Environment Canada

Environnement Canada

Canadian Water Management Policy Instruments

Outline for OECD Water Management Sector Group

D. F. Bellinger

SOCIAL SCIENCE SERIES NO. 13
(Disponible en français)

INLAND WATERS DIRECTORATE,
WATER PLANNING AND MANAGEMENT BRANCH,
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Preface

This paper was prepared for the Water Management Sector Group of the Organization for Economic Cooperation and Development. It was intended to summarize Canadian water management policy instruments to permit comparisons with those of other OECD members. The OECD plans to prepare an analysis, based on the various national monographs, that will hopefully provide guidance on water management policy objectives and on organizing, implementing and evaluating alternative management instruments.

The information in the paper is derived from directories, annual reports and public statements prepared by various agencies and represents the situation generally as it was in the fall of 1974. Changes in organizations and programs affecting water arise quickly, but it was felt that this overview might serve wider purposes than that of the OECD project, and for that reason it has been published in this series.

The contribution of John Demakeas and the co-operation of my other colleagues in the Water Planning and Management Branch in preparing this paper is gratefully acknowledged and that of officials in provincial agencies across Canada who commented on it in draft form.

D. Bellinger,
December, 1974.

Abstract

Canada is endowed with abundant water resources yet their availability, in place and time, to meet the needs of an irregularly spaced population, is somewhat restricted. This paper briefly outlines the physical nature of water resources and the problems and conflicts associated with their use, and goes on to outline the structures and policies that Canadian governments have devised to deal with them. The interrelated nature of federal and provincial jurisdictions over subjects that affect water resources is also described. Within and among governments, the need to deal with aspects of water management that cut across the traditional boundaries of agency responsibilities is becoming increasingly apparent. As well, the nature of government roles affecting water and other renewable natural resources is changing, so that new structures and programs are being added to the old.

Provincial governments continue to perform their long-standing functions related to water supply, sewage collection and treatment, health protection, and wildlife management. Day-to-day administration is generally delegated to municipal and regional agencies or to single-purpose bodies such as hydroelectric utilities and irrigation boards. Relatively recent public concern for environmental quality protection and integrated resource development planning has affected traditional activities and spurred the development of new structures and programs. Some provinces have tended to assign additional responsibilities to existing natural resource departments; others have created new environmental protection or planning agencies with interdepartmental representation and powers; most have done both. Policies adopted to promote environmental or resource use objectives that include or affect water cover a wide range. Emphasis is placed on controls through permit systems, standard-setting and inspection, with a growing tendency to require environmental impact assessments of planned developments and varying (and changing) emphasis on delegation of ongoing responsibility for resource policies to regional or watershed authorities. Specific provincial water management policy instruments, for quantity and quality, are reviewed under the headings research and education, regulation and enforcement, economic incentives and comprehensive planning.

Integration of the various aspects of water resource management that are within its jurisdiction, either by consolidation or inter-agency cooperation, is also apparent within the federal administration. The Department of the Environment, formed in 1971, groups responsibilities for renewable resource management and environmental protection and is the major water resource manager. Other federal departments, such as Regional Economic Expansion, Indian and Northern Affairs and Transport, have important roles affecting water that are incidental to their primary tasks.

Federal policy instruments for water resources range from research and data gathering through flood protection, water quality protection under the Fisheries Act or by marine pollution controls and special controls in the North, financial incentives for municipal pollution abatement and joint resource use planning, with provinces, on a river basin basis.

In an appendix, some preliminary quantitative information is presented relevant to an evaluation of Canadian water management in terms of its success in meeting objectives. The information available is generally inadequate to permit definitive conclusions. A second appendix describes recent developments in the use of effluent charges by municipal governments as a means of diminishing the social costs of waste treatment.

Résumé

Les ressources en eau abondent au Canada, mais selon le lieu et le temps, leur disponibilité à répondre aux besoins d'une population mal répartie est limitée. Ce document résume la nature physique des ressources en eau ainsi que les problèmes et les conflits reliés à leur utilisation; il donne également les structures et les politiques créées par les gouvernements canadiens pour les résoudre. On y décrit aussi la corrélation existant entre les compétences fédérales et provinciales quant aux questions relatives aux ressources en eau. Au niveau gouvernemental, le besoin de traiter des aspects de la gestion des eaux qui dépassent les limites traditionnelles des responsabilités dévolues aux organismes devient de plus en plus évident. De plus, la nature des rôles des gouvernements en matière des eaux et des ressources naturelles renouvelables est en voie de changement et de nouveaux programmes et structures sont ajoutés aux anciens.

Les gouvernements provinciaux continuent toujours de remplir leurs fonctions en ce qui concerne l'approvisionnement en eau, la collecte et le traitement des eaux d'égout, le maintien de l'hygiène, et la conservation de la faune. L'administration quotidienne est généralement déléguée aux organismes municipaux et régionaux ou à des services à but unique, tels les services hydro-électriques et les conseils d'irrigation. Les préoccupations relativement récentes du public quant à la protection de la qualité de l'environnement et à la planification intégrée du développement des ressources ont eu un certain effet sur les activités traditionnelles et ont favorisé le développement de nouveaux programmes et structures. Certaines provinces ont eu tendance à donner des responsabilités additionnelles aux ministères des ressources naturelles déjà existants; d'autres ont créé de nouveaux organismes de protection ou de planification de l'environnement qui ont une représentation et des pouvoirs interministériels; mais la plupart ont appliqué les deux solutions. Les politiques adoptées pour promouvoir la création d'objectifs d'utilisation des ressources ou de l'environnement et qui comprennent ou touchent l'eau sont très diversifiées. L'accent est mis sur les mesures de contrôle dont les systèmes de délivrance des permis, l'établissement de normes et l'inspection, et il y a accroissement de la tendance à exiger des évaluations des impacts environnementaux des travaux prévus. Il y a modification de l'accent mis sur la délégation des responsabilités permanentes en matière de politiques des ressources aux autorités régionales ou chargées des bassins hydrographiques. Certains instruments d'une politique provinciale de gestion des ressources en eau sont étudiés sur le plan quantitatif et qualitatif du point de vue de la recherche et de l'éducation, de la réglementation et de l'application, et, des stimulants économiques et d'une planification détaillée.

Au niveau du gouvernement fédéral, l'intégration des divers aspects de la gestion des ressources en eau qui sont de sa compétence, soit par fusion, soit par collaboration entre organismes, est également évidente. Créé en 1971, le ministère de l'Environnement est responsable de la gestion des ressources renouvelables et de la protection de l'environnement; il est aussi le principal agent de gestion des ressources en eau. D'autres ministères fédéraux, dont le ministère de l'Expansion économique régionale, le ministère des Affaires indiennes et du Nord canadien et le ministère des Transports, ont des responsabilités importantes en ce qui concerne les eaux, responsabilités qui sont accessoires à leurs tâches premières.

Les instruments de la politique fédérale des ressources en eau englobent la recherche et la récolte de données pour la prévention des crues; la protection de la qualité des eaux en vertu de la Loi sur les pêcheries ou des mesures de lutte contre la pollution marine et des mesures antipollution spéciales dans le Nord; et, des stimulants financiers pour réduire la pollution municipale et planifier, conjointement avec les provinces, l'utilisation des ressources en se basant sur un bassin hydrographique.

On donne en annexe certains renseignements quantitatifs provisoires qui portent sur l'évaluation de la gestion des eaux au Canada en termes de sa capacité à atteindre les objectifs. Les renseignements disponibles sont, en règle générale, insuffisants pour conclure de façon définitive. Une seconde annexe décrit les développements récents dans l'utilisation des redevances de pollution par les autorités municipales pour réduire les coûts sociaux du traitement des déchets.

CHAPTER 1

Introduction

CANADA'S PRINCIPAL HYDROLOGIC CHARACTERISTICS

Canada, occupying the northern half of the North American continent with the exception of Alaska and Greenland, is the largest country in the Western Hemisphere and the second largest in the world. The lands within its 3,851,809 square miles (9,976,185 sq. km) are extremely diverse with regard to climate, topography and other natural features and much of its territory is mountainous, rocky or under an arctic climate, and thus inhospitable for settlement.

Immensity and diversity characterize its water resources as well. About 7.6% of Canada's total area is covered by fresh water (292,000 sq. mi., 756,280 sq. km), and the country probably has more lakes than any other in the world. A large portion of this water is contained in the Great Lakes, about 37% of whose area lies in Canada. The mean annual flow of Canadian rivers has been estimated at 3,500,000 cu. ft. per sec. (990,500 cu. m per sec.), about 9% of the total flow of all the world's rivers.

Since Canada has one of the longest coastlines of any country (about 42,000 mi. or 67,590 km), bordering on three of the world's oceans, its coastal waters are also extensive. Because of their extent they are also diverse in terms of sea-bed topography and character and in terms of biological resources.

The major hydrogeological regions of Canada are: (i) the Canadian Shield, which comprises over half the area of Canada and is characterized by variable precipitation [ranging from 10 to 40 in. (250 to 1,000 mm) per year] and rapid runoff from a generally impervious surface; (ii) the Appalachian region, southeast of the Shield, which comprises the Maritime Provinces and southeast Quebec, and also has a relatively impervious terrain, but with a higher precipitation (ranging from 40 to 55 in. or 1,000 to 1,400 mm per year); (iii) the St. Lawrence lowlands, which are drained by the lower Great Lakes and the St. Lawrence River with precipitation varying from 30 to 40 in. (760 to 1,000 mm) per year; (iv) the Great Plains region, which is bounded on the east by the Canadian Shield and on the west by the Cordilleran region and has a precipitation ranging from 20 in. (500 mm) per year in the east to 15 in. (380 mm) in the south and west, though its wide rivers and pervious terrain permit only about 2% of the precipitation to appear as runoff; (v) the Cordilleran region, which forms the western part of the continent and consists of three approximately parallel mountain ranges where, because of the great variety in topographic and climatic conditions, it is difficult to generalize about runoff. On the eastern slopes of the Rocky Mountains, runoff varies between 7 and 27 in. (180 to 680 mm) and includes melting snow from higher altitudes. In the central belt of plateaux and mountains it varies from 14 to 40 in. (355 to 1,000 mm), and on the western coastal and insular mountain range, average runoff exceeds 50 in. (1,300 mm) on some watersheds.

WATER MANAGEMENT PROBLEMS

The mean annual flow indicates the supply of water available in the long term, but it fails to indicate the fluctuations which either limit the supply from year to year or conversely, create annual or occasional flood dangers. For instance, the generally abundant precipitation in British Columbia, combined with the high proportion of runoff in the late spring, poses a chronic flood threat to communities in the valleys of that province. The problem of water shortage is generally more evident in the southern Prairies where streamflows represent the lowest percentages of precipitation. Rather than average annual flows, which fail to indicate fluctuations over years or seasons, a better indication of water availability is flows that are available most of the time; say 90% of the time. On an annual basis (available 9 out of 10 years) and on a minimum monthly basis (available in all except the lowest month in 10 years), these "reliable" flows are considerably lower than average flows and, in fact, on a minimum monthly basis are below 50% of the average flow in most Canadian basins. That is, flows as low as this can be expected to occur during one month in 10 years. In general, the variability of flow in Canada is such that though the average supply of 90,000 gallons (409,100 litres) per person per day appears abundant, much of the settled southern portions of the country have less than 50,000 gal. (227,300 litres) per capita per day of reliable annual flow. On the basis of minimum reliable monthly flows, parts of the Prairies and southern Ontario

have less than 1,000 gal. (4,550 litres) per capita per day available, and in two basins, less than 100 gal. (455 litres) or less than what is used in the average urban household.*

Aside from the problems posed by wide variations of flow on a regional or seasonal basis, Canada is also facing problems with reference to water quality in association with urban growth. Pollution of the water environment is usually correlated with concentrations of population and industrial activity. Three out of four Canadians now live and work in cities and towns which occupy less than one percent of the land area. In the immediate vicinity of these urban complexes, rivers, lakes and shorelines show marked evidence of impaired water quality. Areas particularly affected are the lower Great Lakes, the St. Lawrence River Valley and the lower mainland of British Columbia. Abatement measures by public and private treatment systems have reduced some of the harmful effects of waterborne wastes, but much more remains to be done to restore waters to the levels of quality necessary for desired water uses.

It has been estimated that about two thirds of the urban population is served by municipal sewage treatment facilities and about 90% by some form of sewage collection system. These proportions are higher in the southern Prairies and Ontario, the areas already identified as being short in reliable water supplies. Expenditures on municipal treatment facilities are now growing faster than population. Municipal systems treat much of the wastes produced by industrial operations, though they are inadequate in dealing with many organic and inorganic compounds resulting from industrial processes. After treatment, over 60% of biochemical oxygen demand (BOD) and suspended solids produced by industry in Canada (and a similar proportion of municipal wastes) enter the Great Lakes-St. Lawrence system, therefore, this area has a high priority for water quality control measures. It has been estimated that for these two measures of waste loading (similar data on other types are not available) the national total from municipal sources is only about one third of the total industrial waste load.

In summary, water problems in Canada include flood-plain management, localized water shortages and less-than-desirable water quality. With water quality perhaps representing the newest problem area, the onus of response over the last few decades is shifting generally from individual action to governmental action. Regulation of flows of surface waters is one of the oldest forms this response has taken. Channel improvements, dykes, dams and diversions were first implemented on a local scale to deal with water shortages and fluctuations. Man-made storage is still small in comparison with natural storage in Canada's many lakes, but the number and scale of surface storage and diversion projects has increased greatly over the last two decades. Most large dams have been constructed primarily for hydroelectric power purposes and the remainder, for irrigation or domestic water supply. Present dams and diversions are generally in the southern portion of the country, but future projects will likely be located largely in northern areas. The scale of future development will be large and this, combined with fears of adverse environmental and social effects (disruption of life-styles of northern aboriginal peoples), will lead to conflicts over their advisability. Other conflicts are developing over the pressures of urbanization on water quality and the growing demand for recreational use of water resources by these urban populations. Growing demands for water in all its uses, including waste assimilation, agriculture, fish and wildlife propagation, recreation, power generation and transportation, are increasingly leading to conflicts and consequent demands for public policies and programs to resolve them. This process in Canada is complicated by regional diversity and a federal system of government that depends on, and contributes to, this diversity.

CONSTITUTIONAL AND INSTITUTIONAL FRAMEWORK FOR WATER MANAGEMENT

Among the major federations of the world, Canada is unique for many reasons because of the major role played by federal-provincial "diplomacy", and this unique characteristic is well illustrated by the constitutional aspects of water management. The division of governmental powers on a regional basis is strongly marked, and particularly where overlapping responsibilities exist, as in the case of water, the provinces can influence, directly or indirectly, matters of national as well as regional policy-making. For this reason, a brief review of the constitutional framework is a necessary preliminary to a discussion of water management policy.

The British North America Act of 1867 is Canada's major constitutional instrument, supplemented by British common law heritage and by 100 years of judicial amplification and interpretation of the Act and its division of powers. Under it, the provincial governments were given major legislative responsibilities in areas that involve water management. The federal government has certain specific powers, which can strongly influence water resource development and use. Ownership of natural resources, including water, is primarily provincial and this forms the major source of their legislative and managerial authority. Provincial ability to legislate in water matters also stems from

*The average daily intake of water is estimated to be about 175 gal. (796 litres) per urban resident.

their exclusive jurisdiction over property and civil rights, matters of a local and private nature and local works and undertakings. As a result, all provinces have extensive bodies of law in the fields of water supply, power development, irrigation, land development and reclamation and water-based recreation. In fact, statutes in most provinces now give to water authorities extensive power to control water quantity and quality, whether in streams and lakes, coastal waters or surface and groundwater. In some cases all rights relating to the use of the resource are placed under public (provincial government) control. Water pollution is generally dealt with by the legislative and administrative means developed to deal with environmental pollution of all kinds, whether of water, land or air and whether by liquid, solid or gaseous wastes or by any other means. Provinces also affect water when they administer the use of natural resources, including forests and lands, as public and private property.

On the other hand, the federal government has powers to deal with specific subjects that affect water resources and certain powers related to its own property, but has limited general legislative powers over local water and natural resource matters. Constitutionally, it has legislative power over navigation and shipping, sea coast and inland fisheries, migratory birds, and over the Northwest and Yukon Territories, and legislative responsibilities with regard to interprovincial and international trade and undertakings (such as railways, pipelines, canals), agriculture, trade and commerce and Indians and Indian lands. Certain general federal powers can influence water development even more than its specific ones. They include power to legislate for "peace, order and good government," banking, taxation and the public debt, census and statistics, defence and external affairs (including international waters), and the criminal law. The power of the federal government to raise funds by taxation and spend them in a great variety of ways gives it an additional source of influence over water development.

These spheres of responsibility are obviously not entirely independent. Many intergovernmental arrangements and agreements exist to coordinate water management actions. The federal government may delegate the administration of some of its specific powers to provincial or joint agencies, for example, some administrative powers over inland fisheries are delegated to provincial fisheries departments. The provinces, in turn, assign a great deal of responsibility in areas affecting water resources to municipal and local governments. Traditionally, these have had the major responsibility for sewage treatment, land-use planning and water supply systems, though provincial governments are now tending to exercise greater central control over such matters.

Other forms of intergovernmental relations have been developed to influence policy formation and, in particular, to coordinate federal and provincial activities. They include special federal-provincial conferences, regular meetings of responsible ministers, permanent joint consultative committees of officials and ad hoc joint working groups and boards for water development study and planning in particular cases.

CHAPTER 2

Provincial Water Management Policy Instruments

ADMINISTRATIVE STRUCTURES

One way of gaining an overview of provincial policy is first to review the administrative structures developed for water management, since they have a strong influence on the nature and operation of policy, and then to discuss policy instruments. Provincial policy and administration generally affecting water varies widely from province to province, and a large number of direct and indirect instruments could be identified. The intention here is to focus on the most obvious of such instruments.

There are certain characteristics shared by all the provinces that can be looked at first in terms of administrative responses to water management. As noted already, all provinces delegate large areas of responsibility over such local matters as water supply, sewage collection and treatment, land-use planning in rural and urban areas, urban recreation and health to municipal or regional governments. These governments have authority under regulations set by the province to raise funds by levying taxes on property, charging fees, licensing, borrowing and other methods. The provinces retain the power to approve and influence local activities and all have departments of municipal affairs to coordinate them, provide provincial funds to supplement local sources and enforce minimum standards of quality and adequacy for local government services. All provinces also have health departments to impose or supervise minimum standards of quality for water and waste disposal as required to protect human health, though in most cases, this role has been taken over by departments of environment. This objective lay behind early efforts to control pollution in all provinces by the appointment of local health officers and the enforcement of minimum standards. The general coordination of local land-use planning by municipal affairs departments also affects water development, since the type, size and location of residential and industrial activities and their resultant water demands are influenced or determined by land controls.

Almost all provinces assign the development, production and distribution of hydroelectric (and thermal) power on a utility basis to semi-autonomous public corporations, which can have an important independent effect on this aspect of water management because hydro and thermal operations use so much water. Also, many private generating plants serve the needs of individual industrial operations. Most of the provinces assign tourism planning and development (including aspects of water recreation), administration of public lands and associated waters, and fish and wildlife management (including propagation and habitat protection) to separate ministries.

It is in the specifically water-related areas of renewable resource management and environmental quality protection that the provinces appear to have varied most widely in terms of administrative structures. The four eastern provinces (New Brunswick, Newfoundland, Nova Scotia, Prince Edward Island) share common characteristics of small populations, relatively light industrial development and per capita incomes below the national average. They also share a tendency to integrate water management matters in multi-purpose agencies. New Brunswick's Department of Fisheries and Environment groups commercial fisheries administration with such matters as control and abatement of domestic and industrial water pollution, water resource inventories and coordination of water programs. It approves waste treatment, hydro and water supply projects and enters into cost-sharing agreements for them with local authorities.

The Newfoundland Department of Provincial Affairs and Environment has general responsibility for water resource allocation and for environmental management. It operates water supply or sewage systems in municipal or industrial use or, in other cases, shares in their design and finance with local authorities. All applications for such systems must have prior review, and approval by this ministry. The Newfoundland and Labrador Clean Air, Water and Soil Authority, formerly a separate agency reporting to the Minister, now forms part of this department. It reviews and makes recommendations to the Minister on pollution problems and on applications for sewage, industrial and hydro projects and for dams and diversions.

The Nova Scotia Department of the Environment constitutes an integrated environmental protection agency. It can regulate waste treatment and water supply facilities, set pollution standards and eliminate or reduce pollution

sources. The Nova Scotia Water Act gives the Minister of the Environment extensive power over water resources in the province, including authorization of the use of water for all purposes under any conditions, prohibition of discharges into water courses and approval of all applications for water and sewage works.

Prince Edward Island has established a separate, semi-autonomous body, the Prince Edward Island Environment Control Commission, reporting through a Minister (of Environment and Tourism) to control water (and air and land) pollution and the allocation and use of water. It can also enter into agreements to construct and operate sewage systems and enquire into any activities causing pollution.

The province of Quebec is somewhat different from the others in its organization of water management. The major environmental protection agency, the Environment Protection Service, reports to the Minister of Municipal Affairs (who is also Minister of the Environment). It has the usual responsibilities in the areas of municipal and private water and sewage systems, that is, to approve and help finance them, and in the area of water quality monitoring. A separate Department of Natural Resources has responsibilities for quantitative aspects of water use, including planning the use of water and hydro resources, streamflow regulation, water inventories, and hydraulic and engineering research. Another agency, the Bureau of Planning and Development, coordinates land-use planning and regional resource use studies, including river basin studies.

In Ontario, the most populous and industrialized province, many aspects of water administration are among the responsibilities of the Ministry of the Environment. It is responsible for water resource development, for setting and enforcing water supply and effluent standards, construction and operation of water or sewage projects or review of such projects prior to issuance of certificates of approval. The Ministry of Natural Resources has additional responsibilities affecting water besides those related to the management of fish and wildlife, parks and public lands which similar agencies in other provinces also have. Ontario has emphasized the regionalization of watershed development and management by creating 37 river basin conservation authorities.* The Natural Resources Ministry coordinates their activities and provides financial and technical assistance. The conservation authorities have power to lease, buy or expropriate land, build and operate water diversion or control structures, and prevent or reduce the effects of floods or pollution. They charge their member municipalities proportionate shares of costs incurred, the province usually paying 50%.

*Manitoba's Watershed Conservation Districts Act provides for regional management agencies and similar enabling legislation exists in a few other provinces.

Reflecting the natural response of governments in water-short areas, the three Prairie provinces (Alberta includes water-rich mountain slopes) have a long background of development of water management institutions. Manitoba's administration is more integrated than most provinces, since it groups all natural resource management (including wildlife, fisheries, forestry and minerals) in a single Department of Mines, Resources and Environmental Management. Its water resources component has general power to plan and regulate water use, including approval of all water control works. It also administers all water use applications. Another component deals with environmental management, provides engineering services to local water and sewage agencies and carries out water quality studies. A semi-autonomous Clean Environment Commission sets specific controls on waste discharges and emissions by industry and issues permits for any activity adversely affecting the environment.

The Saskatchewan Department of the Environment is charged with water management as well as environmental protection. It administers water rights allocations for all uses, industrial water charges, reservoir and stream operations and provides hydrologic services to other provincial agencies. The department is also concerned with streamflow forecasting, regional and basin planning, drainage and flooding problems. Its water pollution control component recommends industrial effluent quality requirements to the Minister, approves water supply and sewage works and administers financial assistance programs for water pollution control in cities. The provincial department concerned with tourism regulates water as it pertains to public lands, parks and fish and wildlife.

The Alberta Department of the Environment has similar powers to its Saskatchewan counterpart. It issues conditional approvals for all waste emissions and discharges into air and water, develops effluent standards for specific projects and industries, and is generally responsible for controlling pollution. The water resources component provides financial and technical assistance to local and regional water management projects concerned with supply, flow regulation, flood or erosion control and water conservation. All applications to divert and use water for any purpose must be approved by the Water Rights Branch.

British Columbia has integrated renewable resource management in its Department of Lands, Forests and Water Resources. It controls the use of all waters and issues licences for use, provides support to local supply, sewage or irrigation agencies or operates such works itself and carries out research and information projects. The Pollution Control Branch issues permits for all effluents, regulates the quality of specific industrial effluents and inspects and approves local sewage works.

Water resource management in the Yukon and Northwest Territories is provided generally under the Northern Affairs Programs of the Department of Indian and Northern Affairs. This department administers the Northern Inland Waters Act, which creates Water Boards for each of the Territories with general power to provide for the management, conservation and utilization of their water resources. The Act provides for the creation of water management areas wherein all users and diversions require prior licensing by the relevant Board and prohibits all deposits of waste except as permitted by the Board.

POLICY INSTRUMENTS

The above discussion of organizational arrangements has suggested some general conclusions about provincial water management policy, at least as it is reflected in organization. All provinces delegate responsibilities for local and regional water supply and sewage management while retaining the power to supervise and assist local agencies and, occasionally, to take back the operational role. Most provinces have recognized the interrelationships between water quality and water quantity management by placing responsibility for both in one department. At some level in the organization, however, these two aspects of water management are assigned to different organizational components. Water quality control is usually grouped with air and land quality protection in an environmental quality control agency. There are, however, differences in provincial policies that can be at least noted in summary form by considering each form of policy instrument, taking water quantity first and then water quality.

Water Quantity Management

The provinces share certain common approaches to water quantity control, such as supporting it with basic physical research, conducting regular and special-purpose inventories, delegating local water activities to various agencies, either multi-purpose (municipalities) or single-purpose (drainage commissions, water boards), and assigning aspects of water management (hydro-power production, fish and wildlife habitat protection, recreational water development) to agencies separate from those charged with general water administration. The important role played by hydro power in Canadian industrial development has left its legacy in strong, semi-autonomous, publicly owned, province-wide electric utility systems in most of the provinces. They still have major roles in water development, though a few provinces, such as Nova Scotia and Prince Edward Island, have only limited or no hydro-power resources. The provinces also exhibit some differences, partly related to resource base variations, to the nature of economic activities and to similar factors.

The four western provinces, as already noted, have developed advanced systems for licensing and allocating priorities among all water uses. The issuance of licences forms a major instrument for control over water use on both the small scale of local irrigation or conservation projects where some responsibility for design and operation is usually delegated, and the large scale of massive flood control or hydroelectric projects. Controls over flows and storage are particularly necessary because of the highly variable natural flows that were noted in an earlier section. Interprovincial cooperation in water management, with the participation of the federal government, is also a result of the natural flow patterns of rivers, and a number of joint agencies and programs have resulted.

In Ontario, water conservation and flood control can be delegated and decentralized more completely to the watershed level because of the lack of large-scale water projects and the larger and more evenly distributed population and industrial resources. Since the major water system serving southern Ontario, the Great Lakes-St. Lawrence system, includes boundary waters, much of its administration is shared with, or dominated by, federal or joint agencies, and coordination with U.S. quantity management policies is required. The major control instrument under the Ontario Water Resources Act is the "certificates of approval" required by all persons (and municipalities and industry) who wish to remove water from a body of water (or discharge sewage into it).

Tha major policy instrument in the province of Quebec is to retain responsibility for all natural resource use planning, including water and hydro-power resources, at a province-wide level. Specific water management policies are at a developmental stage, and a recent study commission* has recommended a number of changes generally contributing to a more integrated approach. Some sort of regional management of water quantity on a watershed basis may be considered. Quebec's water quantity management policies have been dominated by the development of its vast hydroelectric power resources, which exceed those of all other provinces. The large dams and diversion projects already completed or planned have required large investments and centralized financial control.

With their relatively more abundant and less variable water resources, the four Atlantic provinces have not had to utilize many instruments for water quantity management. In all four, tourism forms an important source of revenue, and efforts are made to maintain the attractiveness of water resources for recreational purposes. This is especially true of coastal recreational resources on fresh or salt water. In New Brunswick, an interdepartmental committee on stream

*Commission d'Étude des Problèmes Juridiques de l'Eau.

alterations reviews all applications for physical changes in lakes or streams. The New Brunswick Hydro Electric Power Commission has had an important role in influencing development of the major provincial river, the Saint John, which is well developed for power purposes. A federal-provincial planning group is preparing recommendations for multi-purpose management of this river and improvement of its quality.

Newfoundland's major river basin, the Churchill, is in the Labrador portion of the province and is also highly developed for power purposes, at least in its upper portions. The Churchill power site, with its capacity of 4,750,000 kilowatts, is the largest in Canada. The Department of Provincial Affairs and Environment reviews the environmental aspects of all water control dams and diversions.

Nova Scotia also ranks the preservation of recreational (including sport fishing) water use patterns high in priority, and water quantity management reflects this course. The Lands and Forests department regulates the protection of wildlife habitats and the preservation of ocean bathing areas. The possibility of harnessing the wide tidal variations in the Bay of Fundy for power continues to attract the governments of both Nova Scotia and New Brunswick in spite of the conclusion of a 1969 study that it was not economical at that time.

Water management policy in Prince Edward Island, which lacks major surface-water resources, has been dominated by the need to maintain, protect and develop groundwater sources of water supply. Local agencies are assisted in the development of new wells and, depending on well type, permits may be required under the Prince Edward Island Well Drillers Act.

Water Quality Management

All provinces have environmental protection legislation (including water quality protection) among their statutes and most have supplemented the legislation with regulatory and other policy instruments. Such laws contain general prohibitions of polluting activities. Many provinces complement this regulatory approach to water quality management with distributive policies of various kinds that provide financial encouragement for environmentally favourable activities. Many have applied their large powers over land use planning and control to the comprehensive management of renewable natural resources, including water. They also gather hydrologic and other water-related data, partly in joint programs with Environment Canada for national purposes and partly to support their own programs. Most conduct research into various aspects of water pollution, monitor water quality and have public advisory boards and information programs to promote communication and education on environmental quality protection. The following discussion will be somewhat selective in identifying the major water quality management instruments and will treat these instruments in the following groups: research and education, regulation and enforcement, economic controls, and comprehensive management.

Research and Education

All provinces provide various laboratory and technical services to local agencies or to private organizations or individuals that contribute to understanding water quality and its protection. Professional and technical staff are available to analyze water or waste-water samples, monitor waste treatment systems, provide instruction for waste-water treatment operators,* investigate fish kills, conduct baseline environment quality surveys and perform similar functions. Technical support is provided to owners and operators of water supply and waste-water treatment systems of all types, including farming operations where pollution by livestock is a problem. Most provinces support research councils which, in some cases, carry out extensive programs in the water field. For instance, the Saskatchewan Research Council has investigated provincial groundwater resources.

Most of the provinces have public environmental advisory councils of some sort, which perform such functions as conducting hearings to provide educational forums and to produce reports on particular matters, providing advice to the responsible Ministers and reviewing environmental policies and programs of government agencies. These agencies are usually partly or wholly made up of non-governmental persons. Sometimes (e.g., British Columbia, Alberta) these bodies have the power to hear appeals from decisions of the operating agencies charged with pollution control and, in British Columbia, to hold hearings at the request of anyone affected by effluent permits. These advisory or quasi-judicial bodies are also becoming involved in the environmental impact assessments that more and more provinces (Alberta, New Brunswick, Ontario and Saskatchewan are examples) are requiring for major projects that might adversely affect the natural environment. As an aid to public education, the advisory councils and the operating ministries issue news releases, brochures, written reports and other material, provide speakers for public groups and cooperate with institutions of general education.

*The three provinces of Nova Scotia, New Brunswick and Prince Edward Island sponsor, with the federal government, a centralized operators' training program. Manitoba, Saskatchewan and Alberta also have a joint training program with reciprocal certification.

Regulation and Enforcement

The most common form of regulatory instrument for water quality protection was noted earlier. It is the approval of all waste treatment systems and the issuance of permits under appropriate conditions for the construction and operation of these systems. Either there is a standard set of technical characteristics that the domestic, municipal or industrial treatment system must have or the provincial authority will assist the applicant to design an appropriate system. The province of British Columbia requires registration and approval by permit for all emissions of waste to the environment, while most of the other provinces require permits for the controlled release of treated waste-waters when the systems are built or modified or specify conditions for effluent quality in approvals to operate systems.

Another general form of regulatory approach used by most provinces is to issue specific effluent regulations for various industries that tend to be major water polluters or to set specific limits on particular polluting substances emitted from any source. The provinces of Alberta, British Columbia, Manitoba, Nova Scotia, Ontario and Quebec have all issued orders that set specific limits on contaminants emission by various types of industrial operation. The other provinces have developed similar controls for specific enterprises rather than whole industries. In many cases, these effluent controls and the enforcement mechanisms to ensure their observance are still being developed.

Another general form of control that is relatively long-established is that provided by public health acts in all provinces. These permit medical health officers to conduct inspections and prohibit actions that are or might be injurious to health. This form of control extends to water supply sources, urban or rural sewage treatment and other elements of water management.

Other forms of control are provided under mining acts, which impose certain standards on developers and operators of mines; fish and game legislation, which controls activities detrimental to natural propagation; and pesticides legislation, which regulates the use of contaminating substances near water bodies, etc. Another specific area of water pollution protection is that provided under acts such as the Alberta Oil and Gas Conservation Act and the New Brunswick Oil and Natural Gas Act, which regulate the activities of energy exploration and production to prevent pollution.

As noted earlier, a number of provinces are instituting the practice of requiring environmental impact assessments before major projects are approved. New Brunswick, for instance, has undertaken such assessments for marine terminal and industrial developments planned near Saint John and for a hydroelectric project proposed for the Green River. Both these assessments were conducted jointly with federal government agencies. Alberta's Environment Conservation Authority can hold public hearings on environmental impact assessments and prepares reports.

The Quebec Environment Quality Act has provision for classifying waters and defining water use standards and effluent limits for particular streams or regions, and Ontario's Water Resources Act provides for setting of water quality standards following consultation with persons having an interest in the present or future use of water in a basin.

Economic Water Quality Controls

Under this heading are included policy instruments that involve transfers of provincial funds from general revenues to particular water quality control purposes. This definition excludes the collection, by municipalities in all provinces, of funds from all those using public sewage collection and treatment facilities. Water and sewage charges are usually collected together, and the sewage charge for households and commercial and industrial users may be based on quantities of water used, on assessed value of property or on a combination of both. A few municipalities in the provinces of Alberta, Manitoba, New Brunswick, Ontario and Prince Edward Island have supplemented this form of financing by charging industrial users of public systems per unit of waste discharged in excess of certain base limits. The effluent charge schemes are in effect in ten municipalities with a combined population of about 4.2 million and may be growing in importance.*

Various programs of the federal government involve incentives and other financial support for water quality control incidental to such objectives as guiding urban development or reducing regional economic disparities. These are discussed in Chapter 3 under the heading "Control Through Economic Instruments." All provinces aid their industries and municipalities to take advantage of these programs, either by advice and assistance or by supplementing federal funds with provincial aid. For instance, Nova Scotia supplements the Central Mortgage and Housing Corporation loan program for municipal sewage projects by paying 20% of capital costs. Saskatchewan's Water Pollution Control Assistance Act provides similar grants to cities of 10% for secondary treatment and 15% for advanced treatment. The provinces of Newfoundland, Prince Edward Island, Manitoba, New Brunswick, British Columbia (where a new Sewage Facilities Assistance Act is in preparation) and Quebec also provide such assistance. In Ontario, funds are available to aid municipalities whose sewage treatment

*See Appendix B for details.

costs per household exceed provincial norms. Similar aid is available under the British Columbia Municipal Treatment Plant Assistance Act.

Funds supplementary to those available from the federal Department of Regional Economic Expansion (DREE) for industrial water pollution control, where this is incidental to creating jobs in high unemployment areas, are also available in some provinces on an ad hoc basis or under general agreements. In the Atlantic provinces, some industrial waste treatment costs may be shared (or low interest loans provided) on the basis of specific agreements. Quebec's Environmental Quality Act makes provision for loans or grants to municipalities and to others for pollution control. Ontario's Pollution Abatement Incentives Act provides a rebate of provincial sales taxes on pollution abatement equipment. In the prairie provinces, a DREE program provides aid for the construction of municipal water and sewage facilities that can serve both residential and commercial users in designated agricultural service centres on the Prairies, and provincial governments help administer or finance this program.

Water Quality Control by Comprehensive Management

Comprehensive management of natural resources obviously includes purposes relating to both water quantity and quality and is discussed here for the sake of convenience. As noted above, all provinces have extensive powers over land use planning and regional development planning, which more and more are being used in such a way as to protect and enhance environmental quality, including water quality. Much of this effort is in conjunction with federal agencies operating under such legislation as the Canada Water Act, Agriculture and Rural Development Act, and Prairie Farm Rehabilitation Act. Besides taking part in joint

Table 1. Major provincial water management and advisory agencies

Province	Water quantity management	Water quality management	Advisory agencies
Alberta	Department of the Environment–Water Resources Division	Department of the Environment–Pollution Control Division, Standards & Approvals Division	Environment Conservation Authority
British Columbia	Department of Lands, Forests & Water Resources–Water Rights Branch, Water Investigations Branch	Department of Lands, Forests & Water Resources–Pollution Control Branch	Pollution Control Board, Environment and Land Use Committee
Manitoba	Department of Mines, Resources & Environmental Management–Water Resources Branch	Department of Mines, Resources & Environmental Management–Environmental Protection Branch, Clean Environment Commission	Environmental Advisory Council
New Brunswick	Department of Fisheries and Environment–Water Resources Branch	Department of Fisheries & Environment–Pollution Control Branch	Environmental Council
Newfoundland	Department of Provincial Affairs & Environment–Environment Management & Control Division	Department of Provincial Affairs & Environment–Environment Management & Control Division	Advisory Commission on Environmental Quality
Nova Scotia	Department of the Environment	Department of the Environment	Environmental Control Council
Ontario	Ministry of the Environment–Water Resources Division; Ministry of Natural Resources–Conservation Authorities Branch	Ministry of the Environment–Water Supply & Pollution Control Division	Environmental Hearing Board
Prince Edward Island	Environment Control Commission	Environment Control Commission	Environmental Advisory Council
Quebec	Department of Natural Resources–Waters Branch	Department of Municipal Affairs & Environment–Environment Protection Services	Advisory Council on the Environment
Saskatchewan	Department of the Environment–Water Management Service	Department of the Environment–Environmental Protection Service	Environment Advisory Council

resource and environmental planning programs, the provinces also delegate urban and rural land use planning powers to municipal governments, regional authorities, watershed management agencies and similar bodies. Generally, some central resource use planning body retains some coordinating and assisting authority over local and regional agencies. The Newfoundland Cabinet Committee on Resource Policy, for instance, includes environmental aspects of resource development in its scope.

The Prince Edward Island Comprehensive Development Plan is probably unique in its scope, since it provides for joint federal-provincial planning of all land and associated water resource use over a 15-year period (1969-84) at a total cost of over $700 million. In all the Atlantic provinces rural development and rehabilitation programs include environmental quality enhancement aspects. The three Maritime provinces share in financing (with federal participation) the Maritime Resource Management Service, which provides technical inputs to comprehensive land and water planning. Watershed conservation authorities in Ontario and Manitoba have similar comprehensive powers. Quebec's Bureau of Planning and Development oversees plans, programs and projects, including river basin studies, for the territorial development of the province and provides for coordination of federal-provincial programs. In British Columbia, an Environment and Land Use Committee of ministers has a general coordinating role for land and resource allocation problems and environmental matters and has its own operating secretariat. It has a particularly strong mandate to ensure that "all the aspects of preservation and maintenance of the natural environment are fully considered in the administration of land use and resource development."* Orders made on its recommendation can override all other acts and regulations.

Table 1 identifies the major water quantity and water quality management agencies in each of the provinces and also includes the names of the respective advisory councils.

*Environment and Land Use Act, Statutes of British Columbia, 1971, c. 17, s. 3(b).

CHAPTER 3

Federal Water Management Policy Instruments

ADMINISTRATIVE STRUCTURE

As with the provincial governments, the structure of the federal administration affecting water management policy over recent years has tended towards greater concentration and integration. Apart from the exercise of direct jurisdiction in water management matters in the Northwest Territories and the Yukon, the federal government has been actively developing a response to the need for resolving the problem of water pollution. Until the late 1960's the federal role in environmental pollution control was restricted primarily to data collection, research, financial aid and general coordination. Since then, however, the federal government has become more involved in the policy-setting and regulatory aspects of pollution control which, until that time, had been chiefly a provincial prerogative. Because of the constitutional division of power described earlier, federal-provincial negotiation and discussion has been necessary to reach a mutually agreeable set of policies. The choice of new federal policies and strategies is reflected in its organization, which is described below in summary form.

The Canada Department of the Environment (or Environment Canada) came into existence in 1971, though the process of organizational consolidation of which it is the culmination had been underway for several years. It combines responsibilities for renewable resource (fisheries, forests, wildlife) management and environmental (air, land, water) protection and management. Of its five services, three are relevant to water resources management, and a fourth, the Atmospheric Environment Service, gathers meteorological data which are necessary for water resource planning.

The major water resource management agency with the responsibility for improving Canada's inland water resources and the social and economic benefits they yield is the Inland Waters Directorate of the Environmental Management Service (E.M.S.). The Directorate conducts national water quantity and quality monitoring and survey programs to provide base-line data and regional programs to aid federal-provincial planning. It maintains a national network of hydrometric stations and conducts research on limnology, water quality, glaciology, groundwater and other hydrological matters. The Directorate is also involved with comprehensive water resource planning and implementation, both nationally and in conjunction with the provinces, on a regional and river basin basis. The Canada Centre for Inland Waters is the major research and survey institute, which serves as a base for a number of water-related research programs.

The other E.M.S. components are primarily involved with lands, forests and wildlife, but each one is concerned with aspects of water resources. For instance, the Canadian Wildlife Service helps to promote the preservation of waterfowl habitat; the Canadian Forestry Service promotes the reduction of air and water pollution by wood-using industries through a government-industry research program.

The Environmental Protection Service is responsible for national environmental protection by direct regulation and by cooperating with provinces and industries on developing codes of practice and effluent quality requirements. It is organized into programs for policy and planning, water pollution control, air pollution control, ecological protection, environmental emergencies and pollution control related to federal activities and facilities.

The Fisheries and Marine Service is concerned directly with water in its oceanographic research and hydrographic mapping programs and indirectly through its responsibilities for fisheries development, operations (regulation and protection) and fisheries research on both coasts and in inland waters. The Service is responsible for defining water quality criteria for the protection of aquatic resources.

Other federal departments have responsibilities which involve them indirectly in aspects of water development. These include the Department of Regional Economic Expansion (DREE) (land and water conservation and development), the Department of Indian and Northern Affairs (water resource development and protection in the north, water in national parks, recreational canals), the Ministry of Transport (regulation of navigation and of shipping, including pollution from marine activities in Canadian and arctic waters), the Department of Energy, Mines and Resources (hydro-power development, water pollution aspects of oil, gas and mineral exploration and development), the Department of Agriculture (irrigation

and drainage, regulation of pesticides), and the Department of External Affairs (foreign relations affecting water, including boundary waters shared with the United States).

This brief review indicates that though the consolidation referred to earlier has proceeded far, the many aspects of water use and development continue to require the involvement of many organizations. Coordination of federal water policy is achieved by the Interdepartmental Committee on Water, which provides advice to the government on all programs affecting water. The departments also work together on specific aspects of water policy through joint participation in boards and working groups.

POLICY INSTRUMENTS

Like that for the provincial governments, this discussion of federal water management policy will deal separately with water quantity and quality, though this distinction is often somewhat artificial, since policies may deal with both simultaneously. Indeed, this comprehensive approach to water management is part of the philosophy behind the Canada Water Act, which is touched on briefly at the end of the water quality section.

Water Quantity Management

The above review of the administrative structure has indicated a number of aspects of national water quantity management. The objectives pursued include the development of water resources for economic and recreational returns and the mitigation of the adverse effects of natural fluctuations in flows and levels.

Environment Canada gathers basic data on water resources, partly in conjunction with the provinces, and conducts research on hydrology and water engineering. It undertakes special programs with U.S. agencies on boundary waters, including a major study of Great Lakes water levels and means to regulate them. It is developing national policies on flood damage reduction and cooperates with provinces on flood protection projects. Federal disaster and flood-protection assistance may, for example, become linked with long-term flood damage reduction programs rather than be made available on an ad hoc basis. The Department of Regional Economic Expansion helps with water resource development in economically disadvantaged regions, including irrigation and water conservation on the Prairies, flood protection and urban and industrial water supply and sewage systems. Its policy is to develop water and other natural resources where this can yield economic returns. The Department of Indian and Northern Affairs is similarly concerned with water resource development in the north where this is compatible with environmental protection and preservation of life styles of northern indigenous peoples.

Water Quality Management

The various federal policy measures are classified into the same four groups as provincial water quality management. Also, as in the case of the provinces, some aspects of federal policy are still in the course of development.

Research and Education

Environment Canada spends yearly about $5 million to monitor water quality and sediments on a national basis, partly in cooperation with provincial agencies. These data provide a basis for long-range planning, policy-making and for regional and basin programs. They are available, on a computerized basis, for use by researchers and others and will, where possible, be translated into indicators of water quality for public information. Research is carried out on many aspects of water quality and pollution and is directed primarily towards specific problem areas, sometimes in conjunction with river basin planning studies. Physical and biological research is supplemented by water quality modelling studies, studies of socioeconomic aspects of water quality and of water quality management institutions. A priority area for research is the Great Lakes-St. Lawrence basin; a Canada-U.S. agreement and agreements with Ontario and Quebec have all identified specific water quality problems. The Department conducts and sponsors research on waste treatment methods and on the effects of water pollution on aquatic organisms. Environment Canada also promotes and carries out research and development into pollution abatement technology by sharing its costs with industry, especially the major polluting industries, such as pulp and paper.

Canada's central research body, the National Research Council, is also involved with aspects of water pollution research and maintains a central scientific information retrieval system. Other departments, such as Indian and Northern Affairs (water pollution control in the north) and Central Mortgage and Housing Corporation (urban water pollution), have related research programs.

Educational projects of Environment Canada extend to the provision of speakers for public meetings, public involvement in environmental policy development at the international (e.g., U.N. Stockholm conference), national and river basin level, and distribution of books, pamphlets, brochures, press releases. An Environmental Advisory Council, with members selected from public groups and organizations, including prominent Canadians from educational, industrial and scientific fields, discusses aspects of environmental protection and resource development and

provides advice to the Minister of the Environment. The Minister is also a member, along with his provincial counterparts, of the Canadian Council of Resource and Environment Ministers, which sponsors public education projects of various types.

Control of Water Quality by Regulation and Enforcement

Direct regulation of water quality by the federal government is somewhat recent, since it dates only from the formation of the Department of the Environment and its Environmental Protection Service. Before that, the Canada Fisheries Act contained general prohibitions of polluting activities that endangered fish, and polluting activities were restricted in various pieces of legislation dealing primarily with pest control, animal contagious diseases, national parks, national harbours and protection of navigable waters. These acts were generally prohibitive rather than regulatory and had relatively narrow application and objectives.

The new strategies for environmental protection pursued by the federal government after 1970 included a number of instruments, the most important of which are discussed below.

Ambient Water Quality Objectives – These are being developed to provide basic objectives for the quality of all inland and coastal waters and are expressed in descriptive statements, as well as in parametric terms for water quality required to support specific uses. The ambient objectives suggest, generally, that the quality of Canada's waters should be such as to meet the requirements for all legitimate uses of water, and unpolluted waters should not be allowed to deteriorate. A specific statement of these goals has been incorporated into the Canada-U.S. Agreement for Great Lakes Water Quality (1972) to provide objectives for the two governments. The International Joint Commission, which is charged with many aspects of boundary waters, is responsible for overseeing progress made in reaching the objectives and has established various boards and working groups to aid in this task. Studies are underway to establish water quality objectives for waste heat, radioactivity and toxic substances. Other studies deal with disposal of dredged material and waste treatment on vessels. Plans to respond quickly to environmental emergencies on the Great Lakes have also been developed (similar plans have been prepared for Canada-U.S. cooperation on both coasts).

On federal-provincial and provincial waters, the objectives will be subject to federal-provincial agreement. It is expected that there will be full agreement on nationally applicable general objectives and case-by-case agreement on specific objectives to meet the requirements of specific waters or areas. Some provinces (e.g., Ontario) have already developed general quality guidelines of their own and Saskatchewan, Manitoba and Alberta have jointly developed and adopted common water quality objectives.

Effluent Standards – This policy instrument in use in most provincial jurisdictions is also being developed on a national scale by the federal government. The legislative basis for the program is the Canada Fisheries Act, which was amended in 1970 to prohibit the deposit, without a permit from the Minister, of deleterious substances into waters "frequented by fish." Prior ministerial approval is required for all works likely to result in the deposit of deleterious substances. Fines up to $5,000 per day can be levied for infractions of regulations and polluters can be assessed the costs of cleanup.

Regulations specifying permissible effluents have so far been issued for the pulp and paper industry, the petroleum refining industry and for mercury from chlor-alkali plants, and are in preparation for other major polluting industries, such as food processing, base metal refining, metal plating and fabricating, and textiles. Guidelines for operation of bulk shipping terminals, exploratory drilling on and offshore and other activities are also being developed in cooperation with provinces. In general, the regulations require the adoption of the best practicable technology for pollution abatement and specify maximum pollutants per unit of output. It is estimated that for pulp and paper, the regulations will have the effect of reducing discharges of BOD and suspended solids by about 75% from the levels expected before their application; about $250 million has been spent or committed by the industry for pollution abatement. The guidelines are ordinarily used where known technology is inadequate and are considered interim measures.

These national guidelines and effluent regulations will be supplemented as required on specific water bodies by local effluent quality controls. The Canada Water Act of 1970 provides a legislative framework for setting such standards on federal waters or, after joint federal-provincial study, on any designated water bodies or river basins. They will be based on stated ambient quality objectives for the waters concerned, which will, in turn, be based on a review of the present and future water uses to be supported.

Product Standards – The only example of federal regulation of water quality by specifying product characteristics is also supported by the Canada Water Act. It prohibits the manufacture or import for use or sale in Canada of cleaning agents and water conditioners containing nutrients (so far, phosphorus) in concentrations exceeding those set by regulations.* The problem of pollution resulting from

*At present, the regulations permit a maximum of 5% phosphorus pentoxide by weight in laundry detergents.

excessive nutrients had been identified in 1969 by the International Joint Commission as being particularly evident in the Great Lakes, and the Canada Water Act provided a vehicle for action on this problem. The problem of over-enrichment of lakes was evident in many other parts of Canada as well. Before they were regulated, household detergents contributed up to 50% of the phosphorus content of municipal sewage plant effluents. With their phosphorus content progressively being lowered by regulation, it has been estimated that phosphorus in domestic sewage has declined by as much as 80%. Another example of product regulation, not as directly related to water quality, is the banning of DDT in Canada. Further contaminants regulation is being planned in the form of an Environmental Contaminants Act.

Marine Pollution Controls – Another new vehicle for federal water quality regulation, also dating from after 1970, is provided by amendments to the Canada Shipping Act, passed in 1971. Whereas pollution controls in the act prior to that date reflected those in the 1954 International Convention for the Prevention of Pollution of the Sea by Oil, the amended version contains a broader definition of pollution and more detailed regulation is possible. It deals with substances that, if added to water, would degrade or alter the quality of those waters to an extent that is detrimental to their use by man or by any animal, fish or plant that is useful to man. Discharge of pollutants by shipping sources is prohibited, in excess of the manner or amount prescribed, in all Canadian waters (either part of Canada's territory or in its legislative jurisdiction). The Department of the Environment, in conjunction with the Ministry of Transport, is preparing regulations to determine adequate levels of shipboard treatment. Under the Shipping Act, vessels can be inspected, re-routed, seized and even destroyed to prevent water pollution, and the Act provides for a Maritime Pollution Claims Fund. Levies on oil imported or exported make up the fund from which claims for losses attributable to any pollution from ships can be paid when they cannot be collected from the owners of the ship. The Act is administered by the Ministry of Transport, as is the Navigable Waters Protection Act, which requires a permit for any works affecting such waters and prohibits dumping of rubbish into them. The Department of Energy, Mines and Resources has similar powers to prevent marine pollution under the Oil and Gas Production and Conservation Act, which lays down standards for exploitation of undersea energy resources on the coasts of Canada. A joint Environment-Transport project is preparing a Small Craft Harbours Act, which will provide a basis for regulating onshore and offshore pollution from small craft.

Regional Pollution Controls – Two other new pieces of legislation provide for control of pollution in northern inland and arctic waters. The Northern Inland Waters Act (1970) deals with water diversions as well as water quality: it prohibits the discharge of waste directly or indirectly into water, other than according to licence or regulation, and prohibits the diversion of water in water management areas without a permit. The Act provides for Water Boards in each of the Yukon and Northwest Territories to administer it under the general authority of the Department of Indian and Northern Affairs. The Arctic Waters Pollution Prevention Act (also 1970) regulates the polluting effects of shipping and of exploration and development of the natural resources of the sea-bed and the land north of the 60th parallel. Again, the deposit of waste is prohibited except as provided by regulation, and there is provision for collecting from offenders, either ships or persons, the costs of clean-up and civil damages. Ships and cargoes can be seized where an offence appears to have been committed and fines are provided for infractions.

Environmental Impact Assessment – An environmental assessment and review process has been established by Environment Canada for all projects, procedures and activities in which the Government of Canada has an interest. Some assessments of this type are already underway or completed, and appropriate methods for ensuring that they result in designs and procedures which will protect the natural environment are being developed.

Control Through Economic Instruments

For economic efficiency, effluent charges are often supported as the preferable form of water quality control, but so far, at the federal level, they have not been implemented in Canada. Mention has already been made of their use in certain cities. The Canada Water Act does make specific provision for all forms of control, including effluent charges, when these are recommended by water quality management agencies set up under the terms of the act. Mention is also made of "treatment charges" which can be levied to cover the cost of regional sewage treatment.

Another form of "economic" control is to provide a financial incentive for pollution abatement. The principal national incentive program is that provided under the National Housing Act, whose primary purpose is to promote construction and repair of houses and to improve living conditions. Since 1961, the Act has permitted the Central Mortgage and Housing Corporation to make long-term, low-interest loans to provinces, municipalities or municipal sewage corporations for up to two thirds of the costs of the construction or expansion of municipal sewage treatment facilities. Provision is made on projects completed on or before March 31, 1975, for the forgiveness of 25% of the loan principal and 28% of the interest accruing during the construction period upon satisfactory com-

pletion of the project. By 1972, about $628 million had been expended under this program indicating a total investment in sewage treatment of about $942 million.

Federal funding of public water and sewage systems is also provided by the Department of Regional Economic Expansion (DREE), which supports "infrastructure" development in special areas, growth centres and "agricultural services centres" (on the Prairies), including water supply and waste disposal systems. The primary objective of DREE programs is to ensure that economic growth is dispersed across Canada and to create employment in slow-growth regions.

DREE grants under the Regional Development Incentives Act can also include support for pollution abatement by private industry. Indirect support is also given for such costs under the Accelerated Capital Cost Allowance program, which permits accelerated depreciation rates for air and water pollution abatement equipment. This program is administered by the Federal Government through its taxation operations.

Water Quality Control by Comprehensive Management

This form of control obviously affects both quantity and quality and comes primarily under the Canada Water Act. Though it provides for an integrated approach to all aspects of water management, the Act makes special provisions for water quality management. Planning studies conducted under the Act and the water quality management agencies for which it provides are intended to ensure that water resources, in both quantity and quality, meet the various demands that, by general agreement of governments and the people concerned, should be met.

The process of water quality management under the Act requires, first, ranking in order of priority of the various water basins and regions according to their quality problems. This was completed soon after passage of the Act. Then, the designated regions for joint federal-provincial action are evaluated with regard to the physical, social, demographic and economic factors that affect the water quality. Alternative future patterns of water use are selected and the water quality necessary to maintain them is defined. Public involvement contributes to the selection of a particular pattern and a comprehensive water management plan results.

This process has been launched in several basins in Canada under joint federal-provincial agreements, and negotiations are proceeding on further river basins and water management regions. The process is similar to the one being followed jointly with the United States under the Great Lakes Water Quality Agreement. Similar comprehensive planning of land and related water resources is undertaken by DREE, with provincial governments, under its Agricultural Rehabilitation and Development program and its Fund for Rural Economic Development.

Conclusion

The foregoing description of Canada's water management policy instruments indicates that many approaches and objectives have been adopted. Aside from the structural factors imposed by the Canadian system of government, which gives its constituent regional entities a great deal of autonomy, this diversity of public policy with regard to water may also reflect physical realities. The size of Canada and its varying topographic and hydrological characteristics make it difficult to conceive of unified, nationally applicable specific policies that would be practicable in more than a few areas of public concern.

Appendix A gives some quantitative information relevant to an evaluation of Canadian water management. However, this information is inadequate to support any definitive conclusions regarding the success of water management policies and programs in meeting objectives. Further clarification will be required of the various objectives pursued and more information is needed than is now available for assessing performance.

The policies that have been described, however wide in range, tend to emphasize a regulatory approach to water management, in particular to water quality control, though the use of economic charges, at least at the municipal level, is beginning to find favour. The federal and provincial governments pursue separate but related objectives in water management and work together on large water resource development projects, on water use planning and on establishing policy frameworks for water quality control. The developing of environmental impact assessment procedures will provide a future area for further federal-provincial cooperation within councils such as the Canadian Council of Resource and Environment Ministers. Obviously, such councils provide a forum for vetting federal policies of national application with provincial governments, but also permit mutual understanding and coordination among all agencies involved in water resource management.

APPENDIX A

Towards an Evaluation of Water Management

Towards an Evaluation of Water Management

This appendix presents some information relevant to evaluating Canadian water management policy, however, no claim is made for its completeness or adequacy. Work is underway to produce further statistical and other information of this nature, but results are not yet available.

The numerical information in Table A-1 gives a general overview of public (federal, provincial and municipal) expenditures in areas related to water management, and of total (public and private sectors) construction expenditures on structures relating to water. Some historical data on public expenditures related to water are provided in Table A-2. These data serve partly to place in perspective the size of provincial and federal inputs into water resources. They throw no light on the results that management policies and expenditure levels have produced and how these results correspond with those intended. The most relevant measurement of results in water quantity management is probably case studies of particular projects and river basins. Some work is being done to review past water management policies in this way but has not yet been completed.

For review of water quality policies, monitoring of trends in water quality on a national or basin basis should provide some indication of effectiveness. Again, preliminary work of this kind is underway, but no overall conclusions are yet available. In one important area (the Great Lakes), the International Joint Commission, under the Canada–U.S. Great Lakes Water Quality Agreement, is charged with monitoring the progress of the two countries towards the objectives of the Agreement. In its first annual report, the Commission indicated that the degradation of the water quality of the Great Lakes may have been slowed down in some respects, but no strong scientific basis is available yet to support a claim for improvement except in local areas. A joint board established under the Agreement has begun the work of establishing a scientific basis for future evaluation. Its 1973 Report* suggested that "the assessment of water quality data trends has greatly lagged the data collection programs." According to the Report, "adequate" sewage treatment was provided for 80% of the 4.8 million people in the Canadian portion of the region in 1971, for 84% in 1973 and it is expected will be provided for 98% in 1975. The Board concluded "that, based on available information, the water quality of Lake Erie and Lake Ontario generally has not changed significantly from 1970 to 1973. There are, however, some definite signs of improvements in certain . . . problem areas."* National monitoring of water quality at specific sites is undertaken by Environment Canada, and, as noted earlier, most of the provinces also monitor water quality.

Another indication of the results of water quality management policies is the proportion of the Canadian population served by waste treatment systems. Some data on municipal waste treatment are provided in Table A-3.

Estimates have been made of the effectiveness of waste removal in Canada by using standard coefficients of treatment plant efficiencies and applying them to the above data. In this way, the average removal efficiency for Canada as a whole for biochemical oxygen demand (BOD) and suspended solids is calculated to be 45% and for phosphates, 10% (its removal requires tertiary treatment). Some indication of the size of investments in municipal waste water treatment in Canada is available from data on the total value of loans under the Central Mortgage and Housing Corporation program referred to earlier (see Table A-4). It has been estimated that this program covers about two thirds of total system costs. Estimates of total future investment required to install adequate treatment facilities in Canada's municipalities have ranged as high as $2.7 billion. A 1971 agreement between Canada and Ontario covering the lower Great Lakes basin calls for an accelerated loan rate under the CMHC program for municipalities in this region. Federal loans of up to $210 million over the 1971-75 period will be coordinated with Ontario government expenditures of $131 million for municipal waste treatment. Since the inception of the federal Accelerated Capital Cost Allowance Program (mentioned under "Control through economic instruments," page 15), which provides an incentive to industry to install air and water pollution abatement equipment, some $190 million worth of equipment has qualified for accelerated write-off of costs.

*Great Lakes Water Quality Board, 1973 Annual Report to the International Joint Commission, April. 1974, pp. 3-4, 7.

Table A-1. Selected financial statistics related to water
(in millions of dollars)

A. PUBLIC EXPENDITURES

Province (1971 Population)	Water Supply and Treatment[1]				Other water resource development[2]	Total
	Water supply	Sewage	Pollution control admin., etc.	Subtotal		
Newfoundland (522,000)	1.5	1.7	1.0	4.2	0.2	4.4
Prince Edward Island (112,000)	0.3	0.3	0.8	1.4	0.1	1.5
Nova Scotia (789,000)	6.8	7.4	3.8	18.0	0.7	18.7
New Brunswick (635,000)	4.0	4.6	2.1	10.7	1.1	11.8
Quebec (6,028,000)	53.6	61.1	28.6	143.3	4.7	148.0
Ontario (7,703,000)	82.2	84.4	47.0	213.6	16.1	229.7
Manitoba (988,000)	8.1	9.3	4.9	22.3	12.9	35.1
Saskatchewan (926,000)	7.6	8.6	4.2	20.4	5.4	25.8
Alberta (1,628,000)	20.0	22.9	10.7	53.6	4.8	58.4
British Columbia (2,185,000)	24.2	27.9	14.1	66.2	8.9	75.1
Yukon (18,000)	1.0	0.4	0.4	1.8	–	1.8
Northwest Territories (35,000)	0.6	0.3	0.1	1.0	–	1.0
PROVINCIAL TOTAL	210.3	228.8	117.7	556.6	54.9	611.5
Add: Federal Government	10.9	8.4	3.5	22.7	30.1	52.8
TOTAL, CANADA	221.2	237.2	121.2	579.3	85.0	664.3

B. VALUE OF CONSTRUCTION (PUBLIC AND PRIVATE) IN CERTAIN WATER-RELATED CATEGORIES[3]

Province	Waterworks and sewage systems	Dams and irrigation	Marine	Total
Newfoundland	12.4	N.A.	19.6	32.0
Prince Edward Island	2.9	–	3.0	5.9
Nova Scotia	16.4	1.3	8.7	26.4
New Brunswick	12.7	2.0	23.0	37.7
Quebec	167.6	7.1	69.3	244.0
Ontario	270.0	22.5	26.0	318.5
Manitoba	19.8	4.4	7.1	31.3
Saskatchewan	19.4	7.4	3.7	30.5
Alberta	54.4	12.5	0.6	67.5
British Columbia	89.0	11.6	39.5	140.1
Yukon	–	–	N.A.	–
Northwest Territories	–	–	N.A.	–
TOTAL, CANADA	664.6	68.8	200.5	933.9

[1]Gross general expenditures, year ending December 31, 1970. Besides construction and operation of water supply and purification and sewage collection and disposal facilities, "Total" includes expenditures on other pollution control facilities and other research and control activities not necessarily all related to water; "Canada" expenditures are mostly transfers to other governments. (Source: Statistics Canada, "Consolidated Government Finance, 1970," Cat. No. 68-202).

[2]Gross general expenditures, fiscal year ending March, 1970. Includes hydraulic research and surveys, control and regulation of dams and other storage facilities, planning of power installations, and flood control. (Source: Statistics Canada, "Provincial Government Finance, 1969," "Federal Government Finance, 1969," Cat. Nos. 68-207, 68-211.)

[3]Total value of construction work performed by governments and others, new and repair, 1972. "Marine" includes docks, wharves, piers; retaining walls; canals and waterways; dredging; dykes; logging booms. "Waterworks and sewage systems" includes drains and storm sewers; water services; sewage systems; pumping stations; storage tanks. "Dams and irrigation" includes dams and reservoirs; irrigation and land reclamation. (Source: Statistics Canada, "Construction in Canada, 1970-72," Cat. No. 64-201.)

Table A-2. Public expenditures in Canada related to water (by category, 1961 to 1969) ($ million)

Year	Agriculture[1]	Fishing[2]	Flood control	Hydro-thermal electric power	Water resources[3]	Waterworks and sewage systems	Recreation[4]	Marine or navigation[5]	Total
1961	6.7	12.5	22.5	226.4	9.7	120.6	50.0	61.5	509.7
1962	7.8	12.4	25.9	256.2	11.7	110.8	53.5	60.5	538.9
1963	3.2	12.1	19.7	253.3	24.2	113.4	43.8	57.3	527.1
1964	1.7	13.8	23.7	279.4	22.3	109.7	47.2	62.1	559.9
1965	1.6	17.3	27.1	353.0	43.8	122.3	62.0	89.5	716.8
1966	17.1	22.2	17.5	525.0	44.7	124.6	82.6	117.1	950.8
1967	4.4	23.4	20.3	574.9	42.5	227.2	102.8	116.1	1,111.6
1968	5.0	21.4	22.3	546.6	58.7	264.6	109.3	105.3	1,133.2
1969	6.6	17.4	25.8	520.3	54.4	243.8	83.4	88.0	1,039.7

Source: "Public Investment in the Canadian Water Industry," June, 1973; unpublished paper prepared by Mr. J.J. Dolan, Inland Waters Directorate, Environment Canada; includes selected capital and operating expenditures by federal, provincial and local governments; excludes private sector expenditures.

[1]Irrigation and land reclamation projects.
[2]Investment in capital assets, provincial expenditures on fish and game operations.
[3]General expenditures related to water resources as part of natural resource administration.
[4]Chiefly, acquisition and operation of national and provincial park systems and municipal expenditures on recreation services.
[5]Marine construction, navigation aids.

Table A-3. Municipal waste treatment in Canada, 1972 (percentage of urban population served)

Region	Primary systems	Secondary systems	Tertiary systems	Total
Pacific	32	30	1	63
Prairie	15	83	–	98
Ontario	17	77	*	94
Quebec	3	14	–	17
Atlantic	2	38	–	40
Canada	13	53	–	66

Source: "Canada Water Yearbook," Environment Canada, Ottawa (in press).
*Indeterminate amount.

Table A-4. Total value of Central Mortgage and Housing loans, by province, 1961-72

Region	Total value of loans ($ million)	No. of loans	Average value of loans ($ thousand)
Newfoundland	3.5	33	105
Prince Edward Island	4.8	26	184
Nova Scotia	18.1	99	183
New Brunswick	14.3	66	216
Quebec	86.8	379	229
Ontario	295.3	781	378
Manitoba	31.1	168	185
Saskatchewan	16.0	307	52
Alberta	46.0	253	181
British Columbia	111.7	235	475
Total	627.6	2,347	266

Source: "Canada Water Yearbook," Environment Canada, Ottawa (in press).

The quantitative information given above provides only a very imperfect evaluation of the effectiveness of Canadian water management policies. The relative newness of public programs to control water quality makes it difficult to assess them. The federal Canada Water Act, whose philosophy of cooperative comprehensive management of water resources is complemented in a number of provincial statutes, is still relatively new and untried in application. It has recently been estimated, however, that about $36 million has been spent or committed since 1967 by federal and provincial governments for joint planning and investigation activities under the Act. These expenditures are intended to lead to plans for all aspects of water quantity and quality management. Comprehensive plans under federal-provincial agreements have been or are being developed for the Saint John, Qu'Appelle, Souris and Okanagan Basins, and joint studies for specific purposes have already begun on the St. Lawrence River, Great Lakes, Lake Winnipeg–Nelson River–Churchill River and Fraser River Basins. The future pattern of implementation of these action-oriented framework plans, as well as a further period of implementation of water quality control programs, will throw light on the overall effectiveness of recent policy initiatives.

A Canadian paper submitted for discussion at the "Comparative Review of the Management Options" of the Organization for Economic Cooperation and Development (OECD), June 1974

APPENDIX B

Effluent Charge Schemes in Canada (by John Demakeas)

Effluent Charge Schemes in Canada (by John Demakeas)

This paper describes the use of effluent charges in Canada, and, based upon this experience, draws some general conclusions respecting their significance and effectiveness.

The government of Canada, in common with the other members of the Organization for Economic Cooperation and Development, is interested in the developing theory of effluent charges as a water pollution control instrument. The only examples of this instrument in actual operation, in Canada, exist presently at the municipal level of government.[1]

Municipal effluent charges have proliferated in recent years in response to local conditions. There are ten municipalities[2] known to have effluent charge schemes in operation at the present time, seven of which are large communities with a population of over 100,000. These ten municipalities contain a combined population of about 4,200,000, that is, 20% of the population of Canada. In addition, several cities have bylaws providing for imposition of effluent charges, but these bylaws have not yet been implemented. Still other cities have effluent charges under review or under consideration, and could well have bylaws in place and charges in operation in a year or two.

The effluent charge schemes in the ten communities referred to above are similar in that industrial enterprises within municipal boundaries are not only restricted in terms of what they are permitted to discharge into sewers, but they also must pay charges on the basis of the amount of wastes (the quantity and strength of their effluent) in their permitted discharges. Thus, in all cases, there is a direct economic inducement or incentive for industry to limit the amount of wastes discharged, and, indeed, to accomplish this as efficiently as possible. The range of alternatives to payment of charges that is available to industrial management is very broad, as it includes changes in raw materials and in production processes (to reduce or eliminate the need for water as a medium of waste disposal), pre-treatment of effluents before discharge into sewers, and full treatment of effluents (thus bypassing municipal waste treatment plants entirely). Indeed, to the extent that incentives are offered for decision-making, industry is fully expected to exercise its customary ingenuity in reaching a least-cost solution to its water pollution problem. Likewise, to the extent that there is some degree of financial incentive, the "externalized" cost of pollution (that downstream users as well as the public, through damages to health and aesthetics, would otherwise be required to bear) are forced back upon the industry on the basis of the amount of wastes it discharges, that is, in accordance with the "polluter pays" principle.

From the point of view of financing municipal waste treatment, effluent charges tend to transfer a larger share of the cost burden from domestic-commercial users to industrial users. Whether categories of users of this service provided to the public are charged equitably involves a financial analysis of all sources of revenues (capital grants from senior governments, local property and sewer taxes, etc., as well as effluent charges) and all sources of wastes, which is outside the scope of this paper.

In determining effluent charge levels, municipal authorities do not normally take into account that portion of the physical plant provided by grants and other financial assistance from senior governments. As a matter of fact, municipalities normally do not seek to recover any capital costs, not even their own, in fixing the charge level, although it is these annualized capital costs that are of prime importance in these capital-intensive enterprises. In almost every case, effluent charges are levied only on the "excess strength" of the industrial firm's effluent over the "normal strength" of the domestic-commercial effluent. No account is normally taken of the fact that domestic-commercial effluents are relatively stable in quantity and strength in comparison to industrial effluents, so that the latter are considerably more expensive to treat. In practi-

[1] Effluent charges as a policy instrument are mentioned in the Canada Water Act (1970), which is administered by the Department of the Environment. Part II of this Act, providing for the creation of regional or river basin "water quality management agencies," stipulates that these agencies may utilize both "effluent discharge fees" (based upon the amount of wastes discharged into the water environment) and "treatment charges" (covering the cost of regional sewage treatment and sample analysis). However, to date none of these agencies has been established.

[2] A national questionnaire now under preparation may uncover additional smaller communities not covered in this report.

cally every case, the municipal authorities granted a further measure of leniency in fixing the effluent charge level by defining the "normal strength" of domestic-commercial effluent at considerably higher levels than actually the case. For example, effluent charges in Toronto begin when industry's effluent exceeds 500 parts per million of BOD and 600 parts per million of suspended solids, while the average domestic-commercial load varies between 200 and 300 ppm for these parameters.

From the viewpoint of the municipality, it is not feasible to charge a fee or tax on industrial effluents deposited directly into streams, or, for that matter, on its own sewage plant effluent. Such a fee or tax would raise major issues (e.g., natural resource ownership and control, definition of "assimilative capacity," and tax jurisdiction) with senior governments. Therefore, municipalities tend to generate revenues under the principle of compensation for services rendered. Industries are charged as water users and/or as property owners for the sewage treatment "service." Effluent charges are seen as another "user charge" or "service charge" imposed upon industry. Since charges are levied only on the excess above the "normal" strength of domestic-commercial effluent, they are known technically as "surcharges."

However, even from the viewpoint of the municipality, there is no reason, in the case of certain kinds of wastes, why the effluent charges could not be levied on a "zero-basis." A case in point concerns Metro Toronto, where under certain conditions, a charge of 1.5 cents per pound is placed on phenols in industrial wastewater. The "normal strength" of phenols in domestic-commercial effluent is taken as one part per million. Thus, if a firm's wastewater shows 1,000 parts per million of phenols, it will be charged at a rate of 999 ppm. For all practical purposes, this should be considered a zero-basis "charge," not a "surcharge." While this is the only present example that can be cited, it is known that other wastes are being considered for zero-basis charging at certain locations.

In terms of international discussions of policy alternatives, it seems advisable to apply the term "effluent charge schemes" to these municipal instruments, provided, of course, that the charge is levied *per unit of waste in the effluent,* that is, on the product of the concentration of the waste per unit of wastewater multiplied by the quantity of the wastewater. The practicability of levying a charge or tax on the amount of wastes discharged, whether into sewers or directly into the environment, is a matter of fundamental importance to the economics of environmental control. This broader viewpoint should be considered in the selection of terminology.

This discussion of the general characteristics of the effluent charge schemes presently in effect would not be complete without an appraisal of the effectiveness of these schemes. If the objective of the municipalities is to place a monetary incentive upon industries so that polluting discharges are reduced closer to each firm's "optimal level"[3] (this appears to be the sole or main objective in almost all cases), then the schemes must be judged as highly successful. This is because practically every municipality that has had these charges in effect can cite numerous, convincing instances where these charges (or the threat of imposing these charges) have caused industry to reassess its past practices and to reduce wastes significantly or substantially. In several cases, this economic inducement has worked where other strategies have proved ineffective, as exemplified by the experience at Winnipeg, Manitoba, where:

> ". . . . . it was not until surcharges were imposed in 1958 that industry took any major steps to reduce the concentrations of their wastes. Initial attempts at education and persuasion had little effect. Restrictive by-laws, with their threat of legal action and fines, did not speed up the installation of pre-treatment facilities, *and only when the surcharge by-law was instituted,* when it became an economic advantage to industry to install pre-treatment facilities in lieu of paying surcharges, *were any major advances made in reducing waste concentrations.*"[4] (Italics added.)

If, conversely, the main objective of the use of effluent charges is to raise funds for the municipality to cover the marginal cost of treatment, then it safely can be inferred from the above discussion that success has been limited. (It should be noted that this is not considered the main objective of most of the charge schemes in effect.) The table on page 27 sets forth the estimated gross revenues accruing to municipalities from effluent charges for a recent year (usually 1973).

These revenues should be placed in the context of the additional sewer and treatment costs incurred by the public to handle industrial wastes. Since these costs are not

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[3] In environmental economic theory, the economic or optimal level of pollution is represented by the equilibrium of the marginal cost of pollution abatement to the firm with the marginal benefit of pollution abatement to society. However, from the viewpoint of the firm faced with a "given" effluent charge, the economic level of pollution is represented by the equilibrium of its marginal cost of pollution abatement with the amount of effluent charge. This point is optimal to the firm as its costs are minimized if it reduces its discharges of wastes to this level, allowing the municipal sewage plant to treat the balance.

[4] Alexander Penman, "The Experience with the Effluent Charge Scheme of the City of Winnipeg," a paper prepared for and presented to Environment Canada on February 14, 1974.

Municipality	Estimated revenues from effluent charges (recent year)
Toronto, Ontario	$ 250,000
Edmonton, Alberta	229,000
Winnipeg, Manitoba	220,000
Calgary, Alberta	140,000
London, Ontario	120,000
Waterloo Region, Ontario	100,000
Other	80,000
TOTAL	$1,139,000

known, the revenues might be related to total public sewer and treatment costs. At present, the revenues from industrial effluent charges appear to be less than 1% of these costs. (Note: this factor is sensitive to write-off rates used). However, revenues are expected to increase sharply, perhaps between 20% and 40% per year, in the immediate future, as a result of the following factors:

1. A tendency to reduce the "normal strength" allowed without charge to a more realistic level, thus, narrowing or eliminating the free margin.
2. Increases in charge rates (per unit of waste) at several locations. In part, this factor reflects the increasing tendency to recover the full amount of operating costs that can be allocated to industry (and, in several instances, to recover annualized capital costs as well).
3. The tendency to include a wider range of wastes in the charge schedule, and to charge wastes separately instead of on the basis of the "highest concentration" of several wastes.
4. Implementation over the near future of effluent charge bylaws as planned by other municipalities, such as Windsor, Ontario, and Oshawa, Ontario, and a number of other communities.
5. A possibility of extending effluent charges to a "zero-basis," which would serve to convert effluent charges to a major means of municipal taxation.

To summarize, the amount of revenues presently being collected by municipalities from effluent charges is not impressive when related to aggregates of funds required for sewage treatment, but it should be kept in mind that these revenues are expected to escalate sharply in the years immediately ahead, even as this instrument continues to prove effective in reducing industrial wasteloads.

The following sections of this paper will discuss experiences with effluent charges at each major municipality, which should serve to illustrate the rather wide range of philosophies, objectives, accomplishments, and future plans developing at the local level. It is acknowledged that the informational basis for each of the following sections was provided for this paper by responsible municipal officials, usually the engineer-in-charge.

Winnipeg, Manitoba

Effluent charges were pioneered in the Canadian western prairies 16 years ago, which may reflect the relatively greater importance attributed to the water resource in the regions of Canada where water is considered in relatively short supply for several uses.

More or less continuously from 1935 to 1950, the municipality of Winnipeg utilized a variety of educational techniques in a vain attempt to bring about desired reductions in industrial wasteloads. By 1950 the sewage system was overloaded, and it was seriously contemplated to implement provisions in the Greater Winnipeg Sanitary District Act for the imposition of surcharges for extra strong sewage. Implementation was delayed in favour of construction of screen chambers at packinghouse outlets at public expense. Despite elimination of packinghouse solids, facilities overload continued to occur, and the authorities reluctantly imposed the effluent surcharges on January 1, 1958.

Surcharges have been found to be effective in inducing packinghouses and other factories to curb their wasteloads through pre-treatment and by effecting other changes. For example, a food-processing factory was influenced to re-cycle water to reduce the quantity of its BOD effluent from 7 million gallons per day to 3 to 4 million gallons per day. Experience has encouraged the municipality to allow very little discretion in administering the surcharges. The cost of sampling which falls upon the public totals less than 10% of the funds collected, while the total of all operating costs of the Industrial Waste Control Branch generally runs to less than 20% of the funds collected. At present, charges average 7.77 cents for 1,000 gallons of effluent for combined excessive BOD and suspended solids, and a flat charge of 4 cents per pound for grease. Chlorine demand and "other wastes" are not charged at the present time.

While many specific and impressive examples of industry cutbacks in wasteloads can be cited, the effectiveness of effluent surcharges is not limited to this factor. Effluent surcharges have influenced industry to undertake very substantial amounts of materials recovery. They have also had the effect of reducing the water requirements of various industries as less water is put to the waste disposal use. Thus, industrial behaviour has been modified so that its surcharges are reduced, valuable materials are recovered, and the valuable water resource is conserved.

Calgary, Alberta

Calgary has had an effluent charge scheme in effect for 16 years (since 1958). Along with charges, which it regards as "penalties" to industries for sending it sewage, it has a liberal "reward" system to further induce industry to reduce its wasteloads. When a firm agrees to treat its own wastes, it is rewarded by reimbursement of all effluent charges collected from it over the previous three years. Thus, a packinghouse was recently reimbursed $368,000 when it agreed to handle its own wastes. Over the past few years, reimbursements have been relatively large, while effluent charge collections have declined from nearly $400,000 a year to $140,000 (1974 estimate). This decline in effluent charge collections is perceived as a measure of the success of the penalty-reward system in encouraging better environmental behaviour on the part of industry. (Note: after January 1, 1975, the reimbursements will be reduced to 50% of effluent charge collections over the previous three years.)

Calgary's domestic sewage averages considerably less than 200 ppm of BOD and suspended solids (SS). It allows industries to send it sewage up to 300 ppm without charge, and then, charges industry .041 cent per thousand gallons for BOD, and .037 cent per thousand gallons for SS, for each part per million in excess of 300. In addition, for each part per million of grease above 100, .043 cent per thousand gallons is charged. In all cases the charge is "forgiven" entirely if it works out to less than .08 cent per thousand gallons. The plant will not accept BOD and SS in concentrations in excess of 1,200 ppm and will not accept grease in concentration in excess of 450 ppm. While companies are not required to keep daily records of the strength of their effluents, in actual practice most companies keep good records and make these available to the authorities.

The intent of the municipality in utilizing effluent charges is to improve the ultimate quality of the environment by inducing industry to reduce wastes discharged. Nevertheless, certain firms tend to cling to the *status quo* and are content to depend on the municipal treatment service even if they must pay substantial treatment charges. It appears difficult to force them to take positive actions. But all in all, the experience with effluent charges has been satisfactory.

The effluent charge, by imposing a larger proportion of cost upon industry, helps rectify a charge structure that tends to impose a disproportionately large share of costs on residences. For example, the water service rate (60% of which helps finance sewers and sewage treatment) is 68 cents per thousand gallons for the first 5,000 gallons (i.e., for the typical residence) and then is radically reduced to 23 cents per thousand gallons for users that take over 5,000 gallons (i.e., for industrial firms). Even with effluent charges and reimbursements, the proportion of industrial to domestic effluent continues to rise, and since industrial effluent is costlier to treat, industry may be required to pay proportionately more for sewage treatment in the future.

Edmonton, Alberta

After about 10 years of experience with an effluent charge scheme in Edmonton, the municipal officials are of the opinion that the principle has been generally accepted, and, in practice, the charges have created an effective economic incentive causing industry to undertake abatement measures. While the primary intent has from the beginning been to reduce wasteload levels by encouraging industries to pre-treat their wastes, nevertheless, the charges have been set so as to recover the full cost (both capital and expense) of treating the industrial sewage. Thus, in 1973, the surcharge brought in $229,000 in revenues for the city, while the 1974 revenues are estimated to range between $350,000 and $375,000, reflecting a recent increase in rates.

Edmonton bylaw 3723, dated June 1971, supplies background information on the charging scheme. However, the surcharge for "collection, transmission and treatment" is at the present time being adjusted upwards, and the new limits on strength ("standards") programmed as follows:

Pollutant	Target Dates		
	Immediately	1-1-1975	1-1-1977 (circa)
Biochemical oxygen demand	700 mg/l	500 mg/l	300 mg/l
Suspended solids	400 mg/l	350 mg/l	300 mg/l
Grease	200 mg/l	150 mg/l	100 mg/l

Above these limits, BOD is charged 1.4 cents per pound, suspended solids 0.4 cent per pound, and grease 0.6 cent per pound (plus 15% if industrial point source is out of town).

In the future, it is anticipated that the guidelines restricting industrial wastes that can be introduced into municipal sewers will become more rigid, and standards for heavy metals are foreseeable. The use of surcharges is likely to be extended.

London, Ontario

While approximately $120,000 annually is raised by effluent charges imposed upon industry, it is the policy of the city of London to use persuasion and education to encourage industry to take the actions necessary to reduce their wasteloads. Effluent fees (for BOD and SS) are seen as

a "last resort," as a "stick" which ideally is never used. Prolonged negotiations are conducted with industry to work out problems without resort to the bylaw. Firms are given up to three years to meet negotiated standards. Reductions in full charges are often made as helpful inducements when necessary.

Nevertheless, there are many instances where firmness is required. Some problems seem difficult to resolve. For example, one firm is presently paying about $25,000 a year in effluent surcharges, but, despite this and other pressures, it continues to choose to rely on the city to treat its wastewater.

Toronto, Ontario

For the past seven years (since 1967), the municipalities in the Metro Toronto area have undertaken to enter into agreements on behalf of the four sewage plants with industries located within the area so that wastewater from industries is treated and the operating expenses (not capital) charged back to them. The city is selective in that only BOD, suspended solids, grease, and more recently, phenols are taken, and then only up to the limits the individual treatment plants can handle, and only if the industry agrees to primary pre-treatment.

This effluent charge scheme thus results in rather modest charges. There is no charge for BOD up to 500 ppm, SS to 600 ppm, grease to 150 ppm, and phenols to 1 ppm. Above these limits, a charge of 1.5 cents per pound is levied on the waste that is most prominent in the wastewater—the other wastes, if present, are not charged. This charge yields approximately $250,000 per year in revenues. It is noted that this surcharge is expected to be revised upwards later this year from 1.5 cents per pound to perhaps 2.4 cents per pound. Since the annual total operating costs of the treatment system approximate $9,000,000, it can be seen that the revenues from effluent charges, even with the foreseeable increases, will not fully recover these costs.

Many of the affected companies install measuring devices in accordance with the terms of agreement. Likewise, the several municipalities retain personnel to sample, where feasible and necessary. In certain cases, the charge is levied on the basis of the amount of water consumed by the industry as a proxy measure for the quantity of effluent.

While there were minor complaints from industry when the surcharges were instituted, these have died down in favour of a cooperative spirit as industry comprehended that the program was beneficial. For example, many industries cannot acquire the land that would be needed if they were to treat their own BOD. It is generally appreciated that joint treatment provides economies in which all can share.

Waterloo Region, Ontario

Almost two years ago, the City of Kitchener decided to buttress its control bylaw dealing with toxic and nuisance waste discharges with a system of effluent charges based on the strength of BOD and SS in industrial wastewater. At first there was some opposition from some affected industries in the perverse form of the "licence to pollute" argument. However, when letters soliciting comments were sent to all affected companies, only two companies complained (mildly) about the charges, while the vast majority of the companies showed a great awareness of the pollution problem and their resultant responsibilities.

Once the charges went into effect and the industries had a hard economic inducement to do something to improve their effluents, *most industries* (especially the large companies) immediately implemented measures to pre-treat their wastewaters. Thus, there is little question of the effectiveness of effluent charges as a "tool of policy."

The Kitchener charge scheme is closely modelled after the Winnipeg scheme, partly because it was considered the most simple, partly because it appeared the most relevant (since both cities were confronted with meat-packing industry pollution on a major scale). However, in Kitchener only BOD and SS are charged. These two pollutants are charged equally, with the total charge covering the operating cost of treatment, which works out to 11.45 cents per thousand gallons (1972). Up to 300 ppm (SS) and 350 ppm (BOD), there is no charge. For the excess, charges in Kitchener alone totalled $100,000 for the first year the scheme was in operation.

Present plans call for early completion of studies, so that the scheme can be expanded throughout the Waterloo region (including Cambridge, Elmira, and many other towns) by January 1, 1975. This will have the effect of doubling revenues, even if large allowances are made as expected for improved pre-treatment. It is contemplated that charges will be adjusted upwards to include the full cost of treatment (i.e., to include capital cost), which will bring the annual revenues to the one-half million dollar range.

Other Municipalities

There are a number of other municipalities that have effluent surcharge schemes in operation, although not on as ambitious a scale as those mentioned above. The following may serve as examples.

In Prince Edward Island, the industrial waste bylaw calls for industry to pay surcharges for its wastewater treatment at Charlottetown (three municipalities) and Summerside. Both plans are quite new, having been implemented late last year. Industrial wastes are charged if in excess of 200 ppm of BOD and/or SS, and if in excess of 150 ppm of grease, in accordance with a formula similar to that applied in Winnipeg. The level of the charge is geared to the incremental capital and operating cost of facilities (such as oversize digesters for sludge at the new Charlottetown plant that were put into operation in March) which would not be necessary except for the excessive strength of industrial effluents. The plan has been well received (for example, a multi-plant firm which will pay about $20,000 per year would have to pay even more for its own treatment, and finds the charge in line with its experiences at other locations in Canada).

In New Brunswick, Sussex has had an effluent charge scheme for treating industrial wastewater in effect for approximately five years. The charges are based on BOD strength and flow.

In Hamilton, Ontario, the regional municipality can make agreements with industries to treat their wastes in excess of 300 ppm BOD and 350 ppm SS. The first agreement was negotiated in 1972, the second last year, and a third is presently being finalized. The first two agreements are each estimated to yield revenues of almost $10,000 per year. The formula used takes the higher of the two excesses multiplied by the cost of sewage treatment (now approximately 15 cents per 1,000 gal.) multiplied by a factor of 1.333.

In Windsor, Ontario, the 1969 bylaw is presently under review by the legal department, and it appears likely that an industrial effluent charge scheme will be implemented soon.

Conclusions

Certain general conclusions that may be drawn as a summary of the experiences of the ten municipalities that at present have effluent charge schemes in operation are:

(1) Effluent charges are an effective weapon in the hands of municipal authorities to induce or influence industrial firms to reduce their water pollution loads so that progress can be made towards achieving desirable environmental improvement.

(2) The revenues collected, while rapidly increasing in national total, are still relatively small. This aspect must be relegated to a secondary status so that the true objective of this instrument is not obscured.

(3) The costs associated with collecting effluent charges are normally a small part of the revenues generated and easily absorbed by the municipality.

(4) To a small extent, the revenues collected have helped shift a larger proportion of the total cost of sewage treatment from residences and small business to industry.

(5) To an important degree, effluent charges have increased the responsibility of industry to reduce discharges of waste into the environment, in accordance with the principle that "the polluter must pay."