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CANADA'S WATER

(Reproduced from Water by W.V. Morris, a booklet published by the Public Relations & Information Services, Department of Energy, Mines & Resources.)

In terms of fresh surface water, Canada is one of the world's most fortunate countries. There are probably more lakes here than in any other country in the world, so many that they have not even been counted, much less measured. Estimates, however, have placed Canada's total lake area at 292,000 square miles. Since the country's total area is 3,852,000 square miles, this means that about 7.6 per cent of Canada is covered by fresh water. Most of Canada's lakes have not yet been surveyed but, including Canada's share of the Great Lakes, they contain as much as one seventh of the world's fresh, liquid, surface water.

Streamflow is the true measure of water supply

Not all the stored water in Canada's lakes is available for use. It would be unrealistic to suggest, for instance, that the entire 5,500 cubic miles of water in the Great Lakes, of which an estimated 1,800 cubic miles is in Canada, could be removed and used. The water is very valuable where it is, as storage which can be drawn upon in time of drought to be replaced in time of plenty. But the true measure of a country's water supply is in its streamflow rather than in its storage capacity.

Not all of Canada's rivers have been gauged but, based on actual measurements where these are available, supplemented by estimates for ungauged areas, it has been estimated that the combined average flow of all Canada's rivers is about 3.5 million cubic feet per second.

This means that each year, on the average, Canada's rivers carry about 750 cubic miles of water to the oceans, almost 9 per cent of the total flow of all the rivers of the world. Set against a population which is less than one per cent of the world's population, Canada's endowment of fresh water is generous indeed.

Even though the flow is not uniformly distributed throughout the country, nor during the year (a large portion of the annual supply for example, is frozen for several months during the winter, to be released only when Spring

arrives), the 750 cubic miles of water is available every year and is constantly replenished by the continual operation of the hydrologic cycle.

FLOW OF CANADA'S RIVERS

River	Drainage Area (Square Miles)	Mean Flow (cfs)
St. Lawrence	295,000	400,000
Mackenzie	700,000	300,000
Fraser	90,000	100,000
Columbia ^M	40,000	80,000
Nelson	414,000	75,000
Yukon ^M	130,000	75,000
Churchill (Labrador)	30,000	60,000
Skeena	21,000	40,000
Saint John	22,000	30,000

Canada's history has been moulded by the influence of great rivers

The country's first industry, the fur trade, depended upon the ready access provided by the St. Lawrence River, the Great Lakes and their tributary streams and the many other great waterways which provided transportation to the interior.

The early settlement of the country depended on this same ready means of access. The plentiful water supplies of the flat, fertile plains of southern Ontario and Quebec, the river-borne transportation of lumber and later the power of water-driven turbines, all were vital factors in the building of a Canadian nation.

An adequate supply of fresh water is vital to modern Canada

Today, more than ever, water is the key to Canada's development, supplying the renewable energy required in industrial growth, providing access to raw materials and playing a vital part in the processing of these materials.

Domestic and municipal supplies. Canada's earliest settlers, who had to carry or pump their household water supplies by hand, probably got by on five gallons or less per day for each person. Today each member of the average Canadian family uses from 20 to 70 gallons or more each day. Bathing, washing clothes and dishes, disposing of wastes, watering lawns and washing cars require considerable quantities of water and any curtailment of the supply arouses surprise and resentment. Fortunately, in Canada, shortages have usually been local and temporary. Most Canadians have not had to worry seriously about water shortages.

Despite its variety of uses, water is probably the least expensive material used in the household. Compare the price of oil for heating (20 cents per gallon) or gasoline for the automobile (50 cents per gallon) with the cost of water piped to the house (about one-thirtieth of a cent per gallon in Ottawa). At a cost of 34 cents per thousand gallons, water costs about 7 cents a ton, delivered. No other material costs so little.

* At International Boundary.

Commonplace, convenient, low in cost -- it is hardly surprising that little thought is given by the average Canadian to this most necessary commodity.

Twenty gallons to take a bath or do the laundry, ten gallons to wash dishes, five or six gallons to flush the toilet -- all this water is used without much thought in the average household, which uses some 50 gallons a day per person. Industries located within cities also use a very large amount of water, much of which comes from municipal supplies.

The city of Ottawa in 1965 used 100 gallons a day per person. Winnipeg used 80 gallons per person, Vancouver and Montreal about 120 gallons and Toronto about 175 gallons per person per day. Industrial use accounts for most of the difference between the average of 50 gallons a day per person and the city's total consumption. Per capita use for domestic purposes probably does not vary appreciably from city to city.

Industry. Industry has an enormous thirst for water. The largest quantity is used for cooling purposes, but considerable quantities are also used directly in many manufacturing processes; another important use is in plant sanitation. Frequently, figures are published to indicate how much water is used in various industries -- figures like 10 gallons of water to refine a gallon of gasoline, 18 barrels of water to refine a barrel of oil, 250 tons of water to produce a ton of sulphate wood pulp, 100 gallons of water to produce a gallon of alcohol. These figures are interesting as a general indication of the need for water, but they may be misleading. Far too often they reflect the fact that water is easily available, inexpensive, and therefore often used inefficiently.

Take for example, the amount of water required in the production of steel. The usual, or average, amount of water used to produce a ton of steel is about 60,000 gallons; yet there is a steel mill in California which, by cooling and recycling its water uses only about 1,400 gallons per ton of steel produced. A wide variation like this is by no means unusual. When water becomes scarce, and therefore valuable, it can be and is used much more efficiently than if it is plentiful and cheap.

The fact remains, however, that water is an essential material in all industrial operations and increasing industrialization inevitably leads to greater use of water.

It is impossible at the present time to say exactly how much water is used by Canadian industry. Some industrial plants purchase water from their municipality. Others find it more convenient, or more economical, to develop their own water supplies by drilling wells, or by building their plants beside a lake or a river.

Many industrial uses are non-consumptive in nature -- that is, the water is returned to a stream channel after it has been used. The returned water, however, is often polluted, either by the addition of undesirable material or by heating during use. Pollution of this kind is a constantly increasing problem wherever industry is concentrated in Canada, particularly on some of the Great Lakes, on the St. Lawrence River and on some rivers in British Columbia.

Hydro-electric power development. Electrical energy has been called the master tool of mankind. In Canada, it is the economy's mainspring -- the efficient servant of modern life. To a remarkable degree, it is true to say that the Canadian economy is a hydro-electric economy. Canadian industrial development, since the turn of the century, has depended upon water power as its principal source of energy and, despite the current emphasis on thermally-generated power, water power is still by far the leader.

Of the 158,000 million kilowatt-hours of electrical energy generated in Canada in 1966, 130,000 million kilowatt-hours, or about 82 per cent, was generated in hydro-electric plants. Industry used over half of the total energy, commercial operations and street lighting about 15 per cent, and residential and farm almost a quarter of the total.

Every year, new generating capacity is added to help satisfy modern Canada's rapidly increasing demands. In recent years, there has been a marked trend to the installation of thermal plants, because, in many parts of Canada, most of the hydro-electric sites within economic transmission distance of the population and industrial centres have been developed. Planners, therefore, have had to turn to other sources of electric energy. Canada still has a vast undeveloped hydro-power potential which, if developed, would more than treble the 22.7 million kilowatts of hydro capacity installed at the beginning of 1967. Moreover, recent advances in extra-high-voltage transmission techniques are providing a renewed impetus to the development of hydro-power sites previously considered too remote. Already, work has begun on the development of the power potential of the Nelson River in Manitoba, the Churchill River in Labrador, and the Peace and Columbia Rivers in British Columbia.

Transportation. Water provides the most economic means of transportation for the bulky raw materials of Canada's vital export trade -- wheat, pulp and paper, lumber and minerals -- on their way to the world's markets. The idea that inland transport by water was becoming obsolete has been contradicted by the continuing growth in the volume of water-borne goods not only in Canada but in the United States and Europe.

Annual freight traffic through Canadian canals and canalized rivers in the ten-year period from 1956 to 1965 increased from 40 million tons to 99 million tons, an increase of 150 per cent.

The \$470 million St. Lawrence Seaway, completed in 1959 (Canada's share of the cost was \$330 million), is an indication of faith in the future of water-borne transportation. In 1965, nearly 25 million tons of cargo moved up the Seaway, and over 35 million tons moved down.

On the Mackenzie River, the freight carried by the Northern Transportation Company (the major carrier on that river) in 1954 was 91,000 tons. In 1964 this had risen to 128,000 tons, an increase of 40 per cent.

Much of Canada's wealth depends on the forest industry and, for both the raw material and the finished products, rivers and coastal waterways have long been an important means of transportation and a key factor in the industry's economy.

For large, bulky cargoes, transport by water is unlikely to be displaced as the most economical method and, far from becoming obsolete, water-borne transportation will likely continue its steady increase.

Agriculture. Most of Canada's agriculture depends on the direct natural supply of water to the land by snowmelt and rainfall. Of the approximately 62 million acres of land devoted to crops each year, an estimated 1,000,000 acres is irrigated -- less than two out of every hundred acres of crop-producing land. Practically all the irrigated land is in Alberta, British Columbia, and Saskatchewan.

In Alberta, about 545,000 out of the 15.6 million acres of land devoted to crops each year is irrigated (four per cent). British Columbia, with a much smaller area of land devoted to crops -- about 800,000 acres -- has over 200,000 irrigated acres (25 per cent).

Irrigation projects continue to be developed in the Canadian west. The South Saskatchewan River project, for example, will permit the irrigation of 500,000 acres in Saskatchewan; the Waterton River diversion, completed in 1964, has made irrigation water available to an additional 200,000 acres in Alberta.

In humid areas, where irrigation is not generally required, methods of agriculture can have a substantial effect on streamflow. Careless farming methods can speed the runoff of rainfall and result in erosion of soil. Besides the loss of precious soil, this can have two effects on the streams which receive the runoff -- it can increase the danger of flooding downstream, and it can cause streams to become turbid because of the eroded material being carried. Farmers are recognizing more and more the value to themselves and to others of proper agricultural practices which will conserve precipitation for crop use, prevent the loss of soil, and preserve the quality of the streams which drain the land.

Fisheries. In 1867, the year that Canada became a nation, some 3.5 million pounds of fish were taken from fresh-water sources, primarily the Great Lakes-St. Lawrence River system. Since 1867, fresh-water fisheries have continually expanded to the extent that, by 1964, the annual catch had increased to 105 million pounds, worth \$18.3 million. A little less than half of this catch was taken from the Great Lakes-St. Lawrence system.

Although this value is less than one-tenth the value of Canada's coastal fisheries, it should be remembered that the value of rivers lies not only in their yield of fresh-water fish, but also in the fact that they provide the spawning grounds for commercially profitable anadromous ocean fish.

Besides the commercial fresh-water fisheries, there are thousands of sport fishermen who each year cast their lures into lakes and rivers in all parts of the country.

To an increasing extent, commercial and sport fishing are receiving important consideration in the preliminary design of water-use projects affecting fisheries. In some cases, this consideration has not only dictated the nature of the project but also has influenced the choice of location.

Fish require a pollution-free environment, and the increasingly-polluted condition of many lakes and streams has had a serious effect on both the quantity and type of fish available for sport or commerce.

Recreation. In 1941, little more than 50 per cent of Canada's population lived in towns and cities. In the 1960's, by contrast, town and city populations make up about 70 per cent of the total. Over 40 per cent of Canada's people, in fact, live in the thirteen cities with populations over 100,000.

This trend toward living in large urban centres has been accompanied by a desire to return occasionally to non-urban surroundings as an escape from the pressures of modern city life. The annual exodus from the cities during the summer months stems directly from the increase in leisure time enjoyed by most Canadians and the fact that many more people now own cars (car ownership increased from one for every eight persons in 1949 to one for every four in 1963).

Much of the recreation sought by holidaying Canadians is water-oriented. Swimming, fishing, boating, water-skiing, all increasingly popular, require clean water. But many rivers and lakes close to urban centres are polluted to such an extent that they are useless for recreational purposes. This increases the demand on those which are suitable, and creates also a demand for new recreational lakes. The demand is such that many large reservoirs have been built with recreation as one of their primary purposes. The South Saskatchewan River project is one example.

Several of the flood-control and conservation dams built recently in southern Ontario are designed so that their reservoirs can also be used for recreational purposes. Five reservoirs to be built in the Metropolitan Toronto region have recreation as their only purpose.

Recreational requirements are no longer overlooked in the development of water-use projects. The demands of recreational interests have in some cases been strong enough to affect decisions involving the location of hydro-power projects. How an existing project is operated is frequently influenced by the effect it will have on recreation.

Pleasure boating on natural and artificial waterways has shown a phenomenal increase in the past few years. Thousands of pleasure craft travel the rivers of Canada every year, retracing the old voyageur routes that once carried the commerce of a young nation. The Rideau Canal from Ottawa to Kingston, built in 1830 for national defence, has for many years been a popular waterway for pleasure craft travelling between the Ottawa and the St. Lawrence Rivers. The Trent Canal System is another mecca for pleasure-boat operations.

A growing awareness of the recreational value of clean water to the country, to say nothing of the tourist dollars which water-oriented recreation can attract, will undoubtedly give rise to many programmes for the restoration of natural waterways which have become damaged or destroyed through indifference.

Waste disposal. Usually last to be mentioned, but far from least in importance, is the vital service which water renders in diluting and carrying away the wastes of a modern society. Unfortunately, this use leads easily to abuse, as demonstrated by the condition of most of the rivers serving populated areas.

Because of the apparent abundance of water in this country there has been a tendency to ignore or forget the fact that there is a limit to the amount of waste material which can be absorbed by any watercourse. This rapid growth of large population centres, and the expansion of industry in certain areas of Canada, have produced unpleasant evidence of what uncontrolled pollution can do to a river, and this is beginning to correct the complacent attitude of Canadians to water.

There can be no suggestion, of course, that Canada's rivers should not be used to transport waste. Water is an efficient and an economical carrier of undesirable materials. To a certain extent it can, by natural processes, dispose of those materials, but there is a limit, both in quantity and type of waste, beyond which the river is incapable of recovery. The prohibition of all waste products from streams is as impractical and undesirable as the excessive use of streams for this purpose.

The goal of wise water management is the attainment of an acceptable, economic balance which takes into account all the many and varied services which a stream is called upon to render.

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Several of the main watercourses in Ontario are being used for various purposes, and it is not possible to give a list of all of them. ...

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