External Affairs Canada
Affaires extérieures Canada

Reference Papers

No. 123
(Revised September 1973)

CANADA'S WATER

(Based on *Water*, a booklet published by the Inland Waters Directorate of Environment Canada, Ottawa.)

As regards fresh surface water, Canada is one of the world's most fortunate countries. There are probably more lakes in Canada than in any other country in the world -- so many that they have not even been counted, much less measured. Estimates, however, have placed the total lake area at 292,000 square miles. Since the country's total area is over 3.8 million square miles, this means that about 7.6 per cent of Canada is covered by fresh water. Most of its lakes have not yet been surveyed but, including the Canadian share of the Great Lakes, they contain as much as one-seventh of the world's fresh, liquid, surface water.

Stream-flow 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 are in Canada, could be removed and used. The water is very valuable where it is, as storage that can be drawn on in time of drought to be replaced in time of plenty. But the true measure of a country's water supply is its stream-flow rather than its storage capacity.

Not all Canada's rivers have been gauged but their combined average flow is about 3,500,000 cubic feet a 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 that is less than 1 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), 750 cubic miles of water are available every year, replenished by the continual operation of the hydrologic cycle.

Flow of Canada's Rivers

River	Drainage Area (Square Miles)	Mean Flow (cfs)
St. Lawrence	503,000	540,000
Mackenzie	700,000	300,000
Fraser	90,000	125,000
Columbia*	40,000	100,000
Nelson	414,000	85,000
Yukon*	130,000	80,000
Churchill (Labrador)	30,000	60,000
Skeena	21,000	45,000
Saint John	22,000	35,000

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

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

The early settlement of the country depended on this 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, providing the moisture needed for food production, supplying the renewable energy required in industrial growth, providing access to raw materials and playing a vital part in the processing of these materials. It also adds immensely to the beauty of the countryside and thus to the enjoyment of life.

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 a 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 their water supply.

Despite the variety of its uses, water is probably the least expensive household material. Compare the price of oil for heating (30 cents a gallon) or gasoline for the automobile (60 cents a

* At the International Boundary.

gallon) with the cost of water piped to the house (about one-thirtieth of a cent a gallon in Ottawa). At a cost of 34 cents a thousand gallons, water costs about 7 cents a ton, delivered. No other material costs so little.

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

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 person every day. Industries located within cities also use a very large amount of water, much of which comes from municipal supplies.

In 1972, Ottawa -- the capital -- used 100 gallons a person every day. Montreal used 150 gallons a person, Vancouver 140 and Toronto 120 gallons a person every day. Industrial and municipal use account for most of the difference between the average of 50 gallons a day used by each 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 amounts are also used directly in many manufacturing processes; another important use is in plant sanitation. Figures are frequently published to indicate how much water is used in various industries -- like ten 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 that, by cooling and recycling its water, uses only about 1,400 gallons to produce a ton of steel. 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 were 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 present to say exactly how much water is used by Canadian industry. Some industrial plants purchase water from their municipalities. Others find it more convenient, or more economical, to develop their own water-supplies by drilling wells or by building their own plants beside lakes or rivers.

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. Canadian industrial development since the turn of the century has depended on water-power as its principal source of energy and, despite the current emphasis on thermally-generated power, water is still far in the lead.

Of the 237,000 million kilowatt hours of electrical energy generated in Canada in 1972, 178,000 million, or about 75 per cent, were generated in hydro-electric plants. Industry used nearly 60 per cent of the total energy, commercial operations and street lighting about 15 per cent, and residences and farms more than 20 per cent 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 greatly increase the 31 million kilowatts of hydro capacity installed at the beginning of 1973. 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, the Peace and Columbia Rivers in British Columbia, and the rivers flowing into James Bay in Quebec.

By the year 2,000, hydro-electric capacity will probably be double the 1973 level. Although this will not exhaust all the potential hydro-electric resources of Canada, it reflects the increasing economic and environmental limits to hydro-electric development. It indicates the increasing competitiveness of generation from nuclear fuels; by the end of the century, about 30 per cent of Canada's electrical energy will be from hydro-electric sources.

Transportation: Water provides the most economical means of transportation for the bulky raw materials of Canada's 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, 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 a symbol of faith in the future of water-borne transportation. In 1972, a total of 72,500,000 tons of cargo moved over the Seaway, compared to only 60,000,000 tons in 1965.

On the Mackenzie River, the freight carried by Northern Transportation Company (the major carrier on that river) in 1954 was 91,000 tons. By 1964, this had increased to 128,000 tons, and by 1972 it had risen to 399,000 tons, more than tripling the previous figure.

Much of Canada's wealth depends on its forest industries 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 economy of these industries.

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

Agriculture: Most of Canada's agriculture depends on the direct natural supply of water to the land by the melting of snow and by rainfall. Of the approximately 62,000,000 acres of land devoted

to crops each year, an estimated 1,000,000 acres are irrigated -- less than two out of every 100 acres of crop-producing land. Practically all the irrigated land is in Alberta, British Columbia and Saskatchewan.

In Alberta, over 600,000 acres of the 15,600,000 acres of land devoted to crops each year are irrigated (4 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, and the Southwest Saskatchewan Irrigation Projects take in another 25,000 acres; the Waterton River diversion, completed in 1964, has made irrigation water available to an additional 200,000 acres in Alberta. In addition, there are at least another 25,000 acres under individual farm irrigation schemes in Saskatchewan and Alberta.

In humid areas, where irrigation is not generally required, methods of agriculture can have a substantial effect on stream-flow. 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 that 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 others of agricultural practices that will conserve precipitation for crop use, prevent the loss of soil, and preserve the quality of the streams that drain the land.

Fisheries: In 1867, the year Canada became a nation, some 3,500,000 pounds of fish were taken from freshwater sources, primarily the Great Lakes/St. Lawrence River system. Since 1867, freshwater fisheries have continuously expanded, to the extent that, by 1971, the annual catch had increased to 89,000,000 pounds, worth $18,400,000. Controls were imposed in some areas during 1971 where mercury was found to be high in certain species of fish.

Although this amount 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 freshwater fish but also in the fact that they provide the spawning grounds for commercially profitable anadromous ocean fish.

Besides the commercial freshwater fishermen, 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 has also 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 1970s, by contrast, town and city populations make up about 76 per cent of the total. Almost half Canada's people, in fact, live in the 19 cities with populations over 100,000.

The 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 automobiles (car ownership increased from one to every eight persons in 1949 to one for every 3½ in 1972).

Much of the recreation sought by holidaying Canadians needs water. 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 that 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 remarkable 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 the 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 St. Lawrence Rivers. The Trent Canal System is another mecca for pleasure-boat operations.

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

Waste disposal: Usually last to be mentioned but far from least in importance is the vital service 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 that can be absorbed by an water-course. The 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 change the complacent attitude of Canadians to water.

To a certain extent water can, by natural processes, dispose of some waste materials, but there is a limit, both in quantity and type, to what a stream can handle.

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

RP/A