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the business of the Water Quality Branch

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Water Quality Branch
Inland Waters Directorate
Ottawa, Ontario, 1985

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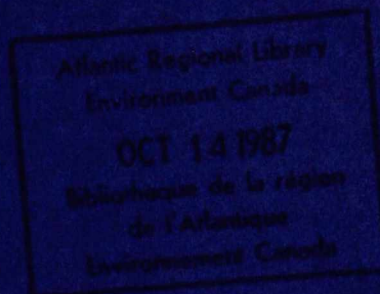
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Preface



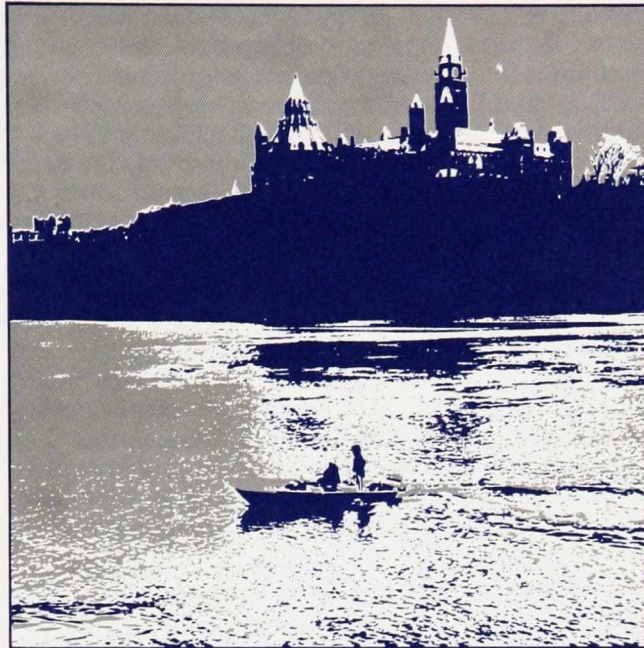
During its 50-year history, the Water Quality Branch (WQB) and its predecessors have had to respond to policy changes and adapt to changing social and economic conditions. From its infancy, the Branch's methods have evolved from simple chemical analysis and written data records to sophisticated analytical techniques and electronic data processing. And this evolution continues.

In March 1982, Environment Canada received Cabinet approval to enter into federal-provincial water quality monitoring agreements. In response to this new directive, the Branch has set a course of action. Although the activities undertaken by Branch staff are expected to remain basically the same, the means of conducting these activities are even now changing dramatically to meet the new mandate.

It is timely therefore that those concerned with water quality management become familiar with the Water Quality Branch as it is structured today, the information it has and will have to offer, and the highlights of significant changes now being implemented to provide more effective and comprehensive understanding of Canada's water quality. This document is intended to elaborate on and clarify the role of Branch staff in the management of the water resources of Canada and to assist senior management in understanding and evaluating Branch proposals and activities. It should also give other federal and provincial officials interested in water quality an appreciation of the Branch's contribution to water quality management in Canada.

Reports are planned to describe the ambient water quality monitoring network, to outline the use of water quality objectives in water quality management, and to explain the role of the National Water Quality Laboratory. It is hoped that the Business paper, supplemented by these reports, will give the reader a comprehensive picture of the Water Quality Branch and its work.

Background



There is no substitute product for water. The survival of all forms of life is dependent upon an adequate supply of water of acceptable quality. A sound knowledge of its quality is essential to all levels of government for the management of present water uses and for the planning of future uses. Quality can affect the suitability of water for human consumption, recreation, irrigation, livestock watering, and industrial uses. In addition to describing the general state of Canada's water resources, water quality information can be used to identify natural or man-made pollution sources and to determine treatment methods or remedies to enhance or maintain water quality.

A long-term commitment to assessing water quality is necessary to determine whether water quality is getting better or worse and whether the aquatic environment is endangered. In many instances, proof of environmental change can only be obtained through the regular collection of data over a period of years. For example, historical water quality data collected in Eastern Canada have provided evidence of widespread water quality impairment attributed to acid rain.

The Evolution of Water Quality Concerns in Canada

The earliest Canadian water quality concerns centred on drinking water supplies. The first public health laboratory in North America was set up in York (now Toronto) in 1855 after the recognition of the relationships between water pollution and disease, especially typhoid. This primary concern for public health

continued into the twentieth century and was a catalyst for the Boundary Waters Treaty of 1909 (Appendix A). It is still one of Canada's major concerns.

During the first half of the twentieth century, agricultural, industrial and other water uses became more extensive and added to the concerns expressed for water quality. For instance, the use of water for irrigation may be limited if it contains high levels of certain salts, and water used in steam generation must be free from corrosive and scaling materials. The lack of information necessary to determine whether the quality of Canadian lakes and rivers was suitable for these uses prompted the federal government to set about collecting the required data at the start of the 1930s.

In the 1940s, wartime economic expansion progressed with little concern for instream ambient water quality. The development of Canada's industrial base and the rapid growth of new products both during and after the war compounded the water quality problem.

With the expansion of chemical and other industries in the 1950s and 1960s, the concern for adequate water quality supply was broadened to include the impact of these industries on the quality of lakes and rivers. This period also marked the beginning of environmental awareness in Canada and the expansion of the spectrum of water quality concerns to include recreation and aesthetics, commercial fisheries and, ultimately, the aquatic ecosystem. Federal and provincial agencies responded with water quality programs to meet these new concerns. In 1961, the federal government, through the National Housing Act administered by the Canadian Mortgage and Housing Corporation, introduced a cooperative financial assistance program with municipalities for the construction of municipal sewage treatment facilities. This 20-year program provided \$2 billion in loans and grants to municipalities and became an integral part of several Canada Water Act agreements.

The 1970s saw a number of significant accomplishments in federal water quality management. The Canada Water Act of 1970 provided the framework for joint federal-provincial management of Canada's water resources. One of the areas covered by regulations under the Act was the limitation of the amount of phosphorus in laundry detergents. This helped to alleviate to a great extent many of the eutrophication problems that were widespread in earlier years. The Canada-United States Agreement on Great Lakes Water Quality was signed, and phosphorus removal

facilities at municipalities in the lower Great Lakes were constructed. This, coupled with detergent phosphorus controls, greatly reduced the algae levels in these lakes. Regulations under Section 33 of the Fisheries Act resulted in significant reductions in pollutant discharges from a number of industries such as pulp and paper, petrochemical and mining. In the chlor-alkali industries, mercury discharges in effluents have been reduced to less than 1% of their pre-regulation levels.

At about this same time, even though water quality improvements were being noted, a more disturbing and pervasive form of pollution was gaining attention. The use of some toxic materials and the dangers of many man-made and relatively nondegradable substances such as PCBs (polychlorinated biphenyls) and mirex were being recognized. Although some progress has been made in reducing the entry of mercury, cadmium and other materials into the environment, the rapid proliferation of man-made compounds and the nature of dispersal make their control extremely difficult.

An increase in the awareness of the toxic and carcinogenic properties of many metals, pesticides and other chemicals has brought us to the most recent phase, with the emphasis on determining residues and effects of toxic chemicals in water, sediment and biota on the health of aquatic ecosystems and ultimately man.

Evidence of the long-range transport of airborne pollutants, particularly acid rain, has made Canadians aware of the international and even global character of many water quality problems. To resolve current and future water quality problems, sound water quality management is required from many sources.

Development of the Federal Water Quality Capability

Accompanying the changing focus on water quality in Canada has been a growth and change in the organization, size and activities of the principal federal monitoring agency, the Water Quality Branch. Its history dates back to a 1934 investigation by the Department of Mines and Technical Surveys (now Energy, Mines and Resources) into the quality of surface waters of importance to industry and municipalities. At that time chemical analyses of lakes, rivers and municipal water supplies were conducted in the laboratory of the Industrial Minerals Division in Ottawa, the results being published by the Mines Branch.

In 1946, following a curtailment of activities during the war, work resumed on a program to obtain information needed for industrial and municipal developments, as well as data of geological significance. The results were published in a series of 15 reports entitled "Industrial Water Resources of Canada," with each report covering a specific area such as a major drainage basin.

During the 1960s, the Water Quality Unit reached "Division" status under the Water Research Branch, and later under the Inland Waters Branch of the Department of Energy, Mines and Resources. Its work involved the examination of waters across Canada and the reporting of inorganic or mineral analyses of water. Support and advisory services were also provided to other departments.

The role of the Division was influenced considerably by a growing awareness by Canadians of environmental issues and the need for comprehensive information concerning Canada's water resources by water managers. New provincial agencies were being formed, such as the Ontario Water Resources Commission (1959), the Nova Scotia Water Authority (1963), the Saskatchewan Water Resources Commission (1964), and the Prince Edward Island Water Authority (1965).

The International Hydrological Decade (1964-1974) led many countries to monitor water quality as part of a global undertaking. In Canada, a national network was established between 1966 and 1971, and regional laboratories were opened by the Branch in Calgary and Moncton. The network grew to about 1000 stations at its peak. During the 1960s and 1970s, much work was also done for the International Joint Commission, particularly with regard to its references on the Great Lakes; the connecting channels of the Great Lakes; the international section of the St. Lawrence River; the St. Croix, Red, Rainy and Poplar rivers; and the Garrison Diversion Project.

The next major changes occurred in the early 1970s with the passage of the Canada Water Act (1970). Water quality management was explicitly included in the final legislation, recognizing water quality as an issue of national significance. A wide range of cooperative federal-provincial ventures has been carried out under this act, many of which have water quality components or implications. For instance, implementation agreements for the Qu'Appelle and Okanagan basins have required Branch water quality information, as have studies for the Saint John, Shubenacadie-

Stewiacke, St. Lawrence and Souris basins. Other cooperative arrangements that have received Branch input include those with the Prairie Provinces Water Board, the Mackenzie River Basin Committee, and the Yukon River Basin Committee.

The Government Organization Act, which created the Department of the Environment (DOE), was passed in 1970, and an Interdepartmental Committee on Water was struck to allow for interdepartmental consideration and approval of all federal water programs. The Water Quality Division was transferred to the new department and became a Branch. Regional offices were set up at Vancouver, Regina, Burlington, Montreal and Moncton. The Ottawa laboratory was transferred to Burlington, and new laboratories were opened in Vancouver and Longueuil.

A review of departmental activities in 1977-78 coincided with the development of a new federal policy statement concerning inland waters that had a significant impact on the Branch. The policy statement outlined federal policies to address water quality issues and helped to set Branch directions in terms of identification of pollution problems, trend assessment, establishment of water quality objectives and the assessment of the effectiveness of regulatory measures. A major drawback in implementing the policy was that the federal water quality monitoring network had become limited almost exclusively to boundary stations and to providing support to basin studies that were the subject of formal agreements. The acquisition of data from non-boundary waters within the provinces and territories was not considered to be within the Department's mandate. Consequently, the data collected by federal agencies lacked the consistency and areal coverage required for addressing emerging Canada-wide issues, e.g., the impact of acid deposition on the aquatic environment. The basis for resolving this situation is now at hand as a result of a Cabinet decision in 1982 which authorized Environment Canada to negotiate federal-provincial water quality monitoring agreements. These agreements will provide the data base which will permit the Branch to make more comprehensive assessments of water quality both nationally and regionally.

The ECS Water Quality Mandate



The purpose and program objectives of the Environmental Conservation Service (ECS) are derived from the mandate and policies of the Department of Environment. (See Appendix A for a detailed review.) Since the Department has many diverse concerns, its mandate and policies are broad. The relationships between the objectives of the Service and the policies of the Department, however, become clearer as one descends through the organizational levels from the Department to the Service, to the Directorate and, finally, to the Branch level.

At the departmental level, the mission of Environment Canada is to foster harmony between society and the environment for the economic, social and cultural benefit of present and future generations of Canadians.

At the Service level, there are certain objectives of the Environmental Services Program (Appendix B) and of the Environmental Conservation Service (Appendix C) which have implications for water quality. They provide for the conservation and wise allocation and use of international and interprovincial waters, and promote the best use of water for sustained productivity and net social benefit. This includes planning and managing in environmentally sound ways as well as application of environmental conservation principles.

The next level is the Inland Waters Directorate (IWD), which has the prime federal responsibility for monitoring freshwater resources in Canada as well as other responsibilities. The Directorate's work is carried out by

three operational branches and one coordination branch at headquarters and five regional components across Canada. Two institutes — the National Hydrology Research Institute (NHRI) in Ottawa and the National Water Research Institute (NWRI) in Burlington — comprise the main research components of the Directorate. The objectives of the Directorate's programs with water quality components are given in Appendix C.

Purpose of the Water Quality Branch

The purpose of the Branch is to promote the conservation and enhancement of the quality of Canada's inland water resources for the economic and social benefit of Canadians by providing scientific and technical information and advice on water quality.

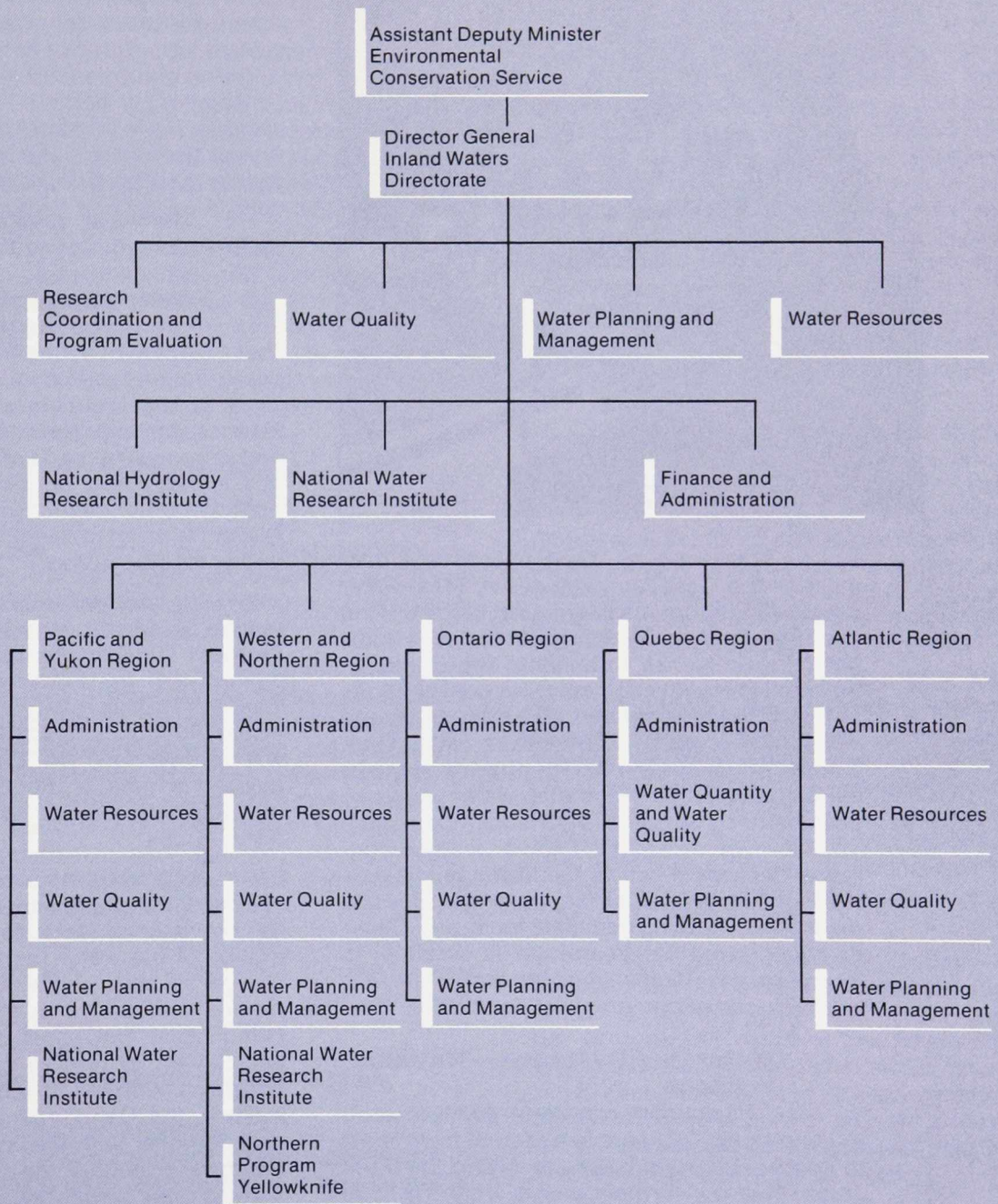
Role of the Water Quality Branch

The role of the Branch is

1. To provide scientific and technical information and advice to government, private agencies and the public, and to promote the wise management of the quality of waters:
 - (a) shared by Canada and the United States, and by one or more provinces and/or territories;
 - (b) on federal lands, such as national parks, Indian reserves and heritage canals; and other properties and facilities where water resource management is primarily a federal responsibility;
 - (c) where there is federal responsibility such as for fisheries and wildlife;
 - (d) subject to impact by federally funded projects.
2. To detect emerging water quality problems and to evaluate water quality issues on Canada's inland waters from a regional and national point of view.

The Branch's role is operational. Research and related support services are provided by the research institutes NWRI and NHRI. The Branch in turn provides operational support to both institutes.

Inland Waters Directorate Organization



Meeting the Challenges of Today and Tomorrow



Freshwater of good quality is a hallmark of the Canadian way of life. Freshwater covers 750 000 square kilometres, or 7.6% of the country's surface. These resources have had a profound influence in shaping the Canadian nation. They provide invaluable contributions to public health, fisheries, migratory birds and other wildlife, water for agriculture, water for industrial processing, water for power and recreational development and also water for waste disposal. Any suggestion of superabundance of freshwater in Canada, however, is an exaggeration because much of this water is inaccessible or is available at inappropriate times to meet the competing demands for its use. Canada recognizes that freshwater is essential to long-term development and the quality of life to which that development must contribute.

Water Quality Issues — National in Scope

All Canadians can relate readily to water quality issues. They are to be found from coast to coast. There are issues involving the Saint John River concerning wastes from the food processing industry and hydroelectric developments. Municipal discharges are affecting the St. Francis River and the St. Croix River. The Niagara River has special toxic chemical problems that result from the leaching of chemical waste dumps on the American side and the production of persistent toxic compounds both in Canada and the United States. In Western Canada, the proposed Garrison Diversion Unit could cause water quality problems in the Souris and Red rivers as well as the possible introduction of foreign fish species, parasites and fish diseases

to the Hudson Bay Basin. Water quality is a concern on the East Poplar River as a result of power plant construction and on the Kootenay River as a result of water degradation from the production of wood pulp. These issues are of direct concern at the federal level due to their inter-jurisdictional nature. In addition, federal experts work in close harmony with all provinces to resolve water quality issues that are, for the most part, of provincial concern.

The water quality issues given priority by Environment Canada are as follows.

Water Management

Freshwater could be the crisis of the 1990s that energy was in the 1970s. Elements of this issue include growing imbalances between water supply and demand, particularly on the Prairies; inadequate water quality in Quebec and various other parts of the country; multiple-use management of the Fraser Estuary; and potential water quality and other concerns with respect to major diversions between river basins and ecological zones.

In meeting its responsibilities to provide federal leadership for inland waters, the Environment Minister has appointed an Advisory Committee on Federal Water Strategies. Through public examination, current water issues, including those related to water quality, will be discussed and the federal government advised on what it should do within its limited constitutional powers to cope with emerging water issues.

Within the Canada-United States sphere, the Branch is specifically involved with the provision of technical input relating to the quality of the water (surface and subsurface) shared by both jurisdictions through studies, reports and advice to the International Joint Commission (IJC) special and regular boards established to resolve bilateral disputes and concerns. With the current increase in development in the Canada-United States boundary area together with the limited water resources along the boundary, the potential exists for conflicts to grow in number and complexity.

A significant contribution of the Branch over the years has been in the surveillance and measurement of ambient water quality within the Great Lakes system, a body of water which contains about 20% of the world's fresh surface water. In 1972, Canada and the United States formally recognized the need to reverse the trend of eutrophication through the signing of the 1972 Great Lakes Water Quality Agreement. It was apparent by the late 1960s and early 1970s that long-term ambient water quality was

deteriorating and the Great Lakes was a "dying water body." By joining forces, Canada and the United States have been successful in arresting Great Lakes eutrophication. It is a continuing battle which along with toxic chemical pollution of the Great Lakes became the focus of an amended 1978 Agreement. The Water Quality Branch plays a major role in meeting Canadian continuing obligations, such as above, through its measurement and assessment, analytical laboratory and water quality objectives programs.

Interprovincial and provincial-territorial water issues involve the Branch formally through Canada Water Act studies or other negotiated agreements. This involvement includes preplanning, development of water quality objectives and preparation of water quality assessment reports.

The geographic scope of the Branch activities, although limited by the division of jurisdictional responsibilities, nevertheless includes cooperative or unilateral undertakings within the provinces to provide accurate national and regional assessments of interjurisdictional water quality issues.

The Branch, in recognition of public needs and to ensure an adequate national understanding and knowledge of water quality, will conduct comprehensive measurements and assessments of Canada's inland waters. Although some of these activities may be federally sponsored, most are expected to be undertaken cooperatively with the provinces through federal-provincial agreements currently being negotiated.

The state of the aquatic environment in Canada is of national concern, and the Branch intends to undertake more comprehensive regional and national assessments of water quality and to publish reports for use by resource managers and the general public.

Toxic Chemicals

The occurrence of toxic chemicals in Canada's lakes and rivers is a serious water quality concern. Ours is a chemical society; chemicals are used to treat foods and in the manufacture of pharmaceuticals and other industrial products.

Toxic chemicals are common household names. They are ploughed into our fields, released into the air we breathe and flushed into our lakes and rivers. In North America over 4 million chemical compounds are registered, of which about 32 000 are in commercial use. More than 75 billion kilograms of synthetic chemicals is produced yearly. This is increasing at a rate of

at about 7% per year. Inorganic chemicals have been monitored for decades and health-related criteria have been set. Consequently, very few adverse health effects have been reported as a result of toxic inorganic elements in drinking water. Surveillance studies, however, indicate that organic chemicals are present in some of Canada's ambient freshwater basins at the low levels of parts per billion or parts per trillion. This could mean serious problems tomorrow. Many groups are contributing to the federal government's efforts to resolve the issues now and avoid future toxic chemicals problems. The Water Quality Branch's contribution is the identification of toxic contaminants in Canada's ambient waters and the development of water quality objectives based on use protection.

Environment Canada's basic strategy is to prevent toxic substances from entering the environment. A "cradle to grave" toxic chemical management system with clearly identified responsibilities for all concerned is being developed. Integral features of this system will be testing, monitoring, registration and, where necessary, the development of guidelines and regulations to be consistently enforced.

Many toxic chemicals have already escaped into the environment, while others, stored under questionable circumstances, threaten to do so. Remedial actions are necessary and must be shared among governments and polluters. The most pressing issue is the cleanup of the Great Lakes-St. Lawrence system. The Niagara River, with its threat to the safety of drinking water, is an insidious trouble-spot.

The Environmental Conservation Service has been delegated departmental responsibility for leading and coordinating activities designed to measure and determine the characteristics of toxic chemicals. Therefore the Branch monitors and studies the presence and abundance of toxic chemicals in the aquatic ecosystem, their geographic distribution and their effects on aquatic biota.

Long-Range Transport of Airborne Pollutants (LRTAP)

The long-range transport of airborne pollutants, of which acid rain is an example, is the most recent of a long list of global environmental problems which have confronted society since the late 1960s. Acid deposition in Canada is caused by emissions of sulphur dioxide and nitrogen oxide both here and in the United States. The government's goal is to reduce acid deposition in central and eastern Canada, by 1990, to no more than 20 kilograms per hectare

per year. This level is required to protect moderately sensitive aquatic systems. The acid rain problem affects all aspects of environmental management but in the case of water can be devastating. The problem manifests itself through increased acidity in lakes and rivers. Particularly hard hit are areas of granitic rock where overburden and sediments lack the buffering capacity to keep the acidity in check. The effects on fish are such that a complete fish-kill can be the long-term result.

The total annual cost to Canada of reducing acid-causing emissions of sulphur and nitrogen oxides to an acceptable level has been estimated at \$500 to \$700 million for the next 20 years. The Branch has established a network to help determine trends in the acidification process and evaluate the effect of emission controls.

In addition, the Branch works with the Atmospheric Environment Service and NWRI in the development of a scientific data base by collecting and archiving all significant LRTAP information on the National Water Quality Data Base (NAQUADAT) for use by managers and researchers. Furthermore, the Branch provides scientific information which aids Canada in its participation in international scientific discussions and continues to examine analytical methods, sampling schedules and trend assessment practices to increase the knowledge of LRTAP.

The Northern Environment and Water Quality on Federal Lands

The environmental uniqueness and sensitivity of the area north of 60°N, its harsh climate and geography for economic development, and the federal government's broad responsibilities in the territories all make the North a DOE priority. Proposed large-scale hydroelectric developments could have significant impacts on water quantity and quality, and also on the fish and wildlife that depend upon the water. The challenge will be to manage the water in a way that will sustain fish and wildlife populations while accommodating other water uses.

The federal government shares the responsibility for water resource management with the provinces (see Appendix A for further discussion). Within those areas for which it is responsible, the federal government demonstrates leadership in various ways, for example, by establishing good water quality management practices. The Water Quality Branch is the federal agency which normally provides

the scientific and technical information and advice for the sound management of water quality to other federal agencies.

The Branch has begun to document water quality management strategies for specific federal land areas. The Branch role is to provide advice, recommend studies, develop water quality objectives and report on non-compliance with the objectives and on any other water quality problem. The actual management responsibility normally lies with other federal agencies, e.g., Health and Welfare, Indian and Northern Affairs, and Parks Canada.

Freshwater Supplies for Human Consumption

Public concern over freshwater supplies for human consumption is high, especially where chemical contamination of either surface or ground water drinking supplies is suspected. This contamination can result from leaching of toxic waste dumps; pesticide contamination owing to runoff from agricultural areas; percolation of pesticides into farm wells; nitrate contamination in prairie provinces resulting from use of fertilizers; arsenic and uranium contamination in some regions because of former mining activities; contamination owing to sewage disposal and the leakage of storage tanks.

The resolution of such problems normally comes under provincial jurisdiction. Federally, the Department of National Health and Welfare provides national water quality drinking guidelines and is often requested to assist the provinces in resolving localized problems. Through participation with the Department of National Health and Welfare, the Water Quality Branch assists in the establishment of national guidelines and in providing information on the quality of potable water sources.

Canadian Guidelines for Water Quality

Water quality objectives are limiting characteristics of water, sediment or biota that have been negotiated to support and protect designated uses of water within a specified location. The limiting characteristic may be physical, chemical or biological.

Water quality objectives have been established through the Canada-United States Great Lakes Water Quality Agreement and for other bilateral agreements. At the 1984 meeting of the Canadian Council of Resource and

Environment Ministers (CCREM), the decision was made to publish Canadian guidelines for water quality. The guidelines are the basic scientific information necessary for the establishment of site specific water quality objectives.

The Water Quality Branch will be working with provincial agencies in harmonizing water quality guidelines throughout Canada by publishing the Canadian Guidelines for Water Quality.

Water Quality Conservation

Water quality conservation balances present development of the resource with future requirements and is an integral part of the long-term sustainable use of Canada's freshwater resource. Conservation must be based on sound scientific knowledge which, when disseminated, will promote a shared responsibility between the various levels of government and the Canadian public. The Branch promotes water quality conservation, and both publishes information and gives advice that can be used to achieve this goal. Information and advice relating to water quality objectives, environmental impact statements and basin management are provided to a wide variety of agencies including federal departments, provincial agencies, the United Nations, and the International Joint Commission.

Responding to the Issues

Water quality data and information play a vital role in water resource management. Federal emphasis on environmental quality suggests that water quality issues must be recognized and appropriately dealt with. The Branch, as the lead federal agency for water quality, works to provide appropriate data, information and advice to those who manage the resource.

Project planning is carried out between the various Branch offices and often with other federal and provincial agencies. For example, some regions have water quality field and laboratory coordinating committees which seek out possible areas of cooperation with Services such as the Environmental Protection Service, the Atmospheric Environment Service, the Canadian Wildlife Service, as well as federal departments such as Indian and Northern Affairs, and Fisheries and Oceans. Joint planning and implementation favours good relations and more comprehensive undertakings, avoids duplication and promotes the sound expenditure of resources.

Negotiation and Implementation of Agreements

Responsibility for Canada's water resources is divided between the federal and provincial governments and has necessitated a close degree of cooperation. The Canada Water Act has provided a mechanism for this cooperation, and water quality is an important component of many of the implementation plans and agreements associated with Great Lakes Water Quality, the Qu'Appelle Basin, the Okanagan Basin, the Yukon River basin, the Shubenacadie-Stewiacke Basin, and the Ottawa River.

In January 1982, Environment Canada obtained Cabinet approval to negotiate agreements with the provinces for the collection of water quality data and information. These agreements are expected to provide for long-term commitments and compatible data bases, accurate and comprehensive information and improved federal-provincial relations. In the past, ad hoc monitoring arrangements with some provinces have been negotiated annually, but these will be superseded in those cases where formalized federal-provincial agreements are negotiated. The first agreement was signed with Quebec in 1984.

The Branch also negotiates agreements with other federal agencies to assist them in their responsibilities for preserving and enhancing the quality of the aquatic environment. In this regard, studies have been carried out in a number of national parks with Parks Canada.

Development of Water Quality Objectives

The quality of water is usually judged by the ability of that water to support desired uses. Is it suitable as a drinking water source? Can it support the propagation of a healthy fish population or biological community? Will direct contact result in skin irritations? Is the water acceptable for irrigation or stock watering? These apparently simple questions can be difficult to answer, particularly considering that (1) the acceptability of drinking water depends on public perception and the availability of appropriate treatment technology; (2) the need for supporting the fisheries depends on the economy, fish species and the supporting food web; (3) water recreation is a growing industry even in areas of poor recreational potential; and (4) the desired quality of irrigation water depends on soil type and the crops themselves. The Branch addresses these questions by developing or selecting the water quality cri-

teria needed to support a particular use. Water quality objectives for use by management agencies are then developed, based on these criteria, for water bodies that normally have multiple uses. These criteria are expressed as desirable or acceptable limits of concentration of various substances in water, sediment or biota.

The Branch serves on national, inter-provincial and international committees to establish water quality objectives for waters of national significance. Also, advice and assistance are given to the provinces and territories regarding the formulation of water quality objectives.

Water quality objectives not only provide a yardstick to determine the suitability of water quality but also provide a means of implementing effective water quality management. For interjurisdictional waters, negotiated water quality objectives form a basis for managing water quality by establishing limits which, if not exceeded, protect designated uses in the downstream jurisdiction without undue restriction on the upstream jurisdiction.

The Branch prepares national and regional water quality assessments and publishes reports which compare ambient quality of surface and ground waters with these objectives.

Field Operations

Most of the projects have a field component which involves collecting representative samples and carrying out field tests of water, sediment and biota. Experience has shown that representative sampling requires considerable attention. The scope and intensity of a sampling program are usually determined by the nature of the problem, the desired degree of resolution, and the goal of the project.

Transportation of staff and equipment to and from sampling locations; transportation of bottles, acids, samples, etc. to and from the laboratory and field offices; outfitting of mobile laboratory units and field laboratories; communications; safety considerations; and aircraft charters, all are part of the operation. Sampling frequencies are often statistically designed and require strict adherence to avoid discontinuities. In most instances, the laboratory operations are organized to meet anticipated work loads; consequently, all the related parts of the program must function as a cohesive unit.

Field staff are trained in first aid, winter and cold water survival and other safety aspects. Sampling in remote locations requires individuals to drive snowmobiles, operate boats in fast water, sample from helicopters and winged aircraft, and work on ice. Special circumstances involve the use of qualified scuba divers. Because of the diversity of the sampling programs and because of the many dangers, training of staff is carried out on the job and by qualified experts from outside the Branch.

Staff of the hydrometric program of IWD often assist the Branch in the collection of samples when they are in the vicinity of the station, particularly those in remote areas. Branch staff train the hydrometric program staff and "lay collectors" in the techniques of sampling, preserving and shipping of samples.

Samples must sometimes be analyzed for certain parameters at the time of sampling or within a short period after. Advances in technology have resulted in equipment that can be transported and used in field vehicles; advances in knowledge surrounding the variables for characterizing water quality have put emphasis on *in situ* analysis and sample preparation. In response to this evolving technology, mobile laboratories (first introduced in 1975) are now used frequently for Branch operations. In some studies, fixed field laboratories are either constructed for the duration of a study or remain permanently in place because of a long-term monitoring program.

The sampling activities of the Branch are carried out to assess the chemical, biological and physical characteristics of the aquatic environment. Sampling is usually considered to fall into two major categories: monitoring and surveys. These are discussed in more detail in the following sections.

Monitoring

Monitoring involves the systematic collection of water samples, usually at fixed locations for a fixed suite of variables and substrates over an extended period of time. Monitoring may also include repeated intensive surveys of river basins. The frequency of sampling is related to estimating trends over the long term, providing overviews of water quality and describing the general baseline characteristics at strategically located areas. The fixed network operated by the Branch falls under this approach and typically involves the collection of water, sediment, and biological samples.

Occasionally, depending on the need, monitoring is conducted with remotely operated equipment. Real time data acquisition, linked with satellite transmission, is used to provide an early warning of undesirable quality conditions for those limited variables for which reliable sensors exist. Because of the increasing tendency toward more effective water quality management, monitoring approaches are continuing to evolve. Recently, networks have been upgraded and a recurrent basin study approach adopted in response to the need to provide additional information for national and regional assessments of water quality, for formulating objectives and for determining compliance. The Branch actively improves its monitoring technology through sponsoring or influencing research into this area as well as undertaking its own investigations.

Surveys

Surveys are usually carried out to achieve a specific objective within a short time frame and are oriented toward either (1) reconnaissance, (2) short-term intensive assessments, or (3) comprehensive assessments (studies).

Reconnaissance surveys are frequently conducted when water quality information for a particular area or pertaining to a potential issue is limited and some preplanning details are required. They are used to gather information to plan further in-depth investigative water quality assessments. The focus may include examination of the intrinsic characteristics of sampling sites, sampling techniques, delineation of pollution sources, spatial components of flow and quality, etc. Reconnaissance surveys are common in remote undeveloped areas such as the territories or national parks. These surveys employ grab sampling techniques and may last only a few days or be repeated under selected flow regimes. They identify issues and point the way to acquiring the appropriate information to resolve potential problems.

Intensive water quality surveys are the most demanding of the Branch field operations. The relationships between chemical variables and sediments, temporal and spatial characteristics, and land use activities and hydrology are studied as well as their effects on the biological community. This type of intensive approach provides the most detailed knowledge about selected aquatic environments and the temporal and spatial components of water quality.

Comprehensive water quality assessments are, as their title suggests, complex and demanding of financial and manpower resources. They are usually a single component of larger water resource undertakings such as those under the Canada Water Act. These surveys are multidimensional, sometimes relying on computer models and multidisciplinary teams of experts from many agencies. International Joint Commission references and the attendant involvement of Branch personnel in preparing water quality assessments and annual reports are considered comprehensive assessments. Pre- and post-development investigations instrumental in predicting or determining development impact such as the Arctic Islands and Alcan Pipeline Studies are generally comprehensive in scope.

Laboratory Operations

Data generated by Branch laboratories are the starting point of many major scientific programs of the Department, such as the National Water Quality Assessment Program, the Long-Range Transport of Airborne Pollutants Program, and the Toxic Chemicals Management Program. The data are needed to identify pollution problems and to quantify their extent. Once the problems are identified, management decisions are made and data are generated to evaluate the effects of the remedial measures taken, such as regulations or agreements. The laboratories therefore provide the analytical results on which environmental policies depend. The laboratories also provide analytical support to research programs of the Inland Waters Directorate and other directorates of the Department on a cost recovery basis.

The evolution of environmental concerns by the public and governments has led to changes in the variables analyzed. Emphasis has changed from major ions to constituents causing eutrophication, and more recently, to toxic chemicals including industrial pollutants such as dioxins, polynuclear aromatic hydrocarbons, polychlorinated biphenyls, pesticides and metals. Approximately half a million analyses are performed each year, yielding quantitative evidence of constituents in precipitation, surface and ground waters, waste waters, sediments and aquatic organisms.

Assessment of water quality requires reliable data. The laboratory devotes approximately 15% of its effort to inter- and intralaboratory quality assurance to ensure the production of high quality reliable data.

National Water Quality Laboratory

Although laboratories in Moncton, Longueuil, Burlington, Saskatoon and Vancouver provide immediate support to field units in each region, the Branch is in the process of consolidating its capability for complex and expensive analyses in the National Water Quality Laboratory at the Canada Centre for Inland Waters in Burlington, Ontario. The National Laboratory's primary purpose is to provide analytical services to support regional Branch programs. It also provides chemists and technologists for shipboard analyses during monitoring cruises on the Great Lakes for the Ontario Region.

The implementation of the new laboratory system was started in 1983 and will be completed in 1985. The National Laboratory brings together teams of highly skilled analysts with the most sophisticated instruments and significantly improves the efficiency of the operational laboratory system.

Regional Laboratories

Many chemical and biological analyses must be performed within the shortest possible time after sample collection. In other cases, although the analysis of some constituents may be delayed indefinitely, the samples may require extensive pre-treatment within certain critical time frames. The regional laboratories provide these capabilities as well as some response capabilities to handle emergency needs. Organic extraction of sediment, biota and water for shipment to the National Laboratory is handled by regional laboratories, depending on the requirements of the field projects.

Electronic Data Processing and Data Management

The handling of tens of thousands of samples and hundreds of thousands of tests annually by laboratories and by the data users requires computer assistance. High technology has assisted the program by improving the quality of data, speeding up processes of data verification, information handling and data dissemination. The data management and electronic data processing (EDP) activities fall into three categories: laboratory management, data management, and data analysis.

Laboratory Management

The Branch utilizes several software systems to keep track of the samples collected each year. The Automated Water Quality Laboratory System (AWQUALABS) is the primary way of managing samples within the National Laboratory. With sophisticated data

capture/data management algorithms, the system accepts data directly from analytical instruments, performs quality control checks, and produces immediate reports on the status of any sample. Regional laboratories have developed customized computer systems of smaller scale to perform similar functions. The shift to laboratory automation has necessitated the in-house development of specialized software and computer interfaces. This activity is continually evolving in response to laboratory and field needs as well as advances in technology.

Data Management

Upon completion of sample analyses, the laboratory transfers the verified data to regional computer systems and/or directly to NAQUADAT. This data storage and retrieval system is designed to accommodate both federal and provincial data from stations across Canada. The system provides a flexible structure for storing the results of "environmental analyses" and other data about the samples and sampling locations, and for producing a large variety of graphical and statistical reports. NAQUADAT has recently been converted to operate under the System 2000 data base management system to improve accessibility and ease of data manipulation. Some 2.5 million results from 8500 stations are now available for inspection via dial-up computer terminals anywhere in Canada. The data system is used to assist interpreters in assessing water quality.

Both printed and on-line references are available to keep users up-to-date on developments in the NAQUADAT data management capabilities and the status of their data. Users' manuals for the system are published and training is scheduled as required. A "Dictionary of Parameter Codes" is maintained and distributed to document the hundreds of parameters which are stored and to associate each measurement with a particular analytical method. The development of data management software is an ongoing task, responding to the needs of data users and new technology.

Regional computer systems perform interfacing functions between the regional and national laboratories and with NAQUADAT. Data verification, some report preparation and other management needs are performed by regional computers.

Data Analysis

The transformation of raw water quality data into information that is useful in the management of water quality is perhaps the single most important EDP activity of the Branch. Be-

cause most of the data generated by field projects and laboratories are stored in NAQUADAT, the increased emphasis on interpretive information has, in recent years, out-paced the data analysis capabilities of the Branch. This has placed considerable pressure upon the EDP staff to make the computer software more efficient and responsive to those involved with data interpretation. Regional computers and sophisticated software packages have been acquired to permit in-depth data analysis in concert with NAQUADAT.

In the past, data analysis consisted simply of providing descriptive statistics. Now, to be more useful to water managers, water quality interpretations are supported by more comprehensive data analysis and graphical presentations. More powerful tools are being applied and new approaches developed to understand water quality in both time and space dimensions. These tools include such techniques as time series and cluster analysis.

Graphics capabilities are used throughout data analysis. At the beginning, graphics are used to explore the data, and at the end, to present the findings of data analysis. During analysis graphics are used to monitor the progress and appropriateness of the analysis.

The specific need to detect trends or change in environmental quality, to prepare data for use in establishing water quality objectives and to contribute to a better understanding of the quality of the aquatic environment with respect to the multiple uses it must support, has resulted in the Branch actively evolving its data analyses capabilities.

Water Quality Reports

The preparation of water quality reports is usually the final step in the measurement and assessment activities of the Branch. As water quality data alone without interpretation are of limited value, report preparation is a priority activity of the Branch.

Reports may be either national, regional or local in scope, depending on the issues addressed. Water quality reports cover topics such as aquatic processes; toxicity, distribution and abundance of chemicals; trophic status; cause and effect relationships; trends in quality; national or regional overviews; status of aquatic quality; compliance of water quality with objectives; models; sample collection. The topics addressed usually fall into one or more of the following broadly defined categories:

- (i) policy and activities
- (ii) interpretive reports
- (iii) data reports
- (iv) brochures
- (v) data management
- (vi) water quality guidelines and objectives
- (vii) laboratory and field methods.

Branch publications conform with departmental language requirements and IWD publication guidelines and are published in either the IWD Scientific Series or Technical Bulletin Series, in the Branch's own Interpretive Series, in scientific journals and conference proceedings, or as internal documents.

In many instances, reports are prepared as joint undertakings with provincial or other federal agencies. This joint participation is actively pursued, particularly with the provinces.

The Structure of the Water Quality Branch



Structure

The Water Quality Branch comprises an interdisciplinary team of chemists, biologists, geologists, hydrologists, mathematicians, engineers, meteorologists and technicians, each of whom fills a specialized role in the undertaking of the measurement and assessment of water quality.

The Branch is decentralized with Headquarters in the National Capital Region and regional offices in Moncton, N.B. (Atlantic Region); Longueuil, Que. (Quebec Region); Burlington, Ont. (Ontario Region); Regina, Sask. (Western and Northern Region); and Vancouver, B.C. (Pacific and Yukon Region). The Western and Northern Region also has district offices located in Winnipeg, Manitoba, and Calgary, Alberta, and a water quality specialist located in Yellowknife, N.W.T.

Administratively, the Headquarters and regional components function under different lines of authority, with the Headquarters group reporting through the Water Quality Branch Director and the Director General, Inland Waters Directorate, and the regional offices reporting through their respective Regional Director and the Director General, Inland Waters Directorate.

The Branch at Headquarters and in the regions has three primary divisions which are briefly described below; more complete descriptions are presented in Appendix D.

Division Responsibilities

Rather than examine the respective roles of each division for regions and Headquarters, the organizational structure described favours the Headquarters component but has been designed to include both Headquarters and regional program perspectives.

Monitoring and Surveys Division

This Division is responsible for the measurement and assessment activities of the Branch, which involve planning of projects, collection of samples, interpretation of data and preparation of reports. The Division is also concerned with developing policies, negotiating water quality monitoring agreements, identifying issues and contributing information for the management of the water resource.

Water Quality Objectives Division

The Water Quality Objectives Division provides the Branch with the expertise for defining, negotiating, formulating and evaluating the benefits of water quality objectives and other tools for affecting management of water quality. The Division considers the need to reconcile industrial growth with the preservation or enhancement of water quality.

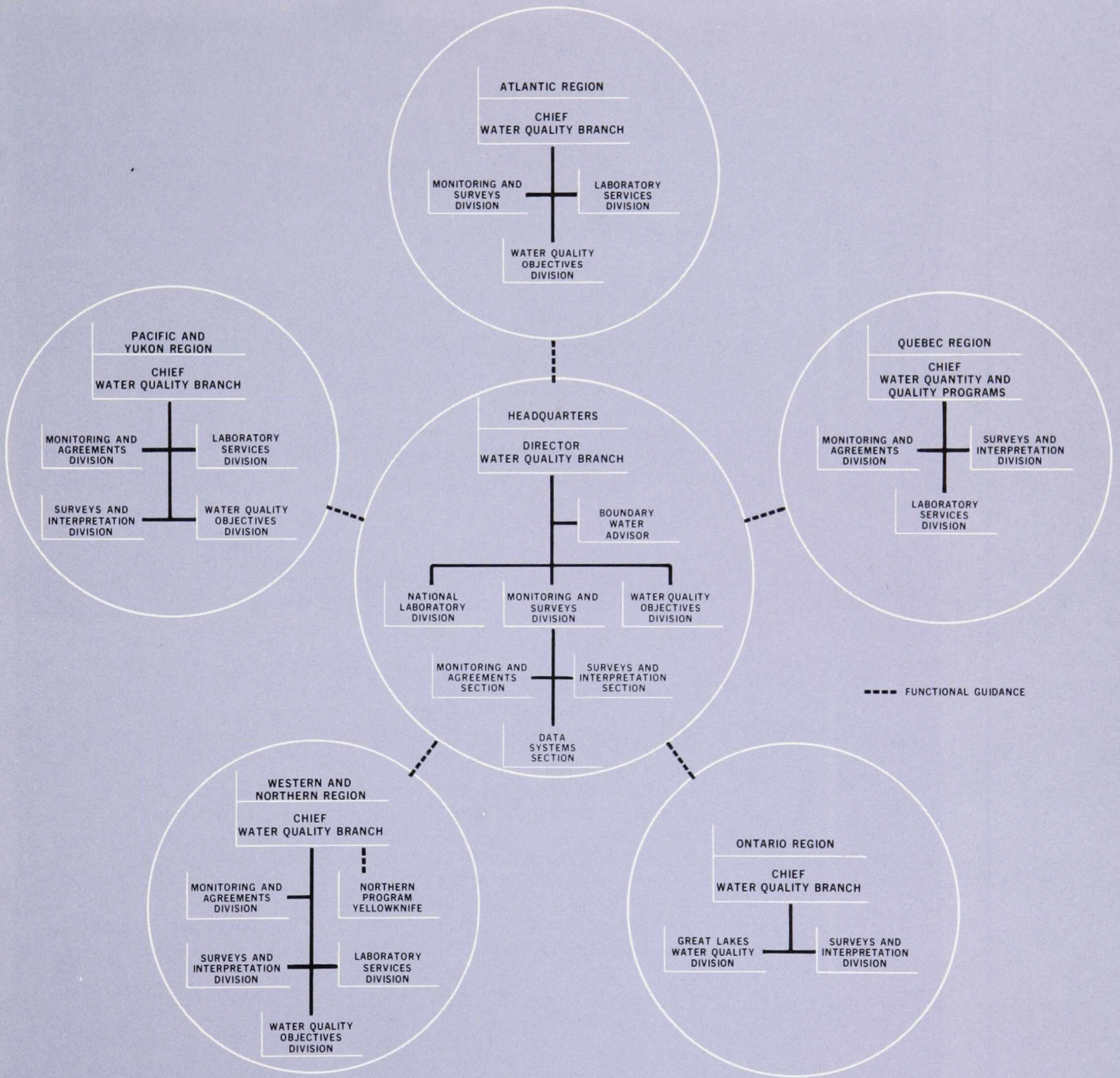
Laboratory Services Division

The Division is responsible for providing water quality data by the analyses of environmental samples in the Branch laboratories located in Burlington, Moncton, Longueuil, Saskatoon and Vancouver. Staff provide an advisory and consultative service to senior officials, scientists and researchers in the Department, other departments and agencies on analytical chemistry, laboratory operations, water chemistry and data interpretation. The Division maintains the *Analytical Methods Manual*, which documents the approved methods and techniques used by analysts in the Branch laboratories and many other federal, provincial and private laboratories.

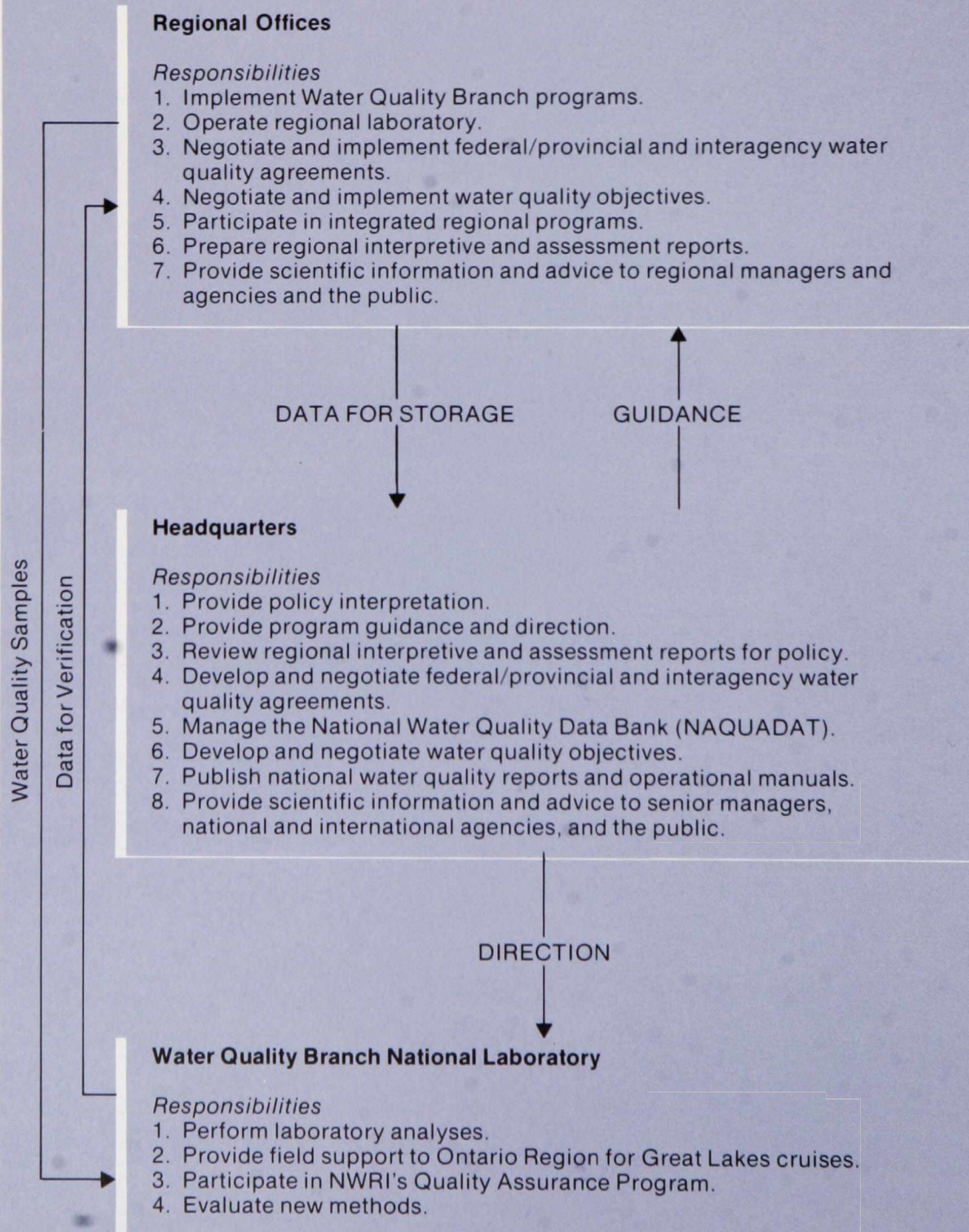
Headquarters and Regional Roles

The Headquarters and the regional offices share the responsibility for delivering an effective and efficient federal water quality program. Here only major responsibilities will be discussed. Specific details concerning responsibilities will be described in the "Water Quality Branch Operational Manual," to be published later.

Water Quality Branch Organization



Responsibilities within the Water Quality Branch

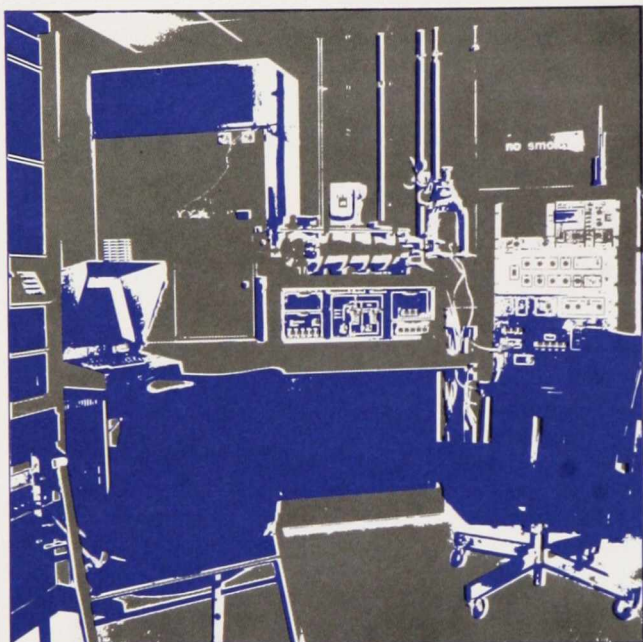


Headquarters is responsible for coordinating water quality programs to meet national requirements. It must also formulate national policies and provide guidance in the development of the operational plans, establish national goals and priorities, and prepare nationally focussed water quality reports. The regional offices are responsible for planning, designing and implementing water quality programs and for providing regional information.

Both Headquarters and regional offices share the responsibility for identifying research needs relevant to achieving Branch objectives. Operational contacts are appointed to liaise with researchers in both government and private sectors, and in this way the Branch influences the direction of research undertaken by the two national research institutes and arranges for the transfer of research results to the operational program.

The "management team" concept is an important facet of the Branch infrastructure. At the top, the team is composed of the Branch Director and his advisors and the Headquarters and regional Chiefs who collectively plan, review and influence the course of the Branch in response to the external influences described in the next section. The heads of the respective sections contribute to the management process on matters relating to project implementation and provide advice to the chiefs.

The Branch in Transition



Over the past five years the Branch has had to respond to rapid and pronounced changes in such diverse areas as technology, policy and environmental awareness. The ecosystem concept with its view of man as part of the environment has broadened the Branch's view of water quality from a purely chemical one to include aquatic biota and consideration of other components such as air and land. The broadening of water quality concerns has led the Branch to use more sophisticated monitoring techniques and to consider biological effects as well as the impact of sediments on water quality. Many of these concerns have also demanded lower levels of chemical detection for a wide range of chemical substances. The high equipment costs associated with the increasing complexity of analytical technology led the Branch in 1983 to consolidate certain laboratory functions at the National Water Quality Laboratory in Burlington. The increasing use of computers has made the Branch a leader in electronic data processing in laboratory management, data management, and interpretation.

The Branch has therefore not been static; it has changed to meet new priorities. Reviewing current influences and modifying Branch activities has been a continuing process for the Branch, and this report is part of this ongoing process. In the future the Branch will continue to respond to a wide range of diverse influences from policy changes to economic conditions and new scientific information. This section will review some of these influences.

Operational Efficiency

The review of existing legislation (Appendix A) shows that although legislation constrains Branch activities, the major constraint faced by the Branch in meeting its responsibilities has been a lack of resources. With limited resources the Branch will continue to tailor its programs so that they are responsive to new federal, departmental and directorate priorities. Some changes along these lines are now occurring. The National Water Quality Laboratory is being developed to provide efficient and effective analytical capability in the future. Federal-provincial monitoring agreements are being negotiated, giving both federal and provincial officials access to water quality data at less cost than if they had collected data themselves. The Branch must continue along the course of maximum efficiency and actively pursue the goal of doing more at least cost.

National Water Quality Assessment

In the discharge of its responsibilities for implementing the water quality monitoring network across Canada, the Water Quality Branch has endeavoured to meet its role as outlined in the Federal Policy Statement on Inland Waters. While this policy statement effectively highlights the types of issues the federal government should address, its implementation has exposed both strengths and weaknesses in meeting today's challenges. A major obstacle in implementing the policy has been the limitation of the federal water quality monitoring network almost exclusively to boundary stations. Acquisition of representative data from other areas of Canada has been left to provincial governments and territorial agencies. Recent water quality assessments have indicated that under this approach, water quality data available to the federal government and collected internally have lacked consistency and national coverage. Basic data essential to providing information and advice regarding interjurisdictional water quality issues are lacking. The network, in turn, cannot provide national assessments of areas such as the effectiveness of nutrient control measures, the impact of acid precipitation on surface waters and the degree of protection afforded to aquatic organisms by water quality conditions.

In past years Environment Canada has attempted to fill gaps in its water quality network by requesting provincial data collected from non-interjurisdictional stations. However, it has had little or no control over the location of these stations, the choice of parameters to be analysed, the quality of the data or other factors affecting the utility and compatibility of

the data. The water quality network in Canada, from a federal point of view, therefore, has proved to be less than satisfactory. This is also the case from a provincial point of view. Quebec and the three Prairie Provinces have expressed a desire for federal-provincial cost-sharing agreements, which is seen as a solution by Environment Canada. This approach provides for a truly national water quality monitoring network analogous to the agreements now in effect for hydrometric and meteorological networks. The development of such a network for water quality became feasible in 1982 when Cabinet provided authority for negotiating federal-provincial water quality monitoring agreements. The first agreement was signed with Quebec in 1984. This development provides a much needed mechanism to obtain comprehensive water quality data across Canada.

The Branch will meet this responsibility by developing a National Water Quality Assessment Strategy meeting the requirements of the Federal Policy Statement on Inland Waters, with the following objectives:

- (1) to determine changes and long-term trends in water quality,
- (2) to detect emerging problems,
- (3) to determine the effectiveness of regulatory actions, and
- (4) to assess the need for special investigations.

The Branch is negotiating agreements with the provinces to enable it to meet these objectives.

Provision of Public Information

Public information workshops held by Environment Canada have revealed public concern for water quality and the need for more water quality information to help them make decisions. In the future the reports produced by the Branch must address a much wider and more general audience. The Branch must recognize its responsibility to the general readership who are interested in water quality.

Advances in Science and Technology

The scope and complexity of water quality concerns have expanded to such an extent that they tend to touch almost every scientific discipline. This creates a problem for the Branch in keeping abreast of new scientific discoveries that it can use in identifying and resolving water quality concerns. For instance, advances in environmental assessment have resulted in ecosystem concepts being applied

to provide better information for developing policies, determining impact and risk factors, determining the distribution of contaminants, understanding cause-effect relationships and ultimately developing more complete information pertaining to the water resource. The Branch recognizes the value of biological monitoring and the need to develop its expertise through training programs and workshops.

It also recognizes that multi-media sampling is needed to describe more accurately the presence, stability and distribution of aquatic contaminants. And sediments and biota must be considered as well as chemical analysis of water.

Computers already play an important role in the Branch's activities, and advances in technology must be continually reviewed and appropriately applied. Computers will be particularly important in laboratory automation, management of multidisciplinary information (e.g. chemistry, biology, physical) and data interpretation and presentation.

In the future, the Branch must not only maintain its awareness of scientific advancements but also continue to identify gaps in scientific knowledge that prevent the achievement of its goals. It will do this by organizing seminars and training programs and taking part in exchange programs.

The Branch will work closely with NWRI to identify its research needs and will increasingly rely on NWRI for the resolution of these needs.

Canada-United States Water Quality Concerns

There will undoubtedly be continuing pressure from the United States to maintain or enhance the quality of boundary and trans-boundary waters. The United States often regards parts of its northern border as its last wilderness area, whereas Canada regards its southern boundary as an area for development. In the future the Branch must increase its emphasis on collecting information, negotiating and establishing water quality objectives on these waters so that Canadian uses are not jeopardized.

Conclusion



With new mandates, such as the federal-provincial water quality monitoring agreements, Branch staff can expect to face changes for some time to come. These agreements are a positive step forward. They will permit the Branch to do a better job and will provide benefits to all Canadians. Such a transition, however, will not occur without considerable adaptation on the part of Branch personnel. With each agreement, new "rules of the game" are to be identified. In some areas this will mean formalizing informal arrangements; in others, changes in field operations and water quality analyses could be significant. Regional and Headquarters components will be more involved in the process of national assessments of water quality than in past years as well as in coordinating activities with those of the provinces. National water quality assessments of the future will likely involve cooperative undertakings with the provinces. For the Water Quality Branch this transition is expected to proceed smoothly and will be aided by recent measures to improve the effectiveness of the Branch.

Review of Legislation and Policy



The basis for the activities of the federal and provincial governments in relation to water in Canada is derived from the Constitution. The Constitution provides for provincial jurisdiction relating to proprietary rights, which includes the use, regulation and development of water resources within their boundaries.

In the Northwest and Yukon Territories, the federal Parliament has complete jurisdiction in matters related to water. Elsewhere, the federal government can legislate exclusively with regard to navigation and fisheries. Moreover, the federal government has many responsibilities related to interprovincial and international waters.

Environment Canada, and the Environmental Conservation Service in particular, administer a series of acts in which water quality is directly mentioned and some others in which water quality is implied. A review has been carried out of the water quality provisions of some of these acts. This review follows.

Government Organization Act (1979)

Environment Canada received its present mandate from Part III of the Government Organization Act of 1979. Sections 5 and 6 concern water quality.

Section 5 sets out the duties, powers and functions of the Minister, which extend to and include the following:

- (a) All matters over which the Parliament of Canada has jurisdiction, not by law assigned to any other department, board or agency of the Government of Canada, relating to
 - (i) the preservation and enhancement of the natural environment, including water, air and soil quality,
 - (ii) renewable resources, including the forest resources of Canada, migratory birds and other non-domestic flora and fauna,
 - (iii) water,
 - (iv) meteorology,
 - (v) notwithstanding paragraph 5(f) of the *Department of National Health and Welfare Act*, the enforcement of any rules or regulations made by the International Joint Commission, promulgated pursuant to the treaty between the United States of America and His Majesty, King Edward VII, relating to boundary waters and questions arising between the United States and Canada, so far as they relate to the preservation and enhancement of the quality of the

natural environment, and
 (vi) the coordination of the policies and programs of the Government of Canada respecting the preservation and enhancement of the quality of the natural environment and

- (b) Such other matters over which the Parliament of Canada has jurisdiction relating to the environment as are by law assigned to the Minister.

Section 6 states in addition that the Minister of the Environment, in exercising his powers and carrying out his duties and functions under Section 5, shall

- (a) Initiate, recommend and undertake programs, and coordinate programs of the Government of Canada, that are designed
 - (i) to promote the establishment or adoption of objectives or standards relating to environmental quality, or to control pollution,
 - (ii) to ensure that new federal projects, programs and activities are assessed early in the planning process for potential adverse effects on the quality of the natural environment and that a further review is carried out of those projects, programs, and activities that are found to have probable significant adverse effects, and the results thereof taken into account, and
 - (iii) to provide to Canadians environmental information in the public interest;
- (b) Promote and encourage the institution of practices and conduct leading to the better preservation and enhancement of environmental quality, and cooperate with provincial governments or agencies thereof, or any bodies, organizations or persons, in any programs having similar objects;
- (c) Advise the heads of departments, boards and agencies of the Government of Canada on all matters pertaining to the preservation and enhancement of the quality of the natural environment.

Section 5 establishes the duties, powers and the functions of the Minister over water including water quality and the natural environment. Section 6 establishes what the Minister shall do in carrying out his functions. In relation to water quality the Minister must promote the establishment of objectives and standards, provide environmental information to Canadians, and give advice to other departments and agencies in environmental matters.

It is concluded that from the point of view of the Water Quality Branch the powers given to the Minister in aspects related to water quality are broad and give authority for a variety of programs in the Branch. Water quality objectives and environmental impact assessment of federal projects are mentioned directly. Also mentioned directly is providing "...environmental information in the public interest," which is interpreted here as providing a mandate for programs such as national assessment of water quality, LRTAP, toxic chemicals or any other special study responding to current issues.

Canada Water Act (1970)

The preamble to the Canada Water Act states that "...more knowledge is needed of the nature, extent and distribution of [water] resources, of the present and future demands thereon and of the means by which these demands may be met." Sections 4 and 5 of the act permit the Minister to carry out a number of activities among which the following are relevant to the Water Quality Branch:

- (a) Establish and maintain an inventory of those waters and
- (b) Collect, process and provide data on the quality, quantity, distribution and use of those waters.

The Minister's authority under Sections 4 and 5 varies according to the nature of the waters under consideration, as follows:

- (i) For waters under federal jurisdiction, the Minister may act directly provided he has the approval of the Governor in Council;
- (ii) For interjurisdictional waters there must be "a significant national interest" and the approval of the Governor in Council (the Cabinet). In this case, the Minister cannot act directly unless "all reasonable efforts have been made to reach an agreement with the one or more provincial governments having an interest in the water resources management of the waters in question";
- (iii) For waters other than those described in (i) and (ii), the Minister may act only if he has reached an agreement with the province(s) concerned and if there is significant national interest and if the Governor in Council has approved.

By specifying "...agreements with... provincial governments..." or "...all reasonable efforts...to reach an agreement..." Sections 4 and 5 somewhat limit the authority of the Minister to conduct inventory, data collection and

research in waters which are not under federal jurisdiction. Section 6, however, permits the Minister to "conduct research, collect data and establish inventories respecting any aspect of water resource management or the management of any specific water resources...." There is no requirement under this section for Governor in Council approval, significant national interest or federal-provincial agreement. This is interpreted here as giving the Department the authority to carry out its activities anywhere in Canada, at the request of the Minister (see also the Federal Policy Statement on Inland Waters, which appears later in this appendix).

Boundary Waters Treaty (1909)

Article IV of the Boundary Waters Treaty of 1909 between the United States and Canada states that "...boundary and waters flowing across the boundary shall not be polluted on either side to the injury of health or property on the other."

The provisions of Article IV are interpreted here as giving Environment Canada, through the Department of External Affairs, the authority to undertake, itself or in collaboration with other agencies, any studies it deems necessary in boundary and transboundary waters and their direct tributaries, including long-term water quality data collection, intensive water quality studies, and establishment of and compliance monitoring for water quality objectives. Furthermore, the Department responds to requests from the International Joint Commission in matters referred to the Commission under the provisions of the Treaty. Under the authority of the Treaty, IWD and ECS can also establish principles for boundary waters management, carry out studies in support of the IJC or other bilateral institutions, and provide advice to the government on the acceptability of IJC recommendations (ECS Program plan 1981-82).

International Rivers Improvement Act (1955)

This act is intended to restrict the construction of any dam, canal, reservoir or other work (called "improvements" in the act) on any international river which has the effect of (a) altering the natural flow and (b) interfering with, altering or affecting the actual or potential use of water outside Canada. The second point is important with respect to water quality.

Under the act a licence must be obtained from the Minister "to construct, operate or maintain an improvement." The regulations of the act specify what information must be sup-

plied to obtain such a licence. With respect to water quality the important provisions are in Sections (e) and (f):

- “(e) details as to the effect of the improvement on the use of water outside Canada;
- (f) details of the adverse effects of the improvement on flood control and other uses of water together with information as to plans to minimize such effects.”

To be able to judge a request for a licence submitted under this act from a water quality perspective, the Branch should be able to carry out any work it deems necessary on the specific water body for which a licence has been requested.

Acts Potentially Relevant to the Water Quality Branch

The acts listed below have implicit water quality provisions, and specific water quality projects can be carried out under these provisions by the responsible department:

- Fisheries Act (as amended in 1977), responsibility of Fisheries and Oceans;
- Environmental Contaminants Act (1975), responsibility of Environment Canada;
- Migratory Birds Convention Act (1916), responsibility of Environment Canada;
- Arctic Waters Pollution Prevention Act (1972), responsibility of Indian and Northern Affairs;
- Northern Inland Waters Act (1972), responsibility of Indian and Northern Affairs.

Federal Policy Statement on Inland Waters (1978)

Although not an act of Parliament, the policy statement approved by the Cabinet states the objectives of the Government of Canada in matters related to water resource management. It contains several articles directly related to water quality, which are considered to be part of the responsibility of the Water Quality Branch.

The articles referring directly to water quality follow:

- Article 3. “The federal government is committed to the restoration and protection of water quality and the enhancement of aquatic ecosystems through the development of water quality objectives to protect water uses....”
- Article 9. “The federal government is committed to monitoring the quality of international, interprovincial, Indian reserve, national park and other

waters in Canada where there is a significant national interest.”

In addition, the following articles (5, 6, 10, 15) have water quality implications:

- Article 5. “All water related projects initiated by the federal government or for which federal funds are solicited, or for which federal property is required, are subject to the Environmental Assessment and Review Process.”
- Article 6. “The federal government is committed to the preservation, restoration and commemoration of water bodies and their adjacent landscape, if the area is of prime geographical, geological, biological or historic importance, for the benefit, education and enjoyment of the people of Canada.”
- Article 10. “The federal government is committed to ensuring that water management actions and activities which affect boundary and international waters are consistent with the principles of the Boundary Waters Treaty of 1909.”
- Article 15. “The federal government is prepared to negotiate agreements with each province whereby the costs of operating joint water data collection networks for surface and groundwaters, effluent discharges, waterworks and wastewater systems, and snow and ice are shared according to the proportionate value of the data to the federal government and the province.”

The water quality considerations of the Federal Policy Statement reinforce and state more explicitly the provisions of the federal acts. The Policy Statement also focuses on the most important aspects of the water quality field. Among the water quality activities specified in the Policy Statement are establishing baseline information, identifying water quality trends on a national and regional scale, developing water quality criteria, establishing water quality objectives and compliance monitoring for water quality objectives.

The Policy Statement is interpreted here as giving the Water Quality Branch the mandate for carrying out its activities in any water body of “significant national interest.” “Significant national interest” includes, but is not limited to, areas of direct federal responsibility such as boundary, international and interprovincial waters; waters in federal lands (e.g. Indian reserves, national parks, the Terri-

tories); and waters where federal jurisdictions, such as fisheries and navigation, are major concerns.

Federal-Provincial Agreements for Monitoring Networks (1982)

In March 1982, Cabinet approved a new policy authorizing the Minister to negotiate federal-provincial cost-sharing agreements for water quality monitoring networks. A significant feature of the new policy is the provision for monitoring of water quality, in collaboration with the provinces, in non-boundary areas of Canada. This was based on the need for information on water quality on a national scale. This Cabinet decision will enable the Branch to fulfill its function of informing the government about the state of the environment with respect to water quality, and of detecting and evaluating new and emerging water quality issues in Canada.

Environment Canada: Its Evolving Mission

"Environment Canada: Its Evolving Mission" was published by the Department in September 1982. The paper reviews the legislated authority of Environment Canada and states that the Department's broad mission is to foster harmony between society and the environment for the economic, social and cultural benefit of present and future generations of Canadians. The paper elaborates on some of the key terms in that statement, the foundation stone for all departmental activities. It describes the way in which the Department has evolved in response to the challenges and opportunities of its first decade and looks forward to its continuously evolving role in its second decade.

Conclusion

The analysis of existing legislation and policy with direct or indirect water quality implications shows that the various acts, treaties or federal policy statements have strong, and, in many cases, overlapping water quality provisions. This overlap is interpreted as a reinforcement of these provisions. The existing legislation permits the Water Quality Branch to carry out activities related to all aspects of water quality on a wide geographic basis. The programs of the Branch are limited by departmental priorities and by the availability of resources rather than by legislation.

Environmental Services Program Objectives



The publication *Government of Canada Estimates 1981-82*, also known as the "Blue Book," gives the following objective and sub-objectives for the Environmental Services Program of the Department.

Objective

"To promote and undertake programs to protect and enhance the quality of the environment, and programs designed to improve the management and sustained economic utilization of the forest, wildlife, and inland water resources of the nation."

Sub-Objectives

- "To promote the quality, management and use of inland water resources.
- To develop preventive and other control measures directed to air and water pollution.
- To provide meteorological and ice information services and to encourage and promote the application and development of meteorological science.
- To assist in the improvement of the quality, management and use of land.
- To promote effective and economic management and use of the forest resources of the nation.
- To conserve and manage wildlife resources including migratory birds and their habitat in Canada."

Environmental Conservation Service Objectives



The ECS 1983 "Manual of Instructions for the Preparation of Long-term Operational Plans" states the following objective for the Environmental Conservation Service:

"To conserve and enhance Canada's renewable resources of water, lands and wildlife and their related ecosystems and promote their wise use in a sustainable manner for the economic and social benefit of present and future generations."

ECS National Programs Objectives (1984-85)

1. Inland Waters Conservation (a sub-activity or a program component) "to promote sound management and development of Canada's water resources in keeping with federal responsibilities and national objectives." Programs in italics indicate IWD involvement.
 - 1.1 *Canada-United States and Interjurisdictional Water Management*
"To resolve interjurisdictional water resource problems and realize interjurisdictional water resource opportunities in accordance with national interests."
 - 1.2 *Flood Damage Reduction*
"To reduce future flood damage and federal disaster assistance payments."
 - 1.3 *Water Quality Management Data*
"To provide comprehensive, accurate and timely data, information and advice on the quality of Canada's inland waters."
 - 1.4 *Water Quantity Management Data*
"To provide comprehensive, accurate and timely data with information on the quantity of Canada's inland waters."
 - 1.5 *Water Management Research*
"To advance knowledge and provide information and understanding required for the solution of water management problems and the realization of water development opportunities."
 - 1.6 *Management and Administration*
"To plan, manage and control the policies, programs and activities of the Inland Waters Directorate in an effective and efficient manner."
2. Lands Conservation
(incorporates three national programs)
3. Wildlife Conservation
(incorporates four national programs)
4. Multiple Resource Conservation
 - 4.1 *Toxic Chemicals*
"To provide information on the characteristics and presence of toxic chemicals in the environment, the pathways of these chemicals through ecosystems and knowledge of their actual and potential impacts on the environment."
 - 4.2 *Long-Range Transport of Airborne Pollutants (LRTAP)*
"To monitor, predict and evaluate impacts of airborne pollutants on aquatic and terrestrial ecosystems."
 - 4.3 *Environmental Assessment and Baseline Studies*
"To participate effectively in the Environmental Assessment and Review Process and to provide environmental knowledge and predictive capability which will ensure that federal decisions on major development proposals reflect environmental and renewable resource concerns."
5. Management and Common Support Services
(incorporates two national programs)

Division Responsibilities in the Water Quality Branch



The Branch has three operational divisions which are briefly described below:

Monitoring and Surveys Division

The Division is responsible for the measurement and assessment activities of the Branch, which involve planning of projects, collection of samples, interpretation of data and preparation of reports. The Division is also concerned with developing policies, negotiating water quality monitoring agreements, identifying issues and contributing to the management of the water resource by

- (1) Administering the water quality assessment activities of the Branch by planning and conducting monitoring and surveys;
- (2) Preparing timely interpretive and data reports for use in water quality management initiatives;
- (3) Providing scientific and technical information and advice to senior managers, other agencies and the public;
- (4) Maintaining a national computerized data base for storing and retrieving data and for statistically processing and presenting records for reports;
- (5) Negotiating and administering federal-provincial agreements and agreements with other agencies;
- (6) Developing policies concerning the Branch's role in addressing priority issues (e.g. Toxic Chemicals, LRTAP);
- (7) Reviewing and evaluating new technology and holding workshops and training seminars.

Water Quality Objectives Division

The Water Quality Objectives Division provides the Branch with the expertise for defining, negotiating and evaluating the benefits of water quality objectives and other tools for effecting management of water quality. Water quality management must allow for industrial growth while at the same time preserving or enhancing environmental quality. The Division is responsible for ensuring that a balanced approach to water quality management is pursued. The Division also is responsible for

- (1) Establishing federal policies for objectives on Canada/United States transboundary rivers and, with provincial agencies, negotiating their acceptance with American agencies;

- (2) Promoting the use of objectives and other tools toward managing interprovincial rivers, and working with provincial groups in establishing them;
- (3) Promoting the use of objectives by other federal agencies as tools for water quality management;
- (4) Reviewing and maintaining a literature base on a wide variety of water-based scientific and technical information pertinent to water quality management;
- (5) Publishing guidelines for the quality of water needed to support areas such as drinking water, aquatic life, agriculture, recreation and various industries;
- (6) Assembling information on existing water quality conditions and potential future uses;
- (7) Reporting on compliance with objectives, their effectiveness and any future changes that may be required to the objectives and compliance monitoring technology in light of advances in sciences and technology.

Laboratory Services Division

The Division is responsible for providing water quality data by the analyses of environmental samples in the Branch laboratories located in Burlington, Moncton, Longueuil, Saskatoon and Vancouver. Staff provide an advisory and consultative service to senior officials, scientists and researchers in the Department, other departments and agencies on analytical chemistry, laboratory operations, water chemistry and data interpretation. The Division maintains the *Analytical Methods Manual*, which documents the approved methods and techniques used by analysts in the Branch laboratories and many other federal, provincial and private laboratories. The Division is responsible for the following:

- (1) Conducting a wide variety of chemical, physical and biological analyses on water, sediment and biota samples;
- (2) Providing an advisory and consultative service to other scientists and senior officials of the department and outside the department and to other countries on analytical and field methods, quality assurance, preservation of aquatic environmental samples, shipping and storage of samples and water quality laboratory operating criteria;
- (3) Providing federal leadership in Canada concerning laboratory operations for aquatic environmental quality programs;

- (4) Maintaining an automated laboratory data management-data capture system for processing analytical data, thereby providing management with timely information such as sample status laboratory statistics and performance measurements;
- (5) Preparing cost recovery policies and schedules and allocating laboratory capability to clients to ensure that projects are carried out in a manner that is economical, efficient and effective;
- (6) Developing policies concerning quality control procedures to ensure accuracy, validity and compatibility of analytical data generated by Branch laboratories;
- (7) Participating in the planning of Branch activities and in investigative studies to optimize the quality of samples collected and data generated;
- (8) Evaluating and recommending new methods, techniques and standards to resolve problems associated with field-laboratory operations;
- (9) Participating in NWRI's Quality Assurance Program to ensure continuing high level performance and data compatibility among laboratories contributing to national programs.

