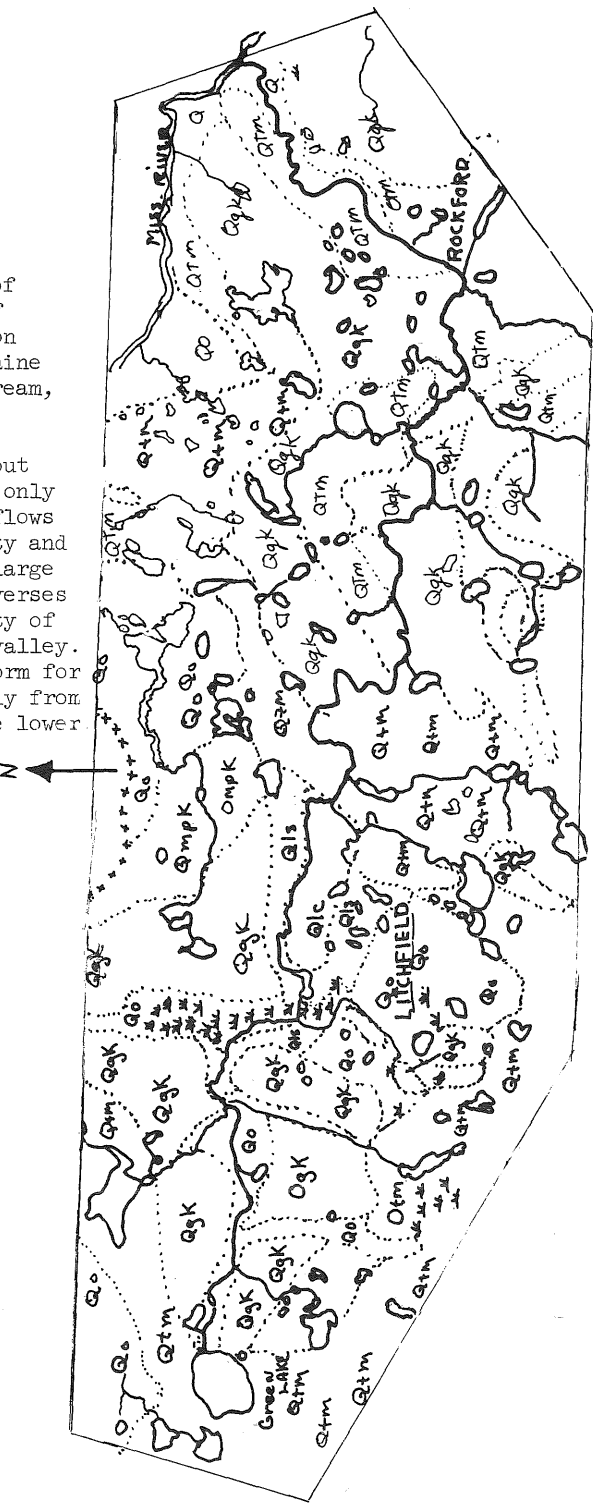
The river is a canoeable river, but it's aesthetic appeal is very low. It is not recommended for further study or development and is recommended only for local use.

GEOLOGY

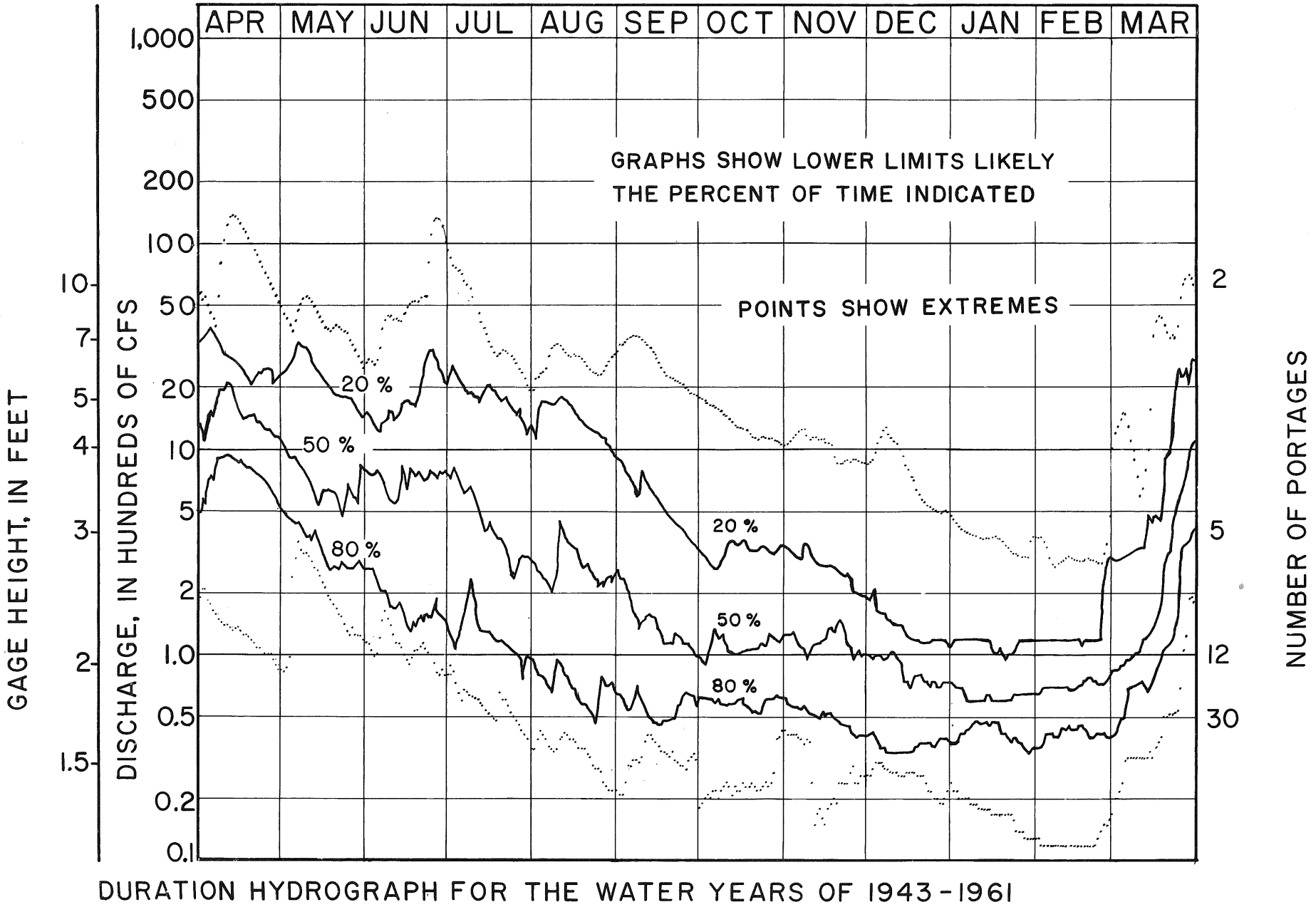
CROW RIVER

The Crow River flows through a complex segment of terminal moraines formed by the Grantsburg Sublobe of the Des Moines Lobe ice. Generally, from the junction of the North and South Forks, it flows on ground moraine between two terminal moraines. From Rockford downstream, it flows on recently deposited alluvial sediments.

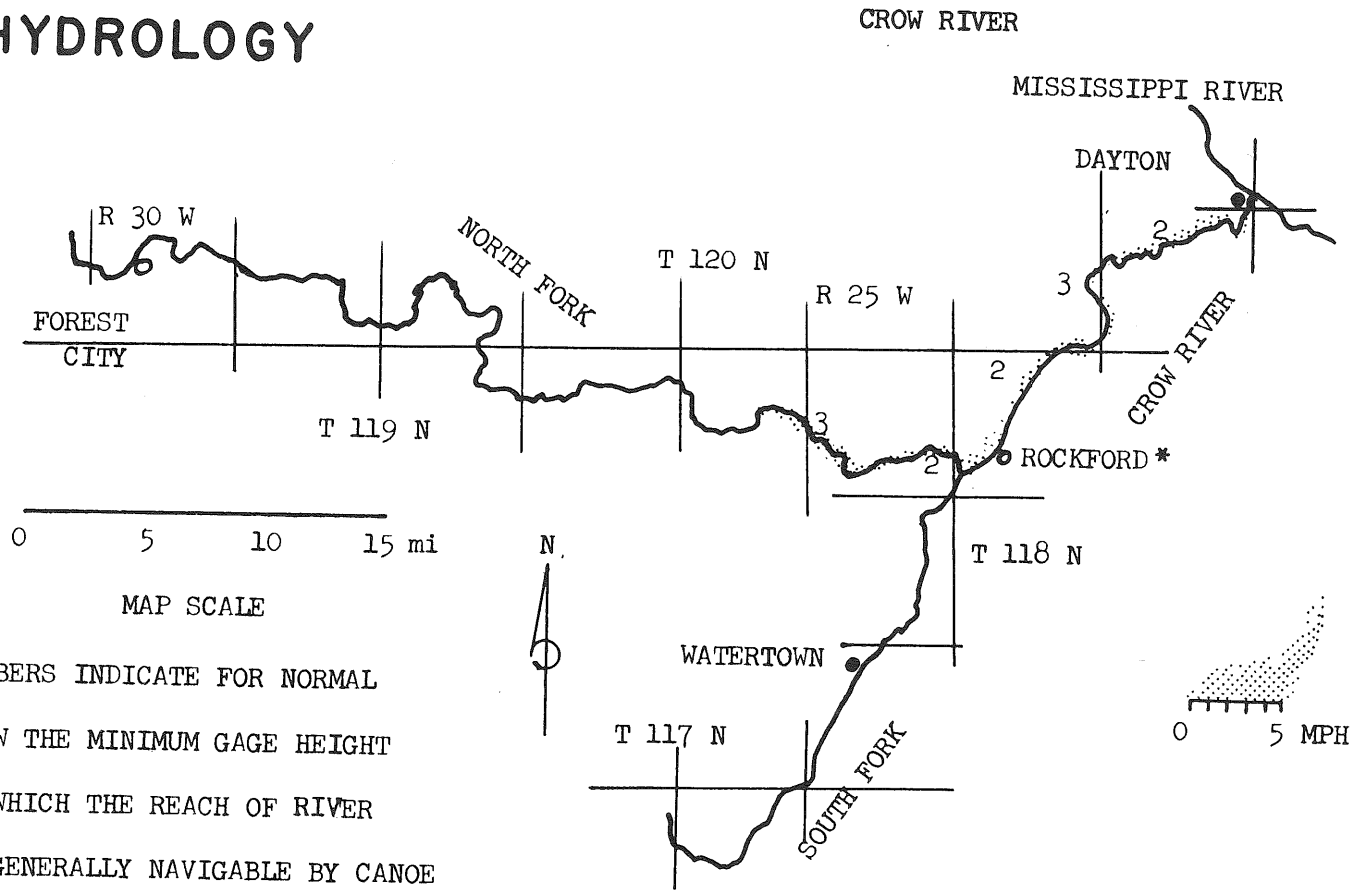
Bank exposures are uniform glacial till throughout the canoeable reach of the river. Upstream there is only slight variation. The upper part of the North Fork flows through glacial lake clay deposits between Forest City and Kingston. Upstream from Forest City it traverses a large swamp deposit for several miles. The South Fork traverses ground moraine for most of its length. The uniformity of the rock units is reflected in the character of the valley. The gradient of the stream is almost completely uniform for 95 miles. Further, the width increases very gradually from 50 feet in the upper reaches to about 100 feet in the lower



Surficial Geologic Map
(after Leverett, 1932)


CROW RIVER AT ROCKFORD
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
JAN
FEB
MAR
1,000
500
200
100
50
20
10
5
2
1.0
0.5
0.2
0.1
GRAPHS SHOW LOWER LIMITS LIKELY
THE PERCENT OF TIME INDICATED
POINTS SHOW EXTREMES
20 %
50 %
80 %
20 %
50 %
80 %
GAGE HEIGHT, IN FEET
10
7
5
4
3
2
1.5
DISCHARGE, IN HUNDREDS OF CFS
NUMBER OF PORTAGES
2
5
12
30
DURATION HYDROGRAPH FOR THE WATER YEARS OF 1943 - 1961

HYDROLOGY



MAP SCALE

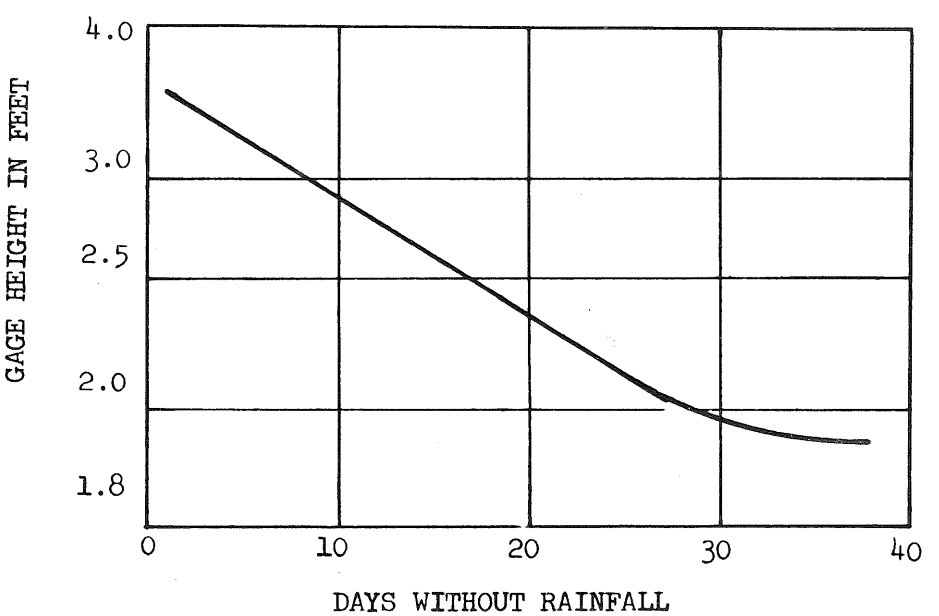
NUMBERS INDICATE FOR NORMAL FLOW THE MINIMUM GAGE HEIGHT AT WHICH THE REACH OF RIVER IS GENERALLY NAVIGABLE BY CANOE

DRAINAGE AREA ABOVE GAGE
2,520 sq. mi.

WIDTH OF STREAM INDICATES VELOCITY OF FLOW AT A GAGE HEIGHT 2.8 FT AT THE GAGING STATION

* GAGING STATION LOCATION

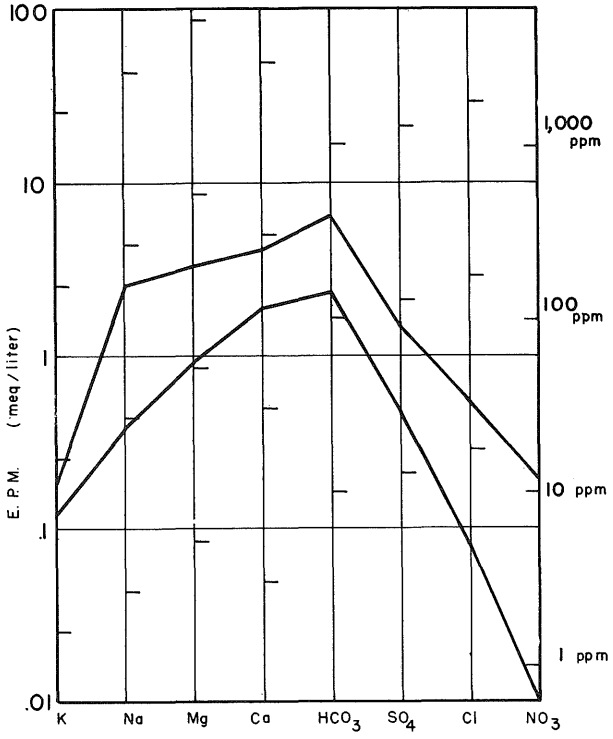
RECESSION CURVE INDICATES AT THE GAGING STATION THE NORMAL DECLINE IN GAGE HEIGHT FOLLOWING A PERIOD OF RAIN



WATER QUALITY

CROW RIVER

RANGE OF CONCENTRATION OF MAJOR IONS IN 9 SAMPLES TAKEN AT MILE 23 JAN. 1961 – JAN. 1964



WATER TEMPERATURE
SUMMER 1966
STATION: ROCKFORD
DATES: JUN 30 – AUG 31
MAX. 12-HOUR ΔT = 7°
AVG. 12-HOUR ΔT = 3.6°
MAX. 5-DAY ΔT = 15°
BEGINNING DATE: AUG 26
DAYS EXCEEDING 80°F: 40

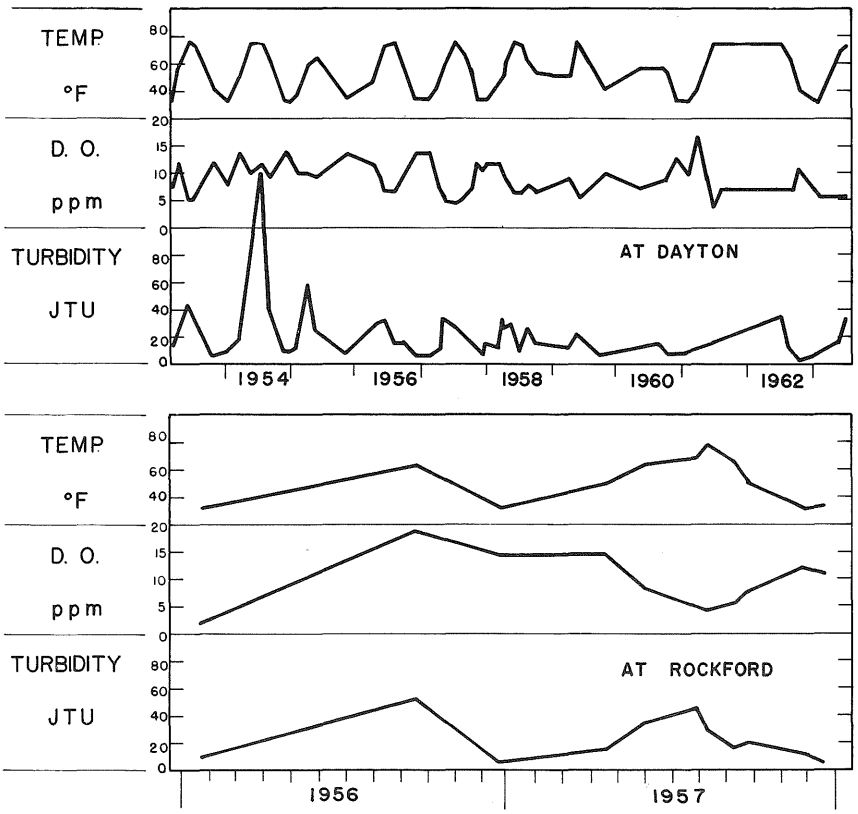
NUTRIENT
PHOSPHORUS, ppm

HI	LO	AVG	SAMPLES
.36	.07	.21	10

AT DAYTON

1958-1959
1962-1963

FACTORS OF HIGH CONCERN TO ECOLOGY



OTTER TAIL RIVER

Reconnaissance by canoe was made June 7, 8, 9 and 10, 1966 between Frazee and the mouth by U.S.G.S. observers.

Dams and low bridges or fences were the only portages on the river. Approaches to the dams should be marked. The open water of the lakes and one stretch of fast water below the large dam above Fergus Falls are potential danger areas.

The bank vegetation is about 50 percent hardwood forest and 50 percent marsh. Very good camping areas are well spaced. The setting through which the river flows is one of agriculture and summer home development and has no wilderness aesthetic value. The banks above Fergus Falls are mostly sandy. Those below Fergus Falls are mostly clay.

The water was very clear. The bottom is predominantly sand and gravel. The average temperature was 65 degrees fahrenheit. Below Fergus Falls the river is polluted. Trash dumps and tree fall are numerous in this reach.

Ducks were the only wildlife seen.

There are numerous easy accesses.

The stream has statewide recreational value, but it does not offer the high wilderness value.

GEOLOGY

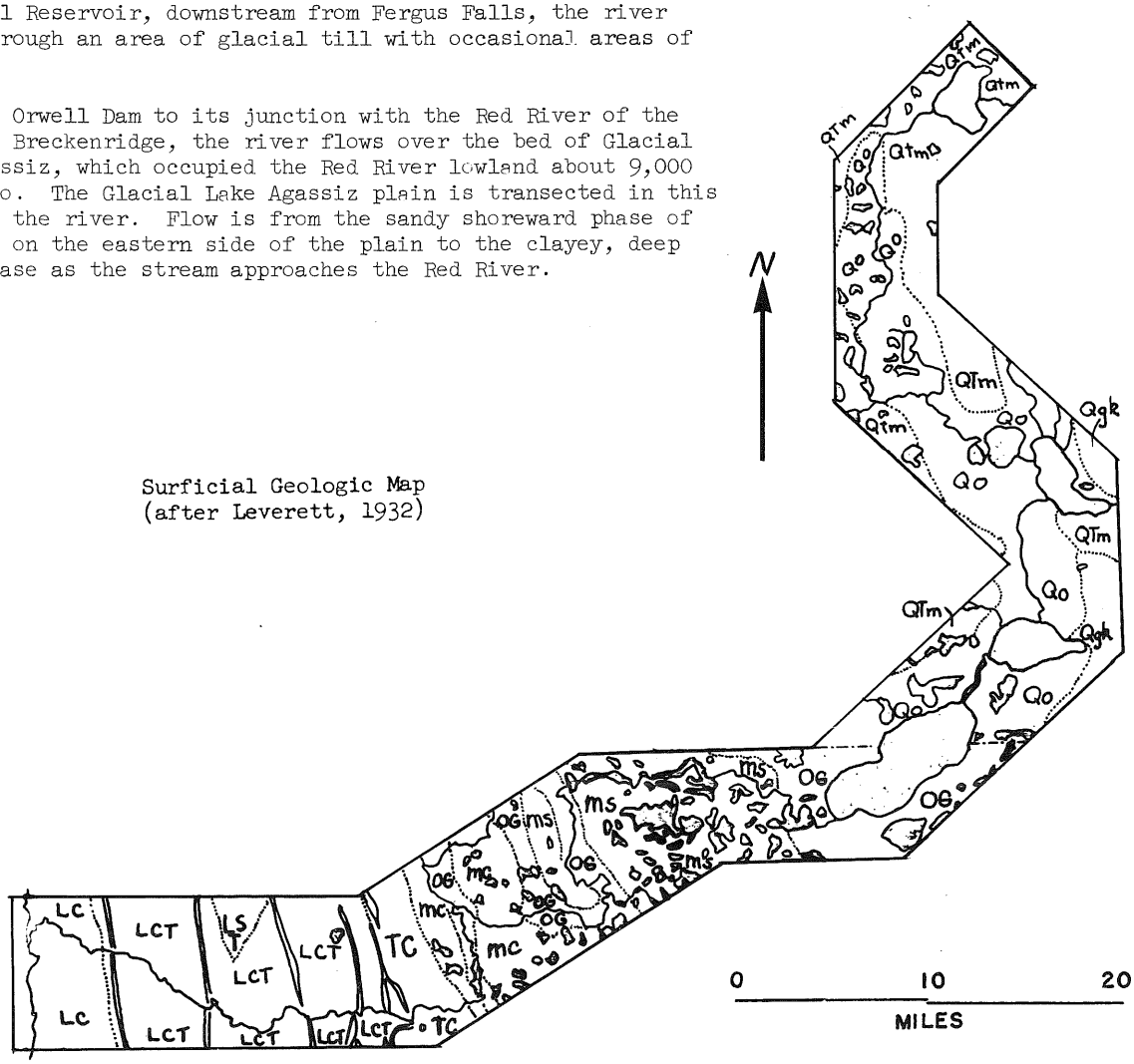
OTTERTAIL RIVER

More than 36,000 years ago, the Wadena glacial ice Lobe moved into the area of the Otter Tail River from the northeast and reached its maximum extent in west-central Otter Tail and Becker Counties. At this point, large hills of glacial till were deposited. When the glacier retreated from the area, very large amounts of sand and gravel were washed out in front of the glacier and deposited as an outwash plain over many square miles in central Otter Tail County.

The Otter Tail River flows through this outwash plain from its source to several miles below Otter Tail Lake, over half the total length of the river. The river's depth, maintained by the ideal ground-water storage capabilities of the sand and the sand bottom itself, make this reach of the Otter Tail River one of the finest, clear water canoeing streams in the state.

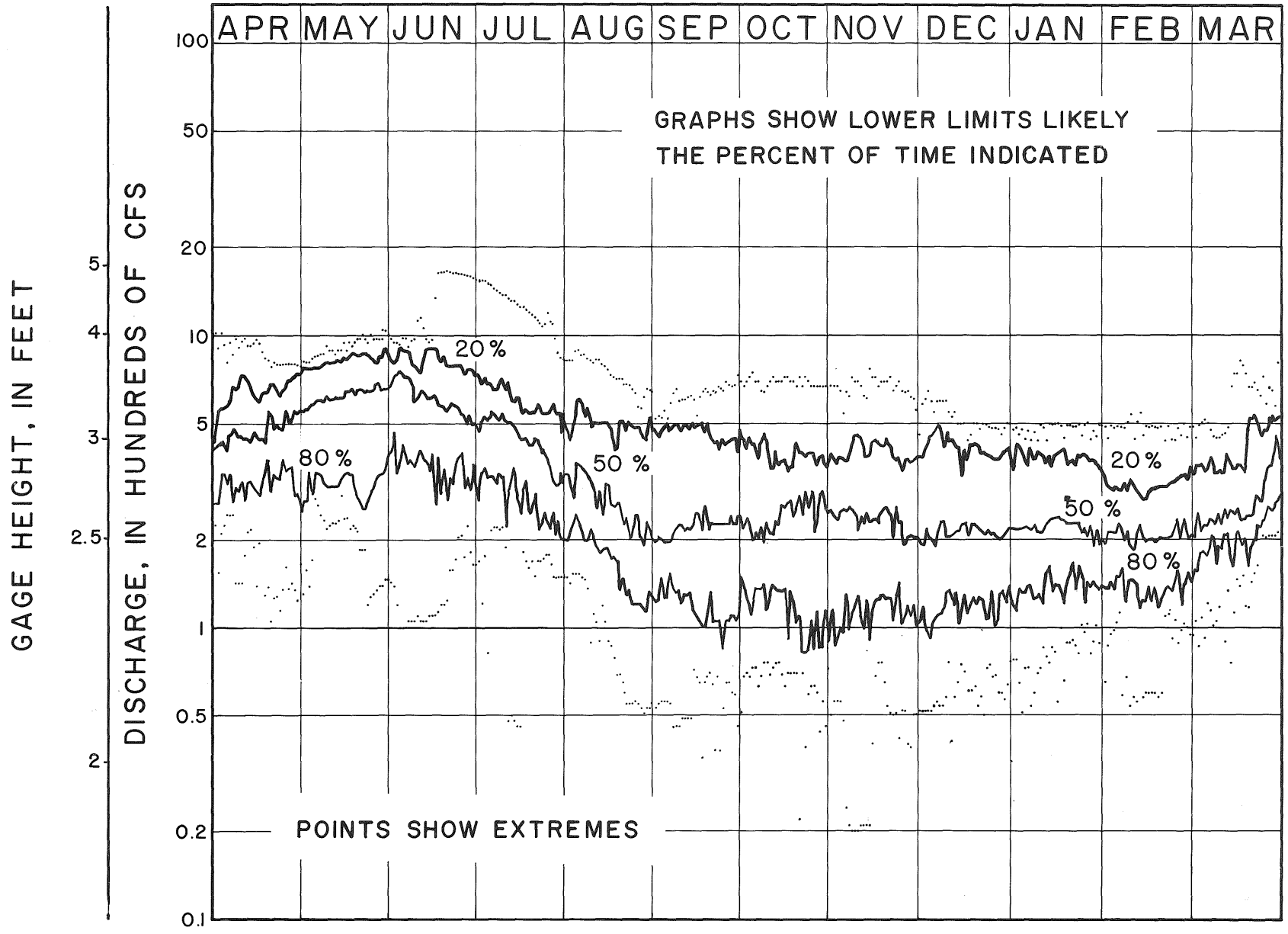
From the edge of the outwash plain near Otter Tail Lake to Orwell Reservoir, downstream from Fergus Falls, the river flows through an area of glacial till with occasional areas of sand.

From Orwell Dam to its junction with the Red River of the North at Breckenridge, the river flows over the bed of Glacial Lake Agassiz, which occupied the Red River lowland about 9,000 years ago. The Glacial Lake Agassiz plain is transected in this reach of the river. Flow is from the sandy shoreward phase of deposits on the eastern side of the plain to the clayey, deep water phase as the stream approaches the Red River.

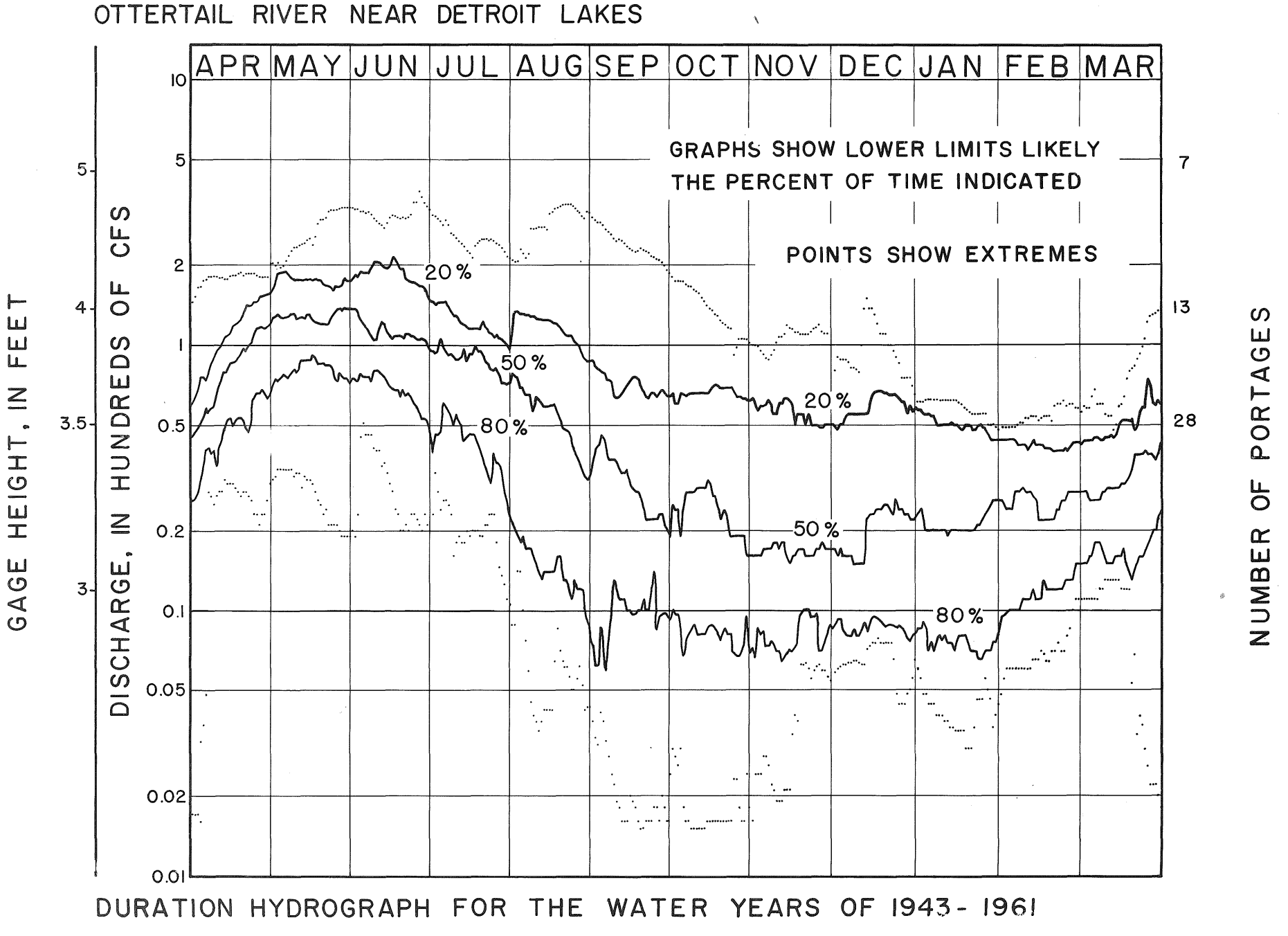


Surficial Geologic Map
(after Leverett, 1932)

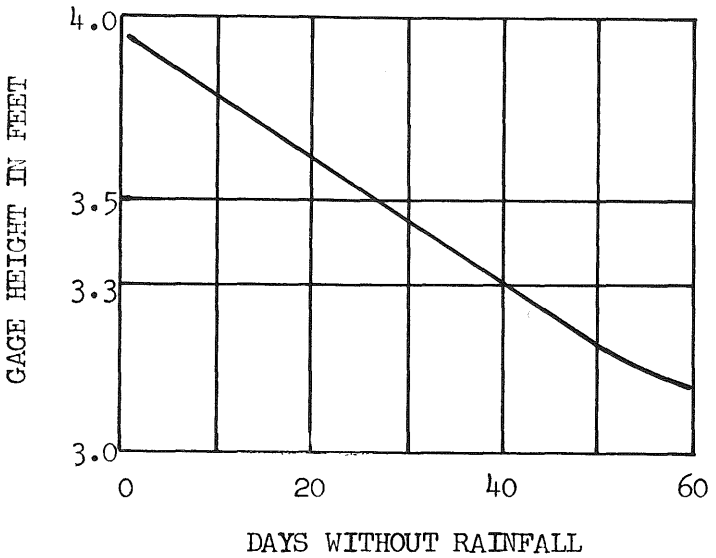
OTTERTAIL RIVER BELOW ORWELL DAM NEAR FERGUS FALLS



DURATION HYDROGRAPH FOR THE WATER YEARS OF 1943 - 1961


OTTERTAIL RIVER NEAR DETROIT LAKES
APR MAY JUN JUL AUG SEP OCT NOV DEC JAN FEB MAR
GRAPHS SHOW LOWER LIMITS LIKELY THE PERCENT OF TIME INDICATED
POINTS SHOW EXTREMES
20 %
50 %
80 %
20 %
50 %
80 %
GAGE HEIGHT, IN FEET
DISCHARGE, IN HUNDREDS OF CFS
NUMBER OF PORTAGES
10
5
2
1
0.5
0.2
0.1
0.05
0.02
0.01
5
4
3.5
3
7
13
28
DURATION HYDROGRAPH FOR THE WATER YEARS OF 1943 - 1961

HYDROLOGY



RECESSION CURVE INDICATES AT THE GAGING STATION THE NORMAL DECLINE IN GAGE HEIGHT FOLLOWING A PERIOD OF RAIN

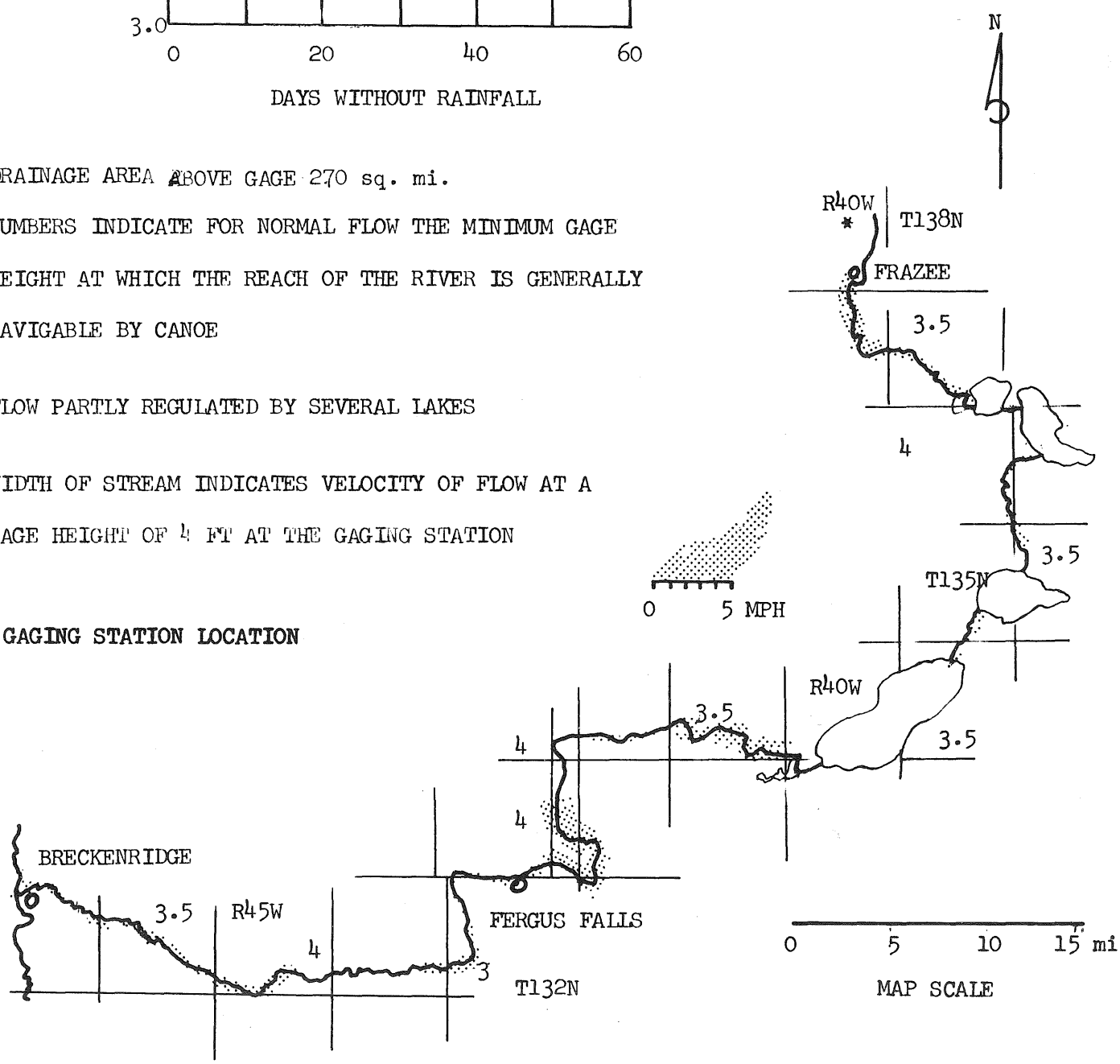
DRAINAGE AREA ABOVE GAGE 270 sq. mi.

NUMBERS INDICATE FOR NORMAL FLOW THE MINIMUM GAGE HEIGHT AT WHICH THE REACH OF THE RIVER IS GENERALLY NAVIGABLE BY CANOE

FLOW PARTLY REGULATED BY SEVERAL LAKES

WIDTH OF STREAM INDICATES VELOCITY OF FLOW AT A GAGE HEIGHT OF 4 FT AT THE GAGING STATION

*** GAGING STATION LOCATION**

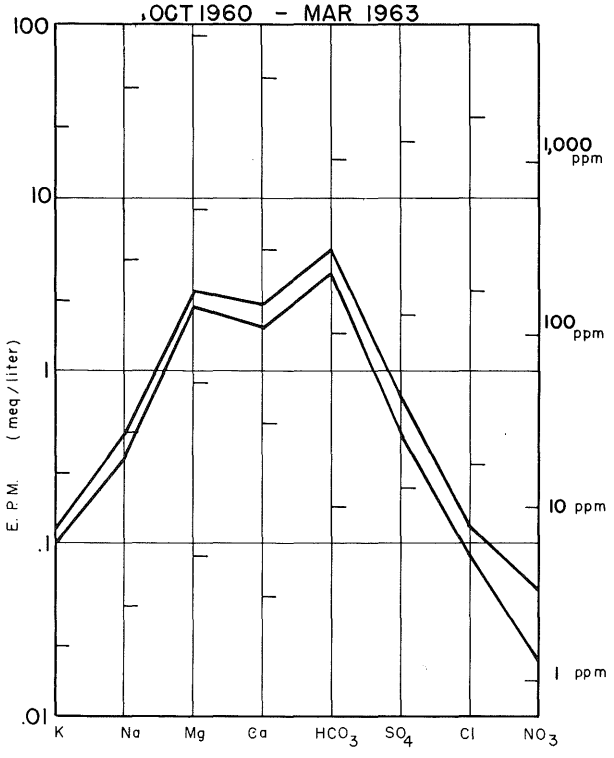


WATER QUALITY

OTTERTAIL RIVER

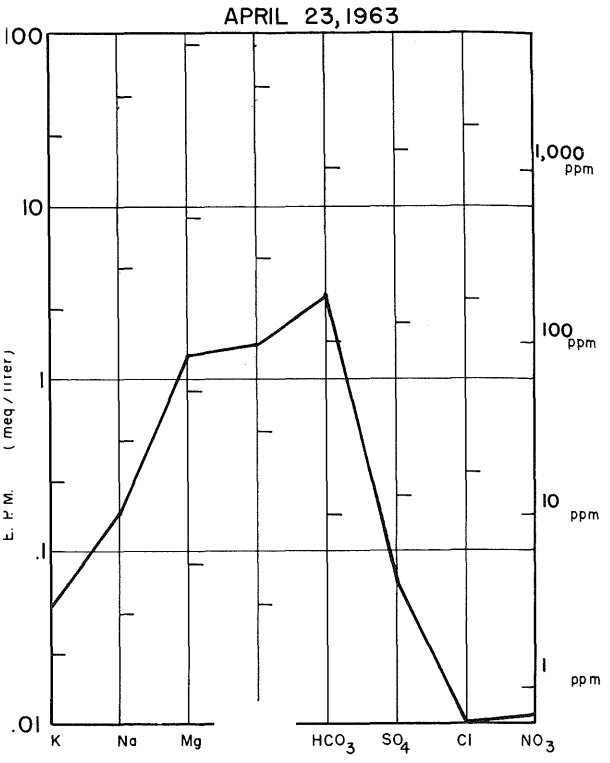
RANGE OF CONCENTRATION OF MAJOR IONS IN 9 SAMPLES TAKEN AT ORWELL DAM

OCT 1960 - MAR 1963

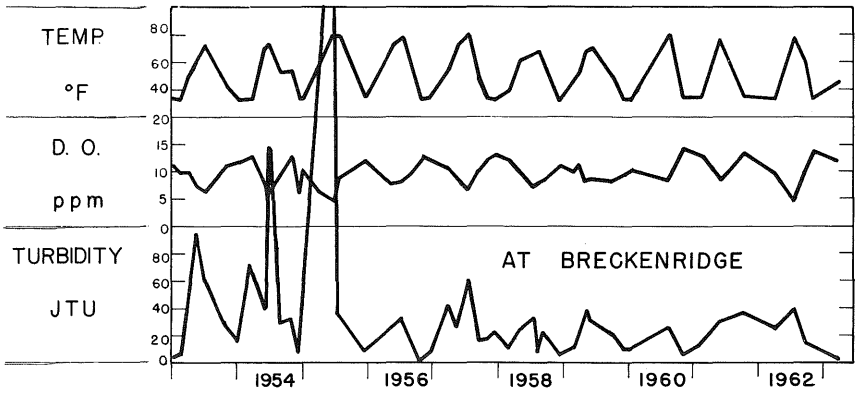


CONCENTRATION OF MAJOR IONS AT DETROIT LAKES

APRIL 23, 1963



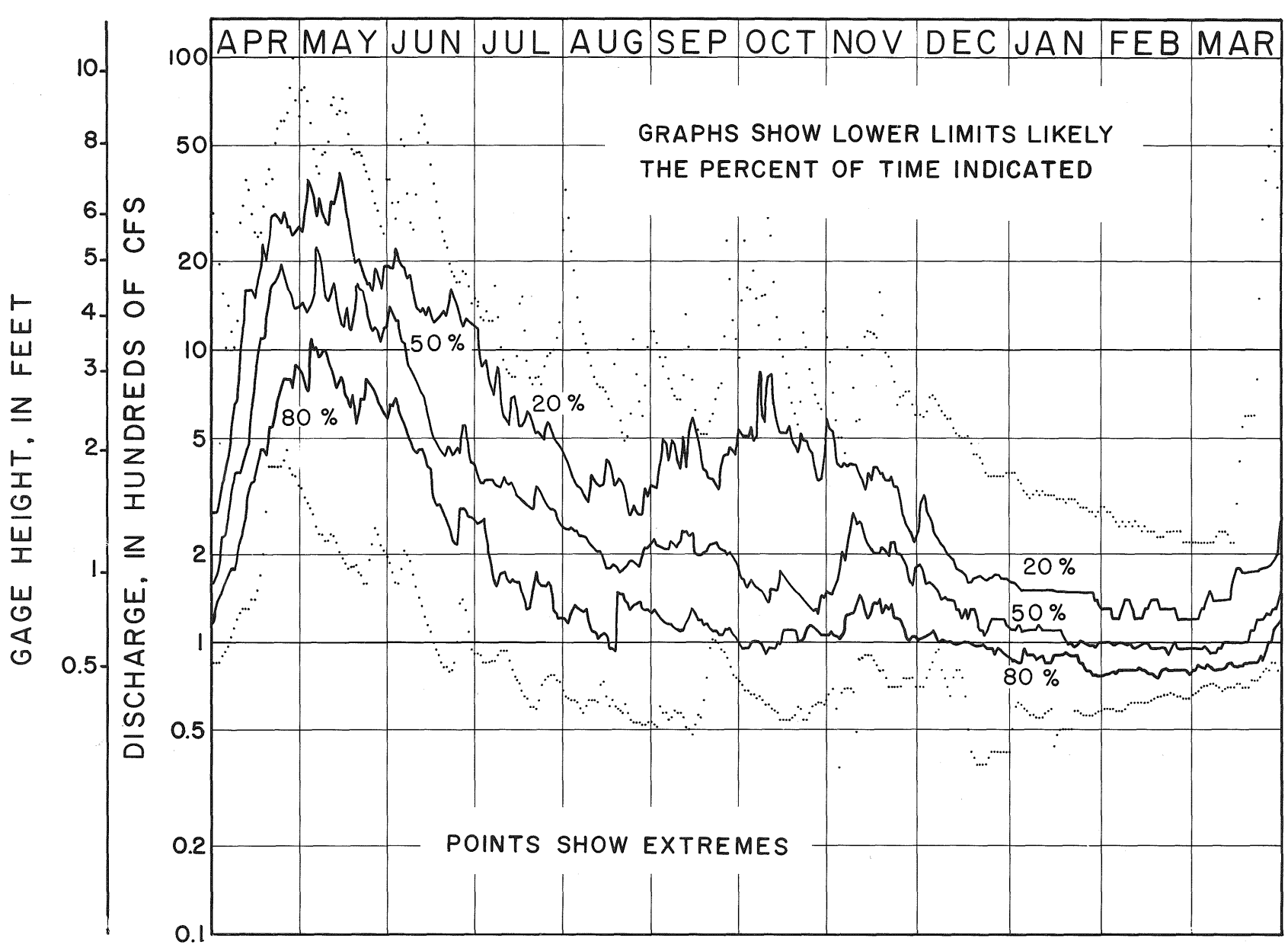
FACTORS OF HIGH CONCERN TO ECOLOGY



NUTRIENT			
PHOSPHORUS, ppm			
HI	LO	AVG	SAMPLES
.33	.11	.19	15

AT BRECKENRIDGE

1958-1959
1962-1963


PIGEON RIVER AT MIDDLE FALLS BELOW INTERNATIONAL BRIDGE
APR MAY JUN JUL AUG SEP OCT NOV DEC JAN FEB MAR
GRAPHS SHOW LOWER LIMITS LIKELY
THE PERCENT OF TIME INDICATED
80 %
50 %
20 %
20 %
50 %
80 %
POINTS SHOW EXTREMES
GAGE HEIGHT, IN FEET
DISCHARGE, IN HUNDREDS OF CFS
10
8
6
5
4
3
2
1
0.5
100
50
20
10
5
2
1
0.5
0.2
0.1
DURATION HYDROGRAPH FOR THE WATER YEARS OF 1943- 1961

PINE RIVER

Reconnaissance was made from the town of Pine River to the last bridge above the confluence with the Mississippi River, June 15, 16, and 17, 1966 by U.S.G.S. observers.

The stream was generally attractive but shallow. The upper reach from Pine River to Whitefish Lake had very appealing, clear water and some attractive pine woods, but mostly dense underbrush growing down to the waterline. The last mile had deeper water, more attractive shoreline, and some campsites. Whitefish Lake is very attractive and the islands offer numerous good campgrounds. There are also good campgrounds on the mainland in many places where cabin development has not yet taken place. The island on which we camped was an esker and had a tern rookery on the northeast end. Channels for motorboats are marked between lakes; cabin development is moderate to heavy. Most of the motorboats are large including some cabin cruisers. A campground, picnic-ground, and park adjacent to the Cross Lake dam is maintained by the Corps of Engineers. The policy is to maintain lake level regardless of flow in the stream, therefore the flow in the stream from the dam to Pine Lake may be very irregular. Anyone before making the trip should check to see if water is to be let through or if the gatemaster can be persuaded to let enough water through to make the trip. The survey trip below Cross Lake was made with one gate five percent open. In general, the upper part of the trip was marginal on water, although adequate. Gage reading on Norway Lake was 4.5 feet. The gate was closed, but leaking about 20 cubic feet per second. On the outside of the meander bends there is plenty of water, but in crossing from meander to meander, the water is shallow and in some places we had to get out and wade with the canoe. Because the water is so clear and the bottom generally clean sand and gravel, this is pleasant. Rapids, riffles, and adjacent banks in the reach from the dam to Pine Lake are very attractive. The bottom is clean, the algae is interesting and attractive, especially some dense, branching, "beavertail" algae.

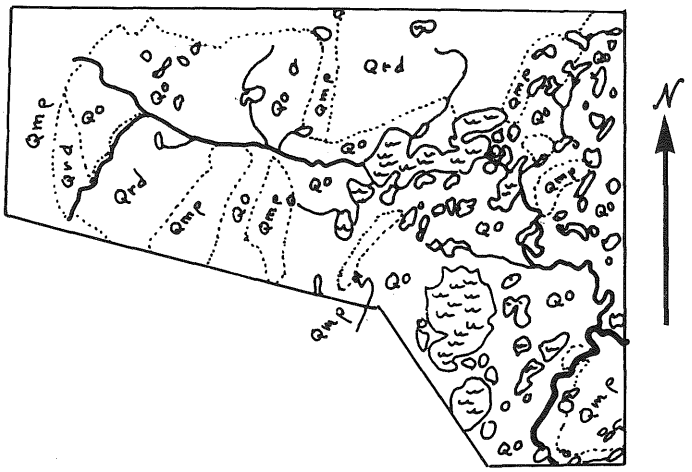
Below Pine Lake the river is significantly larger. It is uniformly deep with no rapids, and a sand bottom. The current is relatively fast, although not readily apparent because there are no irregularities on the bottom. With the dam open, navigability from the dam downstream seems adequate and makes a very good trip.

Beautiful Norway pine grow in some areas along the high banks on the outside of the meander bends. Jack pine is also plentiful. A large number of wildfowl were seen in the lower reaches of the Pine. Porcupine, deer, beaver, and muskrats were seen in the upper reach above Pine Lake.

Accessibility is more than adequate. Access at Pine City and Cross Lake Dam is all that is needed for even a one day trip. An additional access is on Pine Lake. Access points along the river have resulted in critical deterioration of the banks. These access points should be modified to reduce bank damage or should be closed.

Fishing is reported good locally, but the greatest attraction is the canoeing in the fast water reaches and the scenery in the Red pine lined banks below Pine Lake.

The river is an excellent one for a short trip or a two day trip including the lakes, but suffers from two major problems: The volume of flow is inadequate the entire length unless water is released from the dams; and the sandbanks are very fragile and significant use might quickly destroy the quality of the river not only by unsightly erosion, but also by increased bedload of the stream from the bank erosion resulting in constructional sandbars in the river. Solutions for these two obvious problems should be found before any increased use of the river is considered.



Surficial Geologic Map
(after Leverett, 1932)

The Pine River flows on glacial deposits throughout its entire length. Bedrock is deeply buried in the area. The course of the Pine is determined in part, by a complex system of glacial moraines and, in part, by the position of the numerous lakes through which it flows.

The moraines are a part of the St. Croix moraine formed by the Superior Lobe advance and, particularly in the eastern border of the Pine River, by the Mille Lacs Moraine, formed by a later re-advance of the Superior Lobe ice.

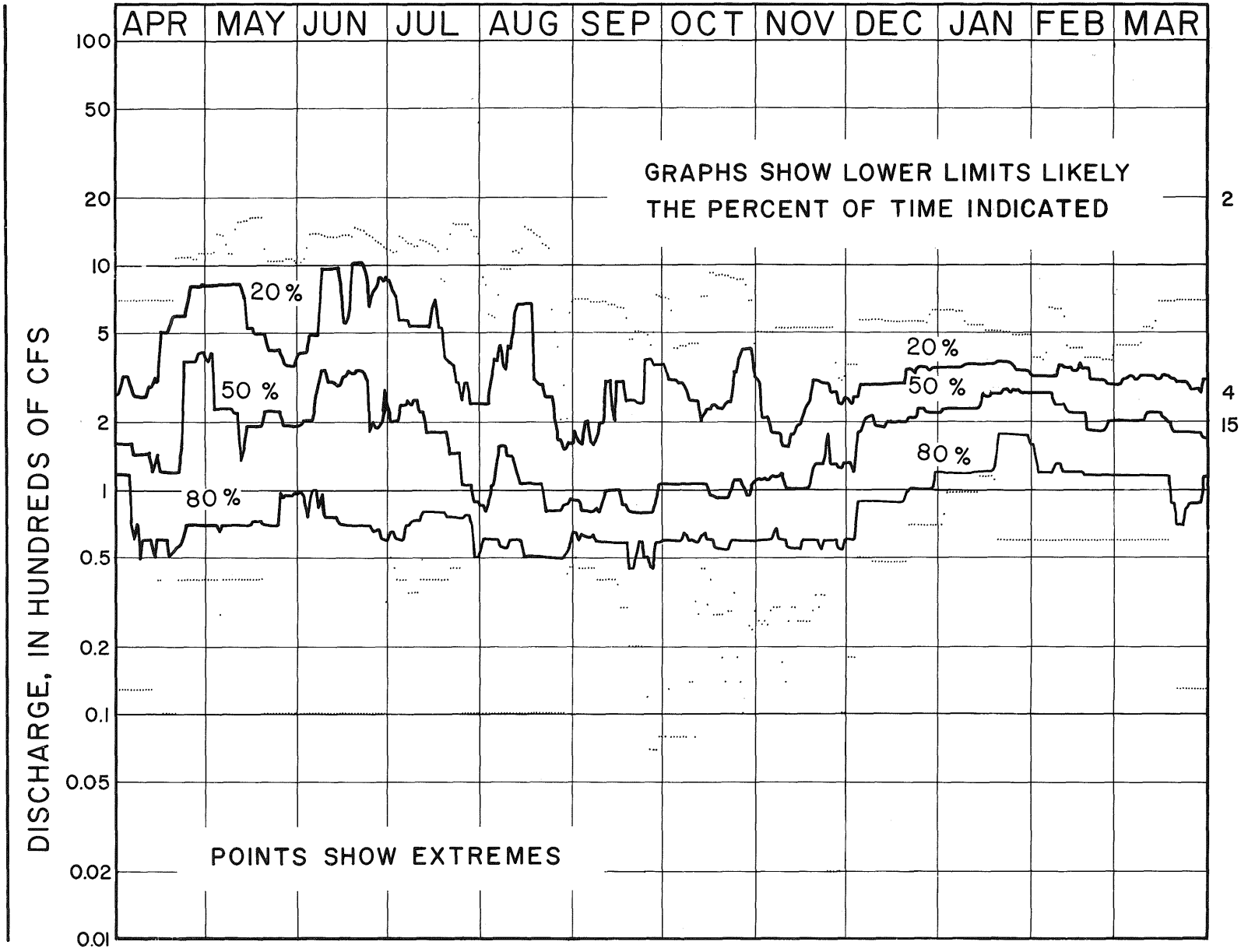
In the reach from Pine River to Whitefish Lake, the Pine River flows through a terminal moraine which lies just downstream from the Northern Pacific bridge. Because of the effect of the moraine the river bed here contains numerous large boulders and there are numerous rapids interrupted by short pools. The drop here is about 6 feet per mile compared to 1.5 feet per mile in the lower reach of the Pine. The steep banks are glacial till containing some large boulders, sand and gravel.

Below the moraine for most of the river's length, the bank material is outwash sand and gravel. The only steep section of the river through the outwash material is below the dam at Cross Lake where the river drops from the lip of Whitefish Lake at 1,230 feet altitude to Pine Lake at 1,195 feet in less than 3 miles.

Exposures of outwash are particularly good below Pine Lake where high sand banks support a mature stand of Red Pine. These banks are very fragile and climbing them even one time may produce longterm erosion damage. At several access points, wooden steps have been constructed to minimize erosion; however, the sand is so well sorted that it erodes badly beside the steps and under them. The stream bottom is exceptionally attractive because it is clean washed sand, and, in part, because of this the water is exceptionally free of sediment.

The numerous large lakes were formed by melting of blocks of ice that were included in the outwash deposits. The lakes are generally 20 to 40 feet deep and the islands they contain are thick outwash deposits. The first island reached in Whitefish Lake, paddling east from the outlet of the Pine River, is an "esker" remnant, a steep sided narrow ridge composed of sand, gravel and boulders, which was formed by deposition of sand and gravel in tunnels under glacial ice.

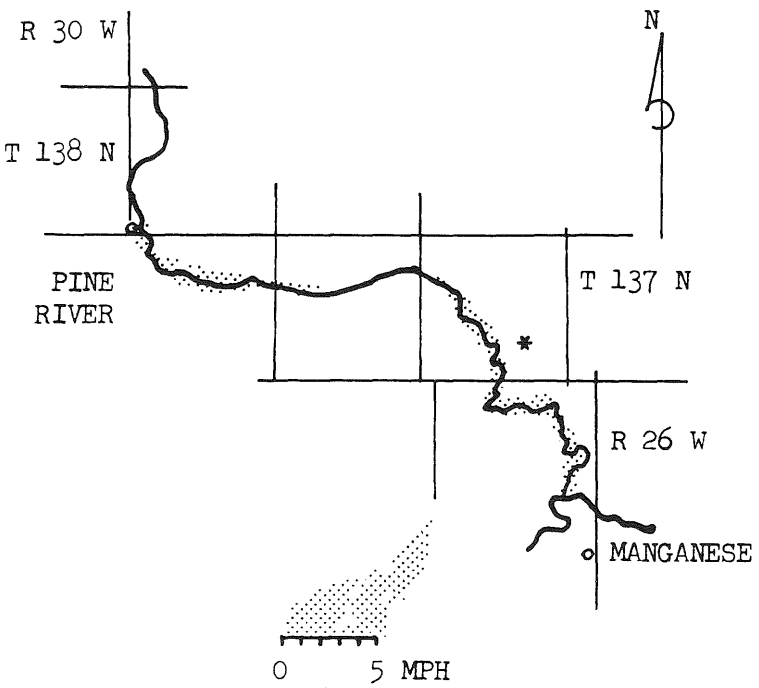
PINE RIVER AT CROSS LAKE DAM AT CROSS LAKE



DURATION HYDROGRAPH FOR THE WATER YEARS OF 1943-1961

HYDROLOGY

PINE RIVER



THE REACH OF RIVER INDICATED IS GENERALLY NAVIGABLE BY CANOE WITH A DISCHARGE OF 310 CFS OR MORE

WIDTH OF STREAM INDICATES VELOCITY OF FLOW AT A DISCHARGE OF 310 CFS, CUBIC FEET PER SECOND

DRAINAGE AREA ABOVE GAGE
562 sq. mi.

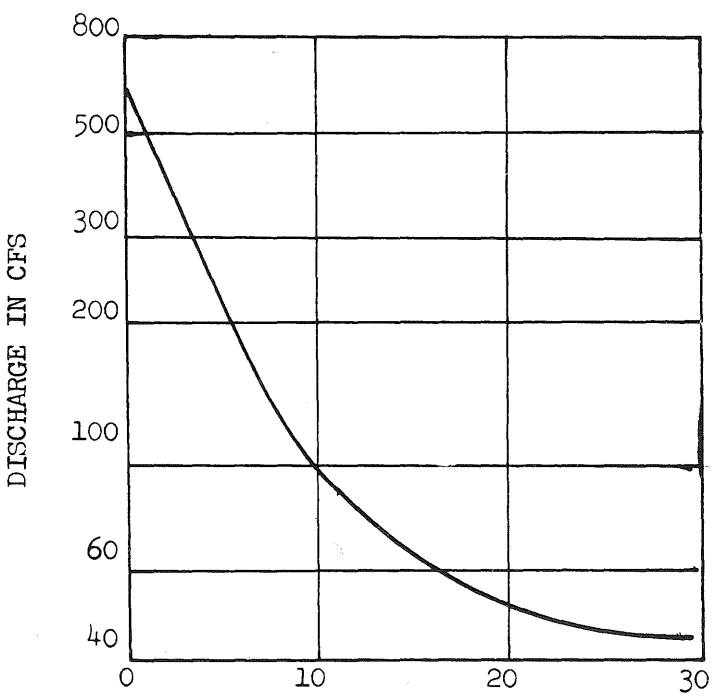
0 10 20 mi

MAP SCALE

RECESSION CURVE INDICATES AT THE GAGING STATION THE NORMAL DECLINE IN GAGE HEIGHT FOLLOWING A PERIOD OF RAIN

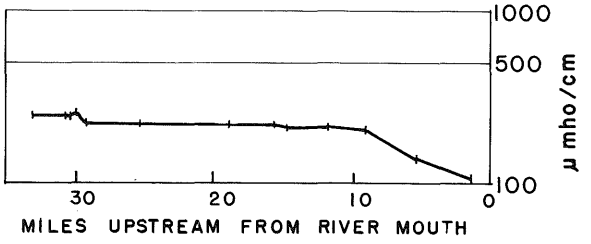
FLOW COMPLETELY REGULATED BY PINE RIVER RESERVOIR

* GAGING STATION LOCATION



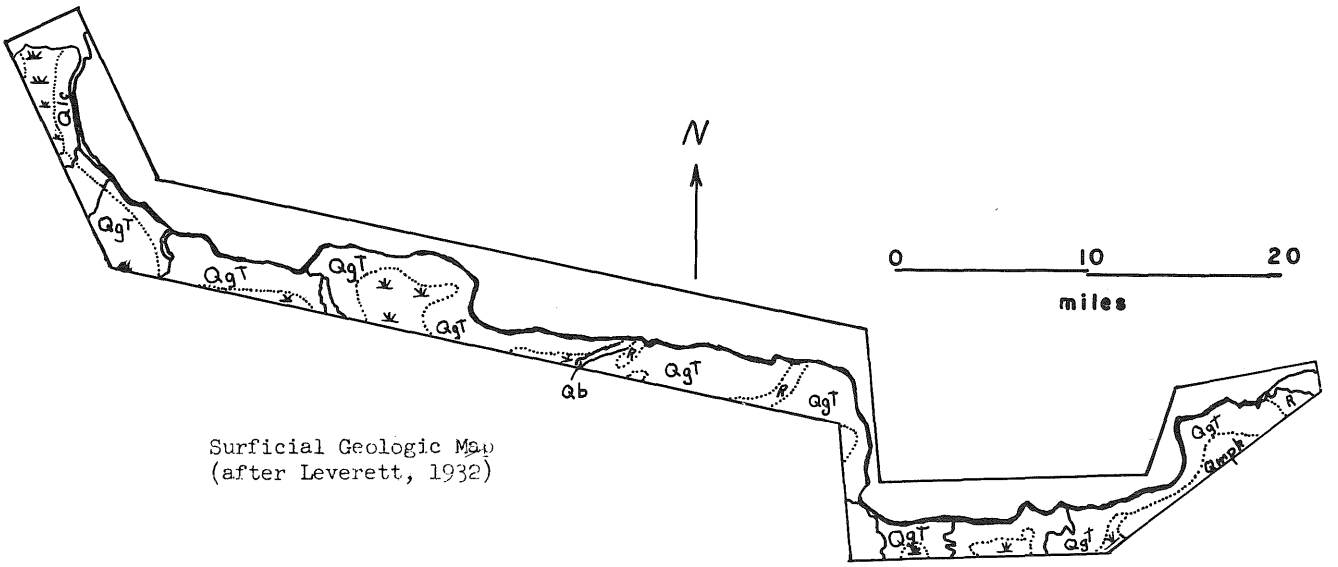
DOWNSTREAM VARIATION IN CONDUCTIVITY

JUNE 15,16, 1966



WATER TEMPERATURE VARIED FROM 64° TO 73° F

GEOLOGY



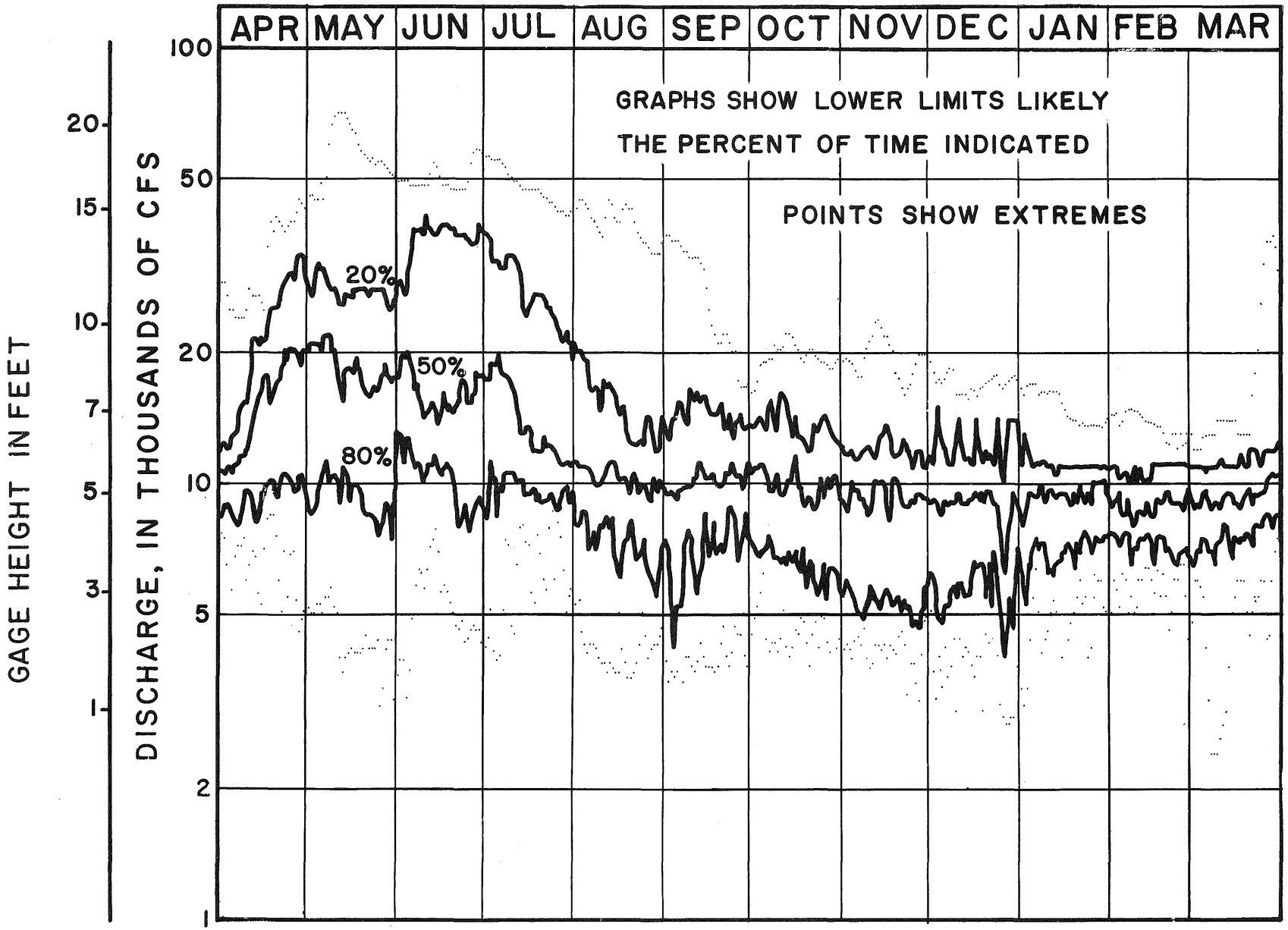
Surficial Geologic Map
(after Leverett, 1932)

The Rainy River that forms a part of the boundary between Minnesota and Ontario, Canada flows through a channel cut into the lake clays of Glacial Lake Agassiz. From Rainy Lake to Ft. Francis, the river flows through light colored sandy lake clay. The banks are about 10 feet in height. The "falls" area is underlain by granite and gneissoid granite. The photograph shows an exposure on the Canadian shore.

Through the falls, the river drops just over 20 feet and as the surrounding area is very flat, the banks increase in height to about 30 feet. To the Long Sault Rapids, the river flows dominately through featureless lake clay. At the rapids, hornblende schist, a dark gray foliated rock is exposed from about one-fourth mile above the rapids to near their foot. Here the schist is in contact with reddish granite gneiss. These are rocks of Kewatin Age and are related to similar exposures in the Big Fork and Little Fork Rivers.

The Rainy River is uniformly 200 to 300 feet in width. The banks are fairly uniform and high, and the meanders not well developed. This uniformity results from the large area of glaciated lake basin that contributes sustained moderate flows to the river, and the homogeneous lake clay and silt through which the river flows.

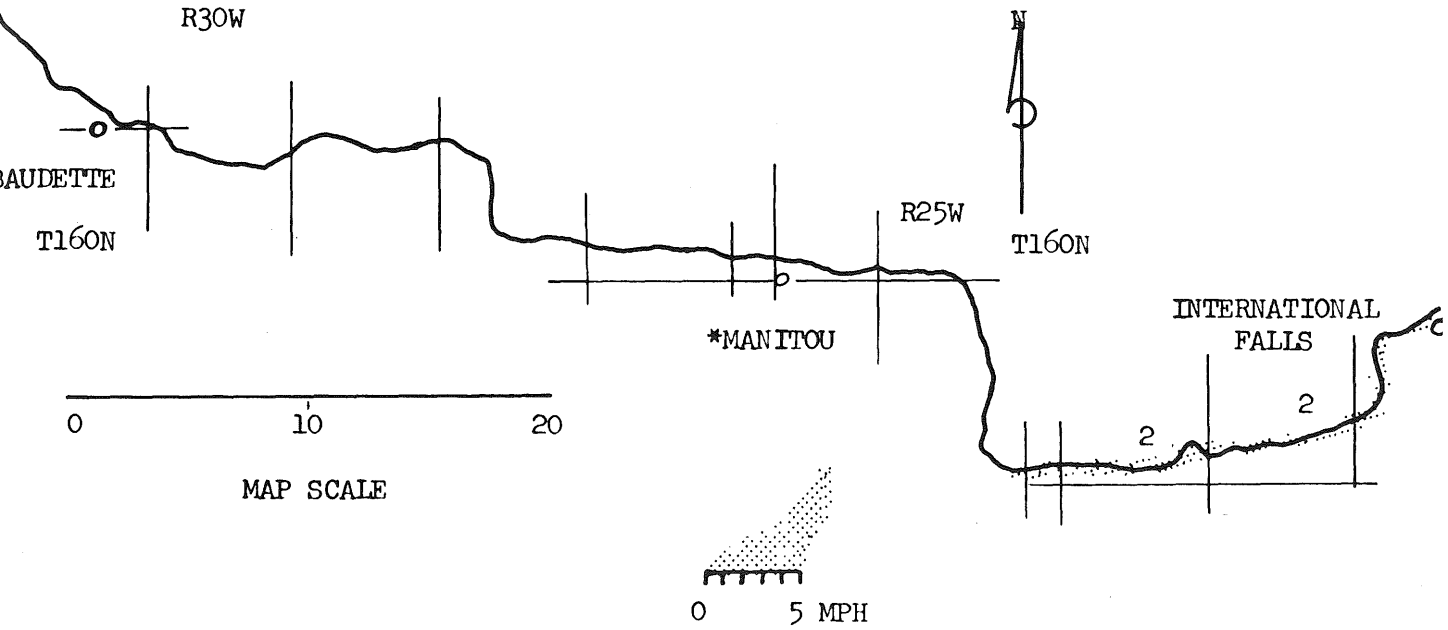
RAINY RIVER AT MANITOU RAPIDS



DURATION HYDROGRAPH FOR THE WATER YEARS OF 1943-1961

HYDROLOGY

RAINY RIVER



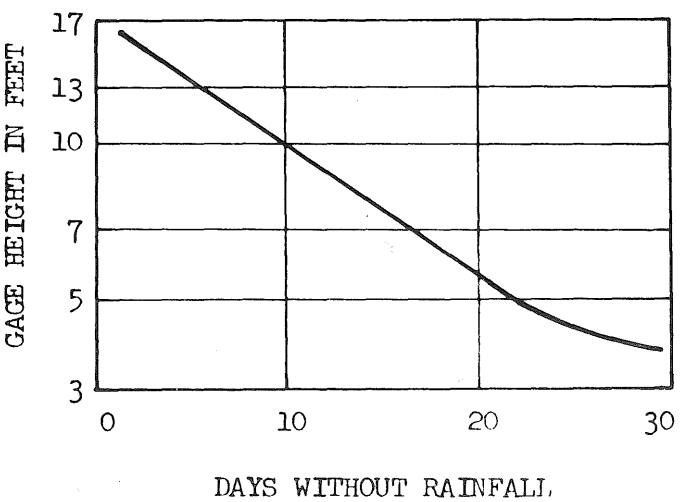
DRAINAGE AREA ABOVE GAGE 1,560 sq. mi.

NUMBERS INDICATE FOR NORMAL FLOW THE MINIMUM GAGE HEIGHT AT WHICH THE REACH OF THE RIVER IS GENERALLY NAVIGABLE BY CANOE

WIDTH OF STREAM INDICATES VELOCITY OF FLOW AT A GAGE HEIGHT OF 6.5 FT AT GAGING STATION

*** GAGING STATION LOCATION**

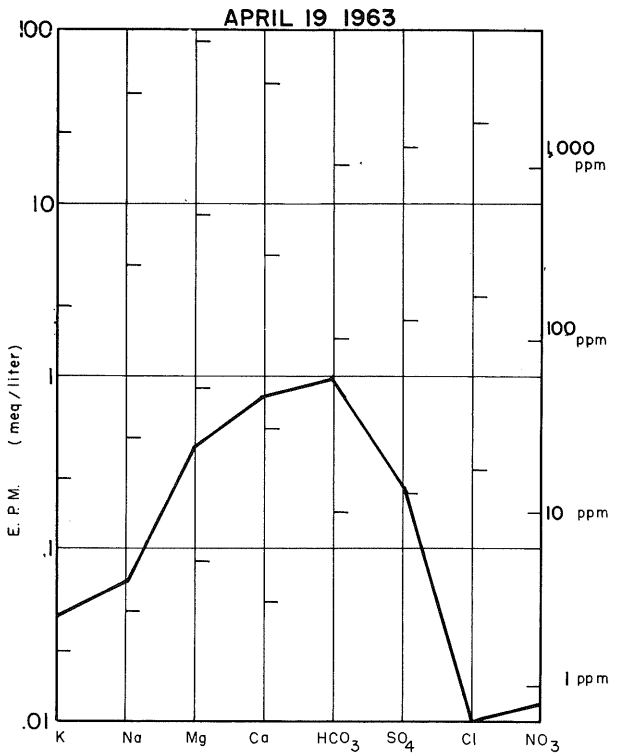
RECESSION CURVE INDICATES AT THE GAGING STATION THE NORMAL DECLINE IN GAGE HEIGHT FOLLOWING A PERIOD OF RAIN



WATER QUALITY

RAINY RIVER

RANGE IN CONCENTRATION OF MAJOR IONS AT MANITOU RAPIDS



NUTRIENT

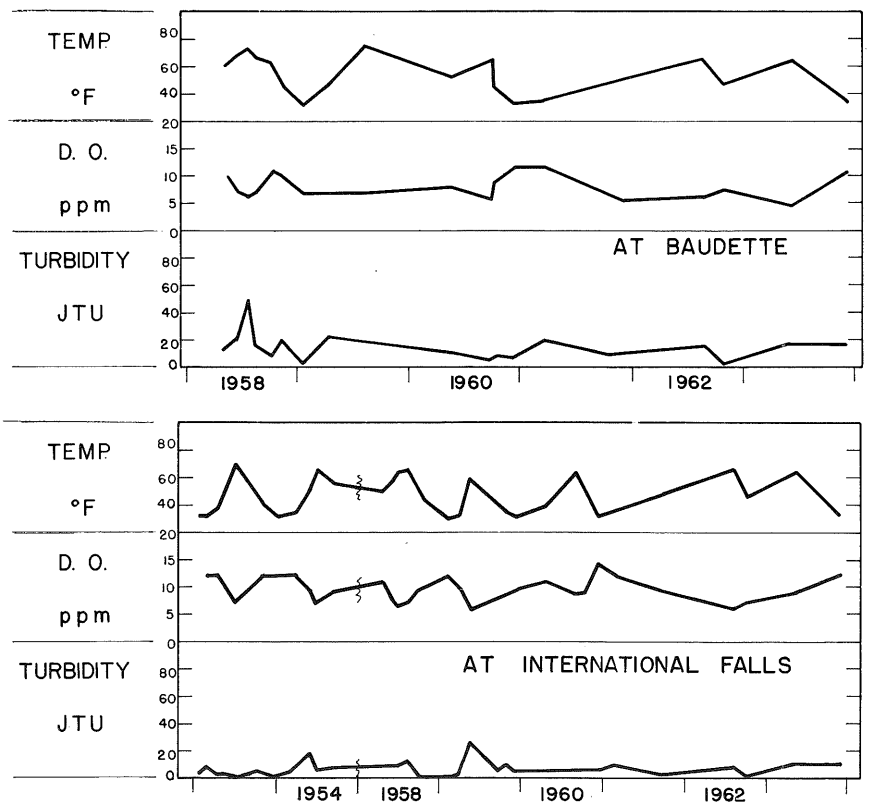
PHOSPHORUS, ppm

HI	LO	AVG	SAMPLES
.65	.03	.21	12

AT BAUDETTE

1958-1959
1962-1963

FACTORS OF HIGH CONCERN TO ECOLOGY



RED LAKE RIVER

Reconnaissance of the Red Lake River throughout its entire 196 mile length from the outlet of Red Lake to East Grand Forks, Minnesota was made July 19-23, 1966 by USGS observers. This long, variable river is generally navigable throughout, with portage around two large dams, one weir, one washed out dam. Some rapids require walking at lower stages. The gage height at Red Lake outlet dam tailwater staff gage was 6.62, the gage at High Landing also read 6.62 corresponding to discharge of 1,000 cubic feet per second. If one starts at one of the access points on the lake itself then portage of some equipment is necessary at the Red Lake control dam though a loaded canoe may be easily roped over the dam.

The reach above the weir at mile 174 (all mileages above mouth) is very interesting and unique among Minnesota's rivers. It passes through swamp area, very open, not closed-in by the usual corridor of large trees. Other than the swamp grasses and bull rushes only scrub willows are seen. The area is rich in birdlife. The bottom can be seen through five feet of the clear water. There is a slight gray-green cast to the water; none of the deep amber color that is encountered in northern bog rivers is present. Large aquatic plants abound. Algae such as lemna are abundant, but no large unactractive scum algae "blooms" were seen. Very large water lilies were also seen. The bottom is gray to gray-green silt to fine sand and contains many small shells. This area is picturesque, unchanged by man, and should prove very fascinating to photographers, naturalists, ecologists, and nature lovers. There are no camping possibilities within this stretch. At the weir there is an access road, portage over cobbles, and a sign "Fishermen must have guide".

The river in the reach below the weir is considerably different from that above, no swamps, two feet high, grass covered, stable, banks with willows, and small scrub trees. Trees are sparse and small with some poplar and elm on high ground back from the river. Some sweet clover and yellow flowers also occur along the banks. Channel width is very constant, about 75 feet. Bottom material becomes coarser, in some places mainly course gravel and shells. In the reach near High Landing vegetation is more attractive, larger trees, and the banks are lower than upstream. The meanders are more prevelent, with no evidence of dredging, generally the river now has more of a wilderness look. Color of the water is very green though still quite clear (turbidity only 10 JTU). Width below here exceeds 100 feet and depth is usually over six feet, with gravel bottom. Between High Landing and Thief River Falls farms, some of which are very attractive, are more numerous. The town of Thief River Falls is exceptional in its riparian beauty. The shoreline, stabilized by the dam control, is often the terminous of well manicured back yards. There are very attractive public access and boat launching facilities in the city park areas. The portage at the dam is short but high, steep, and difficult (see photo sheet). There are no facilities provided for portaging; in fact the area from the bridge above the dam to the dam is posted due to the danger of the high dam and overflow. Turbidity at this point has doubled to 22 JTU, color is still a gray-green but floating debris and small solids are prevelent below the dam. The banks immediately below are high and generally junky. From Thief River Falls to St. Hilaire there are occasional rapids but otherwise the

river is similar to that above Thief River Falls. From St. Hilaire downstream to mile 80 the river is predominantly a series of one rapids after another, with only short pools in between. They are, at the present stage, mostly navigable and would probably remain so even at 50% reduction in stage. There are large boulders in the river throughout its length and width in this stretch. Depth through the rapids at this stage averages two feet and can be negotiated with relative ease in a canoe. Below St. Hilaire wild celery is plentiful and some pond weed grows. There has been considerable bank erosion and slump since and during the flood of spring 1966. The abandoned dam at Red Lake Falls is both an eyesore and hazard to navigation. Only a three foot drop remains but construction is such that if you float over it you will drop into obstructions below the lower water level causing serious damage to the craft utilized. Near here can be seen high, almost vertical cliffs of till. Most of the channel is cut through till leaving very picturesque steep till slopes. Some cottonwoods grow on the lower reaches. The river passes to an area of clay deposits at mile 79 where there are almost no boulders in the river and navigation is easy. Bank navigation becomes thicker and severe bank slumping is common, reaching back sometimes as far as 200 feet. The clay is very hard when dry but pliable when wet.

From 20 miles above Crookston to 25 miles below Crookston the river is an occasionally shallow, moderately turbid (up to 98 JTU), and low in esthetic appeal. The banks at the town of Crookston are littered with trash and debris. The banks are often high and clayey, commonly with grazing land on the outside of meanders, heavily covered with vegetation on the inside. There is evidence that the river follows paths completely different from the present thalweg during time of flood and in some places cuts significant channels which will, after several floods, radically change the meander pattern of the river. Muddy banks detract from camping enjoyment.

In the lower reaches of the river great deposits of very large trees lie along the outside bends. These are the trees that were torn from the eroded banks and large slump areas upstream and carried down during the spring flood (see picture sheet). At Crookston there is another dam around which portage must be made. The slopes are steep and covered with loosely-piled, well-rounded boulders. This portage, again, is not long but is steep, slow, and somewhat difficult. At East Grand Forks there is another dam that is small with short, easy portage. This is only a mile or so from the mouth of the river and exit can be made here or easier yet at the park on the left bank behind the housing development at the upstream edge of the suburban area.

The Red Lake River is interesting in its great variety from a wilderness swamp region with long views and much wildlife, to its dull featureless dredged trench, to the beauty of a town like Thief River Falls and the trash-laden Crookston banks. The areas of repeated, lovely, and navigable rapids and high cliffs, to the long placid sameness of the lower 30 miles. It can be traveled most of the way by motor and small craft, though the rapids area should be enjoyed by motorless canoe. Scientifically it can be interesting throughout but general esthetic appeal is limited to the areas above the weir and to the rapids and high cliffs reach from Thief River Falls to Huot. It is a very long river, has limited access and camping areas but certain reaches are worth further consideration for recreatinnal development of special appeal in a part of the state where such attractions are uncommon.

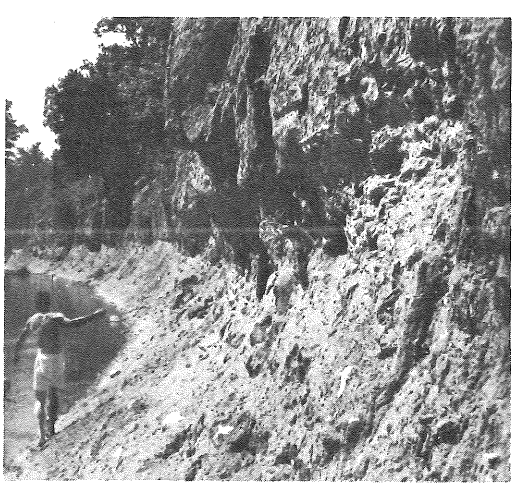
GEOLOGY

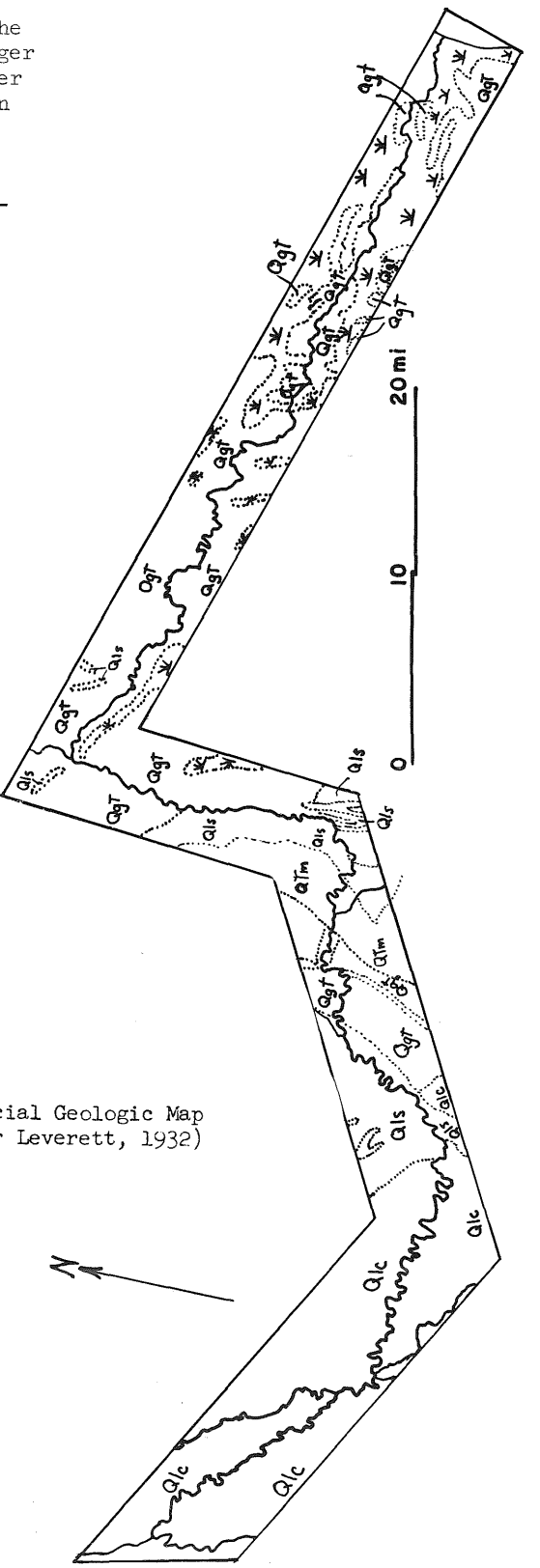
RED LAKE RIVER

For its entire length, the Red Lake River flows on the ancient lake bed of Glacial Lake Agassiz, a lake once larger than all of the present Great Lakes combined. In its upper reaches, where the river flows through the Red Lake Indian Reservation, it flows on a very flat floor of thin peat deposits. Flowing slowly, almost due west, toward the junction with the Thief River, the channel is little affected by geologic changes. However, west of the reservation boundary there are few swamps. Here the banks are dark clayey glacial till and occasional large sandbars.

The Thief River, a tributary of the Red Lake River, flows south parallel to a series of morainal hills that were deposited by the Late Wisconsin Des Moines ice Lobe moving south out of Canada into the Lake Agassiz basin. Red Lake River and Thief River join at Thief River Falls and flow south parallel to the moraines to St. Hillaire. From here the valley swings west again and the Red Lake River flows through a spectacular canyon-like area. The steep valley walls are hard, light gray till of the Des Moines Lobe ice sheet, (see photograph), and stand as nearly vertical cliffs up to 100 feet in height. The steep drop to the ancient shore of a shallow stage of Lake Agassiz results in almost continuous rapids to Huot. Here the river banks change abruptly to low, dark silty clay, bottom sediments of Lake Agassiz.

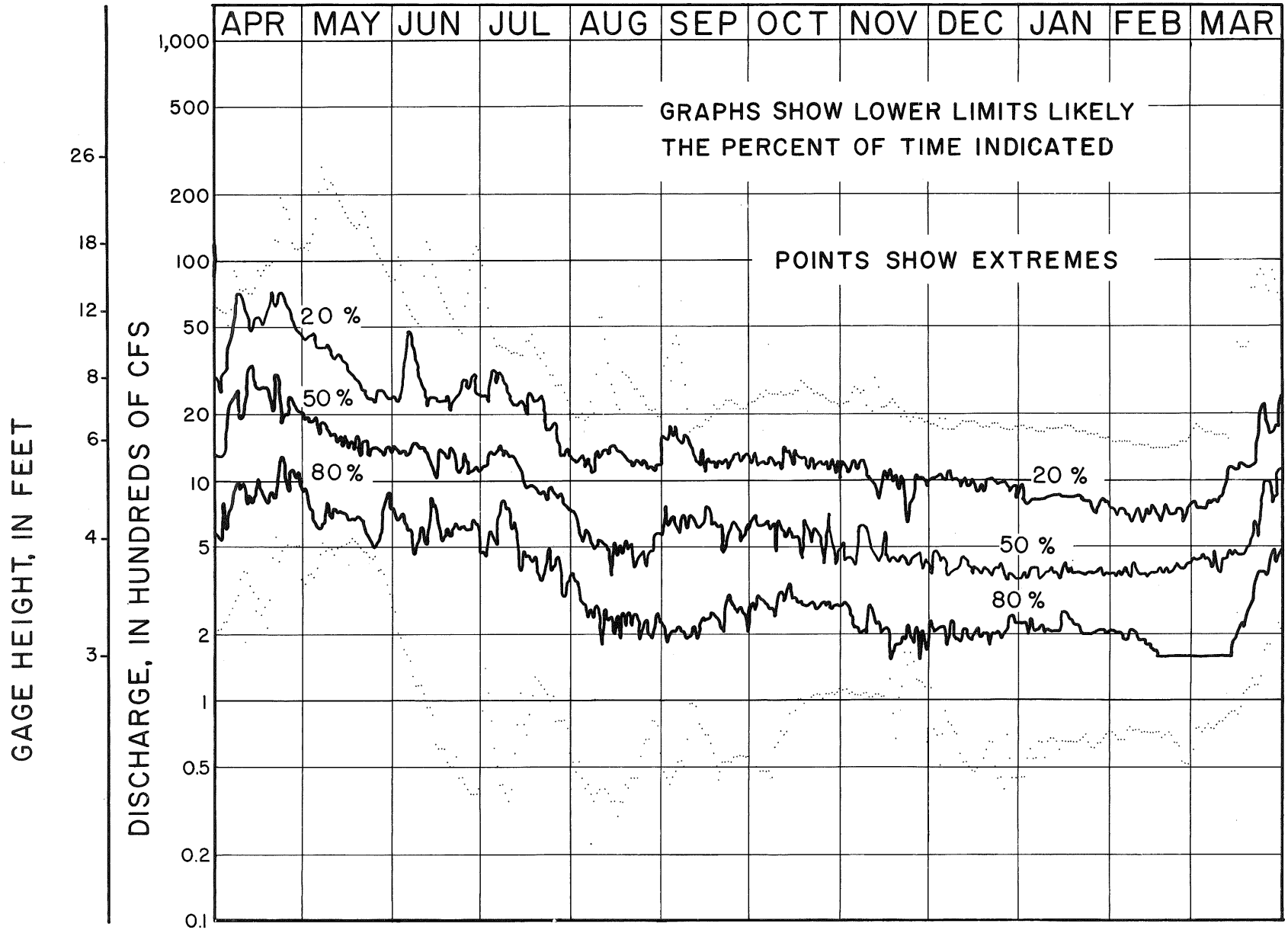
The uniform mud bank channel varies little in appearance across these lake sediments to the mouth of the river at Grand Forks. Severe erosion of these clay banks by recent floods is evident. In many places, several hundred yards of bank as much as an eighth of a mile from the river has been recently eroded. This lake clay material is not easily protected from severe water erosion and channel migration is a severe problem. These banks tend to be poor campsites as the clay holds large quantities of water and during rainy periods turn into a sea of mud.





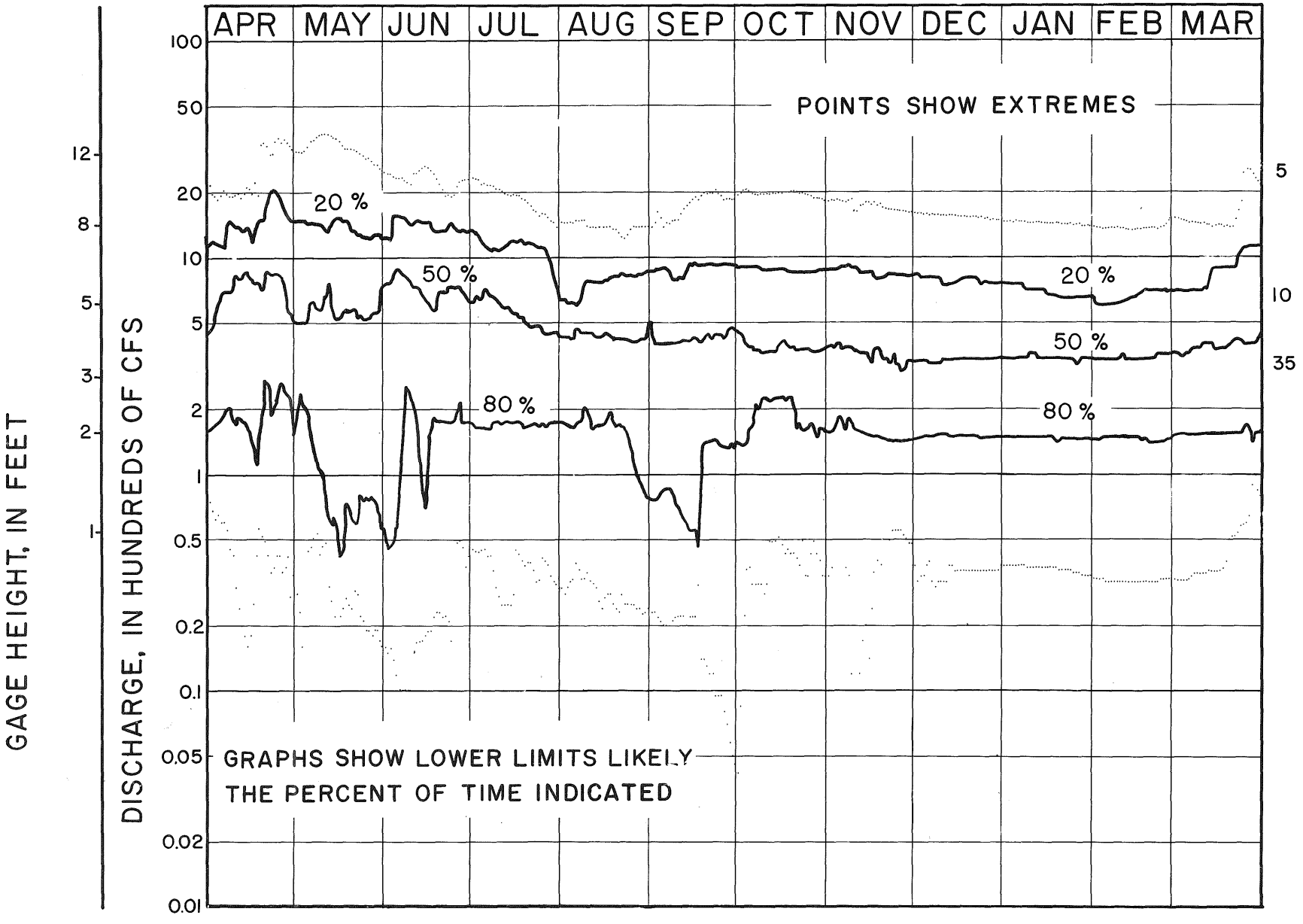
Surficial Geologic Map
(after Leverett, 1932)

RED LAKE RIVER AT CROOKSTON



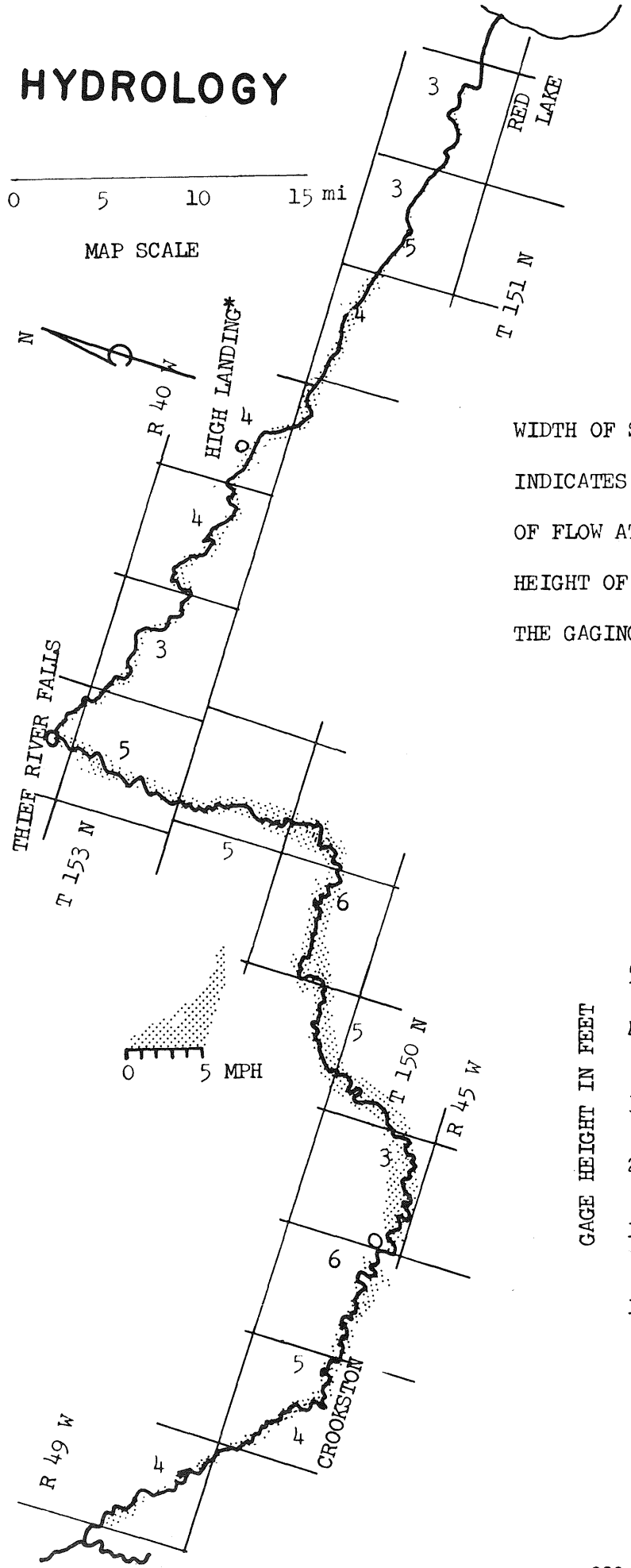
DURATION HYDROGRAPH FOR THE WATER YEARS OF 1943-1961

RED LAKE RIVER AT HIGH LANDING NEAR GOODRIDGE



DURATION HYDROGRAPH FOR THE WATER YEARS OF 1943-1961

HYDROLOGY



WIDTH OF STREAM INDICATES VELOCITY OF FLOW AT A GAGE HEIGHT OF 5 FT AT THE GAGING STATION

RED LAKE RIVER

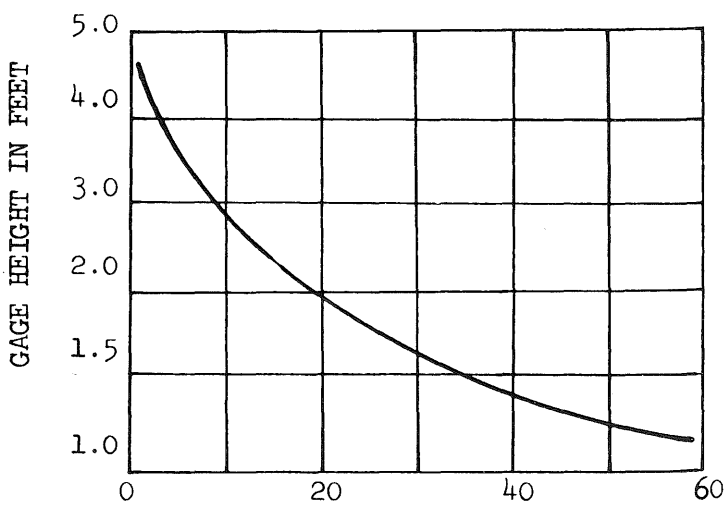
DRAINAGE AREA ABOVE GAGE 2,300 sq. mi.

NUMBERS INDICATE FOR NORMAL FLOW THE MINIMUM GAGE HEIGHT AT WHICH THE REACH OF RIVER IS GENERALLY NAVIGABLE BY CANOE

FLOW REGULATED BY DAM ON LOWER RED LAKE

RECESSION CURVE INDICATES AT THE GAGING STATION THE NORMAL DECLINE IN GAGE HEIGHT FOLLOWING A PERIOD OF RAIN

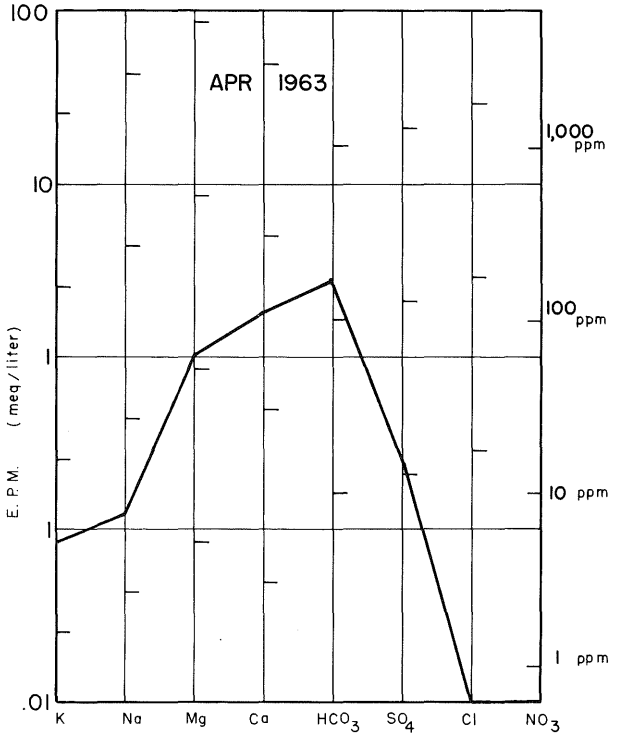
*** GAGING STATION LOCATION**



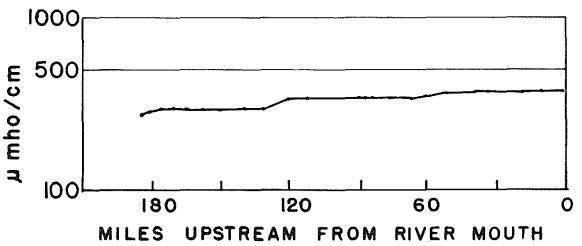
WATER QUALITY

RED LAKE RIVER

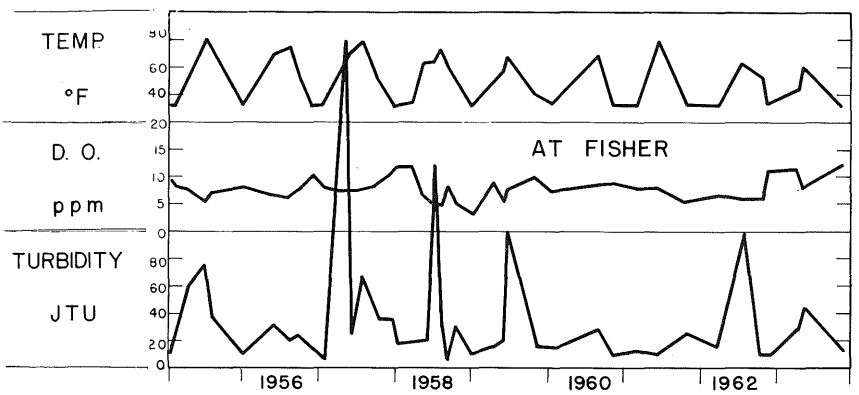
CONCENTRATION OF MAJOR IONS AT GOODRIDGE



DOWNSTREAM VARIATION IN CONDUCTIVITY JULY 19-23, 1966



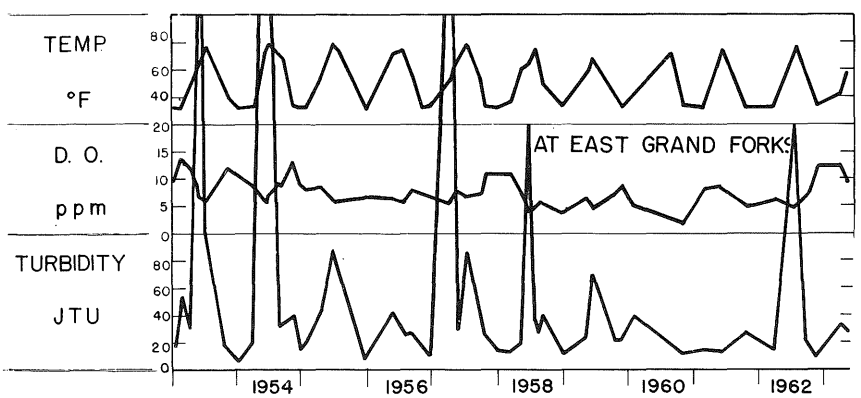
FACTORS OF HIGH CONCERN TO ECOLOGY



NUTRIENT PHOSPHORUS, ppm			
HI	LO	AVG	SAMPLES
.32	.04	.14	13

AT GENTILLY

1958-1959
1962-1963



NUTRIENT PHOSPHORUS, ppm			
HI	LO	AVG	SAMPLES
.51	.04	.17	13

AT EAST GRAND FORKS

1958-1959
1962-1963

ROOT RIVER

Reconnaissance by canoe was made June 4 and 5, 1966 between Highway 52 below Chatfield and Houston by U.S.G.S. observers.

Low discharge is the main navigation problem. Fences also present some danger. In the section near Houston, it is littered with debris from the spring flood. The stream consists mainly of pools and riffles with the pools sometimes being one fourth mile long.

The banks are alternately high and low as the stream meanders through its valley. The higher banks sometimes reach an estimated height of 75 feet where the river flows along the valley wall. Here may be seen many samples of the sandstone and limestone bedrock of the area. The higher banks do have some conifers on them, but mostly the banks are covered with open hardwood forest. Many very good camping spots are available, however, the best sites are grazed pasture. Some bank erosion is taking place. The banks are composed mostly of silt and sand. The stream width ranged from 40 to 150 feet. The river has an agricultural setting with very little wilderness character.

Suspended sediment gives the water a brown or gray appearance. It shows little evidence of pollution. The temperature averaged about 69 degrees fahrenheit. Aesthetic values are not very high, but if one does not desire a wilderness environment, the stream is quite pleasant to canoe.

Ducks were the only wildlife observed.

Accesses are numerous, but few are convenient for canoe launching.

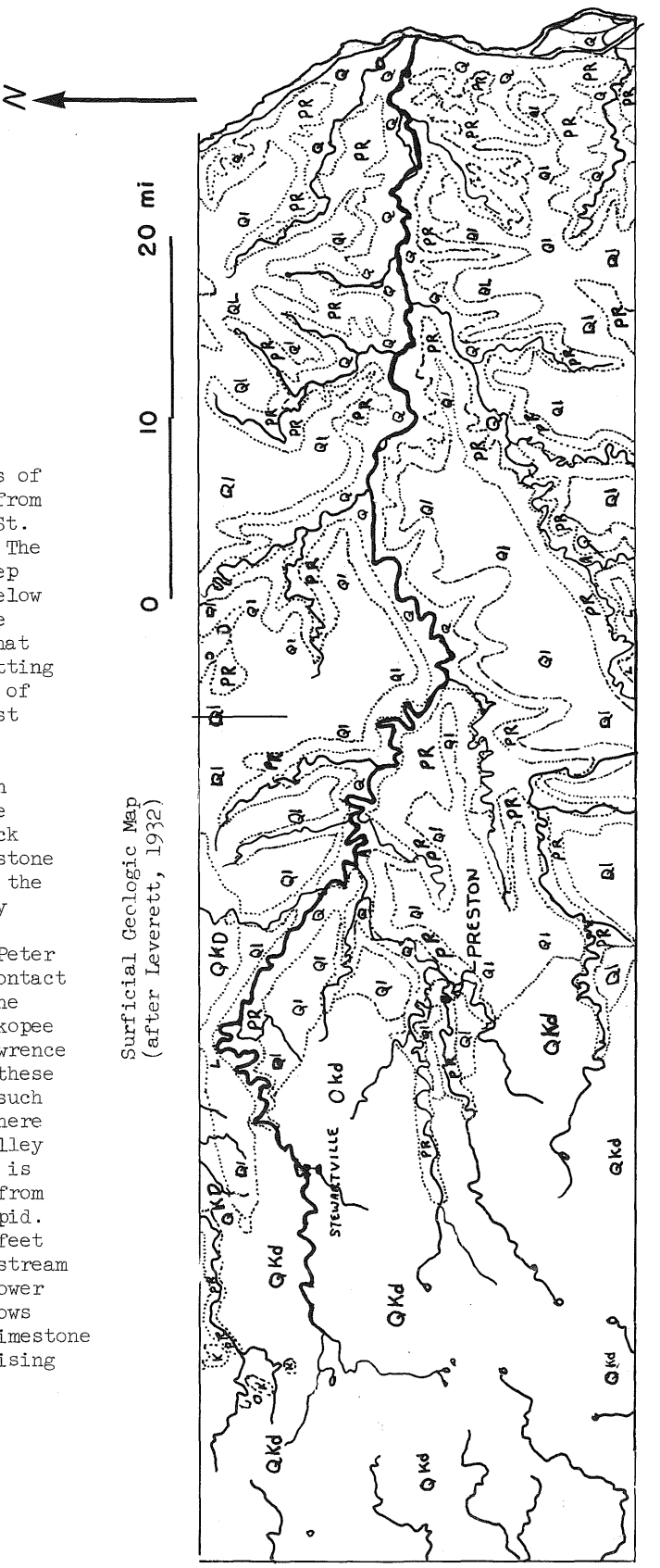
The stream has the limiting factor of too little flow most of the time, but it could be of value as a local-use stream.

GEOLOGY

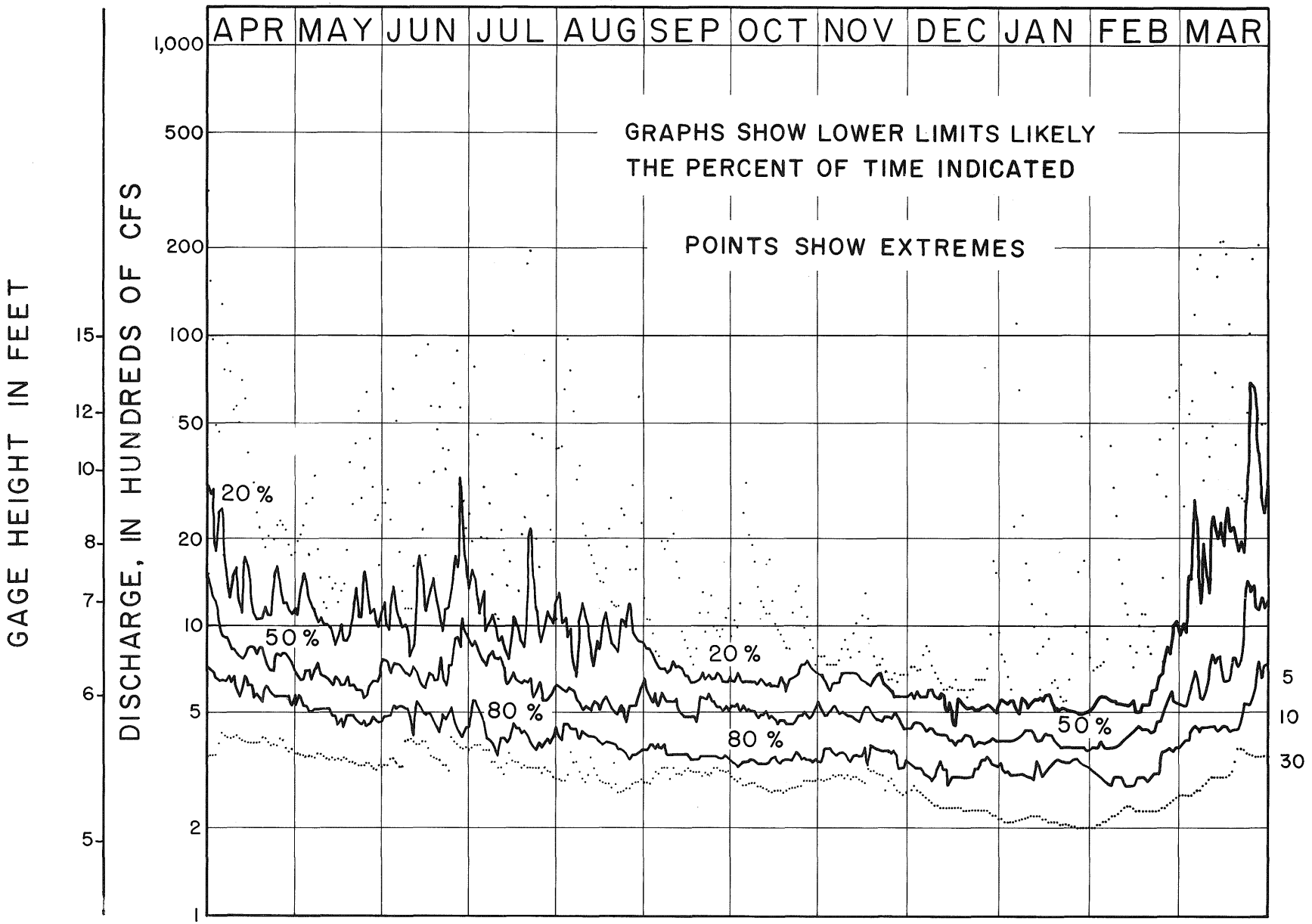
ROOT RIVER

During Late Glacial time, torrents of water flowed down the Minnesota River from the outlet of Glacial Lake Agassiz to St. Paul and thence down the Mississippi. The erosive force of the water carved a deep valley for the Mississippi River far below the level of the surrounding area. The Root River is one of the tributaries that downcut its valley to match the downcutting of the Mississippi. The steep profile of the river results in many falls and fast water.

The Root River, having cut through whatever glacial drift once covered the area, now flows across Paleozoic bedrock consisting of alternating beds of sandstone and limestone. The upper valley is in the Platteville Limestone, where it is very narrow. Downstream from Chatfield the river has cut into the underlying St. Peter Sandstone. Rapids are formed at the contact and other rapids occur downstream as the Root flows successively across the Shakopee Dolomite, Jordan Sandstone, and St. Lawrence Formation. Early mills were built at these contacts where rapids occur and towns such as Chatfield developed around them. Where the valley walls are limestone, the valley is narrow; where sandstone, the valley is wide. The first evidence of a change from limestone to sandstone is a fall or rapid. Scenic limestone cliffs more than 100 feet high form the walls of the valley downstream 10 miles from Chatfield. The entire lower section of the river below Peterson flows through the Franconia Sandstone with limestone cliffs of the St. Lawrence Formation rising above the valley floor.



ROOT RIVER BELOW SO. FORK NEAR HOUSTON



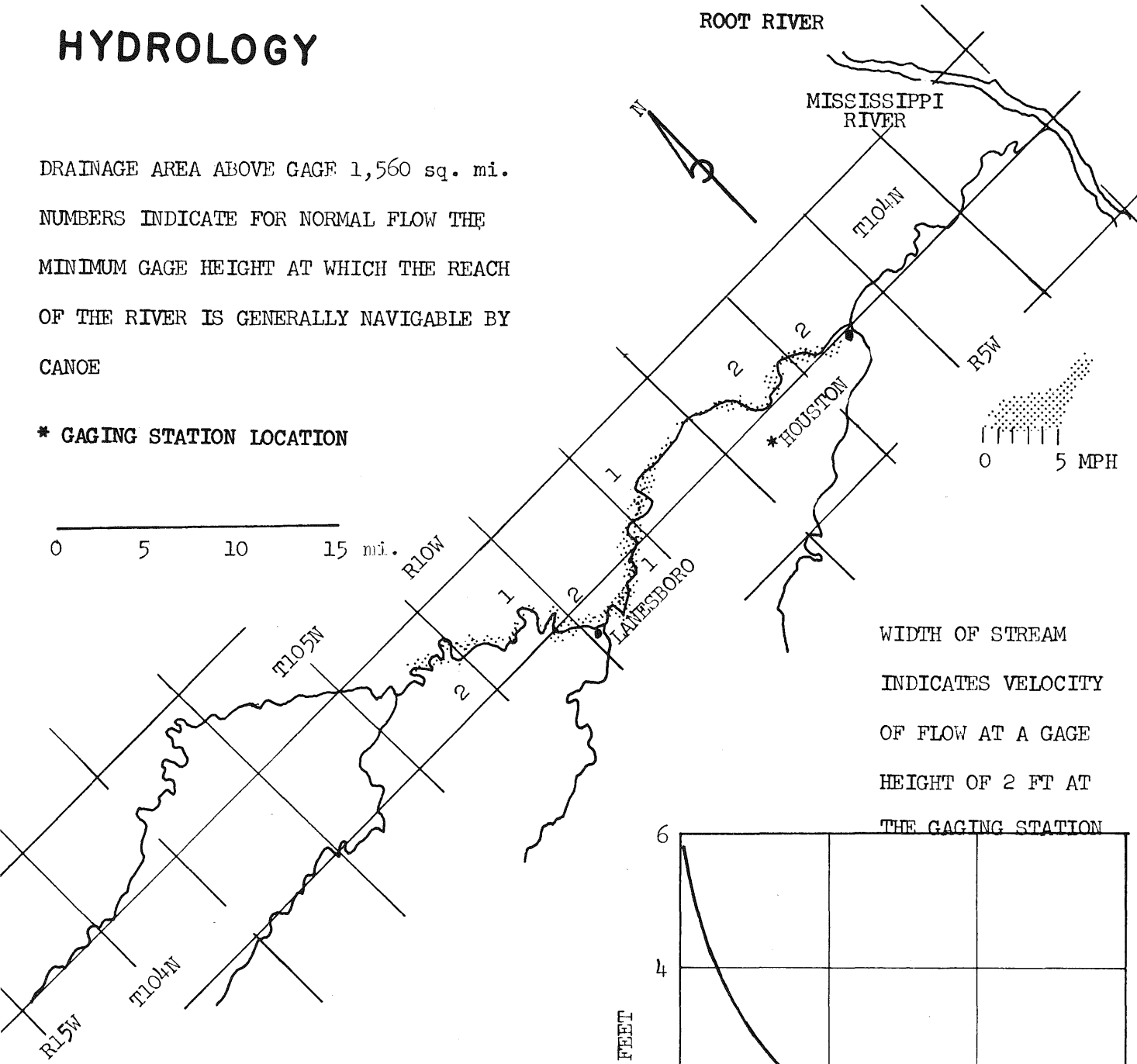
DURATION HYDROGRAPH FOR THE WATER YEARS OF 1943 - 1961

HYDROLOGY

DRAINAGE AREA ABOVE GAGE 1,560 sq. mi.

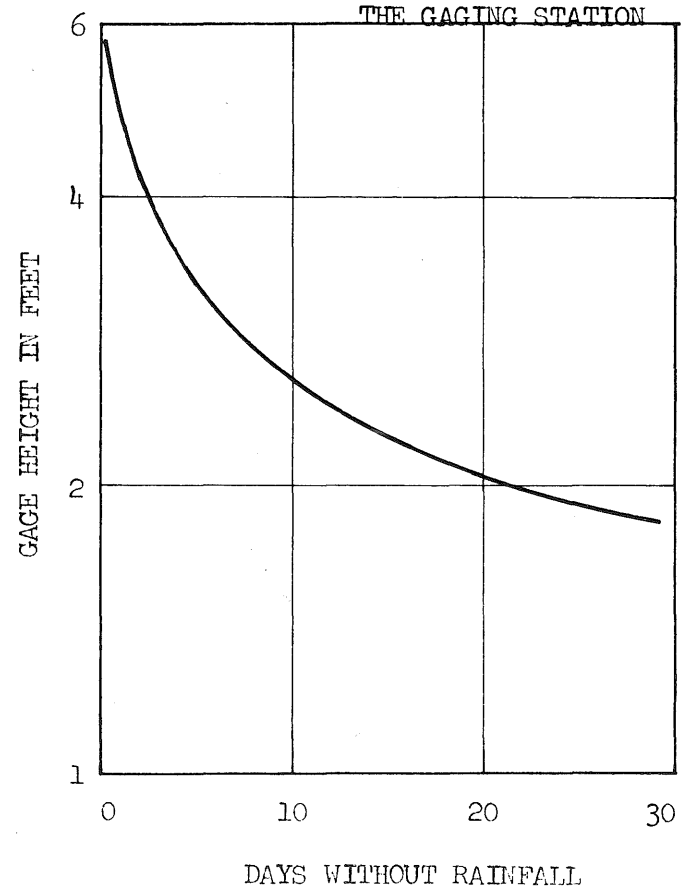
NUMBERS INDICATE FOR NORMAL FLOW THE MINIMUM GAGE HEIGHT AT WHICH THE REACH OF THE RIVER IS GENERALLY NAVIGABLE BY CANOE

*** GAGING STATION LOCATION**



RECESSION CURVE INDICATES AT THE GAGING STATION THE NORMAL DECLINE IN GAGE HEIGHT FOLLOWING A PERIOD OF RAIN

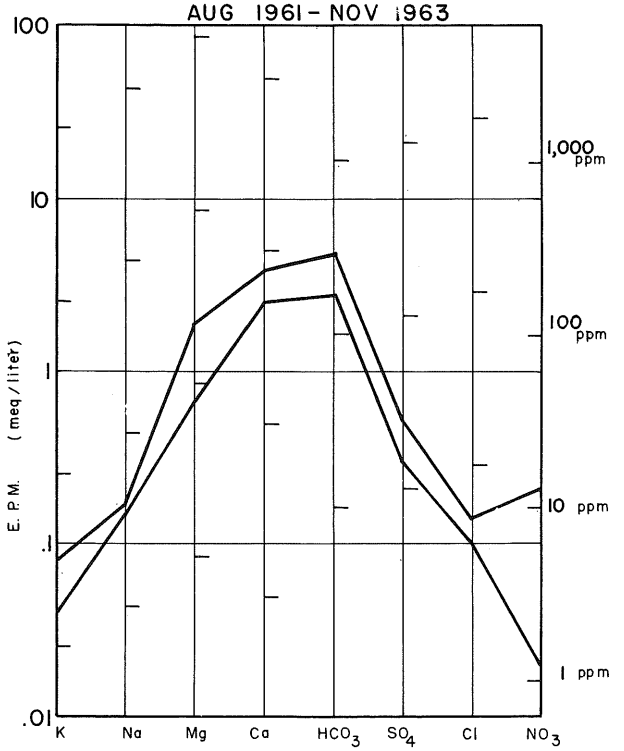
WIDTH OF STREAM INDICATES VELOCITY OF FLOW AT A GAGE HEIGHT OF 2 FT AT THE GAGING STATION



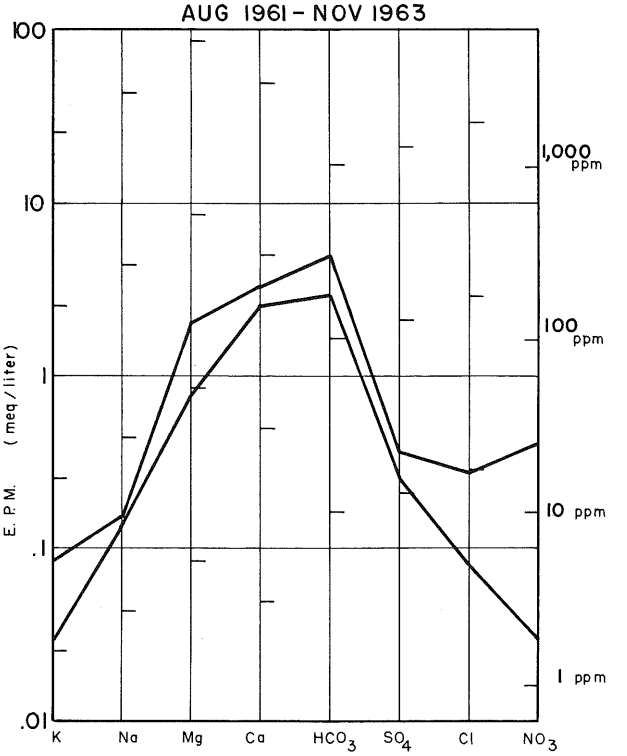
WATER QUALITY

ROOT RIVER

RANGE OF CONCENTRATION OF MAJOR IONS IN 6 SAMPLES TAKEN AT LANESBORO AUG 1961 - NOV 1963



RANGE OF CONCENTRATION OF MAJOR IONS IN 5 SAMPLES TAKEN AT HOUSTON AUG 1961 - NOV 1963



WATER TEMPERATURE
SUMMER 1966

STATION: HOUSTON
DATES: JUN 1 - AUG 25
MAX. 12-HOUR ΔT = 9°
AVG. 12-HOUR ΔT = 3.7°
MAX. 5-DAY ΔT = 17°
BEGINNING DATE: AUG 7
DAYS EXCEEDING 80°F: 6

NUTRIENT
PHOSPHORUS, ppm

HI	LO	AVG	SAMPLES
3.9	.21	.90	6

AT LaCRESCENT

1958-1959

RUM RIVER

Reconnaissance of the entire length of the Rum River from Lake Onamia outlet to Anoka was made July 14, 15, 16, 1965 and June 7, 8, 10, 11, 1966 by U.S.G.S. observers. The reach from the source to Princeton is generally not navigable, being a series of pools and riffles which must be portaged or waded. In some areas the tree fall is nearly inpenetrable without a saw. From Princeton to Cambridge the river is deep enough for small craft travel although there are again some areas of tree fall and log and debris jams that present problems. Before the river swings south toward Cambridge the banks are low and connect with backwater areas most of the year so that it is difficult at times to follow the true channel. Use of the available topographic maps and careful observation of the slow flow will prevent the user from becoming lost.

The reach from the bend to the south above Cambridge to St. Francis, with the exception of the washed-out dam at Cambridge is navigable and a pleasant trip. The remains of the dam at Cambridge may be passed over or may require walking boat over depending on stage. It does not require bank portage.

There is another washed-out dam at St. Francis, erroneously shown as still intact on the topographic maps. Portage should be made here. The chute left of the center island is sometimes passable but hidden rock just below the drop can cause damage to the craft. From St. Francis to mile 12 there are several areas of rapids that would require wading at lower stages. From mile 12 to Anoka the river is wide, deep, and placid.

The banks throughout the reach from Princeton to the Anoka are sandy to muddy, a foot to many feet high, and often grassy. On the outside of some bends the banks are very high sandy cliffs often topped with conifers, while the opposite, depositing, banks are low flat and willow covered.

Silver maple forests predominate the river corridor. There is some riparian farmland, mostly pastures and grazed woods, along the last half of the reach, that more often than not enhance the beauty of the area.

Good camping sights are limited but available enough to enable use of the river for overnight trips. The area abounds with ducks and many heron were observed on the reconnaissance trip. Muskrats and evidence of beaver were also noted in the upper reach.

Good access points on the river are quite limited. Two parks, one at Princeton and one at Cambridge, provide both easy access and camping grounds. There is a municipal parking lot at Princeton near the park access where a car may be left. A restaurant is adjacent to the park. At Cambridge ordinances provide that cars may be left for over 23 hours with permission only in the city lot, 3/4 mile from the river. Camping Facilities are excellent here. There is also good access on the right bank just at the outskirts of Anoka.

The water has mild amber to muddy-brown color and generally the turbidity is less than 40 JTU. It is a warm river, the temperature having exceeded 80°F 19 days in the summer of 1966. Limited amounts of algae were noted.

The forest in the lower reach is generally different than that in the Cambridge area. There is more open space, larger trees, more hardwoods, and large willow. Some areas of pine and cedar exist in the lower reach.

The river's potential as a recreational river is somewhat limited but considering it's proximity to the large population density of the Twin Cities it can be of high value for week-end or afternoon canoeing and boating. It is worthy of some development consideration and especially, protection.

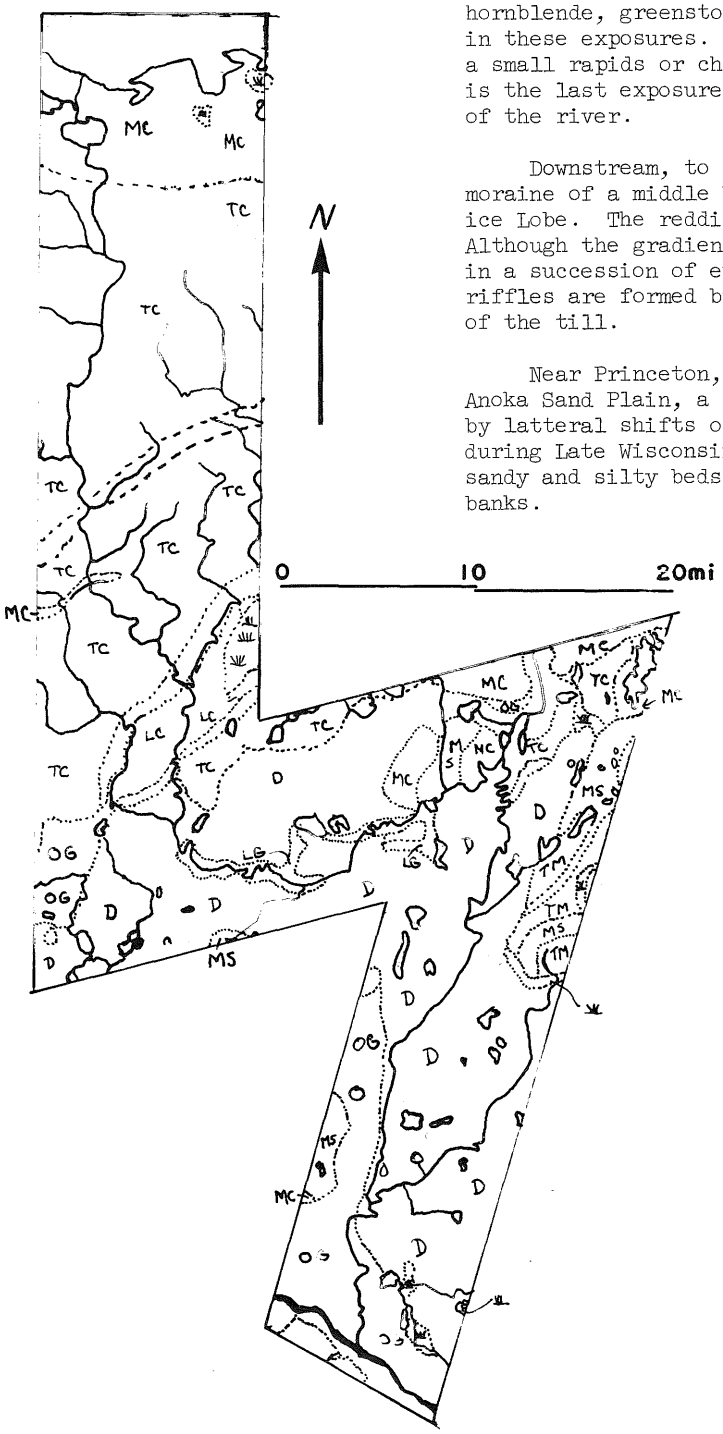
GEOLOGY

RUM RIVER

The headwaters of the Rum River is Lake Mille Lac, formed by the terminal moraine of Late Wisconsin ice moving southwestward out of the Lake Superior basin. The lake drains south over a low section of the moraine, where the Rum flows through two small lakes in the moraine before it starts its normal channel 140 miles above Anoka. Between Onamia and Bradbury Brook, there are three stretches where granitic bedrock is exposed in the channel. Syenite, hornblende, greenstone, and granite gneiss are also found in these exposures. Each of these bedrock ledges causes a small rapids or chute. Just a mile below Bradbury Brook is the last exposure of rock to be seen in the entire reach of the river.

Downstream, to near Princeton, the Rum flows on ground moraine of a middle Wisconsin advance of the Lake Superior ice Lobe. The reddish till is well exposed on steep banks. Although the gradient is relatively steep, the river flows in a succession of evenly spaced pools and riffles. The riffles are formed by gravel accumulations weathered out of the till.

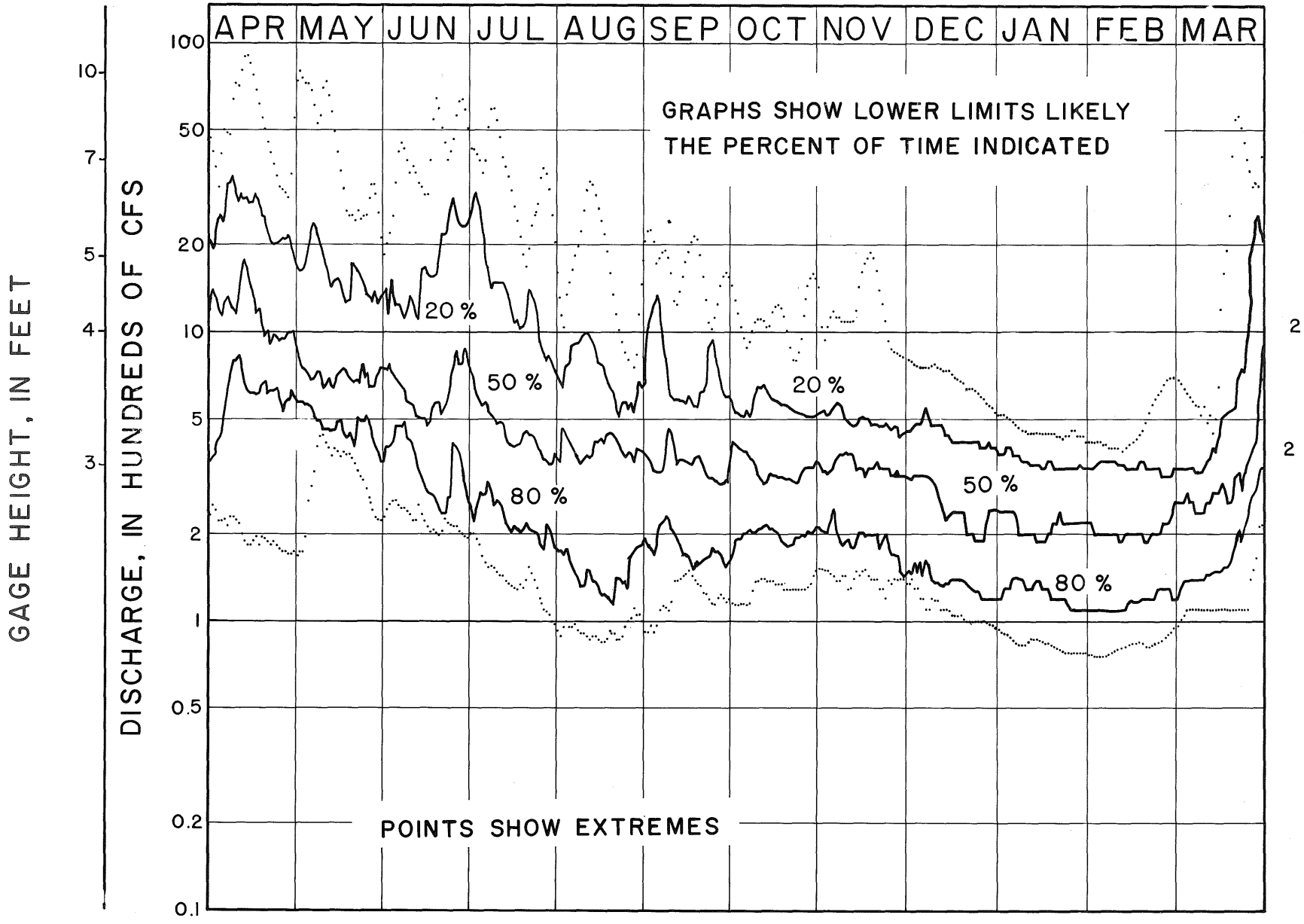
Near Princeton, the Rum flows onto the edge of the Anoka Sand Plain, a large area of glacial outwash formed by latteral shifts of the channel of the Mississippi River during Late Wisconsin time. Downstream to St. Francis, the sandy and silty beds of the sand plain are exposed in the banks.



At St. Francis, the Rum crosses onto glacial till deposits again and a series of rapids mark this transition. To Cedar Creek, the river flows alternately on till and sand plain at a steep gradient. From Cedar Creek to Anoka, it flows across gravel outwash deposits at a lower gradient. Through this reach, the river is deeply entrenched and bordered by very high sand and gravel banks. In places, these sand banks are badly eroded by man's use. They are, however, spectacularly scenic in places and where natural vegetation is growing, are relatively stable. The water clears slightly through this reach because of the sand banks.

Surficial Geologic Map
(after Leverett, 1932)

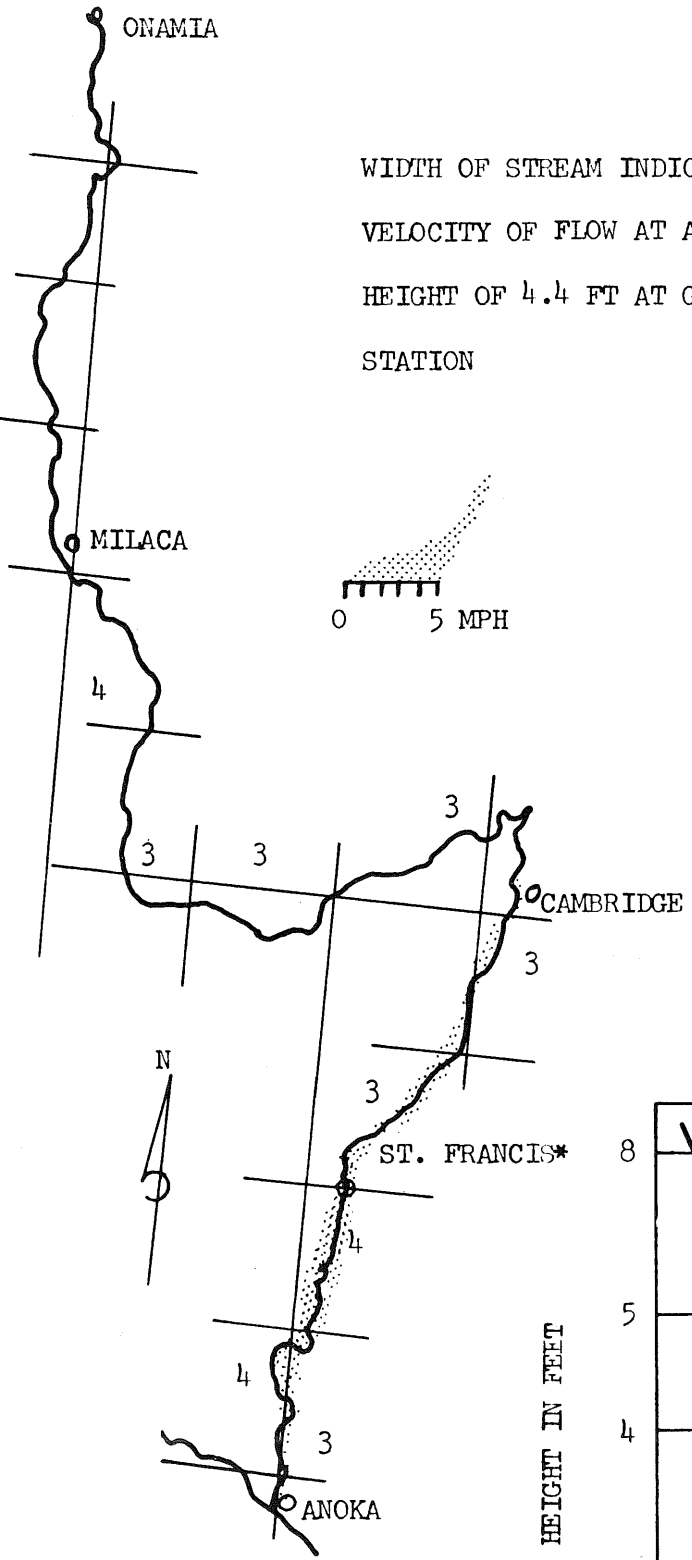
RUM RIVER NEAR ST. FRANCIS



DURATION HYDROGRAPH FOR THE WATER YEARS OF 1943 - 1961

HYDROLOGY

RUM RIVER



WIDTH OF STREAM INDICATES VELOCITY OF FLOW AT A GAGE HEIGHT OF 4.4 FT AT GAGING STATION

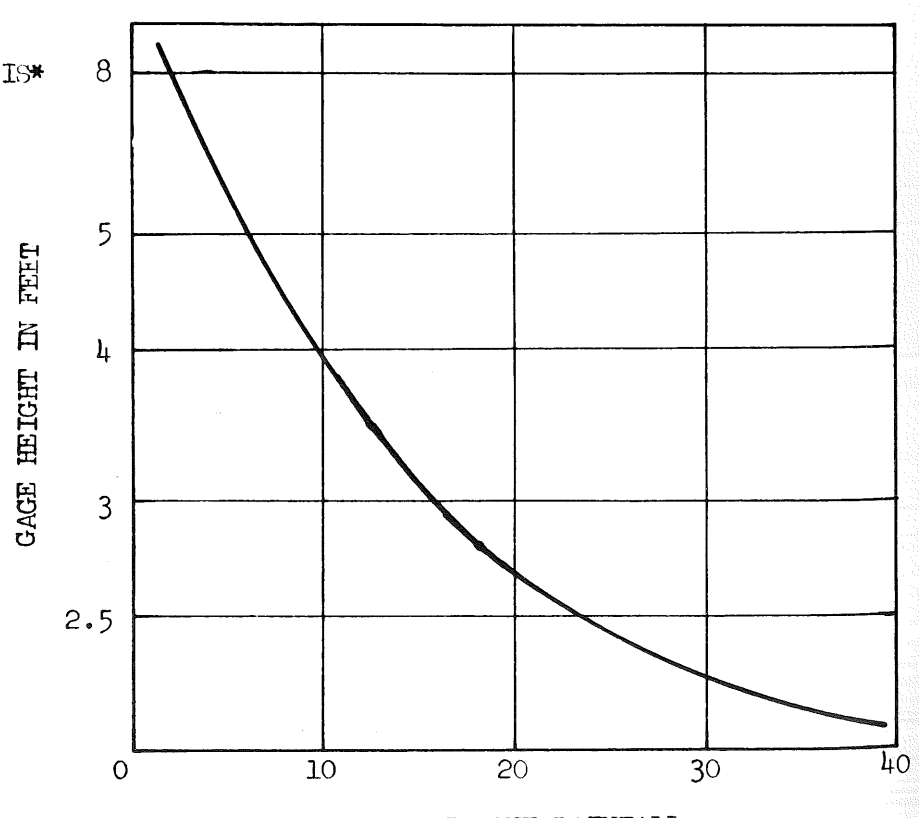
DRAINAGE AREA ABOVE GAGE 1,360 sq. mi.

NUMBERS INDICATE FOR NORMAL FLOW THE MINIMUM GAGE HEIGHT AT WHICH THE REACH OF THE RIVER IS GENERALLY NAVIGABLE BY CANOE

0 10 20 mi

MAP SCALE

RECESSION CURVE INDICATES AT THE GAGING STATION THE NORMAL DECLINE IN GAGE HEIGHT FOLLOWING A PERIOD OF RAIN



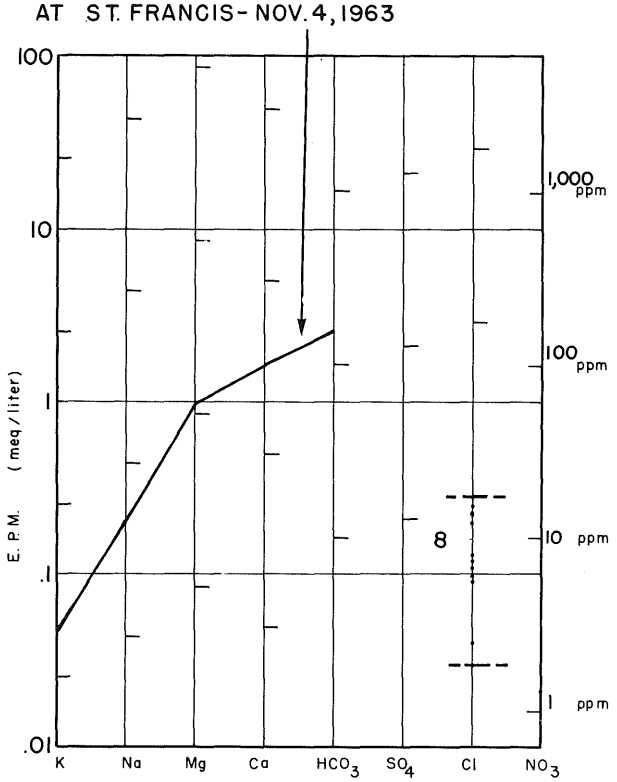
OCCASIONAL REGULATION BY OGECHIE AND ONAMIA LAKES

*** GAGING STATION LOCATION**

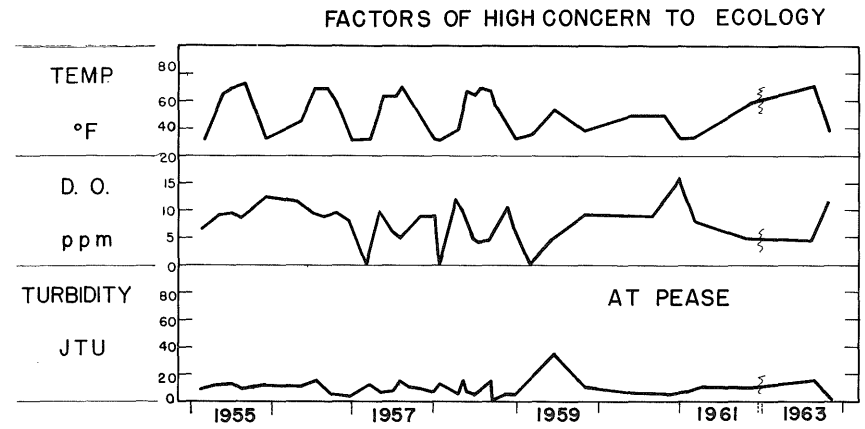
WATER QUALITY

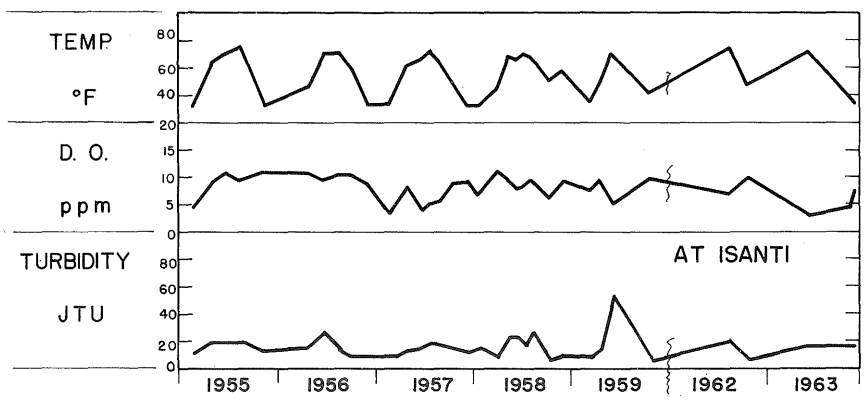
RUM RIVER

RANGE OF CONCENTRATION OF MAJOR IONS
AT ST. FRANCIS - NOV. 4, 1963



FACTORS OF HIGH CONCERN TO ECOLOGY





WATER TEMPERATURE
SUMMER 1966
STATION: PRINCETON
DATES: JUN 1 – 30 JULY
MAX. 12-HOUR ΔT = 4°
AVG. 12-HOUR ΔT = 0.6°
MAX. 5-DAY ΔT = 9°
BEGINNING DATE: JUN 23
DAYS EXCEEDING 80°F: 19

NUTRIENT
PHOSPHORUS, ppm

HI	LO	AVG	SAMPLES
.31	.01	.18	11

AT ST. FRANCIS

1958-1959
1962-1963

NUTRIENT
PHOSPHORUS, ppm

HI	LO	AVG	SAMPLES
.32	.01	.16	5

AT ANOKA

1962-1963

SNAKE RIVER

Reconnaissance by canoe was made August 7 and 8, 1966 between Highway 65 above Mora and the mouth by U.S.G.S. observers.

The river consists of an upper reach with a moderate gradient and a lower one with a steep gradient. River discharge is, therefore, more critical in the lower section than in the upper one. The lower reach, below Pine City, may be dangerous to the inexperienced canoeist during periods of high flows. The upper reach of the river is mainly a marsh type stream while the lower section is of a pool and riffle nature.

The river has an agricultural and woodland setting. There is also much summer home development. The higher banks (10 feet or more) are generally sandy with a few conifers growing on them. The lower banks are usually overgrown with willows, weeds and brush. Good camping sites, usually grazed pasture, are within a half days canoeing of each other. Many piles of trash detract from the aesthetic value of the stream.

The sandy or gravel bottom could be seen in most places. The water in some areas was turbid, probably due to feeding carp, while in others it was clear. During the canoe trip, the water temperature averaged 70 degrees fahrenheit.

Ducks, muskrats, and indication of beaver were seen.

Access points are quite abundant, but there are only a few where a canoe may be put in with ease.

The stream would make a good family canoeing stream above Pine City and a good sporting stream below. The flow limits use of the lower reach to early spring and brief periods following heavy summer rains.

GEOLOGY

SNAKE RIVER

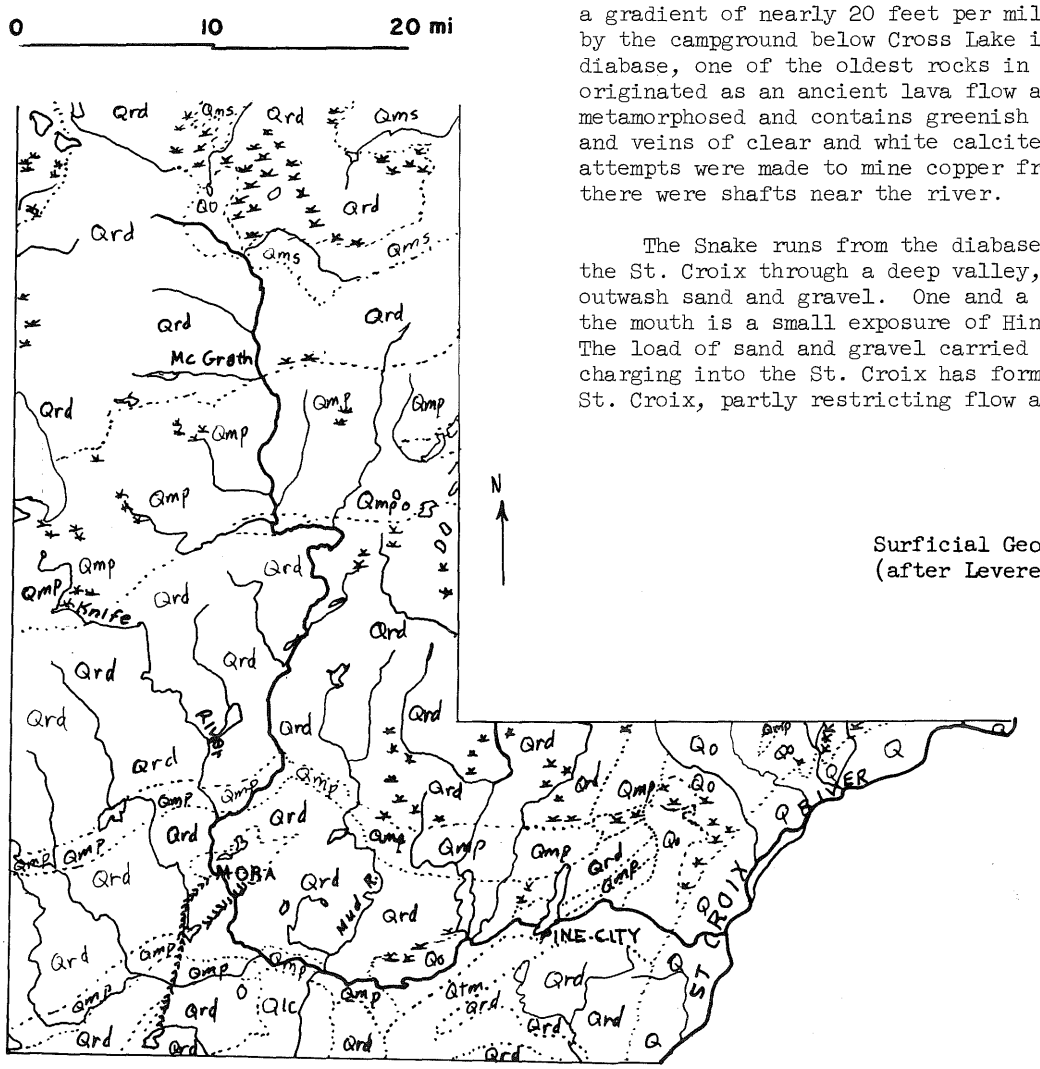
The Snake River headwaters are on the south facing slope of the Mille Lacs moraine. From the moraine the Snake flows south across a small moraine, then turns northeast along the terminal moraine formed by northeast moving ice of the Grantsburg Sublobe of Late Wisconsin time. Meltwaters from the Des Moines Lobe glacier flowing from the St. Cloud area eastward, probably cut the lower course of the Snake River.

Bedrock is found in only a few places along the Snake River. In the upper part, just below the Pine County line, the Snake drops down through a narrow chute (about 30 feet wide) of gray granite. Feldspar and large veins of white quartz are exposed here. The channel is enclosed in zig-zag vertical walls 10 to 15 feet high. About a mile downstream there are similar exposures along the Lower Falls. Here the river falls some 20 feet through broken and jointed granite ledges. The dark crumbling platy rock is mica schist. The maximum width of the schist is about 100 feet, where it is best exposed in the lower part of the falls. Hinckley Sandstone is exposed in the river near Knife Lake and again about a mile north of Mora.

From Mora to Pine City the banks are largely till and sand and gravel of the Des Moines Lobe drift. The numerous riffles at low water stages are from accumulations of pebbles and cobbles that have weathered out of the drift.

At Pine City the channel steepens abruptly to a gradient of nearly 20 feet per mile. The bedrock by the campground below Cross Lake is copper bearing diabase, one of the oldest rocks in Minnesota. It originated as an ancient lava flow and in places is metamorphosed and contains greenish chlorite schist and veins of clear and white calcite. Several early attempts were made to mine copper from this rock and there were shafts near the river.

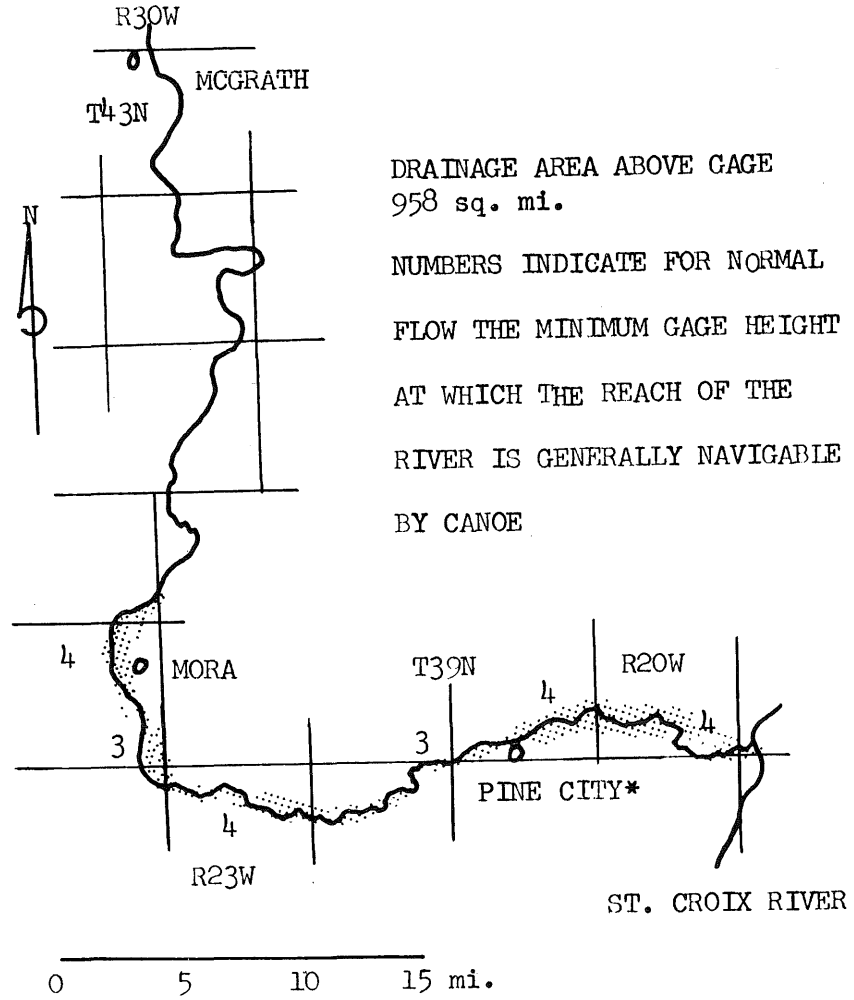
The Snake runs from the diabase to its mouth at the St. Croix through a deep valley, largely glacial outwash sand and gravel. One and a half miles above the mouth is a small exposure of Hinckley Sandstone. The load of sand and gravel carried by the Snake discharging into the St. Croix has formed a delta in the St. Croix, partly restricting flow at this point.



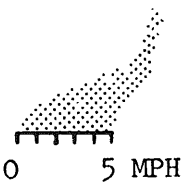
Surficial Geologic Map
(after Leverett, 1932)

HYDROLOGY

SNAKE RIVER



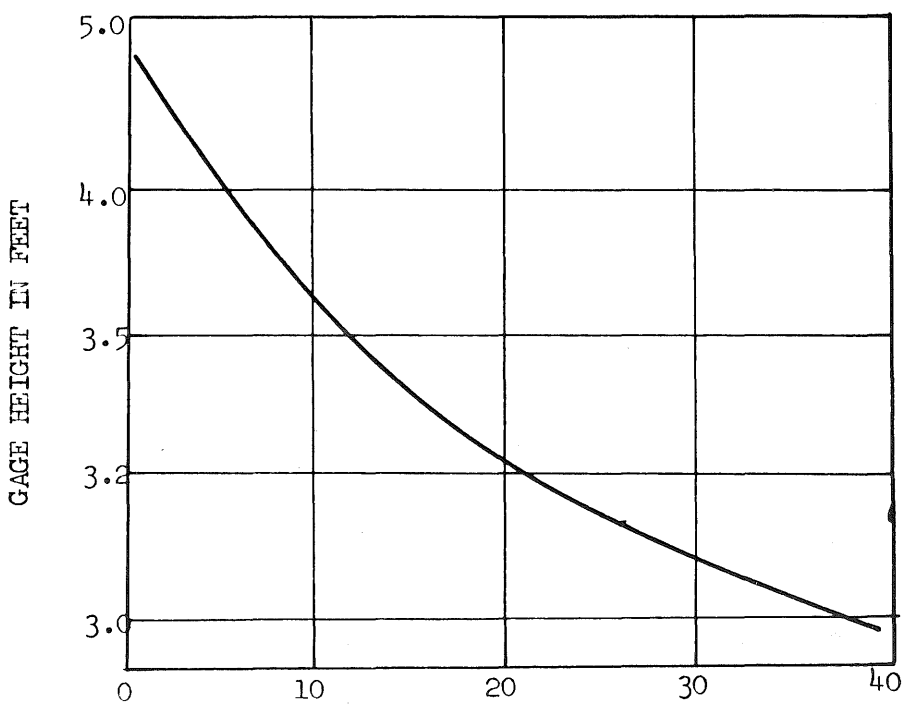
MAP SCALE



WIDTH OF STREAM INDICATES VELOCITY OF FLOW AT A GAGE HEIGHT OF 3.3 FT AT THE GAGING STATION

*** GAGING STATION LOCATION**

RECESSION CURVE INDICATES AT THE GAGING STATION THE NORMAL DECLINE IN GAGE HEIGHT FOLLOWING A PERIOD OF RAIN

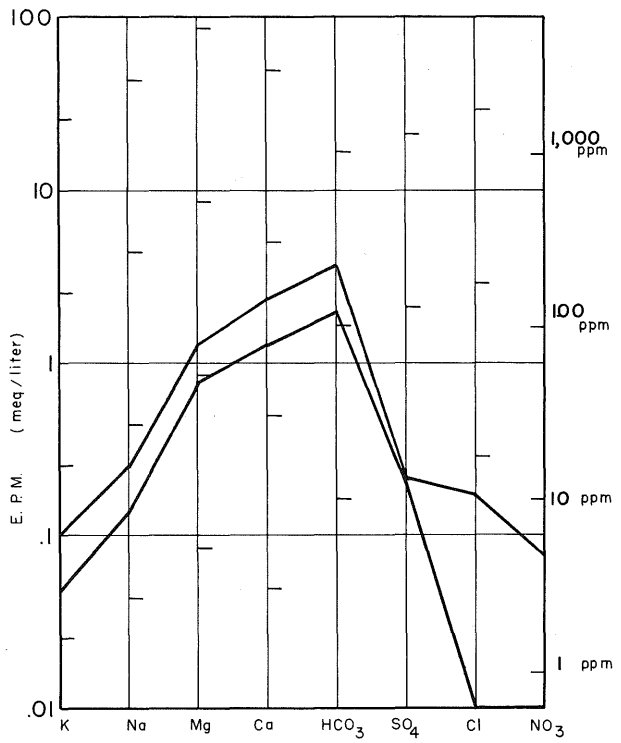


WATER QUALITY

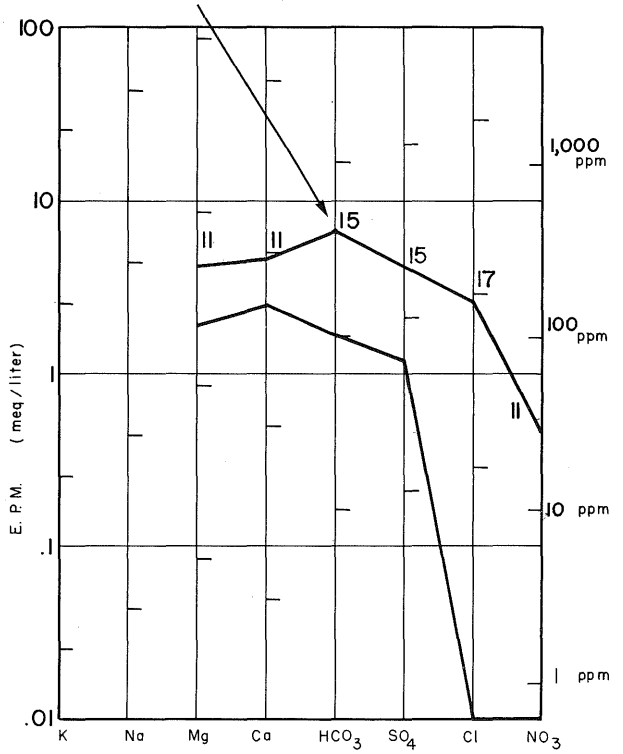
SNAKE RIVER

RANGE OF CONCENTRATION OF MAJOR IONS

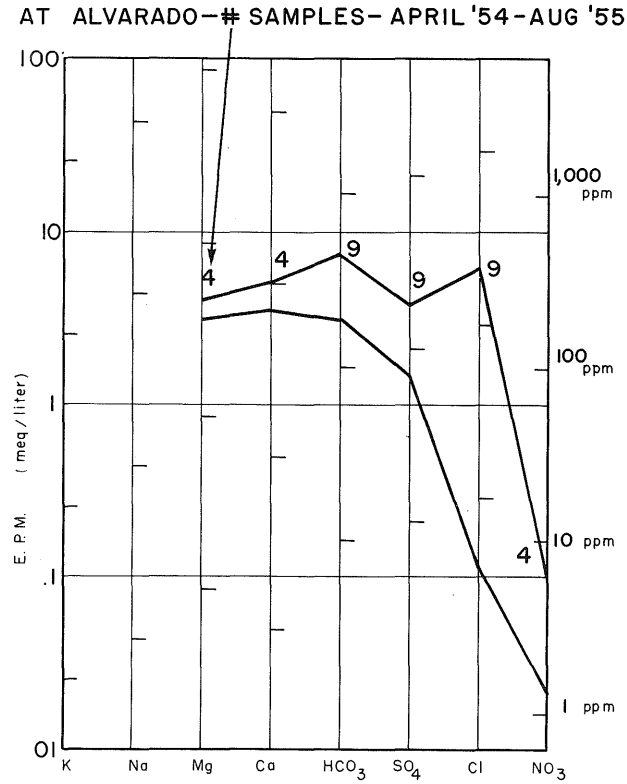
AT PINE CITY - 4 SAMPLES - SEPT '62 - NOV '63



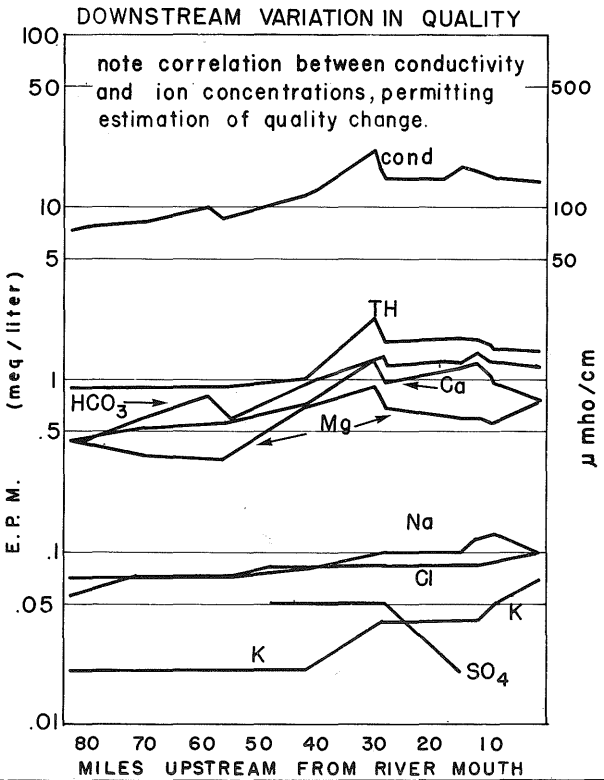
AT WARREN - # SAMPLES - SEPT '53 - JULY '55



AT ALVARADO - # SAMPLES - APRIL '54 - AUG '55



DOWNSTREAM VARIATION IN QUALITY



ST. CROIX RIVER

A reconnaissance, by canoe, was made on the St. Croix River, May 29, 30, and 31, 1966 between Riverside, Minnesota and Taylors Falls by U.S.G.S. observers. The St. Croix is navigable by canoe at almost any stage except for the segment adjacent to the St. Croix State Park in Minnesota, where an abrupt drop and a delta from the Kettle River make particularly shoal areas. The first rapids are about ten miles downstream from the upper part of St. Croix State Park and consist of approximately seven miles of rapids starting at Head-of-the-Rapids Island. Stage at the date of the trip was which was more than adequate for navigation. With only moderate care, the entire trip was made without scraping any rocks. A portage must be made at Taylors Falls because of the high dam. There is good access next to the edge of the breakwaters on the west side of the river. Equipment can be carried through the streets of town and put in at the boatlanding on the Minnesota side. There is also launching space for canoes in the Wisconsin State Park.

The banks are generally attractive and suitable for camping. The valley is filled with well-washed alluvium and contains only a minor amount of silt- and clay-sized material. Generally, the material is sand or sand and gravel. In some cases, it consists dominantly of coarse gravel, cobbles, and boulders. Vegetation is mixed deciduous and conifer; dominantly deciduous above the St. Croix State Park; dominantly conifer through the State Park and down to Grantsburg; dominantly deciduous from the vicinity of Grantsburg downstream to Taylors Falls, and mixed from Taylors Falls to the mouth.

The water is amber in color, due to the organic acids that are common in areas of bogland. Turbidity is low. The bottom is generally clean sand and gravel in the upper reaches with some large boulders and very little vegetation. In the lower reaches, where the river is deeper, the bottom cannot be observed and there is conspicuous plant growth in shallow water.

Wildlife was much in evidence throughout the trip. There were a large number of ducks, several deer, hawks, and osprey. The amount of wildlife is exceptional and unusually evident considering the heavy use to which the river is already subject and the proximity to heavy population centers.

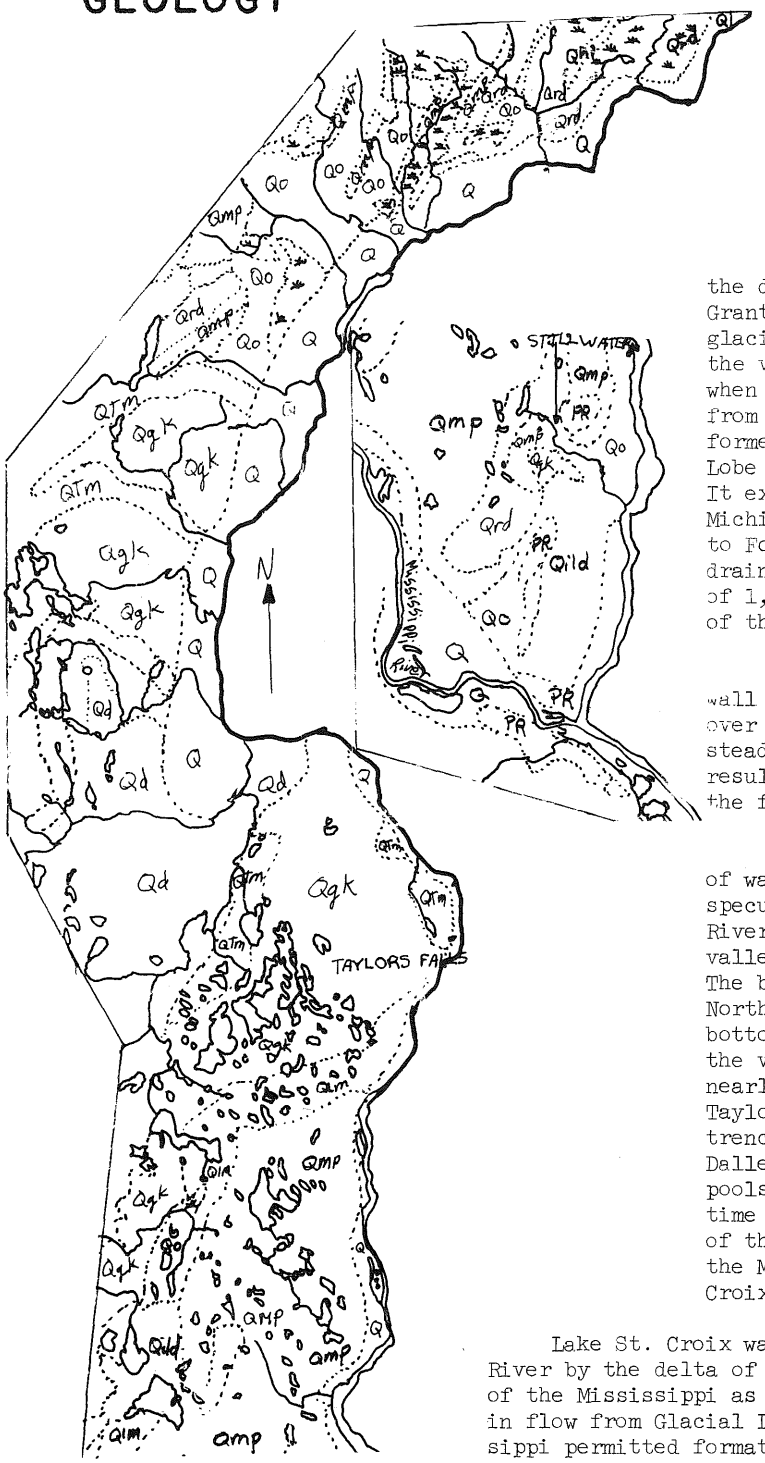
The river is accessible at numerous points, both with canoes and with powered boats. If there is any problem, it is that access is too great and that bank deterioration results from this accessibility. There are a number of summer homes, particularly in the stretch below the State Park, but at present, this is not excessive.

One of the most striking attractions of the river is the geology exposed at Taylors Falls. Certainly, the St. Croix dalles area and that below, compares favorably with any river in the country in the scenic value with its high sandstone and diabase banks. These are little inhabited and attractively covered with mixed vegetation. They are attractive in the summer, and especially in the fall.

The St. Croix is certainly one of the outstanding rivers in the state. In the reach of rapids from Head-of-the-Rapids Island, downstream past the Kettle, is one of the finer safe areas of fast water within the state. The river is large but generally not dangerous. Because of its size, clear, clean water, accessibility to the heavy population area of the Twin Cities, the excellent character of the banks, and the many sand islands, it certainly should receive primary consideration for preservation and intelligent management by the state as well as by the Federal government. The pattern of land ownership that has protected it for so long is undoubtedly subject to change in the future and consideration should be given to the effect on the morphology of the stream that changing use patterns of these lands might have.

GEOLOGY

ST. CROIX RIVER



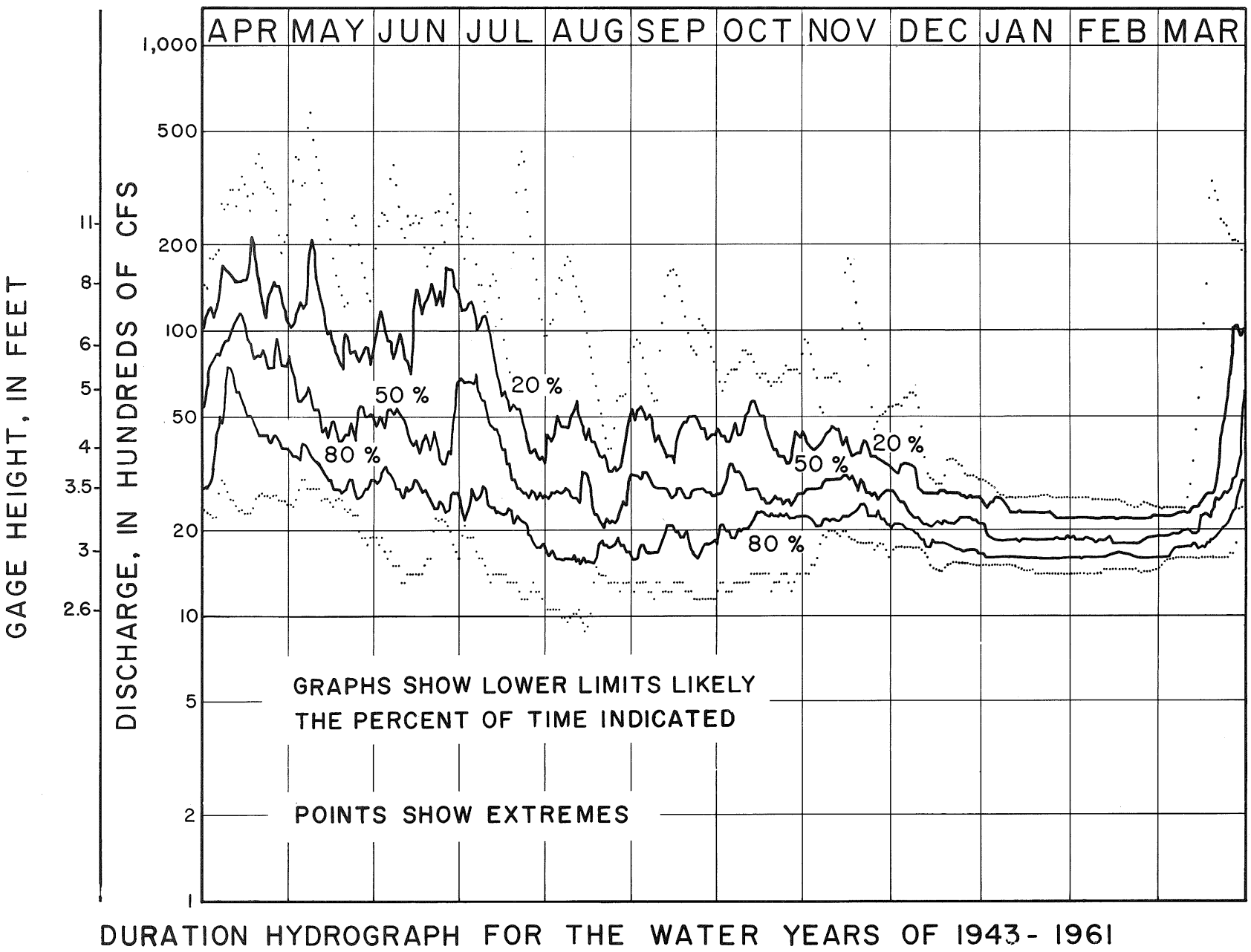
The early St. Croix River carried the drainage from the north side of the Grantsburg Sublobe of the Des Moines Lobe glacier and from the Kettle River. Later the volume of water was greatly increased when the St. Croix received the discharge from Glacial Lake Duluth. This lake, which formed in front of the retreating Superior Lobe ice, occupied the Lake Superior basin. It extended east to the Huron Mountains in Michigan on the south shore, and at least to Fort Williams on the north shore. The drainage outlet was lowered from an altitude of 1,070 feet to 1,020 feet during the life of the lake.

The Grantsburg Sublobe, acting as a wall on the west, forced the river to flow over the diabase rocks at Taylors Falls instead of over the lower land farther west, resulting in the spectacular Dalles area and the falls at Taylors Falls.

The erosive power of the huge volume of water draining from Lake Duluth is conspecuous in the valley. Opposite the Snake River, the bluff on the west side of the valley is 3 miles from the present channel. The bluff describes a large arc between North Branch and Sunrise around an area of bottomland 6 miles wide. Below Sunrise, the valley narrows, but even here it is nearly a mile wide. In the area below Taylors Falls, the river has cut a deep trench through diabase rock forming the Dalles. Large "potholes" formed by whirlpools in the Dalles area during glacial time are one of the unique geologic features of the area. A deep channel, erroded to the Mississippi is now occupied by Lake St. Croix.

Lake St. Croix was formed by the damming of the Mississippi River by the delta of the Chippewa River and subsequent ponding of the Mississippi as far upstream as St. Paul. The decrease in flow from Glacial Lake Agassiz down the Minnesota and Mississippi permitted formation of the Chippewa delta.

Surficial Geologic Map
(after Leverett, 1932)

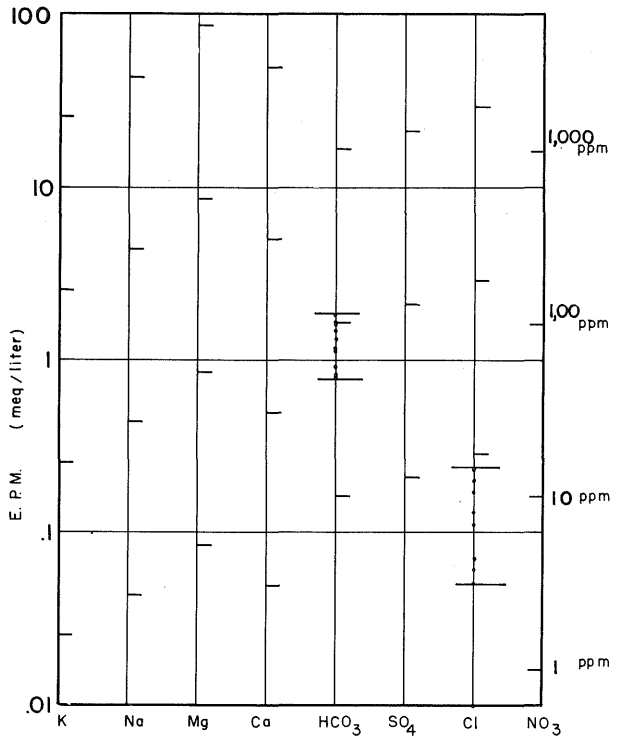


DURATION HYDROGRAPH FOR THE WATER YEARS OF 1943 - 1961

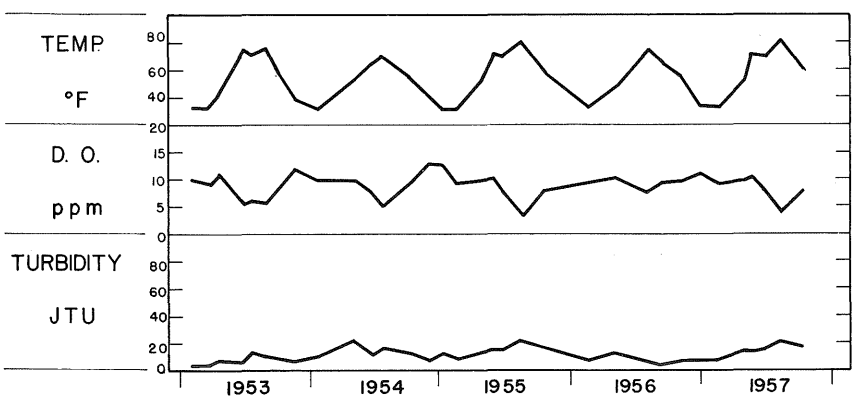
WATER QUALITY

ST. CROIX RIVER

RANGE OF CONCENTRATION OF MAJOR IONS IN 10 SAMPLES TAKEN AT STILLWATER



FACTORS OF HIGH CONCERN TO ECOLOGY



AT TAYLORS FALLS

NUTRIENT PHOSPHORUS, ppm			
HI	LO	AVG	SAMPLES
.48	.01	.19	13

AT DANBURY

1958-1959
1962-1963

NUTRIENT PHOSPHORUS, ppm			
HI	LO	AVG	SAMPLES
.30	.03	.15	11

AT STILLWATER

1958-1959
1962-1963

ST. LOUIS RIVER

Reconnaissance by canoe was made August 3, 4, and 5, 1966 between a point a few miles above the bridge crossing at Highway 53 and the town of Cloquet by U.S.G.S. observers. Navigability in the upper portion above the new dam at the Eveleth Taconite Company, (mile 118) is very good. It is 60 to 80 feet wide and generally 6 feet deep. Portage must be made at the dam. The portage is short over large boulders placed as part of the dam construction. From the dam to the confluence with the Swan River there are many boulder and gravel rapids and riffles, some of which were not navigable at this stage. Going is slow in many stretches. The river here is generally 80 to 100 feet wide and from less than a foot to four feet deep, (gage at Forbes read 6.18). Below the Swan River, the St. Louis changes from a meandering river to a peculiarly straight one, running almost due south to just east of Meadowlands. It is about 100 feet wide and up to 15 feet deep in some places. A few miles above Floodwood the river turns off its straight course, but does not strongly meander. More boulder rapids and riffle areas of difficult navigation are again encountered. Above Brookston, the river becomes wider, 300 feet or so, and generally navigable. At Brookston, the wide, placid, waters extending full view downstream gives the appearance that the rest of the downstream trip might be slow and dull. But one should not disembark here, for the best is yet to come. From the area near the confluence with the Cloquet River to two miles above the town of Cloquet, there are many sets of large, and sometimes long, boulder-rapids, attractive, navigable, and fairly fast even though the river is very wide. Some boulders in this area and the reach above Brookston are ten and twenty feet in diameter. Near Cloquet, the waters are again calm and deep, for here a pool is formed by the dam at Cloquet.

The banks in the area above the Eveleth Taconite Company dam are generally a few feet high, sandy, and clean, topped with very attractive conifer woods and many very attractive potential campsites. Below the dam, the woods vary from predominantly conifer to mixed hardwoods. The banks vary from low and sandy to high cuts of glacial till, to banded clay outcrops. In the lower reaches of the river, the banks at water level are made of a unique assortment of very well-rounded, remarkably well-sorted boulders washed from the glacial moraine through which the river flows. Some farmland is present in the Floodwood to Cloquet reach. Here forests are predominantly hardwood.

There are many interesting things that a traveler may observe on the St. Louis River. The variation in geology, from the moraine containing gigantic boulders, to the fine-banded outcrops of lake clay deposits, shows two types of glacial deposit. Portions of buried trees can be seen sticking out from banks in the mid-reaches under well-developed forests indicating the changes that have occurred in the channel over a very long period of time. Manmade islands of rock and logs constructed in to break up ice, still remain in the river above Cloquet. Some of the large boulders in the center of the river have attached to them, eye-bolts used in the logging days.

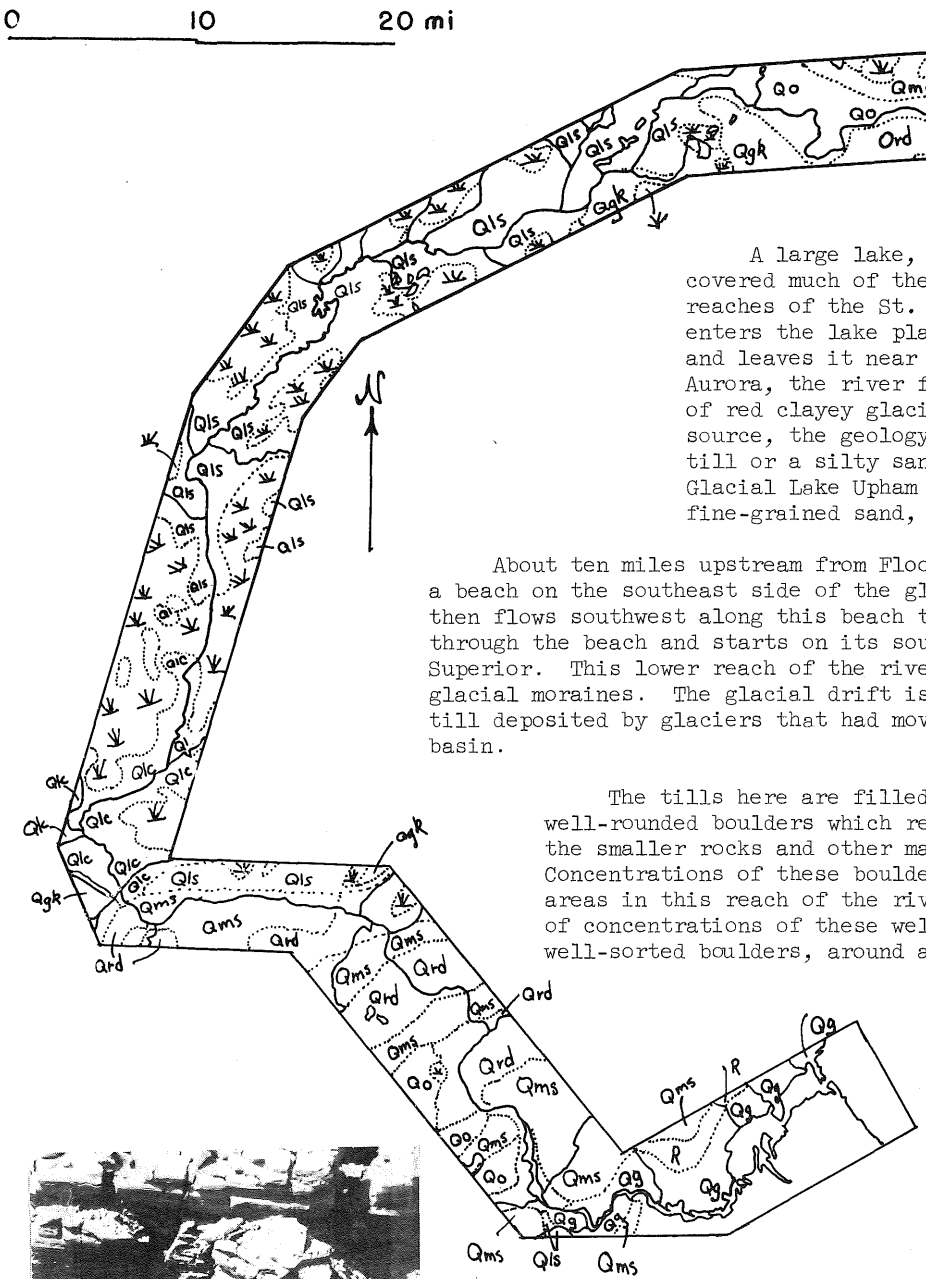
The water is amber color, characteristic of many of the northern Minnesota rivers. This is caused by complex organic acids that originate mostly in the upper reaches in the bog areas. Turbidity ranged from 27 to 32 and the temperature ranged from 72 degrees to 78 degrees during the observation trip. Some filamentous algae was observed growing in dense crops on the rocks in the upper reaches. The bottom varied from a clean, well-sorted sand to boulder gravel. Clams are abundant in some areas. Numerous ducks, but little other wildlife were observed.

There are many reasonably good access points along the whole length of the river, and many areas suitable for camping, so that a river traveler may select the reach that he would like to cover. The park at Cloquet provides an easy point from which to leave the river, having clean toilet facilities with free hot-water shower, camping grounds, and facilities to wash boats and cars. Plans are now underway for further expansion and improvement of this already high-quality municipal park.

The uppermost part of the reconnaissance trip, from Highway 53 to Forbes, and the last part from Brookston to Cloquet, were the most enjoyable reaches. There are reaches in between that will be navigable only at times of plentiful discharge, but most areas will not require portage, only wading for a short distance. The abundance of gravel and boulders in the streambed can prove damaging to canoes even with careful handling because of the randomness and density with which they often occur. Half the river, as a whole though, is attractive and worth further considerations and study as a recreational river. The very pleasant trip down either of the two reaches mentioned, could be made in one day without need to camp along shore overnight.

GEOLOGY

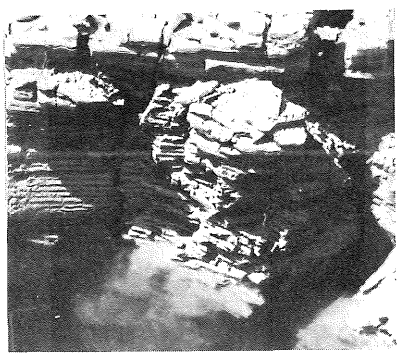
ST. LOUIS RIVER



A large lake, Glacial Lake Upham, once covered much of the area through which the upper reaches of the St. Louis River flow. The river enters the lake plain several miles south of Aurora and leaves it near Floodwood. Upstream from Aurora, the river flows through five to ten miles of red clayey glacial till and from there to its source, the geology is mostly a cobbly, bouldery till or a silty sand and gravel. Through the Glacial Lake Upham plain the river flows through fine-grained sand, silt, or clay deposits.

About ten miles upstream from Floodwood, the St. Louis encounters a beach on the southeast side of the glacial lake plain. The river then flows southwest along this beach to Floodwood where it cuts through the beach and starts on its southeastward course to Lake Superior. This lower reach of the river cuts through an area of glacial moraines. The glacial drift is largely sandy or silty red till deposited by glaciers that had moved out of the Lake Superior basin.

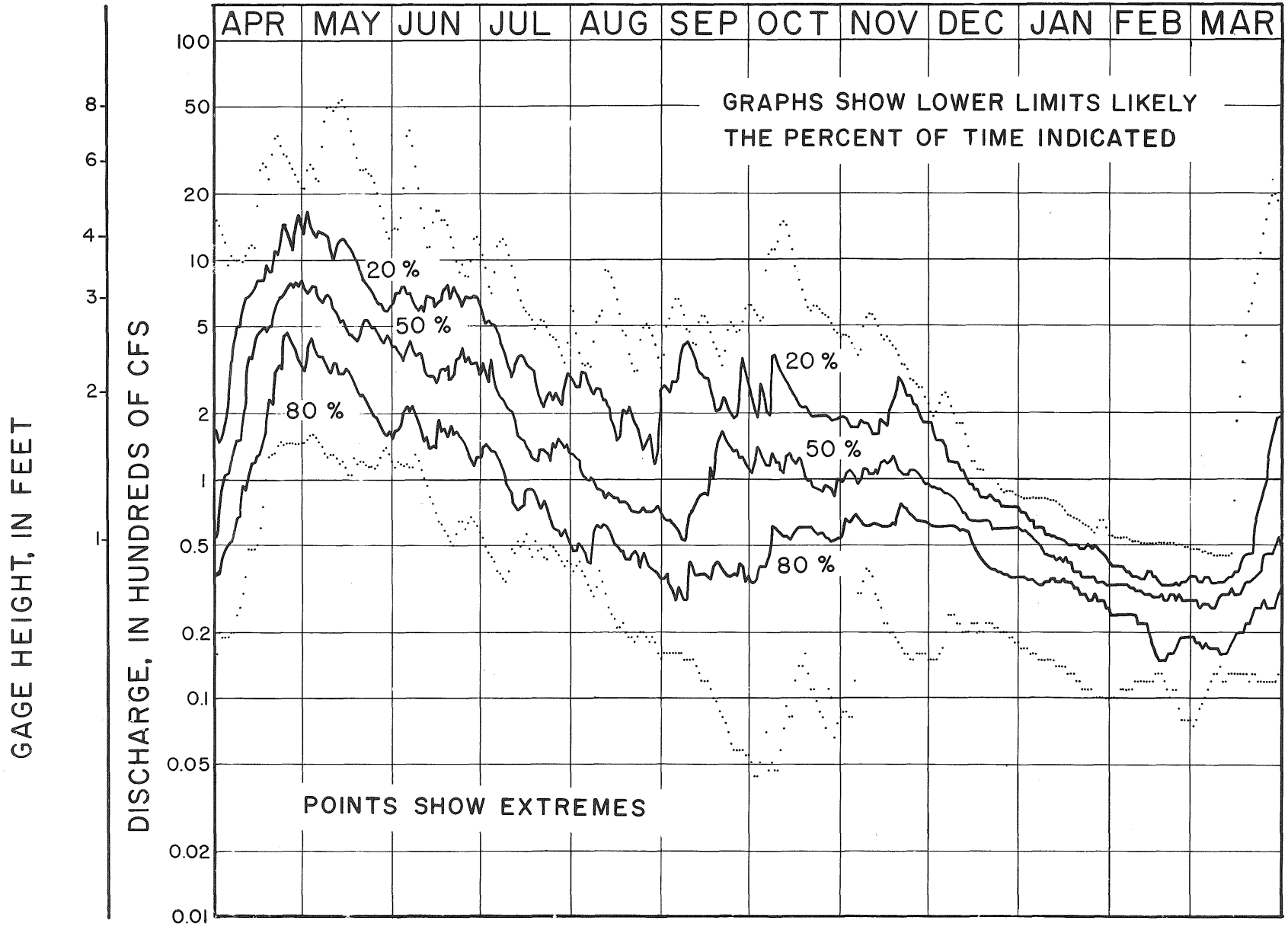
The tills here are filled with an abundance of large well-rounded boulders which remain in the river bed after the smaller rocks and other material have been washed out. Concentrations of these boulders form many rapids and riffle areas in this reach of the river. The banks are often made of concentrations of these well-rounded and exceptionally well-sorted boulders, around a foot or two in diameter.



Surficial Geologic Map
(after Leverett, 1932)

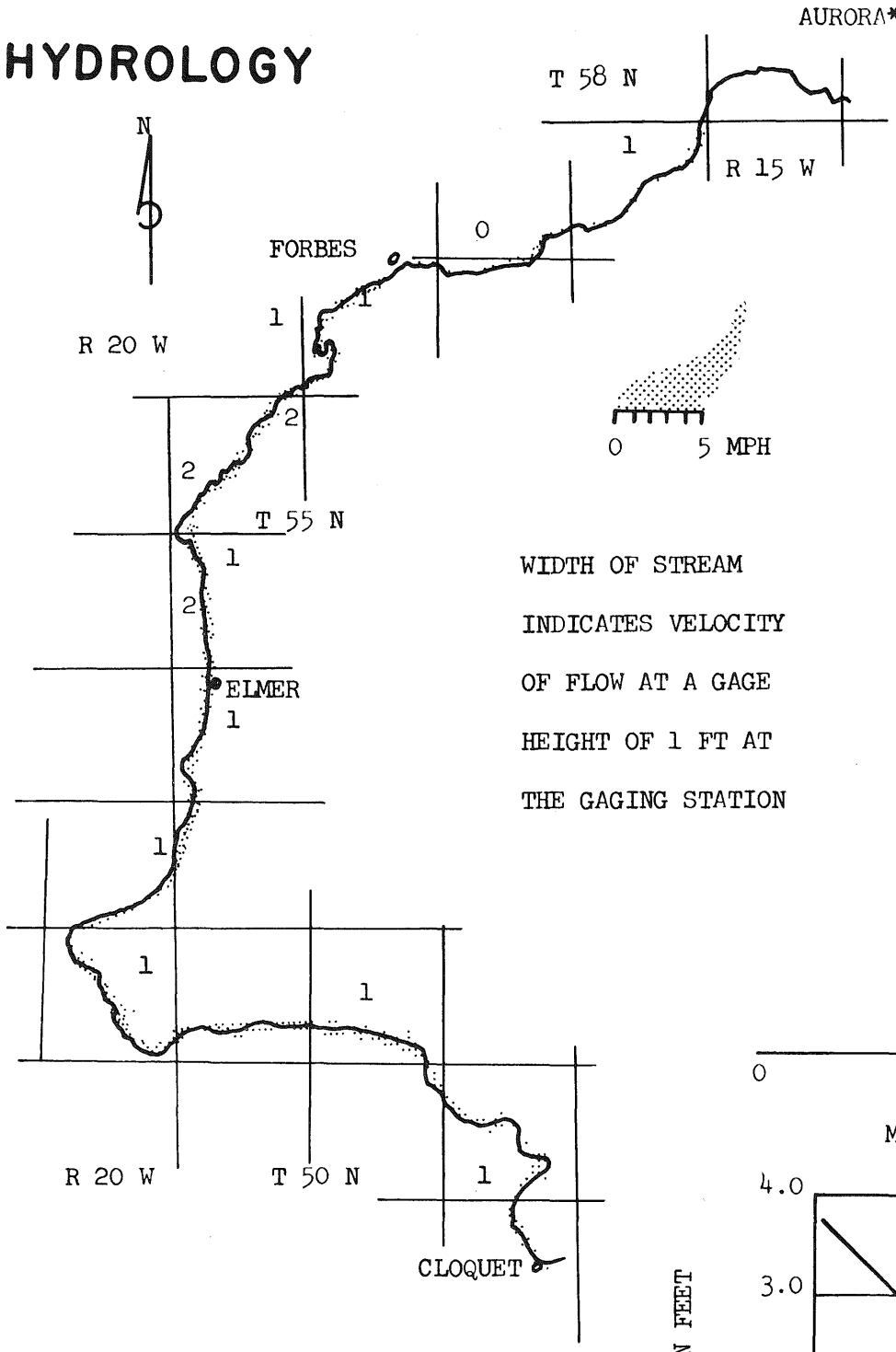
Downstream from the Highway 2 crossing, the stream has a considerable number of rapids caused by boulders from the glacial till or from the bedrock which is quite near the surface. The further downstream the river goes, the more bedrock is encountered until the Jay Cooke State Park the river cascades down an almost continuous series of rapids caused by the outcropping of the Thompson slate.

ST. LOUIS RIVER NEAR AURORA



DURATION HYDROGRAPH FOR THE WATER YEARS OF 1943-1961

HYDROLOGY



ST. LOUIS RIVER

DRAINAGE AREA ABOVE GAGE 312 sq mi.

NUMBERS INDICATE FOR NORMAL FLOW THE MINIMUM GAGE HEIGHT AT WHICH THE REACH OF RIVER IS GENERALLY NAVIGABLE BY CANOE

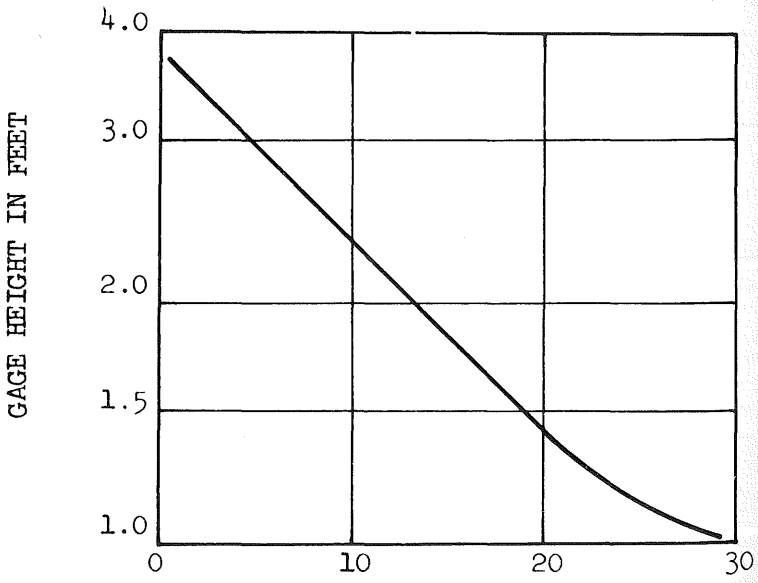
WIDTH OF STREAM INDICATES VELOCITY OF FLOW AT A GAGE HEIGHT OF 1 FT AT THE GAGING STATION

FLOW REGULATED AT TIMES BY PARTRIDGE AND WHITEFACE RESERVOIRS AND BOULDER ISLAND, RICE AND FISH LAKES

*** GAGING STATION LOCATION**

0 10 20 mi

MAP SCALE

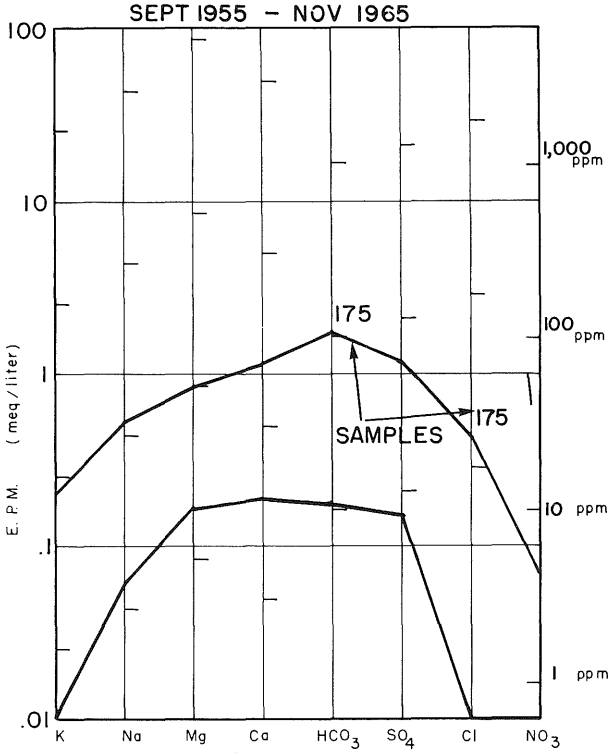


RECESSION CURVE INDICATES AT THE GAGING STATION THE NORMAL DECLINE IN GAGE HEIGHT FOLLOWING A PERIOD OF RAIN

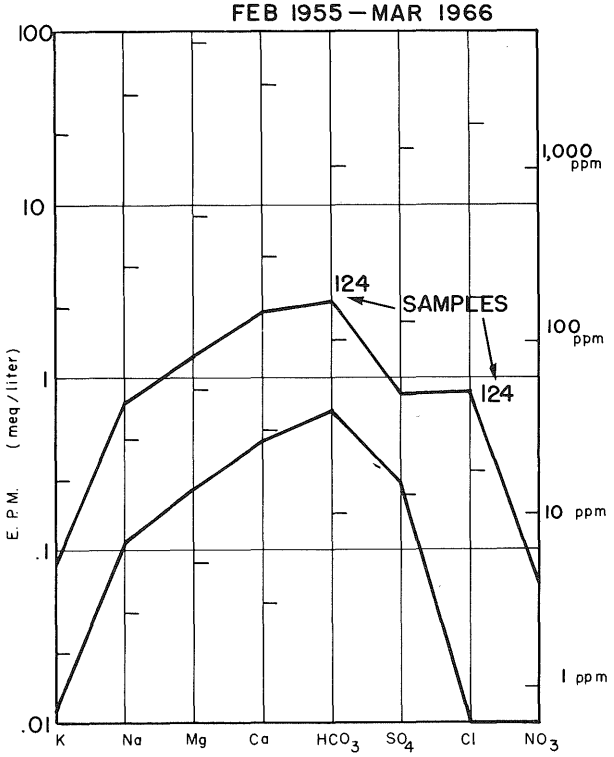
WATER QUALITY

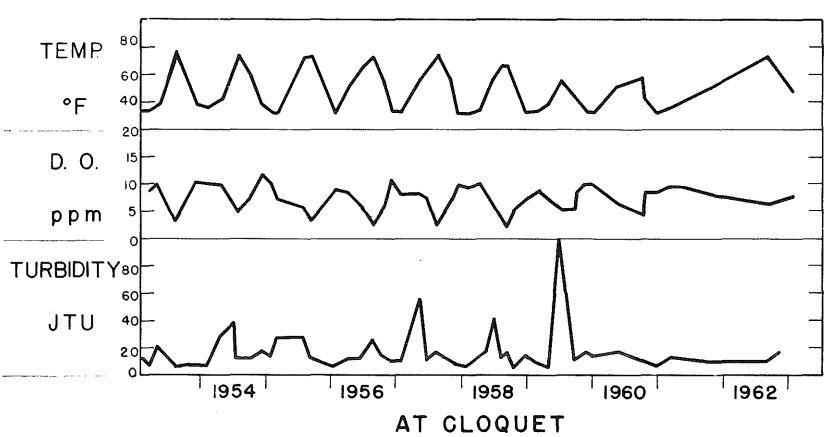
ST. LOUIS RIVER

RANGE OF CONCENTRATION OF MAJOR IONS IN 140 SAMPLES TAKEN AT AURORA
SEPT 1955 – NOV 1965



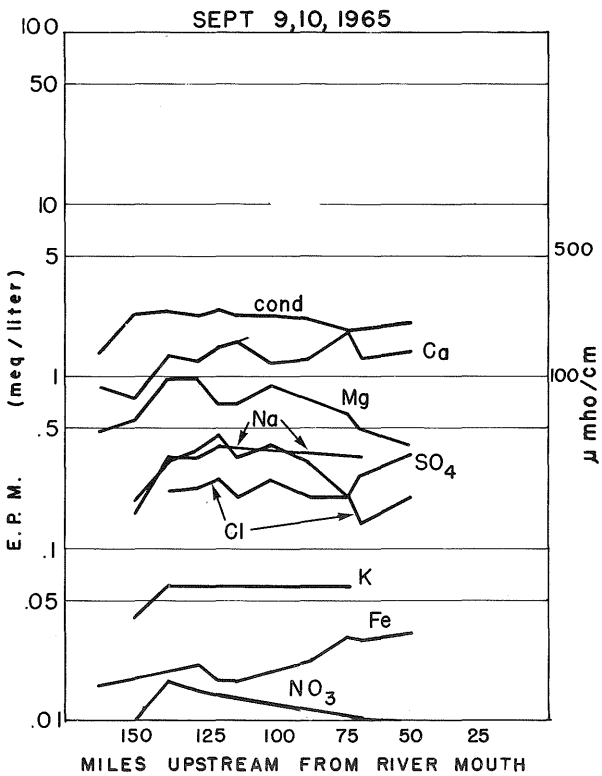
RANGE OF CONCENTRATION OF MAJOR IONS IN 106 SAMPLES TAKEN AT SCANLON
FEB 1955 – MAR 1966





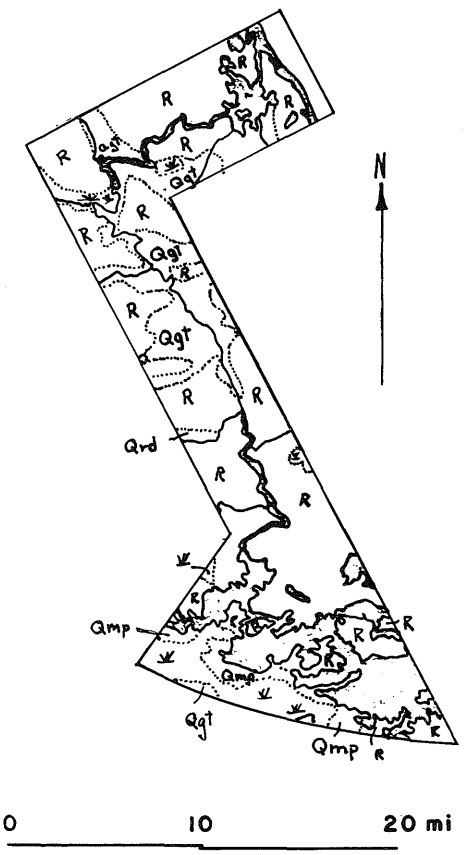
NUTRIENT			
PHOSPHORUS, ppm			
HI	LO	AVG	SAMPLES
.40	.12	.23	10
AT CLOQUET			
1958-1959 1962-1963			

DOWNSTREAM VARIATION IN QUALITY
SEPT 9,10, 1965



GEOLOGY

VERMILION RIVER



Surficial Geologic Map
(after Leverett, 1932)

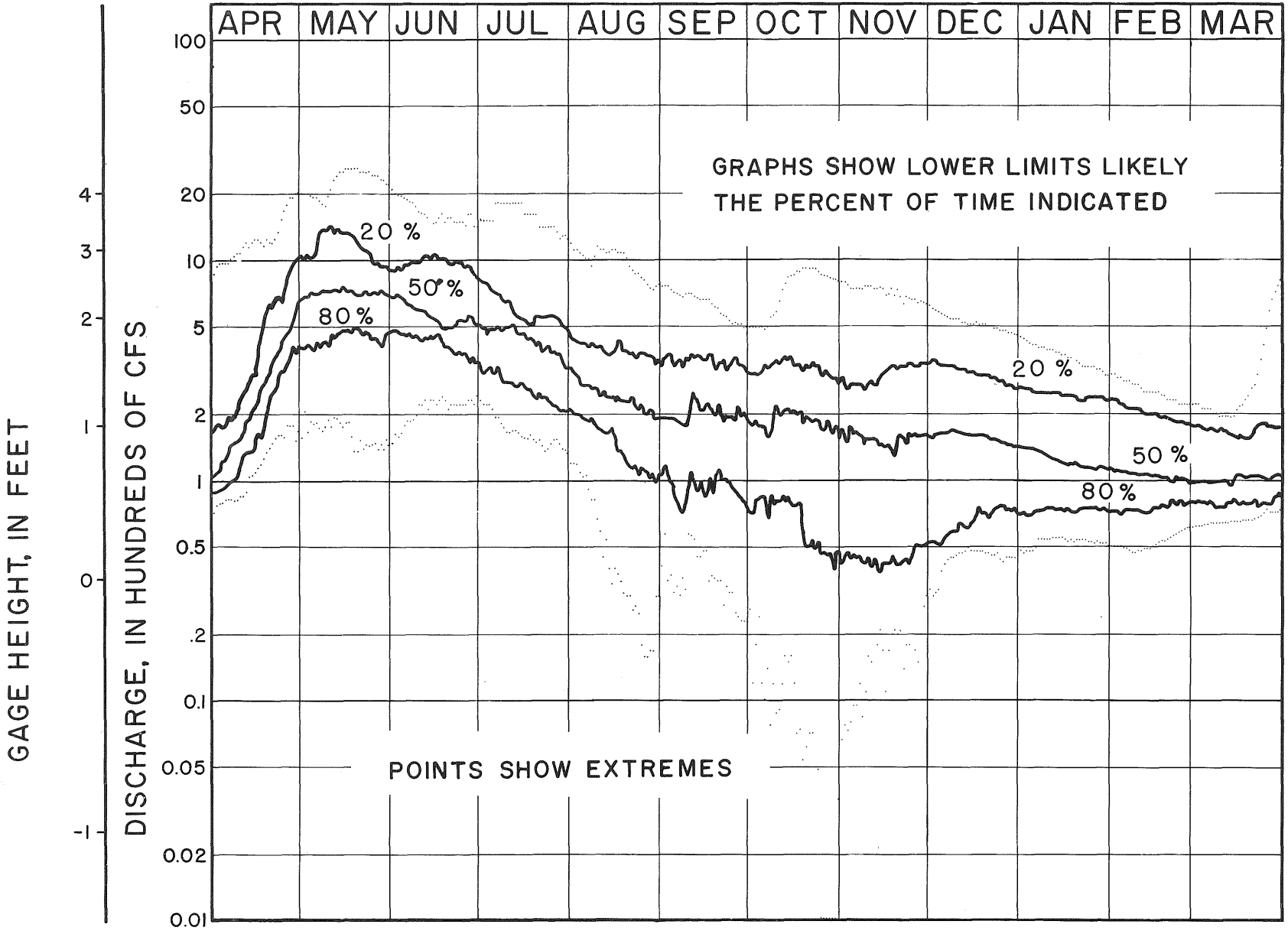
The entire basin of the Vermilion River is underlain by rocks of Precambrian Age. Except for the middle reach, the Vermilion River flows directly on this bedrock in a series of falls and steep rapids. Most of the rock is granite, but the upper five miles below the dam where it leaves Lake Vermilion consists of a series of mica schist.

The middle section flows on till, washed and re-worked by waters of Glacial Lake Agassiz. The till was deposited by Des Moines Lobe ice. In this area it is neither thick nor extensive.

At the outlet of Vermilion Lake, the river drops rapidly through rather soft mica schist although this is not well exposed and the bed is mostly large boulders. Downstream there are a series of major falls and rapids. At mile 31 there is a fall of about 80 feet, another two miles downstream of 15 feet, and about two miles further a fall of six feet. Except at the falls, the banks through this reach are lake washed till. Further downstream about five miles is another fall. The river here turns east and drops some 75 feet through three major falls and rapids from mile 4 before reaching Crane Lake.

The exposures of rock are picturesque as are the numerous falls and rapids. From the geologic standpoint, the river is outstanding, however, the numerous falls and rapids would make posting of warning signs along the river mandatory for average use. Because many of the reaches must be portaged, some minor opening of portage trails would be of possible value.

VERMILION RIVER BELOW VERMILION LAKE NEAR TOWER



DURATION HYDROGRAPH FOR THE WATER YEARS OF 1943-1961

WILLOW RIVER

Reconnaissance was made from Haypoint on Hwy. 169 to a few miles above the mouth on July 6 and 7 by the U.S.G.S. observers.

The gradient is gentle and even the width from 20 to 85 feet, and the depth from 2 to 6 feet, with no falls and only two riffles. From the standpoint of channel depth the stream is easily navigable, but heavy tree fall and debris jams in the upper reaches make it impassable for boats or canoes. In the lower reaches, the tree fall is also heavy but due to the greater channel width one can usually find a way to push through.

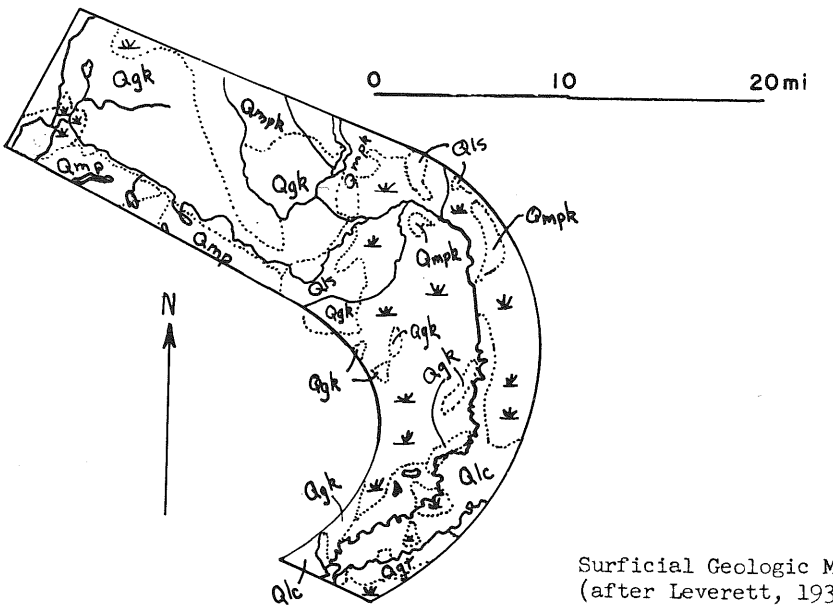
The banks in the upper, narrow (25 foot), straight, dredged portions of the streams are about 15 feet high and forested atop predominantly with birch, poplar and jackpine. Downstream to mile 12 or 13 the banks are wet, low, heavy with underbrush or grass, and forested mainly with maple and some oak and other hardwoods. It is generally very poor for camping. Below mile 12 the banks become higher, dryer, and sandy in some places, with occasional areas of birch and spruce. The forest here is mainly maple, elm and oak trees. Barely is the namesake, willow, seen through it is quite common on most of Minnesota's rivers.

The water is warm (73^{o}) and varies from an amber color with turbidity of 25 JTU to a pale chocolate brown with a turbidity of 40 JTU. The color is in part due to the organic acids that are common in areas of bog lands such as this. The bottom is generally clean sand to gravel. Filamentous algae grow on the tree fall and debris jams but are sparce elsewhere.

Wildlife was noticeably sparce although two heron and a few ducks were observed. Most of the crossing roads are abandoned and the bridges collapsed. Farming population in the area is declining. Because of this and the general lack of navigability, the river receives very little use. This has the advantage of making it a very good fishing stream according to local residents. Even with extensive clearing the river would remain low in value as a recreational resources to other than the local residents.

GEOLOGY

WILLOW RIVER



Surficial Geologic Map
(after Leverett, 1932)

The Willow River flows nearly its entire length on lake plain deposits of Glacial Lake Aitkin, although there are few places where the deposits are well exposed. Mostly the banks are densely covered with vegetation. The natural channel meanders intensively on the flat surface, much of which is swamp away from the river banks. The Willow has, through periods of flooding, deposited material adjacent to the channel so that one has the impression of traveling through high land. This is illusionary however because these deposits are "natural levees" deposited where the velocity of the river is slowed by vegetation, and they extend only a few tens of feet from the river.

The only reach in which the geology is distinctive is two small areas of ground moraine having beach ridges of Glacial Lake Aitkin around them. These are in T. 50 N., R. 25 W., the larger of the two being in the reach where the Willow first trends west from its south flowing reach.

Except for this area of ground moraine the remainder of the bank exposures are dominantly clay, silt, and fine sand.

The combination of low uniform gradient, extensive meandering, uniform bank material, and natural levees make the river relatively monotonous for canoeing and poor for camping. However it is also deep and has low, uniform velocity. The water is relatively clear because of the low velocity and heavy cover of vegetation on the banks.