Fisheries and Environment Canada
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Manufacturing Water Use Survey, 1972 – A Summary of Results

Donald M. Tate

SOCIAL SCIENCE SERIES NO. 17
(Résumé en français)

INLAND WATERS DIRECTORATE,
WATER PLANNING AND MANAGEMENT BRANCH,
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Cat. No.: En36-507/17

ISBN 0-662-00593-7

Contract No. 07KX.KL210-6-4526
THORN PRESS LIMITED

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Preface

Water is one of Canada's most valuable natural resources. While a great deal is known about the physical nature of the resource, public agencies have only recently begun to collect statistics on water use. Water use statistics are necessary inputs to water management and planning.

This paper examines water use in the primary manufacturing industry as of 1972. The data used were derived from the 1972 Survey of Industrial Water Use, which was the first of its kind in Canada. In addition to water use in manufacturing, the survey covered the mining, oil and gas extraction, and hydroelectric and thermal power generation sectors of industry. The results obtained for these other sectors will be reported at a later date.

Major parameters of water use dealt with in this report include water intake, water recirculated, and water discharge. Water intake is quantified by type of source (e.g. surface, ground, tidewater) and by the first use made of the water (e.g. cooling, processing). Water recirculated is quantified functionally (e.g. cooling, processing). Water discharged is broken down by discharge point (e.g. public sewers, surface water). The amount of pollutants borne by the waste stream is not quantified.

The Survey was conducted jointly by Fisheries and Environment Canada and Statistics Canada. The Manufacturing and Primary Industries Division (MAPID) of Statistics Canada provided the mailing list, survey administrative facilities (e.g. mailing, receiving and follow-up procedures), advice on the form of the questionnaire and assistance in the estimation of results for survey non-respondents. The Inland Waters Directorate of Fisheries and Environment Canada determined the contents of the questionnaire, provided assistance to respondents and was responsible for editing, processing and analysis of the results, under the direction of Mr. D. Tate, who can be reached by telephone at 997-1783 in Ottawa.

Abstract

This report summarizes the results of the Manufacturing Section of the 1972 Survey of Industrial Water Use, the first of its kind to be undertaken nationally in Canada. The report presents figures and discussion on various parameters of water used by industry, such as intake, recirculation and discharge. Similar figures are given for water used by industry within each province.

This survey is the first of a continuing series of surveys to be undertaken at five-year intervals, with the next survey beginning early in 1977. These statistics will provide a valuable input to water management, planning and related activities such as water needs forecasting.

Résumé

Le présent rapport est un sommaire des résultats de la section qui porte sur la fabrication dans le cadre du relevé de 1972 sur l'utilisation de l'eau par l'industrie, lequel constitue le premier travail du genre à être exécuté à l'échelle nationale au Canada. Le rapport présente des statistiques et discute de divers paramètres de l'utilisation de l'eau par l'industrie tels que la prise d'eau, la recirculation et le rejet. Des chiffres comparables y sont donnés pour l'utilisation faite par l'industrie dans chaque province.

L'ouvrage en question s'inscrit dans le cadre d'une série de relevés qui seront entrepris à intervalles de cinq ans, le prochain étant prévu pour 1977. Les statistiques qu'ils permettront de compiler seront d'une aide précieuse à la gestion et à la planification des eaux, ainsi qu'à des activités connexes comme la prévision des besoins en eau.

Manufacturing Water Use Survey, 1972 — A Summary of Results

Donald M. Tate

INTRODUCTION

Basic data on Canada's water resources are essential to the operations of the Inland Waters Directorate. For many years now, IWD has collected data on the physical characteristics of surface and groundwater. These data have enabled researchers and planners to gain a good basic understanding of the physical resource base. However, many water resources studies (e.g. comprehensive river basin planning) require data on the use of water as well as on the purely "physical" aspects of the resource and, until recently, such use data have not been available. As a result, planners and others have relied upon coefficients of water use per unit of input or output to estimate water use, an approach which has been unsatisfactory for application to individual firms or small areas, and may result in errors of several orders of magnitude when estimating industrial water use. This report outlines the results of a water use survey for manufacturing, designed to begin the collection of primary data for various water-using activities in Canada.

Survey Methods

The mailing lists for the various parts of the Industrial Water Use survey, developed by the Manufacturing and Primary Industry Division, were based on a section of the 1971 long-form questionnaire[1] of MAPID's survey of various industrial sectors, such as manufacturing, mining, power generation and others, which requested respondents to indicate their annual intake of water by intake size group. Firms indicating a total water withdrawal of 10 million gallons or more automatically received the water use questionnaire. Following this preliminary selection, the lists of potential respondents were examined in detail, and firms were added on the basis of special water use characteristics, e.g. high pollution-emitting industries, despite the fact that the quantities of water intake may have been small. A somewhat similar procedure was employed by the U.S. Bureau of Commerce in a survey of water use in manufacturing,[2] using a cut-off point of 20 million gallons or more of annual water

[1] Long-form questionnaires are those which request detailed input and output data from "large" establishments. The definition of "large" varies from industry to industry, but in general terms, includes all those establishments of a specified size which together account for a significant proportion (usually 90%) of total industry shipments of goods of own manufacture. Remaining establishments in the industry receive a short-form questionnaire, requiring minimum information. This procedure significantly reduces the response burden on small firms and, at the same time, provides essential operational-type statistics for the industry, with a minimum loss of commodity detail.

[2] U.S. Department of Commerce, Bureau of the Census, *Water Use in Manufacturing*, Census of Manufactures, 1972. Washington, MC72(SR)-4, 1975.

intake. The Bureau calculated, on the basis of a pre-survey of the type used in 1971 for Canada, that some 97% of the total water withdrawal by all manufacturing was accounted for by this procedure. Thus, it is thought that the survey of manufacturing water used for Canada accounts for at least 95% of the total water withdrawal by all manufacturing establishments.

The survey was conducted in 1973-74. Difficulties in adapting the results to a computerized system for data storage and retrieval and in editing the survey returns led to delays in obtaining useful results, and the contents of this paper represent the first output from the project.

In the course of preparation for the survey, various provincial agencies were contacted, primarily to convey information about the survey, but also with a view to avoid duplicating similar exercises should they be under way provincially to collect 1972 data. It was discovered that a very similar survey was under way in the Province of Alberta by that province's Environment Department. Thus arrangements were made for a data transfer, and the federal questionnaire was not used in Alberta. The Alberta results[3] have been incorporated into this paper.

The data presented in this paper pertain only to manufacturing establishments. The total number of plants in the survey was approximately 4,450, including those surveyed by Alberta. Of these, some 3,800 or 85% surveyed, returned questionnaires. About 500 questionnaires, or 11% of those returned, were discarded because of lack of information. The chief reason for this lack of information was that the firms involved did not meter and could not estimate their water use. Thus, 3,298, or about 74% of the plants surveyed completed usable questionnaires.

On the basis of responses to the questionnaire, results for the non-respondents were estimated by Statistics Canada. Initially the estimation involved calculating a coefficient of total water intake per employee for each 4-digit industry group in each province. The survey results plus employment information from Statistics Canada's records provided the data for the calculation of coefficients. These coefficients were then multiplied by the number of employees in the plants being estimated to determine the total water intake at those plants. Following this procedure, all of the parameters of quantitative water use[4] were calculated as a percentage of total water intake. These percentages were then multiplied by the total water intake for the plants being estimated to arrive at estimated values for the various parameters of water use. The results of this estimation procedure were then

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[3]Alberta Environment, *Alberta Industrial Water Use Survey*, 1972, Volumes 1 and 2, Edmonton, 1974.

[4]That is, all boxes except those of Sections A, B.9, B.10, D.6, E.7 and E.8 of the attached questionnaire. These data were not estimated, as they pertained either to qualitative aspects of water use or to non-numeric information.

combined with the survey results to permit statistical summarization. Estimation by this method brings the total number of plants included in the survey results to 4,437.

Terminology

The water use terminology and definitions employed in the survey were derived from Bower's work on industrial water utilization.[5] *Total water intake* refers to the total amount of water added to the water system of the plant to replace water discharged or consumed during production. Water intake is broken down in this paper into both the amounts withdrawn from various sources and amounts used for cooling, processing, condensing and steam generation, sanitary, and other purposes. *Cooling and condensing water* refers to water used exclusively for the dissipation of heat. *Boiler feed* refers to that water used for the production of steam. *Processing water* refers to that water which comes in contact with an intermediate or final product of the manufacturing operation. *Sanitary water use* is self-explanatory. *Recirculated water* refers to water used at least twice in the manufacturing process. Recirculation does not refer to water which is used a number of times within a particular process subsystem of a plant but only to water which leaves a particular process subsystem and re-enters it or is used in another process. *Gross water use* of a plant or a process refers to the total amount of water which is used in the production of the product. It is the sum of total water intake and water recirculation.

Water consumption refers to that water which is lost in the production process. In other words, consumed water is not returned to its original source. The two major portions of consumed water are escaped steam and the incorporation of water into a product, as for example in the production of soft drinks. *Water discharged* refers to that water which is returned to the environment in the form of water, usually in close proximity to the plant. Discharged water may be treated or untreated. Together, water discharge and water consumption form the effluent subsystem of the plant. The sum of these two parameters is approximately equal to the total water intake of the plant.

PATTERNS OF CANADIAN INDUSTRIAL WATER USE

The following sections describe the results of the survey and present some basic analyses of the data. The first section deals with the data on an industry-by-industry basis, while the second focuses on interprovincial comparisons.

Industry-by-Industry

The 4,437 establishments in the survey withdrew 5,677 million gallons of water per day (mgd) in 1972. Table 1 shows that the total gross water use for these firms was

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[5]Bower, B.T., "The Economics of Industrial Water Utilization," in Knesse, A.V., and S.C. Smith, *Water Research*, Resources for the Future, Baltimore: Johns Hopkins Press, pp. 143-173. The terminology and definitions are also the same as those used by the U.S. Bureau of the Census, op. cit.

Table 1. Characteristics of Manufacturing Water Use in Canada, 1972 (mgd)*

Industry group	Number of plants	Total water intake	Recirculation (estimated)	Gross water use (total)	Consumption (estimated)	Total discharge
Food and beverage	1,469	338	142	480	18	320
Rubber and plastic	242	282	86	368	2	280
Textile	174	88	29	117	3	85
Wood	148	156	37	193	5	151
Paper and allied	375	2,015	4,280	6,295	76	1,939
Primary metal	201	1,023	820	1,843	28	995
Transportation equipment	204	154	75	229	6	148
Non-metallic mineral products	330	99	80	179	5	94
Petroleum and coal products	47	431	493	924	22	409
Chemical and chemical products	380	1,007	1,207	2,214	65	942
Total of ten (10) other groups†	867	84	126	210	9	75
CANADA TOTAL	4,437	5,677	7,375	13,052	239	5,438

*In this table, recirculation = gross water use - total water intake, and consumption = total intake - total discharge.

†These industries include tobacco industry, leather industry, knitting mills, clothing industry, furniture fixtures industry, printing publication & allied products, machinery industry, metal fabricating industry, electrical products, and miscellaneous manufacturing.

13,052 mgd, meaning that, on the average, the water intake was recirculated 2.30 times. Of the total water intake, 239 mgd, or 4.2%, was consumed, and 5,438 mgd was discharged back to the environment.

The paper and allied products, primary metals, chemical and chemical products, and petroleum and coal products industries were the four largest water-using manufacturing groups covered in the survey, and together accounted for about 79% of both total intake and total effluent and 77% of total consumption.

Table 2 shows the use rates and the consumption rates for industries within the survey. The use rate is formed by the ratio of gross water use and water intake, and is an index of recirculation. The ratio's minimum value is 1.00, denoting no recirculation, however, the ratio may assume very high values for firms which recirculate large amounts of water. As noted above, the average use rate was 2.30 for the survey, and ranged between 1.3 for the textiles and rubber and plastic industries and 3.1 for paper and allied industries. The other three large water-using industrial subgroups have use rates slightly below the national average.

Table 2. Use Rates and Consumption Rates by Industry

Industry group	Use rate	Consumption rate (%)
Food and beverage	1.4	5.3
Rubber and plastic	1.3	1.0
Textile	1.3	3.4
Wood	1.2	3.2
Paper and allied	3.1	3.8
Primary metal	1.8	2.7
Transportation equipment	1.5	3.9
Non-metallic mineral products	1.8	5.1
Petroleum and coal products	2.1	5.1
Chemical and chemical products	2.2	6.5
Total of ten (10) other groups	N.A.	N.A.
CANADA AVERAGE	2.3	4.2

$$\text{Use rate} = \frac{\text{total gross water use}}{\text{total water intake}}.$$

$$\text{Consumption rate} = \frac{\text{total water consumption}}{\text{total water intake}} \times 100\%.$$

The consumption rate is an index of the amount of water lost during production, most commonly through evaporation or incorporation into the product. As noted above, the national average rate of consumption is 4.2% of intake. This varies between 6.5% for the

chemical and chemical products industry and 1.0% for the rubber and plastic industries. The high consumption rate for the former is attributable to the use of water to dissipate large amounts of heat generated in the production processes. The petroleum and coal products and non-metallic mineral products industries are also relatively large consumers of water, with a consumption rate of 5.1% of intake.

Table 3 classifies the water intake of the surveyed plants according to source. About 17% of the 5,677 mgd total water intake is derived from public utilities. Most industrial water, about 76%, is obtained from privately owned surface sources. Slightly more than one percent of the total comes from fresh groundwater sources, while the remaining 5% is accounted for by private brackish sources. Because of inadequate amounts or poor quality, the last two sources do not account for a significant proportion of total intake.

There is a notable difference with regard to water source between industries dominated by large establishments and those dominated by relatively small establishments. This observation emerges both from examination of individual plant returns and from inspection of the aggregate data of Table 3. For example, the food and beverage industry, composed generally of many relatively small water users, withdraws 48% of its total intake from public sources. This industry is characterized not only by small plants but a requirement for high quality intake water. Thus, it relies upon public water supplies for much of its water. In contrast, the four largest water-withdrawing industries -- paper and allied products, primary metals, petroleum and coal products and chemical and chemical products -- withdraw 7%, 5%, 2% and 9% respectively from public supplies. These industries are characterized by fewer and generally larger plants than the food and beverage industry.

Table 4 examines the distribution among discharge points of the 5,438 mgd of industrial water discharge. By class of discharge point, this distribution is as follows: public sewers, 10%; private surface water disposal, 70%; tidewater, 19%, and less than 1% to groundwater. The food and beverage industry discharges 44% of its effluent to the public sewer, a proportion equal to its withdrawal from the public water supply system. In contrast, the four largest water-using industries discharge relatively small amounts of water to public sewers (i.e. paper and allied products, 3%; primary metals, 10%; petroleum and coal products, less than 1%; and chemical and chemical products, 2%). The use of various discharge points is related to the magnitude of the wastewater discharged, the location of the plant and also to the characteristics of the pollutants in the wastewater. The food and beverage industry, being composed of relatively small water users, usually does not have sufficient water discharge to justify building and operating individual waste treatment facilities. There are, of course, exceptions to this general point, and many plants in the industry pre-treat their waste before discharging it to the public sewer. Also, wastes from plants of this industry, being composed mainly of biochemical oxygen demand (BOD) and suspended solids, tend to be compatible with municipal waste treatment processes. On the other hand, the larger plants of other industrial groups generate large volumes of waste. Often, these volumes are too

Table 3. Water Intake by Source for Industrial Groups (mgd)*

Industry group	Public water system	Private surface system	Private groundwater system	Brackish (private)	Estimating error†	Total
Food and beverage	162	86	34	55	-	338
Rubber and plastic	263	14	4	-	-	282
Textile	28	55	4	1	-	88
Wood	24	104	1	26	-	156
Paper and allied	145	1,820	20	13	17	2,015
Primary metal	51	892	11	59	10	1,023
Transportation equipment	67	71	-	16	-	154
Non-metallic mineral products	57	32	5	-	5	99
Petroleum and coal products	8	366	1	56	-	431
Chemical and chemical products	87	851	11	49	9	-
Total of ten (10) other groups	68	11	1	-	4	84
CANADA TOTAL	960	4,302	95	275	45	5,677

*Blanks refer to negligible withdrawal.

†Estimating errors arose because of rounding in the estimation program.

Table 4. Water Discharge by Point of Discharge (mgd)*

Industry group	Public sewer	Freshwater body	Tidewater body	Ground	Estimating error†	Total
Food and beverage	142	73	89	15	1	320
Rubber and plastic	31	246	-	-	3	280
Textile	35	50	-	-	-	85
Wood	2	112	34	2	1	151
Paper and allied	55	1,201	672	2	9	1,939
Primary metal	102	813	77	3	-	995
Transportation equipment	33	98	16	1	-	148
Non-metallic mineral products	43	49	-	2	-	94
Petroleum and coal products	2	341	64	1	1	409
Chemical and chemical products	20	824	93	4	1	942
Total of ten (10) other groups	55	18	-	1	1	75
CANADA TOTAL	520	3,825	1,045	31	17	5,438

*Blanks refer to negligible discharge.

†Estimating errors arose from rounding in the estimation program.

large to be handled in municipal treatment plants, with the result that most of the wastewater has to be handled internally and discharged directly to surface waters. Also, some of the pollutants generated by large industries are incompatible with municipal waste treatment processes, resulting in the need for internal treatment and subsequent direct discharge.

Table 5. Discharge Points of Major Water Users

Industry	Discharge to freshwater (%)	Discharge to tidewater (%)
Paper and allied products	62	35
Primary metals	82	8
Petroleum and coal	83	16
Chemical and chemical products	88	10

Since freshwater or tidewater bodies are the most common discharge points for industrial wastes, it is interesting to examine the proportion of discharge from the major water users to each type of water body (Table 5). This distribution reflects the location patterns of the respective industries. The paper and allied products industry, in contrast with others in the table, has a relatively larger number of plants located on the Atlantic and Pacific coasts, thereby discharging more wastes to the sea.

Provincial Analysis

Tables 6 through 9 examine the same data as did Tables 1 through 5, but focus upon patterns of water use between provinces. Table 6 shows that Ontario accounts for over 47% of the total Canadian industrial water intake of 5,677 mgd, followed by Quebec, with 20% of the total, and British Columbia with 17%. In contrast, Prince Edward Island accounts for an insignificant proportion of the total. This distribution of water intake among the provinces is to be expected, given the geography of Canadian industry.

Table 7 analyzes the data of Table 6 with respect to use rates and consumption rates. In general, the use rates in the Atlantic region, i.e. the four eastern provinces, are among the lowest in Canada. This result occurs for a variety of reasons. It may be because water is more readily available in the Atlantic region, reducing the need to recirculate water. It may also occur because of the industrial mix of the region in that industry groups with higher use rates, such as petroleum and coal products industries and chemical and chemical products industries, are not predominant here. Finally, the industrial base of the Atlantic region tends to be older than that in the rest of Canada and thus employs some older technological methods which do not recirculate large amounts of water. The low use rate for Ontario is probably due to a generally plentiful water supply because of proximity to the Great Lakes. The use rates for the three Prairie provinces are substantially higher

Table 6. Manufacturing Water Use by Province (mgd)*

Province	Total water intake	Recirculation (imputed)	Total gross use	Consumption (imputed)	Total water discharge
Newfoundland	232	343	575	7	225
Prince Edward Island	7	1	8	-	7
Nova Scotia	212	151	363	9	203
New Brunswick	231	325	556	4	227
Quebec	1,133	1,647	2,780	44	1,089
Ontario	2,646	2,246	4,892	105	2,541
Manitoba	82	221	303	6	76
Saskatchewan	34	147	181	5	29
Alberta	157	527	684	20	137
British Columbia	943	1,767	2,710	39	904
CANADA TOTAL	5,677	7,375	13,052	239	5,438

*Blanks refer to negligible withdrawal.

than those in the rest of Canada, due at least in part to a semi-arid climate. The scarcity of water increases the need for water conservation efforts, such as greater recirculation of water, by plants in this region. The use rate for British Columbia is lower than the Prairies, but above the national average, probably reflecting the industrial mix and locational patterns of industry in this province.

Table 7. Use Rates and Consumption Rates by Province

Province	Use rate	Consumption rate (%)
Newfoundland	2.5	3.0
Prince Edward Island	1.1	-
Nova Scotia	1.7	4.2
New Brunswick	2.4	1.7
Quebec	2.5	3.9
Ontario	1.9	4.0
Manitoba	3.7	7.3
Saskatchewan	5.3	14.7
Alberta	4.4	12.7
British Columbia	2.9	4.1
CANADA AVERAGE	2.3	4.2

$$\text{Use rate} = \frac{\text{total gross water use}}{\text{total water intake}}.$$

$$\text{Consumption rate} = \frac{\text{total water consumption}}{\text{total water intake}} \times 100\%.$$

Consumption rates vary substantially among provinces, ranging from 1.7% in New Brunswick to 14.7% in Saskatchewan. No figure is given for Prince Edward Island because the amounts of water are so small that the results would not be reliable. The most notable point in comparing the consumption rates among provinces is the occurrence of high rates in the three Prairie provinces vis-à-vis the rest of Canada. These higher rates reflect high evaporation rates in the summer owing to greater recirculation, which in turn is due to frequent water shortages.

Table 8 shows how the total water intake is distributed among sources within various provinces. The four Atlantic provinces exhibit a slightly greater dependence upon public water supplies than do other regions in Canada. Some 22% of industrial water in that region is withdrawn from public systems, as opposed to an average of 17% nationally and a low of 8% in B.C. Firms in the Atlantic region withdraw less water (44%) from their own fresh water supply systems than the national average of 76% and than Ontario (79%) and Quebec (81%). It appears that the smaller plants in the Atlantic region rely more heavily upon the public systems than larger plants in Ontario, Quebec and B.C. The Prairie provinces and B.C. satisfy

Table 8. Water Intake by Source for Province (mgd)*

Province	Public water system	Private surface system	Private groundwater system	Brackish (private)	Estimating error†	Total
Newfoundland	68	112	2	50	-	232
Prince Edward Island	2	2	1	2	-	7
Nova Scotia	50	48	5	109	-	212
New Brunswick	30	148	4	45	4	231
Quebec	181	921	13	2	16	1,133
Ontario	504	2,099	18	2	23	2,646
Manitoba	16	46	20	-	-	82
Saskatchewan	11	22	1	-	-	34
Alberta	21	130	6	-	-	157
British Columbia	77	775	25	66	-	943
CANADA TOTAL	960	4,303	95	276	43	5,677

*Blanks refer to negligible withdrawals.

†Estimating errors arose due to rounding in the estimation program.

more of their water needs than other provinces from fresh groundwater, withdrawing 4% of their total intake from this source. The national average is about 1% of total withdrawals from this source.

Table 9. Water Discharge by Point of Discharge by Province (mgd)*

Province	Public sewer	Freshwater body	Tidewater body	Ground	Estimating error†	Total
Newfoundland	3	35	187	-	-	225
Prince Edward Island	1	1	5	-	-	7
Nova Scotia	6	5	189	-	3	203
New Brunswick	4	60	159	1	3	227
Quebec	198	792	89	9	1	1,089
Ontario	225	2,301	-	7	8	2,541
Manitoba	21	52	-	2	1	76
Saskatchewan	7	21	-	1	-	29
Alberta	41	94	-	2	-	137
British Columbia	14	464	416	9	1	904
CANADA TOTAL	520	3,825	1,045	31	17	5,438

*Blanks refer to negligible withdrawals.

†Estimating errors arose because of rounding in the estimation program.

Table 9 shows how industry disposes of its water after use. In the Atlantic region and B.C., plants rely heavily upon discharge to the ocean, while plants located in inland provinces do not of course have this option. The inland provinces rely substantially upon discharge to surface water. In all provinces, a small proportion of wastewater is discharged to public systems, usually by the smaller firms.

SUMMARY OF RESULTS AND CONCLUSIONS

On the basis of this survey, water use by major manufacturers in Canada totals 5,677 mgd. The aggregate use rate is 2.3, which gives a total gross water use of 13,052 mgd. The consumption rate is 4.2 or some 239 mgd. This leaves a total discharge of 5,438 mgd.

As this survey was the first of its type in Canada, it is worthwhile discussing the validity of the results. As part of a study done in 1972 of water needs in various Canadian economic sectors, water use was estimated for the Canadian manufacturing industry in 1970. The methodology used in that project was to develop water use coefficients per employee from the 1968 U.S. survey of Water Use in Manufacturing and to multiply these

coefficients by employment for Canadian manufacturers. The results indicated that the total estimated water intake for the Canadian manufacturing industry was 6,944 mgd in 1970. It is not possible to compare the totals of the 1972 project to the results which were obtained through the water use surveys. The principal reason for this lack of comparability is that the method of selecting the firms surveyed was different from the method used in the 1972 survey, with the result that many of the firms for which 1970 water use figures were estimated were not included in the actual survey, which was carried out at a later date. However, it is possible to draw conclusions from examining use rates and consumption rates. In the 1970 estimates, the use rate calculated from the estimated figures was 2.4 and the consumption rate was 6.4% of total intake. It is clear that the use rate of 2.3 found as a result of the 1972 survey is very close to that which was estimated for 1970. The consumption rate of 6.4% found in the estimates is somewhat higher than the 4.2% consumption rate based on the 1972 survey, however, the difference between these two rates is not substantial in terms of the amount of water consumed. Since the survey has been completed for Alberta, it is possible to compare the total water intake estimated in the 1971 exercise with the survey results. The 1971 estimated total intake was 160 mgd for Alberta, while the survey showed total intake to be 157 mgd. On the basis of aggregated data, it appears that the survey results are reasonably consistent with those of the United States.

The survey enables an important conclusion to be drawn on estimating water use by means of coefficients. The above facts showed that an earlier industrial water use estimation exercise approximated some of the parameters of water use found via survey. In the course of preparing this paper, however, the accuracy of the coefficients in predicting water used by individual firms was found to be poor. In many cases, the use of coefficients to estimate the volume of water used resulted in figures which were under- or over-estimated by several times. Aggregation of estimated water use by many firms allows errors to be "cancelled out," thus making the estimated total water use a reasonably accurate indicator of actual use. Therefore, in dealing with relatively small areas, such as in the planning process, coefficients based upon data from other areas or nations should not be used. This finding seems to be similar to that of Kollar and Brewer:[6]

> "One of the greatest obstacles to long-range water-resources planning is the lack of basic data on which to base judgments in regard to allocation of resources and competing waste requirements. This is especially true of the industrial sector that is so important to economic goals and their attendant development benefits. The use of foreign-country data may serve for a time, but it is no substitute for a continuing accumulation and analysis of reliable local experience and data."

[6]Kollar, K.L. and R. Brewer, "Industrial Development Through Water Resources Planning," *J. Am. Water Works Assoc.*, January, 1976, p. 690.

Statistics Canada
Environment Canada

Statistique Canada
Environnement Canada

WATER USE IN MANUFACTURING INDUSTRIES 1972

A joint survey taken
in conformity with the
Statistics Act, S.C.,
1970/1/2, c. 15.

WHERE PRECISE DATA ARE NOT AVAILABLE PLEASE USE ESTIMATES

PLEASE COMPLETE AND RETURN WITHIN 30 DAYS

KEEP ONE COPY FOR YOUR FILES

Pour un questionnaire dans l'autre langue officielle, veuillez communiquer avec
la Division des industries manufacturières et primaires, Statistique Canada,
Ottawa K1A 0V6

SECTION A: GENERAL INFORMATION

1. All Information requested relates to your fiscal year which ended between April 1, 1972 and March 31, 1973.
2. This water use questionnaire is collected under the authority of the Statistics Act which guarantees the confidentiality of your return. *THE ACT STATES THAT THE FILING OF A COMPLETED RETURN BY THIS ESTABLISHMENT IS COMPULSORY.*
3. Under section 11 of the Statistics Act an agreement has been made with the Department of the Environment for the exchange of data reported herein. *SUBJECT TO YOUR APPROVAL. UNLESS YOU OBJECT IN WRITING AND MAIL YOUR LETTER TOGETHER WITH THE COMPLETED QUESTIONNAIRE TO STATISTICS CANADA*, the Manufacturing and Primary Industries Division of Statistics Canada will share the data with the Department of the Environment. The Department of the Environment will share the data with provincial agencies listed in the covering letter *UNLESS YOU OBJECT IN WRITING.*

A1. Please specify the physical location of this plant. In a town or city, please give the street address. Otherwise, please specify the physical location as either "Lot 10, Concession 6" or "Section, Township, Range", etc.

Do Not Use	010	020	030	040

A2. During the fiscal year in question, how many days was this plant in operation? 050

A3. What was the average number of hours that this plant worked per typical operating day? 060

A4. During the same fiscal year, what was the number of man-years devoted to the operation or maintenance of water pollution abatement facilities at this plant? 070

A5. Please indicate the major products made at this plant and list the type of process used so that a distinction between a product made by different processes can be made. Where the number of products exceeds the space below please list on a separate sheet.

PRODUCT	PROCESS

A6. Please indicate the value of the following expenditures made during fiscal years 1972 and 1971. Report values in Canadian dollars, omitting cents.

	FISCAL YEAR 1972	FISCAL YEAR 1971
Gross investment for new process or new abatement equipment made at this plant and eligible for accelerated writeoff as Class 24 assets as defined by the *Income Tax Regulations*	080	090
Capitalized repair expenditures made at this plant's water pollution abatement facilities	100	110
The dollar value of research and development expenditures made at the *COMPANY LEVEL*. Includes expenditure made on behalf of new production processes or on new abatement techniques		

A7. Please check here ☐ if any expenditures have been made at this plant for water pollution abatement, (includes expenditures made for new production processes or for treatment facilities), during fiscal years 1968 to 1970 120

SECTION B: WATER INTAKE BY KIND AND SOURCE

In this section please report the quantity of new water brought into your operation. For the purposes of this questionnaire, new water is defined as *water introduced for the first time in this operation, regardless of quality or source.*

Brackish water is defined as *water containing more than 1000 parts per million of dissolved solids.*

Include in item B1 below the amount of water supplied by any type of water utility which serves either the general public or industry (or both).

In items B2 to B4 below, include water obtained from your own water supply system and your portion of water obtained from any joint water supply system. *EXCLUDE WATER RECIRCULATION IN YOUR PLANT.*

SOURCE PLEASE INDICATE ESTIMATES BY AN 'E' AFTER FIGURE.	IMPERIAL GALLONS/ AVERAGE OPERATING DAY	
	FRESH	BRACKISH
B1. Water utility system. Enter the name of the municipality or utility.	205	
210 220 230 240		
B2. Self-supplied surface water system. Enter the name of the (freshwater) river or lake:	215	
250 260 270 280		
B3. Self-supplied groundwater system. Enter location of wells, deep springs, etc.	225	325
290 300 310 320		
B4. Self-supplied tidewater (salt water) system. Enter name of estuary, bay, or ocean:		335
330 340 350 360		
B5. Mine water	245	345
B6. Other; please identify and enter location:	255	355
370 380 390 400		
B7. *TOTAL WATER INTAKE* (Sum of B1 to B6)	299	399

B8. Was any water intake treated prior to use? YES ☐ NO ☐ 410

B9. If the answer to question B8 was YES, please provide the following information:

TREATMENT METHOD	IMPERIAL GALLONS/ AVERAGE OPERATING DAY	
1.	420	430
2.	440	450
3.	460	470
4.	480	490

B10. What percentage of your water intake was purchased? 500 %

If some or all of your water intake was purchased, please indicate whether the price you paid was calculated on a flat rate basis ☐; or a metered basis ☐; or both ☐. 510

SECTION C: WATER USE BY PURPOSE

PURPOSE	IMPERIAL GALLONS/ AVERAGE OPERATING DAY	
PLEASE INDICATE ESTIMATES BY AN 'E' AFTER FIGURE		
C1. PROCESS WATER. *Includes all water which comes in direct contact with products and/or materials. It is further defined to include water which is consumed in milling and special processes, water which is included in final output, or water which has been used for another purpose but which is finally used as process water*	505	
C2. COOLING, CONDENSING AND STEAM. *Defined as water which does not come in direct contact with the products, materials, or by-products of the processing operation. Includes pass-through water used in the operation or cooling of process equipment (including air conditioning) and water introduced into boilers for the production of steam for process operations or electric power*	515	
C3. SANITARY SERVICE	525	
C4. OTHER USES. Please specify: _____	535	
C5. *TOTAL.* (The sum of C1 to C4)	599	

SECTION D: WATER RECIRCULATED AND REUSED BY PURPOSE

D1. Was any water recirculated or reused? YES ☐ ; NO ☐ If NO, go to section E of the questionnaire. 610

If your answer to question D1 was YES, please estimate the additional quantity of water that would have been required, by purpose, had no water been recirculated or reused.

PURPOSE	IMPERIAL GALLONS/ AVERAGE OPERATING DAY	
D2. Process	605	0
D3. Cooling, condensing, etc.	615	0
D4. Other uses; please specify: _____	625	0
D5. *TOTAL.* (The sum of D2 to D4)	699	0

D6. Was the water destined for recirculation or reuse treated before actual recirculation or reuse? 620

NO ☐ ; YES ☐ If YES, what treatment methods were used?

1. _____ 630
2. _____ 640
3. _____ 650

SECTION E: WATER DISCHARGE

In this section please report the volume of *all* water routed to its ultimate discharge point.

Do not report the volume of water held in ponds, lagoons or basins and intended for recirculation or reuse *until such water is actually discharged.*

Do not include the volume of water lost through evaporation or otherwise consumed and not brought to the ultimate discharge point.

DISCHARGE POINT PLEASE INDICATE ESTIMATES BY AN 'E' AFTER FIGURE.		IMPERIAL GALLONS/ AVERAGE OPERATING DAY
E1. Public utility sewer. Enter name of the municipality:	710	705
E2. Freshwater body. Enter name of the river or lake:	750	715
E3. Tidewater (salt water) body. Enter name of estuary, bay, or ocean:	790	725
E4. Ground; including seepage from holding ponds, lagoons, etc. Enter location of wells, spray, or seepage:	830	735
E5. Transferred to other uses. Enter name and location:		745
(a)	870	755
(b)	910	799
E6. *TOTAL WATER DISCHARGED.* (The sum of E1 to E5)		

E7. Please check here ☐ if the discharge volume reported in E6 above was treated prior to discharge, and enter the volume treated in *imperial gallons per average operating day.* 950

E8. For the volume reported in E7 above, please list the water treatment methods in use at this plant, (e.g. coagulation, activated sludge, reverse osmosis), and the estimated volume of discharge treated by each method during an *average operating day. If more than one treatment method is reported, the sum of the volumes treated may add to more than the volume reported above.*

	TREATMENT METHOD	IMPERIAL GALLONS	
1.	960	970	0
2.	980	990	0
3.	1000	1010	0
4.	1020	1030	0
5.	1040	1050	0
6.	1060	1070	0

Print name of signing officer	Title of signing officer	Date
Business address if different from mailing label:		
Telephone (area code and number)	Telex number	TWX number