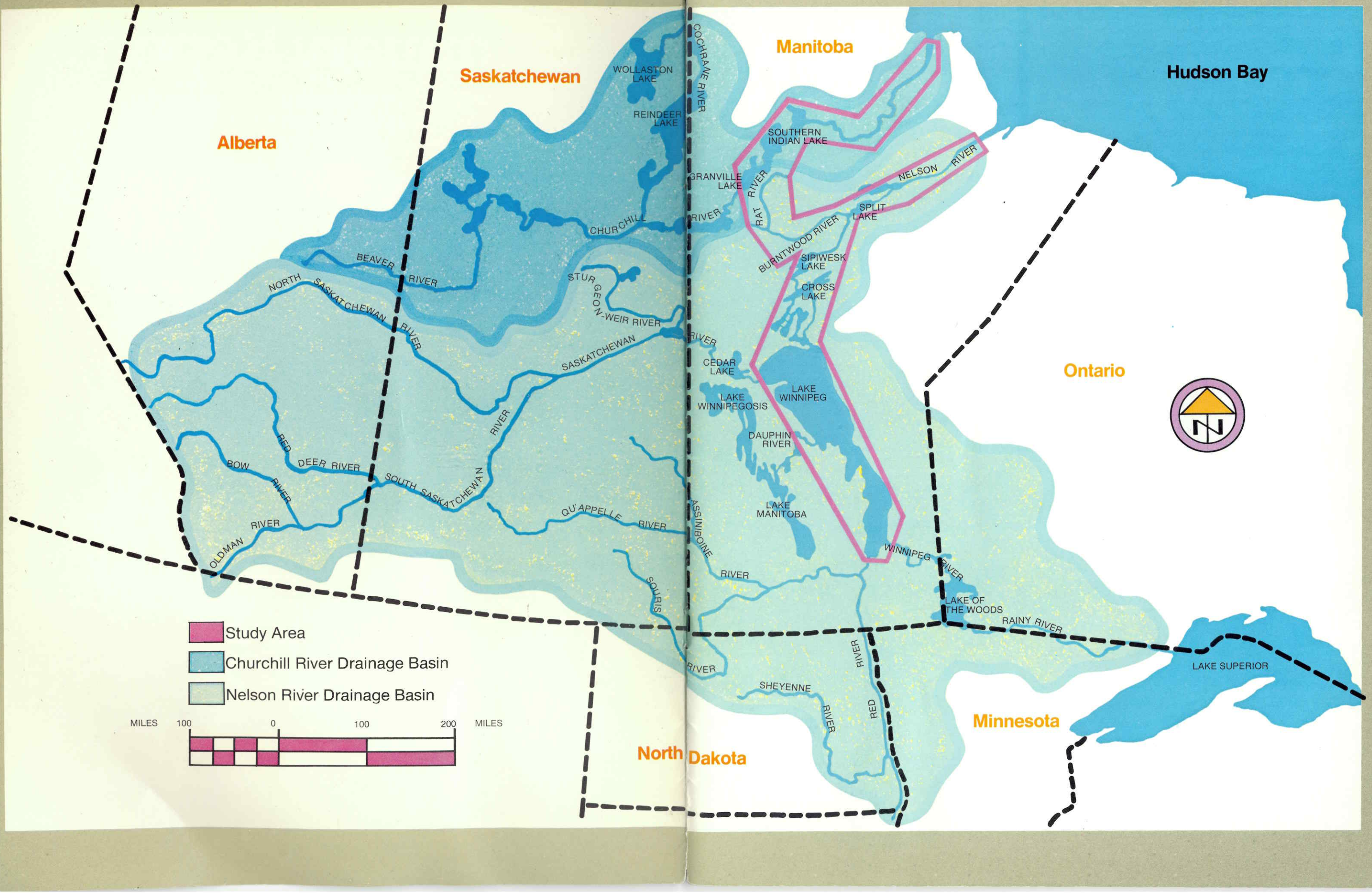
Summary Report

Lake Winnipeg, Churchill and Nelson Rivers Study Board
Canada, Manitoba / April, 1975


Alberta
Saskatchewan
Manitoba
Hudson Bay
Ontario
Minnesota
North Dakota
WOLLASTON LAKE
REINDEER LAKE
COCHRANE RIVER
CHURCHILL RIVER
BEAVER RIVER
NORTH SASKATCHEWAN RIVER
STURGEON-WEIR RIVER
SASKATCHEWAN RIVER
SOUTH SASKATCHEWAN RIVER
QU'APPELLE RIVER
BOW RIVER
OLDMAN RIVER
RED DEER RIVER
SOUTHERN INDIAN LAKE
GRANVILLE LAKE
RAT RIVER
NELSON RIVER
SPLIT LAKE
BURNTWOOD RIVER
SIPIWESK LAKE
CROSS LAKE
CEDAR LAKE
LAKE WINNIPEGOSIS
LAKE WINNIPEG
DAUPHIN RIVER
LAKE MANITOBA
ASSINIBOINE RIVER
WINNIPEG RIVER
LAKE OF THE WOODS
RAINY RIVER
LAKE SUPERIOR
SHEYENNE RIVER
RED RIVER
SOURIS RIVER
Study Area
Churchill River Drainage Basin
Nelson River Drainage Basin
MILES 100 0 100 200 MILES

Manasan Falls (Manitoba Government).

Introduction

The people and industries of Manitoba as in all areas of North America are demanding more and more electrical energy every year. The demand in Manitoba has more than doubled in the last decade (Figure 1) and there is reason to believe that it will double again in the next 10 years.

In parallel with the accelerating demand for electrical energy, there is an ever increasing awareness of the need to preserve Manitoba's natural environment and to allocate its natural resources with a view to benefiting Manitobans now and in the future.

Satisfying the demands of Manitobans for electrical energy and for environmental quality requires advance planning and compromise.

The Government of Manitoba decided in 1966 to proceed with developments to harness the potential energy of the Nelson River and to add to that potential by diverting a major part of the Churchill River flow into the Nelson River. The hydroelectric development program included a generating station at Kettle Rapids, a high voltage transmission line from the Nelson River to Winnipeg, regulation of the outflow from Lake Winnipeg and diversion of substantial flow from the Churchill River into the Nelson River.

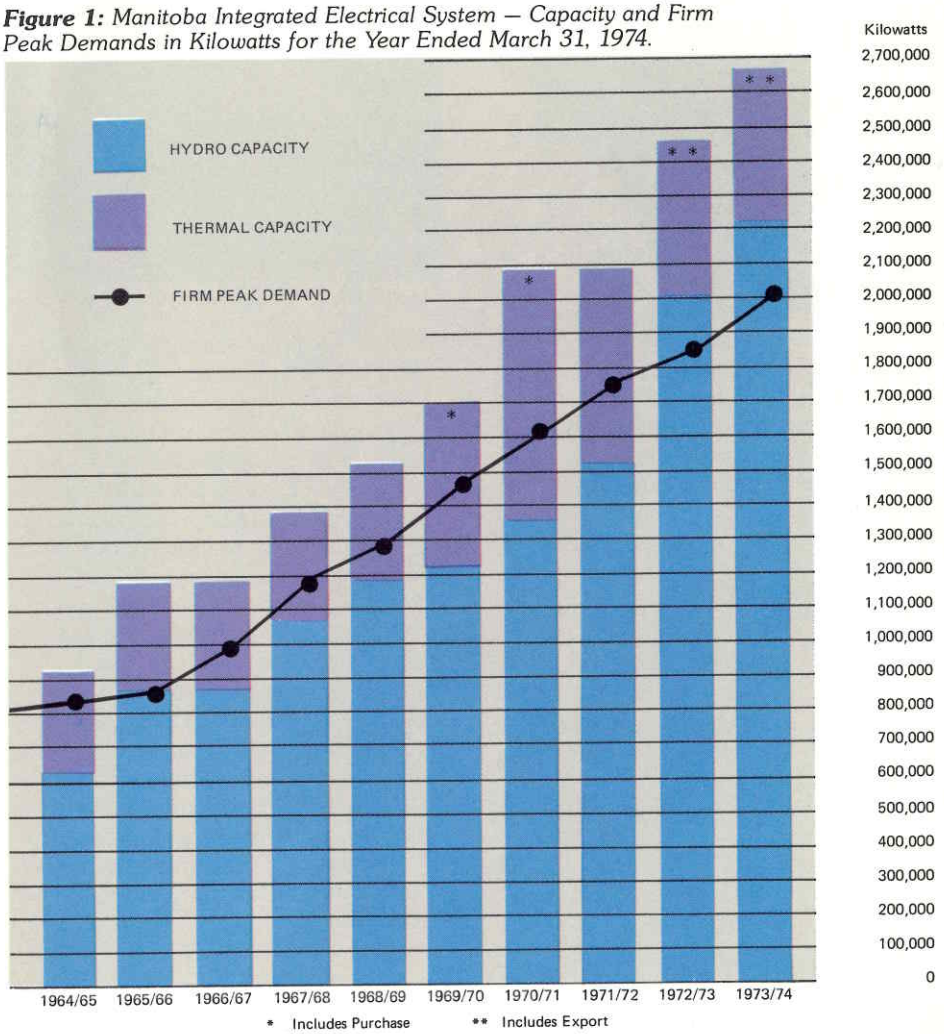
The Kettle generating station and the transmission line have been completed. The Lake Winnipeg regulation and Churchill River diversion projects are under construction.

The governments of Canada and Manitoba, recognizing the overall interest and conflict over the use of the water and related resources, initiated the Lake Winnipeg, Churchill and Nelson Rivers study. The study was intended to determine the effects which the regulation and diversion projects are likely to have on other water and related resource uses, to indicate ways in which the projects may prove beneficial to such other uses, to recommend modifications in the design and operation of the works, and to recommend remedial measures where considered necessary to lessen undesirable effects.

The study took over three years to complete at a cost of $2,000,000. It involved many experts from federal and provincial agencies, universities and consulting firms representing a variety of disciplines.

The salient aspects of the study, including the social, economic and environmental conditions in regions affected by the regulation and diversion projects, are summarized in this report along with the anticipated implications to the people and the environment. Opportunities for increasing overall benefits and lessening harmful effects are also outlined. Further details of the study are to be published separately in the Technical Report.

Figure 1: *Manitoba Integrated Electrical System — Capacity and Firm Peak Demands in Kilowatts for the Year Ended March 31, 1974.*



Kettle Dam, Nelson River (Study Board).

Canada Geese (Manitoba Government).

The study was authorized under a joint Canada-Manitoba agreement entered into on August 24, 1971. A six-member federal-provincial board, established under the agreement, directed the study. A study office was set up in Winnipeg and a four-member technical advisory committee was appointed. The complete study agreement and the study organizational chart are included at the end of this report. The study agreement established the objective, terms of reference and administrative framework for the conduct of the study. Funding for the study was shared equally between Manitoba and Canada. The Board was required to report to the Minister of Environment Canada, to the Minister of the Manitoba Department of Mines, Resources and Environmental Management, and to Manitoba Hydro.

The objective for the Lake Winnipeg, Churchill and Nelson Rivers study was defined in the agreement as follows:

> *... to determine the effects that regulation of Lake Winnipeg, diversion from the Churchill River and development of hydro-electric potential of the Churchill River diversion route are likely to have on other water and related resource uses and to make recommendations for enhancing the overall benefits with due consideration for the protection of the environment.*

The agreement outlined the general terms of reference.

> *The study of probable effects of Manitoba Hydro's projects must be sufficiently broad so as to include all important effects on the water regime and on related resource uses and it must be adapted to provide reliable data on present natural conditions and the anticipated and actual conditions arising from the operation of the controls and diversion as designed and constructed. Recommendations will be made consistent with the stated objective of the study. Canada and Manitoba agree to give priority to those studies which may lead to recommendations for modifications or additions to the works, or operation of the works, that may be under construction, approved or proposed. Although there will be no imposed change in regime for at least the next three years, early attention will also be directed to studies which will establish and measure the parameters that define the state of nature conditions for the lakes and rivers involved.*

The Study Program

The agreement stipulated that the study of the probable effects of Manitoba Hydro's projects be sufficiently broad so as to include all important effects on the water regime and on the related resource uses. Consequently, the program had to consist of studies to determine (a) the effects on the water regime, (b) the effects on the uses of water and related resources, and (c) the social implications.

At the outset of the study, the Board recognized the need to formulate a study plan. To this end, the Board held a seminar in which senior federal and provincial employees, university faculty members, and private consultants participated. A study plan was developed from the advice and information obtained at that seminar.

The Board realized that the study would be undertaken concurrently with construction of the Manitoba Hydro projects and that certain studies would of necessity have priority. The Board examined the priority issues and weighed the expected value of the results from each component of the study against the cost and timing to obtain those results. These considerations resulted in a study program which concentrated, in the first year, on studies in the areas affected by the Lake Winnipeg regulation project. The construction of Lake Winnipeg regulation works was one year further advanced than the works associated with the Churchill River diversion project. Studies that might result in design modifications to the Manitoba Hydro works were also given priority.

The Manitoba Department of Mines, Resources and Environmental Management recognized the need to initiate certain component studies prior to the signing of the agreement. These component studies were undertaken during the 1971 summer field season and included the mapping of the shoreline of the south basin of Lake Winnipeg, the Lake Winnipeg shoreline erosion and sand movement study, the Lake Winnipeg recreational demand study, and the archaeological study along the Churchill River diversion route. These pre-agreement studies were incorporated into the study program.

For study purposes, the Board divided the area to be studied into six geographic regions. These regions are delineated on Figure 2 and are designated as Lake Winnipeg, Outlet Lakes, Southern Indian Lake, Diversion Route, Lower Churchill River and Lower Nelson River.

The program was divided into a number of components which are listed in Table 1. This table also includes a listing of the component studies by areas of investigation, study period, contract agency and approximate cost. The majority of the studies were initiated in the spring of 1972 and completed in the ensuing two years. The results and findings of these studies are the basis for this summary report and the Technical Report.

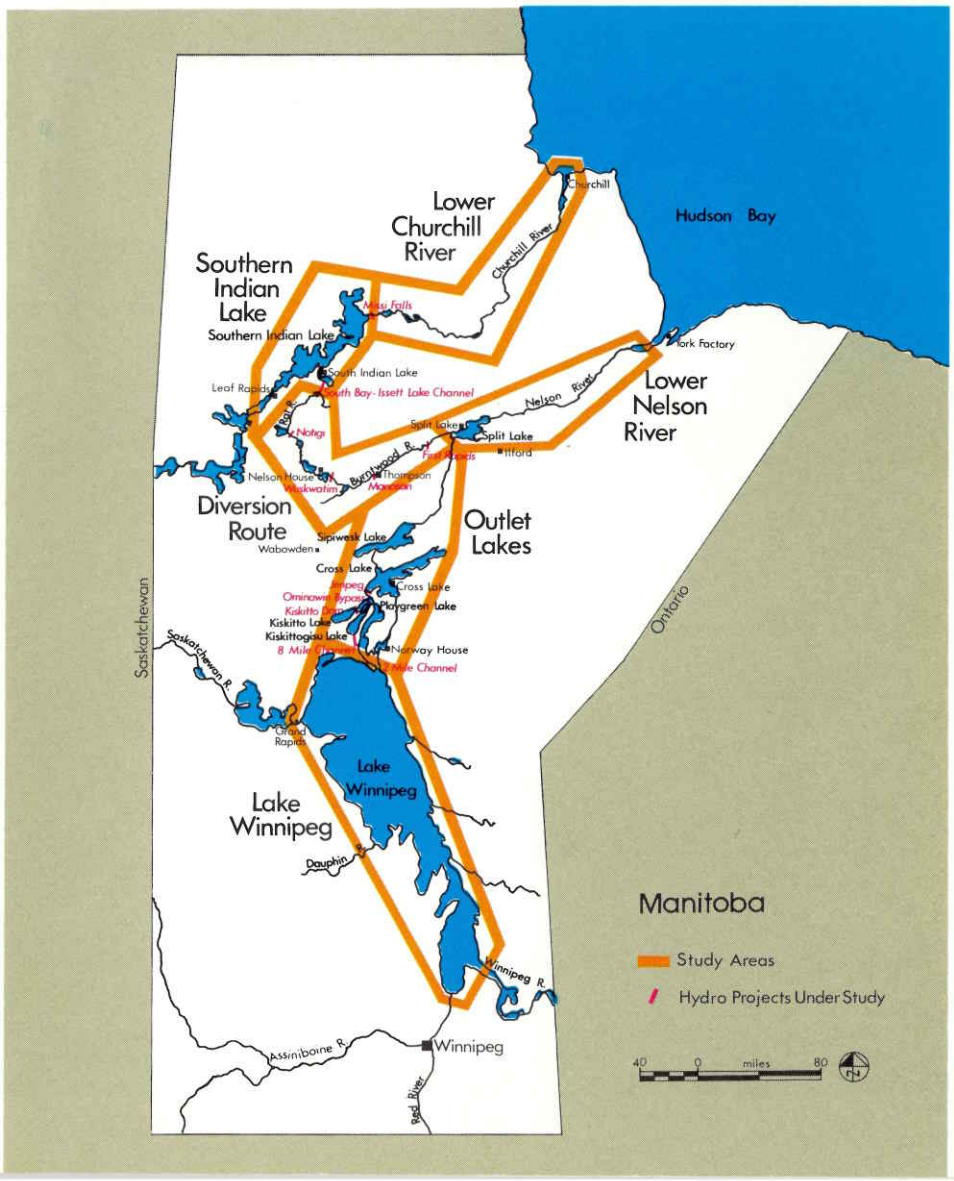


Figure 2: *Study Areas*

TABLE 1.

Lake Winnipeg, Churchill and Nelson Rivers Study

STUDY COMPONENTS, AREAS OF INVESTIGATION, STUDY PERIODS, CONTRACT AGENCIES AND COSTS

STUDY COMPONENT	INVESTIGATION AREA	1971	1972	1973	1974	1975	AGENCIES	COSTS
MAPPING	Lake Winnipeg (South Basin)						Manitoba Surveys, Mapping & Lands Br.	$ 38,900
	Diversion Route (Notigi Lake to Manasan Falls)							161,900
WATER QUALITY Monitoring Program	Study Area						Manitoba Environmental Protection Branch (Co-ordinating Agency)	1,800
HYDROLOGIC, HYDRAULIC & GEOMORPHOLOGIC STUDIES 1. Physical Impact Study	Outlet Lakes, Southern Indian Lake Diversion Route, Lower Churchill River, Lower Nelson River						Manitoba Water Resources Br.	117,500
2. Channel Studies	Two-Mile Channel Impact Study, Eight-Mile Channel Impact Study, Eight-Mile Channel Review, South Bay to Issett Lake Channel							15,900
3. Bank Stability Studies	Burntwood River (Thompson), South Indian Lake Settlement, Nelson House Settlement, Cross Lake Settlement							16,100
4. Shoreline Erosion & Sand Movement Study	Lake Winnipeg (South Basin)							95,000
5. Real Property Assessment	Outlet Lakes, Southern Indian Lake & Diversion Route, Lake Winnipeg Dyking System							14,600
6. Community Water Supply	Cross Lake, Norway House Churchill and Thompson, Nelson House, South Indian Lake, Leaf Rapids						Man. Environmental Protection Br.	3,000
7. Water Level & Flow Data Interpretation	Study Area						Manitoba Water Resources Br.	28,000
8. E. Channel Hydraulic Study	Nelson River (East Channel)							5,100
9. Ice Studies	Lower Churchill River						La Salle Hydraulic Lab. Ltd.	12,100
SOILS, LAND-USE	Outlet Lakes, Diversion Route & Southern Indian Lake						U. of Manitoba Man. Soil Survey	40,600
FISHERIES-LIMNOLOGY	Outlet Lakes, Southern Indian Lake, Nelson River (East Channel), Churchill River, Lake Winnipeg & Diversion Route						Environment Canada, Freshwater Institute	300,300
WILDLIFE	Outlet Lakes, Southern Indian Lake, Diversion Route, Lake Winnipeg & Lower Churchill River						F. F. Slaney & Co. Ltd.	155,000
GEOLOGY	Kiskittogisu Lake, Ospwagan Lake						Manitoba Mines Br.	51,200
RECREATION	Lake Winnipeg (South Basin), Outlet Lakes, Diversion Route, Southern Indian Lake, Lower Churchill River						Manitoba Dept. of Tourism, Recreation & Cultural Affairs	71,100
FORESTRY Timber Inventory	Outlet Lakes, Southern Indian Lake, Rat River, Burntwood River						Manitoba M.R.&E.M. Forest Inventory Section	19,200
Growth Study	Cedar Lake & Sipiwesk Lake						Research Branch	2,400
Timber Clearing	Study Area (General), Outlet Lakes, Diversion Route, Southern Indian Lake						F. F. Slaney & Co. Ltd. & Study Office	7,500
ARCHAEOLOGY	Diversion Route, Outlet Lakes						U. of Wpg. Archaeological Research Centre	93,000
NAVIGATION – TRANSPORTATION	Outlet Lakes, General Study Area, Southern Indian Lake & Diversion Route						U. of Manitoba Administrative Studies	32,100
SOCIAL and ECONOMIC STUDIES							Acres Consulting Services Ltd.	42,600
Program Development Preliminary Studies	Study Area						Harry Hill Consulting Ltd.	8,200
Impact Study							Manitoba M.R.&E.M. Social and Economic Study Group	121,400
OFFICE ADMINISTRATION								346,700
Study Office							Study Office	108,800
Field Coordination								90,000
Final Reports								
								$2,000,000

Special Issues and Concerns

The agreement required that recommendations be submitted to the Ministers and to Manitoba Hydro whenever studies revealed information relevant to the design or construction of the works associated with the Manitoba Hydro projects. Priority issues were investigated and, where considered necessary by the Board, recommendations were submitted. From time to time, the Board was alerted to concerns which because of time and funding constraints could not be fully investigated. These concerns were made known to the Ministers and to Manitoba Hydro. The majority of the special issues and concerns were reported in the annual progress reports which are available in the Provincial Library, Legislative Building, Winnipeg. Special issues were reported on separately.

Timber Clearing—Guidelines were developed for timber clearing in the areas to be flooded as a result of the Manitoba Hydro projects. A report, entitled "General Guidelines — Timber Clearing," was forwarded to the Ministers and to Manitoba Hydro. In addition, site specific pre-flood clearing recommendations for the Outlet Lakes, Southern Indian Lake and the Churchill River diversion route were provided to the Manitoba Department of Mines, Resources and Environmental Management.

Kiskitto Lake Regulation—An assessment of the impact of Kiskitto Lake regulation was completed in July 1973. Kiskitto Lake regulation is an integral part of the Lake Winnipeg regulation project. The assessment resulted in modifications to the Kiskitto Lake regulation structure which will permit flexibility in lake level control enabling the lake to be managed to the benefit of fish, wildlife and recreation resources. A report on this issue, entitled, "Impact Analysis of Kiskitto Lake Regulation," was forwarded to the Ministers and to Manitoba Hydro in October 1973.

Clearing Piles, Jenpeg (R. J. Lay).

Kiskitto Dam, Construction (R. J. Lay).

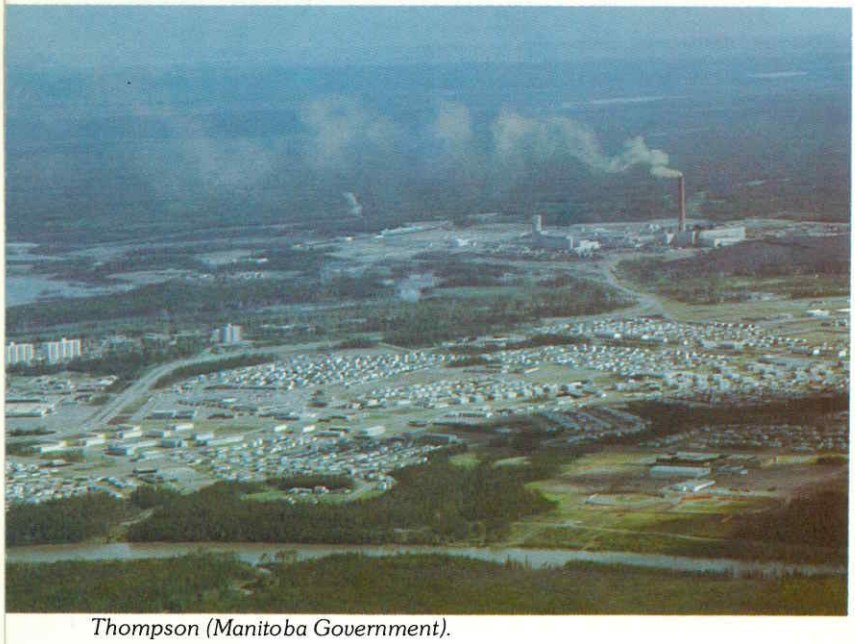
Water Sampling (J. Sigurdson).

Long-Term Ecological Monitoring—The Board, early in the study, identified the requirement to collect "baseline" ecological data and to carry out the long-term monitoring program necessary to identify future effects of the projects. The report, entitled, "Long Term Ecological Monitoring of the Lake Winnipeg, Churchill, Nelson Rivers Impact Areas," was submitted to the Ministers and to Manitoba Hydro in January 1974.

Churchill River Estuary—During the course of the study, the Board became aware of special problems that could arise in the Churchill River estuary as a result of the Churchill River diversion project. Problems associated with the water supply for the townsite of Churchill, wildlife in the area, navigation, and recreation were identified. These problems were brought to the attention of the Ministers and Manitoba Hydro in a letter report in April 1974.

South Indian Lake (Study Board).

Nelson House (Study Board).



Thompson (Manitoba Government).

Cross Lake (Study Board).

Northern Communities

One important contribution of the Lake Winnipeg, Churchill and Nelson Rivers study is that it has served to focus attention on a large section of Manitoba's northland and its residents and environment. Relative to southern Manitoba, the north is underdeveloped and sparsely populated except for recognized centres such as Thompson, Leaf Rapids and Churchill.

Two distinct types of communities exist in northern Manitoba. One type, such as Thompson, originally developed rapidly around a single resource industry. The other type, the native community, evolved from the traditional pursuits of hunting, trapping and fishing, and developed over several generations.

The industrial communities are largely dependent upon a single industry managed by one predominant organization. They are basically site specific in their resource use, but place demands for recreational and other services on resources which support native communities. The residents of these industrial, urban centres are highly skilled, articulate, and organized to influence governments in the development of their communities.

The residents of native communities are dependent on extensive use of land and water resources for their livelihood. The people settled in their particular locations because of land allocations, abundant fish and game resources (historically if not currently) or for the conveniences offered through early establishment of trading posts. They are less highly skilled than urban residents in the conventional sense of employable skills. Furthermore, the communities in which they live usually lack access facilities. The native community residents, however, are beginning to organize in order to communicate their needs to governments.

There is a basic difference between the two types of communities. The industrial communities developed rapidly and depend entirely on wage economies with strong ties to the general provincial economy and lifestyle. The native communities are relatively isolated from the mainstream of Manitoba life and have just begun to make the difficult transition into the modern industrial age.

In addition, there are fundamental differences between northern native communities and rural communities in the southern part of the province. Northern native communities are separate entities with no surrounding populated area. Southern agricultural centres, on the other hand, have strong social and economic ties with neighbouring rural areas.

As a result of these characteristics, the problems facing northern native communities are distinguishable from those facing other Manitoba centres. Therefore, conventional attitudes which are based on assumptions relevant to southern rural communities are not applicable to northern native communities. Similarly, such native communities cannot be analysed on the same basis as single industry northern communities.

Of the nine communities in the study area, two (Thompson and Leaf Rapids) can be classed as recently established single industry centres, five (Norway House, Cross Lake, Split Lake, Nelson House and South Indian Lake) can be categorized as native communities, and two (Churchill and Ilford) have aspects of both of these categories.

In the early stage of development, the economy of native communities was almost entirely dependent on hunting, fishing and trapping. There are two factors which make it difficult to maintain this reliance on traditional pursuits.

(1)*Rising Populations and Limited Physical Resource Base* — The latest available estimates (Table 2) indicate that there will be a substantial increase in population within northern native communities by 1990.

To a limited degree, returns from the resource base can be increased through more efficient use of fishing and hunting potential. However, it is unlikely that these limited resources can maintain an increasing population, even at the present standard of living. It would be impossible to achieve and maintain a higher standard of living based on traditional use of natural resources. Problems arising from the limited resources and increasing population have been given limited attention. These problems will become critical in the future.

TABLE 2
POPULATION ESTIMATES FOR SELECTED NATIVE COMMUNITIES

Community	1971	1975	1990
South Indian Lake	590	669	1,134
Split Lake	950	1,077	1,833
Nelson House	1,200	1,360	2,315
Cross Lake	1,917	2,174	3,698
Norway House	2,763	3,133	5,330
	7,420	8,413	14,310

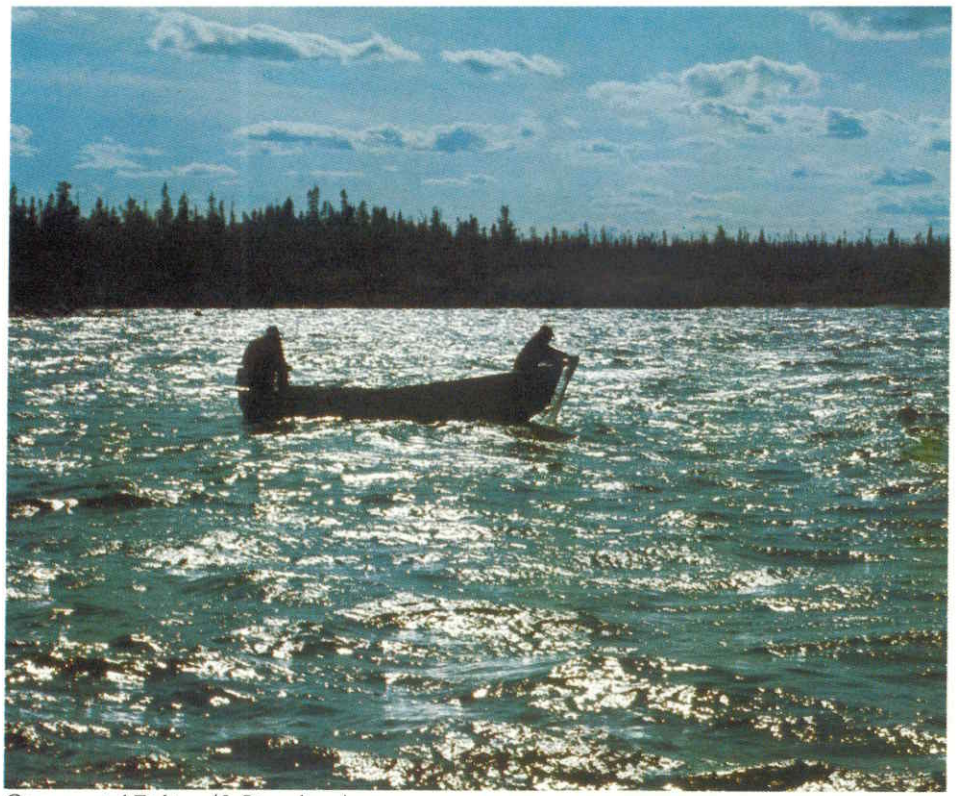
(2) *Conflicting Resource Needs* — Of more immediate concern is the competition between industrial and native communities for the natural resources of the area. Because of their demand for energy and recreational facilities, industrial communities inevitably encroach upon the natural resources available to the native communities. As a result, some residents in the native communities must find alternative means to provide for their social and economic needs. In addition, if the encroachment takes the form of a construction project, the increasing availability of money and goods has an

impact on the community's perception of "needs." Thus, the initial contact with a wage economy reinforces the trend away from traditional pursuits. This is particularly true of the young people who show an unwillingness to accept the rigors and low financial returns characteristic of traditional activities.

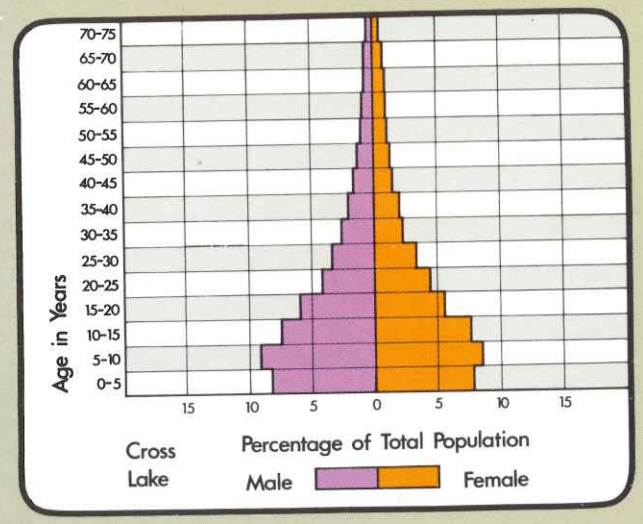
The problems facing native communities in the north are different from those associated with both northern industrial communities and southern rural centres. In addition, there are some significant differences among the native communities themselves. Although they share some common problems, each community has developed a distinctive lifestyle based on a particular set of circumstances.

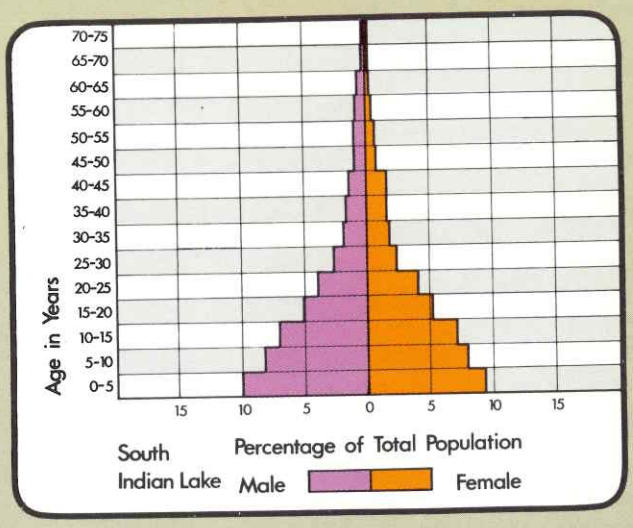
The Demographic Resource Base— The age and sex distributions of the population in the native communities of northern Manitoba are substantially different from the provincial, northern industrial, and southern rural distributions (Figure 3). This unique distribution has significance in terms of the options currently available to the native community and how these will change as younger residents enter the labour force. For example, approximately 50% of the population in most northern Manitoba native communities is under 15 years of age, as compared with 27% for Manitoba as a whole, and 31% for Thompson.

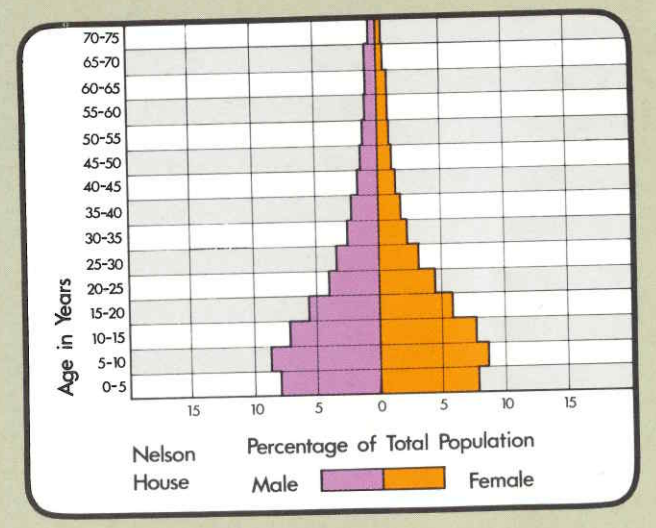
The high preponderance of future parents implies that, barring a substantial increase in emigration, population in northern native communities will be increasing at an accelerated rate over the next generation. Thus, economic expansion within this region must occur to support the increasing numbers who will be entering the labour force. In addition, the high dependency rate

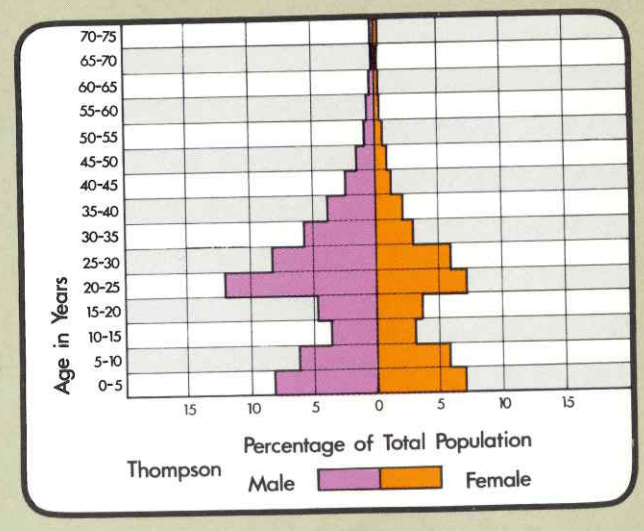


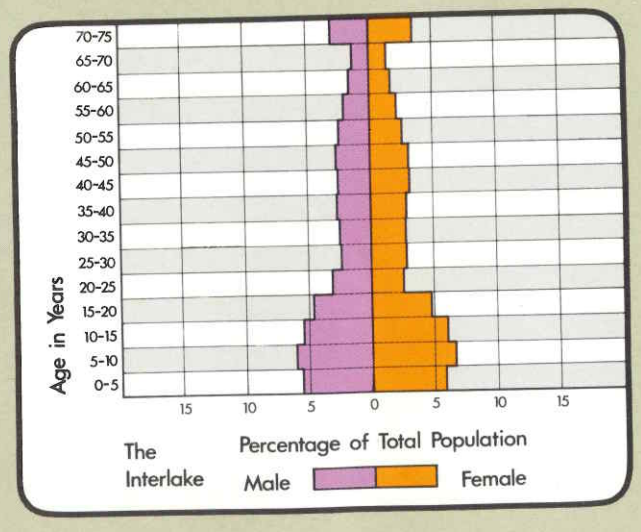
Commercial Fishing (J. Sigurdson).











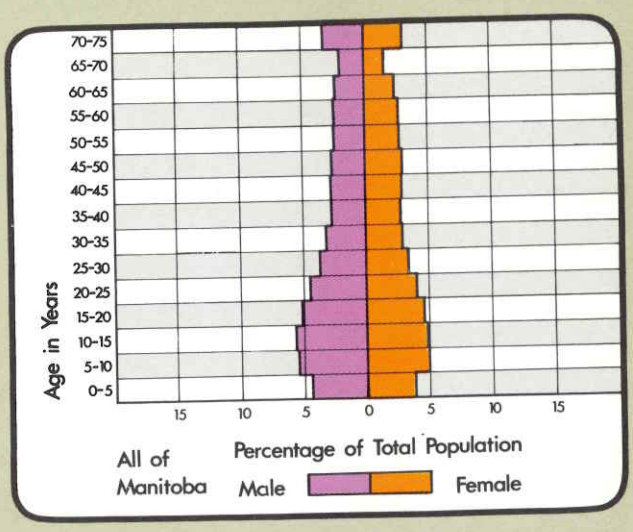


Figure 3: *Age — Sex Pyramids for Selected Communities and Regions*

means that in these communities a smaller group of working people is supporting a larger group of dependents that in the case of other Manitoba communities.

Economic Subdivisions—The economy of a native community in the north may be viewed as a composite of three basic sub-economies. These are:

(1) the traditional economy based on hunting, fishing and trapping;

(2) the wage economy based on work for wages; and,

(3) the transfer payment economy based on family allowance, old age pension and social assistance.

The family which works as a unit is characteristic of the traditional economy, whereas the wage economy is based on the individual wage earner.

Since the mid 1960's, the move away from traditional pursuits, combined with the scarcity of alternative economic opportunities, has resulted in transfer payments becoming a significant source of income for residents of northern native communities. In 1972 the average per capita transfer payment for treaty Indian residents in a number of northern communities was approximately $150 as compared with the average for Manitoba as a whole of $65 to $70.

The transition from a traditional society to one based on a wage economy is characterized by a number of changes, both social and economic. Economic data are easier to quantify. The 1972-73 income data for three selected communities that will be affected by the Manitoba Hydro development are provided in Table 3. Only about 15% of the income of the residents of Cross Lake and Nelson House is derived from the traditional sector. In the case of South Indian Lake, the wage economy accounts for almost as much income as the traditional economy (35% as compared with 37%).

Community Analyses—Although the communities of South Indian Lake, Nelson House and Cross Lake are similar in many ways, there are significant differences between them. An obvious disparity is the greater dependence of South Indian Lake on traditional income sources. There are also some major distinctions between the types of wage employment in Cross Lake and those prevalent in Nelson House. In addition, and related to these differences in economic factors, there are significant inter-community variations in value systems, leadership structures, and decision-making processes. The differences between these communities must be recognized in order to avoid the dangers of over-generalization of problems and its corollary, application of inappropriate solutions to specific local issues.

TABLE 3
PERCENTAGES OF INCOME SOURCES IN 1972-73 FOR SELECTED COMMUNITIES CROSS LAKE, NELSON HOUSE AND SOUTH INDIAN LAKE

	Cross Lake		Nelson House		South Indian Lake	
	1972/73 Income $2,194,000		1972/73 Income $1,279,200		1972/73 Income $543,800	
TRADITIONAL ECONOMY						
Fishing —Cash	2.0		1.0		15.0	
—Income in Kind	6.0		4.0		7.0	
Trapping —Cash	1.0		1.0		2.0	
—Income in Kind	1.0		2.5		2.0	
Hunting —Income in Kind	5.0		2.5		8.0	
Wood Cutting—Income in Kind	0.0		3.0		3.0	
Sub-Total:		15.0		14.0		37.0
WAGE ECONOMY						
Resource Development						
—Fishery	0.0		0.0		21.0	
—Forestry	1.0		0.0		0.0	
—Manitoba Hydro	29.0		37.0		5.0	
Government	18.0		19.0		6.0	
Service Industries	7.0		2.0		3.0	
Sub-Total:		55.0		58.0		35.0
TRANSFER PAYMENT ECONOMY						
Government	30.0	30.0	28.0	28.0	28.0	28.0
TOTAL:		100.0		100.0		100.0

NOTE: The term earned income used throughout the report refers to cash income plus income-in-kind.

Native Community Profiles

Northern Native House (Manitoba Government).

South Indian Lake, Winter 1972 (J. Sigurdson).

The following description of the current economic and social structures of the communities within the study area provides a baseline against which to assess the impact of the Manitoba Hydro projects on the communities. The communities of Cross Lake, Nelson House and South Indian Lake have been highlighted because they will be affected by the projects to a greater degree than will the other communities within the study area.

Cross Lake—The community of Cross Lake is scattered along the southeast corner of Cross Lake for a distance of approximately five miles and is divided into two parts by a small branch of the Nelson River. Internal transportation for the local residents, approximately 2000, is provided by gravel and dirt roads skirting both shores, and by means of footbridges and causeways. There is no permanent road link across the branch of the Nelson River between the east and west portions of the community. During open water, this linkage is provided by a footbridge while, in winter, the ice is utilized for transportation. There is considerable traffic between the two portions of the community by boat, snowmobile and the footbridge. The community lies 40 miles from Wabowden, the nearest town and 77 miles from Thompson, the nearest large centre. It is relatively isolated in that there is no all-weather road or rail access to the "outside." The majority of freight into the community arrives via a 15-mile winter road (suitable for truck haul) which links with the Jenpeg road. Some freight also arrives during the open water season from the Lake Winnipeg navigation system via Whiskey Jack Portage; this volume has declined in recent years.

The 548 people in the labour force of Cross Lake derived a total community income of $2,194,000 in 1972-73 or about $1100 per capita. Approximately 70% of this amount represented earned

income while the remaining 30% consisted of transfer payments in the form of pensions, family allowances and social assistance. This earned income was derived from: wage work on the Lake Winnipeg regulation project in and around Jenpeg, some 15 miles to the southwest; salaries paid to local employees of government agencies; wage work on government projects; local private service industries such as The Bay (Hudson's Bay Company store); domestic and commercial fishing, primarily on Cross Lake and Walker Lake; trapping, in an extensive area around the community; and, hunting, also in the surrounding area. The relative importance of these activities to the total community income was indicated previously in Table 3.

The existence of two groups in the community, about 1770 treaty Indians and 230 non-treaty people, results in a duality in the provision of local government services. The treaty Indians are governed by a Chief and Council while the non-treaty residents are governed by a Mayor and Council. The Chief and Council relate to the federal Department of Indian Affairs and Northern Development for administrative and financial support while the Mayor and Council are provided with parallel services by the Manitoba Department of Northern Affairs. This duality in the provision of local government services creates problems in two areas:

(1) the coordination of planning and development for the whole community; and,

(2) the formalization of the distinction between the two major groups in the community which otherwise might be much less evident.

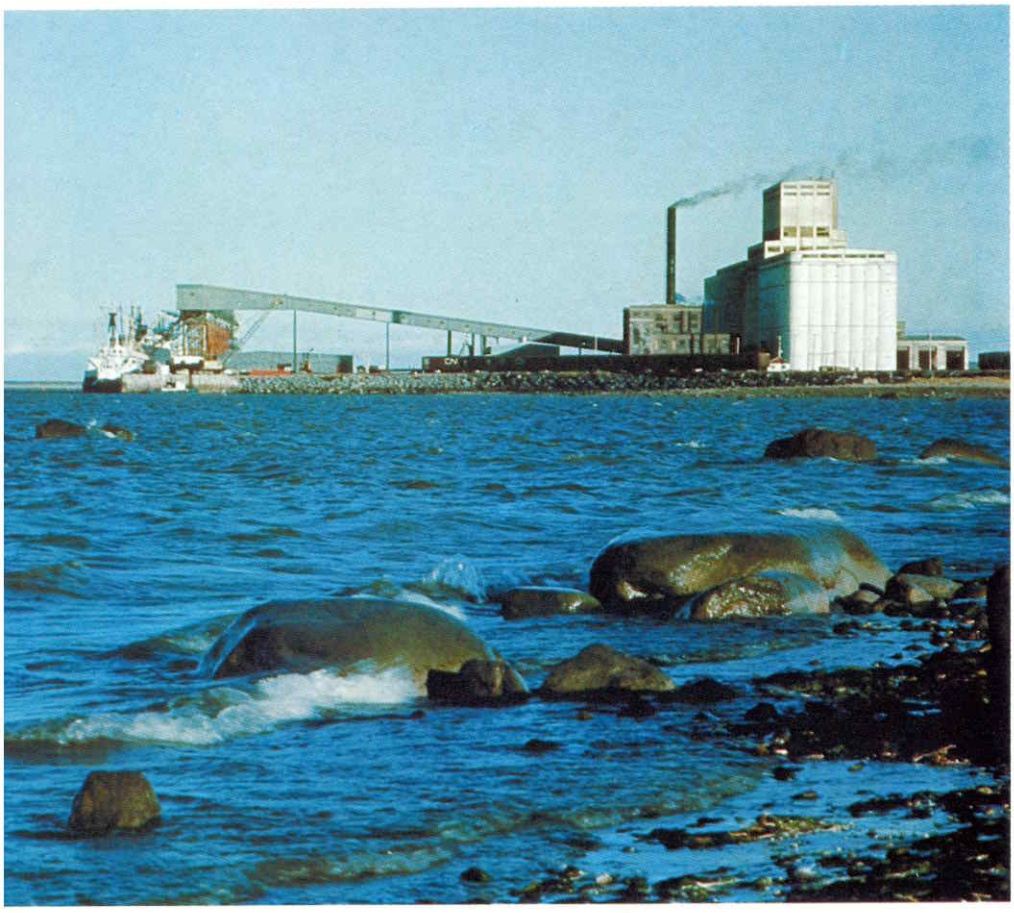
Decision-making processes in the community resemble those of a representative democracy. Decisions are made by elected leaders on behalf of the people but with only minimal consultation with the people. This process has the inherent advantage of time efficiency. However, because internal communications systems tend to be by word-of-mouth rather than by a formal or deliberate system of news dissemination, there is a "no one knows what's going on" attitude among many members of the community. The recent addition of a local radio station which is considered to be the major source of news about community events has not as yet altered this attitude.

Nelson House—The community of Nelson House is located on Footprint Lake, an expansion of the Footprint River. The Footprint River flows into Threepoint Lake in the Burntwood River system. The community is connected by road to Thompson, approximately 50 road miles to the east. The population is approximately 1260, of which 1200 are treaty Indians. They live in two areas, Poplar Point and Dog Point. The remainder are non-treaty Indians who have recently moved to a new housing development located just off the reserve some five miles away. Unlike most northern native communities, the houses in Nelson House are located in street patterns rather than scattered along a shoreline. A large part of the population is very young (53% under the age of 15). At present, the community has one governing body, an elected Chief and Council, which relates to the federal Department of Indian Affairs and Northern Development for administrative and financial support. The non-treaty portion of the population is provided with local services by the Manitoba Department of Northern Affairs.

The labour force of Nelson House in 1972-73 numbered 343 and the total community income was approximately $1,280,000 or $1015 per capita. Approximately 72% of this value represented earned income while the remaining 28% was derived from government transfer payments. Earned income was derived from: wage work on the

Jenpeg Construction Camp (R. J. Lay).

Commercial Fishing (J. Sigurdson).



Port of Churchill (Manitoba Government).

Nelson House (Study Board).

Churchill River diversion project at and around Notigi; employment by government agencies on various local projects or in administrative functions; local private industries, such as The Bay; trapping; domestic and commercial fishing, primarily on Wuskwatim and Wapisu lakes; hunting; and, wood cutting. The relative importance of these activities can be seen from the values shown previously in Table 3.

Decision-making processes in the community resemble traditional consensus patterns. Decisions are delayed by community leaders until a clear perception of the community's opinion on an issue is obtained and then the decision usually reflects that majority viewpoint. This process appears to be shifting to a more complex system of representative decision-making with the advent of a number of issue oriented local committees such as the Flood Committee and the School Committee. The pressure from outside agencies for rapid decisions on issues relating to the Manitoba Hydro project has greatly increased this shift and has contributed to a substantial increase in the level of social stress in this community with its attendant problems in the areas of social control and organization.

South Indian Lake—The community of South Indian Lake is scattered along both sides of the narrows between the main body of Southern Indian Lake and South Bay. It is the only native community in the study area that is not situated on an Indian Reserve. The nearest large centre is Leaf Rapids, approximately 40 miles to the southwest. South Indian Lake is relatively isolated since there is no all-weather road or rail access to the community. Its population in 1971 was approximately 590 (400 treaty Indians). Because the community is located entirely on Crown land, it is governed by a Mayor and Council that relate to the Manitoba Department of Northern Affairs. Thus, the community does not experience the problems related to a duality in the provision of local government services as in the case of Cross Lake.

Like other native communities the population is predominantly very young. Approximately 52% of the population is below age 15.

The community of South Indian Lake was supported by a labour force of 129 in 1972-73. The total community income in that year was $543,800 with the average income per capita about $920. Approximately 72% of this community income represented earned income while the remaining 28% was composed of government transfer payments in the form of pensions, family allowances and social assistance. Earned income was derived from: domestic and commercial fishing on Southern Indian Lake; wages from the local fishery; hunting and trapping in the area; cutting wood; wages on local Manitoba Hydro and government construction; and, service activities. The relative importance of these activities was indicated previously in Table 3. Since 1972, there has been a substantial increase in employment opportunities related to the new townsite development and to Manitoba Hydro's South Bay diversion channel project. This has resulted in a considerable shift in local employment from the traditional activities to the higher paying, short-run construction jobs.

In 1972, decision-making processes could be classified as taking the traditional consensus approach. Since that time, increased pressure on the community leadership to make complex and rapid decisions concerning matters related to Manitoba Hydro developments has resulted in a shift toward a more representative form of local government.

Norway House—The community of Norway House which includes the settlement at Rossville is located on the East

Channel of the Nelson River approximately 18 miles north of the outlet of Lake Winnipeg. The population is approximately 3000 of which 67% are treaty Indians. The remainder are non-treaty Indians with the exception of a small group of transient professional persons, mainly in the medical and educational fields. The population under 15 is large, approximately 47%. As noted previously, this is typical of most northern native communities.

Trapping in the Norway House region is an important activity in terms of providing seasonal employment but is not an important source of income. Although the number of Norway House trappers has been declining in recent years, about 130 men continue to trap in the region. In the period from 1967 to 1973, the average annual value of the fur harvest was $48,400 and the average annual net income was $19,400. Commercial fishing, on the other hand, is a substantial source of community income. The summer fishery on Playgreen Lake and, periodically, on other small lakes provided seasonal employment for an average of 65 men and an average annual net income of $72,000 between 1969 and 1973. The fishermen have organized the Norway House Fishermen's Co-op. The Co-op maintains fish packing stations on Playgreen Lake at Tait Island and at Flett (Sandy) Island. The main commercial species is whitefish which is transported by boat to Grand Rapids and then by road to the Freshwater Fish Marketing Corporation's plant in Winnipeg. No commercial winter fishing has been undertaken in the Norway House area in recent years.

The labour force of Norway House is estimated to be 900. Apart from seasonal employment provided by trapping and fishing, most employment is provided by the federal and provincial governments. The hospital, airport and government administration provide between 90 and 100 jobs. In addition, approximately 50 jobs are available in the private service sector. Periodic local construction projects provide additional employment.

Split Lake and York Landing—The community of Split Lake is located on the north shore of Split Lake approximately 80 miles northeast of Thompson. Its population is approximately 1000 of which 76% are treaty Indians. As in other northern native communities, about 50% of the population is under the age of 15. York Landing, with a population of approximately 200, is located 10 miles south of the community of Split Lake on the south shore of the lake at the mouth of the Aiken River.

In the past five years, commercial fishing has resulted in an average net income of about $400 per year for each of the 10 to 12 residents engaged in this activity. As a result of problems arising from mercury pollution, the fishery was closed for all species except whitefish during 1970 and 1971. Fishing yields and income levels can be expected to rise with the lifting of the mercury ban. Commercial fishing on Split Lake is confined to the summer season.

The level of trapping activity has been very low in the recent past. Between 1967 and 1972, an average of 28 Split Lake residents did some trapping which resulted in an average annual income per trapper of approximately $525. Beaver, lynx and mink were the main species taken. Indications are that trapping activity will continue to be low in the next few years.

Skinning Muskrats (Manitoba Government).

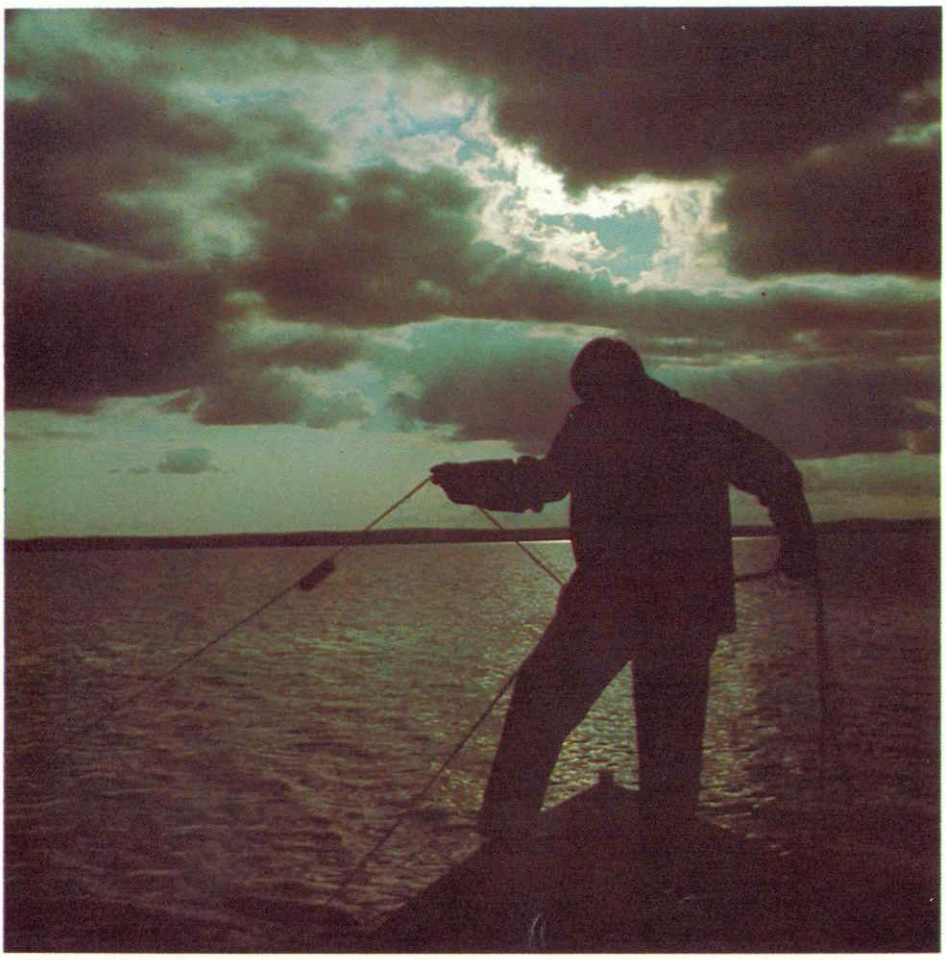
Barge Loaded With Fur (Manitoba Government).

At present, the Split Lake residents rely on water transport in the summer and on an ice road across the lake in winter. Although there is an airstrip, it is not in good condition. It is expected that the community will have an all-weather road link when the Thompson to Gillam road is constructed. The residents of York Landing also utilize the lake for transportation. Linking this community to the Thompson to Gillam road will not be feasible.

At present, Split Lake and York Landing have chronic unemployment problems. Future job opportunities, related to the Manitoba Hydro developments on the lower Nelson River and the Thompson to Gillam road, appear to be excellent.

Churchill and Ilford—Churchill is located at the mouth of the Churchill River at Hudson Bay. Its population is approximately 3500 of which 50% are under age 15. Its major economic activities are related to marine transport, local services and government administration. This community differs substantially from those discussed previously in that traditional pursuits such as trapping and fishing are not important sources of employment and subsistence income. Ilford, with a population of approximately 200, is located on the Canadian National Railways' Hudson Bay branch line approximately 90 miles east-northeast of Thompson. The economy centres around the railway and transportation services, fishing and, to a minor extent, trapping.

Northern Indian Lake, Fidler and Billard lakes on the lower Churchill River have been fished in the recent past by members of the Ilford Co-op. From 1969 to 1973, production from these lakes accounted for about 30% of the Co-op's landed value and provided an average annual gross income to fishermen and packers of $15,845. There is also a substantial investment in four lakeside fish stations along the lower Churchill River. The replacement value of these fish stations is estimated to be $120,000.



Hauling Fire Wood, Split Lake (Manitoba Government).

Commercial Fishing (J. Sigurdson).

Typical Scene at a Remote Fish Station (Manitoba Government).

Rapids on the Upper Nelson River (Manitoba Government).

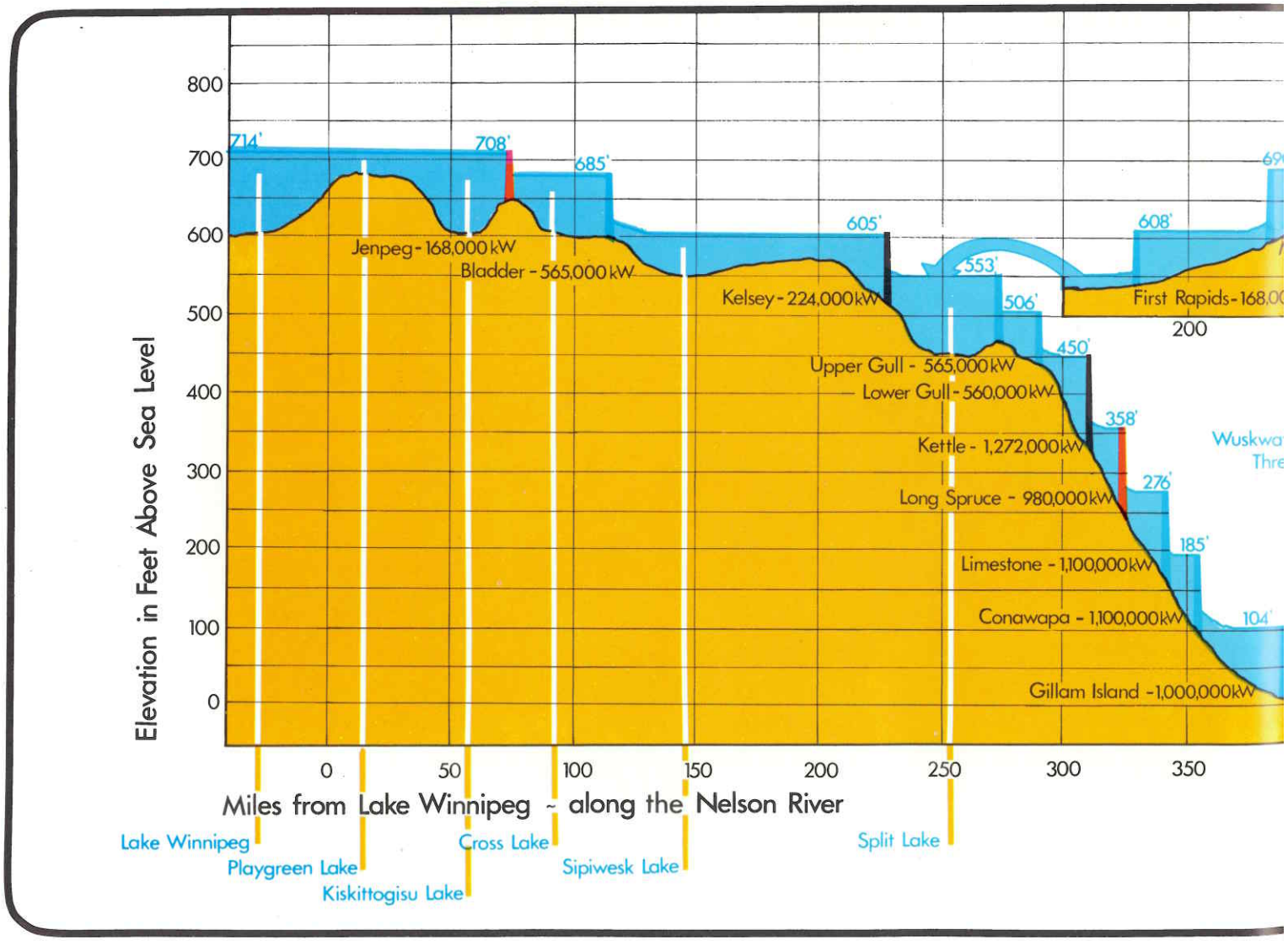
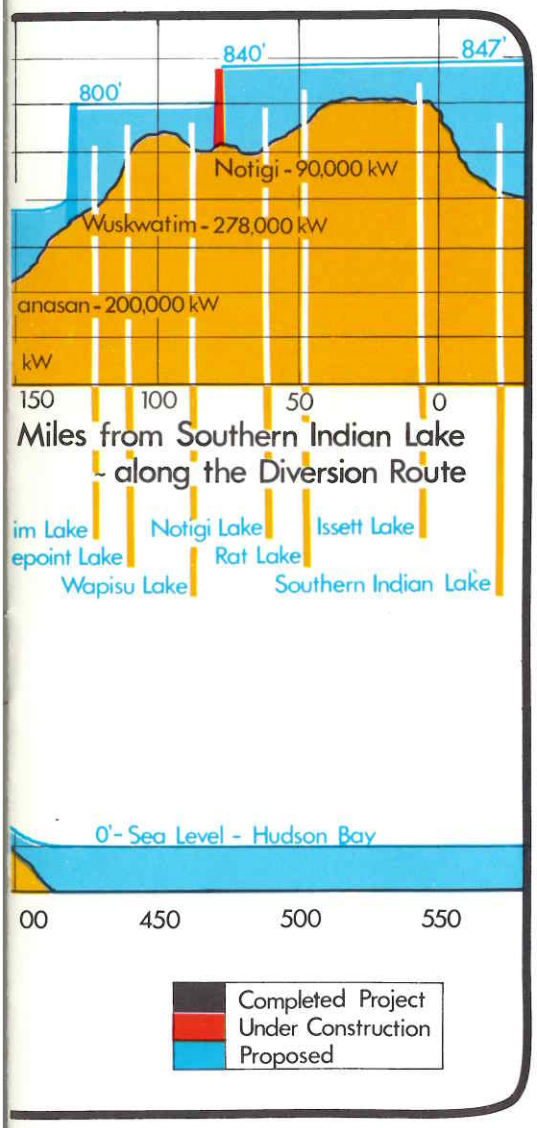


Figure 4: *Hydroelectric Developments for the Nelson River and the Rat-Burntwood Diversion Route*

The Regulation and Diversion Projects

The regulation of Lake Winnipeg outflow, the diversion of up to 30,000 cubic feet per second (cfs) from the Churchill River, and the development of the hydroelectric potential along the diversion route are major components of the Nelson River hydroelectric development program. The program when complete about the turn of this century is expected to include some 14 generating stations capable of supplying over 8,000,000 kilowatts of power. The present peak power demand in Manitoba is approximately 2,000,000 kilowatts. The generating stations will be located in step fashion along the Nelson River from Lake Winnipeg to Hudson Bay and along the Rat and Burntwood rivers from Notigi to Split Lake (Figure 4). Of these 14 power plants, two are complete (Kelsey and Kettle), two are under construction (Jenpeg and Long Spruce), one is committed to produce power by 1981 (Limestone), and the remaining nine are planned to begin initial power production as follows:

- Conawapa (formerly Lower Limestone) — 1984
- Gillam Island — 1987
- Rat-Burntwood plants (Notigi, Wuskwatim, Manasan and First Rapids) — mid 1980's to early 1990's
- Upper Gull, Lower Gull and Bladder Rapids — 1990's



Lake Winnipeg Regulation

Lake Winnipeg, the largest of Manitoba's lakes, is one of the major vestiges of ancient Lake Agassiz, a vast body of water left by the retreating glaciers of the ice age, and which once covered most of what is now the Province of Manitoba. The watershed of Lake Winnipeg encompasses an area of some 380,000 square miles (an area about 1.5 times as large as Manitoba), extending west to east from the foothills of the Canadian Rockies to near the western shores of Lake Superior, south to the headwaters of the Missouri River and the Mississippi River in the northern United States, and as far north as the southern limit of the Churchill River watershed. The river systems of the Red, Winnipeg, Saskatchewan and Dauphin all drain into Lake Winnipeg, together with numerous minor tributaries.

Dredge on the 8-Mile Channel (Manitoba Hydro).

The Winnipeg River, although smaller than either the Red or the Saskatchewan in terms of drainage area, contributes the largest average inflow, due in part to the higher precipitation over the basin and in part to the high runoff characteristics of the forest-covered Precambrian formations which typify the basin.

The Red River drainage basin, which includes that of the Assiniboine River, is characterized by a dry climate, prairie topography and absorbent soils, and therefore exhibits the lowest average runoff, although spring flood flows are relatively large.

The Saskatchewan River, with its two main branches, the North Saskatchewan and the South Saskatchewan rivers, has the largest drainage area of all the tributaries. It carries the snowmelt of the Prairies and, later in the season, that of the eastern slopes of the Rocky Mountains to Lake Winnipeg.

The Dauphin River contributes the runoff water from the west-central portion of Manitoba. The area drained includes Lake Manitoba and Lake Winnipegosis.

The waters flowing into Lake Winnipeg drain out of the lake at the northern

end passing through the outlet at Warren Landing to the Nelson River. At this point, the Nelson River begins its 410-mile course to Hudson Bay, descending some 713 feet. By virtue of its enormous surface area of 9430 square miles, Lake Winnipeg acts as an efficient natural regulating reservoir, with the result that fluctuations between high and low rates of flow in the Nelson River are relatively small.

Although Lake Winnipeg acts as an excellent natural storage and regulating device, the outflow is low when extended dry periods prevail in the drainage basin and runoff is small. Also, the outflow has seasonal variations which are out of phase with power demand. When discharge is high in July, power demand in Manitoba is low. Conversely, when discharge is low in winter, power demand is at its peak. The purposes, therefore, of the Lake Winnipeg regulation project are: to ensure that releases from the lake can be increased during the winter, the higher power demand period; and, to store water from one year to the next in the event of low runoff conditions in the drainage basin. To accomplish these purposes, it is necessary to increase the discharge capacity from the lake and to install a structure across the outlet which permits flow releases from Lake Winnipeg to be controlled.

The regulation project, being constructed by Manitoba Hydro, includes the control works at Jenpeg and outlet channel improvements (2-Mile Channel, 8-Mile Channel, Ominawin Bypass and Kisipachewuk Rapids excavation). In addition to these works, Manitoba Hydro is installing power generating facilities at Jenpeg thereby utilizing the hydroelectric potential at this site. Also included in the regulation project is a system of dykes and control dams along the West Channel to prevent water from bypassing the control works at Jenpeg and to prevent flooding around Kiskitto Lake. The location of these works is shown on Figure 5.

Figure 5: *Lake Winnipeg Regulation Project — Location Plan*

Jenpeg—The regulating structure and generating station being constructed at Jenpeg is located on the West Channel where the Nelson River enters Cross Lake. Approximately 80% of Lake Winnipeg's outflow will be controlled by the structure. The remaining flow passes down the uncontrolled East Channel into Pipestone Lake, an integral part of Cross Lake. The water level on the West Channel immediately upstream of the dam will increase approximately 25 feet and under minimum discharge conditions, will be essentially at the same level as Lake Winnipeg.

The generating facility being installed at Jenpeg consists of six turbine units capable of producing a total of 168,000 kilowatts of power. The first unit is

scheduled to be in operation by July 1976 and the sixth and final unit by May 1977.

Channel Improvements—Three new channels referred to as the 2-Mile Channel, 8-Mile Channel and Ominawin Bypass are being excavated to increase the capacity to discharge water from Lake Winnipeg to the Nelson River. Limited channel improvement has been completed at the Kisipachewuk Rapids.

The 2-Mile Channel will increase the discharge capacity between Lake Winnipeg and Playgreen Lake. The channel is scheduled to be in operation by November 1975.

The 8-Mile Channel between Playgreen and Kiskittogisu lakes will increase discharge capacity between these two lakes. Construction of the 8-Mile Channel commenced in September 1971 and the channel will be ready for service in June 1975.

The Ominawin Bypass will divert some of the flow around the Ominawin Rapids and into the West Channel. Excavation of this channel is nearing completion and it will be operational in June 1975.

Kiskitto Lake Dam—The recently completed Kiskitto Lake dam is an integral part of the West Channel control system which prevents flow in the Nelson River from bypassing the works at Jenpeg. The purpose of the dam is to isolate Kiskitto Lake from the raised water levels in the West Channel. However, a gated conduit has been installed in the dam to permit inflows from the West Channel into Kiskitto Lake whenever required to augment natural runoff into the lake. Outflow from Kiskitto Lake will be discharged through the control structure located on the north side of the lake into Black Duck Creek, a tributary of the Minago River.

Jenpeg Construction, Summer 1974 (Study Board).

Timber Clearing near Jenpeg (R. J. Lay).

Churchill River Diversion

The Churchill River orginates in Alberta and flows for over 1000 miles through Alberta, Saskatchewan and Manitoba emptying into Hudson Bay at Churchill. The 115,000 square mile drainage basin blankets much of the northern half of the Prairie Provinces. Portions of the basin lie within four of the major physiographic provinces of North American, namely the Great Plains, the Central Lowlands, the Canadian Shield

and the Hudson Bay Lowlands. Seven thousand square miles of the Churchill River drainage basin are located in Alberta, 70,000 square miles in Saskatchewan and 38,000 square miles in Manitoba. To the northwest of the Churchill River basin lies the Athabasca River watershed, to the northeast the Seal River and to the south the Saskatchewan-Nelson system.

The Churchill River headwaters consist primarily of three large lakes located in Saskatchewan, Peter Pond Lake, Frobisher Lake and Churchill Lake. In addition, throughout much of its length, the river consists of a series of interconnected lakes. Flow in the Manitoba portion of the river is dominated by the regulating effect of Reindeer Lake and of Southern Indian Lake.

In the late 1920's, the Hudson Bay Mining and Smelting Company built the Island Falls dam and generating station to provide power for its mining operation at Flin Flon. The Island Falls dam is located on the Churchill River in Saskatchewan about 30 miles upstream from the Manitoba border. The Churchill River Power Company, a subsidiary of the Hudson Bay Mining and Smelting Company, operates the Island Falls power plant. In 1942, the company completed the Whitesand dam at the outlet of Reindeer Lake. The increased storage thus obtained on Reindeer Lake enabled the flow of the Churchill River to be supplemented during low flow periods.

The large amount of storage afforded by the regulation of Reindeer Lake and the drop in elevation of some 920 feet from the Saskatchewan-Manitoba boundary to the sea make the Churchill River attractive for hydroelectric power development particularly below Southern Indian Lake. Most of the elevation drop in the river in Manitoba, about 835 feet, occurs below that lake. Below Southern Indian Lake, the river flow is increased leading to increased hydroelectric potential. The average discharge in the Churchill River at the Manitoba-Saskatchewan border is 22,500 cfs which increases to 35,700 cfs at Missi Falls, the outlet of Southern Indian Lake.

The lower Churchill River (Southern Indian Lake to Hudson Bay) parallels the Nelson River which is some 100 miles closer to the power demand centre in southern Manitoba. Since the Nelson River is being harnessed for hydroelectric power purposes, it is economically more attractive to divert a major portion of the Churchill River flow into the Nelson River than to develop the hydroelectric energy potential of the Churchill River. Manitoba Hydro estimated in its October 1970 Task Force report, entitled, "Expansion of Generating Capacity in Manitoba," that a saving of some $400,000,000 could be realized by this diversion.

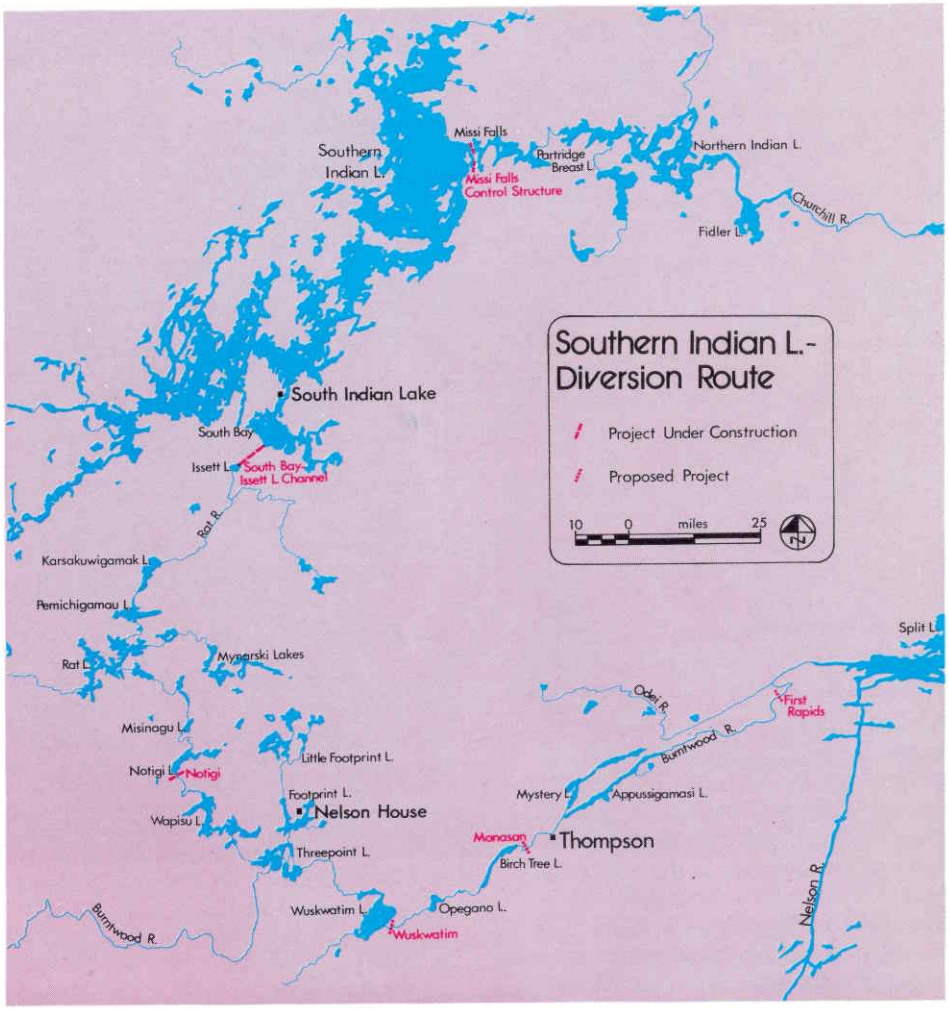


Figure 6: *Churchill River Diversion Project — Location Plan*

Missi Falls before Construction (Manitoba Hydro).

Manitoba Hydro is constructing a control dam at Missi Falls for the purpose of raising the mean level of Southern Indian Lake by about 10 feet. The rise in water level will permit water to be diverted out of Southern Indian Lake at South Bay and into the Rat River which is in the Nelson River drainage basin. Control of the flow into the Rat-Burntwood river system will be achieved by a structure at the outlet of Notigi Lake. The maximum amount of water that may be discharged from the Notigi control structure under the terms of the water power licence issued to Manitoba Hydro by the Provincial Government is 30,000 cfs. To ensure that diverted water will be able to flow by gravity from South Bay, a channel from South Bay to Issett Lake in the headwaters of the Rat River is being excavated. The diverted water will flow down the Rat River to the Burntwood River at Threepoint Lake and then down the Burntwood River past Thompson to Split Lake on the Nelson River. The locations of the Manitoba Hydro works are shown on Figure 6.

Manitoba Hydro proposes to develop the energy potential along the Rat-Burntwood diversion route by constructing power plants at the outlet of Wuskwatim Lake, at Manasan Falls which is just upstream of Thompson and at First Rapids some 15 miles above Split Lake. Manitoba Hydro's plans tentatively call for these plants to be built in the mid 1980's or early 1990's.

The Rat River has its source at the Churchill River drainage basin divide to the south of Southern Indian Lake and to the west of Granville Lake. From its swampy headwaters, the Rat River flows east and south by turns through a chain of lakes and sluggish channels separated by short rapid reaches and joins the Burntwood River at Threepoint Lake.

Below Threepoint Lake, the Burntwood River flows generally eastward for 30 miles to Birch Tree Lake, west of Thompson. In this section, the channel is lined with clay and silt banks, and the flow is sluggish. At intervals, these characteristics are interrupted by falls or rapids, and at two points by the enlargements at Wuskwatim and Opegano lakes.

At Birch Tree Lake. the Burntwood River turns abruptly northeast and maintains this general direction for some 60 miles to its mouth at Split Lake on the Nelson River. This portion of the river is similar in character to that above Birch Tree Lake except that the channel is, for the most part, broader and the banks generally somewhat higher.

A gated control structure and spillway at Missi Falls is being constructed by Manitoba Hydro to control the rate of flow from Southern Indian Lake to the lower Churchill River. The average level on Southern Indian Lake will be raised 10 feet to elevation 846.8 feet. This is in accordance with the licence which also provides for a maximum drawdown or fluctuation of two feet during any 12-month period and a total range of fluctuation of three feet, from elevation 844 feet to 847 feet.

The average discharge at Missi Falls will be reduced by approximately 75%

Pemichigamau Lake on the Rat River (Manitoba Government).

Dock at Missi Falls (Study Board).

Clearing, Notigi Lake (Study Board).

to allow for an average diversion discharge of about 26,900 cfs to the Nelson River. In the past, discharges from Southern Indian Lake have varied from about 22,500 cfs to 83,100 cfs with a long-term mean of about 35,700 cfs. The discharge of the Churchill River at Hudson Bay will be reduced by approximately two-thirds of its historic average rate (40,000 cfs to 13,000 cfs).

Construction of the Missi Falls control structure is proceeding. The works are scheduled to be completed by November 1975.

Manitoba Hydro is using the natural runoff in the Rat River basin to raise water levels in the Notigi forebay from elevation 790 feet to 830 feet by October 1975. A further raising of levels will be achieved by diverting water from the Churchill River via the South Bay Channel beginning in late October 1975.

The impoundment created by the Notigi Lake control facility will flood approximately 100,000 acres (158 square miles). Maximum annual fluctuations in the Notigi forebay are likely to be small but a range of nine feet is possible near the control structure. The minimum water level in the Notigi forebay is constrained by the terms of the licence to elevation 838 feet. Releases through the Notigi structure will be such as to restrict the maximum flow in the Burntwood River at Thompson to 33,500 cfs (the combined average historical flow of 3500 cfs and a diversion flow of 30,000 cfs). Mean monthly discharge in the Burntwood River at Thompson has ranged from a minimum of about 200 cfs to a maximum of about 18,000 cfs with a long-term average flow of 3500 cfs.

Timber clearing required for site preparation and construction activities has been essentially completed. Clearing associated with communities, spawning beds, nesting sites, landing areas, etc. is continuing.

Wuskwatim, Manasan, First Rapids and Notigi Generating Stations

Three generating stations, identified as Wuskwatim, Manasan and First Rapids having a combined capacity of approximately 640,000 kilowatts, have been proposed by Manitoba Hydro for development along the Burntwood River. In addition, Manitoba Hydro has made provision to build a generating station at Notigi (90,000 kilowatts). Manitoba Hydro's preliminary calculations (based on energy production values) show optimum forebay levels of 800, 690 and 610 feet, respectively, for the Wuskawatim, Manasan and First Rapids generating stations. These forebay levels, however, could be as much as 10 feet higher or lower.

Construction Activity at Notigi (Study Board).

Implications for Northern Manitoba

Cemetery near Nelson House, Footprint River (Study Board).

Until recently, the residents of native communities in northern Manitoba have lived within their traditional framework in isolation from the remainder of Manitobans. The society within these communities was characterized by an economy based on trapping, hunting and fishing. Because the lifestyle associated with such activities tended to be semi-migratory, the sophisticated community services and facilities characteristic of more sedentary societies were not required.

Within the past 15 to 20 years, a general process of change has reduced this isolation and thrust the communities into a transition towards modernization. Some of the innovations which have had a significant impact on community lifestyle are: The Northern Affairs Act, with its implications for improved municipal services, including a community-council type local government; the adjacent industrial developments in mining and forestry; the development of new, modern towns; the increasing accessibility through winter roads, all-weather roads, airstrips and scheduled air flights; and, the increased level of government programs and services.

As the "north" and the "south" become more aware of each other, the disparities between them are recognized. The need for local facilities and services, such as housing, electricity, roads, airstrips, safe water supply, sewage works, garbage disposal, and education and health programs, is now apparent. More significantly, there is an increasing awareness of the urgent need for more employment opportunities and community responsibility in decision-making.

Further, there are indications that northern Manitoba is beginning to develop a regional identity in an economic sense. Due to the increased pace of development over the past 15 to 20 years, a few communities are gradually becoming regional economic centres. This process has been facilitated by the expanding northern road system which links larger more economically viable communities like Thompson and Lynn Lake to smaller native communities like Nelson House, as well as to southern Manitoba.

Long Spruce Rapids, Nelson River (Study Board).

Within the context of transition, hydroelectric development is a catalyst in that it causes the needs of northern communities to surface far more quickly than might otherwise have been the case. Toffler[1] describes this state as the "dizzying" disorientation brought on by the premature arrival of the future."

The accelerating rate of change has many implications. One dimension of this issue is that some effects are tangible, for example, loss of natural resources, while others, such as change in lifestyle, are intangible. Another dimension is that different effects occur at different stages in the development process.

Impact Stages

When the hydroelectric projects were announced and prior to any development work, social and psychological problems arose from uncertainty regarding the effects of the developments. During the construction stage, the existence of nearby heavy construction activities suddenly removed the remoteness of these problems. Although new job opportunities developed, many necessary skills were not easily or quickly acquired by local residents. As a result,

[1]Toffler, A., *Future Shock*, Bantam: New York, 1970.

the jobs went to outsiders. Those who filled these new jobs as well as those who observed them, developed an awareness of an economic system previously encountered only on a sporadic basis — a wage economy with many implications in terms of lifestyle, including more complex individual, family and community decision-making requirements. Local residents were exposed to the advantages of better facilities (including housing and sewer and water systems). This affected aspirations not only of individuals but of communities. Stress, in combination with improved access and increased incomes, has often led to alcohol-based problems as well as to various forms of social stratification and intracommunity tension. Construction workers rapidly increased recreation pressures (including hunting). This reduced the supply of "bush" food available, thereby creating demand for expensive replacements.

In the early stages of operation, short-run, tangible and visible effects will become apparent. For example, docks might be flooded or lifted by ice; houses, sheds, or fish stations inundated; traplines flooded or cleared; and, fish nets snagged or fouled by debris. Such effects, by and large, have been identified and, for the most part, have been corrected. Other effects are less easily identifiable. For example, uncertainties in the minds of residents regarding the actual impact will create stress and social tensions that could become manifest in a variety of ways.

Long-term effects depend upon the actual net effects of changes in the water and related resource base as compared with what the situation would have been without the changes. Notwithstanding this simple logic, there will be many who will blame or try to blame all apparent downward trends on the hydroelectric development, even if such trends would have occurred in any case. Critical factors over the long-run are:

(1) available and acceptable sources of livelihood, and

(2) community decision-making processes capable of handling changes, both predictable and unpredictable, during and following the establishment of a new water regime.

In addition to the more general catalytic effects discussed above, hydroelectric development has created and will continue to affect the important issues of employment and transportation in northern Manitoba.

Tangible Impacts

Employment—The development of the hydroelectric potential of the Nelson River and the diversion from the Churchill River have made large numbers of short-term construction jobs available to northern residents. Estimates of the number of jobs available up to 1982 are provided in Table 4.

Beyond 1982, development of further sites on the Nelson River and the diversion route is expected. It can be speculated that, given the nature of these future projects, the level of employment will continue at approximately 2000 jobs annually until about the year 1990. When these figures are combined with estimates of employment in the two other major sectors, mining and forestry, it appears that approximately 10,000 to 12,000 jobs annually will be available during this time period.

In 1974, the number of people employed on the Lake Winnipeg regulation project peaked at 1385 of which 360 were northern residents and 1025 were workers from other areas. The Churchill River diversion project resulted in 200 northern and 660 other workers being employed at the peak period in 1974.

The implications to northern Manitoba of these actual and projected employment levels are significant. They appear to indicate that there is presently no job shortage in this area and that there is not likely to be one in the foreseeable future. However, the ability of northern residents to exploit such job opportunities is less clearcut. The actual levels of employment in the north have had a significant effect on the level of expenditures in this area. Increased income levels have led to expenditures on more consumer goods and services, both in the native communities and, to a greater extent, in centres such as Thompson. However, indications are that such expenditures result in a low multiplier effect since most retail services in this area are owned by outside

TABLE 4
ESTIMATE OF CONSTRUCTION WORKERS ON MANITOBA HYDRO'S NORTHERN PROJECTS

Project	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
Long Spruce	600	1700	2200	2200	2000	1550	475	250	—	—
Lake Winnipeg Regulation —Jenpeg Project	1200	1400	800	300	200	—	—	—	—	—
Churchill River Diversion	500	800	500	—	—	—	—	—	—	—
Others	—	100	500	800	2000	2000	2000	2000	1500	2000
	2300	4000	4000	3100	4200	3550	2475	2250	1500	2000

SOURCE: Manitoba Hydro, July 1973.

interests. This is particularly true of the native communities.

Three general activities appear to be necessary:

(1) planning,

(2) implementation of effective training programs, and

(3) modification of the work environment to facilitate local employment.

The planning function must identify future job opportunities and skill requirements and attempt to develop programs to meet them. It is essential that this program take place in consultation with local representatives. Otherwise, lack of local initiative may jeopardize the success of the program. The second function involves an effective and timely training program. A number of experimental programs which have been implemented in the last few years by the Manitoba Department of Northern Affairs have met with varying degrees of success. Most of these programs have attempted to integrate the third factor mentioned above, that is, a modified work environment for northern native residents.

Transportation—Hydroelectric development has contributed to the acceleration of construction of transportation facilities in northern Manitoba. Some of the roads, airstrips and boat docks have been built specifically to facilitate hydroelectric development. However, in many cases, decisions concerning the provision of transportation infrastructure resulted from a combination of the governments' general northern development policy and specific resource development projects such as mineral exploitation. The Jenpeg access road is an example of a road constructed to facilitate hydroelectric development. The Thompson to Leaf Rapids road falls into the general northern development category. Future road construction along the lower Nelson River can be expected to be, in part, a result of the planned hydroelectric development.

The provision of transportation facilities is, in general, advantageous to the communities under consideration in the study. Reliable, all-weather road links to Cross Lake and South Indian Lake are more feasible because of the closer proximity of new roads. Cross Lake is within 15 miles of the Jenpeg access road, and South Indian Lake is within 17 miles of the all-weather road into the South Bay construction site. Nelson House has a road link as a result of construction of the Thompson to Leaf Rapids road. In addition, the Thompson to Gillam road, now under construction, will link Split Lake with the rest of the northern Manitoba region.

These present and proposed actions have implications relative to the development of an employment strategy in this region and the reduction in the cost of goods and services provided in these

Jenpeg Access Road (R. J. Lay).

Fishing Boat, Lake Winnipeg (Manitoba Government).

communities. The existence of all-weather road links can increase the mobility of the local labour force which will enable fuller exploitation of the job opportunities discussed earlier. In addition, road links could substantially reduce costs of fuel, food and other commodities in these communities. The reliability inherent in all-weather roads could facilitate the uninterrupted supply of such basic community needs. Further, reliable access provides better prospects for the development of tourism.

In general, hydroelectric development has had a beneficial impact on the development of transportation infrastructure in northern Manitoba. These beneficial impacts resulted directly from the construction of new roads and other transportation facilities, and indirectly from improvements in existing transportation services. The Thompson to Leaf Rapids extension of Provincial Road 391 and improvements in air services in the north are examples of indirect benefits.

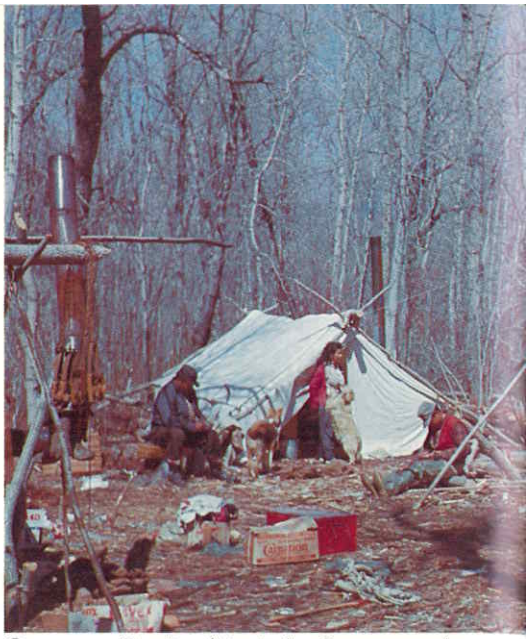
Natural Resource Utilization

The Lake Winnipeg regulation and Churchill River diversion projects will have a negligible impact on natural resource utilization in the northern Manitoba economy with the exception of the commercial fishery which is expected to experience some long-term losses in productivity. This conclusion should not detract from the more substantive study findings concerning disruption of local economic and social patterns.

The Commercial Fishery—The commercially fished waters that will be influenced by the Mantioba Hydro projects comprise Lake Winnipeg, the Outlet Lakes, Southern Indian Lake and the lakes in the lower Churchill River. The fishery along the diversion route is negligible from a commercial viewpoint although it does make a significant contribution to the local economy as income-in-kind (a food source). Of the lakes fished, Lake Winnipeg is by far the most important from a commercial production aspect followed by Southern Indian Lake and the Outlet Lakes. In the 1972-73 fishing year, approximately 35% of Manitoba's 20,000,000 pounds of fish came from Lake Winnipeg. Southern Indian Lake contributed about 5%, the Outlet Lakes contributed about 3% and the remaining lakes in the study area added another one percent to the provincial total.

Fish populations in Lake Winnipeg will likely be unaffected by the regulation project and the availability of commercial species to standard commercial fishing gear is likely to remain unchanged. The Lake Winnipeg regulation project will, however, create minor short-term disruptions to the fishing operations in the Outlet Lakes region, but no ongoing losses to the fishery are expected. These disruptions will occur until the fishermen adapt to the changes in fish migration patterns between Lake Winnipeg and Playgreen Lake, and to the expected new fish migration between Playgreen Lake and Kiskittogisu Lake.

The fishery of the lower Churchill River lakes will likely cease to be commercially viable after the Churchill River diversion project is in operation. Although this local fishery yields only about 100,000 pounds per year and is insignificant in terms of the total Manitoba yield, it is significant to the community of Ilford as it represents 30% of the landed value of the Ilford Co-op. The diversion project will also reduce the long-term biological productivity of Southern Indian Lake by approximately 10%. Although calculations show that the current fishing potential of Southern Indian Lake is not fully realized, the 10% reduction in productivity will result in less fish caught per unit efforts by the local fishermen from South Indian Lake. In addition to lower fish populations, the fishermen on Southern Indian Lake will face an increased number of hazards from floating debris and from more difficult access to the shoreline in case of emergency.



Camp on a Trapline (Manitoba Government).

Wild Fur Industry—Trapping in the study area contributes about 7% of the total wild fur value in Manitoba (based on 1972-73 figures). It is anticipated that the Manitoba Hydro developments will have a minor but detrimental impact on this industry. In general, registered traplines in the areas of Norway House, Cross Lake, Nelson House, South Indian Lake and the lower Churchill River are expected to experience short-term losses in production. In a few cases, notably in the Cross Lake area and along the lower Churchill River, disrup-

Commercial Fishing (Manitoba Government).

Indian Baby in Traditional Clothing (Manitoba Government).

tions may be ongoing. An indication of the most extreme losses possible can be obtained by assuming that any registered trapline which is disrupted will lose 100% of its production. Under this extreme assumption, the value of the Manitoba fur harvest would be reduced by only 3%. More realistically, it can be expected that these impacts will be much less severe. It must be stressed, however, that as in the fishing industry the impact on the wild fur industry is significant to the local communities in both an economic and social sense.

Mining and Forestry—Mining and forestry are two important sectors in the economy of northern Manitoba. Mining activity centres around Thompson, Lynn Lake, Leaf Rapids and Flin Flon while forestry operations throughout the north are, for the most part, connected with the Manitoba Forestry Resources Ltd pulp and paper and lumber plants near The Pas. Geological and forestry studies indicate that the Manitoba Hydro developments will not result in any significant impacts to these sectors. Exploitation of mineral deposits should not be significantly hampered by flooding and the timber lost through inundation will not adversely affect present commercial forestry operations in the north. On the other hand, the improvements to the transportation system in the area will be an advantage to the forest industry.

Intangible Impacts

There are three intangible impact issues which apply to northern native communities generally, social stress, nutrition and cultural change.

Social Stress—The stress which accompanies rapid change is referred to throughout this report. However, the importance of social stress should not be underestimated.

Nutrition—Among the difficulties facing communities within the study area, there is the problem of maintaining adequate nutritional levels.

In the past, northern Manitoba native communities relied heavily on land food such as meat, fish, and berries for their nutrient supply. Purchases of foods other than such staples as flour and salt were infrequent. With the transition from a gathering society to a partial wage economy, this pattern has been undergoing a change. Local residents have more money with which to buy a wider variety of foods, and less time and perhaps less inclination and incentive to hunt and fish. Under such circumstances, they tend to rely more and more on purchased foods. In the absence of adequate nutrition education, this shift in consumption patterns can have a serious effect on health. This occurs when residents consume less protein-rich land food and more candy and soft drinks.

Cultural Change—As industrialization of the north increases, residents become increasingly influenced by the convenience and material goods associated with a different way of life. Gradually social and cultural values are altered so as to approach those prevalent in industrialized societies. Second and third generation residents are thus apt to lose interest in the traditional rituals and artifacts which had been an integral and functional part of earlier community life. At some point, however, developing societies regret the loss of this link with their past and seek to preserve the remnants of a vanishing culture. The timeliness of this re-awakening interest in cultural roots is particularly significant since valuable information will be lost when the pioneer generation dies out. In northern Manitoba native communities, the number of older residents who have information which is crucial to the preservation of native culture is diminishing. In this respect, as in other aspects of community life, hydroelectric development is a significant factor, since it accelerates the rate of cultural change. This could result in a serious loss to the communities concerned, to Indian culture as a whole, and to the Province generally.

Smoking Fish (J. Sigurdson).

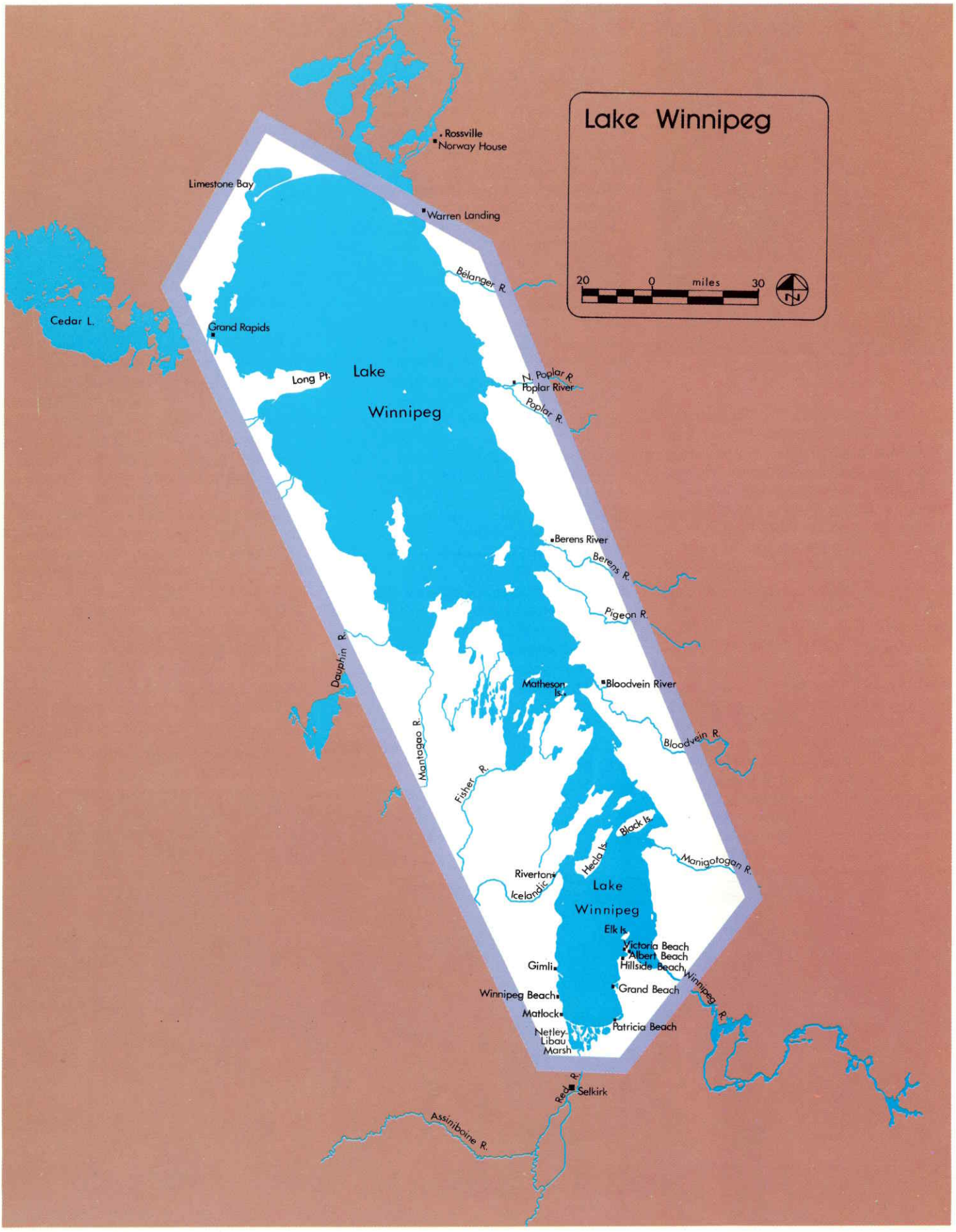


Figure 7: *Lake Winnipeg Study Area*

Study Area I—Lake Winnipeg

The Lake Winnipeg study area is delimited on Figure 7.

The operation of the Lake Winnipeg regulation project will alter the water regime of the lake. The range of fluctuation will be narrower and the long-term average level will be higher. Extreme low levels will be raised and extreme high levels will be lowered. For instance, the maximum instantaneous level of record at Gimli, 720.0 feet, which occurred in 1974 would have been about 1.4 feet lower if regulation had been in effect. The long-term average level after regulation is expected to be raised by 0.65 feet from elevation 713.35 feet to 714.0 feet. The effect of regulation on the lake levels is shown schematically on Figure 8. The values shown are mean monthly values and do not include the effect of wind. Wind setups of as much as 3.8 feet above still water levels have been recorded. Waves and wave uprush on the shores cause the actual elevation to which inundation is experienced at any point around the shoreline to be higher than the recorded lake level.

With Lake Winnipeg regulated, flood levels will be reduced, shoreline erosion rates will increase, beach widths will be narrowed, and marshes around the lake will tend to stagnate. On the other hand, navigation conditions will improve. The Lake Winnipeg fishery is expected to be unaffected.

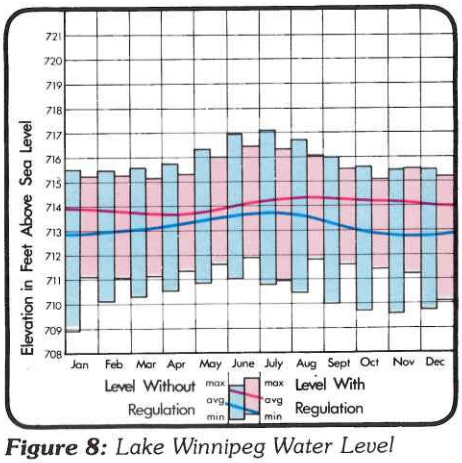


Figure 8: *Lake Winnipeg Water Level*

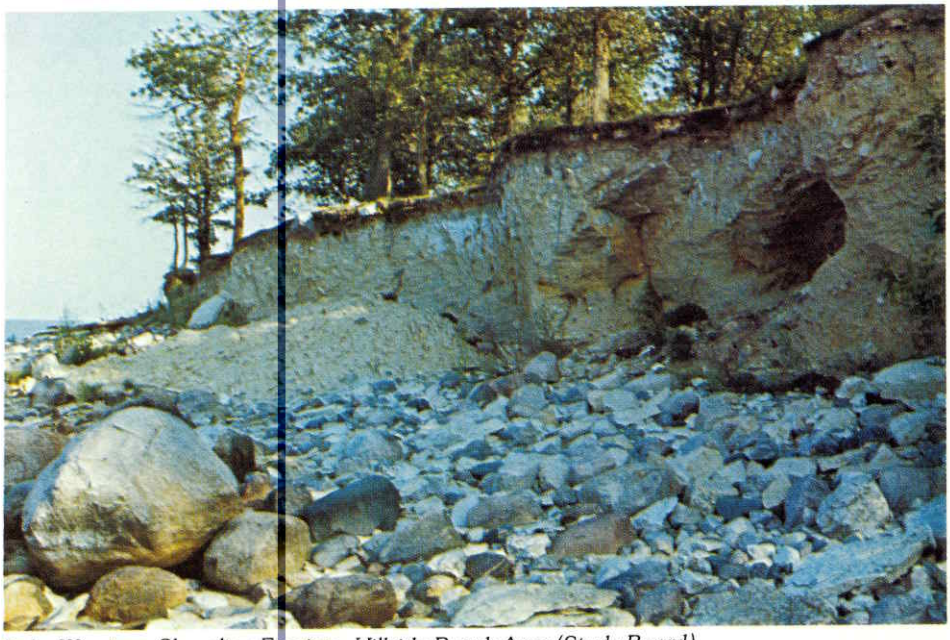
Shoreline Erosion

The unprotected lakeshore around the southern basin of Lake Winnipeg was found to be eroding landward at a typical rate of one to two feet per year with extreme values being as high as 25 feet per year. The actual land loss associated with the present erosion process amounts to a total of approximately 15 acres per year. It has been estimated that after the Lake Winnipeg regulation project is in operation, there will be an initial increase in the rate of shoreline landward movement of approximately 50%. Over time, the rate of recession is expected to approach the historic recorded value as the shore profiles adjust to the new higher mean water level. That is, the rate of land loss will increase initially from the equilibrium rate of 15 acres per year to 23 acres per year for an average rate of 19 acres per year during the adjustment period. The adjustment of the shore profile to the new higher lake levels will result in a landward profile shift of between 5 and 75 feet. The total area of land loss associated with this profile adjustment is approximately 310 acres.

The limits of the time required to effect the profile adjustment and the proportion of the profile shift which may be considered as damage attributable to the regulation of the lake were calculated by using two erosion-time models. One model was used to compute the lower limit and the other the upper limit.

The model giving the lower limit suggests that the profile shift would occur over a period of 5 to 40 years and that approximately 20% (62.5 acres) of the land loss associated with the profile shift would be attributable to the regulation project. On this basis, the weighted average time to effect the profile adjustment would be 16 years.

The model giving the upper limit suggests that the profile shift would occur over a period of 20 to 200 years and implies that 100% (310 acres) of the land loss associated with the profile shift



Lake Winnipeg Shoreline Erosion, Hillside Beach Area (Study Board).

would be attributable to the project. On this basis, the weighted average time to effect the profile adjustments would be 80 years.

The increased rate of lakeshore erosion could be eliminated by altering the pattern of regulation to achieve a long-term mean lake level of 713.35 feet which is equivalent to the average level without regulation. Alternatively, the amount of lakeside property lost through erosion could be reduced by constructing and maintaining suitable protective works.

Lake Winnipeg Beaches — South Basin

The west shore of Lake Winnipeg from Matlock to Riverton generally lacks sand for beaches except at Gimli and Winnipeg Beach. The lack of sand reduces the recreational capability. Portions of the south shore have large volumes of sand below the water surface. Beach ridges and sand dunes above the water level, however, are generally not extensive and are backed by low lying marshy land. Development of these sand deposits as recreational beaches is possible but would require extensive and costly dredging. Excellent sand beaches exist on the east shore at Patricia Beach, Grand Beach, Hillside Beach, Victoria Beach, Albert Beach and around Elk Island. There are, however, extensive reaches of boulder and cobble between these sand beaches.

The increase in wave energy reaching the shoreline during the profile adjustment stage is expected to increase the rate at which sand is removed from the existing beaches and transported along the zone of littoral drift. Concurrently, the generation of sand as a shoreline erosion product will increase. It is expected that overall the two effects will compensate each other, although minor local changes in availability of sand will occur in some areas. Along the south shore and at Patricia Beach, the profile adjustment associated with the regulation of Lake Winnipeg is expected to cause the beach to shift approximately 50 feet landward over a 10 to 50-year period. Similarly, Grand Beach, Hillside Beach, Victoria Beach and the beaches around Elk Island are expected to move landward but only by about 5 to 10 feet over a shorter adjustment period of 5 to 25 years. After regulation, beach widths will be reduced initially by about 15% due to a higher average lake level, and are expected to remain narrower as a result of the reduced range of lake level fluctuations.

Grand Beach, Lake Winnipeg (Manitoba Government).

Hunter in Netley Marsh, Lake Winnipeg (Manitoba Government).

Some beaches in localized areas may be eroded or shifted in location. To combat localized effects, sand can be imported or groin type structures installed to prevent sand loss.

Beach Use

The study results indicate that overcrowding of the recreational beach areas on Lake Winnipeg is already occurring, and to expect existing developed beach areas to accommodate the growth in demand between now and 1980 is unrealistic. Correlating data on the use of the provincial park at Grand Beach with mean July-August lake levels indicates that there is no relationship between the level of the lake and the use of the recreation resource except in 1974 when the lake was unusually high. Even though the usable beach width at Grand Beach was reduced by 80% to 90% in 1974, there was no coincident reduction in the recreation demand. The loss of the beach resource in 1974, as closely as can be determined from present information, resulted in a 20% loss of the expected use of the park. Past years' data suggest that this loss would occur only at such extreme water levels. Therefore, the marginal reduction in usable beach width should have no effect on recreation demand or use of the developed beaches around Lake Winnipeg.

Flood Control

The high water on Lake Winnipeg in 1950 caused $1,200,000 in damage and in 1966 flood damage reached $1,800,000 when the maximum daily

level rose to 719.0 feet. Property damage occurs around Lake Winnipeg when the level rises above elevation 717.0 feet. The flood damage estimates relate to 1968 dollar values. During and subsequent to 1966, temporary dykes were built to protect farm property and to safeguard urban property at Grand Beach, Gimli and Riverton. These dykes were raised and extended in 1970 to offer protection to the 722-foot level. An emergency dyking program was undertaken in 1974 to protect communities and cottage areas against the record high levels of that year.

Regulation will reduce the flood threat and reduce the risk of dyke failure. However, the higher average water level will increase dyke erosion marginally. Extra dyke maintenance costs will be offset by a reduction in costs to pump land drainage water over the dykes. Added protection on the lakeside dyke slopes would decrease the erosive rates.

Fishery

Although lake Winnipeg is the most important commercial fishing area in Manitoba, it was not studied in detail because the ecological implications of the Lake Winnipeg regulation project appear to be minimal.

The small change in the average lake level is not expected to affect the general productivity of the lake and it is improbable that future changes in chemical or biological characteristics of the lake would be attributable to the Manitoba Hydro project. It is predicted that fish populations and production will in all probability be unaffected and that the availability of species to standard commercial gear will remain unchanged as a result of regulation.

Wildlife

Marshes around the southern shores of Lake Winnipeg totalling over 150 square miles have been highly productive of waterfowl and muskrats, particularly the Netley and Libau marshes. The muskrat and waterfowl populations are dependent on a good growth of aquatic vegetation such as cattails and bulrushes for food and house building. Regulation will reduce the incidence of low water necessary to regenerate and maintain good habitat; thus, in the long-term, muskrat productivity of the marshes will decline. The marshes will tend to stagnate. However, in the short-term, muskrat populations are expected to increase as preferred food and cover plants will flourish for 3 or 4 years with raised water levels. However, their numbers will decline sharply as the food and building material source disappears.

Waterfowl also rely on marsh habitat for nesting and food similar to that which supports muskrats. The potential value of the marshes will decrease as nesting habitat diminishes under the more stable, higher water levels associated with the regulation project. As marsh areas deteriorate they will become less attractive to ducks and geese as stopovers in their migration flights.

Several species of water birds such as white pelicans and double-crested cormorants have colonies on islands and reefs in the lake. The effect on the raised, stable levels on these species will be small, although there will be some loss of satellite colonies on low islands. Beach nesters such as Caspian and common terns will be especially affected.

Navigation

The navigation route on Lake Winnipeg used by the principal marine freighters extends from Winnipeg or Selkirk via the Red River to Matheson Island, Bloodvein, Berens River, Poplar River, Norway House, Rossville and Whiskey Jack Landing (for transshipment to Cross Lake). Regulation will not affect this route but will reduce existing low water harbour approach problems, improve docking conditions and benefit the rapidly increasing pleasure boat traffic on the lake's southern pool.

Improvements to navigation will be particularly significant at the Outlet Lakes end of the Lake Winnipeg navigation route. After regulation, it will be possible to extend the navigation route from Whiskey Jack Landing on Kiskittogisu Lake to the Jenpeg structure. In addition, by using the 2-Mile Channel, the hazardous Warren Landing channel can by bypassed. Also, the higher levels on Lake Winnipeg and Playgreen Lake will reduce the incidence of transferring northbound cargo to shallower draught vessels at Warren Landing.

The improvements to navigation in the Outlet Lakes area could reduce costs of bringing cargo into Norway House from the south and reduce costs of moving resource products such as pulpwood and fish southward from the Playgreen Lake–Kiskittogisu Lake region.

M. S. Lord Selkirk Docking at Selkirk (H. Kalen).

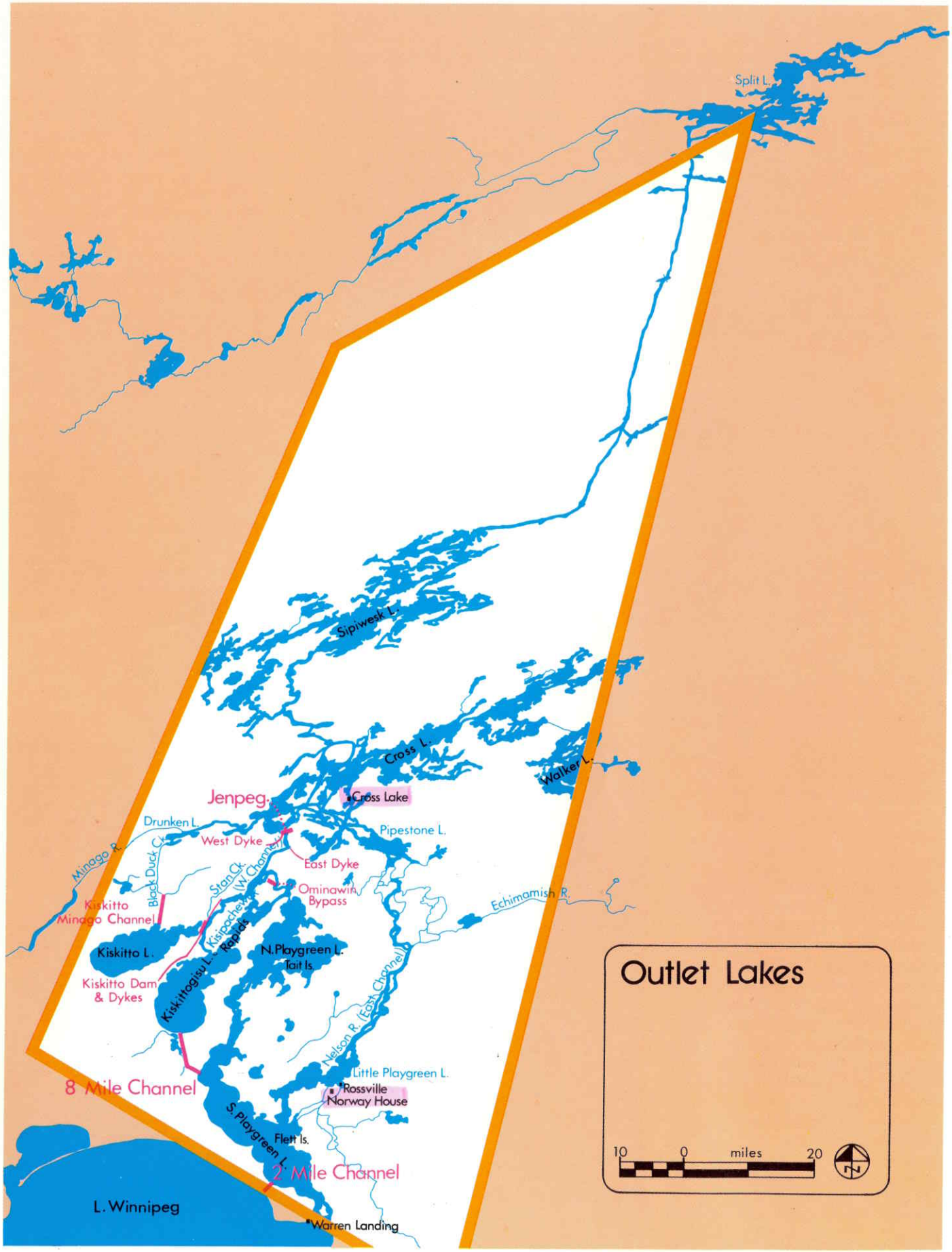


Figure 9: *Outlet Lakes Study Area*

Study Area II – Outlet Lakes

The Outlet Lakes area (Figure 9) includes the East and West channels of the Nelson River and the lakes and connecting streams between Lake Winnipeg and Split Lake. The major lakes are Playgreen Lake, Kiskittogisu Lake, Kiskitto Lake, Cross Lake and Sipiwesk Lake. An impact assessment of Sipiwesk Lake was excluded from the study because it has already been affected by the hydroelectric development at Kelsey. The water level regime on Sipiwesk Lake depends primarily on the operation of the Kelsey generating station and to a lesser extent on Lake Winnipeg outflow rates.

In addition to providing a desirable outflow pattern (Figure 10), the Lake Winnipeg regulation works will be operated to facilitate ice cover formation in the channels upstream from Jenpeg. Manitoba Hydro, as an operating measure, intends to reduce the discharge from Lake Winnipeg significantly, from approximately 85,000 cfs to about 50,000 cfs, for two or three weeks in November each year. After a satisfactory ice cover has formed on the channels upstream of Jenpeg, the discharge from Lake Winnipeg will be increased gradually until the normal operating discharge is achieved during the latter part of December. In most years, the level of Cross Lake will drop between 2.5 and 3.5 feet during the cutback operation and will return to normal by the end of December. In flood years, the short-term drop on cross Lake and the subsequent rise could be as much as 5 feet.

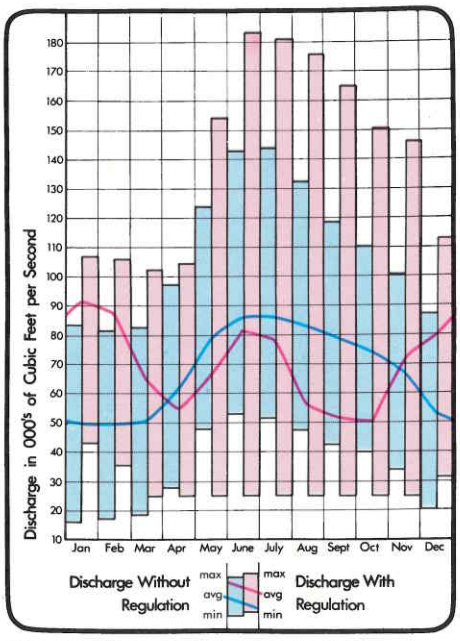


Figure 10: *Lake Winnipeg Outflow*

Landscape Changes

As the water backs up in the Jenpeg forebay area, 23,000 acres will be submerged primarily along the West Channel. According to plan, Manitoba Hydro will have cleared approximately 12,000 acres of timber, but the remainder, largely located in sheltered bays, will be left as is. It is predicted that the treed, muskeg portion of the shoreline of the Outlet Lakes will erode over the next 20 years. The amount of erosion will depend on the wave action and the slope of the backshore. The bedrock, coarse sediment and low-lying willow shoreline areas are expected to re-establish within two to six years.

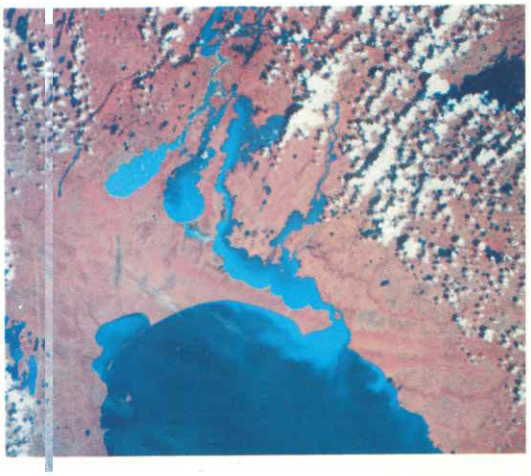
The 2-Mile and 8-Mile channels are being carved out primarily by hydraulic dredging. Excavation in the 8-Mile Channel is essentially complete. In the 2-Mile Channel, excavation has started but will not be finished until the fall of 1975. The material excavated by dredging is deposited beyond restraining dykes. Although the dredge spoil kills existing vegetation, the deposited material has been found to be reasonably fertile and grass is beginning to grow on the spoil areas along the 8-Mile Channel. Manitoba Hydro will remove all of the buildings and debris from campsites and construction areas. Nevertheless, the campsite and construction area clearings, construction roads, transmission lines, and the structural works will leave their mark on the landscape.

Fishery

The Outlet Lakes contain a wide variety of fish and account for approximately 3% of Manitoba's commercial fish output. Whitefish and walleye are the two main species harvested with Playgreen Lake providing 60% of overall production from the area. An important seasonal interchange of whitefish between Lake Winnipeg and Playgreen Lake exists.

The anticipated effect for the Outlet Lakes area is a slight decline in the fish productive capacity over the short-term (due mainly to a slight expected drop in productivity in Playgreen Lake), and a slight increase thereafter (due mainly to expected increases in productivity in Kiskittogisu Lake and Kiskitto Lake). The sudden drop of the Cross Lake level during the November flow cutback period could decrease the whitefish population in the lake by exposing incubating whitefish eggs.

Opportunities to exploit the fish resource will be gained by improved boat access between Kiskittogisu Lake and Lake Winnipeg by way of the 8-Mile Channel, by the construction road to Kiskitto Lake, and by the Jenpeg access road. There could be disadvantages to fishing resulting from the impaired navigability on Cross Lake, and from Cross Lake to Walker and Drunken Lakes, due



Outlet Lakes from ERTS Satellite (Government of Canada).

to lower summer levels (Figure 11). These anticipated navigation problems on Cross Lake could be alleviated by altering the outflow pattern from Lake Winnipeg to ensure an adequate water depth. Summer levels could be raised artificially by building a lake level regulating structure at or below the outlet of Cross Lake.

Wildlife

The Outlet Lakes area contains several thousand moose, two woodland caribou herds, and significant numbers of waterfowl and furbearing animals.

Of the estimated allowable annual harvest of 800 moose in the area, only a small proportion are taken each year. The Manitoba Hydro project is expected to reduce the moose population by about 50. This should have no significant effect on current hunting success. Some local overharvest can be expected around the settlements and existing and future construction camps.

The regulation project should have little effect on the caribou range available in the Outlet Lakes area.

Furbearers provide an important part of the economic base of the communities of Norway House and Cross Lake with the four most important species being beaver, muskrat, mink and lynx. Of the four important species, muskrat and mink will be most affected by regulation. Aquatic furbearers will be displaced by flooding in the West Channel. Some species such as beaver may adapt to higher water levels, but muskrat and others will be unable to exist until new marshes form. Since the mink's prime food source is the muskrat, mink will also be adversely affected. The changed water level regime will also cause a reduction in furbearer populations on Cross Lake. The most significant effect on Cross Lake will result during the flow cutback period at freezeup. The sudden fluctuations in level during this period will cause major disruptions to the aquatic furbearer populations. Further, since the magnitude of the level fluctuations will differ from year to year depending on climatic conditions, it will be impossible for these species to re-establish on a permanent basis unless the lake level fluctuations are moderated.

Significant numbers of ducks and Canada geese use the Outlet Lakes region in the fall. Some Canada geese and several other species of waterfowl breed in the area. Some breeding habitat will be lost through flooding but this is expected to be small. Cross Lake and Playgreen Lake contain the best breeding habitat within the Outlet Lakes region. Flooding will be minimal on those two lakes.

It is anticipated that the harvest rates for moose and waterfowl will increase because of improved accessibility to the area by road.

Forestry

The flooding of some 23,000 acres in the Outlet Lakes region will mean a loss of approximately 16,000,000 cubic feet of usable timber. Fluctuating water levels under regulation could create hazardous ice to shore access conditions, thereby hindering winter logging operations in the area which require ice crossings. New winter logging roads may be necessary which could utilize the Jenpeg dam as a Nelson River crossing point.

On balance, however, it appears that forestry operations in the Outlet Lakes area will be facilitated by improved access made possible by the Jenpeg road and by improved barge transport possibilities between Lake Winnipeg and Kiskittogisu Lake and the West Channel.

Mining

There is, at present, no mining activity in the Outlet Lakes region except for extraction of materials used for construction purposes such as gravel. The bedrock outcrops that will be flooded as a result of the project were examined and mapped. A strip approximately 26 miles long was examined and mapped during the conduct of this study so that the opportunity to obtain pertinent geological information would not be lost. The maps are available from the Manitoba Mines Branch.

Recreation

Studies show that the Outlet Lakes region is suited to only low intensity recreation. The regulation project will result in some losses but will create new potential. The Jenpeg structure will replace white water for canoeing by new opportunities for fishing and power boating. It is predicted that northern pike production will increase in the flooded area above Jenpeg, walleye will be attracted to the fast water in the Jenpeg tailrace and that wildlife and fish populations will increase at Kiskitto Lake. The Jenpeg road and Kiskitto dam construction road will provide access for sportsmen to these new hunting and fishing areas.

Recreation potential in the Outlet Lakes region could be exploited following regulation by installing facilities for visitors and sportsmen at Jenpeg, maintaining the Jenpeg airstrip and removing debris from the Jenpeg forebay.

Archaeology

Concerns that archaeological data in the Outlet Lakes region will disappear under floodwaters are unfounded. Extensive flooding will not occur and field investigators found no evidence to substantiate the theory that the area had been inhabited for the last 10,000 years. However, it has been documented by historians that at least seven fur trading posts had existed in this region. These included: Norway House I (1812-1824) at Warren Landing; Norway House II and III (1826 to the present) at Norway House; Jack River House (1801-1817);

36 *Woodland Caribou (Manitoba Government).*

Canoeing on the Minago River (R. J. Lay).

Marsh on Cross Lake (R. J. Lay).

Rossville Post; Cross Lake House; and, Sipiwesk House (1801-1817). Although no evidence of the historic fur trade period was uncovered, several fishing and trapping cabin sites were located. These sites were not examined in detail and may be destroyed by shoreline erosion.

Communities

There are four settlements in the Outlet Lakes region, Cross Lake, Norway House, Rossville and Warren Landing. Of these communities Cross Lake will be by far the most affected by the regulation project.

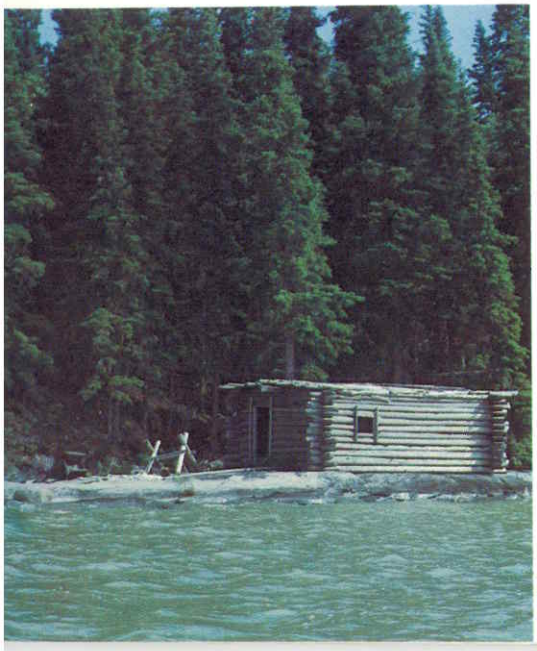
Cross Lake—The major impact of Lake Winnipeg regulation on Cross Lake has been the creation of jobs. Employment generated by Manitoba Hydro accounted for 29% of community income in 1972-73. There has been a keen interest by younger residents in securing employment on the project. An average of 100 have been working on the hydroelectric project, but most were hired as unskilled labourers. When the current hydroelectric project is completed, there will be little or no demand for their labour unless there are new developments. In order to maintain this new found prosperity and higher expectations, local workmen could seek jobs outside the community but studies reveal that low education standards, lack of skills, strong family ties and the security of living in a familiar culture would make migration difficult.

At least four causeways in the Cross Lake community and four footbridges lie below the anticipated maximum water level. Higher levels after regulation will also threaten four homes and 21 other structures such as storage sheds, pumphouses, and docks. An additional 20 buildings are only 3.5 feet above the future maximum level. With increased winter discharges through Cross Lake, the ice cover may be less safe and winter freighting could be affected by poor ice conditions. Summer freighting via Whiskey Jack Portage may also be adversely affected by the possible flooding of wharves at both ends of the portage. However, improved navigation conditions from lake Winnipeg to Kiskittogisu Lake will offset this detrimental effect.

Serious and continuing losses among furbearing animal populations are expected in the Cross Lake region. Dislocation of beaver, muskrat and mink would affect 80 full and part time trappers on 25 registered traplines, including the community trapline. This impact will result in a combined annual cash and income-in-kind loss to the community of approximately $8000. Initial losses could be higher while trappers attempt to relocate traplines. A far more significant impact of regulation will be the disruption of the community trapline which is used to train young people and offers older residents a means of recreation. This type of disruption will alter the community's lifestyle and constitutes a loss of opportunity. Cross Lake fish populations will not suffer from regulation but migration patterns may change. However, fishermen will experience short-term reductions in fish harvests as they adjust to changed fish movement. Low summer water levels may also hamper fishermen moving from Cross Lake to Walker Lake and Drunken Lake, and navigation dangers may increase. Use of the Jenpeg access road, which is about 15 miles from the community, could reduce fish shipment costs which would offset some of the disadvantages of regulation. Moose and waterfowl harvests are worth $100,000 a year to the community as income-in-kind. The availability of moose and waterfowl is reduced due to hunting pressures of construction workers while they are in the area.

There is a great deal of concern over how well Cross Lake residents understand how Lake Winnipeg regulation will affect their community. Studies have shown that the residents have a basic understanding of water level changes and possible effects, but because of lack of communication of detailed information, many distorted and exaggerated opinions exist. Since the regulation project was announced, community leaders have received many demands and requests for decisions from both internal and external sources. These pressures will increase as negotiations proceed over claims for property and resource losses. Two groups administer the affairs of the Cross Lake community, one group (Chief and Council) is responsible to the treaty Indians and the other (Mayor and Council) to the non-treaty people. The two-group approach in the community administration makeup may hamper leadership effectiveness unless the community and government agencies are able to coordinate their approach to problem solving. The long-term social and economic impacts of regulation on the community cannot be predicted since the extent of these impacts will depend upon the leaders' ability to understand the coming environmental changes, convey this understanding to the entire community, represent the community's best interest at the bargaining table and effectively negotiate this position with Manitoba Hydro and the government.

Norway House, Rossville and Warren Landing—Although there were a large number of jobs available at Jenpeg and other project sites, only five to ten residents from the Norway House area were working on the project at any one time. Regulation could produce short-term losses in the fishing industry due to altered and new fish migration patterns and siltation of some spawning beds. The impact on furbearing animal populations and possible difficulties with shoreline access will affect eight trappers and a community trapline used by 77 residents. As in the case of Cross Lake, possible impacts are incurred through loss of traditional lifestyles. The community trapline is used as a training ground for younger residents and as a form of recreation for older citizens.



Trappers Cabin, Kiskittogisu Lake (Manitoba Government).

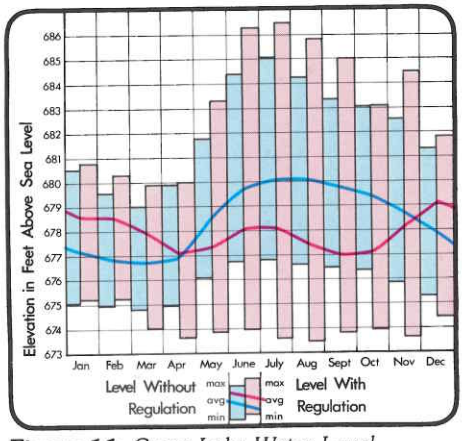


Figure 11: *Cross Lake Water Level*

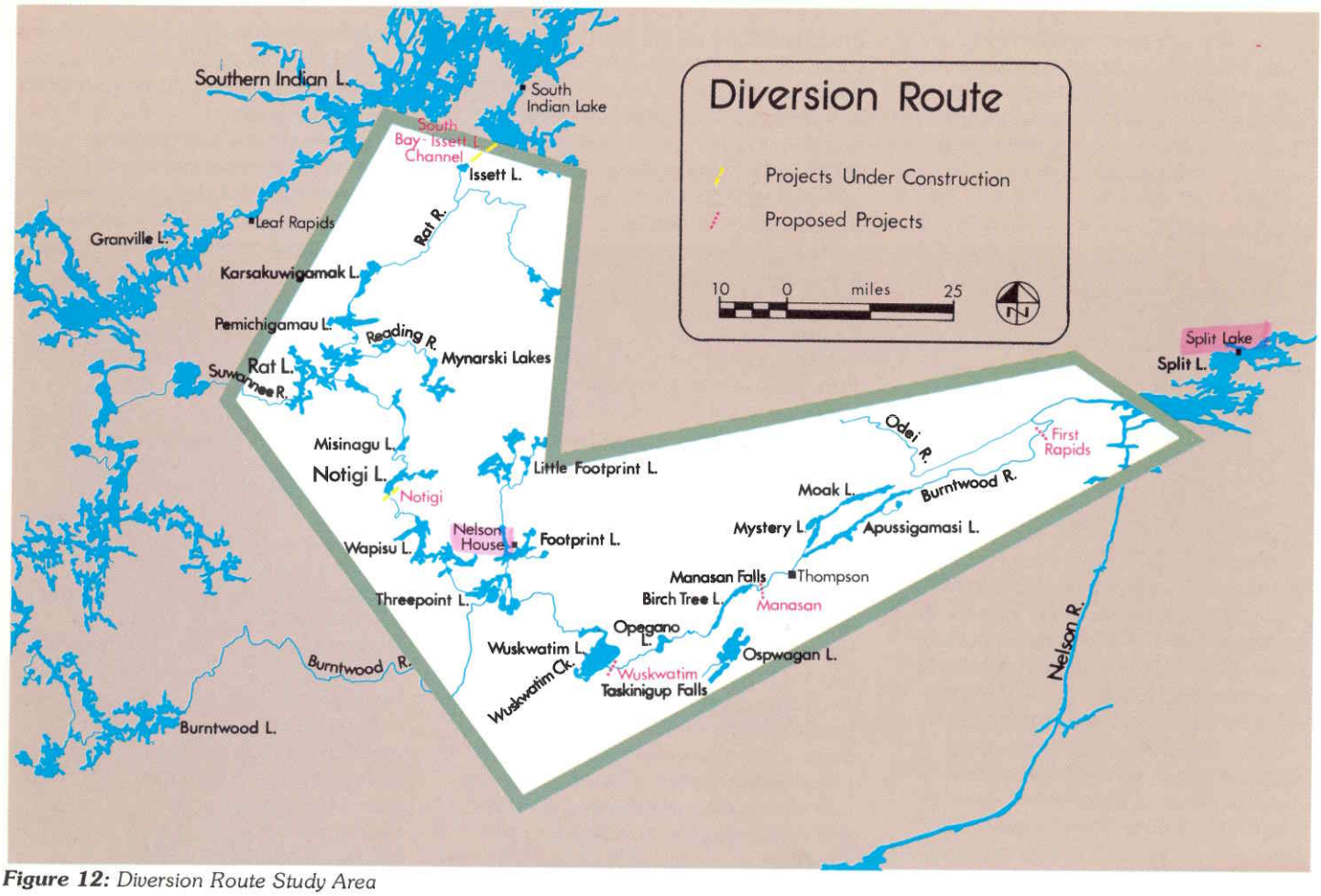


Figure 12: *Diversion Route Study Area*

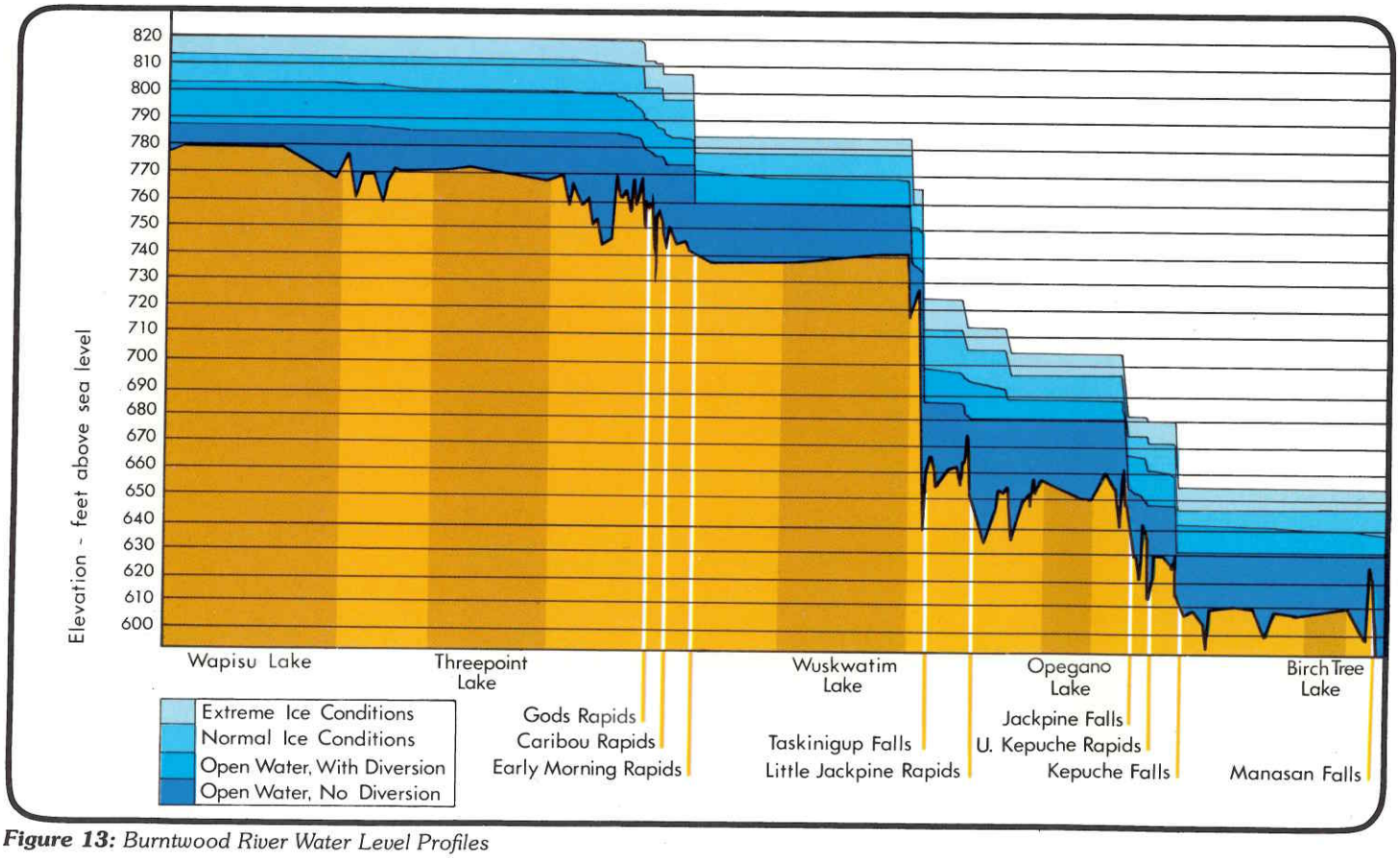


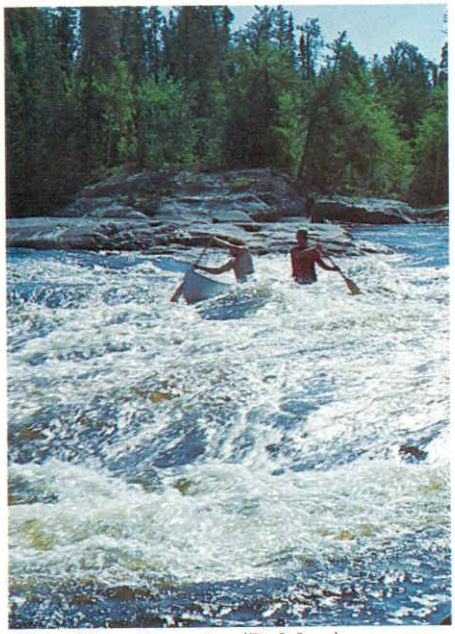
Figure 13: *Burntwood River Water Level Profiles*

Study Area III – Diversion Route

The location of the diversion route study area is shown on Figure 12.

Construction of the Notigi dam and control works is nearing completion and impoundment has begun which will eventually create a long lake extending northward to South Bay. This impounded body of water will become an integral part of Southern Indian Lake. When the Notigi forebay is full, it will flood approximately 158 square miles resulting in a total water area of 224 square miles between South Bay and Notigi. Water depths will increase by 25 feet at the north end of the impoundment and 50 feet near Notigi. With the large flow through the forebay of up to 30,000 cfs, a water level gradient will develop from South Bay to Notigi. Because of this gradient, water level fluctuations will be greater near the Notigi dam than at South Bay. Normally, water level fluctuations near the dam will be small but could under extreme conditions range from elevation 838 feet to 847 feet, the limits imposed by the licence. The licence also limits the flow releases through Notigi to 30,000 cfs with a further proviso that the releases will be such that the flow in the Burntwood River at Thompson will not exceed 33,500 cfs.

Diversion of Churchill River water will cause the average Burntwood River flow at Thompson to increase from 3500 cfs to 31,600 cfs. Water levels along the river and in the lakes along the diversion route below Notigi will rise accordingly inundating 70 square miles. The rise in the winter level will be much higher than the rise in the summer level. Ice jams will raise levels several feet above those prevailing under open water conditions (Figure 13). For example, Threepoint Lake and Footprint Lake are normally at about the 782-foot level, but after diversion the water will rise about 18 feet in summer to elevation 800 feet. However, in winter, the level can be expected to rise even further to 812 feet and in a winter when ice jams are particularly severe, to 820 feet. The proposed power plants at Wuskwatim, Manasan and First Rapids, when built, will drown the rapids and falls along the river, thereby significantly reducing the large differential in level between summer and winter. When the plants are built, however, the forebay levels will be raised and the water levels along the diversion route will be more nearly constant throughout the year than formerly. These power developments at these optimum forebay levels (800 feet at Wuskwatim, 690 feet at Manasan and 610 feet at First Rapids) will flood 172 square miles.



White Water Canoeing (R. J. Lay).

Russell Lake Shoreline after 20 years of Impoundment, Laurie River (Study Board).

Landscape Changes

The upper end of the diversion route, from South Bay to Notigi, will have lake-like characteristics. Below Notigi, the diversion route will be more like a river than a lake. Therefore, the changes in the character of the shorelines and the landscape will be significantly different between these two stretches of the diversion route.

South Bay to Notigi—The Rat River drainage system includes Issett Lake, Karsakuwigamak Lake, Pemichigamau Lake, Rat Lake, the Mynarski Lakes, Misinagu Lake and Notigi Lake, and the Reading and Suwannee rivers. The rivers have clay banks, are sluggish and are flanked by extensive marshes. The lakes, to a large extent, have Precambrian bedrock shores with some sand beach and marsh stretches. The channel connecting the lakes is largely bedrock controlled and has steep banks. The shoreline of the manmade reservoir behind the Notigi control structure will re-occupy the ancient shoreline of the lake left by the retreating glacier. This boundary will ease shoreline impact after diversion. The major change in landscape caused by the impoundment will occur in the upper Rat River region.

Clay banks will be eroded to bedrock and protected bays and stream valleys will remain clogged with standing and fallen timber which will delay shoreline stabilization. Flooding will reduce the variety of shorelines, eliminate marshes and sand beaches and will lengthen the existing shoreline from its present length of 500 miles to a new length of 1400 miles. A number of islands will be created and many low-lying clay islands will disappear. The steep terrain between Rat Lake and Notigi Lake will lessen the extent of flooding. Shoreline readjustment, however, will be delayed by debris and driftwood with the result that the new shoreline is expected to take over 50 years to stabilize.

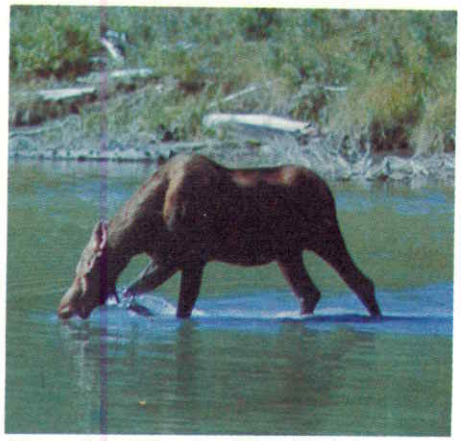
Notigi to Split Lake—The Notigi Lake to Split Lake waterway includes a short section of the Rat River and most of the Burntwood River. Wapisu, Threepoint, Wuskwatim, Opegano, Birch Tree and Apussigamasi lakes are located along this waterway. Major lakes draining into this system include Footprint Lake at Threepoint Lake, Ospwagan Lake below Manasan Falls and Mystery Lake near Apussigamisi Lake. The Odei River joins the Burntwood River just below the site for the First Rapids power development and eight miles upstream from Split Lake. Most of the Rat and Burntwood river banks are silt and clay covered bedrock. Diversion will cause erosion down to bedrock. Banks will remain cluttered with fallen timber. Areas protected from high flow velocities and waves, will be congested with dead standing trees. Sand beaches and marshes will disappear as flow rates and water levels rise. Channel widths will increase and clay banks will recede by as much as 70 feet.

Fishery

The lakes along the upper portion of the diversion route are commercially fished by residents of Nelson House but the catch is not an important source of income to the community. Domestic fishing is more important as it represents some $50,000 in income-in-kind for the community. Diversion will virtually eliminate both types of fishing in the area above Notigi because of debris. Shore access will be hazardous and existing fish camps on the Rat, Notigi and Mynarski lakes will be flooded. Fishing will also be severely restricted on Wuskwatim and Footprint lakes for the same reasons.

However, large areas of standing vegetation in the Notigi reservoir shallows will become spawning grounds for northern pike and trophy size fish are anticipated. Walleye may be attracted to the fast water of the Notigi tailrace to spawn and could provide ideal sport fishing. Methods to offset the effects of diversion on fish in this region hinge on the gathering of more information. Clearing of areas which might become new spawning beds has not been undertaken because it cannot be predicted where fish will spawn after impoundment. Plans to develop a commercial fishery should be delayed until the new system stabilizes. Questions as to the effects of timber clearing on erosion, shoreline adjustment and the biological productivity of the flooded area are important but cannot be answered at this time. A monitoring and research program could be attempted in selected cleared areas to obtain data for the formulation of clearing criteria for future reservoirs in northern Canada.

Moose Habitat (R. R. Taylor).



Moose (Cow) Feeding (R. R. Taylor).

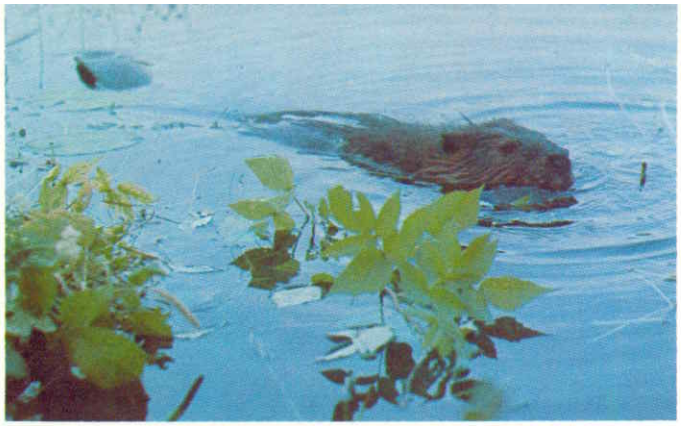
Beaver Lodge (R. R. Taylor).

Wildlife

Hunting along the diversion route is limited to the killing of waterfowl and animals for food and hides by Nelson House residents and for sport by hunters in areas accessible by road. Although moose populations range from low to moderate, moose harvests account for approximately $10,000 of the community's annual income as income-in-kind. Diversion will displace some of these animals and reduce shoreline hunting success. Waterfowl are worth approximately $20,000 annually as a food source for the people of Nelson House. Since most of the birds are taken during the short migration stops, the diversion project should have a negligible effect on this important food supply. Barren-ground and woodland caribou will lose some rangeland, but effects will be minor unless their migration routes change. As in the Outlet Lakes region, a native-sports hunter conflict can be expected as roads are extended and improved. Measures such as restrictions on public hunting are urged to ensure Nelson House residents an adequate supply of important food sources.

Trapping is also an important source of income-in-kind and revenue for Nelson House residents. Beaver, lynx, mink and muskrat pelts have provided over $60,000 annually. More than 60% of the community's 105 trappers will lose trapping territory due to flooding along the diversion route. Implementation of the diversion project and of the hydroelectric developments on the Burntwood River is expected to reduce potential annual harvest of beaver by about 10% (145 beaver) and muskrat by about 25% (4600 muskrats). The muskrat loss estimates are misleading, however, since they are based on potential annual yields; current trapping harvests are only a small fraction (approximately 10%) of the potential.

Apart from the upper Rat River and Wuskwatim Lake, the diversion route is



Beaver (R. R. Taylor).

Coyote (J. Sigurdson).

Red-throated Loon (Canadian Wildlife Service).

Red Fox (Manitoba Hydro).

not an important waterfowl producing area. However, large numbers of Canada geese use the area east of Apussigamisi Lake during fall staging. This staging area will be relatively unaffected by the project. Flooding will destroy existing marshes within the flooded areas along the diversion route. Without clearing, marsh re-establishment may take several decades. The harmful effects of diversion on wildlife could be lessened by promoting such methods as debris control and timber clearing in areas that could develop into marshes.

Forestry

Black spruce, white spruce and jack pine are the only tree species of commercial importance in the diversion route study region. Neither tamarack nor any of the hardwood species are currently harvested, except on a local scale as firewood. However, Manitoba Forestry Resources Ltd. has timber harvesting rights within this study region.

Flooding between Notigi and South Bay will reduce potentially productive forest area by 50,000 acres (78 square miles) and will cause losses of 30,000,000 cubic feet of timber. Below Notigi, another 15,000,000 cubic feet of timber will be lost in the 45,000 acres (70 square miles) that will be inundated. When the proposed hydroelectric generating stations are built at Wuskwatim, Manasan and First Rapids, an additional 20,000,000 cubic feet of timber could be lost in the flooded area which will increase by 110,000 acres (172 square miles). Any commercially valuable timber to be affected by the construction of generating stations along the diversion route should be harvested before the plants are built.

The improved access to the upper Rat River area by virtue of the completion of Provincial Road 391 and the South Bay access road has opened up new areas and might make timber harvesting operations in the area economically viable.

Mining

The Churchill River diversion route crosses a mineralized area. As in the Outlet Lakes area, a geological survey of the exposed bedrock formations which will be flooded was carried out. The survey was limited to the Ospwagan Lake area. Geological maps were completed and are available from the Manitoba Mines Branch.

Recreation

The Churchill River diversion route is an attractive area for wilderness canoeing, camping, hunting, fishing and photography. The area is also suitable for family vacationing especially at points along Provincial Road 391 which provides access to the Footprint River near Nelson House, to the Rat River at Notigi and to the Suwanee River. Northern pike trophy fishing and the possible installation of recreational facilities in the Notigi control structure area are post-diversion opportunities. Flooding, however, will reduce the overall attractiveness of the diversion route for canoeing, camping, hunting and fishing.

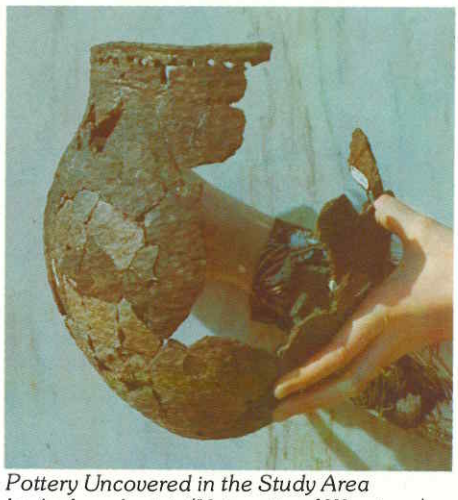
Studies show that one of the best potential recreational areas is located at Manasan Falls on the Burntwood River, approximately five miles upstream from Thompson. The recreational value of Manasan Falls and its environs lies in the area's potential to be developed into a heritage park. Diversion will downgrade this potential and the Manasan power plant, when built, will remove the attractiveness of the area as a heritage park. Suggested actions for utilizing the region's potential recreation value include development of a previously mentioned commercial recreation site, campgrounds and cottage areas near the Notigi dam; changing the location of the Manasan power station to accommodate a heritage park; construction of regulating works to maintain Footprint Lakes water regime and hence its recreational potential; and, a post-diversion debris removal program to reduce boating hazards on the Burntwood River.

Archaeology

The archaeological study produced new and significant data on early settlement ranging from possible Early Man (8000 to 4000 B.C.) to good Early Historic (Post 1690 A.D.) sites and a possible North West Company trading post. The collection of artifacts and information surpassed all earlier survey results as sites yielded a host of arrowheads, scrapers, pottery and other artifacts. The archaeologists also mapped and excavated Early Historic firepits which contained pottery, arrowheads, European trade beads and trade pipes.

One site, unique to Manitoba, is a Cree Indian dancing circle, a religious ceremonial site. Another discovery is believed to be an early European trading post. McGillivray's Rat River Journal (1789-1790) seems to substantiate the findings as it states that a North West Company trading post was located on the southwest point of Threepoint Lake. These sites not only surrendered valuable data, but provide natural opportunities for the development of recreational potential.

Previous information suggested a major movement of population into the area some time after 700 A.D. (the Terminal Woodland Period), but two arrowhead fragments found during the survey contradict this theory and point to a movement in the Early Man Period (8000 to 4000 B.C.). However, the fragments are too small to be conclusive. The archaeological study uncovered six sites containing pottery from the Initial Woodland Period (600 B.C. to 700 A.D.). Two of the sites produced many subsurface features and artifacts. These two are the most northerly sites of the period recorded in Manitoba. Pottery fragments at another 16 sites were traced to the Clearwater Lake Phase of the Terminal Woodland Period. Several archaeologists attribute this phase (1000 A.D. to Early Historic) to a Cree-speaking people. This new evidence suggests that the Cree followed a complex migratory pattern on a regular seasonal basis.



Pottery Uncovered in the Study Area by Archaeologists (University of Winnipeg).

Communities

There are two communities along the diversion route, Nelson House and Thompson. The impact of the diversion will be much more severe at Nelson House.

Nelson House—The most contentious issue arising out of the Churchill River diversion project appears to be the flooding of Indian reserve land. Approximately 2000 acres of the Nelson House Indian Reserve could be flooded.

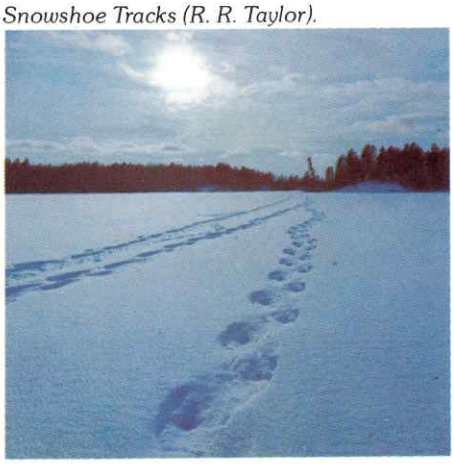
Again, as at Cross Lake, short-term job availability has had a great impact on the community. Of the 340 people in the community work force, an average of 40 to 50 Nelson House residents have been employed each month on

Archaeological Excavation, Wapisu Lake (University of Winnipeg).

Dog Sled Racing (R. R. Taylor).

Sport Fishing in the Study Area (Manitoba Government).

Snowshoe Tracks (R. R. Taylor).



Manitoba Hydro construction works. The majority of the men were involved in unskilled labour such as bush clearing. These jobs accounted for 37% of the community income in 1972-73. After the projects are completed, migration is unlikely because of lack of skills, strong family ties, cultural differences and low education levels. Studies predict a high rate of unemployment in the next few years unless construction of the proposed Wuskwatim development commences following completion of the Notigi dam.

Diversion is not expected to disrupt Nelson House traffic. The all-weather road link to Provincial Road 391 will be flooded in five places but it is to be raised. Within the Nelson House community over ice tranport could be hampered by changing ice levels and conditions. The higher levels will create new islands from peninsulas such as Poplar Point. These areas will be linked to the mainland by the existing roads which are to be raised. The community will experience substantial real property damages. There are 44 structures including 17 homes situated below elevation 815 feet which may either be flooded or damaged by shoreline erosion. There is also a possibility that buildings located above the 815-foot level will be threatened by long-term erosion. The predicted short-term dislocation of furbearing animals will mean pelt losses to 55 trappers on 26 traplines. Cabin losses will also occur. Fishing on Wuskwatim Lake will suffer as a result of the diversion project. However, this activity adds little to the income of the community. Hunting faces a long-term decline but diversion will merely add to a general turning away from the traditional pursuits of hunting, trapping and fishing.

During the course of the study, it became apparent that the Nelson House residents did not fully understand the diversion project and what will happen when it is operating. It was also discovered that prior to mid 1973 the community was unaware of possible effects of the project. Some time later that year the residents were alerted to the possible effects. However, detailed information was not available to counter community fears. This situation resulted in wide gaps between public opinion and actual facts concerning the project and its effects. The situation produced a hostile atmosphere at a time when local decisions related to the hydroelectric development were urgently needed. The pressures on community leadership and the need for correct information led to the formation of the intercommunity Northern Flood Committee. Long-term social impact is uncertain. Whether or not community anxiety decreases will depend on the Nelson House leaders and their ability to make decisions and to communicate with the residents thus helping them to adapt to change. To this end, a more regular flow of accurate information from government agencies to the community is essential. A new awareness by these agencies of community problems and a willingness to cooperate have been steps in the right direction. The community's anxieties and concerns must be recognized and dealt with effectively.

Thompson—The city of Thompson is a major mining and mineral processing centre with a population of approximately 20,000. The Churchill River diversion will have an effect on its water supply, recreational activities and transportation facilities. Increased river flows and higher water levels will force modifications to the City's and the Birchtree Mine's water intake systems. These required alterations are being implemented. A water supply disruption would shut down the International Nickel plant and idle 4000 persons. In addition, stoppage of more than 10 hours would leave the City without water for emergency services. Diversion will also affect water skiing, fishing, snowmobiling and other recreational activities on the Burntwood River. Diversion would also result in relocation of the Burntwood River floatplane base because of water level changes and floating debris.

The airstrip at Thompson may require some protection before the proposed Manasan hydroelectric development is constructed. The southwest end of the runway is between elevations 690 feet and 700 feet and the presently proposed forebay level for the Manasan power development is elevation 690 feet. However, if a subsequent decision is made to raise the forebay level above elevation 690 feet, it would be necessary to provide a dyke to protect the runway.

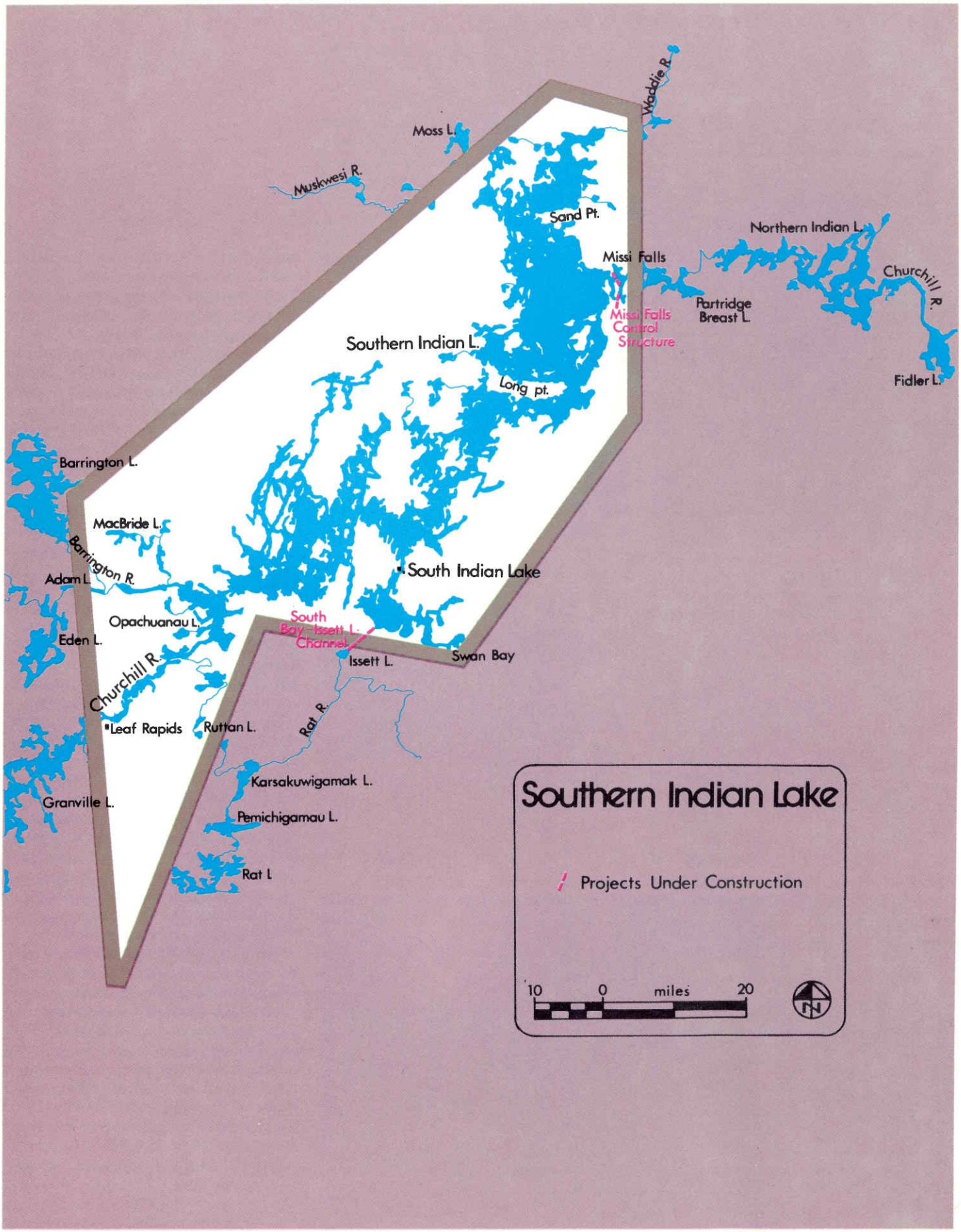


Figure 14: *Southern Indian Lake Study Area*

Study Area IV — Southern Indian Lake

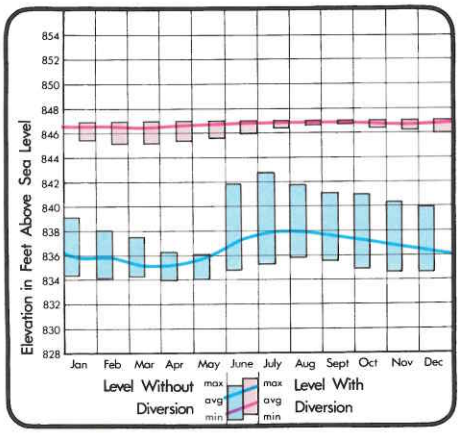
The Southern Indian Lake study area is shown on Figure 14.

The Churchill River diversion licence allows Manitoba Hydro to regulate Southern Indian Lake between elevations 844 and 847 feet, discharge up to a maximum of 30,000 cfs from Notigi, and operate the Missi Falls control structure to provide an outflow of not less than 500 cfs during the open water period and at least 1500 cfs during the ice cover period. Diversion will result in an average 10-foot rise in the level of Southern Indian Lake and its surface area will increase from about 763 square miles to approximately 935 square miles. Regulation of the lake will confine the range of levels to three feet instead of the normal nine feet (Figure 15). However, the licence constrains Manitoba Hydro to hold the range of fluctuation to two feet in any one year. The lake's flow pattern will change as 26,900 cfs, or 75% of its normal flow, is diverted through South Bay. The remaining 8900 cfs of the average flow will flow out of the lake at Missi Falls.

Landscape Changes

Raising the level of Southern Indian Lake will result in the inundation of 110,000 acres (172 square miles) along its 2280 miles of shoreline; 60% of this flooded area is classified as productive forest land. The lake's shoreline is basically bedrock covered with a thin layer of soil and stretches of sand beach, muskeg, willow and marsh. Studies indicate that erosion will re-form the bedrock controlled shorelines within 30 years, but sand beach and marsh areas will never return to normal and will contain standing dead trees for many years. Other anticipated effects of the raised lake level include: the submersion of many small islands and the creation of new ones from existing peninsulas, such as Long Point; an accelerated shoreline erosion; an increased sediment and nutrient loading; and, changes to the ice cover. Pre-diversion ice cover has been thick enough to handle heavy traffic. The lower velocities in the northern portion of Southern Indian Lake after diversion will generally improve ice conditions on the main body of the lake. Only at the South Indian Lake settlement will the ice conditions at the traditional crossings worsen. It is expected that the ice cover will either form later in the season or not at all.

Figure 15:
Southern Indian Lake Water Level



Fishery

Diversion of Churchill River water and impoundment on Southern Indian Lake are expected to lower the long-term biological productivity of the lake by 10% and, hence, the fish populations by a similar amount. The maximum decline will occur in the heavily fished region west of Missi Falls where the Churchill River flow, and consequently the supply of important nutrients, will be substantially reduced. The water will be diverted through South Bay. At present, very little Churchill River water enters this part of the lake. Productivity in South Bay will increase markedly but will not offset losses in the northern part of the lake. In lake regions unaffected by

Northern Pike (R. R. Taylor).

nutrient diversion, there will possibly be short-term decreases in fish production through the effect of increased turbidity caused by actively eroding shorelines. Although shoreline erosion releases new supplies of nutrients as well as sediments, the increase in turbidity is expected to nullify any gains from the increased nutrient supply because nutrient supplies are substantial under the natural regime.

Flooding will affect fish spawing in Southern Indian Lake. Fish migratory patterns could change and reduce spawning success. Suitable spawning grounds for whitefish are likely to be limited until inundated areas have cleared. Studies indicate that walleye spawning will suffer only if suitable sites are not available farther upstream on the lake's tributaries. Sauger spawning grounds will also be lost, but the fish is not abundant now and a number of beneficial factors from flooding are expected to minimize damage to the species. One species which will increase in abundance is northern pike, a species of low commercial value. It is expected to flourish at least temporarily because of new spawning sites and increased food supply. It could be attractive to fishermen in the future particularly in the period before the lake stabilizes at the new level.

Although fishermen have taken about 1,000,000 pounds of fish per year, there is no evidence of overexploitation in Southern Indian Lake. Commercial fishing on the lake will be more difficult following impoundment. The percentage decline in the commercial fishery due to reduced effort is likely to be greater than the overall 10% drop in biological productivity. Floating debris and cluttered shorelines will result in the loss of nets and will increase navigation hazards to the fishermen. The location of present fishing grounds closely match the areas of high biological productivity. If fishermen maintain their present level of effort in these fishing grounds, their catch will decline. Even if the South Bay region makes substantial gains in productivity and potential yield, the gains in this smaller area will not offset the losses in the much larger region west of Missi Falls.

The decline in yield could be offset if the total effort applied to the fishery increased. In other words, decline in catch per unit effort can be offset by more effort. The need for increased effort will probably result in marginal operators becoming discouraged and leaving the fishery. This human element, causing a decline in total effort, is likely to accelerate the decline of the commercial yield. This is especially true in the short-term when catch per unit effort will suffer while fishermen attempt to locate concentrations of fish under the new water regime. It is possible that the fishery may never again reach its present level unless the market for fish improves substantially.

In an attempt to reduce production losses, Manitoba Hydro has been carrying out a pre-flood clearing program which calls for the preparation of whitefish spawning grounds among islands in the Missi Falls area and ensuring that major walleye spawning streams are kept debris free. Clearing is also being undertaken to create safe shoreline landing sites for fishermen and safe boat access to all settlements and fish camps. Boating hazards and equipment losses might be further reduced by installing debris-holding booms in strategic locations. Local fishermen should be consulted on the most advantageous points for placement of booms.

The above impact assessment was based on the assumption that the mean annual discharge at Missi Falls will be approximately 6,900 cfs. Biological productivity in the northern portion of the lake will decline under this flow condition, but the consequences will not be drastic. However, as provided in the licence, Manitoba Hyro can hold the mean annual discharge at 1000 cfs in dry years. With this minimum flow of 1000 cfs, the basic biological productivity of the lake would not remain at an acceptable level. A mean annual discharge of 5000 cfs at Missi Falls would be the minimum flow required to retain an acceptable level of biological productivity in this part of the lake. To be most beneficial, this acceptable annual flow should follow the natural variation, in other words, high in late spring and early summer and low in winter.

Wildlife

South Indian Lake residents shoot about 1000 ducks and geese and as many as 50 moose each year for food and hides. Sport hunting is minimal and is limited to the Opachuanau Lake area near Leaf Rapids. Most of the moose kills are made along the lake's shoreline which will be generally less accessible after impoundment. Flooding will also destroy moose feeding areas along shorelines, thereby reducing the number of animals frequenting the lakeshores. Although

Effect of Flooding, Sipiwesk Lake (Study Board).

waterfowl production has always been low, production will decrease as nesting sites are submerged. At least three species of gulls and two species of terns nest on Southern Indian Lake. Flooding will destroy their colonies and only by clearing suitable small islands can alternative nesting sites be provided. Better road access may produce a native-sport hunter conflict in the South Indian Lake community area.

Trapping of beaver, lynx, mink, muskrat, wolverine, wolf and fox has provided South Indian Lake residents with an average gross annual income of about $35,000 in the period 1967-72. The beaver population will decline after flooding around Southern Indian Lake with losses in potential production of approximately 10%. However, only a small fraction of the region's beaver pelt potential is currently tapped.

Wildlife and wildlife habitat losses can be reduced by clearing offsore timber to assist shoreline redevelopment and by delaying initial flooding until the last week of June or early July to minimize effects on nesting waterfowl, gulls, terns and muskrat. To compensate for the expected decrease of beaver, a fur management plan should be initiated. A management plan should also be developed for harvesting moose and caribou. This plan would only include sport hunting if animal populations are large enough.

Forestry

A large area of productive forest land, amounting to approximately 66,000 acres (103 square miles), will be flooded around Southern Indian Lake. However, the volume of timber flooded is insignificant in terms of total volumes of timber available in the region. Access to localized good stands of timber is and will continue to be difficult. This detracts from the commercial value of the forestry resources in this region particularly in the northern portion.

Loon Narrows Fish Station, Southern Indian Lake (Study Board).

Recreation

Recreation in the Southern Indian Lake region is virtually non-existent at present there is only minor recreational use foreseen in the future with or without the Churchill River diversion project. Sport fishing may become important in some local areas near Leaf Rapids, but generally the lake is too inaccessible to be used for intensive recreation purposes. Areas such as Opachuanau Lake and the Churchill, Barrington and McBride rivers offer some potential but these areas will undergo changes resulting in dead standing timber which will detract from shoreline scenery. Flooding will also increase boating hazards because of floating debris and will reduce moose hunting potential due to shoreline inaccessibility. Recreation benefits will accrue from: improved road access; the completion of the Lynn Lake to Thompson road and the South Bay construction road; and, improved northern pike fishing. There is also a possibility that Leaf Rapids could become a major sport fishing centre. Manitoba Hydro's pre-flood clearing and debris control program will offset losses of recreational potential. The program includes clearing of stream mouths for walleye spawning, clearing of shoreline boat landing areas, and holding of debris in off-stream bays. A plan for recreation should be developed for the Churchill River near Leaf Rapids.

Archaeology

When it was discovered in the late 1960's that the flooding of Southern Indian Lake would cover archaeological sites, the provincial government moved to create a study group known as the Churchill Diversion Archaeological Project (CDAP). The study was funded and coordinated by the Manitoba Parks Branch. The archaeological findings uncovered by CDAP will be published at a later date by the Archaeological Research Centre, University of Winnipeg. Six technical reports have been prepared and will be available at all Winnipeg libraries and university libraries across Canada.

Communities

Two communities are located within the Southern Indian Lake study area, South Indian Lake and Leaf Rapids. The community of South Indian Lake has undergone and will continue to undergo many changes as a result of the diversion project. The impact on Leaf Rapids, on the other hand, will be minimal.

South Indian Lake—The most significant effect of the Churchill River diversion project on the South Indian Lake community has been the creation of new jobs. As at Cross Lake and Nelson House, few residents have acquired skills along with their new prosperity and their higher hopes will go unsatisfied when projects in the area are completed. The attraction of better paying jobs has added to problems in the local fishing industry. South Indian Lake Co-op Fisheries Ltd. was forced to pay higher wages to compete with wages on construction projects, but despite the higher wages the Co-op continued to lose members and employees. The result was a decline in fish catch.

The community's winter road across South Bay may have to be relocated after diversion due to poor ice conditions near the community. However, the possibility of an all-weather road has increased with construction of the road to South Bay, 17 miles away. The South Bay road connects to the provincial road system. Intra-community travel will be seriously affected by the diversion project. South Indian Lake residents use the narrows extensively both in winter and summer. The diverted water flowing through the narrows will probably prevent the formation of a competent cover required for winter traffic. Boating may be impeded by debris. The anticipated rise in water level has prompted the building of 20 new homes and construction of 30 to 50 more is proposed for 1975. Most of these homes will be built in the area around the new town centre on the east side of the narrows, thereby effecting a relocation of the major portion of the community from the west side of the narrows to the east side.

Studies point to some disruption of fishing and trapping in the Southern Indian Lake region. A projected long-term decline in fish populations and increased fishing problems will reduce annual harvests more than 10% below present levels. The fishing problems related to the diversion include changed fish migration patterns and the recurring problem of debris damage to nets, motors and other equipment. Thirty trappers on 22 traplines will be affected by the expected decline in furbearing animal population. Beaver, the furbearer which provides the majority of the community's trapping income, could be reduced in numbers by approximately 10% in some areas. The region, however, is trapped to only a small portion of its potential and, thus, the loss to trappers will be less than 10%. Muskrat and mink will also be affected directly by flooding. Lynx may be affected indirectly through a loss of prey species on productive shorelines. These losses, however, are considered to be insignificant. Trappers will also be faced with some loss of equipment and increased shore access difficulties.

The announcement that the Churchill River diversion project would proceed and the subsequent political and legal controversies placed considerable stress on the residents of South Indian Lake. Some factors which more recently have helped reduce community anxieties are: an increased flow of accurate information on the diversion project; an increased awareness on the part of government agencies and Manitoba Hydro to the need for community participation in local planning and decision-making; a shift to local decision-making which has spurred problem-solving and bolstered harmony with outside agencies; and, a demonstrated willingness by government agencies and Manitoba Hydro to help and to compensate the community.

Leaf Rapids—Leaf Rapids, a mining community having a population of approximately 3000 and located beside the Churchill River near Opachuanau Lake, will experience minor recreational disruptions. Many residents utilize the nearby river and lake for fishing, boating, picnicking and other recreational pursuits. To alleviate boat launching inconveniences and to improve the aesthetics along the flooded shoreline, Manitoba Hydro will clear the shoreline of the heavily used area near the community. Manitoba Hydro will also clear the portion of shoreline north of Leaf Rapids that will be visible from Provincinal Road 391.

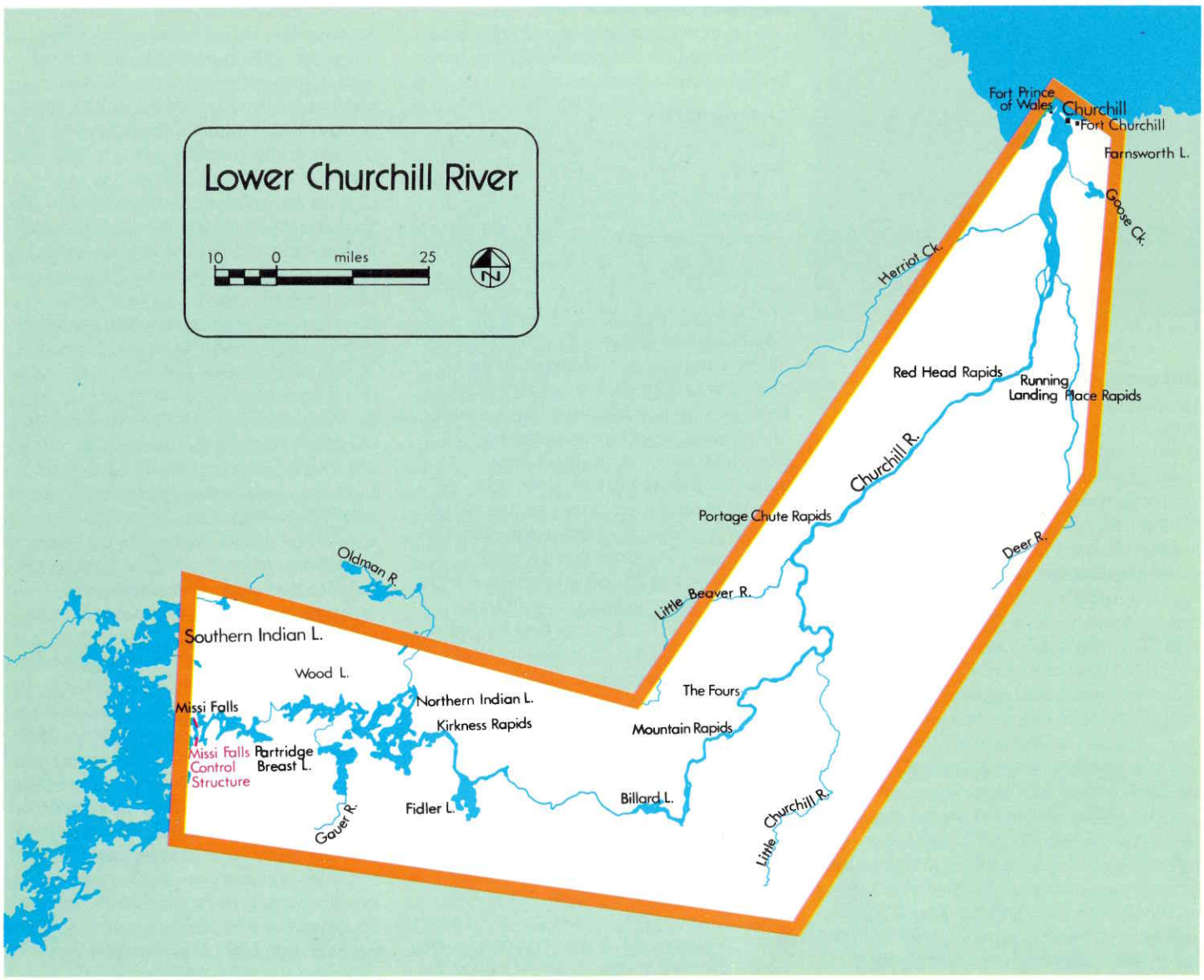


Figure 16: *Lower Churchill River Study Area*

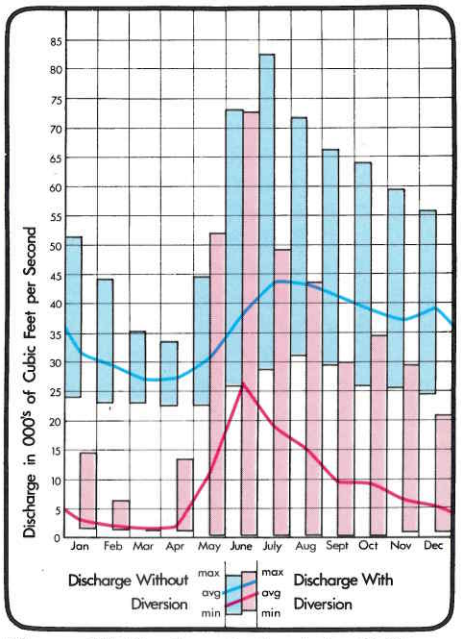


Figure 17: *Southern Indian Lake Outflow at Missi Falls*

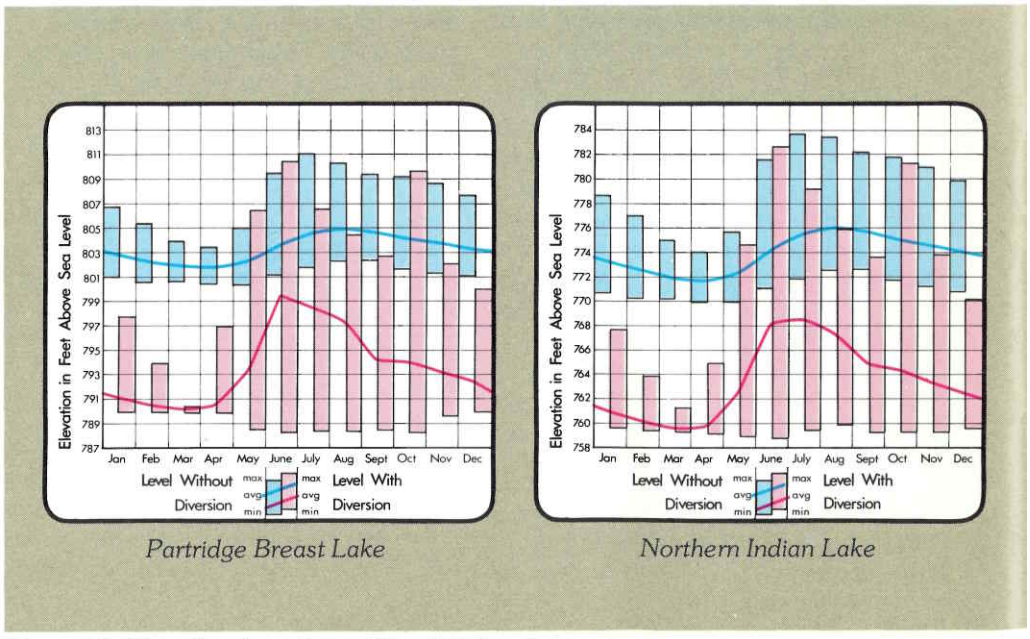


Figure 18: *Water Levels on Lower Churchill River Lakes*

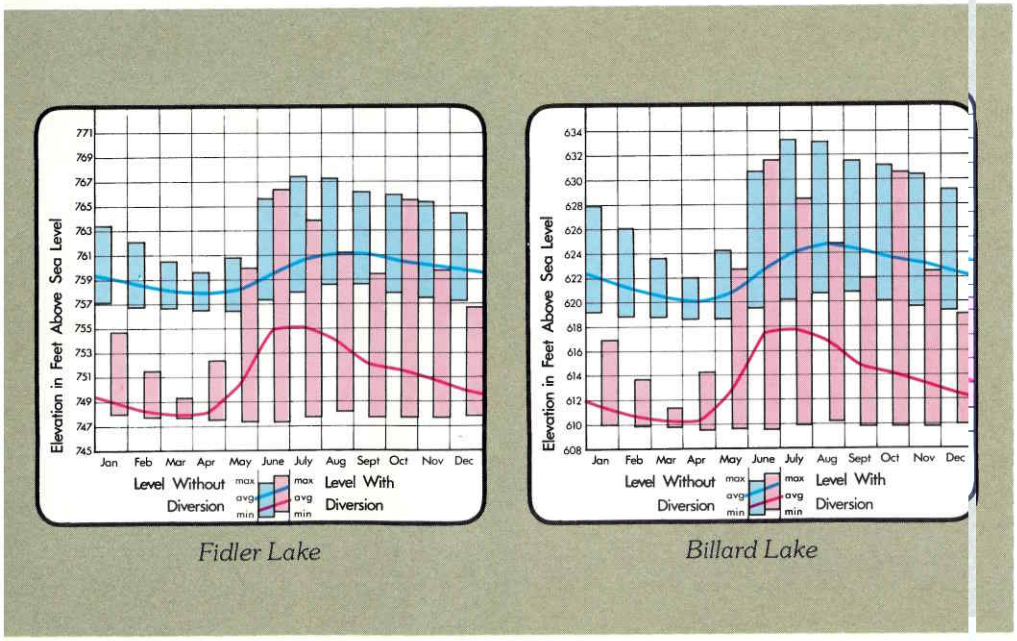
Study Area V — Lower Churchill River

Construction at Missi Falls, Summer 1974 (Manitoba Hydro).

Canada Geese (Manitoba Government).

The lower Churchill River study area is delimited on Figure 16 and the expected mean monthly discharges into the lower Churchill River are shown on Figure 17.

Studies indicate that the post-diversion average discharge through the Missi Falls control structure during the freezeup period, approximately 8,900 cfs, will maintain flow in the Churchill River. However, if the minimum allowable outflow of 1500 cfs from Southern Indian Lake at Missi Falls occurs in combination with low temperatures during the ice cover formation stage, the river could essentially freeze to its bed. To ensure early and stable ice cover and adequate downstream flow, the minimum discharge at Missi Falls should be maintained at 4000 cfs until December 15, the latest date on which ice cover has formed. Lower water levels and ice cover levels will affect the water supply at the Churchill townsite. Low flows and high tides could result in the intrusion of salt water into the local water supply and low ice cover levels could damage the intake pipe. The appropriate government agencies and Manitoba Hydro have been alerted to these study findings. Suggested remedial measures include artificially raising the water level at the intake pipe by building a weir downstream, relocating the intake pipe, and seeking an alternative source such as a nearby lake. Lower flows in the fall could delay ice cover formation in the harbour at Churchill by as much as 15 days. This condition will not necessarily allow an extension of the shipping season as ice formation in Hudson Strait is also a limiting factor.



Fidler Lake *Billard Lake*

Landscape Changes

From Missi Falls to Hudson Bay, the Churchill River traverses a distance of 280 miles. It flows through a zone of granite and then limestone and finally sandstone bedrock. Rapids and falls are frequent. The granite section, part of the Canadian Shield, is overlain with thick glacial till covered with black spruce. The Shield region gives way to tundra in the Hudson Bay Lowlands. Permafrost causes river bank instability and the Churchill River banks are actively slumping except where steep rock outcrops occur. The effect of the diversion will vary depending on shoreline type. The lake sections will undergo more change than the river sections. All four lakes in the lower Churchill River (Partridge Breast, Northern Indian, Fidler and Billard) will experience an average drop in level of nine feet (Figure 18). Of the four lakes, Fidler Lake will be affected most as its surface area will shrink 76% under average flow conditions. Under minimum discharge conditions of 500 cfs in summer and 1500 cfs in winter, the lakes will shrink an additional 20 to 30%. Around the lakes, extensive mud flats and boulder zones will be exposed which may vary from 100 to 1000 feet in width. The existing shoreline sedge and grass areas will be replaced by shrubs in time, but marshes will not redevelop to the extent that existed in the natural state. The majority of the newly exposed area is expected to remain barren. Along the lower

Churchill River, numerous reefs will appear and islands will increase in size. The areas exposed by lower water levels will be subject to wave action and the eroded material will increase turbidity over large areas of the lakes.

Fishery

Three of the four lakes are fished extensively by members of the Ilford Co-op. The three lakes, Partridge Breast Lake, Northern Indian Lake and Fidler Lake, yield a total of 135,000 pounds for an annual income of about $16,000. However, post-diversion water levels and flows will give rise to a decrease in fish food and a reduction of fish populations. Walleye and pike spawning will suffer, but whitefish reproduction will be hardest hit as levels will drop during and after the spawning period. Studies indicate that minimum flow releases at Missi Falls will cause drastic reductions in fish populations and productivity. Not only could lake fishing cease but continued existence of fish in the lower Churchill River could be threatened if the river freezes to the bottom. Such an occurrence would violate the federal Fisheries Act. To lessen these diversion effects, control structures at the outlets of the lower Churchill River lakes could be constructed to stabilize levels. A continued and guaranteed release of 5000 cfs from Southern Indian Lake would ensure an adequate level of nutrient supply to maintain fish productivity. It has been estimated that a 5000 cfs winter discharge would ensure a minimum flow of at least 1000 cfs throughout the entire reach.

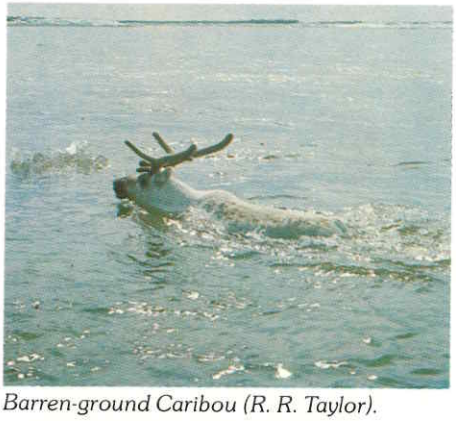
Wildlife

Diversion will have little effect on the moose population of the lower Churchill River. Although a few animals may be shot by trappers and fishermen, moose are scarce and sport kills are negligible. Caribou are also scarce. Some 250 polar bears congregate in the Cape Churchill region each fall prior to moving out onto the ice on Hudson Bay. Since shore ice development at Cape Churchill appears related to the amount of freshwater input from the Churchill River, the low flows after diversion could cause a delay in shore ice formation and delay the bears' normal mid-November departure. In the past, a number of bears have wandered into the townsite and created problems. Delaying the departure of the bears onto the sea ice would prolong the problem period.

The lower Churchill River area has a harsh climate which is reflected by low numbers of aquatic furbearing animals in the region. Although the area is actively trapped, annual income is low being less than $10,000. Overall furbearer productivity will be lower after diversion. Duck production is also low because of the harsh climate. However, the region's remoteness, the existence of peripheral muskeg ponds, islands in the lakes, and vegetation along the ice-scoured shorelines attract a significant number of Canada geese of both the Western Prairie Population and the Eastern Prairie Population. Most important to the geese are the islands in the lakes of the lower Churchill River and the ice-scoured banks which offer sedges and grasses for nesting and grazing. The area subject to ice-scouring will be reduced and the configuration of the islands will be changed after diversion causing a reduction in goose productivity. The reduced production of young could be critical to the Canada geese of the Western Prairie Population. This group is smaller in number than the Eastern Prairie Population and any loss of production would be of proportionately greater consequence. Nesting site destruction could be minimized by ensuring steady flows during the May-June nesting period. Control of levels on the lakes of the lower Churchill River would maintain populations of furbearing animals and waterfowl.

Recreation

Except for a few canoe expeditions down the river each year, the recreational use of the lower Churchill River is confined to the reach extending 60 miles upstream from the Churchill townsite.



Barren-ground Caribou (R. R. Taylor).

Tundra Near Churchill (R. R. Taylor).

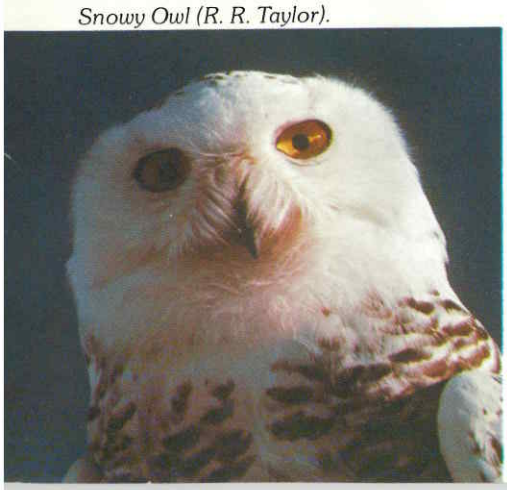
Polar Bear with Cubs (Manitoba Government).

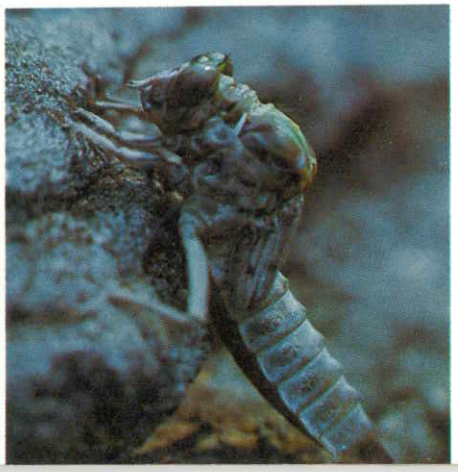
This 60-mile reach of the lower Churchill River has three cottage areas on or near the river. Studies point to excellent grayling fishing at Goose Creek which discharges into this part of the Churchill River. Pike, walleye, and speckled trout are also available in the area. Other activities include goose and duck hunting, winter pike fishing at the mouth of Herriot Creek and snowmobiling. However, local tourism at Churchill is limited by a lack of facilities. There is a demand to upgrade and expand services to the existing cottage areas and a central tourist lodge appears feasible for the Churchill region. Visits to barren land outcamps, to polar bear denning areas and to York Factory could be exploited as part of a 'tundra tours package' as indicated in the provincial governments, "Guidelines For The Seventies" publication of March 1973.

There are further opportunities for tourism and recreation which include guiding and outfitting canoe parties using the Deer River and local cooperative-organized goose hunts. With improved access across the Churchill River at its mouth, Fort Prince of Wales could become a major tourist attraction and Cape Merry could be developed for tourism. Expanded facilities could make Churchill a tourist centre with a broader base than the present Whaling Co-operative and CNR train excursions. Low river flows could lower this potential by rendering cottage areas unattractive and by leaving the Churchill River and its tributaries too shallow for boating and fish. The area around Churchill is part of the Hudson Bay Lowlands and, as such, could receive prime consideration for national park designation. Reduced flows might have such a severe effect on the environment that this consideration would have to be dropped in favour of an area that had not been altered. Possible recreation potential could be safeguarded by the building of river level control works at the head of the estuary to provide a depth of water adequate for boats and fish. Control works at the outlets of the lakes in the lower Churchill River would help to preserve the recreation potential of those lakes.

Port of Churchill (Manitoba Government).

Snowy Owl (R. R. Taylor).



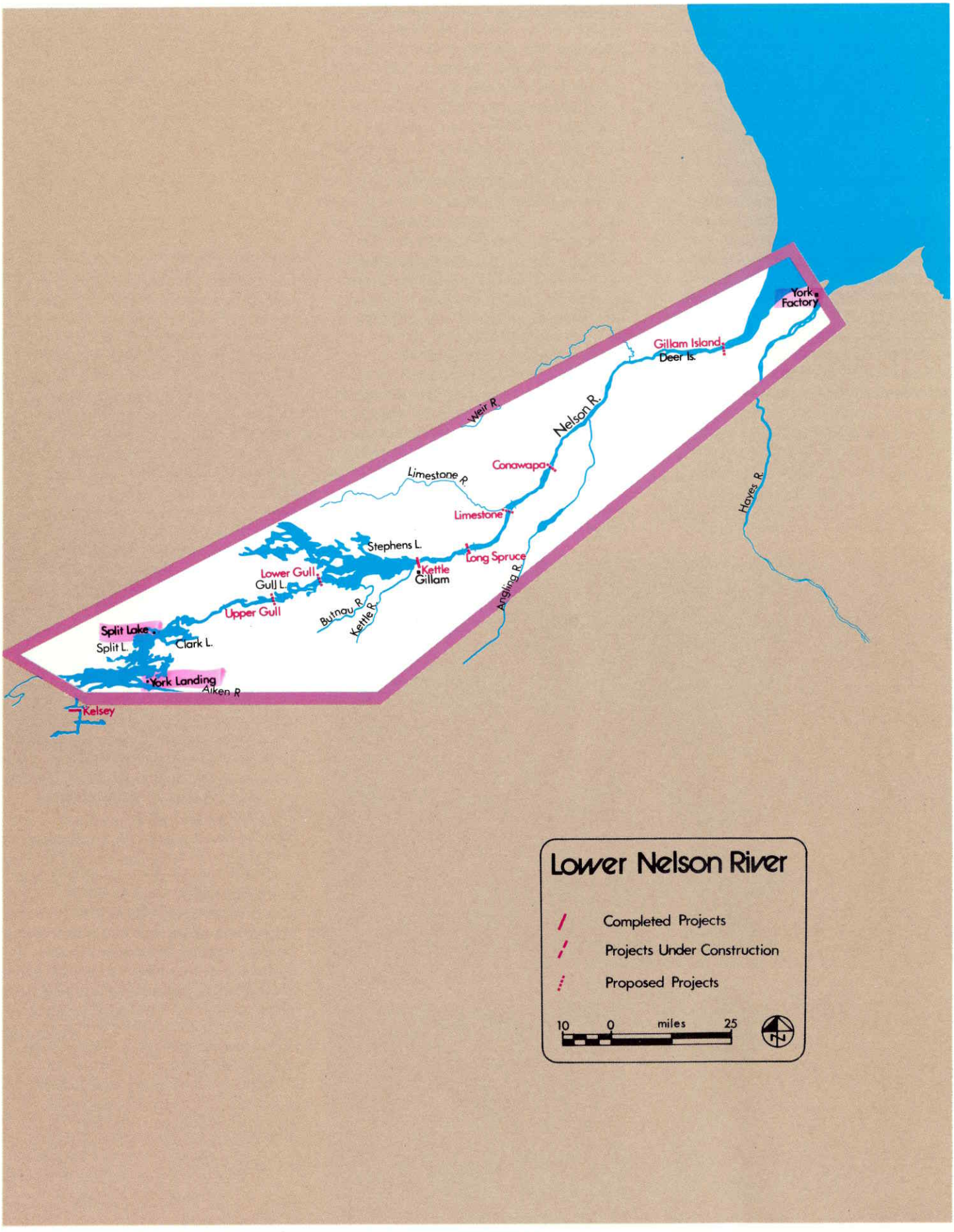


Communities

Churchill—Churchill is linked to the outside by air, rail and sea. The townsite has an elaborate road network connecting its four sections, Fort Churchill, Dene Village, Akudlik and Churchill. A federal-provincial townsite redevelopment program is underway to consolidate these communities and to provide improved municipal services to the 3500 residents. The airport is fully equipped for instrument landings; the Canadian National Railways' Hudson Bay branch line offers a rail link south; a float plane base is located at nearby Farnsworth Lake; and, seaport facilities serve incoming ocean freighters and coastal resupply vessels. The port's main commodity is Prairie grain destined for Europe but such commodities as sulphur are also becoming important. The National Harbours Board is undertaking an extensive program to improve the port's facilities. The low flows resulting from the diversion project could cause the port's ice-free period to be extended by 15 days, thereby extending the shipping season. However, ice buildup in Hudson Strait could be the constraining factor.

Ilford—Ilford, a predominantly non-treaty Indian community of about 200, is located outside of the study area but could experience considerable economic hardship as a result of disruptions to its commercial fishery on Partridge Breast, Northern Indian, Fidler and Billard lakes. It is expected that due to dramatic reductions of levels on these lakes, commercial fishing will become economically unfeasible.The Ilford Co-op has derived approximately 40% of its fish production and 30% of its landed value from these lakes. The loss of this production will likely result in extreme financial hardship both for the 11 men who fish these lakes and for the Co-op as a whole.

Dragonfly Nymph, Common in Study Area (R. R. Taylor).


York Factory
Gillam Island
Deer Is.
Weir R.
Nelson R.
Conawapa
Limestone R.
Limestone
Hayes R.
Stephens L.
Long Spruce
Kettle
Gillam
Lower Gull
Gull L.
Upper Gull
Butnau R.
Kettle R.
Angling R.
Split Lake
Split L.
Clark L.
York Landing
Aiken R.
Kelsey
Lower Nelson River
Completed Projects
Projects Under Construction
Proposed Projects
10
0
miles
25
N

Study Area VI — Lower Nelson River

Nelson River below Kettle (R. J. Lay).

The lower Nelson River, stretching from Split Lake to Hudson Bay (Figure 19), will be affected by both the Churchill River diversion and the Lake Winnipeg regulation projects. Its full potential will be harnessed by seven power plants. The Kettle generating station has been completed and construction has begun at Long Spruce. The other power plant sites include Upper and Lower Gull, Limestone, Conawapa (Lower Limestone), and Gillam Island. All seven projects will affect specific areas in the lower Nelson River region. However, the terms of reference of the study did not provide for assessments of these effects. Therefore, studies reported herein were confined to assessments of water regime and landscape changes resulting from diversion and regulation only. Impacts on the communities of Split Lake and York Landing were also studies.

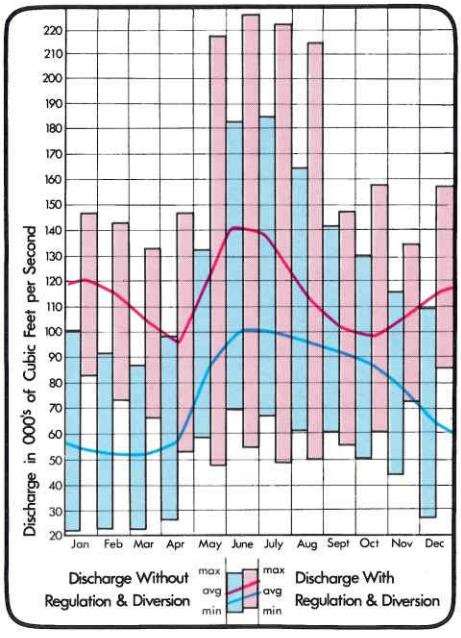


Figure 20: *Nelson River Flow at the Outlet of Split Lake*

The lower Nelson River will be subjected to the combined influence of regulated flows from Lake Winnipeg and diverted flows from the Churchill River (Figure 20). Under these influences, the average annual flow in the lower Nelson River will be increased by 26,900 cfs, the average rate of flow to be diverted from the Churchill River. The lower Nelson River discharge will be increased in most months, and only rarely can it be expected to fall below the natural flow. The highest annual flow occurs in mid-summer and drops gradually to a winter low. With the two projects in operation, the high discharges will still occur in the summer as they are associated with spring runoff. However, the flow will decrease to an annual low in late summer and rise again in winter when power demand is high. The average Nelson RIver winter flow at Split Lake will increase from 63,400 cfs to 104,800 cfs.

Water levels on Split Lake will follow the same pattern of fluctuation as that of the flows. The average level on Split Lake will rise by two feet from its present mean level of 545.6 feet. The range between the maximum and minimum levels will remain unchanged at 10 feet.

Landscape Changes

Largely clay-covered bedrock, Split Lake's shores will erode 10 to 20 feet after diversion and regulation and then stabilize quickly. The wind sheltered bays will accumulate debris eroded from the shores of the lake and from the Burntwood River. It is not anticipated that any great quantity of floating debris in the Burntwood River will reach Split Lake. The Burntwood River for a considerable distance upstream from Split Lake will

be subjected to only a minor increase in water level and much of the floating material from upstream will become lodged along the way. Downstream from Split Lake, granite bedrock gives way to limestone near Long Spruce Rapids. At this juncture, there is a steepening of the banks. Below the Weir River, the Nelson River becomes shallower as it drops toward Hudson Bay. Ice jams form in this section scouring the banks and causing bank slumping. Higher water levels will increase bank erosion but the impact is not likely to be serious.

Water Quality

Although the Churchill River diversion will result in substantial changes to water quality and increases in sediment concentrations in the Burntwood River, little or no reduction in the quality of the water is anticipated in Split Lake. It is predicted that the total suspended sediment load discharged into Split Lake from the Burntwood River will increase from about 200,000 tons per year to 7,000,000 tons per year in the immediate post-diversion period.

Communities

Split Lake and York Landing—Split Lake, an Indian community of approximately 1000 people, has experienced community tension arising out of uncertainty related to the resource impacts of the Lake Winnipeg regulation and the Churchill River diversion projects as well as of the proposed Upper Gull hydroelectric development. It is expected that the impact of these two projects will be minor in terms of the effect on furbearer populations around the lake. However, significant losses to fish populations are expected due to increased sediment loadings which will affect spawning grounds. In addition, there may be periodic damages to fishing equipment due to an increase in the amount of floating debris on the lake. Residents have expressed concern that increasing sediment load will compound the community water quality problems. Study findings, however, have failed to substantiate this concern. In the future, the proposed Upper Gull hydroelectric development and the provision of an all-weather road link resulting from the construction of the Thompson to Gillam road will cause significant social and economic changes both at Split Lake and at the smaller community of York Landing.

Ice Jam, Lower Nelson River (Study Board).

Recommendations

Allocation of existing natural resources for alternative uses and among competing user groups is probably the greatest problem facing resource managers today. The confrontation between wilderness advocates and commercial developers bears witness to this problem. Since benefits and costs from alternative resource uses may accrue to different groups in our society, it is important that the distribution of benefits and costs be examined in detail. Who are the principal recipients of the benefits, and who bears the burden of the costs? Failure to identify the beneficiaries of resource allocation decisions can readily result in a transfer of benefits to one particular group in our society at a cost to another.

Manitoba Hydro is a public utility. It is a corporate "creature of state" which has the provision of electrical service at least cost as its prime motive. As a Crown corporation, the residents of Manitoba may be regarded as "stock holders" in Manitoba Hydro in much the same way as they may be regarded as "stock holders" in Manitoba's natural resources. Therefore, additional costs to Manitoba Hydro to compensate for displaced resource productivity should be equated only to the value of the displaced resource. Private property damages, lifestyle disruptions and income losses resulting from displaced resources, however, should be compensated. To do otherwise would distribute or transfer costs to a specific group of Manitobans.

It is within this context that the Lake Winnipeg, Churchill and Nelson Rivers Study Board developed its recommendations.

A final point to note in understanding the perspective in which the recommendations were made is the fact that the study was undertaken concurrently with the hydroelectric development. To provide the maximum amount of lead time for problem solving, information on specific impacts and actions were recommended during the conduct of the study. Thus, many of the recommendations contained in this report have been acted upon or are under active examination. The recommendations in these categories have been noted. Page numbers noted in parentheses refer to the location in the text where the rationale leading to the recommendations has been developed.

The Lake Winnipeg, Churchill and Nelson Rivers Study Board recommends the following actions to the Minister of Environment Canada, to the Minister of the Manitoba Department of Mines, Resources and Environmental Management, and to Manitoba Hydro:

1. THAT a body with broad representation be established to advise on the management of the waters affected by the regulation of Lake Winnipeg, and the diversion of flows from the Churchill River, with the view to ensuring the optimum utilization of the resources within the area influenced by these waters.

   The functions of this body would be to advise on
   (a) patterns of regulation for the levels of Lake Winnipeg and flows from Southern Indian Lake taking into consideration all resources and recognizing the terms of licences granted to Manitoba Hydro for regulation of Lake Winnipeg and diversion of flows from the Churchill River,
   (b) the development of a comprehensive resource management plan for the area affected by the hydroelectric projects, and
   (c) the implementation of the plan.
2. THAT a flow forecasting program be developed from which projections of inflows to Lake Winnipeg and Southern Indian Lake can be made.
3. THAT Manitoba Hydro and other resource developers provide just compensation or mitigation for all damages resulting directly from the developments.
4. THAT a special appeal mechanism be established to which unresolved compensation issues can be referred for adjudication.
5. THAT a mechanism be established to deal with social and related economic issues including:
   (a) information and communication problems related to hydroelectric development with particular emphasis on the alleviation of social psychological stress,
   (b) mitigation and compensation issues, and

(c) monitoring and analysis of ongoing social and economic changes related to hydro-electric development and, more generally, northern development.

6. THAT federal and provincial government departments and agencies, with special emphasis on consultation with northern residents, develop a long-term northern development program to deal with the needs of northern Manitoba communities including:
   (a) the provision of technical assistance to community councils for the development of decision-making, problem-solving, communications and community life skills; and,
   (b) the establishment of guidelines outlining "developer" roles and responsibilities to clarify and make known the responsibility of potential developers to compensate for effects on infrastructures, livelihood, lifestyle, and local employment as well as to manifest a respect for cultural differences, local authority, community decision-making and communication processes.
7. THAT the concerns of northern residents be more meaningfully recognized and considered in the planning and implementation of resource development projects.
8. THAT a more comprehensive information dissemination program be implemented to inform residents of northern settlements of resource development activities and likely implications to their communities.
9. THAT, where local residents prefer to pursue traditional lifestyles and where it is possible to do so, opportunities to follow such a lifestyle be provided.
10. THAT appropriate government departments and agencies develop and implement a long-term coordinated ecological monitoring and research program to allow impact evaluation and to assist in the ongoing management of the affected area. (Page 7).

This recommendation was transmitted to the Ministers and to Manitoba Hydro during the course of the study.

11. THAT a clean-up and restoration program be carried out at all construction sites and construction campsites after the activities have terminated and the camps vacated.
12. THAT debris control programs be developed and implemented where required in project areas in consultation with local community representatives.
13. THAT an ice cover monitoring program be established to identify safe over-ice crossings in the vicinity of the communities of Cross Lake, Split Lake, Nelson House and South Indian lake, and along all winter roads where they cross lakes and rivers affected by the projects, and to identify and mark areas where ice crossings may be hazardous. (Pages 37, 43, 47).
14. THAT, prior to impoundment, clearing be completed in general accordance with the program developed by the Timber Salvage and Clearing Committee of the Manitoba Department of Mines, Resources and Environmental Management. (Page 7).
15. THAT Manitoba Hydro mark newly created hazards to navigation on existing transportation routes and in float plane landing areas.
16. THAT additional cultural centres or museums be established in northern Manitoba with a view to preserving native cultural heritage. (Page 29).
17. THAT community traplines affected by the projects be re-established to a condition acceptable to local community councils or that some mutually acceptable alternative be provided. (Pages 37, 43, 47).
18. THAT local people traditionally dependent on hunting in the area around construction camps be permitted to continue to hunt in these areas.

19. THAT treed zones be maintained between construction sites (such as borrow pits) and road or water routes. (Page 7).

This recommendation was transmitted to the Ministers and to Manitoba Hydro during the course of the study.

Lake Winnipeg

20. THAT a handbook be developed, published and distributed for the purpose of
    (a) providing interested citizens with information on Lake Winnipeg levels and rates of shoreline recession, and
    (b) assisting lakeside property owners in the construction and maintenance of suitable shoreline protective works. (Pages 31, 32).
21. THAT an experimental program be undertaken to demonstrate methods of developing and maintaining sand beaches along the shores of the south basin of Lake Winnipeg by constructing three or four sand beaches each approximately 400 feet long. (Page 32).
22. THAT the federal and provincial government departments and agencies co-operate to develop marsh management techniques and a management program for the Netley and Libau marshes. (Page 33).
23. THAT an embankment material evaluation program be undertaken to provide full information on the condition of the temporary dykes around Lake Winnipeg. (Pages 32, 33).
24. THAT the current program of dyke maintenance on Lake Winnipeg temporary dykes be continued and further measures be considered for sections of the dyking system which are continually subjected to erosion by wave action. (Pages 32, 33).

Outlet Lakes

25. THAT an all-weather road be built connecting the Cross Lake community road network with the Jenpeg access road. (Page 37).
26. THAT consideration be given to establishing a temporary fish handling station, docking facilities and a regular truck pick-up at the mouth of the Minago River for trucking commercial fish to Wabowden. (Pages 36, 37).
27. THAT consideration be given to managing the level of Cross Lake within a fluctuation range of two feet during the November-December flow cutback period at Jenpeg. (Page 36).
28. THAT, if disruptions to boat accessibility from Cross Lake to Walker Lake and to Drunken Lake occur, a mitigation program be implemented. (Pages 36, 37).
29. THAT resource management and resource agencies investigate further the operational aspects of the Kiskitto Lake regulation works to determine optimum water levels for fish, wildlife and recreational resources. (Page 7).

    This recommendation was transmitted to the Ministers and to Manitoba Hydro during the course of the study.
30. THAT the fish attraction and holding device now installed at Jenpeg be operated for two years to determine the need for a permanent fish passage facility.

Southern Indian Lake

31. THAT fish populations and biological productivity be monitored until populations and productivity have stabilized after the diversion project has been implemented, and that the necessary minimum annual discharge at Missi Falls be determined to maintain fish populations and productivity at an acceptable level in the northern portion of the lake. (Pages 45, 46).
32. THAT the all-weather access road from Ruttan Lake to South Bay be maintained and a means of year-round access be provided from that road to the community of South Indian Lake. (Page 47).
33. THAT the initial impoundment on the lake begin after mid-July to minimize loss of nesting waterfowl, gulls and terns, and muskrats. (Page 46).

Diversion Route

34. THAT Manitoba Hydro, the community of Nelson House and appropriate federal and provincial government departments and agencies continue negotiations to deal with issues arising from the flooding of Indian reserve lands at Nelson House. (Page 42).
35. THAT the Birchtree Mine and Thompson water supply pumphouses and the outfall from the main sewage plant at Thompson be modified prior to flooding to accommodate the projected high water level. (Page 43).

    This recommendation was transmitted to the Ministers and to Manitoba Hydro during the course of the study.
36. THAT consideration be given to the acceleration of the construction scheduling of the Burntwood River power plants. (Page 43).
37. THAT Manitoba Hydro examine the feasibility of constructing the Manasan power development in such a manner as to preserve the falls and adjacent area for a heritage park. (Page 42).
38. THAT a research program be undertaken to evaluate the ecological implications of the various timber clearing methods used in the Notigi reservoir. (Page 40).
39. THAT the appropriate Manitoba government departments, in consultation with Manitoba Hydro, designate areas in the vicinity of the Notigi dam which could be utilized for recreational purposes. (Page 42).
40. THAT all floating debris be prevented from entering the vicinity of the float plane base at Thompson to ensure safe conditions for aircraft. (Page 43).
41. THAT affected sections of Provincial Road 391 and of the Nelson House access road be raised or rerouted prior to being affected by diversion flows. (Page 43).

    This recommendation was transmitted to the Ministers and to Manitoba Hydro during the course of the study.

Lower Churchill River

42. THAT adequate flows be maintained in the lower Churchill River to provide a suitable municipal water supply for the community of Churchill until such time as an alternative method of maintaining a satisfactory water supply is available. (Page 7).

    This recommendation was transmitted to the Ministers and to Manitoba Hydro during the course of the study.
43. THAT, during the initial phase of diversion, the flow down the Churchill River be reduced gradually over a period of two or more years and that appropriate government departments and agencies monitor the levels and flows in the river system in order to establish criteria for flow releases from Missi Falls.
44. THAT appropriate government departments and agencies initiate a study to determine the desirability and feasibility of increasing the range of fluctuation on Southern Indian Lake to improve the flow regime in the lower Churchill River.
45. THAT water depths upstream of Mosquito Point be maintained for boating and boat access to the cottage areas used by the residents of Churchill or suitable alternatives be provided. (Page 51).
46. THAT appropriate government departments and agencies determine the advisability of controlling levels on the lakes on the lower Churchill River. (Pages 50, 51).
47. THAT water releases at Missi Falls be as steady as possible in May and June to minimize damage to nesting waterfowl downstream. (Page 51).

Canada-Manitoba Study Agreement for Lake Winnipeg and the Churchill and Nelson Rivers

THIS AGREEMENT made as of the 24th day of August, 1971.

BETWEEN THE GOVERNMENT OF CANADA, represented herein by the Minister of the Environment (hereinafter called "Canada")
OF THE FIRST PART

AND THE GOVERNMENT OF THE PROVINCE OF MANITOBA represented herein by the Minister of Mines, Resources and Environmental Management (hereinafter called "Manitoba")
OF THE SECOND PART

WHEREAS the Governments of Canada and Manitoba entered into agreements in 1963 and 1964 for joint studies of the power potential and development program for the Nelson River; and

WHEREAS the two Governments entered into a further agreement in 1966, based on the recommendation of the foregoing studies, that construction of the facilities necessary to give effect to the development of the hydro-electric potential of the Nelson River should forthwith be undertaken; and

WHEREAS the electricity generating facilities which the Province undertook to construct under the aforesaid agreement of 1966 included the generating station at the Kettle Rapids site on the Nelson River; works necessary to divert water from the Churchill River to the Nelson River; and works located in the vicinity of the outlet of Lake Winnipeg, which works will be designed to permit the levels of the water of Lake Winnipeg and the outflow to the Nelson River to be regulated and controlled; and

WHEREAS Manitoba Hydro has now installed three of the twelve units ultimately proposed for the Kettle Station and has designed the control works for the outlet of Lake Winnipeg; and

WHEREAS the Government of Manitoba has issued a license to permit Manitoba Hydro to proceed with the construction of the facilities at the outlet of Lake Winnipeg which will be completed in time to meet the electrical energy requirements foreseen for the winter of 1974/75; and

WHEREAS plans have been announced by Manitoba Hydro with the conditional approval of the Government of Manitoba to increase the energy output of generating plants on the Nelson River, commencing in the winter of 1975/76, by diverting flows from the Churchill River at Southern Indian Lake of up to a maximum of 30,000 cubic feet per second provided that the lake is not raised above the 850 foot level; and

WHEREAS the Governments of Canada and Manitoba recognize the increasing need for co-ordinating their efforts and for considering the effects on all interests in water resources planning; and

WHEREAS the social and economic welfare of the people of Manitoba depends to a large degree on the way in which the waters of Lake Winnipeg and the Churchill and Nelson Rivers are managed for energy, water supply, fisheries, wildlife, recreation and transportation; and

WHEREAS the Governments are jointly concerned that these projects achieve the greatest overall benefit possible without unduly prejudicing the present or potential development of these water bodies for other resource uses and users; and

WHEREAS His Excellency, the Governor General-in-Council by Order-in-Council P.C. 1971-1976 has authorized the Minister of the Environment to execute this Agreement on behalf of Canada; and

WHEREAS His Honour, the Lieutenant Governor-in-Council by Order-in-Council 757/71 has authorized the Minister of Mines, Resources and Environmental Management to execute this Agreement on behalf of Manitoba;

NOW THEREFORE THIS AGREEMENT WITNESSETH THAT in consideration of the premises, covenants and agreements herein contained the parties covenant and agree with each other as follows:

1. *Objective*

The purpose of the studies authorized under this Agreement is to determine the effects that regulation of Lake Winnipeg, diversion from the Churchill River and development of hydro-electric potential of the

Churchill River diversion route are likely to have on other water and related resource uses and to make recommendations for enhancing the overall benefits with due consideration for the protection of the environment.

2. *Terms of Reference*

The study of probable effects of Manitoba Hydro's projects must be sufficiently broad so as to include all important effects on the water regime and on related resource uses and it must be adapted to provide reliable data on present natural conditions and the anticipated and actual conditions arising from the operation of the controls and diversion as designed and constructed. Recommendations will be made consistent with the stated objective of the study. Canada and Manitoba agree to give priority to those studies which may lead to recommendations for modificiations or additions to the works, or operation of the works, that may be under construction, approved or proposed. Although there will be no imposed change in regime for at least the next three years, early attention will also be directed to studies which will establish and measure the parameters that define the state of nature conditions for the lakes and rivers involved. Consequently, the program will include studies of:

(a) EFFECTS ON THE WATER REGIME

(i) *Water Levels and Flows* — as required to determine what changes in the existing regime can be expected to result from the operation of proposed storage and diversion works on the Churchill, Rat-Burntwood and Nelson systems, including the timing, range and frequency of fluctuations in lake levels and stream flows. Certain information will be taken as given, namely that Lake Winnipeg will be regulated between the levels of 711 and 715 feet elevation and that Southern Indian Lake will be raised to not more than 850 feet elevation for a diversion out of the Churchill River of up to 30,000 cubic feet per second. In the event that the Government of Manitoba advises that a lower level will be utilized or that an alternative or additional diversion will be used, the foregoing information will be modified accordingly.

(ii) *Erosion and Sedimentation* — as required to estimate changes in channel and bank morphology of both donor and receiving streams below points of diversion, and in shoreline erosion and sediment movement patterns in the larger lakes affected by regulation.

(iii) *Water Quality* — as required to measure existing quality and estimate changes likely to occur to water quality in storage reservoirs and in reaches downstream therefrom.

(b) EFFECTS ON THE USES OF WATER AND RELATED RESOURCES

(i) *Community Supply* — as required to estimate the effects of regime changes on the quantity and quality of water available for domestic, municipal and industrial use, including particularly that for the Town of Churchill; and to project any resulting benefits and any costs necessary to secure them, or for remedial measures.

(ii) *Fisheries and Limnology* — as required to provide an assessment of changes to be expected in the fisheries and aquatic ecosystems; to project benefits and costs for the fishery.

(iii) *Wildlife* — as required to assess probable changes in wildlife populations and habitats; to project benefits and costs to wildlife management and use expected from water level and flow changes.

(iv) *Recreation and Tourism* — as required to assess the impact of water regime changes on existing and potential tourism and recreational activities, including cottage development, sport fishing, boating and swimming; and to consider the benefits and costs of developing such additional recreation opportunities as may be facilitated by the proposed developments.

(v) *Navigation* — as required to assess the impact of water regime changes on existing and potential navigation; the effect of increased accessibility through Lake Kiskittogisu to Cross Lake and the effect of the reduction of fresh water ice on Churchill Harbour; and to integrate

the studies herein described with those presently being carried out separately under the federal Navigable Waters Protection Act.

(vi) *Forestry and Land Use* — as required to inventory and evaluate the forested areas which will be flooded or made more or less accessible by proposed water development; and to examine the probable effect of depositing spoil from dredging operations on the specified muskeg or land surfaces adjacent to the excavated channels and suggest the ultimate use of land so affected, including the steps necessary, if any, for its improvement.

(vii) *Mining* — as required for acceleration of geologic mapping and exploration of potential mining areas along the Churchill River diversion route which are designated for flooding and to estimate the effects of changed access.

(viii) *Archaeological and Historical Sites* — as required to identify and determine significance of such sites in areas which are designated for flooding.

(c) SOCIAL IMPLICATIONS

(i) *Project Impact* —as required to assess the local impact in social and economic terms of the works, including the effects on employment, wage rates, transient population, trade, accessibility, mobility and communications; to consider and propose means of ameliorating any undersirable effects on the people of the communities in the area.

(ii) *Potential Opportunities* — as required to determine means by which the people of the region can, in both the short and long term, obtain the greatest advantage from the social and economic opportunities resulting from construction of the works and associated developments.

3. ***Administrative Arrangement for Joint Planning***

Canada and Manitoba shall participate in a process of joint planning. To facilitate this process in the time available, the following shall be established:

A LAKE WINNIPEG, CHURCHILL AND NELSON RIVERS STUDY BOARD to consist of six members of whom three will be appointed by Canada and three by Manitoba. The Study Board will be responsible for the study, will meet as required and will report to the Minister of the Environment of Canada and the Minister of Mines, Resources and Environmental Management of Manitoba. Chairmanship of the Study Board will rotate on an annual basis between federal and provincial members, as chosen by the members; with the first chairman being a provincial member. The Study Board will appoint a full-time Study Director and a Technical Advisory Committee of two members from each government to assist the Study Director. Under the direction of the Study Board, the Manitoba Department of Mines, Resources and Environmental Management will manage the program described herein and may employ the services of private consultants and firms as well as those of the agencies of the two governments.

4. ***Financing***

(a) Costs of the study shall be borne as follows: Canada 50 percent, Manitoba 50 percent, including, but not limited to administration, the cost of collection and analysis of data, field surveys and the cost of consultants engaged as part of the program. Salaries and related costs of federal and provincial civil servants engaged in the program shall not be paid from funds approved under this Agreement excepting staff specifically assigned to or engaged in studies under this Agreement.

(b) Subject to the terms and conditions of this Agreement and subject to the funds being voted by Parliament, the aggregate sum to which Canada shall be liable in respect of this Agreement is not to exceed $1,000,000.

(c) Subject to the terms and conditions of this Agreement and subject to the funds being voted by the Legislative Assembly, the aggregate sum to which Manitoba shall be liable in respect of this Agreement is not to exceed $1,000,000.

(d) This Agreement shall become binding on the date executed. Costs incurred prior to January

1st, 1971 shall not be eligible for sharing under this Agreement. This Agreement shall terminate on December 31st, 1974, or at such earlier date as may be agreed upon by the parties hereto, but claims for costs incurred may be made up to December 31st, 1975.

(e) Each party shall keep complete records of all expenditures made severally pursuant to this Agreement and shall support such expenditures with proper documentation. Canada and Manitoba upon request shall make these records and documents available to auditors appointed by each other.

(f) Manitoba shall assume responsibility for the funding of this Agreement. The financial arrangements shall be established by the Study Board.

5. ***Reports and Recommendations***

(a) Specific reports or recommendations with documentation shall be submitted to the Ministers and to Manitoba Hydro at any time, as the progress of the studies reveals information or leads to proposals that may be relevant to the design or construction of works that may be proposed or in progress. The first such report to be submitted no later than December 31st, 1971 and subsequent reports not less than annually. A final report will be submitted on or before December 31st, 1974.

(b) The final report will include recommendations for such further measurements, sampling or investigations as may be desirable to provide at a later date an accurate record of the before and after effects of the works involved. An estimate of the cost of such further studies will be included.

6. ***General***

(a) Canada and Manitoba shall exchange copies of all reports and related available information from prior and current studies for use in the program.

(b) This Agreement shall not be construed to vest in Canada any proprietary interests in projects constructed or modified hereunder.

(c) This Agreement may from time to time be reviewed by the parties hereto and, with the approval of the Governor-in-Council and the Lieutenant Governor-in-Council, may be revised.

(d) No member of the Parliament of Canada or the Legislative Assembly of Manitoba shall hold, enjoy or be admitted to any share or part of any contract, agreement, commission or benefit arising out of this Agreement.

(e) The Study Board may recommend to both parties joint participation in detailed studies over and above that which is called for in this Agreement, including the extension of the Agreement to cover studies recommended in the final report.

IN WITNESS WHEREOF the Honourable Jack Davis, Minister of the Environment has hereunto set his hand on behalf of Canada and the Honourable Sidney Green, Minister of Mines, Resources and Environmental Management, for Manitoba.

Signed on behalf of Canada
"Jack Davis"

In the Presence of
"John Mullally"

Date
"Aug. 24, 1971"

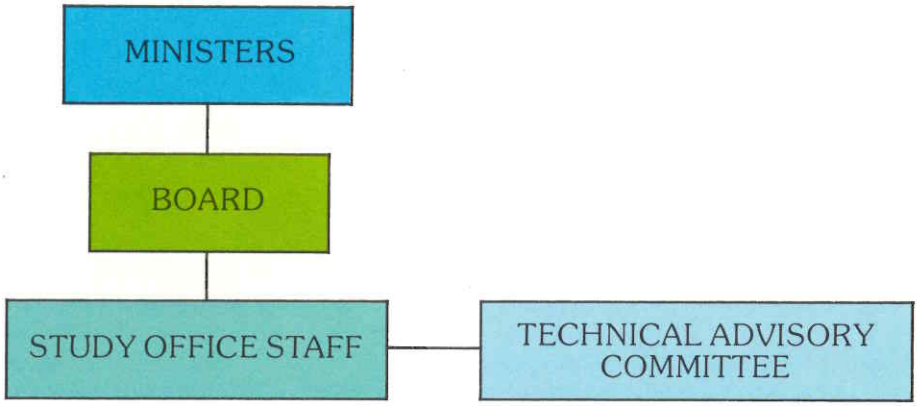
Signed on behalf of Manitoba
"Sidney Green"

In the Presence of
"T. E. Weber"

Date
"Sept. 9, 1971"

NOTE: *The Study Agreement was amended in March 1975 to extend the termination date of the Study. The termination date was revised from December 31, 1974, to April 30, 1975.*

Lake Winnipeg, Churchill and Nelson Rivers Study



CANADA		MANITOBA	
Ministers			
The Honourable Jeanne Sauvé,	— Minister of Environment Canada.	The Honourable Sidney Green, Q.C.,	— Minister of Mines, Resources and Environmental Management.
Board			
N. H. James (Co-Chairman)	Director, Water Planning and Management Branch, Inland Waters Directorate, Environment Canada.	N. Mudry (Co-Chairman)	Director, Planning Division, Water Resources Branch, Department of Mines, Resources and Environmental Management.
E. W. Humphrys	Senior Electrical Adviser, Energy Development Sector, Department of Energy, Mines and Resources.	J. T. Cawley	Deputy Minister Department of Mines, Resources and Environmental Management.
		C. J. Goodwin	Corporate Planning Officer, Manitoba Hydro.
A. L. Hamilton	Acting Director, Research and Development, Fisheries and Marine Service, Freshwater Institute, Environment Canada.	G. H. MacKay (Secretary)	Assistant Director, Planning Division, Water Resources Branch, Department of Mines, Resources and Environmental Management.
Technical Advisory Committee			
H. B. Rosenberg	Chief, Socio-Economic Division, Water Planning and Management Branch, Inland Waters Directorate, Environment Canada.	M. C. McKay	Director, Special Programs Co-ordination and Administration Branch, Department of Northern Affairs.
		K. J. Renger	Manager of Generation Planning, Manitoba Hydro.
L. J. Johnson	Research Scientist, Fisheries Resources Section, Fisheries and Marine Service, Freshwater Institute, Environment Canada.		

Study Office Staff

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B. Nowicki	Assistant Study Director	P. E. Lohrenz	Resource Technician
S. Trachtenberg	Special Adviser	S. H. Arksey	Clerk
R. D. Lyon	Administrative Officer	M. M. Cairns	Clerk-Stenographer