INLAND WATERS BRANCH

DEPARTMENT OF THE ENVIRONMENT

Saskatchewan's Water Resources and Utilization

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The development of an adequate supply of water is a major problem in the prairies. This problem arises from several causes: insufficient rainfall over large areas, particularly during the growing season; the uneven and erratic distribution of precipitation in the region; and the geographic setting of prairie streams. The non-uniform distribution of the water resources in the province presents a very real problem of making the water available when and where it is needed, a problem with which the province is dealing effectively. This paper is concerned only with the broader questions of long-term availability and adequacy of water resources in the prairie region.

Most of Saskatchewan's permanent streams originate on the eastern slopes of the Rocky Mountains and flow easterly across the three Prairie Provinces, eventually emptying into Hudson Bay. About 31,500 square miles of the province are covered with water, with the lakes ranging in size from the 2,180 square miles of Lake Athabasca to the smallest pond. By far the largest percentage of this water exists as relatively shallow lakes in the northern part of the province, outside the agricultural area. On the other hand, the population of about 950,000 is concentrated in the southern half of the province, hence, the problem of distribution.

The mean annual precipitation for Saskatchewan is some 16 inches. This figure is three-quarters of the Canadian average of about 20 inches but is only half of the annual precipitation in the other settled parts of Canada. Figure 1 shows the average precipitation for the various regions in Canada. Figure 2 shows a graphical comparison of the average flow of rivers in the various parts of Canada. The width of the shaded area is proportional to the average flow in the river at any point along its course. When this comparison is related to the major centres of population and industry, including agriculture, the problems of distribution are more apparent. It is evident that Saskatchewan has the greatest problem in this regard. It is evident also that there is much less water available for development in the prairie region than anywhere else in the settled parts of Canada.

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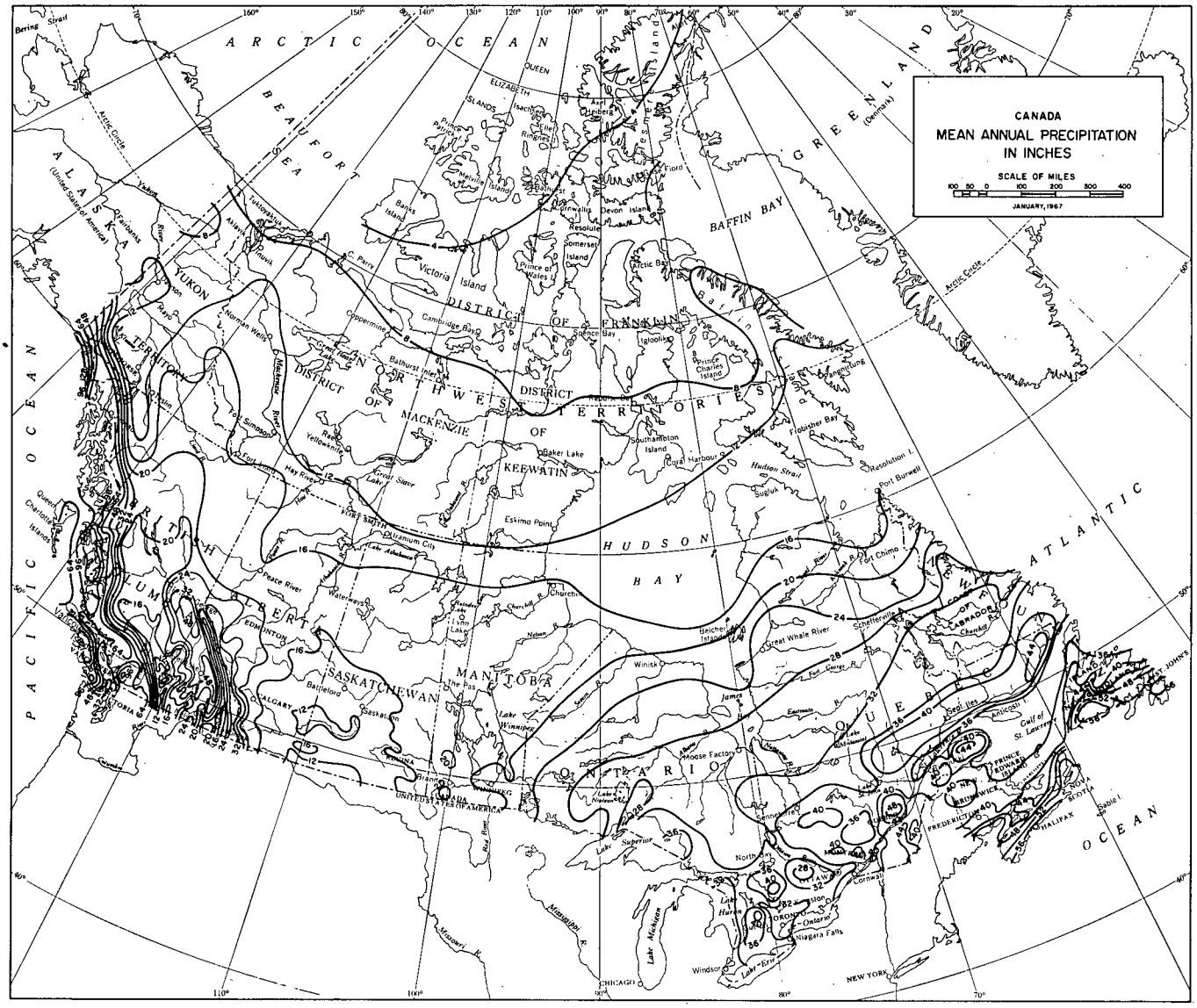

FIGURE 1

The surface of Saskatchewan may be divided roughly into four main drainage basins; the Lake Athabasca basin, the Churchill River basin, the Saskatchewan River basin, and the Qu'Appelle-Assiniboine Rivers basin. Of these four systems, only the Lake Athabasca drainage is from east to west; the other three flow towards the east.

The Saskatchewan River provides the principal drainage system and the principal source of water supply for the settled regions of the province. It is also the obvious route by which to redistribute water to the increasing demand areas. The North and South Saskatchewan Rivers enter the province from Alberta and join just east of Prince Albert. The main river then flows east into Manitoba to empty into Lake Winnipeg. The principal lakes, all of which lie in the unsettled north, are Reindeer Lake, Lac la Ronge, Wollaston Lake, and Montreal, Doré and Peter Pond Lakes. In the south, on the South

FIGURE 2

Saskatchewan River, there is the recently created Lake Diefenbaker, with an area of 170 square miles.

At the present time, runoff available in the settled areas is greater than the demand for domestic, urban, agricultural and industrial uses. However, there is still much to be done in conservation, regulation and relocation of the supply to overcome the non-uniform distribution of the water resources. Development and commitments for development already total 70 per cent of the average flow of the South Saskatchewan River. Moreover, they exceed the flow in a dry year by one and one-half million acre feet. Essentially then, we can now see a ceiling on development in one part of the province imposed by restricted water supply. When development of the irrigation, industrial, municipal and other uses reaches the levels for which they are already licensed, there will be no water left for new uses during dry years.

The non-uniform distribution of water resources has already been discussed as a problem to water users in Saskatchewan. Moreover, some of the uses are not entirely compatible with others. For example, irrigation development requires generally high assured flows during the summer season.

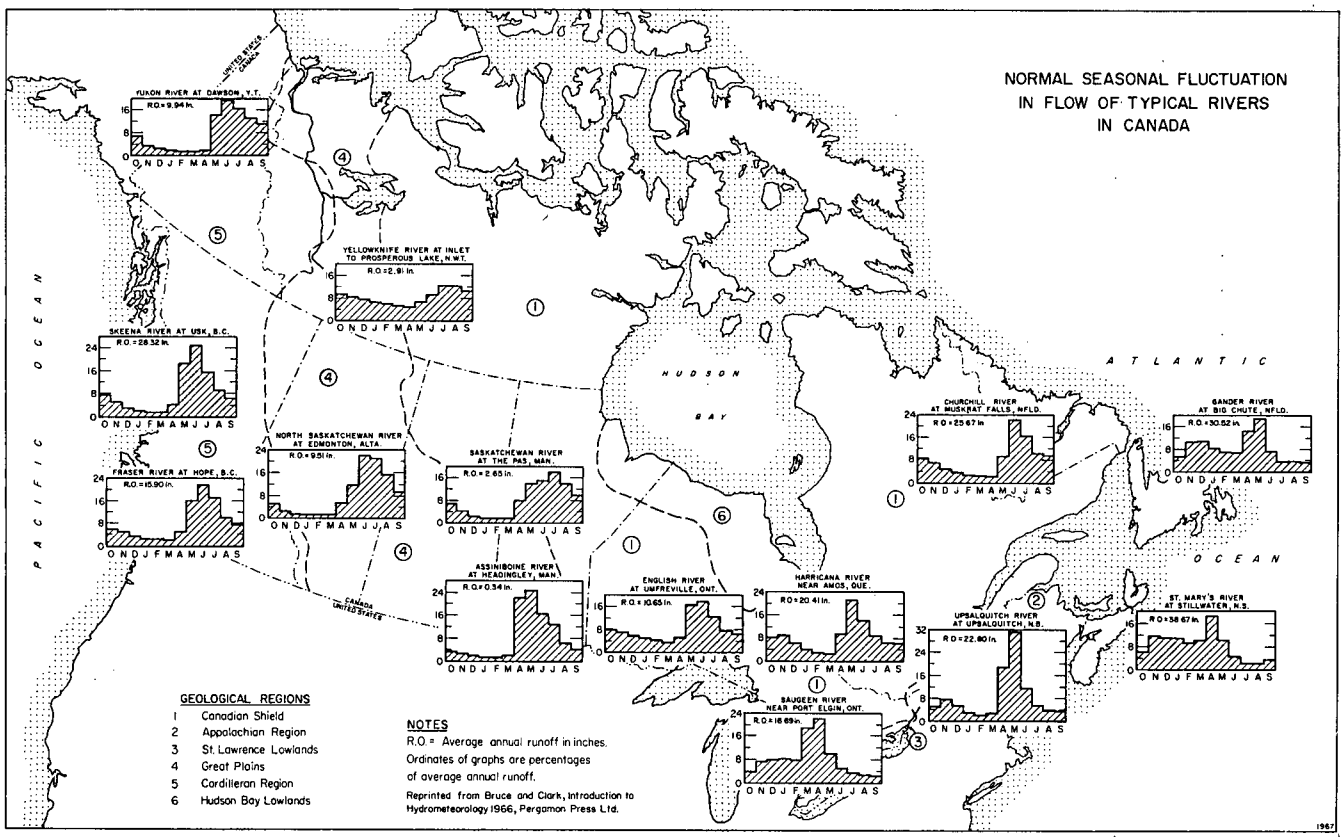

FIGURE 3

Power, at least at this stage in the evolution of power systems, requires generally high assured flows during the late fall, winter and early spring seasons. Water-based recreation requires a fairly constant level in reservoirs and natural lakes, while industry generally requires an assured supply throughout the year.

An idea of the wide seasonal variability of flows in the larger rivers in Saskatchewan may be gained from Figure 3. In general, the variability of the streams in other parts of Canada is not as great as on the prairies. Although it is not shown on Figure 3, flow of the St. Lawrence is extremely well regulated by the Great Lakes, its maximum flow being only about twice the minimum. For comparison, the maximum recorded flow of the Saskatchewan River at The Pas is about 60 times the minimum recorded flow.

Sound policies and planning for Saskatchewan's water resources must be approached from two premises. The first is a knowledge of what constitutes these resources and the second is the knowledge of how these resources may be used now and in the future for maximum overall benefit. These premises can be applied in particular to that part lying in the Saskatchewan-Nelson basin, which is the sixth largest river system in North America.

As the economy of the province expands and the demands for water increase, conservation, regulation and a redistribution of streamflow will be required. Such measures have already been instituted in a number of cases in Saskatchewan, e.g., the Gardiner Dam and the Saskatoon-Southeast Water Supply Scheme. Even with complete streamflow regulation, however, there will be competition among various uses for the available water. A piecemeal approach to water development might ultimately favour those uses first developed, precluding the later development of other more beneficial uses.

Such problems were recognized many years ago by the Governments of Canada, Alberta, Saskatchewan and Manitoba when they established the Prairie Provinces Water Board in 1948. The Board was instructed:

> "to recommend the best use to be made of interprovincial waters in relation to associated resources in Manitoba, Saskatchewan and Alberta and to recommend the allocation of water as between each such province, of streams flowing from one province into another province."

The Board was aware of the difficulties confronting it. The immediate short-term problem of recommending allocations of water for specific projects had to be reconciled with the desirable long-term objective of producing a coordinated water-use program in the Saskatchewan River drainage basin. As more of the river's flow was allocated, the Board became increasingly aware of the difficulties inherent in a continuation of project by project allocation. In addition, the method tended to involve the Board unduly in matters of provincial water administration.

Eventually an apportionment proposal was developed whereby the water of interprovincial streams would be apportioned between provinces rather than allocated to specific projects. A very important milestone in connection with water resources development on the prairies took place on October 30, 1969 with the signing of the Apportionment Agreement by the three Prairie Provinces and the federal government. This Agreement provides for the equitable apportionment of all waters flowing from west to east across the prairies. For example, the flow of the Saskatchewan River, as recorded at The Pas, Manitoba, is shared about equally among the three provinces in an average year. Knowing that a fixed proportion of the natural flow is available to it in perpetuity, no province has to accelerate development to ensure its fair share of the water.

Under the agreement, the responsibility for monitoring the quantity and quality of the flow at boundary crossings has been vested in the federal government, viz. the Inland Waters Branch. The agreement also provides for the future when all available natural flow will be allocated and for diversions necessary to meet growing demands. All parties will share in development costs based on benefits derived. The Prairie Provinces Water Board, was reconstituted, and made responsible for administration of the terms of the Apportionment Agreement. It will also serve as an instrument for joint action relating to water problems and programs of regional interest.

Another very important development, essential to a thorough knowledge of the water resources on the prairies, is the current study now being carried out under the direction of the Saskatchewan-Nelson Basin Board.

The federal-provincial agreement setting up this Board was signed in October, 1967 with the following objective:

> "To study the water resources of the Saskatchewan-Nelson basin, including the potential additional supply by diversion or storage. In making this study, consideration will be given to the feasibility and cost of the many combinations of storage and/or diversion works needed to provide a firm water supply of varying amounts and with varying seasonal distributions, at various selected points along the river system."

As indicated in the objective, the study is designed to examine ways and means of increasing the water that can be made available throughout the basin. The increase in supply may be brought about either by using storage to redistribute the water time-wise or by providing diversions from other basins or combinations of both. During the initial phase of the study, the improvement in supply that could be achieved by storage and internal diversions within the basin were examined. Subsequent investigations are concerned with diversions from contiguous basins, generally the northerly and easterly flowing rivers.

The Board recognized that the existing water agencies of the provincial and federal governments operating in the prairies had the personnel and the required expertise to undertake such a study. It also realized that a considerable amount of coordination and direction would be required if the study was to be concluded successfully. The Board, whose chairman is Dr. A.T. Prince, provides the required direction to a Study Director, Mr. E.F. Durrant, and a small staff in Regina, responsible for coordinating and supervising the study. The other four members of the Board are also senior members of the governmental water agencies operating on the prairies. General direction is provided by a Committee of Ministers consisting of eight members - two Ministers from each of the three Prairie Provinces, and two from the Federal Government.

Much of the work required by the Board is an extension of investigations already underway or contemplated by the various agencies. With their existing staffs, these agencies are undertaking work for the Board to the fullest extent possible without endangering their other programs. The full cooperation from these water agencies has enabled the Board to make excellent progress.

The Board hopes to be able to submit a draft of its final report to the Committee of Ministers by the beginning of next year. The report will provide an inventory of projects and combinations of projects, and the flows that they can supply to various parts of the basin. This inventory will be supplemented by information on engineering costs associated with each project and/or combinations of projects. Thus, part of the information required for the optimum development and regulation of the water resources of the Saskatchewan-Nelson basin will be provided. The study will not, however, result in a comprehensive development plan involving demand and use from which projects could be selected for implementation. The preparation of such a plan will require further investigations involving detailed economic and engineering studies, and cost-benefit analyses. Obviously, the sequence and timing of construction cannot be suggested until detailed studies, subsequent to the present supply study, are undertaken.

It should be emphasized that the Saskatchewan-Nelson Basin Board is conducting a preliminary study of engineering feasibility and the determination of capital costs of works to improve the flow of prairie rivers within the Saskatchewan-Nelson Basin. The amount of water which may be required in the future is not known at this time. The results of the study will tell us what projects are "reasonable", considering only construction costs and flow improvements. It could be thought of as a screening of possibilities to select the more promising projects. Subsequent studies will have to examine the interaction of these projects with the overall environment and the ecosystems, and give consideration to local and regional water needs and requirements, the relative value of various water uses, the benefits lost in one basin by diverting the water into another, and so on. It would be very expensive to apply this detailed approach to all possible projects and combinations, hence the decision to undertake a relatively simple study first. For example, while it may be feasible from the engineering point of view to divert the flow of the Churchill River by way of Frog Portage into the Saskatchewan River at Cumberland Lake, such a diversion may have profound effects on the ecosystems along the Churchill River downstream of the diversion, along the Saskatchewan River and in its delta, as well as on the water courses along the route of the diversion.

While the Saskatchewan-Nelson study will provide an inventory of development possibilities to enhance the available water resources, the Inland Waters Branch and its predecessors over more than 60 years have been monitoring and compiling an inventory of streamflow in Canada. It is on the basis of this continuous, systematic inventory that the characteristics of the variations of the flows and water levels of the rivers and lakes can be defined and the development possibilities determined.

The establishment of a network of streamflow and water level stations to yield adequate information on water resources has been relatively slow. In recent years, however, there has been both considerable and accelerated expansion of the hydrologic network. The federal and provincial governments have increasingly recognized the requirements for long-term hydrometric information. For example, in order to effectively carry out its responsibilities for expanding, maintaining and operating the hydrologic network, the Inland Waters Branch has recently established a District Office in Regina. This new office will assume the responsibilities for the hydrologic network in Saskatchewan formerly shared by the Branch District Offices in Calgary and Winnipeg.

At the present time there are about 2500 surface water gauging stations in operation across Canada with 290 of these in Saskatchewan. Over 2200 of the stations in the national network were installed and are operated by the Inland Waters Branch in cooperation with provincial water agencies.

As might be expected, the data network was initiated in the inhabited southern parts of the province. Only during the past few years has there been some progress in establishing coverage in the northern regions. The installation and operation of gauging stations in the latter regions gave rise to problems which are being solved through the use of new technologies and modification of old ones. Data gathering in the northern regions is much more expensive than in the southern regions of Saskatchewan. Nevertheless, the expansion of the hydrologic network will likely be conditioned by the immediate data needs which continue to be more pressing in the southern regions where more and more data are required to establish a pattern of use for a decreasing amount of unallocated water.

Smaller streams, rivers and gullies also contribute to water availability in the province. In the southern part of the province, there is on the average, about 4,500,000 acre-feet per year of runoff which does not reach the Saskatchewan River. Instead, it proceeds either southward to the Missouri system, eastward to Manitoba or it remains in the thousands of sloughs and small lakes. Although it represents only about 70 percent of the flow of the South Saskatchewan River at Saskatoon, the 4,500,000 acre-feet is nevertheless fairly well distributed over the populated area of the province, and worthy of consideration. Some of the small streams might be developed more cheaply than importing the water by pipeline or canal from large sources. However, averages can be misleading and it should be borne in mind that in unusually dry years complete failure of runoff could occur in any part of the southern region. Storage created by dams, dugouts, etc., is a necessity if surface runoff is to yield a reliable supply. On the other hand, evaporation losses must be reckoned with in storage developments where water has to be retained over several years in order to supply the needs during a drought. In such cases, evaporation would probably consume an amount greater than all uses combined. Such high evaporation losses create an additional problem in that the remaining water often becomes too saline for most uses.

In the foregoing, no mention has been made of the groundwater resources. They are somewhat neglected because they are hidden from view and cannot be evaluated by casual inspection. However, groundwater has a number of attractive features, some of which are: its reservoirs are only slightly affected by short-term variations in amounts of precipitation; in good quality aquifers, groundwater is essentially free of salt and suspended matter; it is not subject to algae and turbidity problems associated with lakes; and it maintains a relatively constant temperature. In many instances there is a tendency for groundwaters to be more highly mineralized than surface waters, thus restricting their use. Nevertheless, groundwaters are an important consideration in the planning and utilization of the water resources of a region.

One of the factors tending to limit or to reduce the usable supply of water is pollution. Sewage and industrial wastes released in a raw state into rivers or lakes may render the whole downstream flow unsuitable for domestic, urban or industrial use unless an adequate minimum flow is maintained to dilute the pollution and aid in the natural purification process. Rigid control of pollution is, therefore, one of the most necessary and pressing measures which must be enforced to conserve water supplies. This will require constant effort and vigilance if we are to avoid the conclusion of 200 experts from 50 countries, participating at a UNESCO conference in 1968. This group concluded that, if present practices go unchecked, life would show signs of succumbing to pollution in 20 years; air would show the first signs of becoming unfit for man and plant to breathe; and lakes and rivers would no longer support life for any creature.

Pollution is very easy to initiate and, if acute vigilance is not maintained, a water supply may become unusable before we are aware of what has taken place. As a by-product of the potash industry, large volumes of waste, both solid and liquid, are generated through mining and processing of potash ore. These wastes are stored in natural depressions or constructed pond areas near the plant where they find their way gradually into the groundwater aquifers and even into the surface waters. The Inland Waters Branch and the Saskatchewan Research Council have research programs directed

to a study of the effect of waste disposal basins on the local groundwater regime. The purpose of these programs is to determine if and when remedial measures must be taken to limit the spread of subsurface pollution, to evaluate the long-term effects of a waste disposal basin on the surface water resources, and to recommend possible alternative solutions. Continuing research, in concert with the compilation of inventories and effective resource planning that have been described will ensure that the optimum use can be made of the available water resources.

Although the administration and control of water resources within provincial boundaries are the responsibility of the provincial authorities, the federal government has responsibilities with regard to navigation, fisheries, wildlife sanctuaries and international waters. The federal government has participated in a large number of flood control and conservation projects such as, for example, the water conservation and flood control projects carried out by the Prairie Farm Rehabilitation Administration. The inter-provincial and international nature of most of the water resources in Saskatchewan require some federal involvement in planning their uses and development.

Under the Canada Water Act, the Department of the Environment, with the approval of the Governor-in-Council, may undertake programs for the formulation of comprehensive water resources management plans on any interjurisdictional or international waters which is of significant national interest. This will complement and supplement studies being carried out under the Boundary Waters Treaty. It is the intent of the Canada Water Act that programs will be undertaken with one or more provincial governments having an interest in the management of those waters. One such program, a comprehensive water planning study of the Qu'Appelle River basin has already been initiated in concert with Saskatchewan and Manitoba. Where an agreement with a provincial government for such a program cannot be reached and there is significant national interest in the resource, the Department may undertake the program directly, an action which it is hoped will never be necessary.

As a means of coordinating provincial and federal approaches to water problems, the Act provides for the establishment of a Consultative Committee for each province consisting of three senior provincial officials and three senior federal officials. The Canada-Saskatchewan Consultative Committee has been named and first met in January, 1970. Continuing federal-provincial contact is maintained through the Consultative Committee process.

Since water is not always where the need is, there will be a greater requirement for redistribution. Redistribution in time is already in common practice and storage reservoirs on the Saskatchewan-Nelson system have already changed the system's regime. New reservoirs are even now being constructed. Geographically, redistribution is a growing possibility. Diversions, large and small, to carry water from places of ample supply to places of maximum need will be increasingly heard of. However, to an increasing degree, matters concerning the ecology and environment must be taken into account in such water resource engineering developments.

As these diversions become more widespread, and undoubtedly larger in size and scope, it is likely that the Federal Government will become more involved in both the planning and implementation phases of these developments, not only because more than one province (and possibly the northern territories) will be involved, but also because the projects will

be so large and expensive, they will require the cooperative action of both levels of government. The Canada Water Act provides the instrument under which the Federal Government can participate in both the planning and implementation phases of these developments.

As we look into the future, we can expect water demands to increase and water to become more valuable. As a result there will undoubtedly be increasing conflict between users. The three Prairie Provinces have already taken a large step towards the elimination of inter-provincial water conflicts by agreeing to the apportionment of waters flowing from west to east from one province to the other. In arriving at this apportionment, the Provinces have realized that a river is more than a necessity; it is a treasure - a necessity of life that must be rationed among those who have power over it.