

WATER QUALITY POLICY MANITOBA  
HISTORY - ADMINISTRATION - IMPLEMENTATION

By

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## ABSTRACT

The Manitoba government has recently developed objectives for surface water quality. The practicum focuses on their implementation feasibility.

A review of legislation pertinent to water quality is included. The roles of the administrative agencies whose actions influence water quality or can effect the implementation of policy towards achieving water quality objectives are presented. Additionally, various techniques for achieving the objectives are described. The feasibility of the objectives, with regard to administrative structure, implementation techniques and equitability of application, is discussed.

Many departments and agencies can influence water quality and policy regarding water quality, and their jurisdictions often overlap. Greater coordination of department and agency activities would facilitate implementation and realization of water quality objectives.

## ACKNOWLEDGEMENTS

In appreciation of their efforts on my behalf, I would like to thank the members of my committee: Mr. W.M. Ward of the Environmental Management Division, Manitoba Department of Mines, Natural Resources and Environment; Mr. H. Gavin of the Environmental Protection Service, Canada Department of the Environment; and, Prof. A. Lansdown of the Department of Civil Engineering, University of Manitoba. Thank you also to the staff of the Natural Resource Institute for their advice and encouragement, and to the many other persons who provided information and otherwise assisted in the preparation of this practicum.

## FORWARD

In December 1978, the Minister of Mines, Natural Resources and Environment released the Clean Environment Commission report entitled Report on a Proposal Concerning Water Quality Objectives and Stream Classification for the Province of Manitoba. In January 1979, the Minister accepted the report in principle, and gave the Commission permission to begin the next phase in the process of implementing the quality objectives, that of beginning to classify Manitoba's surface water bodies according to current and potential uses.

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## Chapter 1

### INTRODUCTION

#### Preamble

During the past decade, the Manitoba government has shown an increasing interest in environmental matters, including water quality. This is indicated by the enactment of the Clean Environment Act in 1968 (Statutes of Manitoba 1968, chapter 7),<sup>1</sup> and the revision of this Act in 1972 (S.M. 1972, c. 76). More recently (in 1976), a document entitled "Proposed Interim Objectives of Surface Water Quality" has been prepared by the Environmental Management Division of the Manitoba Department of Mines, Resources and Environmental Management.<sup>2</sup> Following the submission of this document, hearings were held by the Clean Environment Commission on June 27 and 28, 1977. The purpose of these hearings was

to receive evidence and representation concerning the proposed water quality objectives to assist the Commission to assess the significance and meaning of the objectives and their possible impact should they be adopted and applied to surface waters in Manitoba, and

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<sup>1</sup>Henceforth, Statutes of Manitoba shall be designated S.M., chapters shall be designated c. and sections as s.

<sup>2</sup>On October 20, 1978, this department became the Department of Mines, Natural Resources and Environment (Government of Manitoba, 1978).

to provide an opportunity for those who ... [wished] to express their opinions on the nature of the water quality objectives and on the feasibility and wisdom of applying them to water basins throughout Manitoba. (Manitoba Clean Environment Commission, 1977:1).

Following the hearings, the Clean Environment Commission prepared a report evaluating the proposed objectives, making the revisions deemed necessary on the basis of the information presented at the hearings. This report was submitted to the Minister of Mines, Resources and Environmental Management in May, 1978 (Ward, 1978). The Minister's decision as to the acceptance or rejection of the proposal is awaited. Subsequent to the acceptance of the proposal, further hearings are to be conducted to establish use classifications for Manitoba's surface waters (Manitoba Clean Environment Commission, 1977: 4).

Environmental criteria are important in determining the quality of life. The relationship between environment and quality of life was emphasized at the United Nations Conference on the Human Environment, held in Stockholm, Sweden in 1972 (Federal-Provincial Task Force, 1975: 1). The first principle set out at this conference states that:

Man has the fundamental right to freedom, equality and adequate conditions of life, in an environment of a quality that permits a life of dignity and well-being, and he bears a solemn responsibility to protect and improve the environment for present and future generations. (Federal-Provincial Task Force, 1975: 2).

The environment is recognized as being necessary for the quality of life, therefore, it must be preserved for future generations. In support of this recognition, the

Conference deduced a second principle which states that:

The natural resources of the earth including the air, water, land, flora and fauna and especially representative samples of natural ecosystems must be safeguarded through careful planning or management, as appropriate. (Federal-Provincial Task Force, 1975: 4).

One of the actions necessary to effect this principle is to control environmental pollutants. The sixth principle supports this by stating that:

The discharge of toxic substances or of other substances and the release of heat, in such quantities or concentrations as to exceed the capacity of the environment to render them harmless, must be halted in order to ensure that serious or irreversible damage is not inflicted upon ecosystems. The just struggle of the people of all countries against pollution should be supported. (Federal-Provincial Task Force, 1975: 5).

Canada played an important part in this Conference, and responded to the challenge of ensuring an environment supportive of a decent quality of life by establishing a Federal-Provincial Task Force to set out an approach to environmental action considering both the resolutions agreed upon at the Stockholm Conference, and environmental and resource issues of specific concern to Canadians (Federal-Provincial Task Force, 1975: 3).

Water is an important element of the environment, as it is necessary for industrial and agricultural processes, and is vital to sustain human, animal, and plant life. Consequently, maintaining and improving water quality is important in maintaining and improving the quality of the environment and hence the quality of life. Canada has recognized this through legislative action including the passage of the Canada Water Act in 1970 (Statutes of

Canada<sup>3</sup> 1972, c. 52), and the Environmental Contaminants Act in 1975 (S.C. 1975, c. 72). Additionally, the Fisheries Act has recently been made more applicable to environmental quality by the specific inclusion of fish habitat among the resources which should be protected (Canada Gazette 1977, Part 111 c. 35). The Canada Water Act is the most water oriented of the three, and emphasizes the relevance of water quality to Canadians. For example, included in the preamble to the Act is a statement that:

Pollution of the water resources of Canada is a significant and rapidly increasing threat to the health, well-being and prosperity of the people of Canada and to the quality of the Canadian environment at large and as a result it has become a matter of urgent national concern that measures be taken to provide for water quality management in those areas of Canada most critically affected. (S.C. 1970, c. 50).

Additionally, one of the recommendations of the Federal-Provincial Task Force is that the Canadian government

develop and adopt national ambient quality objectives for air and water and coordinate monitoring programs to collect data for the maintenance and protection of the environment. (Federal-Provincial Task Force, 1975: 12).

Furthermore, it is suggested that programs be developed to ensure compliance with these objectives, to eliminate the effect of contaminants and pollutants on man and the environment, and to develop and refine processes and facilities to control pollutants and contaminants (Federal-Provincial Task Force, 1975: 12).

The Canadian constitution as determined by the

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<sup>3</sup>Henceforth, Statutes of Canada shall be designated S.C.

British North America (B.N.A.) Act outlines the responsibilities of the federal and provincial governments. The provincial governments have the responsibility for works and undertakings within the province. The federal government is responsible for works which affect more than one province, or which are declared to be advantageous for more than one province (Government of Canada, 1967: s. 92-10). Water is not stationary, so projects and programs affecting its quantity or quality may have ramifications for more than one province. Also, as water is necessary for life, maintaining a high quality may be deemed to be important for the national welfare, another issue under the federal jurisdiction. For these reasons, the federal government's views pertaining to water and water quality are relevant to provincial programs and undertakings affecting water and water quality.

Having recognized the connection between environmental quality (specifically water quality) and quality of life, achieving an acceptable quality becomes a goal of the legislative branch of government. After extensive research and evaluation, a policy is developed and is expressed in a legislative Bill. Only after debate and revision by the legislators will the Bill be passed to become an Act, and therefore a basis of law. The Act usually authorizes a Minister of the Crown, or a government department under the authority of the Minister, to develop regulations or guidelines pursuant to the Act. These will expedite the admin-

istration of the Act. At this point, it should be possible to implement the policy previously established, and to begin achieving the goal of maintaining and improving water quality and thus the quality of life. The process of policy implementation is illustrated in Figure 1.

The evolution and implementation of guidelines and/or regulations has economic, political, technological, ecological and administrative ramifications. For example, the implementation of a subsidies program to encourage desired practices related to achieving water quality objectives will have very different economic implications than the establishment of an effluent surcharge.<sup>4</sup> The former involves some expenditure of government funds, probably in substantial amounts, in order to encourage the desired behaviour. The latter has the potential to bring in some revenue as charges are paid by those firms subject to the surcharge.

Water use is also a necessary consideration, as water can be utilized for many different purposes. Some of these uses may require water of a very high quality, while lesser quality may suffice for other purposes. Additionally, some users may produce wastes which are damaging to water quality. Upstream water usages may, therefore, have detrimental implications for downstream water users. In the context of Manitoba, wastes produced by the City of

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<sup>4</sup>Discussed further in Chapter 4.

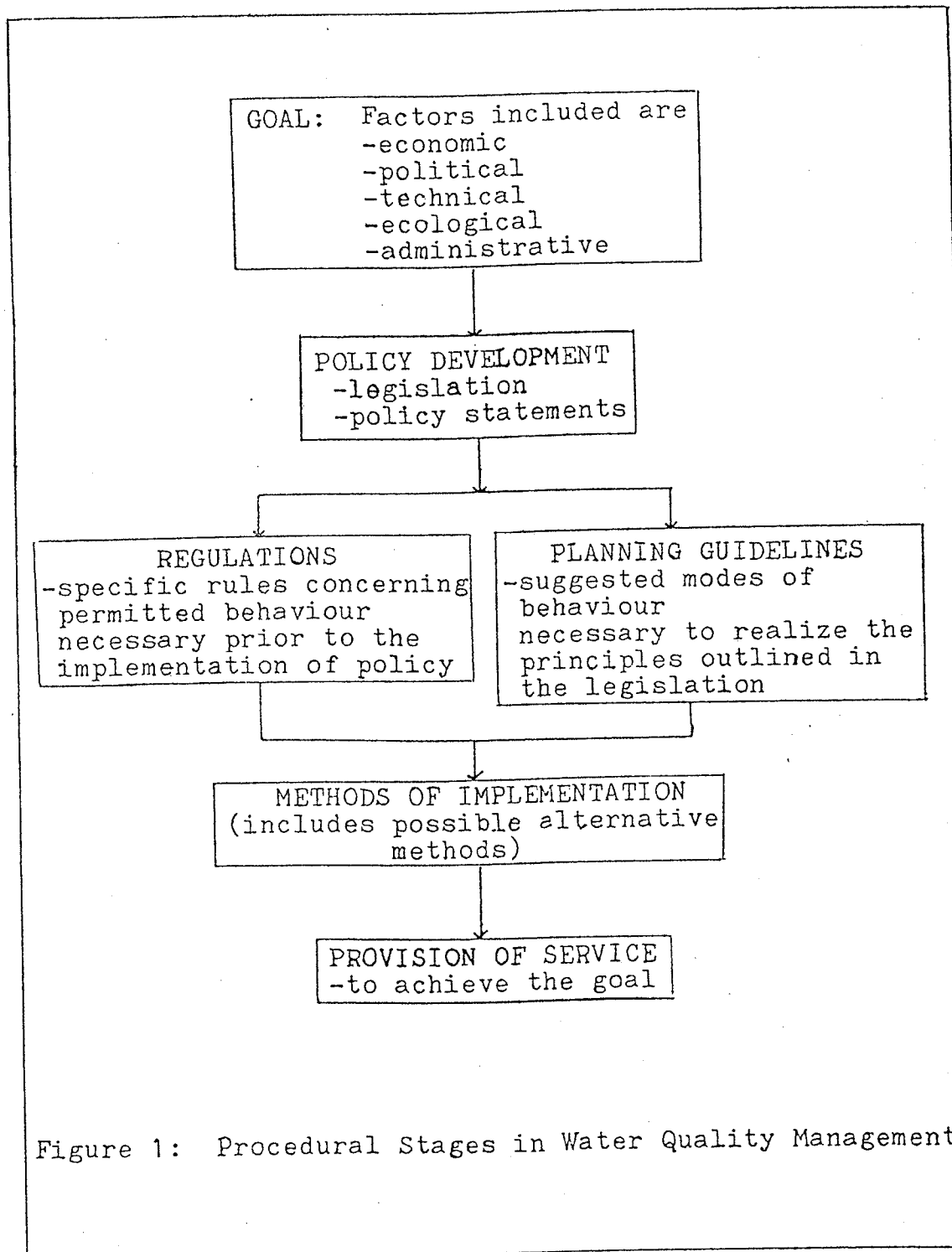


Figure 1: Procedural Stages in Water Quality Management



Winnipeg for example, are such that the downstream community of Selkirk requires more water treatment to make the river water suitable for consumption than would otherwise be the case (Ward, 1977). Location is also important because uses in different locations vary, and each use has a distinct effect on the quality of the water. For example, there is usually more industrial pollution in an urban area than in a rural area, but the latter is likely to experience considerably more agricultural pollution.

In Manitoba, one must consider the different problems of the North<sup>5</sup> and the South.<sup>6</sup> In the North, finding water of a quality suitable for domestic consumption is a serious concern. The waters throughout much of the area naturally have a high metal content (eg: zinc, copper), sometimes exceeding that deemed suitable for domestic consumption, because of the presence of natural ore bodies (Ward, 1978: 108). Pollution may result from the disposal of untreated wastes by small communities such as those on

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<sup>5</sup>According to the Northern Affairs Act, "'Northern Manitoba' means all that part of Manitoba north of the northern boundary of township 21 that is not included in

- (i) a wildlife management area or refuge designated as such under The Wildlife Act; or
- (ii) a provincial forest designated as such under The Forest Act; or
- (iii) a municipality of local government district; or
- (iv) any area designated by the Lieutenant Governor in Council for the purposes of the Act." (S.M., Continuing Consolidation, c. N100 s. 1k).

The approximate boundary is shown in Figure 2.

<sup>6</sup>South is considered to be that area south of the northern boundary of township 21.

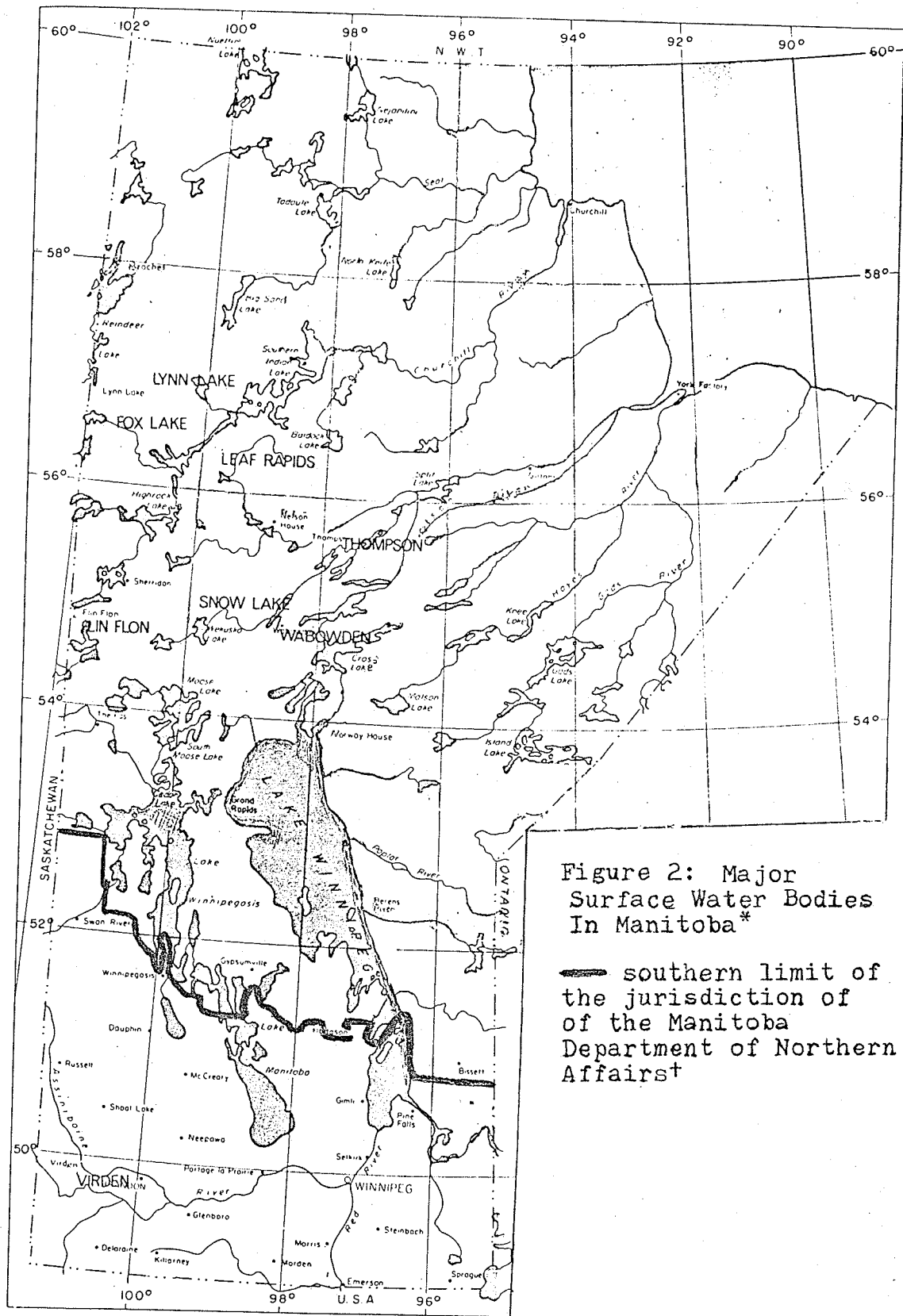


Figure 2: Major Surface Water Bodies In Manitoba\*  
 — southern limit of the jurisdiction of the Manitoba Department of Northern Affairs†

\* Source: Province of Manitoba, 1973: 107, Vol 1.  
 † Source: Manitoba Department of Northern Affairs, 1975.

Indian reserves, and from discharges from mining and forestry operations. Southern communities have, currently, no shortage of water suitable for domestic consumption. Here, pollution results from industrial processing and agricultural operations, as well as from the communities. The majority of these communities have some degree of waste treatment. The differences in the quality of community waste treatment generally reflect the differences in population density. The South has a larger and more concentrated population than the North. A larger population implies a larger tax base (as a general rule), and consequently larger communities can better finance sophisticated water and waste treatment facilities.

A goal regarding water quality in Manitoba was formulated with the passage of the 1968 Clean Environment Act. As expressed by Mr. Witney, then Minister of Health, in introducing the Bill to the Legislature for second reading:

The purpose of the Bill, ..., is to prevent the destruction or spoilage of the natural environment by excessive, harmful or dangerous contamination; and secondly, to ensure that in the years to come the environment will not be despoiled beyond recovery; and third, to make every possible allowance for the reasonable usage of air, soil and water resources of the province for the purpose of final and innocuous disposal of treated and conditioned effluence [sic] in such a way that industry will not be discouraged from entering the province. (Government of Manitoba, 1968: 1944).

The Act of 1972, which replaced the 1968 Clean Environment Act, retained many of the same principles but expanded upon them. In introducing the Bill to the Legislature for second reading, Mr. Evans, then Minister of Industry and Com-

merce, stated that:

The bill ... will enable the government ..., to make much greater strides in the future towards insuring that we live and our children and their children are able to live in an environment which is clean, which is suitable, which is healthy, which is adequate for the quality of life, the high quality of life and living we desire in the Province of Manitoba. (Government of Manitoba, 1972: 3594).

These sentiments express the Manitoba government's goal with respect to environmental quality, including water quality. The Clean Environment Act expresses Manitoba's policy in this regard. The legislation gives the responsible Minister (of Mines, Resources and Environmental Management) general supervisory powers and control over everything related to the preservation and improvement of the environment and to the prevention and control of environmental contamination (S.M. 1972, c. 76 s. 2-1). Both the goal and the policy making steps are authorized by the legislative body, the Manitoba Legislature. The next step requires the development of policy oriented regulations and/or guidelines.

The responsibility for guideline and regulation development is usually assigned to administrative bodies which operate under the authority of the Legislature. In Manitoba, the responsibility for water quality oriented guidelines and regulations is primarily held by two bodies. One of these is the Clean Environment Commission, a body consisting of at least three members appointed by the Lieutenant Governor in Council. The Commission currently has seven members, and its functions include issuing Orders

pertaining to the discharge of environmental contaminants. Additionally, the Commission is responsible for providing a forum through which the public may express opinions concerning the Orders and other environmental issues (S.M. 1972, c. 76). The other body is the Environmental Management Division of the Department of Mines, Resources and Environmental Management. It is responsible for enforcing the Commission Orders and regulations under the Act, as well as other functions pertinent to the maintenance and preservation of environmental quality.

Implementation of policy decisions is attained through application of guidelines and regulations. Since no single department controls all water oriented activity, the cooperation of all departments whose activities can affect water and water quality is necessary, if the goal is to be achieved.

Manitoba is in the process of developing policy guidelines pertaining to surface water quality in the province. The Clean Environment Commission held public hearings on the proposal in June 1977, and then prepared a report which has been presented to the Minister.

The proposed water quality objectives for Manitoba approach the problem of different requirements for different uses by classifying the water uses, and specifying distinct quality characteristics for each use. Each water body is to be assigned a water use classification. The proposed water quality objectives are defined in numerical

and descriptive terms for the following use categories: domestic consumption, fisheries and recreation, industrial consumption, agriculture and wildlife, navigation and waste disposal, and other uses. Water quality objectives are related to dissolved oxygen (DO), faecal coliform and total coliform counts, non-filterable residues,<sup>7</sup> toxic substances such as biocides,<sup>8</sup> temperature, pH values, and turbidity. As one progresses through the use classifications, from domestic consumption to navigation and waste disposal, the proposed surface water quality objectives become progressively less stringent (Manitoba Environmental Management Division, 1976).

Manitoba has a plentiful supply of water within its boundaries, approximately 13.5 percent of Canada's fresh water (Canada Year Book, 1977: 32). This water is found as surface water in bodies such as lakes, rivers and streams as illustrated in Figure 2 (page 9), and as ground water which is obtained from pumped wells or free flowing artesian wells tapping the sub-surface sources.

Manitoba's water resources are used in rural areas for domestic consumption, for livestock watering, and to a limited extent, for irrigation. Towns and other population centres use water for drinking and other domestic purposes,

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<sup>7</sup>Non-filterable residues are suspended solids.

<sup>8</sup>Biocides include pesticides, herbicides, insecticides, and other chemical agents used to destroy living organisms.

and for sewage dilution and treatment. Corporations such as Manitoba Hydro use water to generate hydro-electric power and as cooling water for thermal generating stations. Industries use water for waste dilution and for other purposes within the industrial process. The water resources support the operation of such industries as commercial fishing. Additionally, the waters are important for tourism, and are aesthetically valuable. For each of these uses, minimum quality characteristics are desired for the water, with some uses having more stringent quality requirements than others.

Manitoba does not currently have an overall shortfall in the quantity of water available, though there may be deficiencies in specific local areas, and at certain times of the year (Ward, 1977). Water quality is a concern because of the wide variety of purposes for which water may be required, and because one use may have detrimental effects on another. Water used for sewage dilution may acquire disease bearing organisms making the water unsuitable for domestic consumption downstream, without fairly extensive treatment.

Management of water can prevent some of these conflicts and can generate a solution where conflicts do arise. A sufficient quantity of water with desirable quality characteristics is necessary for a good quality of life. Thus, managing water to ensure that the desired water quality characteristics are achieved is a pertinent

goal in Manitoba.

### Problem Statement

Policy and policy implementation concerning water quality in Manitoba is the primary focus of this practicum.

Managing water to achieve a desirable water quality is a complex procedure. Policy must be designed so that the administration of implementation procedures is feasible. The management techniques must be sufficiently flexible to adapt to changing circumstances and to meet the needs of different users. These attributes are necessary if the program is to be effective in achieving the goals established by policy.

In considering the administrative process for implementing water quality objectives (planning guidelines), a discussion of the water related legislation and policy is necessary. The way the policy evolved must also be considered, as this facilitates an understanding of what the legislators are attempting to achieve. Once the policy is understood, it is possible to discuss the proposed water quality objectives for this province, and to determine the feasibility of achieving the goals for water quality within the province.

### Objectives

The objectives of this practicum are:

- (1). to examine the historical development of water qual-



ity policy in Manitoba;

(2). to identify institutions and administrative entities involved in implementing water quality objectives and planning guidelines in Manitoba, and to determine the role they fill;

(3). to identify and discuss techniques of implementing water quality objectives;

(4). to discuss the proposed water quality objectives in Manitoba, and to examine the feasibility of their implementation in terms of: administration, technical procedures, and equitability; and,

(5). to make recommendations concerning ways to facilitate the implementation of water quality objectives.

#### Glossary of Terms

Criteria: Criteria are

scientific requirements on which a decision or judgement may be based concerning the suitability of water quality for the preservation of the aquatic environment and/or to support designated use(s). Criteria are descriptive expressions of the effects that are expected to occur whenever or wherever a detrimental factor and/or pollution reaches or exceeds a specific level for a specific time. (Canada Inland Waters Branch, 1972: 2).

Environment: An environment includes

the conditions under which any person or thing lives or is developed; the sum-total of influences which modify and determine the development of life or character. (Oxford University, 1971: 880).

As such, an environment is considered to include both the natural and man-made environment.

**Firm:** This is considered to be any municipality, industry or other body which discharges effluents or whose activities can be considered to contribute to the degradation of water quality.

**Objectives:** "Objectives are desirable levels of water quality to be obtained in either short-term or long-term resource management programs" (Canada Inland Waters Branch, 1972: 2).

**Pollution:** This is considered to be

Any alteration of the chemical, physical or biological quality of waters which results in an unacceptable depreciation of its utility or environmental values. (Fish, 1973: 20).

**Standards:** "Standards are legally prescribed limits of pollution and/or deterioration which are established under statutory authority" (Canada Inland Waters Branch, 1972: 2).

**Water Quality:** Water quality is determined by analysis of the chemical, biological and physical characteristics of water. Water quality is considered to have deteriorated or to have been degraded when utility or environmental values have been deleteriously affected.

### Procedure

The information used in this practicum is derived from a review of the literature dealing with water quality and water management practices. Much of the data is obtained from government documents. Interviews conducted

with knowledgeable persons proved invaluable. The information is presented and analyzed in such a way as to fulfill the objectives previously outlined.

#### Scope of the Study

This study is limited to surface waters in Manitoba in recognition of the orientation of the proposal for water quality objectives produced by the Environmental Management Division. Ground water is not considered in the proposal, thus is outside the scope of this study.

There is no in-depth examination of potential health implications related to water quality.

International and interprovincial water quality concerns as they effect Manitoba are mentioned only briefly.

This study does not include a discussion of the specific techniques of water treatment applied prior to domestic consumption, nor of waste treatment prior to effluent discharge. The methods of chemical and biological analysis used in determining water quality are not examined.

An economic analysis, determining the costs and benefits of implementing surface water quality objectives, is considered to be beyond the scope of this study.

## Chapter 2

### HISTORY OF WATER QUALITY POLICY IN MANITOBA

#### Provincial Legislation<sup>1</sup>

The first water quality control legislation in Manitoba was passed in 1871. The legislation was entitled "An Act to Prevent the Deposit of Manure on Banks of Rivers and Streams" (S.M. 1871, c. 28), and was referred to as the Sanitary Act. Later, the title was changed to "An Act to Prevent the Pollution of Rivers and Streams" (C.S.M.<sup>2</sup> 1880, c. 21), and in 1891 it was retitled to become "An Act Respecting Pollution of Rivers and Streams", with a short title "The Pollution of Streams Act" (R.S.M.<sup>3</sup> 1891, c. 118). As the original title suggests, the primary purpose of the Act was to prohibit the deposit of "any stable or barn manure, or any night soil, or any other filthy or impure matter of any kind, along the bank of any river or running stream" (R.S.M. 1891, c. 118 s. 3). The prohibition applied within fifty feet of the normal high water

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<sup>1</sup>The legislation is summarized in Figure 3 (page 37).

<sup>2</sup>C.S.M. refers to Consolidated Statutes of Manitoba.

<sup>3</sup>R.S.M. refers to Revised Statutes of Manitoba.

mark. The Act also served to prevent such "filthy and impure matter" from being dumped into the rivers and streams.

This was the only anti-pollution legislation in force in Manitoba until 1905, when An Act for Protecting the Public Interest in Rivers, Streams and Creeks, was passed by the Legislature (S.M. 1905, c. 43). This Act allowed any individual to float timber, rafts, or other craft down rivers, creeks and streams, but forbade the placing of obstructions in or across those channels. It also forbade the owners or occupiers of sawmills from depositing sawdust, waste wood, and other milling wastes in those watercourses. The legislation thus served to regulate the disposal of some of the more visible forms of water pollution.

The Revised Statutes of Manitoba of 1913 contained a piece of legislation called "The Rivers and Streams Act" (R.S.M. 1913, c. 173). The legislation was a consolidation of the two Acts described above, plus one concerned with river navigation. There was no significant change in the intent of the legislation.

In 1935, the sections on pollution were removed from The Rivers and Streams Act, and were included in a separate piece of legislation, The Pollution of Waters Prevention Act (S.M.. 1935, c. 34), which was created concurrently.

The Rivers and Streams Act retained the provisions

concerning the right to float materials along the water courses, prohibitions about obstructing watercourses, conditions affecting improvements made to water courses, and provisions concerning steamboats and ferries. In 1951, the Legislature added a section on river channel protection (S.M. 1951, c. 51) to regulate construction and anything else which might endanger the stability, or cause the slippage of banks of rivers, streams or other watercourses. With these provisions, there was some protection against bank erosion and hence sedimentation of the watercourses. Since the addition of these clauses, the Rivers and Streams Act has remained basically unchanged.

The Pollution of Waters Prevention Act (S.M. 1935 c. 34) broadened the definition of pollution materials subject to provincial control. Substances such as decaying matter, lime, chemical substances, drugs, poisonous matter, and garbage were added to the class of 'filthy and impure matter' which was not to be deposited on the banks<sup>4</sup> of, or into any body of water.

Shortly after the passage of the pollution control legislation the Finlayson Commission report was published. It recommended the strict enforcement of that section of The Land Drainage Act requiring that the strip of land on the side of the ditch where there is no dump, be seeded

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<sup>4</sup>A bank was considered to be any area within two chains (132 feet) of the normal high water mark (S.M. 1935, c. 34 s. 3).

down, and kept seeded down, to a minimum of seventy-five feet in width (Finlayson, 1936: 65). Prevention of soil erosion reduces siltation in natural water courses. Agricultural soil contains residues of pesticides, fertilizers, and other chemicals used on crops. When this soil drifts into drains, and is subsequently washed into streams, rivers and other water bodies, the chemical residues are introduced into those waters. Water run-off from farm lands also contains these materials, but controlled erosion along drainage ditches would help to limit the influx of the contaminants into water bodies. Thus, this recommendation of the Finlayson Commission served to re-enforce the provisions of The Pollution of Waters Prevention Act concerning the deposit of chemical substances into provincial waters.

The Pollution of Waters Prevention Act allowed for the formation of a Provincial Sanitary Control Commission consisting of at least three persons appointed by the Lieutenant Governor in Council. The duties of this body included "general supervision and control over all matters concerning pollution of, or the discharge or draining of sewage and waste into any body of water" (S.M. 1935, c. 34 s. 13). The Commission received the power to conduct investigations concerning polluting activities and sewage discharges, and the power to order the abatement, control or halting of such actions. It was also authorized to issue licences permitting certain prescribed levels of

drainage or discharge of wastes into water bodies.

The Commission could authorize the formation of sewage districts if a municipality or group of municipalities wished to regulate the disposal of their waste materials. As stated in the Act:

The general purpose and objective of a district incorporated under this Act shall be to promote public health and welfare and prevent pollution by providing an adequate and efficient system of regulation, collecting, conveying, pumping, treating and disposing of all sewage and wastes within the area of the district, so that the pollution resulting from the discharge or draining thereof into any body of water will be so reduced or prevented that such body of water will not be or become a nuisance or offensive or injurious to the health or welfare of the inhabitants of the district. (S.M. 1935, c. 34 s. 30).

To meet these aims, the district could construct or acquire sewage disposal systems within its territory and could improve, maintain and manage such systems. Subject to the authorization of the Commission, the district could prohibit, regulate and control the discharge of sewage or waste, by any person, into sewers or water bodies within the district, and could require the material to be treated before being discharged or that the discharge be discontinued. The district could also "prescribe and enforce regulations for the supervision, protection and management of the sewage disposal works as it ... [might] deem expedient ..." (S.M. 1935, c.34 s.32).

The pollution control legislation was passed partly because of a perceived need to reduce the pollution in the province's river systems, particularly in the Red River. This contamination problem was the result of an extended



period of drought which seriously reduced the flow of waters, and thus reduced their assimilative capacities. Another reason for this form of legislation, allowing for the formation of sewage districts, was that sewage treatment facilities would then be eligible for funding under federal unemployment relief programs (Booy, 1975: 132, 133).

In 1935, The Greater Winnipeg Sanitary District Act was passed (S.M. 1935, c. 80). The intent of this Act was to control water pollution in the City, resulting from the discharge of sewage and waste. An influential factor in the formation of this district, reported by the Winnipeg Free Press, was that by the early 1930's the discharge of raw sewage into the Greater Winnipeg area's rivers had created "virtually intolerable" levels of pollution (September 13, 1971: 1). Increases in population and in industrial activity, combined with the low water flows during the early 1930's created a situation where the flow of sewage was almost equal to the flow of the Red River (Penman, 1971: 2).

The Winnipeg Sanitary District was to be subject to all of the provisions of The Pollution of Waters Prevention Act, except where inconsistent with The Greater Winnipeg Sanitary District Act (S.M. 1935, c. 34 s. 46). These provisions effectively exempted the City of Winnipeg from provincial water pollution control, leaving it free to set its own regulations.

An impediment to the effectiveness of both these

pieces of legislation in controlling water pollution was the fact that membership in a provincial sewage district or in the Winnipeg Sanitary District was optional (S.M. 1935, c. 34 s. 22; Newman, 1978). Many municipalities chose not to belong to a district.

With the passage of The Metropolitan Winnipeg Act in 1960 (S.M. 1960, c. 40), political division among the municipalities was reduced. Cooperation in the matter of sewage treatment became possible (Newman, 1978). This kind of cooperation did not become evident in the provincial sewage districts. In 1972, the province began to assume direct responsibility for municipal sewage treatment through the provisions of The Manitoba Water Services Act (S.M. 1972, c. 72). With the passage of this Act, the Province began to provide financial and technical assistance to municipalities, for the provision of sewage collection, treatment and disposal services.

The Pollution of Waters Prevention Act remained in effect until 1968, when it was repealed and replaced by The Clean Environment Act (S.M. 1968, c. 7). Both Acts focussed on the regulation and control of pollution. The Clean Environment Act was more general than the earlier Act, however, in that it was not restricted solely to water pollution. The pollution of air, water and soil was prohibited. The new Act did not require the formation of districts to implement pollution control. The intent was to prohibit the contamination of the physical environment

without a "valid and subsisting licence" (S.M. 1968, c. 7 s. 2-1,3-1,4-1). The Clean Environment Act was designed to ensure that the entire physical environment be protected from contamination, not just the provincial waters. Consequently, more comprehensive protection was granted to the waters. Pollutants can be carried by air and settle on the waters, thus contributing to water pollution. Soil pollutants can also be carried to the water, through surface run-off and erosion. The Act permitted much greater scope for pollution control as it allowed recognition of the holistic nature of the physical environment.

An administrative tool for regulating a particular aspect of soil pollution, and thereby water pollution, was created in 1963 with the passage of The Pesticides Control Act. This Act required that all distributors and vendors of pesticides acquire licences to operate (S.M. 1963, c. 58). Thus, the provincial government could control the pesticides offered in the market. The legislation was broadened in 1976, when The Pesticides and Fertilizers Control Act replaced The Pesticides Control Act (S.M. 1976, c. 19). Pesticides are intrinsically biocides, and are, therefore, more immediately deleterious to water quality than fertilizers. Both pesticides and fertilizers, however, can contribute to water pollution if they are carried from the land by water run-off or by soil erosion. Pesticides can kill or harm aquatic organisms directly. Fertilizers can stimulate aquatic plant growth which dies and

is biodegraded using the waters' dissolved oxygen that would otherwise be available for use by other organisms.

In 1972, a new Clean Environment Act was enacted (S.M. 1972, c. 76). This revised the provisions of the old Act so that licences were no longer required by dischargers. Henceforth, releasing contaminants in excess of prescribed limits was prohibited (S.M. 1972, c. 76 s. 5). This change may have been partly due to the negative connotations evoked by the phrase 'licences to pollute'. The new Act retained provisions allowing exemptions from the regulations where sufficient reason was shown.

A significant change in the general powers of the Clean Environment Commission, a body consisting of at least three members appointed by the Lieutenant Governor in Council, was made in the new Clean Environment Act. In 1968, the Commission had general supervisory powers and control over all matters related to the preservation of the natural environment, and the prevention and control of any environmental contaminants. Additionally, it could investigate any matter respecting the contamination of the environment, and could summon witnesses and take evidence in the course of any investigations (S.M. 1968, c. 7 s. 11,12). The 1972 Act revised these powers such that:

The commission ... [might], unless otherwise directed by the minister, for the purpose of carrying out its duties and functions under the Act, investigate any matter respecting the environment and for that purpose hold such hearings as it ... [deemed] advisable. (S.M. 1972, c. 76 s. 13-1).

With these changes, the scope of the Commission's

responsibility was limited to this body. The 1968 Act had made it responsible for the environment. All municipalities, industries or other bodies doing anything that could in any way affect the environment had been required to apply to the Commission for a licence to undertake that activity. This licence could be either granted entirely, granted conditionally, or refused. The 1972 Act removed responsibility for the environment from the Commission, and gave it to the Minister (S.M. 1972, c. 76, s. 2-1). The Commission could no longer grant licences permitting or refusing development. It was restricted to setting limits, where the existing regulations did not cover the situation, on the amounts of contaminants which could be released into the environment (Ward, 1977). The Commission had the power to grant Orders permitting operations where the limits were met. Sanctions could be imposed upon firms which did not comply with the Orders. The Commission could suspend or vary an Order in whole or in part, and could issue Orders prohibiting further polluting activity by persons or firms deemed to be contaminating the environment (S.M. 1972, c. 76 s. 14-5,7,8,17).

The 1972 Act added to the Lieutenant Governor's powers regarding environmental matters.

The Lieutenant-Governor in Council ... [might] for environmental reasons restrict or limit the number of industries, undertakings, plants or processes that ... [might] be permitted to be operated in the province, or any part thereof for such periods of time as ... [might] be [deemed] advisable. (S.M. 1972, c. 76 s. 13-2).

In both versions of the Act, the Lieutenant Governor had

the power to make regulations ancillary to those stated in the Act, for the purpose of fulfilling the goals of the Act. Among the possible regulations were provisions respecting the treatment of contaminants prior to their discharge, emission or release, and provisions prescribing the limits of the amount and concentration of contaminants permitted to be discharged, emitted or released (S.M. 1968, c. 7 s. 19-1; S.M. 1972, c. 76 s. 18). These powers remain unamended.

The Clean Environment Act, as first enacted, specifically exempted Metropolitan Winnipeg from the authority of the Act (S.M. 1968, c. 7 s. 4-2), following the precedent set by The Pollution of Waters Prevention Act. Control of emissions and discharges into or onto surface waters within the boundaries of Metropolitan Winnipeg was left under the authority of the City. The 1972 Clean Environment Act allowed the Lieutenant Governor to

delegate such part of the powers of the [clean environment] commission as he ... [deemed] advisable to The City of Winnipeg for such period of time and subject to such conditions as he ... [might] deem fit. (S.M. 1972, c. 76 s. 12-1).

Order in Council #152, passed on February 2, 1972 actualized the exemption by giving the City all the powers held by the Metropolitan Corporation regarding sewage disposal (Part VIII of The Metropolitan Winnipeg Act) subject to the conditions that the Clean Environment Commission might make investigations pertaining to environmental contamination, and that the City provide the Commission with regular

reports concerning discharges into waters within the city boundaries (Government of Manitoba, 1972). This exemption makes the Winnipeg City Council responsible for all discharges into any waters within the city. The City, however, must meet the requirements of federal legislation regarding its waters, as the federal Acts do not provide such exemption.

The Manitoba government is currently attempting to establish objectives for surface water quality under the aegis of The Clean Environment Act. If the proposed program is accepted, Orders in Council will be passed to give the Environmental Management Division, which operates under the authority of the Act, the authority to implement pertinent guidelines and regulations. The administrative sections of government then will have another instrument for implementing water pollution control in Manitoba.

#### Federal Legislation<sup>5</sup>

The federal government also has legislation pertaining to water quality in Manitoba. Related to this is the document entitled Canadian Drinking Water Standards and Objectives, 1968 (Canada Department of National Health and Welfare, [1968]). The proposed objectives for Manitoba's surface water quality recognize these standards and

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<sup>5</sup>The legislation is summarized in Figure 3 (page 37).

objectives, in that municipal water supplies are expected to meet federal specifications (Manitoba Environmental Management Division, 1976: 4).

The Canada Water Act (S.C. 1970, c. 52) is concerned with Canadian water conservation and water quality. This Act was originally placed under the authority of the federal Minister of Energy, Mines and Resources (S.C. 1970, c. 52 s. 2i). With the reorganization of the Government in 1970, however, authority was transferred to the federal Minister of the Environment (R.S.C. 1970 2nd supplement, c. 14 s. 30). The Canada Water Act gives the responsible Minister the power to enter into agreements with provincial governments concerning water quality management, where the matter is of "urgent national concern" (S.C. 1970, c. 52 s. 9), and to designate certain areas as water quality management areas. Waters within areas under federal jurisdiction, and waters which cross provincial boundaries may also be so declared. The water quality management programs instituted may be cost-shared with the province or provinces within which the management areas fall. Within these areas, management agencies are responsible for: determining the nature and quantity of waste in the water; forecasting amounts and kinds of waste likely to be added in the future; recommending water quality standards for those waters, required treatments, estimated costs, and other details of a water quality management plan (S.C. 1970, c. 52 s. 13-1). No management areas have yet been proclaimed



within Manitoba. Studies have been conducted, however, under the authority of the Canada Water Act. These include the Lake Winnipeg, Churchill and Nelson Rivers Study, and the Souris River Basin Study. It is probable that joint federal-provincial management programs for these basins will be developed (Gavin, 1978).

The Environmental Contaminants Act (S.C. 1975, c. 72) prohibits the release of substances classified as being potentially dangerous to human health or the environment, in excess of prescribed amounts, and gives the Governor-General in Council the power to set the permitted maximum quantity or concentration. Substances may also be banned. Contravention of the regulations is subject to prosecution under the Act. The government is currently enacting regulations. On September 14, 1977 the Chlorobiphenyl Regulations #1, which proscribe particular uses for chlorobiphenyls, were promulgated (Canada Gazette, 1977 Part II: 4229). On February 4, 1978, the Canada Gazette published the "Proposed Order and Regulations respecting Dodecachloropentacyclo(5.3.0.0<sup>2</sup> 6.0<sup>3</sup> 9.0<sup>4</sup> 8)decane", commonly known as mirex (Canada Gazette, 1978 Part I: 608), and on April 1, 1978, "Proposed Order and Regulations respecting Polybrominated Biphenyls" (Canada Gazette, 1978 Part I: 1916). For both of these, the regulation provides for banning commercial, manufacturing and processing uses. It is expected that these regulations will soon be ratified. Additionally, a CBC radio report on November 25, 1978 announced

that polychlorinated biphenyls will be banned for most purposes as of January 1, 1979.

Recently, amendments have been made to the Fisheries Act, specifying the responsibility of the Minister of Fisheries and Environment to preserve fish habitat as well as the fish themselves (Canada Gazette, 1977 Part III, c. 35). Thus, this Act becomes much more directly applicable to the environment.

Other federal legislation with less immediate implications for water quality include the Clean Air Act, the Pest Control Products Act, the Fertilizers Act, and the Navigable Waters Protection Act.

The Clean Air Act allows the government to regulate the amount and concentration of contaminants which may be emitted into the air (S.C. 1970-71-72, c. 47 s. 31). As air-borne contaminants can settle on the water, controlling air quality is indirectly relevant to water pollution control.

The Pest Control Products Act requires that all pesticides manufactured in, or imported into, Canada for sale or distribution must be registered, and must meet prescribed standards (S.C. 1968-69, c. 50 s. 5). Since pesticides are poisons they can be deleterious to water quality. As they are found on the soil surface after application, they will be carried to the water through run-off and erosion.

The Fertilizers Act requires that all fertilizers

brought into the country be registered and meet the prescribed standards (R.S.C. 1970, c. F-9 s. 3). Fertilizers can act as pollutants in water as they stimulate plant growth. When the plants die, biodegradation begins, a process which consumes dissolved oxygen. Thus, the oxygen available for other organisms is reduced. Fertilizers can also be toxic directly, if they are present in sufficiently large quantities.

The Navigable Waters Protection Act requires that no structure be placed "in, upon, over, under, through or across any navigable water" (R.S.C. 1970, c. N-19 s. 5-1) without Ministerial approval. Controlling construction helps to control erosion and hence sedimentation of the waters. Also, the Act prohibits dumping anything into waters that might in any way hinder navigation "in any water, any part of which is navigable or which flows into any navigable water" (R.S.C. 1970, c. N-19 s. 19,20). Dumping of floating material into water is thereby prohibited, which regulates visible pollution. Also prohibited is the dumping of wastes which could collect on the stream or river bed in such a manner as to change the flow characteristics of the water course.

The International Boundary Waters Treaty of 1909 was established to mediate the uses of water bodies which flow across the American-Canadian border. It was agreed that neither country would act to reduce the quantity or quality of water on the other side of the border. With

specific reference to water quality, the treaty states:

that the waters defined as boundary waters and waters flowing across the boundary shall not be polluted on either side to the injury of health or property on the other side. (R.S.C. 1970, c. I-20 Schedule-Article IV).

Any works to be implemented which would affect the flow of boundary waters were to be investigated by the International Joint Commission (IJC), whose formation the treaty required. Uses of boundary waters were ranked so that preference would be given as follows: first to uses for domestic and sanitary purposes; second for navigation and the servicing of canals for navigation; and finally for power and irrigation purposes. A provision was included which exempted water uses whose existence preceeded the treaty from the ordering process.

The International Joint Commission was formed with the enactment of the International Boundary Waters Treaty Act in 1911 (S.C. 1911, c. 28), which confirmed the previously signed treaty. The Act is relevant to the management of Manitoba's waters because the treaty specified that one country was not to pollute or contribute to the pollution of the waters of the other. Study boards, under the jurisdiction of the Commission, have been created to investigate international water problems associated with a number of Manitoba's rivers. These boards and their roles will be discussed further in Chapter 3.

### Epilogue

Many pieces of legislation are available, both

provincially and federally, which are (or can be) oriented towards the maintenance and enhancement of the quality of water available to Manitobans. This potential is realized through the actions of the administrative bodies which are responsible for the implementation of policy and the enforcement of regulations.

Figure 3: Summary of Legislation

A. Provincial

- 1871
  - An Act to Prevent the Deposit of Manure on the Banks of Rivers and Streams (Sanitary Act)
- 1880
  - An Act to Prevent the Pollution of Rivers and Streams :retitling of Sanitary Act
- 1891 (consolidated)
  - An Act Respecting the Pollution of Rivers and Streams :replaces Act of 1880
- 1905
  - An Act for Protecting the Public Interest in Rivers, Streams and Creeks
- 1913 (revised)
  - The Rivers and Streams Act :consolidates the 1891 and 1905 Acts into one
- 1930
  - The Manitoba Natural Resources Act
  - The Water Power Act
  - The Water Rights Act
- 1935
  - The Pollution of Waters Prevention Act :repeals and replaces 'pollution' section of Rivers and Streams Act
  - The Greater Winnipeg Sanitary District Act
- 1951
  - An Act to Amend the Rivers and Streams Act
- 1959
  - The Department of Agriculture and Immigration Amendment Act, 1959
- 1960
  - The Metropolitan Winnipeg Act
- 1963
  - The Pesticides Control Act
- 1968
  - The Clean Environment Act

- 1972
  - The Manitoba Water Services Act
  - The Clean Environment Act :repeals and replaces 1968 Act
- 1974
  - The Northern Affairs Act
- 1976
  - The Pesticides and Fertilizers Control Act :repeals and replaces 1963 Act
- B. Federal
  - 1911
    - International Boundary Waters Treaty Act
  - 1968-69
    - Pest Control Products Act
  - 1970
    - Canada Water Act
  - 1970 (revised)
    - Fertilizers Act
    - Government Organization Act
    - Navigable Waters Protection Act
  - 1970-71-72
    - Clean Air Act
  - 1975
    - Environmental Contaminants Act
  - 1977
    - An Act to Amend the Fisheries Act

## Chapter 3

### ADMINISTRATION AFFECTING WATER QUALITY IN MANITOBA

The administrative component of any organization is important as this section implements policy decisions. This is as true in government as in any other organization. Consequently, an understanding of the functions of the administrative bodies with duties related to water and to water quality is necessary. These bodies, and their respective functions regarding water and water quality, are summarized in Figure 4 (page 79).

#### Manitoba Department of Mines, Resources and Environmental Management<sup>1</sup>

In Manitoba, the primary administrative responsibility for water is held by the Department of Mines, Resources and Environmental Management. The Department has been responsible for water use since 1930. At that time, The Natural Resources Transfer Agreement was ratified by

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<sup>1</sup>Order in Council #991, passed October 20, 1978 changed the title of this department to Mines, Natural Resources and Environment. Parks and Renewable Resources are now part of its responsibilities (Government of Manitoba, 1978). Administrative changes are expected to follow.

the passage of The Manitoba Natural Resources Act, and the Province acquired control over all land resources in the province (S.M. 1930, c. 30). Responsibility for surface water use and development was given to the Province by The Water Rights Act (S.M. 1930, c. 47) and The Water Power Act (S.M. 1930, c. 46).<sup>2</sup> The exception is the period between 1959 and 1966 when the responsibility for water rested with the Department of Agriculture (S.M. 1959, c. 4), and the period between 1966 and 1968 when it rested with the Department of Highways (Manitoba Department of Highways, 1966-1967: 3; and 1967-1968: 3).

The Department of Mines, Resources and Environmental Management did not gain responsibility for the environment, and thus for water quality, until 1971. The Department acquired this responsibility when the Environmental Sanitation Section of the Department of Health and Social Development was transferred to the Department of Mines, Resources and Environmental Management (Manitoba Department of Mines, Resources and Environmental Management, 1972: 17). At the same time, the Minister responsible for that department assumed responsibility for the Clean Environment Commission, which previously, also had been the responsibility of the Minister of Health and Social Welfare (Manitoba Department of Mines, Resources and Environmental

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<sup>2</sup>Responsibility for ground water was not specifically included in The Water Rights Act until 1959 (S.M. 1959, c. 4 s. 47).



Management, 1972: 17; Manitoba Clean Environment Commission, 1971: 3,4).

Environmental Management Division. This Division of the Department of Mines, Resources and Environmental Management has administrative responsibility for the environment, and hence for water quality.

[Its] mandate ... [requires] continuing service to the Department of Health and Social Development with regard to 28 regulations under the Public Health Act and the provision of almost all the technical services required by the Clean Environment Commission. (Manitoba Department of Mines, Resources and Environmental Management, 1972: 22).

The Environmental Management Division serves to collect relevant information pertaining to the environment through such procedures as monitoring the water quality of water bodies. It administers and enforces regulations established under The Clean Environment Act, and administers and enforces the Orders of the Clean Environment Commission issued under the same Act. The Division provides support services to the Environmental Assessment and Review Agency, and to the Manitoba Environmental Council, and provides information services to the public (Manitoba Department of Mines, Resources and Environmental Management, 1977: 11).

Matters of primary concern include the provision of safe water supplies ... the disposal of waste materials, maintenance of a non-hazardous environment and the preservation of the natural environment in keeping with advancing social and economic development. (Manitoba Department of Mines, Resources and Environmental Management, 1976: 15).

The Division has a number of distinct sections

including Research, Development and Environmental Studies, and Environmental Control and Waste Management. Prior to the late summer of 1977, Research and Development was a Branch separate from Environmental Studies, and Waste Management was distinct from Environmental Control. The responsibilities were overlapping, however, so they were merged into two branches (Ward, 1978). Two other branches in the Division are Program Development and Review, and Environmental Assessment and Review.

Research, Development and Environmental Studies has the responsibility for conducting research on environmental topics and recommending actions and programs for implementation. Additionally, it reviews and evaluates research proposals. The Branch conducts studies to collect limnological information and to determine the environmental effects of development proposals and projects. The results of the investigations and research are used in the environmental assessment and review process where applicable (Manitoba Department of Mines, Resources and Environmental Management, 1977: 12,13). The research results can also be significant inputs into policy and program development concerning water quality.

The duties of the Environmental Control and Waste Management Branch include developing environmental regulations, and enforcing those regulations, as well as enforcing the Orders of the Clean Environment Commission. The Branch develops standards and procedures for environmental

monitoring, and provides technical advice. It also develops and promotes new methods of managing wastes, including recycling procedures both to reduce wastes and conserve resources (Manitoba Department of Mines, Resources and Environmental Management, 1974: 16,14). The Branch contains a section which is responsible for water pollution control and which "aims to protect and enhance Manitoba's water resources for the broadest possible range of effective use" (Manitoba Department of Mines, Resources and Environmental Management, 1977: 19). This section has several programs including:

(1) the water quality program, which requires stream monitoring to determine existing water quality and whether the quality is being improved or degraded;

(2) the municipal water and wastewater treatment program, which involves technical and environmental evaluations of wastewater systems. Subsequent to the evaluations, recommendations are made concerning discharge limits for wastes being deposited into natural water bodies and suggesting schedules for compliance. Monitoring and evaluating municipal water supplies and treatment facilities is another duty under the program; and,

(3) the industrial pollution abatement program, which requires the monitoring of industrial effluents. The intention is to reduce harmful and potentially harmful discharges into Manitoba's waters. (Manitoba Department of Mines, Resources and Environmental Management, 1977:



19-21).

Program Development and Review is responsible for a number of activities including: the development of new programs; the assessment of existing legislation and the review of existing programs; and, the provision of a contact point between the Environmental Management Division and other agencies and departments (provincial and non-provincial) interested in the environment (Manitoba Department of Mines, Resources and Environmental Management, 1977: 26). The Branch is also responsible for the development of environmental quality objectives (Ward, 1978).

The Environmental Assessment and Review Process "ensures that all proposed provincial projects which may cause significant environmental impact are subject to a comprehensive environmental review" (Manitoba Department of Mines, Resources and Environmental Management, 1977: 27). The Agency which administers the Process is responsible for reviewing all proposals for new projects sponsored by provincial government agencies, and proposals specifying major alterations to existing facilities. An environmental assessment may be recommended where there is deemed to be a possible significant effect on the environment. Guidelines for the impact assessment are provided. The impact assessment statements are reviewed and if necessary, further procedural guidelines are recommended to assist in identifying and mitigating adverse environmental impacts. All reviews and recommendations are then submitted to the

Cabinet which may permit, modify or disallow a proposed undertaking (Manitoba Department of Mines, Resources and Environmental Management, July 1976: 3). Public hearings may be held prior to a Cabinet decision regarding the proposal (Manitoba Department of Mines, Resources and Environmental Management, 1977: 28). This procedure allows some control over development projects (sponsored by provincial government agencies) which may have deleterious effects on water quality, or on other aspects of the environment.

Clean Environment Commission. This is another body with duties related to the environment, including the quality of water. The Commission is structurally separated from the Department of Mines, Resources and Environmental Management, though it is under the jurisdiction of the Minister of that Department. The activities of the Commission include the holding of public hearings pertaining specifically to the limits of waste discharges to be set by the Commission, and pertaining to environmental matters generally. After the hearings, the Commission's duty is to determine the maximum allowable quantity and concentration of the effluent, and to issue Orders prohibiting the release of contaminants in excess of this amount. If the circumstances justify a variation or cancellation of the Order, this may also be done (S.M. 1972, c. 76). The Commission serves, therefore, to protect water quality by regulating the discharge of effluents.

The Clean Environment Commission reports independently to the Minister, but works closely with the Environmental Management Division. The Division does much of the technical work required by the Commission, and often recommends waste discharge limits which may be used in the Orders issued (Stewart, 1978). The Division also has the responsibility of enforcing these Orders once they have been published.

Manitoba Environmental Council. This is a semi-autonomous body operating under the authority of the Minister of Mines Resources and Environmental Management. The Environmental Management Division provides technical services for the Council and also provides staff (an executive secretary). The Council membership consists of interested citizens.

The Council is established under section 2(3) of The Clean Environment Act which permits the Minister to create advisory committees (S.M. 1972 c. 76 s. 2-3). The Environmental Council serves to sponsor forums and publish studies on environmental issues in Manitoba (Manitoba Environmental Council, 1976: 4). It operates through a number of committees which are formed to study a specific problem, or a general class of problems. One committee is concerned with chemicals discharged into the environment, and serves to recommend needed procedural or legislative changes (Manitoba Environmental Council, 1976: 26). A Resource Use

Committee studies resource uses for the purpose of reporting on the uses made of resources in the province, and recommending needed changes (Manitoba Environmental Council, 1976: 42,43). Many other committees exist or have existed, some dealing with very specific questions such as the Garrison Diversion, and others dealing with more general environmental issues. The Council retains its original advisory function in that it can, and to some extent does, prepare resolutions on environmental matters which are presented to the responsible government bodies. Also, the Council frequently appears as an intervenor at Clean Environment Commission hearings (Manitoba Environmental Council, 1976: 4-6).

Water Resources Division. This is a Division of the Department of Mines, Resources and Environmental Management. It operates under the authority of The Water Resources Administration Act (S.M. 1970, c. 28), and is the administrative unit most directly responsible for water use and development in Manitoba. Water use and development have definite implications for water quality, and consequently, these activities must be understood.

The Division is responsible for the following Acts of the Legislature: The Dyking Authority Act, The Ground Water and Water Well Act, The Rivers and Streams Act, The Conservation Districts Act, The Water Resources Administration Act, The Water Power Act, The Water Rights Act, and

The Water Supply Districts Act. In summary,

The Water Resources Division is responsible for long and short range planning and development of the water resources available to the province; the design, construction, and maintenance of provincial waterways, bridges over these waterways, and provincial dams. Responsibilities also include activities associated with issuance of Water Rights licences, subdivision approval, flood forecasting and flood fighting, provision of technical services to ... Conservation Districts ..., and maintenance and operation of flood control works. (Manitoba Department of Mines, Resources and Environmental Management, 1976: 41).

The Division is divided into two Branches: Planning, and Operations. The Planning Branch has the more diverse responsibilities. The Branch contains a section responsible for water power which administers and manages the province's water power resources as provided by The Water Power Act. As this section controls the scope, location, and construction of the water power developments, it is important in maintaining water quality. Construction of water power facilities requires the construction of dams and a resultant flooding of land. There can be serious ramifications for water quality, as has been evidenced by the Churchill River Diversion and the concomitant flooding of South Indian Lake.<sup>3</sup>

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<sup>3</sup>In order to increase the water flow to the Nelson River power sites, the waters of the Churchill River were diverted from South Indian Lake through the Rat and Burntwood Rivers, into the Nelson. South Indian Lake was made into a storage reservoir. The expected results for the Lake, of the diversion and the flooding, include about 211.8 square miles of flooded shoreline (assuming an 850 foot elevation contour as the boundary of the flood), and increased shoreline erosion and thus increased sedimentation and turbidity near the shore. Productivity patterns are expected to be changed, decreased by large amounts in



The section of the Planning Branch which functions under the Water Rights Act is responsible for regulating the use of water in Manitoba. The section receives applications for licences to develop water sites, for all purposes except temporary and domestic use. The administrators are then responsible for issuing the appropriate licences, and for making inspections to ensure that the water is being used only in the authorized fashion (Manitoba Department of Mines, Resources and Environmental Management, 1976: 45). As previously discussed, development projects along a water body may have significant consequences for water quality. Therefore, control over the development process is important in regulating water quality.

The Division conducts studies of water resources with the intention of eventually applying such information to "flood control, water conservation, reclamation, recreation and wildlife rehabilitation projects" (Manitoba Department of Mines, Resources and Environmental Management, 1977: 43). The Division also performs water resource studies of specific lakes and conducts water quality tests (Manitoba Department of Mines, Resources and Environmental Management, 1977: 43,48,49), to add to the information

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some areas of the lake and very little in others. However, the biological productivity for the lake as a whole is expected to decrease by about ten percent (Lake Winnipeg, Churchill and Nelson Rivers Study Board, 1971-1975: 8-46,8-20,8-22).

available about Manitoba's waters.

The Conservation Districts program enables the formation of Conservation Districts within which a single authority controls resource use and development (Manitoba Watershed Conservation Districts Boards, 1973: 1). The Districts may be created to follow either watershed or municipal boundaries (S.M. 1976, c. 38), though the Water Resources Division encourages formation along watershed boundaries (Crooks, 1977). As one body controls all resource development, the possibility of considering the effect of the use of one resource on another resource is enhanced. The Districts have, therefore, a potentially large role in maintaining and possibly improving water quality within their boundaries.

Erosion control is one of the aims of the Whitemud Conservation District. Erosion control is important for water quality maintenance, as reduced erosion results in a reduction in the sedimentation of water bodies. Also, controlling erosion reduces the amount of fertilizers, pesticides, and other agricultural products which are commonly applied to soil, being carried into water bodies. Excessive amounts of these substances can be detrimental as their presence may restrict other water uses, and may deleteriously affect the environmental value of the water body.

The Planning Branch is involved in the use and development of ground water resources in Manitoba. This is

not considered here though, as this practicum is limited to surface water.

The Operations Branch is the other major Branch within the Water Resources Division, and

has the responsibility for the construction and maintenance of provincial waterways, bridges over provincial waterways, provincial dams, and resevoirs. (Manitoba Department of Mines, Resources and Environmental Management, 1976: 64).

Further responsibilities include the operation and maintenance of flood control works, the provision of engineering and technical advice to the Conservation Districts on request, and the provision of engineering services to other government bodies on request (Manitoba Department of Mines, Resources and Environmental Management, 1977: 57). As such, the input of this Branch into water resource development is considerable, and thus, as has already been explained, it has considerable potential for influencing water quality.

Manitoba Water Commission. This body is affiliated with the Department of Mines, Resources and Environmental Management, but like the Clean Environment Commission is a semi-autonomous body reporting directly to the Minister. The Commission is empowered to study any water related matters referred to it by the Minister, and to make recommendations following the investigations (S.M. 1967, c. 69). The scope of the Commission to significantly influence water quality policy is limited as it is restricted to

investigating matters referred to it by the Minister. However, given a general awareness and concern for water quality on the part of the government, the Commission could play a significant role in the collection and dissemination of information.

#### Manitoba Department of Agriculture

The Department of Agriculture could assist in administering policy related to water quality within the rural areas of the province. The Department provides technical advice concerning the handling of agricultural wastes including feedlot wastes which are rich in organic materials and are also potential bacteria carriers. These wastes can be discharged into water bodies. The Department is active in developing alternative ways of disposing of these wastes (Manitoba Department of Agriculture, 1976-1977: 72).

The Department could potentially be very active in land management programs. Land management is important in reducing erosion and controlling drainage. Drainage and erosion are significant factors in distributing farm wastes. Soil washed into water bodies results in sedimentation. Additionally, the soil may contain fertilizers and pesticides, which are potentially deleterious to water quality. Improving drainage increases the speed with which the water flows off the land into the water bodies, thus increasing the potential water erosion. Water drained away from feedlots may have a considerable organic load, because

of the concentration of wastes. Excessive drainage of land can reduce the water table and change the ground water characteristics.<sup>4</sup> As ground and surface water are connected hydrologically, a change in ground water characteristics can be reflected in the surface water.

Direct control over pesticides and fertilizers is possible as the Department of Agriculture must approve their sale and distribution within the province. The Lieutenant Governor has the power to ban the use of these products within the province. Additionally, if the plants or animals, or their by-products are found to be contaminated with pesticides or fertilizers, to such a degree that they may be harmful to health, the contaminated items can be destroyed (S.M. 1976, c. 19 s. 2,4-4,4-2). Concentrations of substances found in pesticides and fertilizers are indicators of water quality, with higher concentrations indicating a less desirable quality. Thus preventing excessive accumulations is beneficial for water quality.

Rural Water Services. This is a Federal-Provincial program which is administered by the Manitoba Department of

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<sup>4</sup>For further information on drainage in Manitoba, see: William P. Elliott. Artificial Land Drainage in Manitoba: History - Administration - Law. Natural Resource Institute, University of Manitoba. Winnipeg, Man., 1978; and, Edward Osborne. Wetland Management in Southwestern Manitoba. Master's Practicum. Natural Resource Institute, University of Manitoba. Winnipeg, Man., in preparation.

Agriculture, and funded partially through ARDA<sup>5</sup> and FRED<sup>6</sup> agreements. Its purpose is "to provide Manitoba farmers with technical and financial assistance in the design and installation of water supply and sewage disposal systems" (Manitoba Department of Agriculture, 1976-1977: 81). There is necessarily a concern with water quality as the water supply must be free of disease-bearing organisms, and must have acceptable colour, taste, and odour. The input into the installation of sewage disposal systems allows some influence over the quantity and concentration of the domestic sewage and wastewater being deposited. Domestic sewage from a farm is not usually sufficiently polluting to exceed the assimilative capacity of the water body, but in combination with wastes from other sources, deleterious effects are possible. Other farm wastes, such as feedlot wastes can exceed the waters' assimilative capacity, however, and deleteriously affect the environmental value of the waters.

Manitoba Water Services Board. This is a semi-autonomous body which reports to the Cabinet through the Minister of Agriculture. The Board is responsible for the supply, treatment and distribution of water in rural communities with which it has contracted these services,

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<sup>5</sup>Canada's Agricultural and Rural Development Administration.

<sup>6</sup>Canada's Fund for Rural Economic Development.

and for the collection, treatment and disposal of sewage (S.M. 1972, c. 72 s. 3). With these responsibilities, the Board can influence the level and method of water and wastewater treatment, within the limits set by the communities' financial abilities plus provincial and federal government assistance. Consequently, some degree of water quality control and policy implementation could be realized through the influence of this administrative body.

#### Other Provincial Departments

A number of other departments in the provincial government have responsibilities which affect water quality in some manner.

Manitoba Department of Health and Social Development.<sup>7</sup> Disease control is a major responsibility of this department. Many disease bearing organisms are carried by water, and the amount in which they are present is an indicator of water quality. The fewer the number of these bacteria, the higher the water quality. Disease bacteria can be carried by municipal sewage or in agricultural wastes. Coliform organisms, especially faecal coliforms, are often used as indicator organisms for disease bearing bacteria. The Department, then, because of its interest in disease

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<sup>7</sup>Since October 20, 1978, this is the Department of Health and Community Services (Government of Manitoba, 1978).

control, has potential to influence water quality in that it could require sufficient treatment of wastes being discharged to ensure that any disease bearing organisms are destroyed.

Manitoba Department of Renewable Resources and Transportation Services.<sup>8</sup> The Department has duties related to land use and renewable resource management (Manitoba Department of Renewable Resources and Transportation Services, 1977: 10,11). As previously discussed, use of land affects the quality of nearby waters through the erosion and leaching caused by construction and other development processes. Additionally, the welfare of renewable resources such as fisheries depends directly on the quality of the water. Changing any of the water quality characteristics can affect fish, or the organisms on which they feed. Because of these responsibilities, the Department has a potential role in water quality policy administration.

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<sup>8</sup>Order in Council #991, issued October 20, 1978, redistributed the responsibilities of this Department. The Minister of Mines, Natural Resources and Environment gained the resource responsibilities which had previously been the responsibility of the Minister of Renewable Resources and Transportation Services. The Minister of Highways gained the responsibility for transportation (Government of Manitoba, 1978).



Manitoba Department of Tourism, Recreation and Cultural Affairs.<sup>9</sup> The Parks Branch of this department has an interest in water and water quality to the extent that provincial park lands are affected. The services provided include recreation, the preservation of natural and historic features, and the management of the lands and associated features (Manitoba Department of Tourism, Recreation and Cultural Affairs, 1976-1977: 20). Water bodies are important features of many provincial parks, and hence are also to be preserved and managed. However, as waters are not isolated but flow through or over the land on which they are found, it is not possible to manage them in isolation. Industrial, agricultural, and construction activities outside the boundaries of the park can, therefore, have effects on waters within the park. The Branch can have no direct effect on water uses and development activities outside the boundaries of the parks, but other departments can be requested to amend their activities so that the parks are not deleteriously affected.

Manitoba Department of Northern Affairs. The responsibilities of this Department include development activities within its jurisdiction (Chapter 1 - Figure 2).

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<sup>9</sup>As of October 20, 1968, this is the Department of Tourism and Cultural Affairs. The Minister of Mines, Natural Resources and Environment gained the responsibility for provincial parks (Government of Manitoba, 1978), a responsibility previously contained within the Parks Branch of the old Department.

For example, the Department, under the authority of the responsible Minister, may assist communities by supplying services such as water supply and distribution systems,<sup>10</sup> as well as sewage and waste disposal systems<sup>11</sup> (S.M. 1974, c. 56 s. 1h, 4-2, 4-3). Because of these responsibilities, the Department has a vested interest in maintaining at least some of the waters at a quality suitable for use as drinking water. Additionally, its interest in sewage disposal allows the Department to influence the quality of any wastewater being emitted into natural waters. Consequently, the Department of Northern Affairs is in a position to participate actively in water quality policy administration in the northern part of Manitoba.

Manitoba Department of Highways.<sup>12</sup> This Department has no direct interest in Manitoba's water or water quality, but its activities can and do effect water. This is because the Department's activities include the construc-

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<sup>10</sup>For further information on water services in the North, see Ian Gillies. A Framework for Improving Water Services in Manitoba's Remote Communities. Master's Practicum. Natural Resource Institute, University of Manitoba. Winnipeg, Man., 1975.

<sup>11</sup>For further information on waste management in the North, see Les Sherwood. A Feasibility Study of Two Alternative Waste Management Systems for Remote Northern Communities. Master's Practicum. Natural Resource Institute, University of Manitoba. Winnipeg, Man., June 1975.

<sup>12</sup>As of October 20, 1978, this is the Department of Highways and Transportation (Government of Manitoba, 1978).

tion of provincial roads and highways (Manitoba Department of Highways, 1976-1977): 5), and the design of river crossings (Ward, 1978). When this construction takes place near a water body the resultant erosion and leaching can result in water degradation, as has previously been explained. Ditches are built to drain water away from the road beds. As has already been described, drainage has implications for water quality. Sediment is carried to natural water bodies in increased amounts. The water table may be lowered, affecting ground water and consequently surface water. Additional problems are created if culverts are too small. They can back up if there are heavy rains or rapid spring run-offs. Culverts also be blocked by sediment and other debris, thus impeding the water flow. Other activities include asphaltting roads, laying gravel which stirs up dust, and ciling roads. Asphalt, dust and oil can, if carried into water bodies, be deleterious to the environmental value and uses of the water. The Department, therefore, has a role to play in water quality policy administration, as its activities are capable of deleteriously affecting the waters' quality.

Manitoba Department of Industry and Commerce.<sup>13</sup>

This Department is only indirectly concerned with water and

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<sup>13</sup>As of October 20, 1978, this is the Department of Economic Development (Government of Manitoba, 1978).

water quality. Among its interests is the attractiveness of the province to new business. Water and water quality affect this in that many industries require a plentiful supply of water of a certain minimum quality for their operations. The operations of the industries produce wastes which are often disposed of into the province's water systems. Industry and Commerce is not responsible for regulating industrial waste disposal. It could, however, become involved in the application of policy towards water quality. For example, the Department can stimulate research into ways of reducing the quantity and strength of the polluting waste materials, and encourage the adoption of these methods.

Manitoba Department of Municipal Affairs.<sup>14</sup> Municipal Affairs has the right to advise on and to coordinate municipal actions. As part of this function, it can advise on water resource management within the municipality. The Department operates under the authority of The Municipal Act and The Planning Act. The Municipal Act gives the municipalities control over all watercourses within their boundaries except those designated as provincial waterways. They control drainage within their boundaries. Municipalities can pass by-laws to prevent water contamination, to

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<sup>14</sup>As of October 20, 1978, this is the Department of Municipal and Urban Affairs.

regulate water use, and to regulate and control waste disposal. The Planning Act allows for the development of districts with goals including the development of land uses and other resource uses, and the control and abatement of pollution (Souris River Basin Study Board, 1978: Supplement 9, c-21 to c-25). These concerns give the Department a reason to interest itself in Manitoba's water quality policy, and the means for actualizing its interest.

#### Provincial Crown Corporations

These entities are not directly within the administrative structure of the government. However, they operate under governmental direction and control, so could be influenced to function in such a way that they do not jeopardize the water quality policy objectives. Manitoba Hydro and Manitoba Forestry Resources Ltd (MANFOR) are two examples of Crown corporations whose activities affect water quality.

Manitoba Hydro. This agency is involved in the construction of dams and generating facilities in order to produce hydro-electric power. Dam construction serves to add sediment to the waters and to increase the turbidity of the water. Land behind the dam is inundated, therefore, organic matter is added to the water. The amount of material added increases considerably if the area to be flooded is not first cleared. The material must be biodegraded, a

process which uses up oxygen in the water, thus reducing the amount available to sustain other life processes. Inundation will increase bank erosion, thus further increasing the water's turbidity. The dam also serves to change the river flow characteristics, thus affecting water quality, as evidenced by the effects on aquatic organisms.

Manitoba Hydro operates coal-fired generating plants as well as hydro generators. These require water for cooling purposes as waste heat is produced. The warm water is usually returned directly to the natural water body from which it was extracted. Temperature changes affect water quality in that the water density, viscosity, and gas solubility are altered (Nakatani, 1971: 564). All of these aspects affect the environmental value of the water. For example, water at higher temperatures is capable of holding a lesser amount of dissolved oxygen. Additionally, increased temperature stimulates bacterial activity which then requires larger amounts of dissolved oxygen. The result is greater pressure on all oxygen demanding organisms in the ecosystem (Kneese, 1968; 19). The range of effects caused by changes in temperature is considerable. Among the aspects which may be altered are the nutrition, metabolism, growth, fecundity, fertility, survival, and behaviour of the aquatic organisms in the affected area (Nakatani, 1971: 564). Species may not be destroyed, but their survival potential may be considerably reduced. The total number of organisms in the ecosystem may not change,

but the combination of species present may shift considerably.

Manitoba Hydro may introduce nuclear generating facilities in the future,<sup>15</sup> when the power potential of the province's rivers has been fully developed. These generating stations produce thermal pollution as do coal-fired plants. Additionally, minute amounts of radioactive materials may escape into the province's waters, creating another potential pollution problem.

Power lines are erected to transport electricity from the generating stations to the population centres. Rights-of-way are cleared to allow for the erection and maintenance of the power lines.<sup>16</sup> Herbicides are used to keep these corridors clear of vegetation. Removing the vegetation increases the soil's susceptibility to erosion, with implications that have already been discussed. Herbicides are poisons, and can act in water as well as on land.

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<sup>15</sup>Plans for introducing nuclear plants in Manitoba exist, but as there is not yet a power shortage in the province, the plans are not being used. Also, the political decision, whether or not to permit the construction of commercial nuclear power plants, has not yet been made.

<sup>16</sup>For further information on the effects of transmission lines on the environment see: Ashmede Asgarali. Proposed Manitoba Hydro D.C. Transmission Line East of Lake Winnipeg: Identification of Alternative Corridors with a View to Minimize [sic] Adverse Effects on Outdoor Recreation. Master's Practicum. Natural Resource Institute, University of Manitoba. Winnipeg, Man., 1978; and Beth Vogel. A Regional Assessment of the Effects of Alternative Transmission Corridors on Outdoor Recreation: Manitoba Hydro's Proposed D.C. Line East of Lake Winnipeg. Master's Practicum. Natural Resource Institute, University of Manitoba. Winnipeg, Man., 1978.

If these substances are carried to water bodies, the water quality may be deleteriously affected.

MANFOR. This is an industrial operation which uses water in the process of making pulp and paper, and then discharges wastewater downstream. The discharges are regulated by the federal government's pulp and paper effluent guidelines, under section 33 of the Fisheries Act (Gavin, 1978). The wastes discharged still contain a variety of chemical and organic products, however, which, upon entering the water body, may have a variety of deleterious effects ranging from immediate toxic reactions on the part of aquatic organisms, to a decrease in the amount of dissolved oxygen available.

#### Federal Administration

The federal Departments of Fisheries and Environment and of Regional Economic Expansion are the two administrative units of the Canadian government which have the most influence on Manitoba with regard to its waters. Several other departments, which are mentioned later in this document, also have some importance.

Fisheries and Environment. This Department is the federal administrative body with primary responsibility for the environment.

Canada's Department of the Environment came into being in 1971, following the Government Organization Act of 1970. Its creation brought together in one department



the responsibility for environmental quality and for protection, enhancement and promotion of the wise use of renewable resources. (Canada Department of Fisheries and Environment, 1976-1977: 1).

The Department has of Fisheries and Environment operated as a unit for several years. The two divisions are now in the process of being separated into two departments. One Minister will be responsible for fisheries and oceans; the other will be responsible for the environment (Gavin, 1978). Fisheries and Environment has three main programs: the Fisheries and Marine Program, the Environmental Services Program, and the Administrative Program.

The Fisheries and Marine Service operates within the Fisheries and Marine Program. Its orientation is towards water and water based resources, and the activities include:

management and development of Canada's fisheries and their associated environmental considerations; ...; fisheries and oceanographic research contributing to the understanding, management and optimum use of aquatic renewable resources and their environment; environmental impact studies affecting coastal and inland waters; and research in support of international agreements related to fisheries management and to the quality of marine and freshwater environments. (Canada Department of Fisheries and Environment, 1976-1977: 2,3).

These functions are fulfilled by the Fisheries Management Division and by the Ocean and Aquatic Sciences Division of the Fisheries and Marine Service. Fisheries Management operates specifically in relation to fish, and has goals which include:

the conservation and restoration of fish stocks, protection and management of fish habitats, allocation and control of access to fishery resources, and programs of

research in support of these activities. (Canada Department of Fisheries and Environment, 1976-1977: 3).

The Ocean and Aquatic Sciences Division is concerned more with water quality than with fish. It is involved in research activities designed to maintain and improve water quality and concurrently to contribute to the effective usage of water (Canada Department of Fisheries and Environment, 1976-1977: 3,4).

There is considerable interaction between Manitoba and the federal government with regard to fisheries because provincial Fisheries Officers have been delegated the authority to enforce parts of the federal Fisheries Act. Fish health and survival are indicators of water quality, with less healthy fish and lower survival rates indicating poorer water quality.

The Environmental Services Program includes the Environmental Management Service and the Environmental Protection Service, both of which are responsible for aspects of the environment.

The Environmental Management Service is responsible for conserving and sustaining the productivity of renewable resources in Canada. Its responsibilities are divided among several services and directorates, each responsible for a different renewable resource. Of particular interest here, is the Inland Waters Directorate. This body

plans and participates in national and international water management programs and policies, and conducts research on inland waters quality and quantity. Major concerns of the directorate include a flood damage reduction program, development of federal policy on

inland waters, coordination of Canada's responses to boundary waters problems, river basin planning with the provinces and the research programs of the Canada Centre for Inland Waters. (Canada Department of Fisheries and Environment, 1976-1977: 5).

The Directorate operates partially under the authority of the Canada Water Act. There are, as yet, no implementation programs for river basin management established between Canada and Manitoba, but several studies have been conducted. The federal government participated in a study of the Souris River Basin with Saskatchewan and Manitoba, intended to assist the development of a general plan for managing the water and land based resources of the Basin. Additionally, the federal government participated in the Lake Winnipeg, Churchill and Nelson Rivers Study, designed to investigate ways of increasing benefits and decreasing negative effects of power developments in northern Manitoba. The Study Board was also to make and implement recommendations for those purposes (Environment Canada, 1975-1976: 6,21,26). It is probable that the future will witness further cooperation between Manitoba and the federal government with regard to the environment and water quality management (Gavin, 1978).

The Environmental Protection Service is the enforcement agency for the Environmental Services Program. This Service is concerned with environmental pollution including water pollution. Additionally, the conservation of resources, including energy resources is a goal of the Service. It operates to mitigate and control environmental

emergencies, participates in environmental impact studies and attempts to control adverse impacts of development. The Service is "the focal point for contact on environmental matters with industry, corresponding agencies of the provincial governments, departments and agencies of the federal government and the public" (Canada Department of Fisheries and Environment, 1976-1977: 6).

The Service operates a Water Pollution Control program designed to control the amount and strength of effluents being deposited into waters, and to clean up existing pollution. Through this program, effluent control requirements are developed and implemented. The environmental impact control program includes responsibilities for environmental contaminants, ecological impact control, federal facilities, environmental emergencies, and noise and waste management (Canada Department of Fisheries and Environment, 1976-1977: 73,80). Federal projects and projects receiving federal funding are required to control effluent discharges to an extent determined by the administrative body.

The Air Pollution Control program is also under the jurisdiction of the Environmental Protection Service. Regulations have been published allowing the Branch to control the emission of asbestos from mines and mills, and mercury emissions from mercury cell chlor-alkali plants (Canada Department of Fisheries and Environment, 1976-1977: 76). As was discussed in Chapter 2, control of air pollution is

important in regulating water quality. Contaminants of the air can settle on the water, or on the soil and then be carried to the water through run-off and erosion.

The Environmental Protection Service also operates programs for contaminant control, environmental emergencies, and waste management. These programs serve to control environmental pollution, of which water pollution is a significant part.

The remaining functions of the Department of Fisheries and the Environment are fulfilled by the Administrative Program. Through this program, departmental policy is developed. Information services are provided for the department and for the public, regarding the departmental policies, services and regulations.

The Administrative Program includes the federal Environmental Assessment and Review office, which serves

to assess the environmental consequences of federal projects and activities before final decisions are made, and to incorporate the results of these assessments in planning, decision making and implementation. (Canada Department of Fisheries and Environment, 1976-1977: 94).

The projects under its authority include those "initiated by federal departments and agencies, those for which federal funds are solicited, and those involving federal property" (Canada Department of Fisheries and Environment, 1976-1977: 95). The assessments are reviewed, and with the approval of the Minister, may be allowed, allowed with certain changes, or disallowed (Canada Department of Fisheries and Environment, 1976-1977: 6,7).

Agreements have been made and committees formed between the federal and provincial governments, to help coordinate environmental issues of joint concern. One of these is the Canada-Manitoba Advisory Committee on Water, established under the Canada Water Act to provide "a forum for government officials to discuss, modify and develop programs to realize the common objective of sound management of water resources" (Souris River Basin Study Board, 1978: 31). Another is the Canada-Manitoba Accord for the Protection and Enhancement of Environmental Quality, signed in 1975.

The objectives of this accord are:

- (a) to provide a more effective overall effort on the solution of pollution problems through better coordination of the activities of Canada and the Province; and
- (b) to provide a broad framework within which specific agreements can be designed to cope with particular problems. (Canada-Manitoba Accord, 1975).

Additionally, there is the Federal-Provincial Liaison Committee for Environmental Protection. This is an advisory body which provides information necessary for environmental protection, and which coordinates activities where the federal and provincial governments may share jurisdiction (Gavin, 1978). All of these agreements and committees are useful for the regulation and control of water quality.

Regional Economic Expansion. This federal department is active in water pollution regulation and water development through its funding programs. The Agricultural

Service Centres Agreement, authorized by the Department of Regional Economic Expansion and the Manitoba government, allows the Department to fund selected Manitoba agricultural centres<sup>17</sup> for the purpose of providing or upgrading water and sewage services (Canada Department of Regional Economic Expansion, 1976-1977: 10; Canada-Manitoba Agreement, 1972: 1,2). The Department will also construct or aid construction of water and sewage services in other rural centres, which do not qualify as Service Centres, through the Prairie Farm Rehabilitation Administration (P.F.R.A.) (Canada Department of Regional Economic Expansion, 1976-1977: 10).

The P.F.R.A. is involved in the administration and implementation of the Agricultural Services Centres Agreement, and also supervises the construction of the facilities for the water and sewage services (P.F.R.A., 1975-1976: 5). Traditionally, the P.F.R.A. has given farmers and small communities assistance in constructing water impoundments, for irrigation and water supply (P.F.R.A., 1949-1950: 50-52). The P.F.R.A. is very interested in reducing erosion on farm lands. Because of these interests, it participates in soil and water conservation projects throughout the agricultural sections of the prairies (P.F.R.A., 1961-1962). The P.F.R.A. actions clearly have implications for water quality in Manitoba. As has already

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<sup>17</sup>Manitoba currently has sixteen centres funded under this agreement.

been mentioned, erosion control is beneficial to water quality. The water supply and sewage service involvement requires an interest in the quality of water being used for consumption purposes, and allows input into decisions regarding the permitted strength of sewage effluent being dumped into water bodies.

The Department is not directly involved in water management and pollution control, but it supplies funding through P.F.R.A programs and the Agricultural Service Centres Agreement, under the Agricultural and Rural Development Act (ARDA), through the Fund for Rural Economic Development (FRED), and under the Regional Development Incentives Act (RDIA) (Canada Department of Regional Economic Expansion, 1976-1977: 4). Consequently, the Department can provide incentives for industries and municipalities to meet the policy objectives for water quality espoused by other departments.

Agriculture. This Department controls the import, sale and distribution of pesticides and fertilizers in Canada, through its Production and Marketing Branch. It also provides an information service on agricultural questions in Canada (Canada Department of Agriculture, 1976-77): 26,52,53). Since pesticides and fertilizers can contribute to water contamination, controlling these products can be beneficial for water quality. Through the information service, the public and the farm population can be made



aware of the effects of agricultural wastes on the quality of water, and of the means to reduce the waste input into waters.

Transport. The Navigable Waters Protection Act is under the authority of the Minister responsible for this department. Thus, the Department of Transport has control over all construction potentially affecting navigable waters, or waters flowing into navigable waters (R.S.C. 1970 c. N-19). The actions of this Department can, therefore, re-enforce policy concerning water quality.

Indian Affairs and Northern Development. This Department is responsible for the well-being of Indian people on reserves, and thus is responsible for water supply and treatment and sewage disposal and treatment on reserves. The Department also manages waters in national parks "including investigation and undertaking water supply projects, protection and propagation of fish and prevention of pollution" (Souris River Basin Study Board, 1978: Supplement 9 B-19). Manitoba contains many Indian reserves and one national park. Waters generally do not remain stationary in any location, so the actions of this Department regarding water affect Manitoba's waters.

National Health and Welfare. The Environmental Health Directorate within this Department "carries out

research to study the effects on health of various environmental pollutants" (Souris River Basin Study Board, 1978: Supplement 9 B-21). Contaminants carried by water can be detrimental to public health.

Defence. This Department operates bases in Manitoba and also conducts military training exercises. Foul- ing of waters can occur during the exercises. Addition- ally, effluents from the bases can contribute to a degraded water quality (Lansdown, 1978).

#### Other Administrative Bodies

Not all administrative bodies with potential to affect the quality of Manitoba's waters are under the direct, or sole, authority of the provincial or federal governments. Examples of these include the City of Winni- peg, the Prairie Provinces Water Board, and the Interna- tional Joint Commission.

City of Winnipeg. This body was made responsible for waste disposal into waters within the city boundaries by Order in Council #152 of the Manitoba government, issued on February 2, 1972. The City, therefore, has responsibil- ity for the quality of waters within its jurisdiction. The City's goal presently is

to achieve a river quality that will be attractive and suitable at all times for secondary contact and recrea- tion such as boating, canoeing, fishing and other activities where ingestion of river water is not a

primary possibility. (City of Winnipeg, [1977b]: 11). A specific objective includes the maintenance of a minimum of 5ppm dissolved oxygen in all rivers and streams within the city boundaries (City of Winnipeg, [1977a]: 7). These goals are established independently of provincial goals.

The quality of water found within the City of Winnipeg is important provincially as water flows downstream to other parts of the province, including other communities (for example: Selkirk).

Prairie Provinces Water Board. This entity was originally formed in 1948, and was reconstituted in 1969. It was set up by an agreement between Canada and the three prairie provinces wherein it was agreed to "share the flow and consider the quality of eastward flowing interprovincial streams and to work together for the benefit of all parties, ..." (Prairie Provinces Water Board, 1977: 1). The apportionment agreement guaranteed each province fifty percent of the water flowing into it. Additionally, downstream users were guaranteed fifty percent of the natural flow. The result was a 1/3:1/3:1/3 allocation of water between the three provinces (Weber, 1977).

The Board is to monitor and report on the water apportionment. In addition, if requested to do so by the parties involved in the agreement, the Board is to consider comprehensive planning, and water quality management, and recommend the actions necessary to implement an investiga-

tion. Also, it may make recommendations to the participating governments (Prairie Provinces Water Board, 1977; 49, Schedule C). In order to carry out the water quality responsibilities, a committee was established. This body has attempted to formulate strategies for water quality management, and in pursuit of this objective "has conducted investigations into the current status of water quality networks, analytical methodology, and methods of storing and retrieving water quality data" (Prairie Provinces Water Board, 1977: 14). The committee's results include a series of water quality reports presenting data collected at the Board's monitoring stations.

The Board's input, to date, into water quality management has not been large. However, it has the mandate to investigate such matters. Thus, in the future, its activities could have a significant effect on Manitoba's water quality policy.

International Joint Commission (IJC). This body was established by the International Boundary Waters Treaty Act (S.C. 1911, c. 28) to investigate situations where the activities of either Canada or the United States affect the quantity or quality of water flowing across the international boundary. Its duty is to identify the source of the problem if possible, and to recommend ameliorative actions. Manitoba has several rivers which flow across the international boundary, including the Red, the Souris, and the

Rosseau. The IJC has established study boards on Manitoba's international rivers to provide for monitoring, to investigate flood control problems, to study the effect of drainage, and/or to investigate pollution (Saskatchewan-Nelson Basin Board, 1972: 43-45). These Boards include the International Souris-Red Rivers Engineering Board, created in 1948 to study water problems generally on the rivers, and the International Souris River Board of control, established in 1959 to monitor water apportionment between the United States and Canada (Saskatchewan-Nelson Basin Board, 1972; 43,44). Another was the International Pembina River Engineering Board, established in 1962 to investigate and make plans for the joint development, between Manitoba and North Dakota, of the water resources of the Pembina Valley, for domestic water supply and sanitation, flood control, irrigation, and other uses (International Joint Commission, 1967: 1,2). This Board reported to the IJC in December of 1964 (International Pembina River Engineering Board, 1964). The International Roseau River Engineering Board was created in 1971 to investigate flooding problems in the Roseau River Basin. It reported to the IJC in September 1975 (International Roseau River Engineering Board, 1975: 1).

To date, only two Boards with a mandate to specifically consider international water pollution, relevant to Manitoba, have been created. One is the Red River Water Pollution Board, established by the IJC on December 2, 1964. The terms of reference of thare Board is:

- (1). to determine whether the waters are being polluted to a level which is harmful to health or property;
- (2). to determine the extent, and the source or sources of the pollution; and,
- (3). to recommend remedial measures considering both sanitary and economic factors (Saskatchewan-Nelson Basin Board, 1972: 45).

The other is the International Garrison Diversion Study Board, established in 1975 (Souris River Basin Study Board, 1978: 30). The terms of reference of the Board were to study and report on:

- (1). current water quality in the Red and Souris Rivers plus their tributaries and other downstream waters potentially affected by the Garrison Diversion, with emphasis to be placed on the Canadian waters;
- (2). present and probable future uses of the waters;
- (3). effects of present water quality on these present and prospective uses;
- (4). impact on the quality and quantity of the waters if the Diversion proceeded as planned;
- (5). impacts on the present and probable future uses if the Diversion proceeded as planned; and,
- (6). impacts on commercial and recreational fisheries in Manitoba, if the diversion proceeded, due to the introduction of foreign species of fish, fish diseases and fish parasites (International Garrison Diversion Study Board, 1976: 3).

The Study Board presented its report to the IJC in October 1976. The Commission in its turn reported to the governments of Canada and the United States in 1977 (International Joint Commission, 1977).

Any water development or management practice which could affect water quality or quantity crossing the international border is potentially a subject of IJC investigation. Therefore, its activities in the future could affect Manitoba's water quality policy objectives.

Figure 4: Summary of Administration (Summer 1978)

Agency	Major Involvement							
	erosion	drainage	const'n	waste control	inform'n	water quality	health	water use
MANITOBA								
(Dep't of M,R&EM) <sup>1</sup>								
Env'tal Mgt. Div.				X	X	X	X	
Clean Env't Comm.				X		X		
Env'tal Council					X	X		
Water Resources	X	X	X					X
Water Commission.					X			
Dep't of Agric.	X	X		X				
Rural Water Serv.					X			
Water Serv. Bd.			X	X				X
Dep't of Health							X	
Dept of R,R&TS <sup>2</sup>								X
(Dep't of T,R&CA) <sup>5</sup>								
Parks Branch								X
Dep't of N.AE. <sup>4</sup>				X				X
Dep't of H'ways		X	X					
Dep't of I&C <sup>5</sup>					X			
Dep't of Munic.Af.				X				X
Hydro			X					X
MANFOR			X					X
CANADA								
(Fisheries & Env't)								
Fisheries Mgt.				X	X	X		
Aquatic Services					X	X		
Env'tal Mgt.				X	X	X	X	
Env'tal Protec.				X	X			
(Admin) EARP <sup>6</sup>				X		X		
Dep't of R.E.E. <sup>7</sup>			X					X
Dep't of Agric					X			

	erosion	drainage	const'n	waste control	inform'n	water quality	health	water use
Dep't of Transport			X					
Dep't of I.A.&N.D. <sup>8</sup>				X				
Dep't of N.H.&W. <sup>9</sup>								X
Dep't of Defence				X				
OTHER								
Winnipeg						X		X
PPWB <sup>10</sup>					X	X		X
IJC <sup>11</sup>	X	X			X	X		X

NOTES

1. Mines, Resources and Environmental Management
2. Renewable Resources and Transportation Services
3. Tourism, Recreation and Cultural Affairs
4. Northern Affairs
5. Industry and Commerce
6. Environmental Assessment and Review Process
7. Regional Economic Expansion
8. Indian Affairs and Northern Development
9. National Health and Welfare
10. Prairie Provinces Water Board
11. International Joint Commission



## Chapter 4

### TECHNIQUES OF IMPLEMENTING WATER QUALITY CONTROL

Water of a minimum quality is essential to the quality of life. However, water is often perceived as a public good, something which no single person or group owns. It is a good to which everyone has equal access, but for which no one assumes responsibility. An infinite supply is assumed to exist, as illustrated by the fact that the definition of a public good includes the statement that no individual's or group's consumption of a good will in any way affect another's consumption of that good (Herfindahl, 1974: 48,49). At one time, one firm's consumption of water may not have affected another's, but with increasing demand for the resource, this is no longer the case. The perception that no-one owns the water resource means that the consumers of the good do not consider the effects of water degradation resulting from their operations on the activities of other consumers of water (Herfindahl, 1974: 51). In this instance, and others where the market of the free enterprise system fails to adjust supply and demand adequately, government intervention is often desirable (Gray, 1977-78).

Once it is recognized as desirable for governments

to implement policies to manage water in order to achieve an acceptable water quality<sup>1</sup>, techniques for effecting the policies must be chosen. Incentives of various types are widely used to encourage firms whose operations affect water quality to modify their activities in order to achieve an acceptable quality. The incentives are classified by economists as either positive or negative. Both are used by governments to achieve their policy objectives concerning water quality.

#### Positive Incentives

Positive incentives require that the government give polluters and potential polluters some inducement to keep their discharges within the limits needed to achieve the acceptable water quality. The inducement is usually in the form of some financial advantage for the firm. Positive incentives include such techniques as tax reductions, subsidies, loans, and grants.

Tax Incentives. There are several ways in which tax incentives can be applied. One method is to reduce the tax on land devoted to pollution control, such as that used for sewage lagoons. The cost of operating pollution control equipment may be deleted from the firm's income at an

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<sup>1</sup>Acceptable water quality is that defined by government policy makers.

enhanced rate,<sup>2</sup> thus reducing the total taxable income. Depreciation allowances are another way of reducing taxable income. A firm may be allowed to accelerate the depreciation of capital equipment designed to reduce pollution output. This is advantageous, especially in combination with an enhanced deduction for the operating costs of the equipment, as it further reduces the taxable income. It is also possible to delete research and development expenses at an enhanced rate.

Economists perceive several disadvantages to the use of an accelerated depreciation allowance. This incentive primarily induces capital expenditures. Land is purchased for sewage lagoons, or equipment is bought and installed to reduce the quantity and concentration of the effluent flowing into water bodies. There is seldom incentive to reduce pollution through operations and maintenance improvements. The discharge of effluents will not be restricted through by-product recovery<sup>3</sup> or by the implementation of changes in the production process. These procedures can be at least as effective as capital investment in controlling the discharge of polluting materials. As tax incentives impose an artificial bias in favour of capital expenditures, monies may be inefficiently allocated by

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<sup>2</sup>A multiple of the actual operating cost (for example: 2 x operating cost) is allowed as a deductible expense (Lansdown, 1978).

<sup>3</sup>This is the recovery of useable materials from the effluent.

firms (Gray, 1977-78; Prakash, 1969: 25).

Permitting enhanced tax deductions for operating costs and research and development expenses allows a firm more flexibility in choosing methods of reducing the strength and quantity of their effluents than does an accelerated depreciation allowance. By-product recovery, production process changes, and other methods of controlling effluents can be introduced at a reduced overall cost to the firm.

Tax incentives generally, are inadequate in controlling effluent discharges as they provide little encouragement to firms which would not implement some pollution abatement even without an inducement. The incentives do not alter the fact that expenditures on pollution control are a net economic loss to the firm. Therefore, operators with no desire to abate their discharges would probably not do so even with the incentives. Additionally, marginally profitable firms remain unable to afford effluent control. By themselves, these incentives are advantageous only to large, profitable organizations (Prakash, 1969: 24,25; Gray, 1977-78). However, if the tax incentives were coupled with a government grant sufficient to make the cost of effluent control to the firm effectively zero, the method could prove to be an inducement to all firms (Lansdown, 1978).

Accelerated depreciation allowances primarily assist in the purchase of capital equipment by profitable

firms. Thus, they are only moderately useful in encouraging a reduced emission of water contaminants. Enhanced tax deductions for operating costs and research and development expenses are more useful as they have a broader applicability. They allow the firm greater choice among methods of effluent control.

Tax incentives generally are advantageous in that the administrative network for taxation already exists. Only minimum expansion should be necessary to allow the new program to be operable. However, any tax incentive requires that the government forego income which it would otherwise collect.

Subsidies. Subsidies can be applied to the purchase of capital equipment, often by a government agency agreeing to pay a certain percentage of the costs (for example: fifty percent). This method of encouraging pollution abatement will provide little assistance to firms which could not otherwise afford to install pollution control equipment, as they are still expected to raise the remaining unsubsidized amount of the purchase price. This is the case unless a one hundred percent subsidy is offered. However, a firm must still pay for the operating expenses of the equipment.

Subsidies need not be applied solely to the purchase of capital equipment. They may also be offered for each unit of pollution withheld. This type of subsidy is,

however, expensive to maintain. It must be offered to all firms, even those not currently contributing to water pollution, to ensure that they do not begin to discharge wastes (Gray, 1977-78).

Susidies are an expensive option in pollution control, not only because of the direct financial outlays, but because an administrative network must be established. Additionally, they provide little incentive to marginally profitable firms to reduce their discharges.

Loans. These are usually designed to lower the cost of capital to firms. Firms which would not otherwise invest in pollution control equipment might apply for a loan for that purpose, especially if the interest rate is low or non-existent (Prakash, 1969: 30-32; Gray, 1977-78). As loans must be repaid, they are, however, less desirable to firms than inducements where the money need not be repaid.

Loans have disadvantages including the fact that they are biased towards the purchase and installation of capital equipment to control effluent discharges. Like accelerated depreciation allowances, they offer little or no incentive to recover by-products or to implement process changes, and so may encourage inefficient allocation of monies. It is possible, however, for the terms of the loan to be such that they may be applied to financing any method of effluent reduction.

Loans are non-discriminating as they may be given to firms which would install pollution control equipment without the extra incentive (Gray, 1977-78). They can, however, provide some incentive for low profit firms to control their effluents.

Loans are not too expensive from the government's viewpoint as the capital is usually recovered (though it may be written off for the firm's benefit). Only the interest which might have been earned in other endeavours is necessarily foregone. The loans must be administered, but most governments already have agencies to fulfill this function.

Grants. Grants may be awarded to any firm at the discretion of the granting agency. The money may be applied to research and development designed to reduce effluent discharges and so enhance water quality. Grants may also be applied to immediate discharge reduction. They can be given simply to lower the costs of effluent regulation for a firm, regardless of its financial capability.

Grants are a flexible positive incentive. They can be used to reduce water pollution through the purchase of capital equipment to treat effluents, production process changes, by-product recovery, or any other method. Additionally, grants are applicable to any firm which meets the approved government criteria for eligibility. This type of incentive is favoured by firms, as the money granted need

not be repaid.

Grants are expensive as the government gets no financial return on its money. However, the administration is not difficult as granting agencies already exist.

Research. Another type of positive incentive is government expenditure on research for the development of pollution control methods. The products of the research may be made available to the firms which discharge wastes into water bodies, without being made responsible for the expense of the research. This is expensive for the government, however, as public monies must be made available to finance the work, and the financial returns to the government may be minimal.

Positive incentives are used to encourage firms to reduce their waste discharges, and thus assist in achieving an acceptable water quality. There is, however, one drawback which applies to all such inducements. The government is required to spend taxpayers' money to achieve the objective, or to forgo tax monies from some firms. However, as positive incentives do not require firms to meet the extra expenses imposed by effluent control (at least not fully), the cost of the goods or services to consumers need not increase.



### Negative Incentives

Negative incentives require that firms which discharge wastes bear the costs of reducing their waste discharges as required to achieve an acceptable water quality. Sanctions such as fines or other legal actions may be imposed by government, if the requirements are not met. The usual forms of negative incentives are: standards, which may be established for the stream or water body, the effluent, or the treatment level required; and effluent charges. These may be used separately or in combination with each other.

Standards. There are several types of standards which can be imposed by a government. Water quality standards generally are an itemization of the minimum acceptable quality characteristics. These may be based on use patterns or health requirements, or on other criteria. Effluent and treatment standards also require itemization of the acceptable characteristics, and are often set in an attempt to achieve overall water quality standards. Establishing standards requires a great deal of advance investigation. The characteristics of the waters to which they will be applied must be determined. The effects of the application of standards on the aquatic environment must be studied, as must the probable economic effects of the standard implementation on the dischargers. For the standards to be effective, achieving them must be both techni-

cally and economically possible (Tax Foundation, 1971: 7), otherwise there is a tendency on the part of both dischargers and enforcers to ignore them.

Standards can be set for each water body. The administrative agency determines which substances must be controlled to achieve an acceptable water quality, and establishes the permitted concentrations. These concentrations are usually set for, and measured at, certain critical points in the water body (Prakash, 1969: 10,11). The use of critical points eliminates the need for monitoring throughout the water body, and allows a consideration of the water's natural assimilative capacity in setting the standards. The firms discharging effluents along the water bodies are responsible for not violating the standards. Problems arise because the operations of upstream firms may be such that the concentrations permitted according to the standards are achieved. The downstream operators then must achieve one hundred percent effluent control if they are not to violate the standards. This is unrealistic. The standards are then usually ignored by dischargers and by the authorities. Because of this problem, standards set for the water body, when used in isolation, are effective only if the number of discharging firms is small (Gray, 1977-78).

Effluent standards are set to control the amount and concentration of polluting substances which a firm is permitted to discharge. These standards can be set for

each discharger, and are often administered through a permit or licencing system. Effluent standards are often used in combination with general water quality standards (Prakash, 1969: 12), which serves to overcome the problem of a few upstream firms monopolizing the water body's assimilative capacity. All firms are required to maintain their effluent at or below the concentration or amount required by the effluent standard. Thus, all of the dischargers are able to utilize some of the water's assimilative capacity.

Effluent standards are a flexible means of pollution control as there is no specification of the means by which the required amount and concentration of the discharge is to be achieved. The most economically viable control method may be chosen, be it by-product recovery, process changes, increased operation efficiency, or increased treatment. Economists criticize effluent standards on the grounds that they are not economically efficient. All firms must meet the required standards regardless of cost. Some may be able to economically achieve much more stringent pollution reduction, but will only attempt to achieve the standard. Others may not be able to meet the standard and retain economic viability. They will be forced to operate at a deficit or cease operations. Standards are relatively simple to administer with the responsible body monitoring the effluents of the dischargers to determine whether or not the standards are being achieved, and enforcing the requirement.

The above system is similar to that used by the State of Minnesota during the 1960's and early 70's. The State's water pollution control agency passed its first regulation concerning the classification of and standards applicable to the Mississippi River and certain of the tributaries on March 28, 1963 (Waelti, 1975: 48). The classification scheme required the setting of water quality standards based on use categories established for various water bodies. The standards were effluent standards issued for each discharger by means of a permit system<sup>4</sup> (Shade, 1975: 39-41). The pollution control measures were not entirely successful during the early sixties, however. It was not until 1967 when enforcement measures began to be more efficiently administered, that the Minnesota program for pollution control began to function effectively (Waelti, 1975: 28-30).

Standards can be set in the form of treatment standards. By this means, the administrative agency requires that a certain minimum level of treatment be performed. This can be on a percentage basis, for example a requirement that the effluent concentration be reduced by

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<sup>4</sup>During the fiscal year 1978-79, Minnesota plans to develop "a new water quality management classification system ... [which] will include the grouping of all waters of the state into four water quality management classes" (Minnesota Pollution Control Agency, [1978b]: 38). Effluent standards are intended to remain in use, but in a somewhat revised form, as is the system of issuing permits to dischargers (Minnesota Pollution Control Agency [1978b]: 38,5).

thirty percent. However, as different contaminants have different effects on the environment, the agency should require different percentages of treatment for each type of pollutant (Gray, 1977-78).

Treatment standards have disadvantages in controlling discharges. The emphasis is entirely on treatment, rather than on process changes, by-product recovery, or more efficient operations and maintenance which might in some instances be less expensive and more effective means of achieving a reduction in the quantity and concentration of the effluent. Such standards are not economically efficient. One discharger with high treatment costs might not be able to afford to treat to the required level and others with lower costs might be able to afford much higher levels of treatment, but because of the standards, would have no incentive to do so (Gray, 1977-78).

Firms are required to pay the extra costs generated by the need to meet the standards. These costs will be passed onto the consumers, in the form of increased prices. This is a disadvantage for consumers, but may be socially desirable as resource allocation decisions will come to reflect at least some of the costs of water pollution (Gray, 1977-78).

Standards generally are a form of direct regulation. They are a feasible method of pollution control, and one favoured by politicians (Dales, 1977: 240). Of the various types available, effluent standards are the most

flexible. They allow dischargers to make their own choices as to the way in which their effluents shall be reduced in quantity and concentration, as well as allowing each firm to benefit from some of the water's natural assimilative capacity. The information requirements are large, but not impossible to achieve. If inefficiencies are perceived, it is possible to alter the effluent standards until the discharges from the firms more closely approximate the desired water quality.

Effluent Charges. Effluent charges require that dischargers pay for the costs their wastes impose upon downstream water users. Thus, the pollution costs are included within the internal decision making process.

Charges have the advantage that the discharger has a free choice of methods for reducing the effluent output, and so can choose whatever is most economically viable for that operation. This may be a production process change or by-product recovery rather than treatment. Wastes will, therefore, be reduced in amount and concentration until the costs of reduction equal the cost of the charge. Charges give firms continuing incentive to reduce effluent discharges as they must pay for all wastes expelled into water bodies. An additional advantage is that a charge system generates revenue which can be used to finance the operations of the administrative agency, or to fund other projects.

The administration of a charges system requires a monitoring system to determine the quantity and concentration of the effluent for each discharger. Additionally, payment of the charge must be enforced. However, a mechanism of enforcement already exists for corporate taxes which could probably be applied to the enforcement of effluent charges (Pearce, 1976: 103).

The imposition of charges increases the costs to dischargers. These costs will be passed onto consumers. This is advantageous from the economist's viewpoint as the result should be a shifting of consumer preferences towards less polluting substitutes for the goods or services produced. The cost of water pollution would then be considered in resource allocation decisions (Gray, 1977-78).

Charges are equitable in that no-one pays more than they are able, to reduce the volume and concentration of waste discharges. They are, however, inequitable in that those firms with higher costs are permitted to continue discharging large amounts of wastes. Politically, charges are not, perhaps, optimal as they can be seen as giving a licence to pollute, if the discharger will pay the required price.

Ideally, effluent charges should be set so that, for each unit of waste discharged, the price exactly equals the cost of the damage caused. Thus, the charge would vary according to changes in the amount and concentration of the effluent (Herfindahl, 1974: 317,318).

The information requirement of the ideal charge system is very large. The administrative unit would have to know the amount of damage caused by each discharger. Separating the effects of one firm's wastes from those of another is not always possible. Wastes from one source can combine with those from another, with an effect that neither could have caused in isolation. Also, the damage caused by a contaminant may be minimal at low concentrations, but once a threshold level is passed, the damage may be quite large. Even if it were possible to collect the necessary information, the process would be time consuming and probably expensive. Therefore, charges tailored precisely to the damage caused by each firm are not feasible to implement.

An accepted compromise is to set a constant effluent charge per unit of waste discharged, which must be met by all dischargers (Gray, 1977-78). The charge should be specific for each type of waste, as some contaminants are damaging at very low concentrations, and others cause minimal damage until concentrations become quite high. The charge must be set at a level high enough to encourage sufficient reduction in the quantity and concentration of the effluent to allow the goal of an acceptable water quality to be achieved. The charge rate must be at least equal to the marginal treatment costs. If it is lower, the discharger would prefer to pay the charge than do any treatment. In practice, the rate must be set by trial and error, until



a charge is found which produces an acceptable reduction in the quantity and concentration of the effluent being discharged into the water bodies. This is time consuming because of the necessity of getting some feedback prior to making adjustments in the rate. However, there should be sufficient information available to set an initial charge adequate for encouraging some effluent reduction. The information requirements of a system using a constant charge are still large, but are possible to achieve.

Another possibility is to set an incremental charge for increasing amounts of waste discharged. Firms with small effluent discharges would then have an advantage over firms with large discharges. The charge could also be set so that the monies payable, at the point where the discharges would cause water quality objectives to be exceeded, would be large enough to discourage most firms from discharging that quantity or concentration of waste. As with the constant charge, the incremental charge would have to be determined by trial and error.

The Delaware Estuary Study in the United States was conducted between 1961 and 1966, with the intent of investigating the water quality in the estuary and determining the costs of achieving different objective sets<sup>5</sup> for water quality (Kneese, 1968: 225,226). Four main methods of man-

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<sup>5</sup>Objective sets are 'packages' of water quality characteristics. Different parts of the estuary were allotted different objective sets.

agement arose from the study. Three have already been discussed: direct regulation or charges, specific to the discharger and the individual costs of waste reduction; uniform treatment; and, a single effluent charge, equivalent to a constant effluent charge (Kneese, 1971: 269,270). The fourth is the zonal effluent charge. With this method, the water body is divided into zones according to the existing water quality characteristics. A constant charge would be applied to each zone, but zones where the water quality characteristics indicated a higher degree of pollution would face a higher charge (Kneese, 1971: 270).

The zonal charge was determined to be best, second only to direct regulation or charges, in achieving an acceptable water quality. The uniform treatment, single charge, and zonal charge were all considered to be possible, with uniform treatment being the most expensive to implement. Direct regulation or charges, specific to each discharger's costs, were determined to be too administratively costly to implement (Kneese, 1971: 272). The zonal charge was considered to be quite efficient in enabling the achievement of a desired water quality, but not very equitable. The industries and municipalities in the most polluted areas would be required to pay a much larger amount of money in response to the charge, or in order to sufficiently reduce their effluent discharge, than those in less polluted areas. This difference is despite the fact that the firms' effluent input into the water bodies, prior to

the implementation of the charge, might be very similar.

The City of Winnipeg uses a charge system to control the discharge of sewage by industry within its boundaries. The technique used is a variant of the pure charge system in that the City's charge is applicable only once the standard for sewage concentration is exceeded. Industries are required to pay a surcharge for every increment in the strength of their effluent, above the strength of normal domestic sewage. The charge is set so that the income accrued from the industries exactly offsets the cost to the City of treating the extra strength sewage, plus the administrative costs associated with using a charge system (Newman, 1978). The City's charge system was put into effect by by-law #90, passed August 1957 and effective January 1, 1958 (Bubbis, 1963: 1407). By 1963, the surcharge had been effective in that the strength of industrial sewage entering the City's sewage system was reduced both in quantity and in concentration (Bubbis, 1963: 1408). The sewage surcharge continues to be used today. The charge has risen to offset rising costs, but otherwise the system remains much the same as when originally formulated (Newman, 1978).

Charges are a flexible method of pollution control, and one favoured by economists (Munroe, 1971: 41). They are economically efficient in that dischargers are able to pay the charge or reduce effluent output to the extent that is economically feasible for each operation. Additionally

charges are flexible. A discharger is allowed to choose the method of pollution reduction that is best for each operation. Effluent charges provide continuous incentive for a discharger to reduce waste discharges. Thus, if new technology, which permits further waste reduction, becomes available at a lesser cost than that imposed by the charge, the new technology will be adopted. Also, the information requirement for the administration of a charge system (other than the ideal system) is not excessive. If the charge is not adequate to achieve the objective of an acceptable water quality, or if it is deemed to be too stringent, the charge can be adjusted until deemed satisfactory.

#### Summary

Positive and negative incentives are both useful for reducing waste discharges. All positive incentives, however, require that the government forego income, in the form of tax revenues, or pay monies out to firms. Additionally, the administrative costs of any program must be covered. Negative incentives require only that the administrative costs of the program be covered. In some cases, negative incentives can generate income, through the payment of fines or charges. This money may be used to offset the administrative costs or to finance other programs. Positive incentives allow costs to consumers to remain relatively stable as the firms do not absorb all the addi-

tional costs of effluent control. Negative incentives imply that costs to consumers will rise as the firms pass on their extra expenses. However, the rise in prices implies that the costs imposed by water pollution are considered by consumers in their purchasing choices, and thus by producers in their resource allocation choices. If the costs are not passed through to the consumer, pollution costs will not be considered in decisions regarding resource allocation.

Tax incentives used alone have a restricted usefulness in that they offer inducements only to those firms which have a relatively high profitability, and which would probably be willing to regulate their discharges without any incentives. If used in conjunction with a technique such as grants, however, they can be useful to all firms. Tax incentives are most useful if they include enhanced tax deductions as these may be applied to the largest variety of methods for controlling effluents. Subsidies and loans are useful primarily in the purchase of capital equipment, and thus discriminate against methods of effluent control which might be more efficient and/or more economically viable for the firm. Both these techniques require some financial capability on the part of the firm, either to pay the unsubsidized portion of the equipment costs, or to repay a loan. Grants are applicable to all firms regardless of financial capability. They are often applied to capital equipment purchases, but may be applied to other

methods of pollution control. Grants are probably the positive incentive most favored by firms as there is no requirement that the money be repaid. Tax incentives, in the form of enhanced tax deductions are probably the most flexible as they can be applied to many methods of pollution control. Grants may be defined so that they too are flexible in application. With all positive incentives, though, the cost of pollution abatement is borne by the government, and financed through the expenditure of (or by foregoing) public revenues.

Standards and charges are both flexible techniques for providing negative incentives for pollution control. Both are implemented to achieve a water quality deemed acceptable by government decision makers. Both can be applied to allow dischargers free choice in deciding how to reduce the quantity and concentration of the effluent. For both systems, monitoring procedures are needed to gather the information required for adequate enforcement.

Charges provide dischargers with a continuous incentive to seek for more effective and cheaper methods of reducing the quantity and concentration of their effluent. Standards provide no incentive to reduce discharges below the required level. With both standards and charges, the extra costs of pollution control will be passed onto the consumer. This shift in price may be greater if a charge system is in effect, as dischargers must pay for all the effluent (unless the charge is set to apply only above a

certain minimum discharge level). Standards allow some discharge free. The shift in costs may be beneficial in the long term as consumer preferences and so resources will be shifted to uses which result in less pollution. In the short term, the shift could cause some hardship to consumers and to producers.

A system of charges, where each unit of pollution discharged by a firm must be paid for, may generate more money for the government than a system of standards, where fines are collected if more wastes are discharged than allowed by the standard (or than charges where the charge only becomes applicable above a minimum strength and amount of effluent discharge). Charges bear the stigma of being a licence to pollute, for those who can afford to pay the charge. Standards supply a regulation beyond which pollution is not allowed, and sanctions to enforce it. Charges are not equitable in that organizations which can reduce their effluent discharge more cheaply will treat or otherwise reduce their waste output more than will firms with higher costs. Standards require that all dischargers reduce their discharges equally regardless of internal costs.

Negative incentives appear to be more desirable from a social perspective, for controlling waste discharges to achieve an acceptable water quality, than positive incentives. This is primarily because resource allocation can be influenced. Both types of negative incentives have

advantages. From an economist's viewpoint, an effluent charge system appears to be preferable. Politically, a system using a combination of effluent and water quality standards might be more feasible.



## Chapter 5

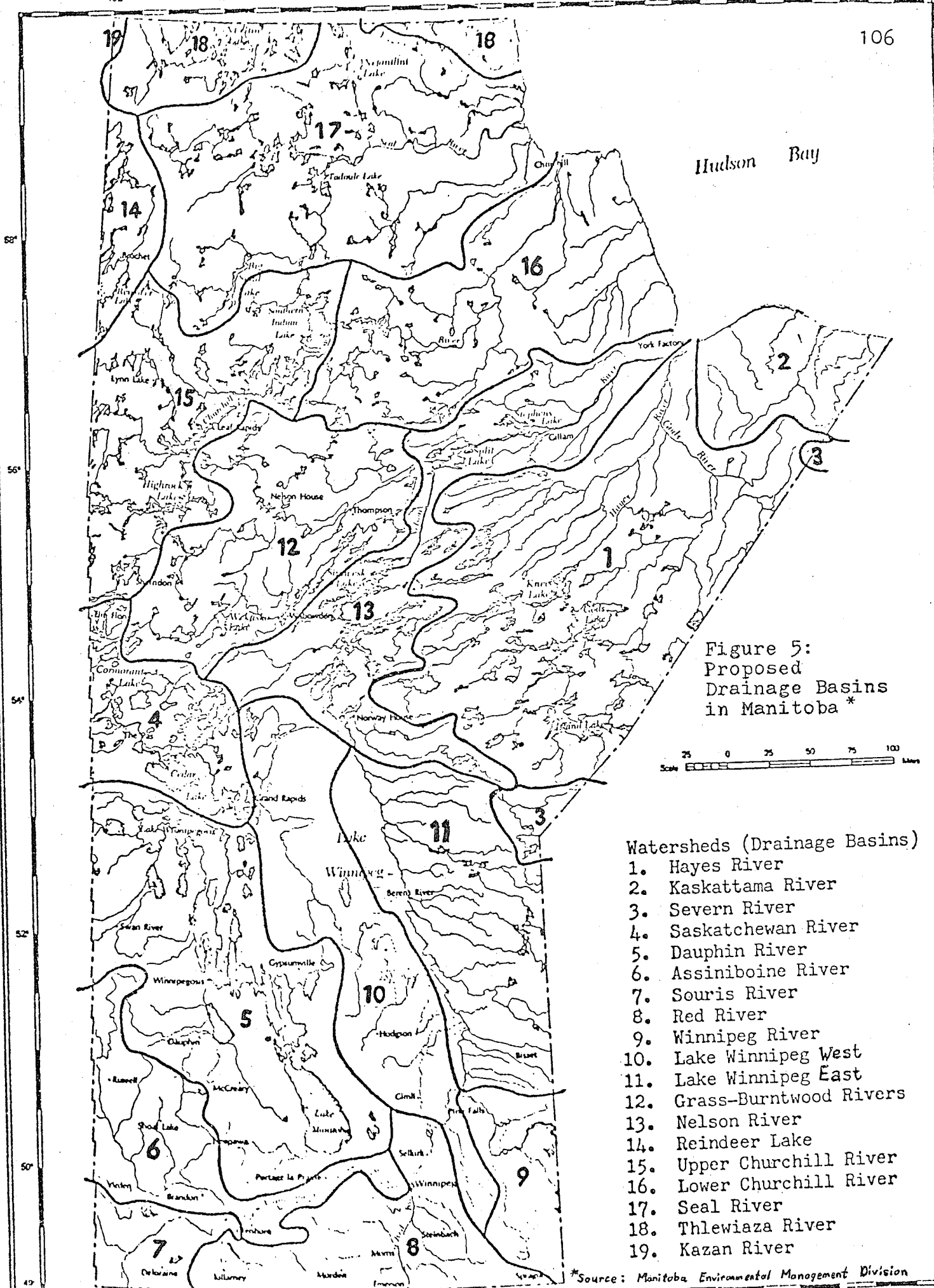
### MANITOBA'S PROGRAM FOR SURFACE WATER QUALITY

Manitoba's current program for maintaining and improving water quality is based on a system whereby individual Orders specifying limits for effluent discharges are published. As has been previously discussed, each discharger is required to submit a proposal to the Clean Environment Commission describing the operation, whereupon an Order will be issued. Orders have the force of law. Under the existing system, the determination of the limits to be set on contaminants is solely the prerogative of the Clean Environment Commission. Currently, the government is attempting to define what 'acceptable' water quality will be in Manitoba. This definition would make the setting of limits on effluent discharges less arbitrary, and would allow for more planning regarding the achievement of the acceptable water quality.

In December of 1976, the Environmental Management Division of the Manitoba Department of Mines, Resources and Environmental Management issued a document entitled "Proposed Interim Objectives of Surface Water Quality". With this, the Manitoba government began to define what 'acceptable' water quality would be within its jurisdiction.

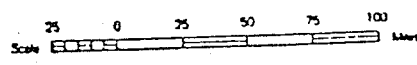
(see Appendix A). The proposed objectives are to be applied to all surface waters within the province. Nineteen basins are proposed (see Figure 5), each of which is to be classified separately. The classification of drainage basins will depend upon uses of the waters within the basin. These uses include: domestic consumption, divided into four sub-categories; fisheries and recreation, divided into three sub-categories; industrial consumption, divided into three sub-categories; agriculture and wildlife uses, divided into two sub-categories; a category for navigation and waste disposal; and, a category of other uses, for which no specifications of water quality characteristics are proposed (Manitoba Environmental Management Division, 1976: 9-23).

Historically, the fact that ground waters are excluded from the proposed objectives is understandable, as ground and surface waters are administered separately. The Water Resources Division has a separate subsection exclusively responsible for ground waters. Additionally, Manitoba did not gain control over ground waters until 1959, whereas surface waters became a provincial responsibility in 1930. The administration of surface waters evolved without a consideration of ground waters. The two types of water sources are, however, hydrologically linked. Surface waters can percolate through the soil to join ground waters, and the latter can flow into surface waters. Thus, contaminants of one water source can come to deleteriously



Hudson Bay

Figure 5:  
Proposed  
Drainage Basins  
in Manitoba \*



Watersheds (Drainage Basins)

- 1. Hayes River
- 2. Kaskattama River
- 3. Severn River
- 4. Saskatchewan River
- 5. Dauphin River
- 6. Assiniboine River
- 7. Souris River
- 8. Red River
- 9. Winnipeg River
- 10. Lake Winnipeg West
- 11. Lake Winnipeg East
- 12. Grass-Burntwood Rivers
- 13. Nelson River
- 14. Reindeer Lake
- 15. Upper Churchill River
- 16. Lower Churchill River
- 17. Seal River
- 18. Thlewiaza River
- 19. Kazan River

\*Source: Manitoba Environmental Management Division

affect the other. It is not, therefore, reasonable to have water quality objectives which exclude ground waters.<sup>1</sup>

The proposed objectives were submitted to a public hearing process under the auspices of the Clean Environment Commission in June 1977, to allow public input. Subsequently, the Commission prepared a report making its recommendations concerning the proposed objectives. This was submitted to the Minister of Mines, Resources and Environmental Management in May 1978. Ministerial response is pending.

#### Administration

If the Minister accepts the proposed objectives for surface water quality, implementation procedures must be initiated. Cooperation among the administrative bodies affecting the quality of Manitoba's waters is necessary to achieve a coordinated program of implementation. To achieve this cooperation, motivation of the individuals involved is required, as well as structural adjustments within the administrative network.

The proposed objectives are not intended to be regulations, and thus would not have the force of law. The

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<sup>1</sup>Including ground water in the water quality objectives is not a simple procedure for a variety of reasons which include the facts that: there is less information available about ground water than surface water; the ground water aquifer has not yet been fully mapped; there is considerable variety in the natural quality of ground water; and, ground water is less in the public awareness than surface water, as it is less visible.

policies and programs of the government agencies involved must, therefore, be structured to encourage the realization of the water quality objectives. Some type of coordinating body may be necessary to mediate jurisdictional conflicts between the agencies. The Minister of Mines, Resources and Environmental Management, or some body operating under his authority, could assume this responsibility provincially, as The Clean Environment Act gives this Minister responsibility for the environment (S.M. 1972, c. 76, s. 2-1).

The existing administrative structures can be adapted to meet the requirements of a program to achieve acceptable water quality in Manitoba. The Clean Environment Commission already serves to prescribe limits for water pollutants. These limits can be set to achieve the goal of acceptable water quality as defined by the proposed objectives. The current role of the Environmental Management Division includes monitoring water bodies to determine the existing water quality characteristics. This role can be adapted to the needs of a management program for water quality. The Division could expand the existing monitoring services to include the inspection of effluents. This service would assist in the enforcement of Commission Orders regarding permitted effluents. The Division and the Commission already have close ties, as one of the Division's current functions is to enforce the Commission's Orders. The development of a program for water quality enhancement would not violate existing ties. It might,

however, require closer cooperation if the Division begins providing expanded technical services for the Commission.

The existence of a program to control and enhance water quality in Manitoba should not alter the role of the provincial Environmental Council. It retains the capability to investigate all issues of environmental concern.

The operations of the Water Resources Division have the capability to affect the quality of water, as has been discussed previously. Achieving the water quality objectives requires the monitoring of waters downstream from all development sites, to determine the magnitude of the effect on the water quality. There must also be feedback to the development agency to ensure that modifications are made if any of the proposed objectives are exceeded. Coordination is necessary to ensure that monitoring functions are not duplicated by the agencies concerned.

The Manitoba Water Commission does not automatically have a role in the implementation of a program to regulate water quality, but could participate if the Minister so directed.

Education programs are necessary to teach farmers about the pollution potential of farm wastes. The Department of Agriculture already provides an information service to farmers and could expand this function to include environmental issues. Regulation of feedlot wastes is already

done,<sup>2</sup> and can be amended to achieve the proposed objectives if necessary. Regulation of other farm waste products such as biocides, fertilizers and eroded soil is, however, more difficult to achieve as the wastes do not enter the waters at any single definable point. Thus, education is desirable to arouse awareness of the problem, and encourage control over these waste products.

The proposed objectives include parameters for biocides, nitrates, turbidity, and dissolved oxygen concentrations. Nitrates and phosphates are both potential polluting materials derived from fertilizers. Nitrates are directly measured. Phosphates are indirectly measured through dissolved oxygen concentrations. If the concentration of phosphates in water is sufficient to cause an algal bloom, the biodegradation of the dead material can seriously reduce the available dissolved oxygen. If growth is not stimulated to excess, the input of phosphates is not normally considered to be deleterious to water quality. The presence of eroded soil is measured directly, by the turbidity of the water. Monitoring is necessary to determine if the agricultural waste products in the water exceed the proposed objectives, and cooperation is needed to ensure that the monitoring functions are not duplicated.

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<sup>2</sup>For further information on pollution abatement with regard to feedlot wastes, see Elizabeth R. Leitch. A Framework for Analyzing Pollution Abatement Controls in Manitoba. Master's Practicum. Natural Resource Institute, University of Manitoba. Winnipeg, Man., April 1975.

If the proposed objectives are exceeded, steps must be taken to ensure that farmers begin to alter their production techniques to reduce the waste inputs into the water bodies. In many cases, all that would be necessary is to control run-off and reduce erosion.

Other departments whose operations affect the quality of water should be able to adapt their operations to fulfill the proposed objectives. A necessary first step is communication of the nature of the objectives and the procedures necessary for their realization.

The Manitoba Environmental Assessment and Review Process is a forum through which it is possible to determine the steps needed to achieve the acceptable water quality for development projects undertaken under the auspices of the provincial government. The Process requires that all provincial projects undertaken, if they are likely to have a significant effect on the environment, be subject to environmental assessment, the results of which are reviewed by the Cabinet. The findings of the assessment and review are applied in the planning, implementation and operation of a project (Manitoba Department of Mines, Resources and Environmental Management, July 1976: 2). The agency established to oversee the Environmental Assessment and Review Process could be directed to ensure that all project proposals include procedures ensuring that the Province's water quality objectives are achieved.

A new administrative agency may be necessary to



implement a water quality management program on a watershed basis. The administrative unit could be made responsible for preserving and maintaining the quality of all water in the drainage basin, according to the characteristics defined for the applicable use classifications. It could operate under the authority of a central coordinating and planning body. If the Board or Authority were made responsible for the necessary monitoring and enforcement within the watershed for which it became responsible, the administration of the management program might be simplified. Each basin is unique in some fashion, and so the objectives for water quality may have to be realized in different ways. Administration on a watershed basis would allow these differences to be handled locally. This type of administrative unit already functions in Manitoba under the authority of The Conservation Districts Act (S.M. 1976, c. 38). Cooperation with the Conservation District Boards could facilitate the administration of a water quality management program in areas where Conservation Districts have been formed.

A forum for cooperation between the provincial and the federal governments, on matters of water quality, exists in the form of the Federal-Provincial Liaison Committee for Environmental Protection. At present, this Committee serves primarily to coordinate activities of Environment Canada and the Manitoba Environmental Management Division, as well as to provide information and advice

(Gavin, 1978). Another forum is the Canada-Manitoba Advisory Committee on Water, established to coordinate water resource management (Souris River Basin Study Board, 1978: 31). The activities of this body could be expanded to include water management to achieve an acceptable water quality. Finally, the Canada-Manitoba Accord for the Protection and Enhancement of Environmental Quality allows for coordination of activities to solve environmental problems generally (Canada-Manitoba Accord, 1975). These committees and agreements operate primarily between Environment Canada and the Manitoba Department of Mines, Resources and Environmental Management, the Environmental Management Division. The coordination of activities should be extended to other government agencies whose activities can affect the quality of water.

The Fisheries Branch of the Canadian Department of Fisheries and Environment maintains close ties with the Manitoba Department of Renewable Resources and Transportation Services<sup>3</sup> administers portions of the Canada Fisheries Act. Cooperation is needed on a broader scale, though, to ensure that Manitoba's surface water quality objectives are achieved. A situation might arise where the Province decides upon a use classification for a water body which

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<sup>3</sup>As of October 20, 1978, this Department no longer exists (Government of Manitoba, 1978). Fisheries and Environment now cooperates with the Manitoba Department of Mines, Natural Resources and Environment.

allows concentrations of contaminants above that recommended for fish health and survival. This would be in contravention of the Canada Fisheries Act which states that no-one

shall deposit or permit the deposit of a deleterious substance<sup>4</sup> of any type in water frequented by fish or in any place or in any conditions where such deleterious substance or any other deleterious substance that results from the deposit of such deleterious substance may enter any such water. (Canada Gazette, 1977, c. 35 s. 33-2).

The sole exception to this prohibition is the deposit of pollutants or deleterious substances within limits permitted by regulations made by the Governor in Council (Canada Gazette, 1977, c. 35 s. 33-4). Therefore, cooperation is necessary between the responsible Manitoban bodies and the responsible Canadian bodies, to prevent conflicts of interest from arising.

The federal and provincial governments cooperate in doing river basin studies, as has been demonstrated by the Souris River Basin Study, and the Lake Winnipeg, Churchill and Nelson Rivers Study. This cooperation could be extended to other river basins and the studies necessary to establish the use classifications required under the proposed scheme to control Manitoba's water quality.

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<sup>4</sup>A deleterious substance is considered to be anything which would alter water quality sufficiently to harm fish or fish habitat, or human usage of fish. This definition includes water that has been treated in such a way that its addition to water bodies could be harmful to fish, fish habitat, or human usage of fish (Canada Gazette, 1977, c. 35 s. 33-11a,b).

The federal government has a number of agencies which provide financing for projects which can have effects on water quality. Cooperation could ensure that federal funding would only be given if project proposals contain provisions for ensuring that the provincial water quality objectives are achieved.

The Canada Department of Agriculture is responsible for the Pest Control Products Act and for the Fertilizers Act. Achievement of Manitoba's objectives regarding biocides, nitrates and dissolved oxygen concentrations could be facilitated by increased cooperation with the agency which controls the import, sale and distribution of fertilizers and pesticides.

Other federal departments also have responsibilities which can influence water uses and hence water quality. Coordination of activities among these departments and the provincial departments involved would facilitate the achievement of water quality objectives.

The City of Winnipeg and the Province of Manitoba are currently negotiating on the issue of river water quality through the forum of a committee which is designed to determine the most feasible method of controlling effluents carried beyond the City through the natural flow of water (Newman, 1978). This negotiation could be extended to more general cooperation on matters concerning water quality within and without the City boundaries.

The Prairie Provinces Water Board has within its

mandate a responsibility for water quality in waters flowing across provincial boundaries. To date, the Board has been primarily concerned with water quantity rather than quality, but in the future this body could be oriented to include the quality portion of its mandate. The Board could, perhaps, help to ensure that water flowing into Manitoba from western Canada meets the proposed water quality objectives for the province.

Canada has an agreement with the United States pertaining to quality maintenance in waters crossing the international boundary. The role of the International Joint Commission, formed under the agreement, is limited to ensuring that the agreement is honoured. Monitoring can determine if Manitoba's quality objectives are achieved. Possibly, the IJC could investigate situations where waters flowing into the province do not achieve these objectives.

#### Technical Feasibility

Manitoba's proposed system for the maintenance and enhancement of water quality is similar to that which has been used in Minnesota for a number of years. Both governments suggest classification schemes based on uses of the water, with different water quality characteristics established for each use classification. The only significant difference is that, in Minnesota, effluent standards are established for all disposal systems discharging into given water bodies (Waelti, 1975: 54-56), based on the quality

characteristics determined for each classification. Manitoba's proposed system does not include effluent standards. Rather, objectives are used as planning guidelines. Unlike standards, objectives do not have the force of law. They are, however, explicitly stated and if accepted by government, any projects conducted under government auspices could be required to meet the objectives (Ward, 1978). Minnesota's system requires dischargers to obtain a permit specifying limits for effluent discharges. The permit includes a timetable scheduling when compliance with the permit is expected to be achieved (Minnesota Pollution Control Agency, [1978a]: 2). Manitoba currently uses a permit system to control the effluent discharges of firms. This system is expected to continue in use to ensure compliance with the planning objectives.

The classification scheme should work in Manitoba as a similar system has functioned for a number of years in Minnesota.<sup>5</sup> By 1977, it was estimated that about seventy-seven percent of the state's waters met the national goals of 'fishable' and 'swimmable' waters, and, given current levels of funding, that approximately eighty-nine percent would meet the goals by 1983 (Minnesota Pollution Control Agency, 1977: 2).

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<sup>5</sup>Minnesota is currently in the process of revising its water pollution control scheme. It will, however, retain a classification scheme for its waters, changing only the basis of classification (Minnesota Pollution Control Agency, [1978b]: 38).

The classification scheme proposed for Manitoba is similar to that used in Minnesota, with the difference that Manitoba's scheme defines many more water quality characteristics than does the Minnesota scheme. For example, in determining the standards for class 2B waters (suitable for fisheries and recreation), Minnesota defines only twelve characteristics<sup>6</sup> (Minnesota Pollution Control Agency, 1977: 6-Table 1). For its equivalent classification, Manitoba defines thirty-two characteristics<sup>7</sup> (Manitoba Environmental Management Division, 1976: Summary Table). The increased number of characteristics defined will increase the amount of work necessary to classify the waters in the nineteen proposed basins, and will add to the monitoring necessary to determine if the water quality objectives are being achieved. However, it will also enable a more precise evaluation and control of Manitoba's water quality.

Minnesota's use classification scheme for water pollution has functioned for about a decade, therefore it is reasonable to assume that Manitoba's proposed plan will be operable. The greatest difficulty probably will be the determination of the watershed use classifications. As the scheme is proposed, the classifications must be established before the planning objectives can be achieved.

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<sup>6</sup>These are: dissolved oxygen, temperature, faecal coliform organisms, turbidity, ph, ammonia, chromium, copper, cyanides, oil, phenols, and radioactive materials (Minnesota Pollution Control Agency, 1977: 6-Table 1).

<sup>7</sup>These are listed in Appendix A - Figure 6. ,

Considerable work is necessary to establish the classifications. Consequently, implementation of the proposal for water quality control will not be a rapid process.

Manitoba's planning objectives resemble general standards for water quality, and the use of orders to regulate discharges allows effluent regulation. As was discussed in Chapter 4, water quality standards used in combination with effluent controls are a viable means of water quality control. The system is administratively feasible, allows flexibility in the choice of method for pollution abatement, and is reasonably equitable. It is not, however, economically efficient. For this reason, the Manitoba government should investigate the technique of effluent charges for regulating discharges into water bodies. Charges are economically efficient, administratively feasible, and allow flexibility in the choice of method for controlling effluents. They can be, however, less equitable than standards. Charge schemes are workable as proven by the fact that Winnipeg's system of sewer charges has functioned for two decades.

#### Equity in Implementation

Clearly, a considerable length of time will be needed to classify nineteen water basins according to their water uses, and to determine the existing concentrations of materials to be regulated according to the proposed water quality objectives. Some areas may not, therefore, have



their waters classified for some time. An effort should be made to classify the water basins as rapidly as possible. This will ensure that all areas of the province realize the benefit of having the quality of their waters regulated. It will also ensure that dischargers in some locations are not obliged to pay for effluent control not required of firms located in different watersheds, for longer than is absolutely necessary.

The background characteristics of water can affect the equity with which a water management program is applied. In parts of Manitoba, the background water quality does not always meet the requirements established for certain use classifications of water, especially for those classifications having the more stringent quality requirements. This is often the case in northern Manitoba. "High zinc, high copper, and high mercury [concentrations] are naturally present in certain lakes and streams due to natural ore bodies" (Ward, 1978: 108). Regions should not be made to suffer economically because their natural waters do not meet the planning objectives for water quality.

Population concentrations affect the the implementation equity of programs. Communities with smaller populations usually have smaller tax bases than larger centres. Thus, they are less able to afford capital equipment for municipal sewage treatment, or the institution of other methods for effluent control. Differences in population density are often regional. For example, the population in

the North is less dense than in the South.<sup>8</sup> Northern communities in general are, therefore, less able to afford the costs of treating wastes to mitigate water pollution.

The implementation of a management program for water quality requires that the different regional concerns regarding water quality be considered, if the planning objectives are to be applied equitably.

Other problems affecting the application equity of a program relates to the source of pollution materials. Manitoba has point source pollution<sup>9</sup>, from municipalities, industrial processing, and from resource extraction operations such as mining and forestry. In addition, there is a significant contribution to water pollution from non-point sources<sup>10</sup> in the form of farm wastes. With this type of waste material, the identification of any specific location for the waste input into waters is not possible. Non-point source pollution is, therefore, much more difficult to regulate than point source pollution as it must be controlled indirectly. Inequities could result if point source polluters are required to remove more than their share of wastes to counter the inability to require non-point source

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<sup>8</sup>Exceptions to this are northern communities such as Thompson, Flin Flon, The Pas, Gillam and Churchill which are of comparable size to some medium-sized southern communities.

<sup>9</sup>Point source pollution is that where the source is a single, clearly defineable, point.

<sup>10</sup>Non-point source pollution is that where there is no single, clearly defineable point of origin.

polluters to regulate wastes.

### Epilogue

If the proposed objectives for surface water quality in Manitoba are accepted by the Minister, implementation procedures should proceed reasonably smoothly. Some administrative adjustments will be necessary, including more cooperation among government departments and agencies. This cooperation will require the motivation of the individuals involved to communicate within and between the various departments and agencies. The creation of new agencies to coordinate a program to regulate water quality may also be required. The proposed objectives should be operable as management schemes with similar formats have functioned in other locations. An optimum economic efficiency will probably not be achieved, but it should be possible to implement the management program quite equitably.

## Chapter 6

### SUMMARY AND RECOMMENDATIONS

Manitoba has, in its legislative background, a considerable history of interest in water quality. This began with a concern for the presence of visible water pollution and has matured to include less obvious pollutants.

This concern is most recently marked by an attempt to implement quality objectives for surface water in the province. The exclusion of ground waters from the proposal is a significant limitation, as ground and surface waters are closely interrelated. A pollutant which affects one, may in the long (or short) run, affect the other. Administratively, the separation is understandable. The two sources of water have, historically, been considered separately. Responsibility for ground water was transferred to the province much later than for surface water. Objectives concerning the quality of water should be established for both surface and ground water, because of hydrological linkages between the two. The provincial government should therefore, endeavour to expand the proposed objectives for surface water quality to include ground water.

Federal government approval is necessary if water quality objectives are to be achieved. This level of

government retains ultimate responsibility for fisheries in the province, and therefore is concerned with water quality where fish and fish habitat may be affected. The federal government may assume responsibility for the waters, and thus water quality, in any basin if federal control can be deemed a national benefit, or a benefit for more than one province. Additionally, the federal government may provide funding for many projects. Therefore, its acceptance of the objectives of a new policy, and the resultant programs, is desirable.

The cooperation of the City of Winnipeg administration is necessary as Order in Council #152, dated February 2, 1972, gives the City responsibility for waste disposal into waters within the City boundaries.

The federal government has a broad administrative network which can be used to implement policy concerning water quality. There are committees and agreements between the federal and provincial governments which may be used to expedite the coordination of policies and programs regarding water and the environment. A committee with members representing the Province and the City of Winnipeg serves to coordinate objectives for water quality within the City's boundaries. These agreements and committees should be adapted to formulate and oversee general policies and programs for regulating water quality. If this is not possible, new liaison bodies should be created.

The implementation of a program regarding water

quality would be facilitated by cooperation among the departments of the provincial government whose activities can affect water quality. A coordinating body could be established to ensure that all agencies and departments understand the policy towards water quality, and know how their actions can help to achieve the objectives. Additionally, the coordinating agency could ensure that overlap in departmental activities be kept to a minimum.

Further work is necessary to determine ways and means of motivating persons operating within a bureaucracy to communicate within and across department and agency lines. Improved communication among personnel would further the coordination of policies and programs.

The implementation of a program for water quality maintenance, with regard to departmental operations, can be achieved through the media of the provincial and federal Environmental Assessment and Review Agencies. All projects which are likely to affect the environment are required to be assessed and reviewed. Meeting the proposed water quality objectives could be made a criterion for positive assessment and review. Local implementation could be expedited by the creation of an agency with the responsibility of managing the water quality in a specific water basin. This body could be given the responsibility for monitoring and for performing other necessary tasks within its jurisdiction. The central coordinating body could be made responsible for the exchange of information between basin

agencies, and in other ways facilitate the smaller agencies' operations.

A variety of techniques are available to implement programs for the achievement of water quality objectives. Most, however, are disadvantageous in that they cannot be equitably applied, or are not economically feasible, either for the discharger to implement, or for the government to administer. The two most useful methods, in terms of equity and economy, from a social perspective, are standards and charges. The Manitoba government's proposed system suggests using a variation on stream, or water body, standards, enforced by effluent standards applied through Clean Environment Commission Orders. Similar systems have functioned elsewhere, therefore, Manitoba's will probably be operable. Systems of water quality control based on standards are often considered to be among the most equitable in application. The Province should, however, investigate further the option of using effluent charges to control discharges. Many economists agree that charge systems are the most economically efficient type available, in terms of the overall social system. In times of economic recession, an economic advantage should not be discarded without careful evaluation.

Manitoba's proposed program for implementing water quality management should be feasible, once the proposal is approved by the Minister responsible and the Cabinet. The administration need not be reorganized extensively to ena-

ble implementation to proceed. The technique chosen, through which the program will be effected, is operable if not ideal. Additionally, the program should be applicable in a reasonably equitable manner.



REFERENCES CITED

Government Documents

- Canada Department of Fisheries and Environment. Annual Report. 1976-1977.
- Canada Department of National Health and Welfare. Canadian Drinking Water Standards and Objectives. 1968. [Ottawa, 1968].
- Canada Department of Regional Economic Expansion. Annual Report. 1976-1977.
- Canada Gazette. "Chlorobiphenyl Regulations #1". Part II, Vol 111 #18. Ottawa: Queen's Printer of Canada, (Sept 14, 1977) 4229-4230.
- . "An Act to Amend the Fisheries Act and to Amend the Criminal Code in Consequence Thereof". Part III, Vol 2 #7. Chapter 35. Ottawa: Queen's Printer for Canada, July 1977.
- . "Proposed Order and Regulations Respecting Dodecachloropentacyclo(5.3.0.0<sup>2</sup> 6.0<sup>3</sup> 9.0<sup>4</sup> 8)decane". Part I, Vol 112 #5. Ottawa: Queen's Printer for Canada, (Feb 4, 1978) 607-608.
- . "Proposed Order and Regulations Respecting Polychlorinated Biphenyls". Part I, Vol 112 #13. Ottawa: Queen's Printer for Canada, (April 1, 1978) 1915-1916.
- Canada Inland Waters Branch. Guidelines for Water Quality Objectives and Standards: A Preliminary Report. Prepared by the Working Group on Water Quality Criteria of the Subcommittee on Water Quality, Interdepartmental Committee on Water, Department of the Environment. Ottawa, 1972.
- Canada-Manitoba Accord for the Protection and Enhancement of Environmental Quality. [Environment Canada, Ottawa], 1975.
- Canada-Manitoba Agreement. Agricultural Service Centres Agreement. Department of Regional Economic Expansion. [Ottawa], August 1972.

- City of Winnipeg. "Stream Pollution in the City of Winnipeg". [Waterworks, Waste and Disposal Division. Winnipeg, Man.], [1977a].
- . "Stream Pollution in the City of Winnipeg". [Waterworks, Waste and Disposal Division. Winnipeg, Man.], [1977b].
- Environment Canada. The Canada Water Act Annual Report. 1975-1976.
- Federal-Provincial Task Force on a Canadian Action Plan. Canada's Environment: A Framework for Action. Environment Canada. [Ottawa], June 17, 1975.
- Government of Canada. A Consolidation of the British North America Acts, 1967-1965. Ottawa, 1967.
- Government of Manitoba. Debates and Proceedings. Vol 14 Nos 76-101. 28th Legislature, 2nd Session. Winnipeg, 1968.
- . Debates and Proceedings. Vol 19 Nos 126-150. 29th Legislature, 4th Session. Winnipeg, 1972.
- . Order in Council #152. Winnipeg, Man., February 2, 1972.
- . Order in Council #991. Winnipeg, Man., October 20, 1978.
- International Garrison Diversion Study Board. Report. Report to the International Joint Commission. October 1976.
- International Joint Commission. Cooperative Development of the Pembina River Basin. Report. Canada and the United States. October 1967.
- . Transboundary Implications of the Garrison Diversion Unit. An IJC Report to the Governments of Canada and the United States. 1977.
- International Pembina River Engineering Board. Joint Investigation for Development of the Water Resources of the Pembina River Basin, Manitoba and North Dakota. Summary of the Report to the International Joint Commission. December 1964.
- International Roseau River Engineering Board. Joint Studies for Co-ordinated Water Use and Control in the Roseau River Basin: Main Report. Report to the International Joint Commission. September 1975.

- Lake Winnipeg, Churchill and Nelson Rivers Study Board.  
Technical Report. Canada and Manitoba. 1971-1975.
- Manitoba Clean Environment Commission. Annual Report.  
[Winnipeg, Man.] Year ending December 31st 1971.
- . "Investigation - Proposed Interim Objectives of  
Surface Water Quality, Province of Manitoba". Hearing  
H-11-77. Winnipeg, Man., June 27 and 28, 1977.
- Manitoba Department of Agriculture. Annual Report.  
[Winnipeg, Man.] 1976-1977.
- Manitoba Department of Highways. Annual Report.  
[Winnipeg, Man.] 1966-1967.
- . Annual Report. [Winnipeg, Man.] 1967-1968.
- . Annual Report. [Winnipeg, Man.] 1976-1977.
- Manitoba Department of Mines, Resources and Environmental  
Management. Annual Report. [Winnipeg, Man.] Year  
Ending March 31st 1972.
- . Annual Report. [Winnipeg, Man.] Year ending  
March 31st 1976.
- . "Environmental Assessment and Review Process for  
Proposed Provincial Projects". Winnipeg, Man., July  
1976.
- . Annual Report. [Winnipeg, Man.] Year ending  
March 31st 1977.
- Manitoba Department of Northern Affairs. Employees Hand-  
book. Winnipeg, Man., 1975.
- Manitoba Department of Renewable Resources and Transporta-  
tion Services. Annual Report. [Winnipeg, Man.] Year  
ending March 31st 1977.
- Manitoba Department of Tourism, Recreation and Cultural  
Affairs. Annual Report. [Winnipeg, Man.] 1976-1977.
- Manitoba Environmental Council. Annual Report Four.  
[Winnipeg, Man.] 1976.
- Manitoba Environmental Management Division. "Proposed  
Interim Objectives of Surface Water Quality".  
[Department of Mines, Resources and Environmental Man-  
agement. Winnipeg, Man.] December 1976.

Manitoba Watershed Conservation Districts Boards. Annual Report. Department of Mines, Resources and Environmental Management. Winnipeg, Man., 1973.

Minnesota Pollution Control Agency. "Minnesota Water Quality". A Report to the Congress of the United States by the State of Minnesota Pursuant to Section 305(6) of the Federal Water Pollution Control Act. Roseville, Minn., June 1977.

-----, "Minnesota's Pollution Control Agency". [Roseville, Minn.] [1978a].

-----, "Minnesota Water Pollution Control Program Plan: Fiscal Year 1979". Division of Water Quality. Roseville, Minn., [1978b].

Prairie Farm Rehabilitation Administration. Annual Report. 1949-1950.

-----, Annual Report. 1961-1962.

-----, Annual Report. 1975-1976.

Prairie Provinces Water Board. Annual Report. Year ending March 31st 1977.

Province of Manitoba. Guidelines for the Seventies. Vol I. Winnipeg, Man., 1973.

Saskatchewan-Nelson Basin Board. Water Supply for the Saskatchewan-Nelson Basin, Appendix I - Study Background. Canada, Alberta, Saskatchewan, Manitoba. 1972.

Souris River Basin Study Board. Souris River Basin Study: Report. Canada-Manitoba-Saskatchewan. June 1978.

-----, Souris River Basin Study: Supplement 9 - Legal, Institutional and Administrative Arrangements. Canada-Manitoba-Saskatchewan. 1978.

### Statutes

Canada. "International Boundary Waters Treaty Act". Chapter 28 (1911), 243-254.

-----, "Pest Control Products Act". Chapter 50 (1968-69), 1147-1155.

-----, "Canada Water Act". Chapter 52 (1970), 1097-1128.

- Revised. "Fertilizers Act". Chapter F-9 (1970), 3059-3063.
- Revised. "International Boundary Waters Treaty Act". Chapter I-20 (1970), 4555-4564.
- Revised. "Navigable Waters Protection Act". Chapter N-19 (1970), 5525-5536.
- Revised - 2nd Supplement. "Government Organization Act, 1970". Chapter 14 (1970), 177-195.
- "Clean Air Act". Chapter 50 (1970-71-72), 951-979.
- "Environmental Contaminants Act". Chapter 76 (1975), 1427-1446.
- Manitoba. "An Act to Prevent the Deposit of Manure on the Barks of Rivers and Streams". Chapter 28 (1871), 73-74.
- Consolidated. "An Act to Prevent the Pollution of Rivers and Streams". Chapter 21 (1880), 393-394.
- Revised. "An Act Respecting the Pollution of Rivers and Streams". Vol II Chapter 118 (1891), 1539-1540.
- "An Act for Protecting the Public Interest in Rivers, Streams and Creeks". Chapter 43 (1905), 111-114.
- Revised. "The Rivers and Streams Act". Vol III Chapter 173 (1913), 2589-2594.
- "The Manitoba Natural Resources Act". Chapter 30 (1930), 229-238.
- "The Water Power Act". Chapter 46 (1930), 438-447.
- "The Water Rights Act". Chapter 47 (1930), 448-465.
- "The Pollution of Waters Prevention Act". Chapter 34 (1935), 98-110.
- "The Greater Winnipeg Sanitary District Act". Chapter 80 (1935), 202-223.
- "An Act to Amend the Rivers and Streams Act". Chapter 51 (1951), 133-139.

- , "The Department of Agriculture and Immigration Amendment Act, 1959". Chapter 4 (1959-2nd session), 11-34.
- , "The Metropolitan Winnipeg Act". Chapter 40 (1960), 255-388.
- , "The Pesticides Control Act". Chapter 58 (1963), 227-229.
- , "The Manitoba Water Commission Act". Chapter 69 (1967), 3979-381.
- , "The Clean Environment Act". Chapter 7 (1968), 47-59.
- , "The Water Resources Administration Act". Chapter 28 (1970), 137-141.
- , "The Manitoba Water Services Board Act". Chapter 72 (1972), 407-412.
- , "The Clean Environment Act". Chapter 76 (1972), 485-496.
- , "The Northern Affairs Act". Chapter 56 (1974), 357-400.
- , "The Pesticides and Fertilizers Control Act". Chapter 19 (1976), 87-91.
- , "The Conservation Districts Act". Chapter 38 (1976), 177-192.
- , "The Northern Affairs Act". Chapter N100 (Continuing Consolidation), 1-44.

#### Personal Communications

- Crooks, Lloyd (Buzz). Personal communication concerning Conservation Districts. Extension Specialist, conservation Districts Program, Water Resources Division, Manitoba Department of Mines, Resources and Environmental Management. Winnipeg, Man., November 1977.
- Gavin, Hamish. Personal communication concerning the federal Environmental Protection Service. Director, Environmental Protection Service (Manitoba), Environment Canada. Winnipeg, Man., July & September 1978.

- Gray, John. Lectures in Natural Resource Economics. Course 18.447. Department of Economics, University of Manitoba. Winnipeg, Man., 1977-78.
- Lansdown, Al. Personal communication on the operations of the Department of Defence, and the ways tax breaks can be used to encourage activities desired by governments. Professor, Department of Civil Engineering, University of Manitoba. Winnipeg, Man., September 1978.
- Newman, George. Personal communication concerning the water quality objectives of the City of Winnipeg, and the sewage charge system used. Manager of Regional Operations, Waterworks, Waste and Disposal Division. City of Winnipeg. Winnipeg, Man., November 1978.
- Stewart, R. Personal Communication on the role of the Clean Environment Commission. Executive Secretary, Clean Environment Commission. Winnipeg, Man., May 1978.
- Ward, W.M. Personal communication concerning Manitoba's proposed water quality objectives. Director, Program Development and Review, Environmental Management Division, Manitoba Department of Mines, Resources and Environmental Management. Winnipeg, Man., July & October 1977 and June & September 1978.
- Weber, Thomas. Personal communication on water resources in Manitoba. Senior Assistant Deputy Minister, Water Resources Division, Manitoba Department of Mines, Resources and Environmental Management. Winnipeg, Man., June 1977.

#### Books and Others

- Booy, C. "Environmental Management and Public Participation in Manitoba". Environmental Management and Public Participation. Edited by P.S. Elder. Toronto, Ont.: The Canadian Environmental Law Association, and The Canadian Environmental Law Research Foundation (1975), 130-161.
- Bubbis, N.S. "Industrial Waste Control in Metropolitan Winnipeg" Journal of the Water Pollution Control Federation. V.35 (Nov 1963), 1403-1413.
- Dales, J.H. "Land, Water and Ownership". Economics of the Environment. 2nd edition. Edited by Robert Dorfman and Nancy S. Dorfman. New York: W.W. Norton and Co., Inc. (1977), 229-244.

- Finlayson, John N. (chairman). Report of the Land Drainage Arrangement Commission Respecting Municipalities Containing Land Subject to Levies Under "The Land Drainage Act". Winnipeg, Man., March 14, 1936.
- Fish, H. Principles of Water Quality Management. Harrow, United Kingdom: Thunderbird Enterprises Ltd., 1973.
- Herfindahl, Orris C., and Allen V. Kneese. Economic Theory of Natural Resources. Resources for the Future, Inc. Columbus, Ohio: Charles E. Merrill Publishing Co., 1974.
- Kneese, Allen V., and Blair T. Bower. Managing Water Quality: Economics, Technology, Institutions. Published for Resources for the Future, Inc. Baltimore, Maryland: The John Hopkins Press, 1968.
- Kneese, Allen V., Sydney E. Rolfe, and Joseph W. Harned (eds). "Appendix C - The Delaware Estuary Study: Effluent Charges, Least-Cost Treatment Systems, and Equity". Managing the Environment: International Economic Cooperation for Pollution Control. New York, Washington, London: Praeger Publishers, 1971.
- Muraro, G. "Anti-Pollution Policy and Cost Allocation: The Issues in Practice". Problems of Environmental Economics. Record of a Seminar. Organization for Economic Cooperation and Development. Summer 1971.
- Nakatani, R.E., D. Miller, and J.V. Tokar. "Thermal Effects and Nuclear Power Stations in the USA". Environmental Aspects of Nuclear Power Stations. Proceedings of a Symposium. Vienna: International Atomic Energy Agency (1971), 561-574.
- Oxford University. The Compact Edition of the Oxford English Dictionary. Vol I, A-O. Glasgow, New York, Toronto, etc: Oxford University Press, 1971.
- Pearce, D.W. Environmental Economics. London, New York: Longman Group, 1976.
- Penman, A. "A Continuing Program for Stream Pollution Control in Metro Winnipeg". The Metropolitan Corporation of Greater Winnipeg. Waterworks and Waste Disposal Division, March 1971.
- Prakash, Ved, and Robert H. Morgan, Jr. Economic Incentives and Water Quality Management Programs. Water Resources Center, University of Wisconsin. Madison, Wisconsin, 1969.



Shade, Barry C. "Trends in Water Quality Management". Proceedings of a Conference on "Trends in Water Management". Water Resources Research Center, Bulletin #80. University of Minnesota Graduate School. Minneapolis, Minn. (January 1975), 36-43.

Tax Foundation Inc. Pollution Control: Perspectives on the Government Role. Research Publication #26. New York, 1971.

Waelti, John J. Surface Water Quality in Minnesota: The Translation of Goals and Policies into Results. Water Resources Research Center, Bulletin #72. University of Minnesota Graduate School. Minneapolis, Minn., February 1975.

Ward, W.M. "Formulation of proposed Manitoba surface water quality objectives". Manitoba Water Quality Objectives: How Far Do We Go? Chairman, Alex Fedoruk. Edited by J.J. Keleher and Willeen Gray. Study 10. Manitoba Environmental Council. Winnipeg, Man. (May 1978), 87-111

Winnipeg Free Press. "Timetable". Winnipeg, Man., September 13, 1971.

Appendix A

MANITOBA'S PROPOSED SURFACE WATER QUALITY  
OBJECTIVES<sup>1</sup>

The Proposal defines numerical and descriptive categories for each use category. Six major categories are suggested, broken down into several sub-categories. These classifications are as follows:

- (1). Domestic Consumption: no wastes, either treated or untreated are to be discharged into these waters.
  - (1A) These waters shall be useable for domestic consumption and will meet the standards of The Canadian Drinking Water Standards and Objectives, 1968 without treatment, except as required by the Public Health Act.
  - (1B) With disinfection, these waters will meet the requirements of The Canadian Drinking Water Standards and Objectives, 1968.
  - (1C) These waters will achieve the objectives of The Canadian Drinking Water Standards and Objectives, 1968 after coagulation, sedimentation, filtration, softening, storage and chlorina-

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<sup>1</sup>These are extracted from "Proposed Interim Objectives for Surface Water Quality", prepared by the Environmental Management Division, December 1976.

tion, or other equivalent treatment.

(1D) These waters will meet the objectives of The Canadian Drinking Water Standards and objectives, 1968 after treatment described for Class 1C, plus additional pre, post, or intermediate stages of treatment.

(2). Fisheries and Recreation: The fishery shall be protected so that there is no significant change in species composition. The propagation or migration of aquatic biota shall not be deleteriously affected by waste discharges. The waters shall be maintained in a state suitable for fishing, fish culture, or recreation.

(2A) These waters shall be maintained to permit the propagation and maintenance of warm or cold water fishes useful for sport or a commercial fishery. Additionally, recreation such as swimming is permitted.

(2B) The uses described for Class 2A also apply.

(2C) The quality of these waters is suitable for the propagation and maintenance of rough fish or species normally inhabiting those waters. Recreation activities such as boating are permitted.

(3). Industrial Consumption

- (3A) The waters shall be useable for most industrial uses, except food processing and other uses requiring very high quality water, without treatment (except softening for ground water). These waters are comparable to Class 1B waters.
  - (3B) Only moderate amounts of treatment are needed to make these waters suitable for most industrial purposes, except food processing and other uses where very high quality water is required. These waters are generally comparable to Class 1D waters.
  - (3C) These waters are useable for industrial cooling and materials transport without a high degree of treatment being necessary to avoid severe fouling, corrosion, scaling, etc.
- (4). Agriculture and Wildlife
- (4A) These waters are useable for irrigation without significant damage to crops or vegetation.
  - (4B) These waters can be used by livestock and wildlife without injurious effects.
- (5). Navigation and Waste Disposal: With waters of this quality, aesthetic enjoyment of scenery is possible. Navigation is possible without damage to property.
- (6). Other Uses: This category includes any possible use not described above.

Figure 6: Water Quality Objectives

Parameter	Units	Use Categories												
		1A	1B	1C	1D	2A	2B	2C	3A	3B	3C	4A	4B	5
Aluminum (Al)	mg/l											5.0	5.0	
Ammonia (N)	mg/l					0.02	0.02	0.02						
Antimony (Sb)	mg/l					0.2	0.2	0.2						
Arsenic (As) tot.	mg/l	0.01	0.01	0.01	0.05	0.05	0.05	0.05	0.01	0.05		0.1	0.05	
Barium (Ba)	mg/l	1.	1.	1.	1.	0.5	0.5	0.5	1.	1.				
Beryllium (Be)	mg/l					0.1	0.1	0.1						
Biocides (1)		fig. 6a	fig. 6a	fig. 6a	fig. 6a				fig. 6a	fig. 6a				
Biocides (2)						fig. 6b	fig. 6b	fig. 6b					fig. 6b	
Boron (B)	mg/l	5.0	5.0	5.0					5.0			0.5	5.0	
Cadmium (Cd)	mg/l	0.01	0.01	0.01	0.01	K 0.03	K 0.03	K 0.03	0.01	0.01		0.01	0.05	
Carbon Alcohol Extract	mg/l	0.2	0.2	0.2					0.2					
Carbon Chlorof'm Extract CEE	mg/l	0.2	0.2	0.2					0.2					
Chloride (Cl)	mg/l	250.	250.	250.		200.	200.	200.	50.	100.	250.	150.		
Chromium (Cr+6)	mg/l	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05				
Chromium (Cr) tot.	mg/l											0.1	1.0	
Cobalt (Co)	mg/l											0.05	1.0	
Colour, true	TCU	15.	15.	15.		30.	30.	100.	15.					
Copper (Cu)	mg/l	1.	1.	1.		L 0.01	L 0.01	L 0.01				0.2	0.5	
Cyanide (Cn)	mg/l	0.01	0.01	0.01	0.2	0.005	0.005	0.005	0.01	0.2				
Dissolved Oxygen	% sat'n mg/l					M 60- 100	M 47- 100	M 35- 100						

	Units	1A	1B	1C	1D	2A	2B	2C	3A	3B	3C	4A	4B	5
Faecal coliform Organisms	counts per 100 ml	none	A 10.0	C 100.	E 1000	N 20.	Q 200.	S 400.	MPN 200.	MPN 200.	MPN 200.	MPN 1000	MPN 200.	MPN 1000
Fluoride (F1)	mg/l	1.2	1.2	1.2	1.5	1.5	1.5	1.5	1.2	1.5		1.0	2.0	
Hardness, tot. (CaCO <sub>3</sub> )	mg/l								50.	250.	500.			
Iron (Fe) tot.	mg/l	0.3	0.3	0.3					0.3			5.0		
Lead (Pb)	mg/l	0.05	0.05	0.05	0.05	0.03	0.03	0.03	0.05	0.05		5.0	0.1	
Lithium (Li)	mg/l											2.5		
Manganese (Mn)	mg/l	0.05	0.05	0.05					0.05			0.2		
Mercury (Hg)	mg/l	0.002	0.002	0.002		.0002	.0002	0.002					0.01	
Methylene Blue Active Subst's (Foaming Agents) (MBAS)	mg/l	0.5	0.5	0.5					0.5					
Molybdenum (Mo)	mg/l											0.01		
Nickel (Ni)	mg/l					0.002	0.002	0.002				0.2		
Nitrate-Nitrite (N)	mg/l	10.	10.	10.					10.				100.	
Nitrite (N)	mg/l												10.	
Oil	mg/l					0.5	0.5	T 10.						
pH		5.0- 9.0	5.0- 9.0	5.0- 9.0		6.5- 8.5	6.0- 9.0	5.0- 9.3	6.5- 8.5	6.0- 9.0		5.0- 9.0	5.5- 9.0	4.5- 10.
Phenol (ic compounds)	mg/l	0.001	0.001	0.001		0.01	0.01	0.01	0.001					
Polychlorinated Biphenyls (PCB)	mg/l					2x 10 <sup>-6</sup>	2x 10 <sup>-6</sup>	2x 10 <sup>-6</sup>						
Radioactive materials		X	X	X	X	X	X	X	X	X		X	X	

	Units	1A	1B	1C	1D	2A	2B	2C	3A	3B	3C	4A	4B	5
Selenium(Se)	mg/l	0.01	0.01	0.01	0.01	0.005	0.005	0.005	0.01	0.01		0.02	0.05	
Silver (Ag)	mg/l	0.05	0.05	0.05	0.05	0.001	0.001	0.001	0.05	0.05				
Sodium(Na)	mg/l											60% tot. cat- ions		
Specific Conductance	µmhos											1000		
Sulfate(SO <sub>4</sub> )	mg/l	250.	250.	250.					250.					
Sulfide(H <sub>2</sub> S)	mg/l					0.002	.002	.002						0.02
Temperature	°C					0 0.5	0 0.5	0 0.5						
Thallium(Tl)	mg/l					0.05	0,05	0.05						
Threshold Odour Number		4.	4.	4.					4.					
Total Coliform Organisms	counts per 100 ml	Y NEG.	Z 100	B 1000	F 5000	D 100	R 500	U 1000	Z 100	F 5000				
Total Dissolved Solids	mg/l	500	500	1000	5000				500	1000		700	3000	
Toxic Algae													BB	
Turbidity	JTU	5.	5.	25.		10.	25.	25.	5.					
Unspecified Toxic Subst's													CC	
Uranium(U)	mg/l					0.1	0.1	0.1						
Vanadium	mg/l											0.1	0.1	
Zinc(Zn)	mg/l	5.	5.	5.		0.02	0.02	5.				2.0	25.	

mg/l=milligrams per litre  
TCU=True Colour Units  
MPN=most probable number

ml=millilitres  
JTU=Jackson Turbidity Units

°C=degrees Celsius  
µmhos=millimhos(conductivity)

Notes (Figure 6)

- (A) At least 95% of the samples in any consecutive 30-day period should have a faecal coliform density of less than 10 MPN per 100 ml.
- (B) At least 90% of the samples in any consecutive 30-day period should have a total coliform density of less than 1,000 MPN per 100 ml.
- (C) At least 90% of the samples in any consecutive 30-day period should have a faecal coliform density of less than 100 MPN per 100 ml.
- (D) Total dissolved solids, sulfate, threshold odour number, carbon chloroform extract, carbon alcohol extract, colour and turbidity values, due to natural conditions, may exceed the specified amounts during periods of low flow.
- (E) At least 90% of the samples in any consecutive 30-day period should have a faecal coliform density of less than 1,000 MPN per 100 ml.
- (F) At least 90% of the samples in any consecutive 30-day period should have a total coliform density of less than 5,000 MPN per 100 ml.
- (K) 0.03 milligrams per liter for waters with hardness greater than 100 mg/l (CaCO<sub>3</sub>).  
0.004 milligrams per liter for waters with hardness lower than 100 mg/l (CaCO<sub>3</sub>).
- (L) or not greater than 1/10 the 96-hour TLM<sup>2</sup> value.
- (M) Percent saturation is at the ambient temperature.
- (N) The median (50 percentile) based on not less than 5 samples per month should not be greater than 20 MPN per 100 ml.
- (O) No change greater than stated degrees Celcius beyond the natural minimum and maximum temperatures.
- (Q) The median (50 percentile) based on not less than 5 samples per month should not be greater than 200 MPN per 100 ml.

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<sup>2</sup>TLM means Threshold Limit Mean.



- (R) The median (50 percentile) based on not less than 5 samples per month should not be greater than 400 MPN per 100 ml.
- (S) The median (50 percentile) based on not less than 10 samples per month should be not greater than 400 MPN per 100 ml.
- (T) 10 mg/l, and none in such quantities as to (1) produce a visible colour film on the surface, (2) impart an oil odour to water or an oil taste to fish and edible invertebrates, (3) coat the banks and bottom of the watercourse or taint any of the associated biota, or (4) become effective toxicants according to the criteria recommended.
- (U) The median (50 percentile) based on not less than 10 samples per month should be not greater than 1,000 MPN per 100 ml.
- (X) Not to exceed the lowest concentrations permitted to be discharged to an uncontrolled environment as prescribed by the appropriate authority having control over their use.
- (Y) At least 90% of the samples in any consecutive 30-day period should be 'negative'. None of the samples 'positive' should have an MPN index greater than 10 per 100ml or an MF<sup>3</sup> count greater than 6 per 200 ml or 15 per 500 ml portions.
- (Z) At least 95% of the samples in any consecutive 30-day period should have a total coliform density of less than 100 MPN per ml.
- (BB) Avoid use of water bearing heavy growth of blue-green algae.
- (CC) None at levels harmful either directly or indirectly.

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<sup>3</sup>MF refers to a measurement technique using a Millipore Filter.

Figure 6a

Water Quality Objectives for Biocides

Public Water Supply, Livestock Watering and Water Contact Recreation  
 (Concentration in Whole (Unfiltered) Water)

Biocide	Type	Not to exceed Limit - $\mu\text{g}/\text{l}$
Aldrin	D	1.0
Chlordane	D	3.0
2,4-D	A	100.
Diazinon	B	I.I.*
Dichlorvos	B	I.I.
Dieldrin	D	1.0
Dimethoate	B	I.I.
DDT	D	42.
Endrin	D	0.2
Ethion	B	I.I.
Heptachlor	D	0.1
Heptachlor Epoxide	D	0.1
Lindane	D	4.0
Methoxychlor	D	100.
Methyl Parathion	B	I.I.
Monocrotophos	B	I.I.
Parathion	B	I.I.
Toxaphene	D	5.0
2, 4, 5-TP	A	10.0
All organophosphates and carbamates, total	B,C	100.

Type - A - Herbicides  
 B - Organophosphates  
 C - Carbamates  
 D - Organochlorines

\*Note: Insufficient Information (I.I.) - Due to a general lack of data, scientifically defensible objectives cannot be set at the time. The biocides limits to protect aquatic life should be based on 0.01 of the 96-hour LC50 value determined using the receiving water in question and the most sensitive important fish species in the area as test organism.

Figure 6b

Water Quality Objectives for Biocides,  
Freshwater Aquatic Life and Wildlife

(Concentration in Whole (Unfiltered) Water)

BIOCIDES (by common name)	CODE (Note 1)	TYPE (Note 2)	NOT TO EXCEED LIMIT (micrograms per liter)
Aldrin plus Dieldrin	-	D	0.003 (Note 3)
Allethrin	-	-	0.002
Amitrole	3	A	300.
Azinphos-methyl	1,2	B	0.001
Carbaryl	1,2	C	0.02
Chlordane	-	D	0.04
Chlorpyrifos	-	B	0.001
Coumaphos	-	B	0.001
Crotoxyphos	-	B	0.10
2,4-D (BEE)	2,3	A	4.0
Dalapon	2,3	A	110.
DDT	-	D	0.002
DDVP	-	B	0.001
Demeton	-	B	1.0
Diazinon	2	B	0.009
Dicamba	2,3	A	200.
Dichlobenil	-	A	37.
Dichlone	-	A	0.2
Dieldrin			(see Aldrin)
Dioxathion	-	B	0.09
Diquat	3	A	0.5
Disulfoton	2	B	0.05
Diuron	3	A	1.6
Endosulfan	1,2	D	0.003
Endrin	-	D	0.002
EPN	-	B	0.06
Ethion	-	B	0.02
Fenac	-	A	45.
Fenitrothion	-	B	10.0
Heptachlor	-	D	0.005
Heptachlor Epoxide	-	D	0.005
Lindane	1	D	0.02
Malathion	1	B	0.008
Methoxychlor	-	D	0.005
Mevinphos	-	B	0.002
Mexacarbate	-	C	0.10
Mirex	-	D	0.001
Naled	-	B	0.004
Oxydemeton-methyl	-	B	0.4
Parathion	-	B	0.0004
Phosphamidon	-	B	0.03
Picloram	2,3	A	9.0
Pyrethrum	-	-	0.01
Rotenone	-	-	10.
Silvex (phenoxypropionic)	3	A	30.
Silvex (BEE)	-	A	2.5
Silvex (PGBE)	-	A	2.0

BIOCIDE (by common name)	CODE (Note 1)	TYPE (Note 2)	NOT TO EXCEED LITER (micrograms per liter)
Simazine	3	A	10.
TDE	-	D	0.006
Temophos	-	B	100.
TEPP	-	B	0.4
Toxaphene	2	D	0.01
Trichlorfon	1,2	B	0.002

Note 1

- Codes - 1 - Insecticides used in vegetable and field production in Southern Manitoba.  
 2 - Pesticides expected to be used in North Dakota irrigation.  
 3 - Herbicides in use in Manitoba.

Note 2

- Types - A - Herbicides, Fungicides & Defoliants  
 B - Organophosphate insecticide  
 C - Carbamate insecticide  
 D - Organochlorine insecticide

Note 3

Biocide limits to protect freshwater aquatic life are generally based on multiplying the acute toxicity values for the most sensitive important fish species by an application factor of 0.01. With respect to a number of biocides in use in Manitoba and adjoining States or provinces, due to a general lack of data, scientifically defensible objectives cannot be set at this time. The limits for these, to protect aquatic life, should be based on 0.01 of the 96-hour LC50 value determined using the receiving water in question and the most sensitive important fish species in the area as test organism.