The plan to develop abundant, clean, self-renewing energy from Manitoba's own great river.

MANITOBA HYDRO
In terms of hydro-electric potential, Manitoba’s greatest water power resources are the Nelson, Churchill, Winnipeg, and Saskatchewan River, in that order.

The Winnipeg River’s 560,000 kilowatts was developed first because of its proximity to the provincial population centre. Next came the Saskatchewan and a 472,000 kW station at Grand Rapids.

Now the mighty Nelson and Churchill Rivers are being harnessed. Together, the Nelson and Churchill can provide a total of 8,270,000 kW of self-renewing hydro power.

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**DEVELOPED HYDRO SITE**

**POTENTIAL HYDRO SITE**
The Electrical Province

In a world belatedly becoming aware that fuels such as oil, coal, and natural gas will one day be completely gone, the value of water power is appreciated more and more. Water power is self-renewing. When the last ounce of mineral wealth is wrested from the ground, our water resources will be intact and worth more than ever.

Manitobans have been enjoying the benefits of low-cost electricity generated from water power since the first all-weather hydro station was built on the Winnipeg River system in 1906. The Winnipeg River, only 80 miles away from the major population centre of Winnipeg, served the province’s hydraulic generation needs for the next half century.

By 1955, with six hydro plants in service along its course, the Winnipeg River was fully developed (560,000 kilowatts) and power planners looked to the more northerly Saskatchewan River for more low-cost power. At Grand Rapids, 260 miles north of Winnipeg, a 472,000 kilowatt station was completed in 1968.

Now the hydro potential of the even more northerly Nelson and Churchill Rivers is being harnessed. Two Nelson plants are already in service at Kelsey (224,000 kilowatts) and Kettle (1,272,000 kilowatts). Two more Nelson stations are under construction at Jenpeg (168,000 kilowatts) and Long Spruce (1,000,000 kilowatts).

Under the plan of development, a total of 8,270,000 kilowatts is available from Nelson-Churchill water power. Applying a nominal present-day value of 1¢ per kilowatt-hour, 8,270,000 kilowatts of hydro power is worth more than $1 million per day forever.

Without question, water power is Manitoba’s greatest natural resource.
Although the rich hydro potential of the Nelson River has been known to power planners for more than half a century, it wasn't until more accessible hydro resources were put into harness that Nelson development became feasible.

In the spring of 1966, following extensive investigations financed jointly by the Federal Government and the Government of Manitoba, a commitment was made to go ahead with Nelson River development. Four separate construction projects were envisaged in the initial plan of development:

a) Immediate construction of a hydro station at Kettle Rapids;

b) Immediate construction of an extra-high-voltage transmission system from Kettle to Winnipeg;

c) Construction of a channel and control structures to divert water from the Churchill River into the Nelson;

d) Construction of control works to regulate the outflow of Lake Winnipeg.

Projects (a) and (b) were completed to the point of initial service in 1971. Projects (c) and (d) will be in service by 1976.
WHY Churchill River Diversion?

The 1000-mile-long Churchill River rises in Methy Lake, Saskatchewan, near the Alberta border. From Methy Lake, elevation 1577 feet above sea level, the river flows eastward crossing the Manitoba border at elevation 920, emptying into Hudson Bay at sea level.

The Manitoba portion of the river has a hydro-electric potential of more than 3,000,000 kilowatts. Instead of harnessing this potential by building plants right on the river itself, however, a considerable economic advantage may be gained by diverting its flow into the Burntwood and Nelson River system to use the water at more southerly generating sites. Diverting Churchill water as opposed to building plants on the Churchill itself reflects a present cost advantage in excess of $600 million.

The diverted Churchill River water can be used at four generating sites along the Burntwood River (with a total potential of more than 700,000 kilowatts) and at the seven Nelson River sites below Split Lake (adding nearly 2,000,000 kilowatts of dependable capacity to the Lower Nelson).
The Mechanics of Diversion

Three major construction projects will accomplish the task of diverting the Churchill River. First, a control structure at Missi Falls, the outlet of Southern Indian Lake, will hold back enough Churchill flow to raise the lake level by up to 10 feet. Next, a channel excavated from Southern Indian Lake to the Rat River will allow the stored water to be diverted by gravity into the Burntwood River and thence into the Nelson. Finally, a control structure along the Rat River at Notigi Lake will regulate the amount of water being diverted.
Terms of the Licence

In December 1972, a licence to proceed with the Churchill River Diversion was issued to Manitoba Hydro by the Water Resources Branch of the Department of Mines, Resources and Environmental Management. Under the licence, Manitoba Hydro is permitted to divert up to 30,000 cfs (cubic feet per second) from the Churchill into the Nelson. The licence also stipulates that certain minimum flows must be maintained in the natural Churchill River course below Missi Falls: 500 cfs during the open water season, and 1500 cfs during the ice cover period.

In the past, outflows from Southern Indian Lake have varied from about 20,000 cfs to 70,000 cfs with a long-term average of 35,000 cfs. Below Missi Falls, tributaries bolster the Churchill natural flow to an average of 45,000 cfs emptying into Hudson Bay. With the diversion system in operation, the most extreme long-term need for diverted water could reduce the Churchill flow into Hudson Bay to an average of 18,000 cfs.
Impact of Flooding

Diverting the Churchill River will alter the shorelines of Southern Indian Lake and of certain areas above and below the Notigi Lake control structure. The total area to be flooded will be equivalent to a lake 23 miles square.

The principal effects of the flooding will be loss of forested area (wild animal habitat and trapping grounds) and changes in the pattern of commercial fishing. Although no whole communities will be flooded, it will be necessary to replace or relocate a number of residences and some commercial buildings.

Studies financed jointly by the federal and provincial governments have been carried out to determine both the socio-economic and ecological effects of the flooding. The studies confirm that the net resource gain far outweighs all other considerations.* The costs of compensation payments for loss of income and for expropriated land, and the costs of mitigation works such as dams and docks and new homes are no more significant than at previous more southerly hydro developments.

Certainly the greatest impact upon residents of the affected areas will be the end of their isolation. All-weather roads, network television, and central station electric service will greatly alter their way of life.

These changes, of course, would inevitably come even without hydro-electric development of the region. Twentieth century conveniences are already much in evidence in isolated communities: dog teams and sails have long been replaced by snowmobiles and outboard motors, and electric service has brought amenities like proper lighting, running water and refrigeration to isolated communities. Today no northern Manitoba community of more than 50 people is without electric service.

Lake Winnipeg, the world's thirteenth largest lake, seventh largest in North America, is contained entirely within the province of Manitoba. Its surface area is 9430 square miles and it collects run-off from a 380,000-square-mile drainage basin extending from the Canadian Rockies to within 12 miles of Lake Superior.

All the waters flowing into Lake Winnipeg flow out at the north end of the lake via the Nelson River and eventually empty into Hudson Bay. The long-term mean outflow of Lake Winnipeg is about 70,000 cfs (cubic feet per second).

The average level of Lake Winnipeg is 713.2 feet above sea level. In its natural state the level has dropped as low as 709.4 feet (in 1940) and as high as 718.4 (in 1974). Manitoba Hydro is now building control works, for hydro-electric purposes, to limit the lake level variation between 711 and 715 feet above sea level.

Manitoba Hydro's interest in regulating the Lake Winnipeg level is to alter the outflow pattern. In a state of nature, the outflow is greatest in summer following spring thaw and rain, and it is least in winter following freeze-up of tributaries. With regulation works, the winter outflow can be improved when the water is most needed for power generation.

The regulation works will not affect the mean outflow of the lake. As long as the Winnipeg River, the Red River, the Saskatchewan River and other tributaries continue to flow into the lake, the same volume of water must flow out of the lake.
The mechanics of regulation

The regulation of Lake Winnipeg will be accomplished by three diversion channels and a control dam. The diversion channels will improve the outflow capability of the lake, and the control dam will provide a way to slow down the outflow.

The three diversion channels bypass natural constrictions in the Nelson River. The channels will make it possible to increase the winter outflow of Lake Winnipeg by as much as 200%.

The control dam at Jenpeg will also be used as a generating station. A flow of 93,000 cfs through the station will yield 168,000 kilowatts. Excess flows of up to 103,000 cfs can be passed downstream through the adjacent spillway.
Effects of Lake Regulation

Even without the hydro-electric value of Lake Winnipeg regulation, the project would have positive benefits for lake-front cottage owners, resort operation, navigation, agriculture, and commercial fishing. The wide range of natural lake levels (from 709 to 718 feet above sea level) has repeatedly proven disastrous to these interests. By limiting the range to only four feet (from 711 to 715) the shorelines will become more stabilized.

The completion of the regulation channels will make it possible for deep-draught vessels like the MS Lork Selkirk II to venture beyond Lake Winnipeg into Playgreen Lake and Lake Kiskittogisu.

Lake Kiskitto, on the other hand, will be maintained as a wildlife breeding ground. A regulation dam at the outlet of the lake will permit its levels to be maintained within an ideal range, vastly superior to its natural state.

The only negative effects of Lake Winnipeg regulation will likely be felt by trappers and fishermen from the communities of Norway House and Cross Lake. Although the lake levels at these sites will not be appreciably higher, the change in river flow pattern will alter the pattern of fishing, fish spawning, ice cover, and trap-line access. While these interests are expected to re-establish themselves within a few years, some form of compensation or other employment may be required in the interim.

LAKE WINNIPEG ELEVATIONS
PLOTTED FROM MONTHLY MEAN LEVELS

ELEVATION IN FEET
ABOVE SEA LEVEL


718
717
716
715
714
713
712
711
710
709
WINNIPEG BEACH 1953: Lake Winnipeg elevation 714.6 feet above sea level.

WINNIPEG BEACH 1966: Lake Winnipeg elevation 717.0 feet above sea level.
Is it necessary to have both Churchill River Diversion and Lake Winnipeg Regulation?

A wintertime flow of more than 100,000 cfs out of Split Lake is required for efficient and economical operation of hydro plants on the Lower Nelson. In its natural state the Split Lake outflow has been as low as 30,000 cfs (1962). Only with the benefit of both Churchill Diversion (maximum 30,000 cfs) and Lake Winnipeg Regulation (24,000-38,000 cfs extra winter flow) can enough wintertime flow be guaranteed.

Putting it another way: the average outflow of Lake Winnipeg into the Nelson River is about 70,000 cfs and only with the addition of 30,000 cfs from the Churchill Diversion can the basic 100,000 cfs be assured; but the demand for power in Manitoba is greatest in winter when the Nelson flow is lowest: only with Lake Winnipeg Regulation can the Nelson River flow pattern be altered to parallel our need for power.

**THE MAIN AIM OF LAKE WINNIPEG REGULATION:**

**TO ALTER THE ANNUAL PATTERN OF NELSON RIVER FLOW**

**TO FOLLOW MORE CLOSELY THE PATTERN OF POWER NEEDS**

The two diagrams at right help to explain the need for Lake Winnipeg Regulation from the standpoint of electrical generation.

The upper diagram shows the typical pattern of Nelson River flow compared with the typical pattern of electric power needs in Manitoba. The Nelson River flow is greatest in the summertime when the demand for power is lowest. In its natural state, a great proportion of Nelson River flow would be of no direct value to Manitoba electrical consumers.

The lower diagram shows the improvement that can be effected with Lake Winnipeg Regulation. The high summertime flows are considerably reduced, and the fall and winter flows are better when they are most needed by Manitoba electrical consumers.

The two diagrams also help to explain the benefits of Manitoba-U.S. interconnection agreements. Because the American power load pattern is almost exactly opposite to that of Manitoba, that is, the Midwest U.S. power demand is highest in summer and lowest in winter, the excess summer flows can be used for generation to be sold to an eager U.S. market, and conversely, Manitoba can draw upon excess U.S. generating capacity to meet the Manitoba winter demand.
Natural Nelson River Flow vs Manitoba Power Load

Regulated Nelson River Flow vs Manitoba Power Load
## Nelson River Potential

(with Churchill River Diversion and Lake Winnipeg Regulation)

<table>
<thead>
<tr>
<th>Site</th>
<th>Potential in Kilowatts</th>
<th>Initial Generation</th>
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<tbody>
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<td><strong>Upper Nelson River</strong></td>
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<tr>
<td>Jenpeg</td>
<td>168,000</td>
<td>1976</td>
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<td></td>
</tr>
<tr>
<td>Upper Gull</td>
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</tr>
<tr>
<td>Lower Gull</td>
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<tr>
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