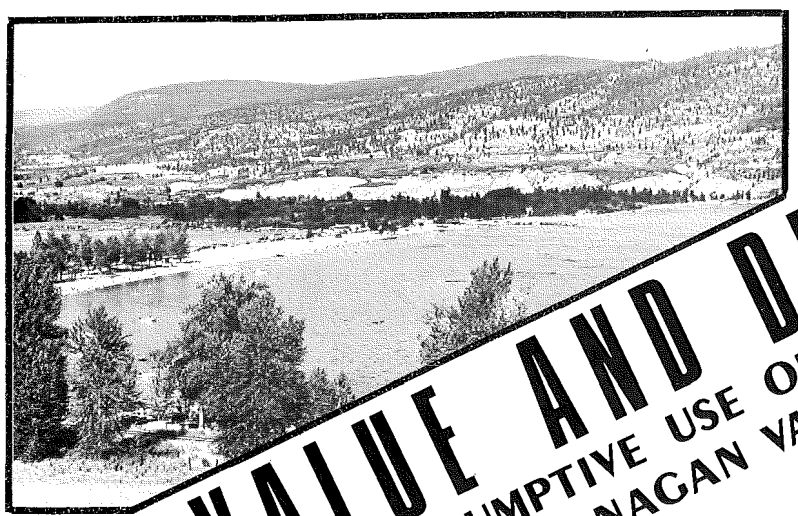
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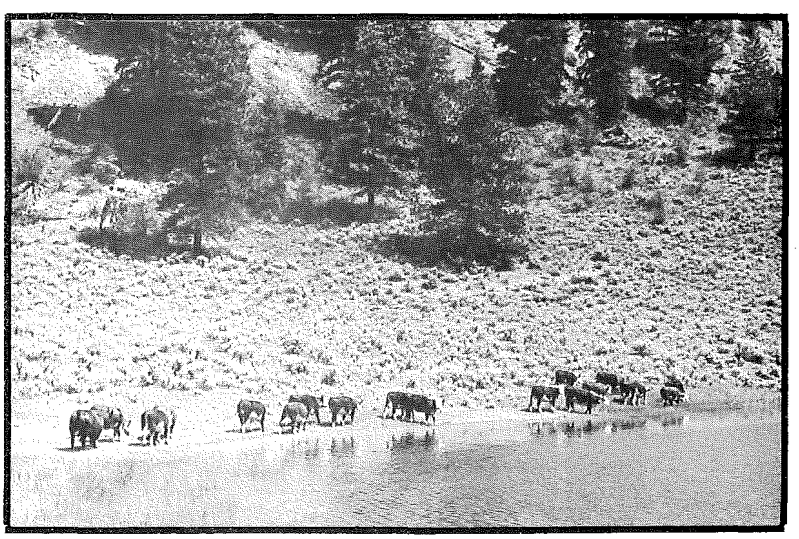
CANADA-BRITIS OKANAGAN BASIN AGREEMENT





VALUE AND DEMAND

FOR CONSUMPTIVE USE OF WATER IN THE OKANAGAN VALLEY



"Just how much worth do YOU place on water."

MARCH 1974

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Irrigation, Skaha Beach at Penticton
and Stockwatering at one of Headwater
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CANADA - BRITISH COLUMBIA OKANAGAN BASIN AGREEMENT

TECHNICAL SUPPLEMENT VII

TO THE

FINAL REPORT

VALUE AND DEMAND FOR WATER IN THE OKANAGAN BASIN

PUBLISHED BY

OFFICE OF THE STUDY DIRECTOR

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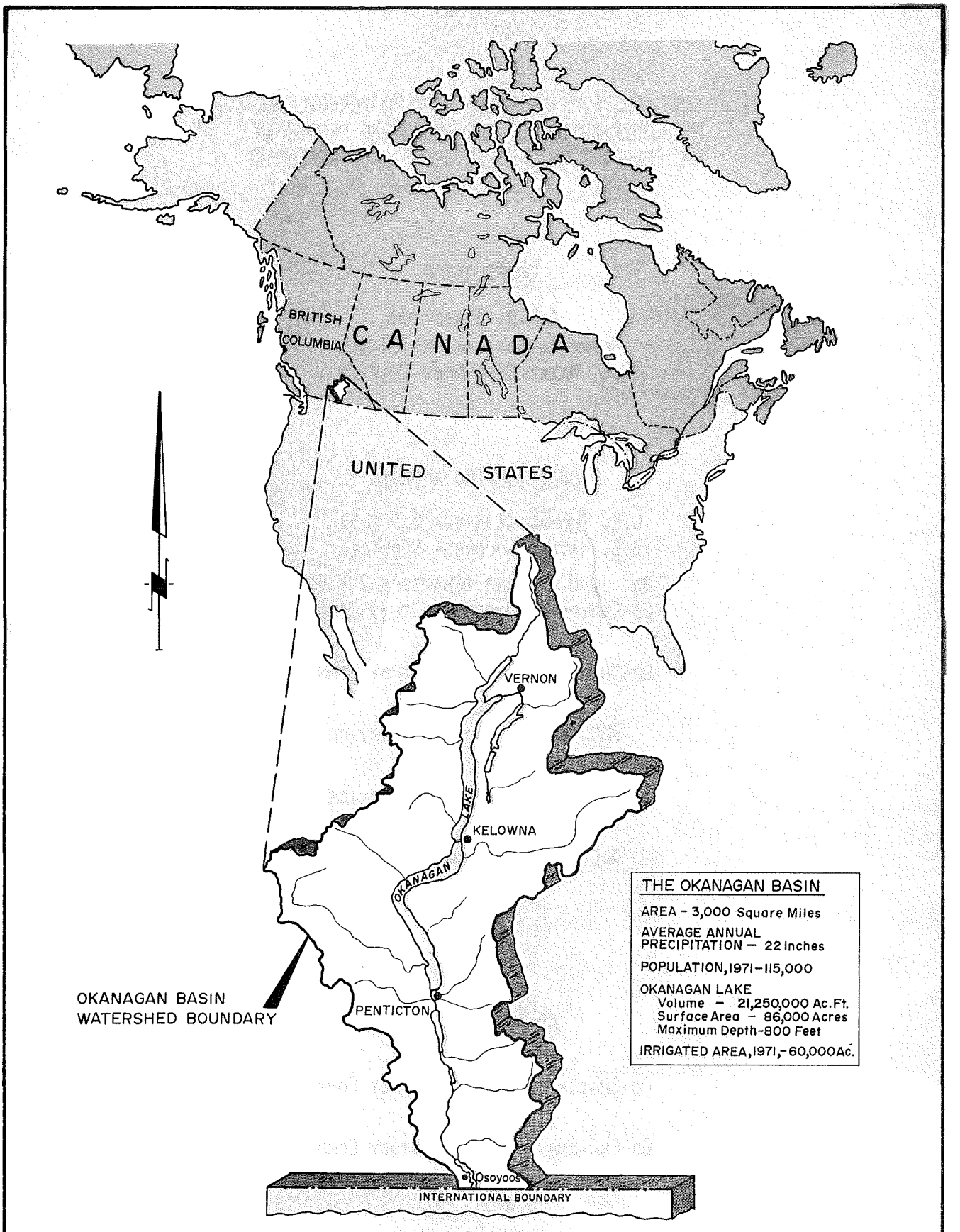
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(1974)

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Study Director



THE OKANAGAN BASIN
IN
BRITISH COLUMBIA – CANADA

Figure A

FOREWORD

This Technical Supplement discusses the value of water in the Okanagan Basin today based on an econometric model of the region, and provides estimates of present and future water requirements within the basin. Two independant reports concerning value and institutional constraints with respect to water management are also included as Appendix C (Water Allocation in British Columbia, An Economic Assessment of Public Policy) and Appendix D (Institutional and Financial Studies). Other Study publications are listed on the inside front cover of this report.

The material presented in this supplement supercedes that of all earlier preliminary reports or publications prepared under the Canada-British Columbia Okanagan Basin Agreement.

A. M. Thomson
Study Director

TABLE OF CONTENTS

FORWORD
TABLE OF CONTENTS
LIST OF TABLES
LIST OF FIGURES
GLOSSARY OF TERMS

PART I VALUE AND COST OF WATER 1

CHAPTER 1 INTRODUCTION 3
CHAPTER 2 WATER RESOURCE VALUATION THEORY 5
2.1 Water as a resource 7
2.2 Valuation problems in Alternative Uses 7
2.2.1 Physical Characteristics of Supply and Use 7
2.2.2 Economic Characteristics of Supply and Utilization 8

CHAPTER 3 ESTIMATING THE VALUE OF WATER 9
3.1 Methods 9
3.1.1 Market Prices 9
3.1.2 Residual Imputation 9
3.1.3 "Alternative Cost" Approach 9
3.2 The Model Developed for the Okanagan Basin Study 10
3.3 Estimated Water Values 11
3.3.1 General 11
3.3.2 Value of Water for Irrigation 13
3.3.3 Value of Water for Industry 16
3.3.4 Value of Water for the Service Sector 17

CHAPTER 4 COST OF WATER IN THE OKANAGAN 19
4.1 Costs of Irrigation Water 19
4.2 Cost of Water in the Service Sector 23
4.3 Cost of Water for Industrial and Commercial Uses 24
4.4 Cost of Water for Fisheries, Recreation and Other Non-Consumptive Uses 24
4.5 Water Licence Fees 26

PART II EFFECT OF PROJECTED GROWTH ON WATER USE REQUIREMENTS 29

CHAPTER 5 LAND USE 31
5.1 Present Extent of Development 31
5.2 Agricultural Capability of the Basin 32
5.3 Future Land Use 37
5.4 Indian Reserve Lands 43

Page

CHAPTER 6 METHODS FOR DETERMINING QUANTITIES OF WATER USED 49

6.1 General 49

6.2 Irrigation Use 49

6.2.1 Land Irrigated 50
6.2.2 Diversion and Farm Duties of Water 53
6.2.3 Return Flow of Irrigation Water 54
6.2.4 Present Application Practicies for Irrigation 57

6.3 Municipal and Domestic Use 58

6.3.1 Unit Requirements 58
6.3.2 Seasonal Variation in Demand 59

6.4 Industrial Use 61

6.4.1 Records Available 61
6.4.2 Requirements in Selected Industries 61
6.4.3 Seasonal Variation in Demand 63

6.5 In-Channel Requirements 63

6.5.1 Minimum Flow Requirements 63
6.5.2 Fishery Requirements 64

CHAPTER 7 WATER QUANTITY REQUIREMENTS 67

7.1 Information Required for the Okanagan Study 67

7.2 Return Flow Considerations 67

7.3 Present (1970) Requirements 68

7.4 Future Water Requirements 69

7.4.1 Irrigation 73
7.4.2 Municipal and Domestic Use 74
7.4.3 Industrial Use 77
7.4.4 In-Channel Water Requirements 79
7.4.5 Discussion of Future Requirements 79

REFERENCES 83

APPENDICES 85

APPENDIX A Background Data Tables - Water Demand Studies 87

APPENDIX B Trickle Irrigation 95

APPENDIX C Water Allocation in British Columbia: An Economic Assessment of Public Policy 101

APPENDIX D Institutional and Financial Studies 127

MAP SECTION

MAP 11 Effect of Projected Growth on Water and Water Related Resources in the Oliver-Osoyoos Regions, 1971 to 2020

MAP 12 Effect of Projected Growth on Water and Water Related Resources in the Penticton Region, 1971 to 2020

MAP 13 Effect of Projected Growth on Water and Water Related Resources in the Kelowna Region, 1971 to 2020

MAP 14 Effect of Projected Growth on Water and Water Related Resources in the Vernon Region, 1971 to 2020

LIST OF TABLES

TABLE NUMBER	TITLE	PAGE
3.1	Direct and Indirect Income Per Acre-Foot of Water Withdrawn by Economic Sector Okanagan Basin, 1970	12
3.2	Total Income and Water Use, Production for Final Demand Okanagan Basin, 1970	14
4.1	Irrigation Water Cost, 1972	20
4.2	Utility Rates for Water in Vernon, Kelowna, Oliver and Osoyoos, 1972	25
5.1	Cultivated Land for Okanagan Drainage Basin and Surrounding Areas (1970)	33
5.2	Classification of Land Within Irrigation Districts and Municipalities, Okanagan Basin (1970)	34
5.3	Map and Overlay Descriptions - Okanagan Basin	36
5.4	Land Use in the Okanagan Basin, 1970	37
5.5	Economic Growth Indicators to the Year 2020	41
5.6	Population and Agricultural Statistics, 1970-2020	42
5.7	Irrigated and Potential Irrigable Land Okanagan Basin Indian Reserves	43
5.8	Water Sources for Existing and Potential Irrigable Indian Reserve Land	46
5.9	Summary of Irrigated and Potentially Irrigable Land and Consumptive Use Requirements Therefore on Indian Reserves in the Okanagan River Basin	47
6.1	Agricultural and Irrigated Land by Region (1970)	50
6.2	Irrigated Crop Acreages by Region (1970)	52
6.3	Coefficients for Estimating Monthly Withdrawals and Return Flows for Agricultural Use in all Regions	54
6.4	Annual Domestic Water Requirements by Region - 1970	59
6.5	Coefficients for Estimating Monthly Withdrawals and Return Flows by Region for Municipal and Domestic Use	60
6.6	Present-Day Industrial Water Use by Sector	62
6.7	Annual Industrial Water Requirements by Region 1970	61
6.8	Coefficients for Estimating Monthly Consumptive Use for Industrial Purpose	63
6.9	Summary of Fishery and Minimum Flow Requirements for the Okanagan River in British Columbia	65
6.10	Water Requirements-Mainstem Okanagan River for 1970 development and 2020 Growth Projections for Present and Improved Operating Conditions	66

TABLE NUMBER	TITLE	PAGE
7.1(a)	Diversion (Withdrawal), Consumptive Use & Return Flow for Okanagan Basin in British Columbia	70
7.1(b)	Diversion (Withdrawal), Consumptive Use and Return Flow for Okanagan Basin in British Columbia	70
7.2	Present (1970) Consumptive Use Requirements in Okanagan Lake Basin and Total Water Requirements Okanagan River Basin in Canada	71
7.3	Duty of Water for Irrigation	74
7.4	Irrigated Land by Region in Okanagan Basin 1970 and Projections to 2020	75
7.5	Consumptive Use Requirements in the Okanagan Basin 1970 and Projection to 2020	76
7.6	Trends in Domestic Water Withdrawals in the Okanagan Basin, 1970 to 2020	77
7.7(a)	Consumptive Use Requirements in the Okanagan Lake Drainage and Total Water Requirements for Okanagan River Basin in Canada	80
7.7(b)	Consumptive Use Requirements in the Okanagan Lake Drainage & Total Water Requirements for Okanagan River Basin in Canada	81
A.1	Estimated Water Use in the Okanagan Valley in Acre-Feet	89
A.2	Water Withdrawal and Consumption by Sub-Basin	89
A.3	Agricultural Water Use by Tributary	90
A.4	Agriculture Water Use from Non-Tributary Sources	91
A.5	Domestic Water Use by Tributary Source	92
A.6	Domestic Water by Non-Tributary Sources	93
A.7	Industrial Water Use by Sector	94
A.8	Regional Distribution of Industrial Water Use	94
B-1	Comparative Costs of Farm Irrigation Systems	98

LIST OF FIGURES

FIGURE NUMBER	TITLE	PAGE
5.1	Agricultural Land Use in Okanagan Basin, 1970	35
5.2	Location of Indian Reserve Lands Okanagan River Basin in Canada	44
6.1	Existing and Potential Irrigation within Okanagan Basin	51
7.1	Comparison of Present and Future Total Water Requirements in the Okanagan Basin for Various Economic Growth Assumptions	72

GLOSSARY OF TERMS

Definitions of terms used in this Technical Supplement are presented here. In general, terms having a common dictionary definition or those for which a definition is provided as part of the narrative, have not been included.

ACRE FOOT	A unit of volume measurement. An acre of water one foot in depth, or 43,560 cubic feet.
AQUIFER	An underground water-bearing stratum or formation
ARABLE LAND	Land that is suitable for cultivation. Land can be classed as arable without requiring irrigation.
CONSUMPTIVE USE	The water that is consumed by evaporation from the field, transpiration through a plant, or that is absorbed by plant tissue and does not return to the valley in the form of water.
CONVEYANCE LOSS	The amount of water lost between the point of diversion and the point of use.
CUBIC FOOT PER SECOND (C.F.S.)	A unit of measureement for flow of water. One cubic foot per second is equal to the discharge of a stream having a cross-section of one square foot and flowing at an average velocity of one foot per second. One cubic foot per second is equal to a rate of 373.9 Imperial gallons per minute. One cubic foot per second flowing for 24 hours is equal to a volume of 1.98 acre-feet.
CULTIVATED LAND	Arable land that is actually cultivated at the time of reference.
DEMAND	The amount of water called for by users, usually expressed in cubic feet per second, or gallons per minute. The term may be qualified as "peak demand", or "average daily demand"; and may apply to the amount diverted, the amount consumed, or the amount required for non-consumptive uses. Because of losses and inefficient operation, demands usually exceed requirements.
DIVERSION	The place where water is taken from a stream, a lake or a groundwater aquifer. The volume withdrawn, usually expressed in acre-feet.
DIVERSION DUTY	The volume of water, including conveyance loss, that has to be diverted from the source to meet unit needs. Usually expressed in acre-feet per acre per year.

DUTY OF WATER	The amount of water required per unit area to sustain crop growth, with due allowance for losses. Usually expressed in acre-feet per acre per year.
EVAPORATION	The process whereby water in a lake or a stream or on the ground becomes atmospheric vapour
FARM DUTY	The duty of water supplied to the farm or orchard to serve a cropped area. It is the crop irrigation requirement plus farm waste and deep percolation, but does not include conveyance losses.
GROUNDWATER	Water in the ground that is in the zone of saturation from which wells, springs and groundwater runoff are supplied.
HORTICULTURE	Market gardening, nurseries and vegetable growing.
IN-CHANNEL REQUIREMENTS	The water needed within the river channel to keep water intakes below the surface, to allow fish to live, to promote flushing of debris, or for aesthetic reasons
IRRIGABLE LAND	Arable land suitable for irrigation
IRRIGATED LAND	Land that is being irrigated at the time of reference
NON-CONSUMPTIVE USES	Those which require water for a designated purpose (e.g. recreation, transportation, fish and wildlife, wastewater dilution, aesthetic satisfaction), but except for concomitant seepage and evaporation, do not affect its quantity within the Okanagan Basin. Non-consumptive uses often affect some of the qualities of water which give it economic value, however. Use of water for cooling reduces its quality by the increase in temperature of the return flow, for instance* Loss of availability for other uses is another factor to be considered.
ORGANIZED AREAS	Properties within the boundaries and jurisdiction of municipalities or improvement districts.
REQUIREMENT	(See "Water Requirement").
RETURN FLOW	The diverted water which is not consumed, and by underground or surface flow, finds its way again to a stream, a lake, or sub-surface aquifer to become potentially re-usable.
SOIL CAPABILITY	The potential of a particular soil type for growing crops.
TOTAL WATER REQUIREMENT	Includes all conveyance losses, consumptive use and non-consumptive use. Water Requirement may be specified as the Diversion Requirement or the Consumptive Use Requirement
TRANSPIRATION	The process whereby water is transformed to vapor through the actions of vegetation.
UNORGANIZED AREAS	Properties outside the boundaries of municipalities or improvement districts.

WITHDRAWAL (REQUIREMENT)	The water to be taken from the source at the point of diversion, including conveyance losses.

*See Reference No. 1 in List of References

PART I
VALUE AND COST OF WATER

CHAPTER 1

Introduction

So that rational decisions can be made about water resource development, the value of water in alternative uses must be estimated.

Part I of this Technical Supplement presents estimates of the value of water resources used for irrigation and industry in the Okanagan Basin. These are derived primarily from the econometric model of the region. The report also discusses the relative significance of water in the economy and the interdependencies of water demands. Water use coefficients were developed for the reference year 1970 by means of an inter-industry survey. These may serve as a basis for determining trends in water use technology and use patterns over time when compared with other statistics. The results could be used in the formulation of Provincial water policy, particularly in the area of licence fees under the Water Act.

As well as presenting derived values, the report contains a generalized review of the economic theory underlying water valuations and the objectives of estimating these values.

Covered in Part II of this Technical Supplement are water quantity requirements in the Okanagan River Basin. Quantity must be measured not only by the amount of water that is consumed and lost from the system, but by the amount that has to be diverted or withdrawn from the source of water. In addition, the so-called non-consumptive needs (for fisheries, recreation, navigation, waste disposal, etc.) must be accounted for. In the Okanagan Basin, the purely aesthetic use of water is also significant.

Consumptive uses of water such as irrigation, domestic and industrial uses have been examined under the Okanagan Basin Study to determine the present consumptive use requirements and to predict the pattern and volume of use up to the year 2020.

Non-consumptive uses, also studied, are reported in other Technical Supplements. Technical Supplement VIII covers Water-Based Recreation in the Okanagan Basin, Technical Supplement IX reviews Fishery Potentials in the Okanagan Basin, and Technical Supplement IV examines the impact of varying types of land use on water quality. Management Alternatives and Evaluations are summarized in the Main Report of the Consultative Board, Okanagan Basin Agreement.

CHAPTER 2

Water Resource Valuation Theory

2.1 WATER AS A RESOURCE

Resources are generally classified as renewable and non-renewable. Water falls within the former classification. However, unlike many other renewable resources, water is not always available at a given point when demand for it is greatest. A further characteristic is that water may vary greatly in quality, in time and location.

A competitive price (value) system allocates resources to those activities yielding the greatest economic returns. However, the mobile, flowing nature of water resources and the uncertainty of the supply make it difficult to establish the property rights upon which a market system depends. There is, therefore, no well-defined market institution to generate the prices which could serve to allocate water among a range of uses.

Value can be imputed to water resources only when its availability relative to use is restricted. In the market system, it is the competition developed by relative scarcity which establishes the value (price of a resource, and serves to channel it into those uses which yield the greatest economic return. Until recently however, water has been considered a "free" commodity, but increasing demands by an expanding population for a secure supply of water of high quality have made it more important that values be determined. Such values can then assist in the rational allocation of water.

Water is used for a variety of purposes in the Okanagan Valley, contributing to both the economic and social well-being of the Valley community. Withdrawal or consumptive water uses generally contribute to economic development, notably in irrigated agriculture, industrial and commercial uses and to some extent in domestic use. In-stream, or non-consumptive uses include sport fishery requirements, water-based recreation and general aesthetics. Water is a fundamental supporting resource for basic ecological systems. In addition, the water resource is also used to assimilate a variety of municipal, industrial and agricultural waste products.

The Okanagan Basin Study was an experiment in comprehensive river basin planning and many new techniques in resource evaluation were tested. This section of the report concentrates on discussion of the methods used to place values on withdrawal uses for irrigated agriculture, industrial and commercial

purposes. Values for non-consumptive water-based recreation are reported on in Technical Supplement VIII, while the value of water for supporting sport fishery resources is discussed in Technical Supplement IX.

Even for so-called "economic uses" of water (irrigation, industrial use), it is not easy to determine economic values for water. In traditional economic theory, the value or price of an economic commodity is related to consumers' willingness to pay. This willingness to pay is based on a complex relationship between availability of a resource, income levels and nature of demand. In British Columbia, all water belongs to the Crown, and the Province licences any right to its use under the British Columbia Water Act. Once a licence has been issued, it becomes an appurtenance to the title of the land upon which the water is to be used. The annual rental fee for the licenced quantity of water is based mainly on administration costs. Thus, payments for water are not based on economic values, but on the average costs of distribution plus a small licence charge. See also Appendix C "Water Allocation in British Columbia, An Economic Assessment of Public Policy", and Appendix D "Institutional and Financial Studies".

As the willingness-to-pay approach could not be used to determine the economic value of water for consumptive uses, other methods were investigated. The one selected in the Okanagan Study involved determining the value of water as a factor of production in various sectors of the Okanagan economy. An economic input-output model of the Okanagan was developed to project economic potential in the valley over the next 50 years (see Technical Supplement X). This model was founded on a thorough understanding of all major economic linkages between the various sectors of the regional economy, as well as outside the Basin. Thus, the total demand and value of goods and services involving water as a factor of production, could be determined. As it was difficult to isolate the specific value of water in the final production of agricultural or manufactured products, only the total values of goods and services per unit of water input were determined.

As mentioned earlier, details of methods for evaluating non-consumptive uses of water (swimming, fishing, waste disposal) are discussed in other Technical Supplements. A brief summary of these mothods is included here to complete the review of evaluation methods. The problem in evaluating non-consumptive water uses is that there is not only no indication of users' willingness to pay, but there is also no direct economic productivity function derived from such demands. Thus, neither the willingness to pay, nor productivity return approaches can be directly applied.

Consequently, a number of indirect approaches were devised. As the viewpoint of economic analysis for the Okanagan Study was considered to be the Okanagan Valley itself, different methods were used to determine user values, for residents and tourists. The value of tourist enjoyment of water-

based recreation, was related to their expenditures while in the Okanagan. To obtain the appropriate estimate of net economic value, total costs incurred by Okanagan residents while providing goods and services for tourists were deducted from gross expenditures. It is perhaps worth emphasizing that net economic values obtained by this approach really reflect the values of demand for the goods and services themselves (hotels, food, gas) rather than water-based recreation per se, but in lieu of any direct measure of the worth of such recreational activities, expenditures were used as substitute data.

In the case of residents, it was assumed that there was no direct economic return from their participation in water-based recreation in the Okanagan, as residents would probably spend most or all of this money on other economic activities in the valley in the absence of such recreational opportunities. However, it was assumed that there was an unpaid or "consumer surplus" associated with resident and possibly with tourist recreation participation. Attempts were made to assess this "social value" in dollar terms through a number of questionnaire surveys. Residents and tourists were asked to compare their satisfaction gained by all or part of a day fishing or at the beach with other recreational experiences for which they have to pay a fee, such as golf, skiing and skating. In the case of tourists, it was ensured that such stated values were over and above the estimated daily expenditures. In this way, economic and social values, both expressed in monetary terms, were determined for sport fishing, swimming and boating.

2.2 VALUATION PROBLEMS IN ALTERNATIVE USES

Having outlined various approaches to placing values on consumptive and non-consumptive water use, a number of more specific problems encountered in the valuation process should now be addressed. These problems can be grouped in three major categories:

1) Physical aspects of water supply and use;

2) Economic characteristics of supply and utilization.

2.2.1 Physical Characteristics of Supply and Use

Although water uses can generally be categorized as consumptive and non-consumptive, the distinction is not always easy to define. Substantial losses of water due to evaporation and seepage (a consumptive use) can result from storages for in-stream uses such as recreation or to provide adequate flows for fish. Furthermore, water may be used for more than one purpose at any point or time. Thus, water released from storages originally developed for irrigation supplies, can be utilized for fishery flows and for industrial or other commercial purposes in addition to agriculture. This general rule does, however, not apply to tributary streams of the Okanagan, because once

water is diverted from the stream channel, it seldom re-enters that channel, even though it will eventually return to the system when it flows into one of its lakes. Water used for agricultural purposes furthermore, is subject to considerable losses by way of evaporation, and these quantities cannot be re-used anywhere in the Basin.

2.2.2 Economic Characteristics of Supply and Utilization

The second problem in water valuation results from potential alternative uses for the resource. In the Okanagan where there are many alternative uses for the resource, one use may affect the availability of water for another in terms of quantity, time, location and quality. In general terms, it can be said that a competitive relationship between two or more users will be such that the increase in the output of one will lead to the decrease of the other. For example, water diverted from tributary streams for irrigation, can reduce flows downstream below those necessary to support the fishery. Conversely, if the quantity of water diverted is reduced to protect the fishery, there is a net loss in agricultural production.

A complementary relationship will lead to a total increase in "production". Up to a point, most recreational activities have a complementary relationship in water use, while the consumptive uses, for agriculture, industry or households, are competitive. A supplementary relationship exists where the increased use of the resource by one does not affect the output of another; for instance, a storage reservoir where increased storage does not affect navigation. In the Okanagan, like many other basins, some or even all of these relationships can be encountered and they have a direct effect on the water valuation procedure.

Variations of volume must also be considered. In economic terms, the total value of production can be greatly constrained when there is unpredictable fluctuation in water supply. Inefficiencies of production increases under such conditions and the economic value of the water decreases. If there are unexpected water surpluses, the resulting increase in value would be less than the increase from a predictable increment in available volume.

Variations in demand for water also present a problem in economic valuation. Demand for residential water or for hydro-power varies on a daily and hourly basis. Agriculture, navigation, recreation and other demands vary seasonally or cyclically.

In the Okanagan Basin, there are some obvious examples of these fluctuations in both supply and demand. In the agricultural sector, demand rises sharply as supply from spring runoff decreases. Furthermore, both the demand and supply diverge significantly from one year to the next in accordance with weather conditions. If therefore, agricultural production decreases in a "dry" year, the net value accruing to the use of water is also less.

CHAPTER 3

Estimating the Value of Water

3.1 METHODS

Several methods for determining water values are available to the economists:

3.1.1 Market Prices

As mentioned earlier, in British Columbia because of the institutional arrangements involving water rights under the British Columbia Water Act, water is not a marketable commodity. However, in the United States and in some other countries, market transactions for water do exist and can provide a useful indication of the value of water in alternative uses. The major difficulty in this approach is to isolate the value of water from related factors of production such as land. In addition, it is necessary to distinguish between instances when the transaction only deals with a specific unit of water, in contrast to the sale of the right to receive a specified volume of water indefinitely into the future (a "water right"). In the latter case, the value of water is equal to the sum of discounted values of individual units of water and obviously is much larger than the value of a given volume of water.

3.1.2 Residual Imputation

A second method is called "residual imputation". The value of an unpriced resource is computed as the residual from the total value of production after the sum of the costs of all other resources are deducted. This is the most common method applied to valuing withdrawal uses, such as irrigation. Particular difficulties arise in assigning prices to other resources for which applicable market prices are not readily obtainable, such as unimproved land, managerial and risk-bearing services and family labor. The regional income concept of water value, as used in the Okanagan Basin Study, is essentially derived by a residual imputation technique. It differs from the other accounting procedures only in that the values attributable to primary regional resources such as land, labor and entrepreneurial services are not deducted as costs from gross value of output.

3.1.3 "Alternative Cost" Approach

There is another valuation technique known as the "alternative cost" approach. Applied to public economic activity, the assumption has to be made that the value of a publicly supplied commodity is no greater than the cost of an economically feasible private alternative source of supply. Where direct estimation of value at the margin is difficult, the procedure provides a means of setting an upper limit on willingness to pay, and is widely applicable to public water project

evaluation. For example, the maximum value of water for industrial use can be estimated as the alternative cost of recycling plant effluent to meet required standards for input water. This may differ from the actual value, if the user is not willing to pay the costs of recycling, in which case, the plant would close down.

3.2 THE MODEL DEVELOPED FOR THE OKANAGAN BASIN STUDY

As noted in a previous section, water values in the Okanagan Basin were derived from an inter-industry model. This method uses the input-output analysis, which although still considered to be in the developmental stage, was undertaken to prepare a number of economic projections for forecasting water demands. Its possible value in dealing with the dynamics of river basin development have been discussed in Technical Supplement X.

The model as developed for the Okanagan Basin Study followed the accepted method of compiling an input-output table from the dollar values of all industry purchases and sales as given in specially conducted economic surveys. A basic assumption underlying the model is that the monetary values can be taken as a quantitative measure of physical purchases in real terms and that relative price changes over time, will not alter the proportion of purchases per unit of output. A further assumption made is that technological change occurs gradually so that although the dollar value matrix of transactions is prepared with data from a single year, a similar pattern of transactions can be assumed to have occurred in both preceding and succeeding years.

The input-output developed for the Okanagan Basin for the base year of 1970 is composed of three tables:

1) a flow table,
2) a table of technical coefficients;
3) an interdependency or inverse matrix.

The flow table shows the total value of output for each sector of the economy and the distribution of this output among receiving economic sectors. Each sector represents an aggregation of business units or farm enterprises producint similar goods or services. The table of technical coefficients lists the values of inputs per dollar of output for each economic sector by sector of origin. The interdependency matrix allows one to estimate both the direct and indirect requirements for output of any economic sector (in value terms), generated by a change in the value of goods delivered to final demand (export, investment, government, and tourism as opposed to inter-industry demand) by each sector.

The total value of outputs and inputs for each sector was calculated from published sources and a survey of a sample of firms in major sectors (agriculture, manufacturing, industry, primary industry and service trades). These data were translated into a flow table, which was inverted into an interdependency matrix

on a computer. From these tables, it was possible to calculate the total value of direct and indirect demands associated with each sector of the economy.

The model used in this report relates to the base year of 1970 only.

Since water use in certain sectors is relatively small, the twenty-nine sector model was aggregated to a sixteen sector model (Table 3.1). The composition of sectors is self-explanatory; note, nowever, sector sixteen - services - includes government enterprises, tourist facilities, finance, trade, personal services, and other low water-using activities.

3.3 ESTIMATED WATER VALUES

3.3.1 General

The average value of water use to the residents of the Okanagan Basin was estimated as a factor of production in each sector of the Okanagan Basin economy. Water withdrawals for the study region were compiled for the major water-using sectors under the water demand studies reported later in this report, and for specific industries under the Economic Growth Studies. These data were then aggregated and average water inputs estimated for the 16 sectors comprising the matrix. Water withdrawal for each sector was divided by sector output for the base year of 1970. The coefficients of the resulting relationships were then taken as a measure of water use per $1,000 of output.

Since each sector requires, to some degree, output from other sectors in the Okanagan economy as the final demand (exports, government, tourism, and investment expenditure, i.e., now inter-industry demand) for its product or service increases, additional income payments and water requirements are generated. In order to evaluate total income created per unit of water use in each sector, income created and water required must be calculated not only on a direct production basis, but also on an average inter-industry basis. The input-output model developed in the Economic Growth Studies provided the tool to calculate direct and indirect water requirements and income generated per dollar of output destined for export for each sector. Total income earned, directly and indirectly, for Okanagan residents per unit of water withdrawn for each sector was then obtained by dividing income by total water required per dollar of output.

Variation of direct plus indirect income earned per acre-foot of water withdrawn (Table 3.1, Column 8) relative to income earned directly among sectors (Table 3.1, Column 5) is a result of production interrelationships of higher income with lower income uses and vice versa. For example, the agricultural sectors are closely linked to services and packing houses - water uses which have a much higher income per unit of water withdrawn. Conversely, processors of agricultural products (sectors 6 to 9) purchase goods from the agricultural

TABLE 3.1

DIRECT AND INDIRECT INCOME PER ACRE-FOOT OF WATER WITHDRAWN BY ECONOMIC SECTOR

OKANAGAN BASIN, 1970

SECTOR	(1) OUTPUT ($1000's)	(2) INCOME COEFFICIENT	(3) WATER WITHDRAWN (Acre-Feet)	(4) WATER USE COEFFICIENT (Acre-feet/ $1000's)	(5) DIRECT INCOME PER ACRE-FOOT OF WATER WITHDRAWN ($)	(6) DIRECT & INDIRECT INCOME PER $1000 OF OUTPUT ($)	(7) DIRECT & INDIRECT WATER WITHDRAWN PER $1000 OF OUTPUT (Acre-Feet)	(8) DIRECT & INDIRECT INCOME PER ACRE-FOOT OF WATER WITHDRAWN ($)
1. Tree Fruits & Grapes	33671.8	.265	110,810	3.291	80.5	571	3.353	170
2. Livestock, Dairy & Field Crops	4767.6	.288	60,630	12.717	22.7	476	13.954	34
3. Vegetables & Nursery	2262.3	.421	6,300	2.785	151.2	541	2.842	190
4. Logging	3932.6	.595	100	.025	23800.0	691	.038	18184
5. Mining	26469.4	.143	1,750	.066	2166.7	180	.071	2535
6. Meat & Dairy Products	14001.9	.184	500	.036	5111.1	270	1.728	156
7. Fruit & Vegetable Canners	16002.0	.149	500	.031	4806.5	298	.692	431
8. Wineries, Soft Drinks & Distilleries	9049.1	.140	7,000	.774	180.9	263	1.150	229
9. Other Food & Beverage Industries	5119.5	.282	50	.010	28200.0	308	.206	1495
10. Sawmills	13438.7	.443	10,000	.744	595.4	629	.763	824
11. Other Wood Products	9527.0	.323	6,000	.630	512.7	581	.815	713
12. Metal Fabricating & Transport Equipment	36597.9	.119	100	.003	39666.7	147	.012	12250
13. Non-Metallic Mineral Products	13646.1	.355	400	.029	12241.4	406	.037	10973
14. Other Manufacturing	11742.3	.321	200	.020	16050.0	353	.024	14708
15. Packing Houses	12275.8	.427	1,400	.114	3745.6	535	.126	4246
16. Services	501911.5	.280	6,184	.012	23333.3	349	.047	7426

sectors which exhibit much lower income per unit of water withdrawn, and the services sector requires goods from relatively lower-valued agricultural and agricultural processing sectors.

An estimate of the direct plus indirect income produced by water use within each sector, presented in Table 3.2, Column 3, can be made by successively multiplying the final demand of each sector (Table 3.2, Column 1) by direct plus indirect water requirements (Table 3.1, Column 7) by direct plus indirect income per acre-foot of water withdrawn (Table 3.1, Column 8).

The values for water used in each sector outlined in Table 3.1 represent average values only, and as such do not reflect any seasonal or other variations. In terms of income gains and losses to the Okanagan, should there be transfers between uses, the values per acre-foot in Table 3.1 should be regarded as maximum since, to some extent, land, labor and capital could also be transferred to other uses within the Basin. Moreover, it should be stressed that these values are probably not the same as the marginal values of water in the system.

3.3.2 Value of Water for Irrigation

The water values determined for agriculture from the input-output model range from $34.00 per acre-foot for pasture and field crops to $190.00 per acre-foot for nurseries and market gardens (Table 3.1). Average values for agriculture, therefore, range from $112.00 to $131.00 per acre-foot. These values reflect the great diversity in agricultural activities and also the increased incomes that can be obtained with increased intensities of land use. Since all agricultural sectors in the Okanagan Basin are dependent on irrigation water, the values presented in this report are to be considered as representing the value of water for irrigation.

Establishing values for irrigation water presents some special problems. As is the case with water generally, market prices for irrigation water are neverencountered, so estimates of value must be based upon less direct approaches.

Crop production, with or without irrigation, is a biological process carried out in relatively uncontrolled, highly variable environments. The process therefore, is subject to the vagaries of diseases and pests and variation in daily weather conditions. Output, even within a field or an experimental plot, may vary significantly with soil texture, fertility and aspect. Soil nutrient levels and seeding rates influence the yield response to irrigation water application. Capital investments in land preparation, distribution and sprinkling systems are also important determinants of irrigation water value productivity.

Alternative crops for any given area will each exhibit a unique value productivity with respect to irrigation water. Further, for each alternative crop, there are a number of adapted varieties, and these may also respond somewhat

TABLE 3.2

TOTAL INCOME AND WATER USE, PRODUCTION FOR FINAL DEMAND[1]

OKANAGAN BASIN, 1970

SECTOR	(1) DEMAND ($1000's)	(2) PRODUCTION FOR FINAL DEMAND (Acre-Feet)	(3) DIRECT PLUS INDIRECT INCOME FROM PRODUCTION FOR FINAL DEMAND ($1000's)	(4) DIRECT PLUS INDIRECT INCOME FROM PER ACRE-FOOT OF WATER WITHDRAWN[2] ($)
1. Tree Fruits & Grapes	29854.1	100,100	17017.0	170
2. Livestock, Dairy and Field Crops	2607.9	36,391	1237.3	34
3. Vegetables and Nursery	2020.5	5,741	1090.8	190
4. Logging	-	-	-	- (18,184)
5. Mining	26031.5	1,848	4684.7	2,535
6. Meat & Dairy Products	12390.5	21,411	3340.2	156
7. Fruit & Vegetable Canners	15870.1	10,982	4733.2	431
8. Wineries, Soft Drinks & Distilleries	8077.0	9,289	2127.2	229
9. Other Food & Beverage Industries	4055.9	836	1249.8	1,495
10. Sawmills	9099.1	6,943	5721.0	824
11. Other Wood Products	7785.3	6,345	4524.0	713
12. Metal Fabricating & Transport Equipment	32897.8	395	4838.8	12,250
13. Non-Metallic Mineral Products	9540.2	353	3873.5	10,973
14. Other Manufacturing	5885.8	141	2073.8	14,708
15. Packing Houses	-	-	-	- (4,246)
16. Services	388449.9	18,257	135576.5	7,426

[1] Household Consumption, Investment, Government Spending, Tourism Expenditure and Exports.

[2] Same as Column 8, Table 3.1.

differently to water application. To some extent, this problem was overcome by aggregating crop types into broad sectors - tree fruits, horticulture, nursery crops, etc. Thus, the values in one sector represent average values of specific crop types within the sector. In addition, total direct and indirect values were taken into account, as output from one sector was reflected as an input in another. Thus, production from the horticultural sector formed one of the inputs in the food processing sector.

Finally, determination of the input-output relationship between crop yield and water application is extremely difficult, being dependent on numerous variables. However, productivity of water varies widely over the year, depending particularly upon soil moisture level and upon stage of growth of the plant. The response of plants to an application of irrigation water when the soil in the root zone is already moistened to field capacity by rainfall or by a previous irrigation, varies greatly. Water productivity tends to increase as the interval of time from the last moistening lengthens. As soil moisture is depleted, a point may be reached at which failure to irrigate would lead to complete loss of the crop. Water applied at this time is extremely valuable because the value is equivalent to the net income loss avoided by the application of irrigation water. Temporal factors, therefore, significantly affect water values. Productivity of water may also vary over the life cycle of a plant. Water application near harvest time may have little impact on yield, or may even diminish productivity by adversely affecting quality of the crop. The yield of many crops whose primary economic value is in a seed or fruit, are known to be highly sensitive to moisture availability during the period of flowering.

These characteristics of crop response to irrigation water exercise significant constraints on the determination of water resource values for irrigation in the Okanagan Basin. The formulation of a dynamic programming model which could accommodate both the multistage and the multiproduct aspects of irrigation water valuation has not yet been successful, because the number of required variables is too great for present day computer capacity.

The water use values for agriculture derived from input-output model (Table 3.1, Column 8 and Table 3.2, Column 4) illustrate the increasing value of water concomitant with an increasing intensity of land use. However, some of the values are masked because of the agricultural process involved. For instance, the production of field crops is encountered primarily in the North Okanagan area, where irrigation requirements are much lower than in the southern sections of the Basin. The type of crops grown in the north are also less sensitive to diurnal availability of moisture. Furthermore, the field crops tend to be grown as an input in the production of higher value food products. Alfalfa, corn and other crops used as silage production serve as a major input in stock rearing and dairy farming activities. Thus, the water use value of $34.00 per acre-foot (Table 3.1) actually includes income earned in all but dairy, fieldcrop

and mixed fieldcrop (forage) enterprises, in addition to the direct value of the alfalfa crop itself.

3.3.3 Value of Water for Industry

The range of values for water used by industry varies widely (Table 3.1) due to the diversity of activity and levels of technology used by different entrepreneurs. The highest values can often be correlated with industrial plants utilizing relatively low amounts of water in production processes, such as industries engaged in relatively sophisticated manufacturing and assembly activities such as motor vehicle production.

Consumptive use of water in industry is not the only consideration however. It does not account for the effect of industrial withdrawals on the quality or the time pattern of availability of return flow water. To the extent that water quality degradation prevents subsequent productive use of such water or makes its use more expensive, it forecloses on other uses. Analysis of effluent from industries in the Okanagan valley indicates that present industries to not seriously pollute surface waters, with the exception of Bryant's Creek, near Kelowna (Technical Supplement IV). Thus, these issues have to be borne in mind when referring to the values outlined for sectors 4 to 15 in Tables 3.1 and 3.2.

Determination of water values for industrial uses presents some problems due to the variety of inter-industry processes even within industries engaged in the production of identical goods. In the Okanagan, water quality for industrial purposes is as yet a relatively minor consideration. Excessively high mineral content resulting in scale buildup and corrosion of boilers is of limited significance since this type of use is limited.

Water quality is an important factor for the food processors and the wineries, soft drink bottlers and distillers (Sectors 6, 7 and 8, Tables 3.1 and 3.2). Estimation of water values for these industries have not included any allowance for costs incurred in obtaining water of a quality satisfactory for their purposes.

A further problem in valuing industrial water use is that the resource may, in some instances, be readily substituted for another since it is not a direct input in the manufacturing process. For instance, in the Okanagan, logging operations may use water for storage of logs, and although land storage is not as convenient, it can be readily adopted if water storage becomes too costly. The value of water for logging (Sector 4, Tables 3.1 and 3.2), therefore, does not disclose this problem.

Because the calculation of water values was based on the relationship between total water withdrawn (as presented in the Water Demand Studies) and income earned by sectors (obtained from the Economic Growth Studies), it was not possible to

segregate process water from other in-plant uses. The values presented therefore, are maximum for any sector. An inverse relationship between water withdrawals and values is noticeable in Table 3.1. This results from the method used for estimating values. Therefore, the unit value of water is highest among those industrial sectors where withdrawals are lowest.

3.3.4 Value of Water for the Service Sector

In the Okanagan Basin the service sector of the economy is the most rapidly expanding area of occupation for the population. The service sector comprises a very large variety of economic activities which do not concern themselves with the production of primary and consumer goods. Aside from the usual range of professional and domestic services found in any community, this sector includes all those services necessary to provide amenities to the important tourist industry in the Basin.

Although the quantity of water withdrawn and consumed by this sector is relatively small, its value is considerable. Values in the tourist portion of Sector 16 (Tables 3.1 and 3.2) do not, however, reflect the very important contribution of the lake system in attracting visitors to the Basin. This latter aspect was examined in considerable detail and is the subject of Technical Supplement VIII - Water Based Recreation and Aesthetic Resources in the Okanagan Basin. Without the aesthetic appeal of the basin lakes and streams, the value of water withdrawn for the service sector would likely be much lower than $7,426 per acre-foot.

Included in the calculation of water values for the service sector, are the amounts of water used by cities in their sprinkling systems for parks and other green areas. This form of water use differs considerably from most others in this sector, which are most closely related to domestic water uses.

For a further discussion of water valuation, see Appendix C, "Water Allocation in British Columbia: An Economic Assessment of Public Policy", and Appendix D, "Institutional and Financial Studies".

CHAPTER 4

Cost of Water in the Okanagan

While water value is a measure of its worth to the community and this may be determined in a number of ways as described in Chapter 3, it is also useful to examine the charge assessed the consumer based on costs, in various communities and areas of the Okanagan Valley. The charge to the consumer generally reflects the amortized cost of constructing the works required to deliver water to the user's property plus the cost of operating and maintaining the system, including concomitant overhead expenses. Although this cost does not represent the full value of water to the economy, it is an expression of value.

The following paragraphs present costs obtained from a number of water systems in the valley to illustrate the variation by type of use and location, and to give comparisons with the information given in Tables 3.1 and 3.2.

4.1 COSTS OF IRRIGATION WATER

Table 4.1 illustrates costs of water delivered to a user's property in irrigation districts in the Okanagan. The irrigation charge reflects the cost of operation and maintenance of the water system plus the cost of amortizing the district's share of construction expenditures.

The four irrigation districts listed have recently reconstructed their systems under terms of the federal-provincial ARDA (Agricultural and Rural Development Act) program, by which two-thirds of the approved capital costs are paid by the federal and provincial governments and only one-third is paid by the local district. Irrigation districts that are participating in the ARDA program are therefore being subsidized, and the charge for water to the irrigators is substantially less than the real cost of building, operating and maintaining the system.

To use Kaleden Irrigation District (listed under "South Central" in Table 4.1) as an example, the revenue derived from irrigation and domestic water taxes was used to repay interest and reduce the principal of the District's long-term debt, which in 1972, amounted to $117,300. The remaining $24,300 of revenue was required for operation and maintenance of the water system:

TABLE 4.1

IRRIGATION WATER COST, 1972

Selected representative irrigation districts in the Okanagan. 1972 statistics from the Improvement District Division, Water Rights Branch, British Columbia Water Resources Service.

DISTRICT	ACRES SERVED	CLASS[1] OF LAND	IRRIGATION CHARGES		AVERAGE DUTY ACRE-FEET Per ac/yr	COST OF WATER AT SERV. CONN. $/ac-ft.	APPROX. EQUIV. WITHOUT ARDA ASSISTANCE	
			TAX $/ac/yr	TOLLS[2] $/ac/yr			IRR. CHGES $/ac/yr.	WATER COST $/ac-ft.
NORTH								
Vernon Irrigation District	9150	-	27.00	-	1.75	15.40	68.00 -	38.80
NORTH CENTRAL								
Black Mountain I.D.	2556	A	25.00	-	2.5	10.00	53.00 -	21.20
	869	B	23.50	-			49.50 -	
	1404	C	11.00	-			23.00 -	
SOUTH CENTRAL								
Kaleden Irrigation District	460	A	28.00	10.00	3.5	10.90	48.00 16.00	18.30
	169	B	1.00	-			2.00	
SOUTH								
Osoyoos Irrigation District	394	-	45.00	-	5.0	9.00	82.50 -	16.50

[1] Individual irrigation districts may identify land according to certain classes or grades, depending on whether the land is irrigated or not, or if a lesser duty of water is required owing to soil or crop type.

[2] $/ac/yr - Dollars per acre per year.

1972 Revenue:

Irrigation levy	$17,000	
Domestic levy	20,300	
		$37,300

Expenditures:

To debenture interest and principal	$13,000	
Hence, to operating & maintenance costs	24,300	
		$37,300

The capital obtained by the Kaleden Irrigation District under the ARDA program totalled $371,000. Two-thirds of this was subsidized by the federal and provincial governments, leaving only $123,700 as the District's share. By 1972, this amount had been reduced to $117,300, listed as "long-term debt" on the District's balance sheet.

The actual cost of water based on the total capital cost of $371,000 is some $63,300 as shown below:

Expenditures without ARDA assistance:

To debenture interest and principal	$39,000	
To operating and maintenance costs	24,300	
		$63,300

1972 Revenue Required without ARDA assistance:

460 acres Grade A (irrigated or irrigable) classification @ $48 annual tax	$22,100	
169 acres Grade B (non-irrigable) class @ $2 annual tax	300	
Tolls on irrigated land	6,400	
Domestic taxes and tolls	34,500	
		$63,300

The above figures (rounded to the nearest $100) show that taxes and tolls on both irrigation and domestic water services would have to increase by 70 percent to support the increased expenditures if ARDA assistance were not available.

The contribution of domestic water revenue in each irrigation district's operation must also be considered. A higher unit charge is generally made for domestic use than for the same volume of water used for irrigation, and thus domestic water service may be considered to subsidize the irrigation.

We may again use the Kaleden Irrigation District as an example. The new water system for Kaleden is essentially a system of distribution pipes supplied

from Okanagan Lake by a battery of pumps. Pipelines have to be large enough to accommodate the peak demand for the various units of the system. Irrigation peak demand during the year was designed at 6.6 U.S. gallons per minute per acre irrigated, and peak hourly domestic demand may exceed 2.0 U.S. gallons per minute per connection. Since the size and capital cost of a system is largely predicted upon the peak demand, irrigation and domestic costs can fairly be compared on the basis of relative peak demand.

Irrigators in the Kaleden Irrigation District in 1972 paid taxes of $28.00 per acre plus $10.00 per acre tolls, or a total of $38.00 per acre per year for their irrigation service, up to a peak demand of 6.6 U.S. gallons per minute per acre. Domestic subscribers, on the other hand, paid $24.00 per parcel (less than 2/3 acre) in taxes plus $54.00 per connection tolls, or a total of $78.00 per connection per year for domestic service up to a peak demand of approximately 2.0 U.S. gallong per minute per connection. In many subdivisions, there are four lots per acre. Using this as a basis for comparison, we conclude that on an acre of land subdivided for four households, peak demand would be 2.0 x 4 - 8.0 U.S. gallons per minute, the charge for which would be $312.00 per year. If the same property were irrigated, annual charges would only be $38.00.

Comparing on the basis of peak demand, the ratio of cost borne by a domestic user as compared to an irrigator is ($78/2.0 U.S.gpm) : ($38/6.6 U.S.gpm), or 6.8 : 1. This ratio takes account of the greater peak domestic demand per acre of land in comparison to peak irrigation demand per acre, and therefore reflects the design criteria for the system.

A comparison may also be made on the basis of total volume used during the course of the year, though it must be remembered that some extra costs are incurred by supplying domestic water during winter months. Distribution pipes must be buried deeper for frost protection, pumping stations and reservoirs must be weatherproofed, and (depending on the design of the system and the number of pumps) unit energy charges may increase disproportionately. These considerations may modify the following results for the Kaleden Irrigation District somewhat.

The duty of water for irrigation in the Kaleden Irrigation District is 3.5 acre-feet per acre per year (Table 4.1), for which the user pays the District $38.00 in taxes and tolls; equivalent to $10.86 per acre-foot per year. From Appendix A-4, it will be seen that in 1970, 200 domestic connections at Kaleden required a withdrawal of 150 acre-feet or 0.75 acre-feet per connection. Domestic users pay a total of $78.00 a year in taxes and tolls to the District, which is equivalent to a charge of $104.00 per acre-foot. On the basis of total volume used during a year for irrigation and for domestic purpose, the ratio of charges to the domestic user as compared to the irrigator is (104.00/10.86), or 9.6 : 1.

It is clear, on any of these bases for comparison, that domestic usage subsidizes irrigation usage to a considerable extent in most irrigation districts in the Okanagan Valley. This, together with the subsidy on capital costs under the federal-provincial ARDA program, must be recognized when considering the apparent cost of water to an irrigator.

In addition to the delivered cost of water for irrigation, the grower has the expense of on-farm distribution. The capital cost of farm or orchard distribution systems is generally estimated at $200 to $300 per acre. Allowing for amortization and the cost of operation and maintenance, the distribution costs to the grower would be $35 to $50 per acre.

A further expense that only concerns the independent irrigator outside an organized district, is the cost of his water licence. The current rental for a water licence for irrigation purpose is 10¢ per acre-foot, with a minimum rental of $5.00. For an independent irrigator in the Okanagan, therefore, the water licence fees could add 17¢ to 50¢ per acre per year to his operating expenses. For irrigators within an irrigation district, of course, the water licence rental is part of the overall charge made by the district for supplying water.

The cost of irrigation water in the Okanagan Valley in an ARDA subsidized district would be between $16 and $44 per acre-foot, depending on location. Disregarding subsidies under the ARDA program (but not including the financial assistance given by domestic users in most irrigation districts, which is difficult to separate from other charges), the cost of water for irrigation could be between $50 and $90 per acre-foot, depending on the location. Reference to the information given in Table 3.1 for Sector 1 (Tree Fruits and Grapes) indicates that the actual cost of putting irrigation water on the land (whether subsidized or not) is substantially less than the value of water for irrigation derived from an appraisal of direct and indirect income. The difference can, in economic terms, be regarded as an indirect subsidy to farmers permitting them to compete with low water value areas elsewhere.

4.2 COST OF WATER IN THE SERVICE SECTOR

Most water for commercial operations and for urban and suburban house and garden use is supplied by water utilities, which in the major centers, are owned and operated by the municipal governments. Smaller areas may be serviced by a separate water utility company, by the developer of a subdivision, or in rare cases, by a private enterprise. Utilities giving service outside a single municipality are subject to provincial regulation under terms of the Water Utilities Act, 1973.

It has already been noted in Section 4.1 that in combined water supply systems in the Okanagan, domestic subscribers pay six to ten times as much for their water service as irrigators do, which makes it extremely difficult to establish the real cost for irrigation or for the domestic services that subsidize the irrigation. No attempt has been made to do so in the following paragraphs, which merely report selected rates being charged in various communities in the Okanagan Valley.

Water rates for various types of service are shown in Table 4.2 for Vernon, Kelowna, Oliver and Osoyoos as representative utilities in the Okanagan Valley. It will be seen that there is a great variation in rates, depending on the type of service and the location. Other variations, not shown in the table, include differentials for the same type of service depending whether the property served is within the municipal boundary or outside. For example, in Kelowna the rate for a single family dwelling unit inside the municipality is $5.20 a month flat rate; outside the boundary the flat rate is $5.50 a month. If the domestic service is metered however, the rate is $5.50 per month minimum, which entitles the user to use up to 401 cubic feet; plus 7 cents for each additional 133.66 cubic feet.

On the minimum rate, this domestic service in Kelowna is equivalent to a cost of $600 per acre-foot. For additional use, the rate becomes lower. Reference to the information for Sector 16 in Tables 3.1 and 3.2 show that the value derived from an appraisal of direct and indirect income for the service sector, which includes domestic and commercial use, is $7,426 per acre-foot - more than 12 times as high as the unit cost of minimum domestic service in Kelowna.

4.3 COST OF WATER FOR INDUSTRIAL AND COMMERCIAL USES

Utility tariffs show rates for a number of commercial and industrial applications, some metered and some on a flat rate basis. In general, the rates for commercial and industrial use are lower than for the same amount of water used for domestic service. As in other sectors, the charges are considerably below the value attributed to the same type of service from an appraisal of direct and indirect income for the same sectors of the economy (Tables 3.1 and 3.2). The values in Tables 3.1 and 3.2, of course, include returns to labor, land and entrepreneurial services.

4.4 COST OF WATER FOR FISHERIES, RECREATION AND OTHER NON-CONSUMPTIVE USES

It is also recognized that costs are involved in making water available for fisheries, recreation and other non-consumptive uses, but it is difficult to establish what costs are attributable to each separate use except in isolated instances where the expenditure on structures such as fish ladders, is known. Because such individual cases are not necessarily representative of the whole class, no attempt has been made to itemize them in this Technical Supplement.

TABLE 4.2

UTILITY RATES FOR WATER IN VERNON, KELOWNA, OLIVER AND OSOYOOS, 1972

TYPE OF SERVICE	RATE DOLLARS PER THREE-MONTH PERIOD			
	VERNON	KELOWNA	OLIVER	OSOYOOS
1. Family Dwelling Unit - flat rate (some are metered)	12.00	15.60	13.50	13.20
2. Auto Courts or Motels				
a) First unit	11.25	15.60	4.50	5.70
b) Each additional unit	3.50	4.50	4.50	-
3. Stores, offices and small commercial establishments	16.50	13.50 min. 6¢ per 134 cu.ft.	10.50	7.50
4. Public Halls and Clubrooms	12.00	13.50 min.	33.00	7.50
Kitchen facilities within, additional charge	6.75			

Statistics from Water Utilities Division, Water Rights Branch, British Columbia Water Resources Service

NOTE: Varying rates are quoted for commercial and industrial metered service, usually with a monthly minimum charge allowing consumption up to a specified volume, and additional charge per cubic foot thereafter.

4.5 WATER LICENCE FEES

Under the provisions of the Water Act of British Columbia, "the property in and the right to the use and flow of all the water at any time in any stream in the Province are for all purposes vested in the Crown in right of the Province, except only insofar as private rights therein have been established under licences issued or approvals given under this or some former Act." (Appendix D).

Fees and charges are made for water licences, which constitute a cost for the use of water. In most instances however, the charges are not related to the value of the water used or stored, but constitute an administrative fee. For every licence, an application fee is charged at the time of application, and annual rentals are paid thereafter. The amount of the application fee and annual rentals depend on the purpose for which the licence is issued. For instance, the application fee for domestic purpose is currently $5.00 for 1,000 gallons per day or less, and $2.00 for each additional 1,000 gallons per day or fraction thereof. Annual rentals for domestic purpose are are the same rate as the application fee. For an industrial use - for example, for cooling engines, compressors and condensers, the application fee is presently

For each 10,000 gallons a day up to 500,000 gallons.	$2.00
For each additional 10,000 gallons a day up to 1,000,000 gallons .	1.00
For each 10,000 gallons a day over 1,000,000 gallons	0.50

With a minimum application fee of $10.00.

Annual rental for the same purpose is at the same rate as the application fee, with a minimum annual rental of $10.00. The scale of fees for the various purposes (domestic, irrigation, industrial, etc.) takes cognizance of consumptive uses and non-consumptive uses, generally levying a higher rental for a consumptive use than for a non-consumptive use.

An attempt has been made to relate water licence fees to the value of the water used in the case of hydro-power. This category is significant in that over 82 percent of revenue collected from water licences is received from holders of power licences - $4,061,000 or a total $4,923,000 in 1972.

Section 5.15 of the Regulations under the Water Act provides that "the annual rentals in respect of a licence or licences issued in respect of a power development shall be computed at the rates set out and according to the plant classifications defined in Schedule "A", and shall consist of the following:

(a) a rental charge based on the construction capacity;

(b) a rental charge based on the balance of the authorized capacity, not included under construction capacity;

(c) a rental charge based on the output of the development."

Class A power plants (10,000 kilowatts capacity or over) pay rentals at the following rates:

(a)	For each kilowatt of construction capacity	$0.05
(b)	For each kilowatt of authorized capacity other than construction capacity	0.40
(c)	For each megawatt-hour of output	0.08

Prior to 1962, rentals were assessed on the plant's output only, without regard to the capacity of the power development or the potential capacity of the site under licence. The Provinces of Ontario, Quebec and Nova Scotia, on the other hand, based their rental charges on the capacity of the plant without any charge for plant output. In a study during the late 1950's, the British Columbia Water Rights Branch recognized that a capacity-based charge reflected the convenience and natural advantages of a power site, but that this alone would not be a fair charge for every situation. Electric utilities must adapt to daily and seasonal fluctuations in consumer demand. A hydro plant used for peaking must have enough capacity for the greatest demand even if it only occurs for a short time each year. Conversely, base-load plants operate at a higher annual load factor than the provincial average. It was concluded that a rental formula based on plant capacity, plant potential and on annual generation should combine the merits of both concepts while minifying their discrete disadvantages. This proposal was finally approved by the Provincial Cabinet in 1962, and with later modifications, has been in effect ever since.

Rentals for hydro power plants in British Columbia are therefore closely aligned to the value of the water used, although the amount of the rentals in relation to the value of water may still be open to debate.

For a further discussion of water licence fees, see Appendix C, "Water Allocation in British Columbia: An Economic Assessment of Public Policy", and Appendix D "Institutional and Financial Studies".

PART II

EFFECT OF PROJECTED GROWTH ON WATER USE REQUIREMENTS

CHAPTER 5

Land Use

A necessary preliminary to the determination of the quantities of water used for various purposes and its distribution within the Okanagan Valley was the delineation of land uses, and the forecasting of how land uses may change between the present and the Study horizon year 2020.

The first stage was to determine the present extent of development of the Okanagan Basin in terms of population, agricultural area and urban area. The second stage involved the determination of the agricultural capability of the Basin. The third and final stage was to determine the patterns of development alternatives foreseen for the Basin as a whole.

5.1 PRESENT EXTENT OF DEVELOPMENT

The first stage, involving the determination of the present state of development of the Basin, required the compilation of census data from the 1971 census (obtained from the British Columbia Department of Industrial Development, Trade and Commerce). A map of Enumeration Areas was also draughted in order to determine the exact distribution of the population throughout the Basin and to determine the urban population for each of the urban centers of the Okanagan Basin.

Compilation of agricultural land use data was based on Present Land Use maps compiled in 1966 by the Canada Land Inventory. The land classification codes as used by the C.L.I. program were retained in order to extend the usefulness of the work beyond the Okanagan Basin Study.

The 1966 data were transposed onto map sheets on a scale of 1:50,000 and each land use category was planimetered in order to determine the acreages. Utilizing the 1966 baseline data, the land use maps were then brought up to date by transcribing new information from colored air photographs taken in July 1970 over the entire Okanagan watershed. (Of the total watershed area flown, it is estimated that less than 2% of all cultivated land was omitted from the air photography.)

In order to meet the requirements of other agencies engaged in the Okanagan Basin Study, the study area was subdivided into three regions:

I North Okanagan - all land lying to the north of the northernmost point on Okanagan Lake. (This area does not include the Vernon Irrigation District.

II Okanagan Lake - all land adjoining the full length of Okanagan Lake,

including the City of Penticton and West Bench Irrigation District.

III Okanagan River - all land south of Okanagan Lake to the International Boundary. This area was further subdivided into three section:
   a) Okanagan Lake dam at Penticton to Skaha Lake dam,
   b) Skaha Lake dam to Testalinden Creek,
   c) Testalinden Creek to the International Boundary

In addition to the three major divisions outlined, the data presented in the accompanying tables of this report has been further aggregated to conform with the boundaries of such administrative units as irrigation districts and municipalities. (Table 5.1 describes the distribution of cultivated land for the Okanagan Drainage Basin and surrounding areas in 1970, while Table 5.2 shows the land classifications for irrigation districts and municipalities in the Okanagan Basin in 1970. See also Figure 5.1, Agricultural Land Use in the Okanagan Basin, 1970 and Maps 11, 12, 13 and 14, at the back of this report*)

Following the completion of planimetering and tabulating of acreages, an up-to-date set of maps at a scale of 1:50,000 was prepared, together with clear plastic overlays to be used in conjunction with other maps as described in Table No. 5.3.

The land use inventory based on the Canada Land Inventory's Present Land Use maps and more recent information from 1970 colored air photography, summarizes the areas of the Okanagan Basin presently under cultivation. This area does not necessarily coincide with the total area presently under irrigation. However, two land use categories, identified as "H" and "G" in Tables 5.1 and 5.2, represent forms of agriculture which require intensive application of irrigation water.

Distribution of population within the Basin was derived from the 1971 census data and maps of Enumeration Areas, coupled with inspection of the 1970 color air photographs. From this information, "urban" areas were identified on the map series described in Table 5.3. (See also Maps 11, 12, 13 and 14).

5.2 AGRICULTURAL CAPABILITY OF THE BASIN

The Canada Land Inventory information was also used to determine the agricultural capability of the Okanagan Basin. By identifying the arable land in use at the present time, the arable land available for possible future development was determined.

It will be seen from Table No. 5.4 that the total arable potential in the Okanagan Valley is 272,000 acres, of which a total of 157,000 acres lies below elevation 1800. Above this elevation, climatic conditions severely limit agricultural crop production. These figures include lands presently developed in

* Selected maps from Map Section of Main Report

TABLE 5.1

CULTIVATED LAND FOR OKANAGAN DRAINAGE BASIN AND SURROUNDING AREAS (1970)

LOCATION	LAND CLASSIFICATIONS WITHIN WATERSHED					LAND CLASSIFICATIONS OUTSIDE WATERSHED*				
	H	G	A	P	TOTAL (acres)	H	G	A	P	TOTAL (areas)
NORTH OKANAGAN										
Organized Area	46	--	498	-	544	-	12	120	36	168
Unorganized Area	943	40	16,349	3,424	20,756	82	865	2,416	34,200	37,563
Totals	989	40	16,847	3,424	21,300	82	877	2,536	34,236	37,731
OKANAGAN LAKE										
Organized Area	1,155	23,401	282	16,508	41,346	-	-	-	-	-
Unorganized Area	409	3,044	377	11,769	15,599	-	-	-	-	-
Totals	1,564	26,445	659	28,277	56,945	-	-	-	454	454
OKANAGAN RIVER										
North Section:										
Organized Area	-	719	-	501	1,220	-	-	-	-	-
Unorganized Area	44	296	-	1,204	1,544	-	-	-	-	-
Totals	44	1,015	-	1,705	2,764	-	-	-	535	535
Middle Section:										
Organized Area	36	2,684	-	12	2,732	-	-	-	-	-
Unorganized Area	372	770	-	2,042	3,184	-	-	-	-	-
Totals	408	3,454	-	2,054	5,916	14	2,672	-	3,934	6,620
South Section:										
Organized Area	-	3,268	-	127	3,395	-	-	-	-	-
Unorganized Area	-	1,354	-	1,168	2,522	-	-	-	-	-
Totals	-	4,622	-	1,295	5,917	-	185	-	10,943	11,128
Total for River Section	452	9,091	-	5,054	14,597	14	2,857	-	15,412	18,283
Total Organized Area	1,237	30,072	780	17,148	49,237	-	12	120	36	168
Total Unorganized Area	1,768	5,504	16,726	19,607	43,605	82	865	2,416	34,200	37,563
Total Cultivated Acreage	3,005	35,576	17,506	36,755	92,842	96	3,734	2,536	50,102	56,468

*1. "Outside Watershed" refers to the areas outside the Okanagan Drainage Basin which are covered by the 1:50,000 scale maps in the series 82 E/3-14 and 82 L/3-14.

2. G - Orchards and Vineyards - tree fruits and grapes
H - Horticulture - vegetables, market gardens, nurseries, flowers.
A - Cropland - sugar beets, potatoes, associated fallow and land in the process of being cleared for cultivation
P - Improved Pasture and Forage Crops - hay, alfalfa, etc.

TABLE 5.2

CLASSIFICATION OF LAND WITHIN IRRIGATION DISTRICTS AND MUNICIPALITIES, OKANAGAN BASIN (1970)

LOCATION	IRRIGATION DISTRICT OR MUNICIPALITY	LAND CLASSIFICATION (acres)				
		H	G	A	P	Total
NORTH OKANAGAN						
Northern end of watershed to northern end of Okanagan Lake	Armstrong Municipality	46	-	498	-	544
	TOTAL	46	-	498	-	544
OKANAGAN LAKE						
Northern end of Okanagan Lake to southern end of Okanagan Lake	Vernon I.D.	450	2,656	282	8,840	12,226
	City of Vernon	2	4	-	99	105
	South Vernon I.D.	38	12	-	311	361
	Oyama I.D.	-	429	-	67	496
	Wood Lake I.D.	-	452	-	180	632
	Winfield & O.K.Center I.D.	-	1,680	-	124	1,804
	Glenmore I.D.	-	1,488	-	1,149	2,637
	Ellison I.D.	8	353	-	466	827
	Scotty Creek I.D.	-	412	-	828	1,240
	Black Mountain I.D.	303	2,775	-	1,128	4,206
	Brent Davis I.D.	42	134	-	128	303
	Bankhead I.D.	-	30	-	-	30
	City of Kelowna	4	245	-	143	392
	S.E. Kelowna I.D.	189	3,456	-	333	3,978
	O.K. Mission I.D.	4	340	-	195	535
	Lakeview I.D.	38	955	-	68	1,062
	Westbank I.D.	7	1,262	-	82	1,351
	Peachland I.D.	2	521	-	91	614
	Meadow Valley I.D.	-	-	-	521	521
	Summerland Municipality	50	3,263	-	585	3,897
	Trout Creek I.D.	-	139	-	-	139
	Naramata I.D.	-	1,055	-	77	1,132
	City of Penticton	14	1,426	-	1,093	2,533
	West Bench I.D.	4	314	-	-	318
	TOTAL	1,155	23,401	282	16,508	41,339
OKANAGAN RIVER						
North - southern end of Okanagan Lake to southern end of Skaha Lake	Shuttleworth Creek I.D.	-	53	-	133	186
	Okanagan Falls I.D.	-	119	-	103	222
	Kaleden I.D.	-	547	-	265	812
Middle - southern end of Skaha Lake to Oliver Hydrometric Station (Testalinden Creek)	S.O.L.I.D. (northern portion)	36	2,596	-	12	2,644
	Black Sage I.D.	-	88	-	-	88
South - Oliver Hydrometric Station to International Border	S.O.L.I.D. (southern portion)	-	2,800	-	59	2,859
	Osoyoos & East Osoyoos I.D.	-	344	-	68	412
	Boundary Line I.D.	-	124	-	-	124
	TOTAL	36	6,671	-	640	7,347
TOTALS		1,273	30.072	900	17,160	49,405

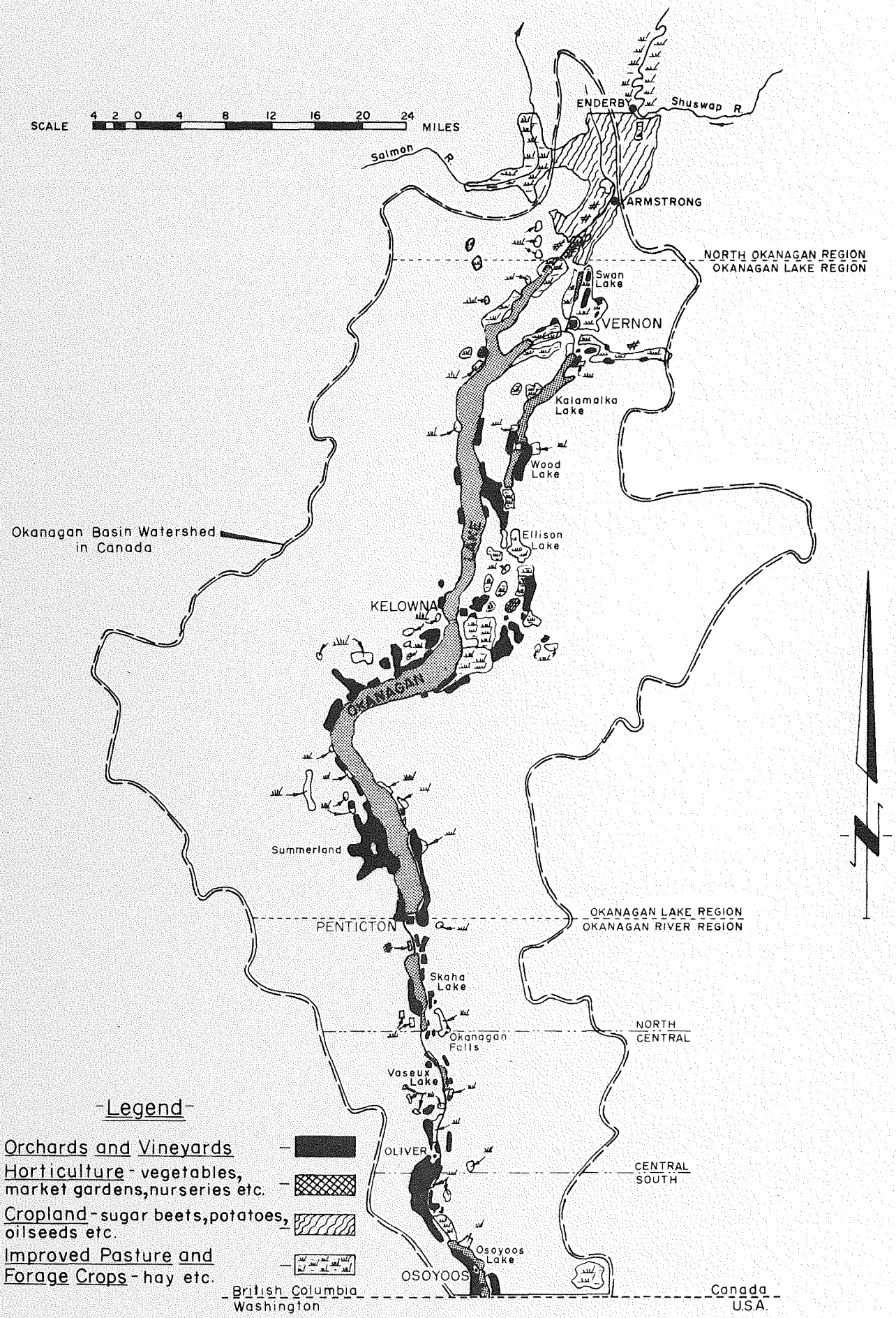
1. "Outside Watershed" refers to the areas outside the Okanagan Drainage Basin which are covered by the 1:50,000 scale maps, in the series 82 E/3-14 and 82 L/3-14.

2. H - Horticulture - vegetables, market gardens, nurseries, flowers

   G - Orchards and Vineyards - tree fruits and grapes

   A - Cropland - sugar beets, potatoes, associated fallow and land in the process of being cleared for cultivation.

   P - Improved pasture and Forage Crops - hay, alfalfa, etc.



AGRICULTURAL LAND USE IN OKANAGAN BASIN, 1970

Figure 5·1

TABLE 5.3

MAP AND OVERLAY DESCRIPTIONS - OKANAGAN BASIN

TITLE	SCALE	SOURCE	CONTENTS
Base Map	1:50,000	National Topographic System map sheets	a) Standard topographic information and land cultural features b) Outline of Okanagan Basin Watershed
Overlay No. 1	1:50,000	National Topographic System Map sheets	a) 1,800' elevation contour line b) Provincial Forest areas c) Indian Reserves NOTE: b) and c) were included here to be used in further studies.
Overlay No. 2	(same scale as source)	Canada Land Inventory "Soil Capability Classification for Agriculture" maps (revised 1972-73)	a) Group 1 - classes 1 to 3 inclusive (class 0 - organic soils, also included in Group 1). b) Group 2 - class 4 only
Overlay No. 3	1:50,000 (same scale as source)	Preliminary Report No. 9 (Task 202) Okanagan Basin Agricultural Land Use" (Published Sept, 1972)	a) Summary of areas presently under cultivation (i.e. orchards and vineyards, horticulture, cropland and improved pasture and forage crops) and "Urban" areas.

NOTE: Copies of the above maps and overlays are located in the Victoria Office of the Water Investigations Branch of the British Columbia Water Resources Service.

dryland farming or under irrigation, and allow for the 56,540 acres of prime agricultural land already removed from production for use as residential, commercial and industrial subdivisions and highway rights-of-way.

TABLE 5.4

LAND USE IN THE OKANAGAN BASIN, 1970

		Acres	%
FORESTS -			
Sustained Yield Units	1,067,000		
Tree Farm Licences	286,000		
		1,353,000	68.3
RANGELAND (not forested)		289,140**	14.6
AGRICULTURE -			
Irrigated	60,070		
Dryland Farming	26,000		
Undeveloped below 1800 elevation	71,000**		
Undeveloped above 1800 elevation	114,930		
TOTAL Arable Potential		272,000	13.7
LAKE SURFACE AREAS		104,000	5.3
URBAN - Cities, Highways, etc.		56,540	2.9
TOTALS		1,980,000	100.0

** Some undeveloped arable land, particularly lying above elevation 1800, may be used as rangeland and hence is included twice in this tabulation.

5.3 FUTURE LAND USE

As described in Technical Supplement X, "Economic Growth Projections in the Okanagan Basin", economic projections were developed for the Valley to provide an information base for forecasting demands for the Okanagan water resource and to permit an assessment of the capability of the resource to supply these demands. Population, agricultural and industrial growth within the basin were forecast between 1970 and the Study horizon year 2020, utilizing the following assumptions.

Recognizing that the Okanagan economy had gained a certain momentum as a result of the Federal Government's economic incentive program during the late 1960's, it was considered that this momentum would continue from 1970 until about 1980. A single economic projection was accepted for the ten-year period 1970-1980, based on trends which had developed in the late 1960's.

The second phase, considered to be less accurate, covered the period 1980-2020, for which three alternative growth patterns were developed:

(a) Projection I - Continuation of existing economic policies in the Okanagan. The high rate of economic growth experienced in the valley over the past ten years was assumed to continue to 1980 and then gradually decline over the next 40 years to 2020. In accordance with present provincial government policy, agricultural lands will be protected from subdivision for residential and industrial purposes, although some limited development in the form of land banks can be anticipated adjacent to the major urban centers.

(b) Projection II - An increase in the rate of economic growth compared to Projection I, assumed to be stimulated by further government support for industrial development. Land use policy is similar to that assumed in Projection I, except that greater rates of population and industrial growth will result in increased transfers of land use from agriculture to residential and industrial development.

(c) Projection III - A decrease in the rate of economic growth compared with Projection I through controls on industrial development. These controls would apply to any economic activity creating employment through the export of goods and services to regions outside the Okanagan. Thus, after 1980, the Valley will grow only in response to internal demands from increasing population rather than expansion of the economic base to support growth outside the basin. As the main emphasis in this projection was on maintaining a high level of environmental quality, agricultural lands were assumed to be protected from subdivision and additional agricultural development was encouraged.

Although economic forecasts for small regions such as the Okanagan have many uncertainties, especially over a long term, and cannot be construed as providing any accuracy in smaller subdivisions, it was necessary to apportion the forecast information into smaller geographic units in order to make predictions of the demand for water in various parts of the Okanagan Valley.

To interpret these assumptions into land use patterns which may be plotted geographically for each Projection, another set of assumptions - or guidelines - had to be set up. The following set of assumptions was derived so that economic and population growth principles may be integrated with the concept of Land Capability.

Projection I

a) Agriculture and potentially agricultural lands will be protected under the guidelines outlined in the Land Commission Act.
b) Some agricultural lands will be lost due to development of "land banks" within or close to urban areas.
c) There may also be development of new agricultural acreage to replace that which is lost within or close to the urban areas.
d) This Projection generally implies moderate urban growth with a relatively distinct transition zone between the urban and rural environments.

Projection II

a) Agricultural and potentially agricultural land will not be protected from subdivision.
b) The decrease in agricultural land will occur in accordance with the pressure from urban and industrial development
c) This Projection generally implies an urban sprawl condition with a broad transition zone between the urban and rural environments. (Industrial growth).

Projection III

a) Agricultural lands will remain protected, as in Projection I, and government subsidies and incentives will stimulate development of new acreage on potentially agricultural lands.
b) This increase will include development of agricultural acreage on Indian Reserves.
c) This projection implies limited urban growth with minimum urban sprawl and a low level of industrial development. (Growth in agriculture).

Although it is recognized that no two areas within the Okanagan Basin will have identical development patterns, the broad assumptions noted above do help to define the land use alternatives for the purposes of this study.

Growth forecasts had been made for various economic sectors (e.g. the tree fruit and grape growing industry, mining, sawmills and planing mills, wholesale trade, municipal government, utilities, tourism). This was done not only for the overall Okanagan Basin area, but for the four selected economic sub-regions of Vernon, Kelowna, Penticton and Oliver-Osoyoos. (See Technical Supplement X).

Population projections for the years 1980, 2000 and 2020 were made according to assumptions developed by the economic input-output model for urban areas and rural areas within the four selected sub-regions of the basin. The known arable land areas available for possible future development (paragraph 5.2) were studied to ensure that the projections of future economic activity, especially population totals and agricultural acreages, could indeed be supported by

the available land resources of the Okanagan. The capability of the land resource to support urban development as well as projected agricultural requirements was assessed by developing a Capability Analysis Matrix for each projection. There were 15 variables for each matrix, and one matrix for each of the four sub-regions. These variables included:

- five population measures - urban, rural and total population counts, and urban and rural population densities;
- urban areas - i.e. residential, industrial and commercial development;
- three agricultural acreage measures - total capability, per capita of rural population, and irrigation acreages (based on the ratio of 1970 irrigated land to 1970 agricultural land in each sub-region.

In this way, the projections for population, for industrial development, and for the use of agricultural land were harmonized. The results are illustrated in Table 5.5 "Economic Growth Indicators to the year 2020", and in Table 5.6, "Population and Agricultural Statistics, 1970-2020".

More detailed land capability studies were done for selected tributary watersheds to Okanagan Lake. These tributary basins were too small for full regional economic analysis, so projections of population and agricultural development were entirely based on land capability. The main purpose of these studies was to assess whether eight of the most heavily utilized tributary watersheds could continue to meet projected water requirements. The selected tributary basins were Trout Creek, Peachland Creek, Powers Creek, Equesis Creek, Vernon Creek, Kelowna Creek, Mission Creek and Penticton Creek.

Growth projections in these tributary basins were closely related to water quantity studies. A computer model was developed to estimate available water supplies for consumptive use (for agricultural and domestic purposes) at the major diversion points on each tributary. This model was adapted to match supply and demand at selected points on each stream, under dry, average and wet runoff conditions for 1970, 1980 and 2020 levels of economic development, In some creeks, minimum flows were also included to satisfy non-consumptive uses for fisheries, wildlife and aesthetic resources.

To test the sensitivity of water supplies in each basin to a range of future water demands, three projections of agricultural and population development were assumed. The first projection involved the maximum possible water requirements based on a high population projection for the tributary basin, assumed to be located on non-agricultural lands, plus a maximum development of Class 1 to 4 agricultural lands for irrigation. The second projection assumed minimum water demands, being based on a low population growth rate and a reduction of existing

TABLE 5.5

ECONOMIC GROWTH INDICATORS TO THE YEAR 2020

PROJECTION	DESCRIPTION OF PROJECTION	POPULATION	EMPLOYMENT	TOTAL VALUE OF BASIN INCOME (millions)+	VALUE OF BASIN INCOME PER PERSON (dollars)+	IRRIGATED ACREAGE* (acres)	TOURISTS
1970 Situation		115,500	29,800	$ 280.8	2,590	60,000	700,000
Projection I Continuation of Existing Economic Policies	Continuation of existing economic growth policies in the valley. The high rate of population, employment and industrial development experienced in the past 10 years is expected to continue until 1980 and then gradually decline over the next 40 years to 2020. In accordance with present government policy, agricultural lands in the valley will be protected from subdivision for residential and industrial purposes.	391,000	104,900	5,060.3	12,900	59,600	2,300,000
Projection II High Economic Growth	Growth that may be realized if the Okanagan economy is stimulated through senior government support for industrial development and employment-creating activities. To provide a contrast with the first projection described above, it is assumed that existing controls on subdivision of agricultural land would be relaxed and some transfers of land-use from agriculture to residential and industrial development would result.	430,000	118,500	5,682.6	13,200	56,600	2,300,000
Projection III Low Economic Growth	Growth that may be realized if there is a retardation of the current economic trends through controls on industrial development. These controls would apply to both non-resource based, or clean industries, such as trailer manufacturing, as well as resource based industries such as lumber mills and pulp mills. In this projection the emphasis would be on environmental quality, agricultural lands would be protected from subdivision, and additional agricultural development encouraged.	290,000	76,400	3,725.1	12,800	73,700	1,800,000

*Totals for Irrigated Acreage in 2020 are preliminary and subject to revision.

+Figures shown based on 1970 Dollars

TABLE 5.6

POPULATION AND AGRICULTURAL STATISTICS, 1970-2020

FEATURE			PROJECTION I		PROJECTION II		PROJECTION III	
	1970 (1971 Census)	1980	2000	2020	2000	2020	2000	2020
1. Population								
Urban	89,861	124,700	197,000	285,000	213,800	314,400	177,900	211,900
Rural	24,672	37,300	65,000	105,700	70,200	115,600	59,100	78,100
TOTAL	114,533	162,000	262,000	390,700	284,000	430,000	237,000	290,000
2. Population Density (People per acre)								
Urban	5.65	6.24	8.21	10.57	7.91	9.83	7.73	8.43
Rural	0.27	0.39	0.63	1.05	1.00	1.92	0.54	0.67
3. Urban Area (Acres)	15,910	20,000	24,000	27,000	27,000	32,000	23,000	25,000
4. Agricultural Area								
Irrigated (acreas)	60,070	59,500	59,400	59,600	58,500	56,600	68,700	73,700
Pop. per Irrigated Acre	1.91	2.72	4.41	6.56	4.85	7.60	3.44	3.93

agricultural lands due to subdivision. The third projection represented the arithmetic mean between these two extreme projections.

5.4 INDIAN RESERVE LANDS

Of the 60,070 acres of land under irrigation in the Okanagan in 1970, approximately 2,000 acres lie within Indian Reserves, as shown in the following Table No. 5.7.

TABLE 5.7

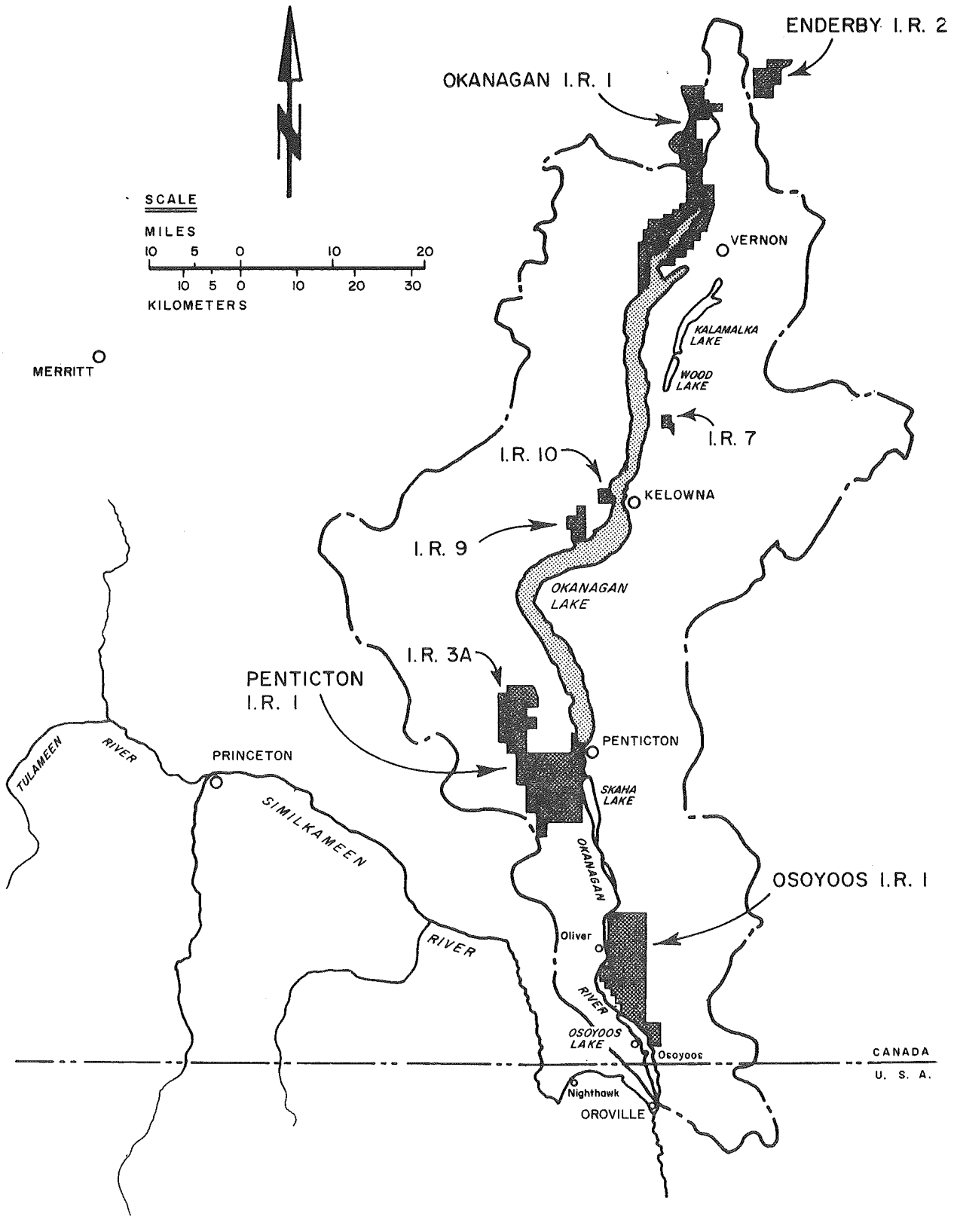
IRRIGATED AND POTENTIAL IRRIGABLE LAND[1]
OKANAGAN BASIN INDIAN RESERVES[2]

LOCATION IN BASIN	NAME OF RESERVE	IRRIGATED OR POTENTIALLY IRRIGABLE LAND		
		IRRIGATED ACRES	POTENTIALLY IRRIGABLE ACRES	TOTAL ACRES
North Okanagan Lake Basin	Okanagan No. 1	400	5135	5535
	Okanagan No. 3	100	25	125
Central Okanagan Lake Basin	Winfield No. 1	0	403	403
	Tisinstekeptum No. 9 & 10	181	1559	1740
South Okanagan Lake Basin	Penticton No. 1 & 3	474	3226	3700
Okanagan River	Osoyoos No. 1	842	1307	2149
	TOTALS	1997	11655	13652

NOTES: (1) Potential Irrigable Land includes all Canada Land Inventory class 1 to 4 land within 500 feet in vertical elevation of potential water source.

(2) Indian Reserves shown in Figure 5.2

It will also be seen from this table that there is considerable potentially irrigable land which is not at present used on the Reserves. Since the late 1960's there has been increasing emphasis on self-help projects under which the Indians are encouraged to make the best use of the land, which is their prime resource. This has led to the commissioning and production of plans for the development of reserve lands, and recently acreages have been leased for fodder crops and grapes near Oliver, and for summer cottage development along the North Arm of Okanagan Lake.



LOCATION OF INDIAN RESERVE LANDS
OKANAGAN RIVER BASIN IN CANADA

Figure 5.2

Two of the three economic projections made by the Okanagan Study indicate a decline in the total irrigated acreage in the Basin (Tables 5.5 and 5.6) due to the expansion of urban development into some of the presently irrigated areas. This will be partially offset by the development of potentially irrigable land, and it is possible that because of the special status of the Indian Reserve lands and the encouragement being given to their optimum use, that arable areas on the Reserves may be put under irrigation, either by the Indians themselves, or on a lease basis.

Such a development during the next 50 years could appreciably change the future water requirements of the basin as originally projected, and a study of the potential arable land within the Indian Reserve lands was carried out in order to identify areas of special significance and possible sources of water for them.

Consultation with the Canada Department of Indian Affairs and Northern Development has resulted in only a limited amount of information, and in the absence of specific plans of development for the several Reserves in the Okanagan, and assumption was made that all potential irrigable Indian Reserve land within an elevation range of 500 feet of a usable water source would be served with water. Table No. 5.8 shows details of water sources for existing and potential irrigable Indian land and the total acreage involved; this is summarized in Table No. 5.9, according to mainstem and tributary diversions points.

It will be seen from Table No. 5.9, that over 9,200 acres of presently irrigated or potentially irrigable land could best be serviced from the mainstem Okanagan Lake and River system, requiring some 15,000 acre-feet of water to meet consumptive use requirements, while an additional 6,500 acre-feet would be required from tributary waters to meet the consumptive use requirements of the remaining 4,400 acres of irrigable land on the Reserves. This compares with an estimated present consumptive use (mostly from the tributaries) of 3,700 acre-feet on the 2,000 acres now under irrigation on the Indian Reserves, as shown in Table No. 5.10.

TABLE 5.8

WATER SOURCES FOR EXISTING AND POTENTIAL IRRIGABLE INDIAN RESERVE LAND

I.R.No.& (Section)	Location of Intake		Elev. feet	Acres of existing & potential irrigable land within 0'-100'	100'-200'	200'-300'	300'-400'	400'-500'	Total
OSOYOOS 1									
(1)	Ok.R.2-1/2 mi.upstream of Tugulnuit L.		975	76					76
(2)-(7)	Tugulnuit L. or Ok.R.nearby		970	380	340	435	227	280	1,662
(9)&(10)	Ok.R.approx.3 m.upstream of Osoyoos L.		930			52	80		132
(12)&(13)	OK.R. or Osoyoos L.		920	104		32			136
(8)	Inkaneep Cr. at 1450' contour		1450	143					143
TOTAL LAND IRRIGABLE/IRRIGATED		acres		703	340	519	307	280	2,149
TOTAL EXISTING IRRIGATED LAND		acres							842
TOTAL POTENTIAL IRRIGABLE LAND		acres							1,307
Diversion (Div.duty 4.25 ft/ac + 10%)		ac.ft.		3,087	1,590	2,429	1,436	1,310	9,852
Return (50% of Div.Rate)		ac.ft.							4,926
PENTICTON									
1 and 3									
3(1) 1(1)	Trout Creek 3/5 m. upstream of								
(2)	2000'contour		2050	12		60	80		152
1 (3)	Trout Creek at 1800' contour		1800				300	100	400
1(4)(5)(7)	Shingle Creek at SE corner map								
(8)	82 E/12W		2250	407	151				558
1(9)&(10)	Shingle Cr.& Shatford Cr.between		2000 & 2220	701	77				778
1(12)&(13)	pt. Aeneas Lake		2150	45	22	47	17	36	167
1(13)(pt)& (14)	Marron Lake		1980	20	90	140	70	40	360
1(16)	Skaha Lake		1108				114	57	171
1(17)&(18)	Okanagan River		1115	834	150	50	40	40	1,114
TOTAL LAND IRRIGABLE/IRRIGATED		acres		2,019	490	297	621	273	3,700
TOTAL EXISTING IRRIGATED LAND		acres							474
TOTAL POTENTIAL IRRIGABLE LAND		acres							3,226
Diversion (Div.duty 2.50 Trout Creek ft./ac/ +10% 3.25 other		ac.ft.		7,211	1,750	1,012	1,905	899	12,778
Return (50% of div.rate)									6,389
WINFIELD 7									
(1)	Ellison Lake		1420	403					403
TOTAL EXISTING IRRIGATED LAND									000
Diversion (Div.duty 2.50 ft/ac + 10%)		ac.ft.		1,108					1,108
Return Flow (50% Div.rate)		ac.ft.							554
TISINSTLEKEPTUM									
9 & 10									
(1)&(2)	OK Lake		1120+	215	290	640	425	170	1,740
TOTAL EXISTING IRRIGATED LAND		acres							181
TOTAL POTENTIAL IRRIGABLE LAND		acres							1,559
Diversion (Div.Duty 2.50 ft/ac + 10%)		ac.ft.		581	796	1,760	1,170	467	4,774
Return Flow (50% Div.rate)									2,387
OKANAGAN 3									
(1)	Otter Lake		1125		125				125
TOTAL EXISTING IRRIGATED LAND		acres			-				100
TOTAL POTENTIAL IRRIGABLE LAND		acres							25
Diversion (Div.duty1.80 ft/ac +10%)		ac.ft.			248				248
Return Flow		ac.ft.							124
OKANAGAN 1									
(22)(21)(20)									
(17)(16)(15)									
(13)(12)(10)	Okanagan Lake		1120+	3,518	510	51	44	7	4,130
(14)	Goose Lake		1630	60	44				104
(19)	Naswhito Creek		1500	21	42	21			84
(18)	Equesis Creek		1480		72	20			92
(11)	Irish Creek		1750	96					96
(7)	Gurney Cr./Irish Cr.		2150	108					108
(6) & (8)	Round Lake		1425	60	451	350	60		921
TOTAL IRRIGABLE/IRRIGATED LAND		acres		3,863	1,119	442	104	7	5,535
TOTAL EXISTING IRRIGATED LAND		acres							400
TOTAL POTENTIAL IRRIGABLE LAND		acres							5,135
Diversion (Div.Duty 2.50 rest) 1.80 (6)-(8))		ac.ft./ac		10,480	2,728	945	240	19	14,412
Return (50% Div.Rate)									7,206

TABLE 5.9

SUMMARY OF IRRIGATED AND POTENTIALLY IRRIGABLE LAND
AND CONSUMPTIVE USE REQUIREMENTS THEREFOR
ON INDIAN RESERVES IN THE OKANAGAN RIVER BASIN

Aggregated according to Mainstream or Tributary Diversion Points

Elevation range of water source	Okanagan Lake Basin (N. of Penticton)		Okanagan R. s. of Penticton, Osoyoos L.		Land / Cons. Use Totals
	Mainstream Diversion Acres/Acre-feet	Tributary Diversion Acres/Acre-feet	Mainstream Diversion Acres/Acre-feet	Tributary Diversion Acres/Acre-feet	Acres/Acre-feet
0' - 100'	3,733 / 5,128	760 / 973	1,394 / 2,800	1,316 / 2,332	7,203 / 11,233
100' - 200'	800 / 1,099	734 / 787	490 / 875	340 / 795	2,364 / 3,556
200' - 300'	691 / 950	451 / 484	569 / 1,305	187 / 334	1,898 / 3,073
300' - 400'	469 / 646	440 / 582	461 / 993	87 / 155	1,457 / 2,376
400' - 500'	177 / 243	100 / 138	377 / 831	76 / 136	730 / 1,348
TOTAL	5,936 / 8,059	2,435 / 2,962	3,291 / 6,991	2,006 / 3,470	13,652 / 21,586

(Based on Table No. 5.8)

TABLE 5.10

PRESENTLY IRRIGATED LAND AND ESTIMATED PRESENT DEMAND - OKANAGAN BASIN INDIAN RESERVES

Source: 1970 Colour aerial photos - District Engineer, Water Rights Branch, Kelowna

RESERVE	ACRES	DIVERSION RATE (incl.10% div.loss) ft./acre	DUTY ac.ft.	CONSUMPTIVE USE ac.ft.
Okanagan 1 - 6	500	350 at 2.75) 150 at 1.98)	1,260	630
Tisinstekeptum 9	124	2.75	341	171
Tisinstekeptum 10	57	2.75	165	83
Winfield 7	0	-	-	-
Penticton 1	434	400 at 3.575) 34 at 2.75)	1,524	762
Penticton 3	40	2.75	116	58
Osoyoos 1	842	4.675	3,934	1,967
Total	1,997			3,671

CHAPTER 6

Methods for Determining Quantities of Water Used

6.1 GENERAL

Parallel to the need to determine the present land use within the Okanagan Basin (Chapter 5) was the need for information on water use, based on present (1970) conditions and patterns of use. An attempt was made to document water use in an "average" year, but since the data-gathering phase of this study took place in 1970-71, all metered flows pertain to 1970. The year 1970 was characterized by a very warm summer preceded by an unusually warm and dry winter, resulting in a low snow pack and a poor spring runoff. This combination greatly affected the supply of water to the Valley, and to a lesser degree, affected the demand in that slightly more water was used than in an average year (though water restrictions were rare and localized).

The original objectives called for detailed forecasts of water demands and requirements for agricultural, industrial and domestic uses as well as for recreation, fish and wildlife and transportation. As the study developed however, its scope was limited to providing an in-depth inventory of consumptive water uses - the agricultural, domestic and industrial interests - leaving the non-consumptive uses to be examined separately.

6.2 IRRIGATION USE

Historically, the greatest consumptive demand on the water resources of the Okanagan Valley has been for irrigation, and even today it accounts for more than 87 percent of the total water consumption in the Valley.

Since irrigation acts as a supplement to natural precipitation, this artificial method of watering requires a large amount of stored water to meet the demand during the hot summer months. The greatest storage reservoir is Okanagan Lake, with a normal operating range of four feet, and thus a potential storage of 340,000 acre-feet; however, only a small portion of the total irrigated land draws on water from this lake. The upland storage in the headwater lakes accounts for about 105,000 acre-feet and this water, combined with the natural flow, supports 44,500 acres with 114,000 acre-feet. The total amount of irrigated land in the basin is 60,070 acres, and it required an annual diversion from all sources, including tributaries, Okanagan River, main lakes and wells, of 176,000 acre-feet, of which some 88,000 acre-feet is consumed and not returned directly to the system.

6.2.1 Land Irrigated

Determination of the number of acres of land irrigated was carried out at the same time as the appraisal of land use (see Chapter 5). Air photographs were studied and discussions were held with growers and irrigation district managers in the valley to establish which of the known cultivated lands were under irrigation. More detail was thus obtained within irrigation districts and municipalities than in the unorganized areas. Areas were taken off the air photographs and maps by planimeter measurement.

The non-irrigated land within irrigated areas (road allowances, buildings and farmyards) was separated by reducing the totals of irrigated land by 10 percent in municipalities and irrigations districts, and by 5 percent in unorganized areas, to give final totals of irrigated land. These reductions were calculated in organized areas as an average of the difference between the planimetered areas on the air photographs and the tax-roll areas of irrigated land.

Table No. 6.1 summarizes the distribution of agricultural and irrigated land by region within the Okanagan Basin in Canada. Existing and potential irrigable land is also shown in Figure 6.1 and on Maps 11, 12, 13 and 14.

TABLE 6.1

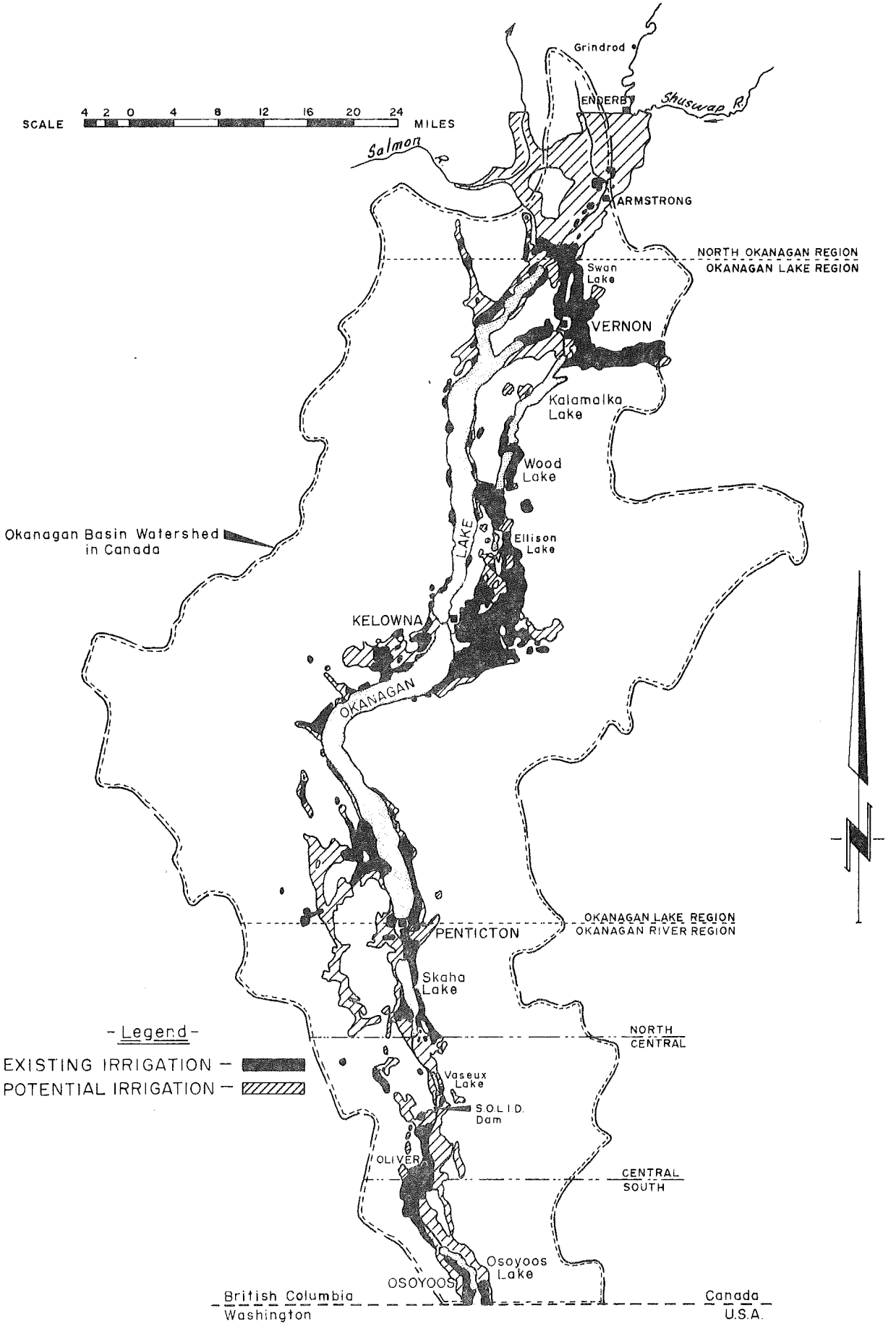
AGRICULTURAL AND IRRIGATED LAND BY REGION

(1970)

REGION	IRRIGATED LAND (1970) Acres	CULTIVATED BUT NOT IRRIGATED (1970) Acres	TOTAL ARABLE LAND Acres
NORTH OKANAGAN	2,000	19,300	47,000
OKANAGAN LAKE	44,070	6,700	161,000
OKANAGAN RIVER	14,000	-	64,000
TOTALS	60,070	26,000	272,000*

* Arable land below elevation 1800 is 157,000 acres

In the above Table No. 6.1, the North Okanagan Region includes the area contained within the Okanagan watershed lying to the north of Okanagan Lake; the Okanagan Lake region includes the remainder of the watershed area tributary to the outlet of Okanagan Lake at the Penticton Control Dam; and the



EXISTING AND POTENTIAL IRRIGATION WITHIN OKANAGAN BASIN

Figure 6.1

Okanagan River region includes the remainder of the Okanagan Basin in Canada south of the Penticton Control Dam to the United States Border.

It was difficult to get reliable information regarding the northern end of the watershed due to the irregular irrigation practised in the area. Although there are slightly more than 21,000 acres of land cultivated (mostly grains, pasture and truck farming) only about 2,000 acres are actually irrigated. Of this irrigated land, 820 acres of horticultural land adjacent to Deep Creek, from its mouth to Otter Lake, is irrigated annually, while the remainder is irrigated only in the driest years (say one out of four). The area's high water table, its clay-based soil which tends to retain moisture, higher precipitation than the southern portion of the valley (17 inches at Armstrong as compared to 11 inches at Oliver), and the shorter growing season (90 frost-free days in Armstrong rather than the 136 days south of Okanagan Falls) all reduce the necessity for constant irrigation for the crops of the area such as feed grains, fodder, corn, hay and cash crops.

While mixed farming predominates in the North Okanagan, the central and southern regions are noted for tree fruits and other horticultural crops, for which irrigation is a necessity. These regions produce over 90 percent of all tree fruits grown in British Columbia and about 10 percent of provincial vegetable production. (See Table No. 6.2).

TABLE 6.2

IRRIGATED CROP ACREAGES BY REGION

(1970)

REGION	TREE FRUITS	GRAPES	NURSERY CROPS	VEGETABLES	FIELD CROPS	FORAGE CROPS & PASTURE	TOTAL
NORTH OKANAGAN	-	-	80	140	340	1,440	2,000
OKANAGAN LAKE	23,100	1,500	460	650	-	18,360	44,070
OKANAGAN RIVER	8,720	800	160	420	-	3,900	14,000
BASIN TOTALS	31,820	2,300	700	1,210	340	23,700	60,070

The Okanagan Lake region is the largest in the study area and contains by far the greatest amount of agricultural land (44,070 acres of irrigated land) concentrated in and around the Coldstream Valley, the City of Kelowna, Winfield, Westbank, Peachland, Summerland, Naramata, and the northern portions of Penticton. The bulk of the water requirements of this region are supplied by the 18 major creeks that drain into Okanagan Lake. The Lake region also contains 19 of the Valley's 27 irrigation districts.

In the Okanagan River region, nearly all the cultivated land is irrigated with the exception of about 150 acres to the north of Vaseux Lake which is sustained by the high water table in the area. Most of the irrigated land is within irrigation districts, the largest being the South Okanagan Lands Irrigation District, which distributes water to more than one-third of the farm land in the region. The combination of the warm climate and the predominantly sandy soil results in a high water use, with the average duty being approximately 5 acre-feet per acre.

6.2.2 Diversion and Farm Duties of Water

The duty of water is defined as the amount of water required per unit area, and is usually measured on a seasonal or annual basis, as for instance "3 acre-feet per acre per irrigation season." The farm duty is the amount applied per acre at the farm or orchard, while the diversion duty includes an extra allowance for conveyance losses between the point of diversion and the farm itself.

Measurement of the diversion duty for any particular irrigation district is complicated by the fact that most districts supply domestic water to farms and subdivided areas within their boundaries, and although many districts have recently improved their works, few have facilities for continuous recording of the total amount of water withdrawn from the source. Among those that do, the Vernon Irrigation District carries out some monitoring and will be able to make more precise estimates of the duty of water in the area as data is collected from year to year. In most districts however, diversion duty is based on the farm duty as determined experimentally from sampling stations, with an additional amount (usually estimated to be 10 percent) included for conveyance losses. As control of water supplies becomes more critical in the years ahead, more precise apportionment of available water will be required. In order to accomplish this, increased monitoring facilities will be required from irrigation districts and other principal water suppliers in the Okanagan.

Farm duty varies with the climatic range, the weather, and the type of crop as well as with the type of soil, topography and elevation of the land. The amount of water required for a particular soil type in a designated area has customarily been recommended by the British Columbia Department of Agriculture after consultation between its own technical staff and soil surveyors and the Canada Department of Agriculture research authorities together with local growers and irrigation district personnel. In this connection, much work has been done in recent years on sampling with evaporimeters to determine the rates of evaporation in different parts of the Okanagan Valley, and hence to find more closely, the demand for water by various tree fruits and other crops.

In the Oliver-Osoyoos region at the southern end of the Valley, farm duty ranges between 5 and 6 acre-feet per acre. In comparison, at Rutland (near Kelowna) the duty is about 2.5 acre-feet per acre, while the average duty at

Vernon is about 1.75 acre-feet per acre. Variations in weather from year year to another affect irrigation requirements, particularly in the northern part of the Okanagan where dry farming is practised in most years; supplementary irrigation may be needed in the dry years of the weather cycle. For all types of crop, weather variations will influence the amount of water needed during the growing season: demands will fluctuate by 20 to 30 percent from a wet year to a dry year. For the purposes of the Okanagan Basin Study however, seasonal variations were assumed the same for each year in determining the water requirements in the various regions of the Valley. Coefficients for estimating monthly withdrawals and return flows are shown in Table No. 6.3.

TABLE 6.3

COEFFICIENTS[a] FOR ESTIMATING MONTHLY WITHDRAWALS AND RETURN FLOWS FOR AGRICULTURAL USE IN ALL REGIONS

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	The Year
WITHDRAWAL	0	0	0	0	.15	.25	.25	.25	.10	0	0	0	1.00
RETURN FLOWS	.04	.04	.03	.04	.11	.14	.15	.14	.12	.09	.05	.05	1.00

Source: T.A.J. Leach, "Okanagan Basin Inflow Determinations," Report No. 1714, Water Investigations Branch. B.C. Water Resources Service, Victoria, B.C., September 1970.

[a] These coefficients are factors which, multiplied by annual withdrawal or return flows, will provide estimates of monthly water use.

Consumptive Use is calculated from the amount diverted less the return flow, month by month.

Orchards, vineyards and improved pasture land in the same climatic region of the valley receive approximately the same amount of water per acre. If less than three crops are taken from the pasture land in a year, the duty is less. Horticulture (market gardening, nurseries, and vegetable growing) requires about 80 percent of the duty for tree fruits. However, in 1970, less than 2,000 acres was devoted to horticulture: this represents only 3 percent of the total irrigated land in the Okanagan Valley. Appraisals of regional water demands which are based on the duty for orchards and vineyards and ignore the slight reduction for horticulture are therefore within practical limits of accuracy. The diversion and consumptive use duties used in the different regions of the Okanagan for 1970, 1980 and 2020 are shown in Table No. 7.3; Chapter 7.

6.2.3 Return Flow of Irrigation Water

Return flow is defined as the diverted water which is not consumed and, by underground or surface flow finds its way again to a stream, a lake, or a sub-

surface aquifer to become potentially re-usable. Because of the varying paths by which return flow finds its way to a point of potential re-use, it is difficult to establish how much of the amount withdrawn is actually returned. Further, it must be recognized that some return water may be used several times over before it is lost to the system.

Although the diversion of irrigation water takes place during the summer months from May to September, with most being withdrawn in June, July and August (Table No. 6.3), return flow is not immediately available for re-use during the same period. Depending upon whether orchard tail-water draing along a surface ditch or percolates through the soil, and the distance to a point of potential re-use, months may elapse before it is again available. The coefficients for return flow shown in Table No. 6.3 allow for this delay factor and show that there would be return flows during the winter months of the year.

Soil type and texture clearly influence the proportion of return flow. There will be a higher percentage of return flow in coarser textured soil, partly because of the shorter irrigation interval required for crops and fruit trees in such soil, and partly because of the faster percolation.

Stevenson and Brownlee, in their report entitled "Some estimates of Return Flows from Irrigation Water in the Okanagan Watershed" in 1970[4]- indicated that there is a very strong relationship between the return flow and the weather during the irrigation season. In hot summers such as 1967, evapotranspiration is high and return flow is consequently reduced. The average return flow in the Okanagan Valley in 1967 was estimated at 44 percent of the amount applied. By contrast, the summer of 1966 was a cool summer, and return flow in the Okanagan averaged 65 percent of the amount applied.

In a 1966 B.C. Water Resources Service Report,[5] 48 percent return flow was used as an average for the Okanagan, based on the amount diverted from the source (including conveyance losses) rather than on the amount applied at the farm or orchard. Reports prepared in 1970 used a rounded figure of 50 percent of the return flow.[6] In more recent work done for the Kalamalka-Wood Lake Basin Water Resource Management Study, measurements at Ribbleworth Creek indicate a return flow of only 25 to 35 percent of the amount diverted. It must also be recognized however, that return flow water may be used several times over before it is lost from a watershed the size of the Okanagan Basin in Canada, and this point has been considered for the Okanagan Study work.

Investigations were carried out under the Okanagan Basin Study in connection with nutrient removal from waste water irrigation using lysimeters. Technical Supplement IV, Chapter 7 reports a sampled return flow of irrigation water to groundwater in direct drainage areas of 9 percent with a further 5.5 percent in tributary sub-basins for a total for the Okanagan Basin of 14.5 percent. This

method of calculating return flow is a direct method, while that of other researchers has been a difference method, where evapotranspiration is directly estimated from evaporimeters and deducted from the applied water volume to find the return flow. Evaporimeter results in the same sampling area have given values of 45 percent return flow. Both evapotranspiration and return flow are difficult parameters to estimate, with an accuracy thought to be less then ± 100%.

The calculated return flow values were felt to be low for the following reasons:

(a) the calculations are based predominantly on lysimeter studies in Penticton, and

(b) Penticton studies were concerned mainly with forage crops, as opposed to orchard crops from which a higher return flow is expected.

It should also be noted that the soil moisture content of the lysimeter samples was not determined at the start and the conclusion of the experiment, which might affect transient volume measurement, and that the lysimeter experiments did not span an entire year.

On the other hand, the return flow values cited in other literature may be somewhat high for these reasons:

(a) the soil profile in certain parts of the Okanagan study area theoretically require 20 years to build up the soil storage capacity before any leachate reaches groundwater; therefore, for this length of time, excess irrigation water would not be returned fully to receiving waters (though this would apply only to areas of the valley that are being newly developed for irrigated agriculture); and

(b) much of the land is sloped, and water seeping out of the root zone can move downslope and be utilized by native vegetation or domestic crops through evapotranspiration or by direct evaporation from bare soil.

In an overall appraisal of the return flow question, these comments must be weighed. It must also be remembered that in many parts of the Okanagan, return flow does not always move in sub-surface aquifers. Ditches on the downslope side of orchards are employed to collect the "tail-water" from the irrigation operation and direct it to natural surface streams where it can be utilized again. The volume of return flow collected by this and similar methods has not been measured in the lysimeter studies.

A return flow of 50 percent from irrigation withdrawals was assumed for much of the work done under the Okanagan Study, although water quantity studies done on the University of British Columbia computer employed the earlier value of 48 percent, and parallel calculations conform to this figure. Coefficients for estimating the monthly distribution of return flows from irrigation water are listed in Table 6.3.

6.2.4 Present Application Practices for Irrigation

The earliest irrigation in the Valley utilized water diverted from a creek or lake, preferably by gravity, and conducted to the farm or orchard by pipe, canal or open flume. The water would then be turned onto the land along lateral furrows or an entire field would be flooded.

Today, spray irrigation from a pressurized distribution system is widely used in the Okanagan. Sprinklers are mounted on portable pipes or on permanent laterals.

This extensive use of sprinklers has meant increased attention to pressure requirements. Systems are required to deliver water at pressures typically not more than 125 pounds per square inch (psi) but not less than 60 psi. Flow-limiting valves at the sprinkler heads (Dole valves) are used in many areas to equalize flow from sprinkler heads on hillside laterals. Dole valves have a second purpose in helping to conserve water use as well as to make it easier to calculate the total water use in a particular orchard or farm area. Such factors are contributing to more efficient use of available water in organized irrigation and improvement districts.

In the last ten years, primarily through the Agricultural Rehabilitation and Rural Development Act, most of the irrigation systems in the Okanagan have been modernized through reconstruction of headwater reservoirs, diversion dams and the replacement of earth ditches with pipelines and lateral feeders to sprinklers through pressure regulating or "Dole" type valves. It has been estimated that gross water requirements have been reduced by as much as 30 percent through reductions in conveyance losses and more uniform application of water.

Many districts have installed flow meters at their pumped diversions which will provide data on total water withdrawals. Extension of this type of metering for gravity supplies will provide irrigation districts and municipalities with basic data needed for future planning of water supplies.

Although rationing or apportionment of available water among users within a particular irrigation district has not been usual in the Okanagan, with only about 15 percent of all farmers using some form of scheduling, such scheduling or rotation of sprinklers within an individual orchard or farm operation has long been advocated as a means of balancing demand during the peak months of the irrigation season. Scheduling among users would only become necessary if individual rotation practices are not followed, or if the distribution pipes of the system are inadequately sized.

In water systems whose greatest demand is for irrigation, peak flows are reasonably steady and if the original system design was adequate, no difficulties develop. Some districts are experiencing difficulties, apparently, due

to the increasing trend in the late 1960's and early 1970's towards subdivision of farms and orchard land for residential purposes. Although the total amount of water used year-round for an average of four domestic connections per acre is approximately the same as the amount of water used if the land was irrigated, the hourly and daily peak demands for domestic use far exceed the peak irrigation demand. Districts with an increasing proportion of domestic water users are finding that the size of the distribution lines is no longer adequate, with resultant drop in pressure in the system. Under such circumstances, the alternatives are to install larger distribution pipelines at considerable expense, or institute some form of scheduling which would limit irrigation and backyard sprinkling among the users of the system.

Reductions in the use of water may also be achieved through metering and pricing. It is probable that metering and price control would be most effective in local areas receiving water from the smaller tributaries where shortages are presently occurring, however, metering should be encouraged where possible, as it allows for better management of the water resource, especially during drought conditions.

Other developments presently under study in the industry include experiments in trickle irrigation.[7,8,9] This is the name given to a relatively new method of applying water under reduced pressure, to crops by a famr distribution system of pipes and fine tubing through which water "trickles" onto the ground. It is described in more detail in Appendix B. Although there is not yet a great deal of experience in trickle irrigation in British Columbia, tests to date in various areas of the Province indicate equal or better crop production with considerably less water applied per acre of planting. Tests are being continued to determine how little water is needed for production of satisfactory crops.

6.3 MUNICIPAL AND DOMESTIC USE

This category includes residential, commercial, public authority and local government uses. Industrial water will be discussed in a further section, even though some municipal and irrigation supply systems cater for industrial water demands, and though in some instances it is difficult to decide if the use should be classed as industrial or commercial.

6.3.1 Unit Requirements

The most reliable records available in the Okanagan Valley are those of established municipal water systems, particularly those with pumped supplies, metered at the pumping stations. However, a detailed breakdown of municipal supplies into:

(i) domestic use (household use and garden sprinkling),
(ii) commercial use (hotels, motels, car washes, stores, etc.),
(iii) public authority use (schools, hospitals, churches, etc.),
(iv) local government use (city halls, municipal yards, park and boulevard sprinkling, etc.).

can only be measured in districts such as Rutland where there are meters for every connection. Unit domestic water requirements have been derived from such separate records in local municipalities and a few rural improvement districts in the Okanagan Valley, supported by engineering studies done for the City of Kelowna[10] and for a number of projects constructed under the Agricultural and Rural Development Act (A.R.D.A.) program. From these sources, present-day (1970) domestic demand has been established at 0.75 acre-feet per connection per year, and is presumed to include conveyance losses.

Tables showing the distribution of annual domestic water requirements by district and according to tributary and non-tributary sources have been prepared and are summarized in the following distribution: -

TABLE 6.4

ANNUAL DOMESTIC WATER REQUIREMENTS BY REGION - 1970

REGION	NUMBER OF CONNECTIONS	ANNUAL WATER WITHDRAWAL (ACRE-FEET)	ANNUAL WATER CONSUMPTION (ACRE-FEET)
NORTH OKANAGAN	759	570	199
OKANAGAN LAKE	29,271	22,186	7,767
OKANAGAN RIVER	2,666	2,108	741
TOTALS	32,696	24,864	8,707

Source: Hall, G.D., "Water Demand Study, Canada-British Columbia Okanagan Basin Agreement," B.C. Water Resources Service Victoria, B.C., July 1972.

6.3.2 Seasonal Variation in Demand

On a monthly basis, there is about a three-fold increase in municipal and domestic water use in the summer as compared to the winter months. Throughout the Valley, there is a rapid increase commencing in May, a peak in July, and a rapid decrease in September.

Consumptive use for domestic purpose, as illustrated in Table No. 6.4, is estimated to be about 74 percent of the annual withdrawal. A varying distribution

of withdrawals, return flows and consumptive use throughout the year has been formulated with consideration given to variations in latitude and climate. Table No. 6.5 following, shows monthly coefficients for estimating withdrawal demands and return flows for domestic purpose by region. Consumptive use is determined by subtracting return flow from the volume withdrawn as shown in Table 7.1 (a) and (b), Chapter 7.

Where records were sufficiently detailed, a breakdown into residential, commercial, public authority and local government uses was made, giving the following present-day annual demand figures: -

Residential	0.75 acre-feet per connection
Commercial - hotels, motels	2.0
Commercial - other	0.5
Public authority - schools	5.0
Public authority - other	1.0
Municipal	1.0

It should be emphasized that these figures are based on limited samples and should therefore be applied with caution. Failing better information however they do provide some indication of the demands in these sectors.

TABLE 6.5

COEFFICIENTS[a] FOR ESTIMATING MONTHLY WITHDRAWALS AND RETURN FLOWS BY REGION FOR MUNICIPAL AND DOMESTIC USE

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	THE YEAR
NORTH OKANAGAN													
Withdrawal	0.05	0.05	0.05	0.06	0.09	0.14	0.16	0.14	0.09	0.07	0.05	0.05	1.00
Return Flows	0.06	0.06	0.06	0.06	0.07	0.12	0.14	0.13	0.10	0.08	0.06	0.06	1.00
OKANAGAN LAKE													
Withdrawal	0.05	0.04	0.05	0.06	0.10	0.13	0.16	0.16	0.08	0.07	0.05	0.05	1.00
Return Flows	0.06	0.06	0.06	0.07	0.09	0.10	0.13	0.12	0.10	0.08	0.07	0.06	1.00
OKANAGAN RIVER													
Withdrawal	0.05	0.05	0.06	0.07	0.11	0.13	0.15	0.13	0.09	0.06	0.05	0.05	1.00
Return Flows	0.06	0.06	0.06	0.07	0.09	0.10	0.13	0.12	0.10	0.08	0.07	0.06	1.00

Source: Municipal Waterworks data for Vernon, Kelowna, Rutland, Penticton and Osoyoos

[a] These are factors which, multiplied by annual withdrawal or return flows, will provide estimates of monthly water use.

6.4 INDUSTRIAL USE

6.4.1 Records Available

A variety of information sources was tapped in an attempt to arrive at a reasonable estimate of industrial water use for the Okanagan Study. Information on the source of water and the quantity withdrawn was taken from economic questionnaires that had been completed by a number of the larger employers in the valley. Where industries relied on municipal waterworks, information was obtained from municipal records. Other sources include provincial water licences, applications and permits filed with the Pollution Control Branch of the provincial government, and personal communication with plant managers or superintendents, especially where there were discrepancies between other sources.

6.4.2 Requirements in Selected Industries

Much of the water withdrawn by industry is used for cooling purposes (between 90 and 95 percent in some plants) and because it is not consumed directly, it is often not measured. Also complicating the picture is a trend towards re-use or recycling of water. Westmills Carpets at Kelowna has been installing a system that will eventually recycle about 60 percent of the water used for dyeing. The Brenda Mines operation near Peachland recovers water from the tailings pond for re-use in the milling process. Based on present demands, the diversion and consumptive use requirements for 12 classifications of industrial operations have been tabulated in the following Table, No. 6.6. Sawmills and other wood industries are seen to be the principal users of water, though only 10 percent of the quantity diverted is consumed. At the other end of the scale, the 6 mining operations listed divert only one-tenth the amount diverted by wood industries in the valley, but 90 percent of this diversion is consumed.

The total annual demand by industry under present-day conditions amounts toaabout 28,000 acre-feet, of which 4,400 acre-feet is actually consumed. This demand is met for the most part from the water of Okanagan Lake: an estimated 20,000 acre-feet being withdrawn from the lake itself. The lake region as a whole accounts for over 90 percent of the total, as shown in Table No. 6.7.

TABLE 6.7

ANNUAL INDUSTRIAL WATER REQUIREMENTS BY REGION - 1970

REGION	ANNUAL WATER WITHDRAWN			ANNUAL WATER CONSUMPTION (acre-feet)
	SURFACE (acre-feet)	GROUNDWATER (acre-feet)	TOTAL (acre-feet)	
NORTH OKANAGAN	250	250	500	75
OKANAGAN LAKE	25,090	910	26,000	4,100
OKANAGAN RIVER	1,000	500	1,500	225
TOTALS			28,000	4,400

TABLE 6.6

PRESENT-DAY INDUSTRIAL WATER USE BY SECTOR

SECTOR	NUMBER OF OPERATIONS	WATER WITHDRAWN (acre feet)			PERCENT CONSUMED	WATER CONSUMED (acre feet)
		Surface	Ground	Total		
1. Meat & Dairy Products	13	250	250	500	20%	100
2. Fruit & Vegetable Canners	11	500	negligible	500	30%	150
3. Wineries, Soft Drinks & Distillers	11	6,950	50	7,000	10%	700
4. Other Food & Beverage Industries	19	50	negligible	50	40%	20
5. Sawmills & Planing Mills	76	9,500	500	10,000	10%	1,000
6. Other Wood Industries	51	5,800	200	6,000	10%	600
7. Metal Fabricating & Transport Equipment	51	90	10	100	30%	30
8. Non-Metallic Mineral Products	25	300	100	400	10%	40
9. Other Manufacturing	80	150	50	200	20%	40
10. Logging	103	50	50	100	30%	30
11. Packing Houses	20	950	400	1,400	10%	140
12. Mining	6	1,750	negligible	1,750	90%	1,550
TOTAL	466	26,340	1,660	28,000	16% (av.)	4,400

6.4.3 Seasonal Variation in Demand

Some seasonal fluctuations do occur in industrial water demand but for the most part it is relatively stable. There is apparently a gradual increase throughout the summer, peaking early in the fall, which can be ascribed to the increase in the evaporation rate of cooling water as well as the increased activity in the fruit packing and processing plants as crops are harvested. Table 6.8 following, showed coefficients for estimating monthly industrial consumptive use from the annual total. These coefficients may be used for any region in the Okanagan Valley.

TABLE 6.8

COEFFICIENTS FOR ESTIMATING MONTHLY CONSUMPTIVE USE FOR INDUSTRIAL PURPOSE

Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	The Year
.07	.07	.07	.07	.08	.09	.10	.11	.12	.08	.07	.07	1.00

The coefficients in Table 6.8 have been used in calculating consumptive use requirements for industry under present-day conditions and for the study horizon year of 2020.

6.5 IN-CHANNEL REQUIREMENTS

In considering the demands on the Okanagan system, there are a number of requirements to be met in the channels of tributaries and of the mainstem river. Although many of these are concerned with low flow or minimum conditions, there is also an obvious requirement that flooding should be controlled as much as possible. Wherever practicable, the control structures on the various streams are operated on this basis.

On the mainstem Okanagan River downstream of the Okanagan Lake Control Dam at Penticton, there is a need to maintain sustained high flows averaging 80 percent of channel capacity over several months during the freshet period. In order to accommodate these high flows, bank protection and bottom paving is required in many reaches of the improved river channel. The unimproved section of the Okanagan River north of Oliver will contribute considerable debris under freshet conditions, which must be cleared from bridge piers, water intakes and control structures downstream.

6.5.1 Minimum Flow Requirements

On the mainstem and on tributary creeks, certain minimum flows are required during the dry seasons of the year in order to satisfy the requirements of water

users diverting from the stream, to provide a flushing action as well as for aesthetic reasons. Along the Okanagan River itself, a minimum residual discharge is also required to ensure that water intakes remain submerged and to maintain the salmon fishery. Fishery considerations will be discussed in a later paragraph.

Along the Okanagan River between Penticton and the International Border, current practice is to maintain a minimum flow of 300 cubic feet per second (c.f.s.) anywhere in the river during the irrigation season (April to September inclusive) to satisfy the requirements of water users and to balance the evaporation from Osoyoos Lake. Minimum allowable flow during the winter months (October to March inclusive) is held at 100 c.f.s., though of course in most years the flow is more. There have been proposals[11,12] for improvements, including lowering the water intakes along the channel, which would allow a reduction of minimum residual flow to 100 c.f.s. during the summer months (see Table 6.9). Flow requirements in the Okanagan River downstream of Okanagan Lake for 1970 levels of development are shown in Table 6.10 reflecting present conditions along the river, and showing the situation of the proposed improvements are carried out.

6.5.2 Fishery Requirements

To preserve the sockeye spawning areas in the unimproved section of the Okanagan River north of Oliver, and to allow the spawning fish and fry to traverse the river itself, a range of minimum and maximum flows has been recommended.[13] To prevent gravel scour, which would estroy the spawning beds, discharges to the river should be kept below 1,000 cubic feet per second. A desirable range of flows to accommodate (a) fish coming upstream to spawn in August and early September; (b) spawning and incubation from that time onwards; and (c) movement of fry downstream after hatching between mid-February and the end of April, is illustrated in Table 6.9.

TABLE 6.9

SUMMARY OF FISHERY AND MINIMUM FLOW REQUIREMENTS FOR THE OKANAGAN RIVER IN BRITISH COLUMBIA

MONTH	FISHERY REQUIREMENTS				MINIMUM FLOW	
	Minimum Flow at Osoyoos Lake outlet	In Okanagan River Channel below S.O.L.I.D. Dam			Okanagan River below Penticton Dam	
		Desirable Range	Maximum (Gravel Scour)	Minimum Fishery Flow	Present Conditions	With Improvements
	c.f.s.	c.f.s.	c.f.s.	c.f.s.	c.f.s.	c.f.s.
APRIL		175 - 1000		175	300	100
MAY					300	100
JUNE					300	100
JULY 1-15	100				300	100
16-31					300	100
AUGUST	100	300 - 450		300	300	100
SEP. 1-15	100	300 - 450		300	300	100
16-30		350 - 550		350	300	100
OCTOBER		350 - 550		350	100	100
NOVEMBER		175 - 1000	1000	175	100	100
DECEMBER		175 - 1000	1000	175	100	100
JANUARY		175 - 1000	1000	175	100	100
FEB. 1-15		175 - 1000	1000	175	100	100
16-28		175 - 1000		175	100	100
MARCH		175 - 1000		175	100	100

TABLE 6.10

WATER REQUIREMENTS-MAINSTEM OKANAGAN RIVER FOR 1970 DEVELOPMENT AND 2020 GROWTH PROJECTIONS FOR PRESENT AND IMPROVED OPERATING CONDITIONS

	1970		2020 GROWTH PROJECTION 1 Continuation of Present Policies		2020 GROWTH PROJECTION 2 High Growth		2020 GROWTH PROJECTION 3 Low Growth	
A. PRESENT OPERATING CONDITIONS - with 300 cubic feet per second minimum flow in the Okanagan River between April & September inclusive, and 100 c.f.s. minimum flow between October & March inclusive.	Population	11,000		51,000		55,000		37,000
	Irrigated Acres	14,000		16,000		15,000		18,000
	Ac-Ft	%	Ac-Ft	%	Ac-Ft	%	Ac-Ft	%
MAINSTEM OKANAGAN RIVER								
(a) Consumptive Use - Okanagan River	32,000	13.2	44,000	18.4	43,000	18.0	46,000	19.0
(b) Evaporation Losses from Skaha, Vaseux & Osoyoos Lakes and from the Okanagan River channel	49,000)		49,000)		49,000)		49,000)	
(c) Minimum In-Channel Needs for intake submergence & flushing	123,000)	86.8	107,000)	81.6	108,000)	82.0	108,000)	81.0
(d) In-Channel Fishery Requirements additional to min. flows in (c)	39,000)		39,000)		39,000)		39,000)	
TOTAL CONS. USE, LOSSES, MIN. FLOW FOR OKANAGAN RIVER REGION	243,000	100.0	239,000	100.0	239,000	100.0	242,000	100.0
B. IMPROVED OPERATING CONDITIONS - with 100 cubic feet per second minimum flow the year round in the Okanagan River channel.								
MAINSTEM OKANAGAN RIVER								
(a) Consumptive Use - Okanagan River	32,000	15.8	44,000	22.1	43,000	21.6	46,000	22.8
(b) Evaporation Losses from Skaha, Vaseux & Osoyoos Lakes and from the Okanagan River channel	49,000)		49,000)		49,000)		49,000)	
(c) Minimum In-Channel Needs for intake submergence & flushing	50,000)	84.2	34,000)	77.9	35,000)	78.4	35,000)	77.2
(d) In-Channel Fishery Requirements additional to min. flows in (c)	71,000)		72,000)		72,000)		72,000)	
TOTAL CONS. USE, LOSSES, MIN. FLOW FOR OKANAGAN RIVER REGION	202,000	100.0	199,000	100.0	199,000	100.0	202,000	100.0

CHAPTER 7

Water Quantity Requirements

7.1 INFORMATION REQUIRED FOR THE OKANAGAN STUDY

The objective of the Okanagan Basin Study, as detailed in the Canada-British Columbia Agreement, is "to develop a comprehensive framework plan for development and management of water resources for the social betterment and economic growth in the Okanagan Basin".

In order to develop water quantity models and explore management alternatives (which will be described in separate Technical Supplements), it was necessary to compare both present and future water requirements with estimates of the water available for use. This information was required not only for the basin as a whole, but for separate regions and, in deed, for a number of separate tributary basins - the detailed studies of which have been reported separately.

Analyses of water quantity were run for the North Okanagan region, for the Okanagan Lake region, and for the total drainage to the control dam at the outlet of Okanagan Lake at Penticton.

In order to appraise effective management and control techniques, and to evaluate any constraints and limitations in the Okanagan River channel and Flood Control Works, diversion and consumptive use requirements for agriculture, for municipal and domestic use, and for industrial use were required for separate regions along the Okanagan River. These regions are delineated by the several control structures and gauging stations along the river. Also required were the in-channel water requirements, both for minimum flow and for flood conditions.

7.2 RETURN FLOW CONSIDERATIONS

In the absence of detailed and comprehensive information about water use and availability in the Okanagan drainage basin, various assumptions were made in order to arrive at estimates of the proportion of water withdrawn which would actually be consumed and not available for re-use. These have been discussed with particular reference to return flow of irrigation water in Chapter 6 (section 6.2.3), but the same principles also apply to municipal, domestic and industrial uses,

In the water quantity studies of the mainstem lakes and river system, it was assumed that return flow of water diverted from a tributary of Okanagan Lake would not be available for re-use until it reached the lake. For the Okanagan River, it was assumed that of the water withdrawn from the river in any particular

region, no return flow would be available for re-use within that region, although it would all be available in the section next downstream. For instance, return flow from water diverted above the SOLID Dam at McIntyre Bluff would not be available for re-use in the river above SOLID Dam, but would be available for use again between the SOLID Dam and Gauging Station No. 8NM-085 south of Oliver. The coefficients given in Tables 6.3, 6.5 and 6.8 were employed to estimate how much of the annual return flow would be available in each month of the year.

7.3 PRESENT (1970) REQUIREMENTS

Present water requirements include agricultural, domestic, municipal and industrial consumptive uses as well as the non-consumptive water required for the maintenance of desirable lake levels and adequate in-channel flows for fisheries, recreation and aesthetics.

While these sometimes conflicting requirements have been met along the mainstem (Okanagan Lake to Osoyoos Lake) in the past in most years, it is only since the construction of the Okanagan Flood Control Works in the 1950's that multiple water use has been effectively developed. Thus, while the name "Okanagan Flood Control Works" implies a single purpose scheme, it is essentially a multi-purpose project maintained by the Federal and Provincial Governments to meet consumptive and non-consumptive water requirements along the mainstem of the Okanagan River.

In contrast to this are the much smaller privately-developed tributary headwater storages which supply most of the water needed for consumptive use purposes. Out of some 60,000 acres of land irrigated within the basin today, about 45,000 acres are served mainly by gravity supplies from tributary streams. While these storages are operated as single purpose projects by irrigation districts, municipalities and private individuals, they do in effect support recreational facilities including sport fishing.

Agricultural water requirements have been based on the amount of land irrigated, supplied at the duties of water recommended by the British Columbia Department of Agriculture (see Chapter 6, Section 6.2.2). These duties have been increased by 10 percent for conveyance losses to arrive at diversion requirements. Values for duty of water for various regions of the Okanagan are shown for 1970 and for the future in Table 7.3 as part of the following discussion on "Future Water Requirements". Acreage of land irrigated in 1970 is listed in Tables 6.1 and 6.2.

Municipal and domestic water requirements have been based on local water use records, from which it has been estimated that 35 percent of the water diverted is consumed, with the rest returning either to groundwater and thence to

a downstream lake or river point as in the case of irrigation, or directly to the surface waters through sanitary sewers.

Industrial water use is predominantly for cooling or process water (Chapter 6, Section 6.4) and in general practice, about 90 percent of it is returned to source with only about 10 percent lost through consumptive use.

Based on the information obtained from field investigations as described in Chapter 6, the present-day requirements for consumptive water uses for the various regions of the Okanagan Basin were established on a monthly and annual basis. The data for the Okanagan Lake drainage and for the Okanagan River region are summarized in Tables 7.1(a) and (b).

It will be noted that there is a negative total consumptive use during the winter and spring months, for both the Okanagan Lake drainage and for the Okanagan River region. This, in effect, means that there is an increase in flow over natural conditions during those months, and is due to the delay in return flow from summer irrigation.

As well as these consumptive uses, there are the in-channel flows needed to meet natural losses such as evaporation and to maintain minimum flows for adequate intake submergence, flushing and aesthetics, plus the additional water needed to meet the salmon fishery requirements in the Okanagan River (Tables 6.9 and 6.10).

Annual values of present (1970) consumptive use requirements and minimum flow requirements are shown with estimates of evaporation losses for the main-stem lakes and river system in Table 7.2, following, and in Figure 7.1. Of the total 312,230 acre-feet needed to satisfy these requirements, over 67 percent is needed for average-year evaporation from Skaha, Vaseux and Osoyoos Lakes and for the minimum flow requirements down the river.

7.4 FUTURE WATER REQUIREMENTS

As discussed in Chapter 5 under "Fugure Land Use" and more extensively in Technical Supplement X "Economic Growth Projections in the Okanagan Basin", the Okanagan Study developed three alternative projections of economic growth to the year 2020. One projection involved the continuation of existing economic policies, a second assumed that the rate of economic growth would be quickened through new industrial incentive programs after the year 1980, and a third projected a slowing-down in the rate of economic growth compared to that expected under current economic policies, through controls on industrial expansion.

Estimates of water quantity requirements were made for each projection. The forecasts of various economic and demographic parameters developed earlier

TABLE 7.1 (a)

DIVERSION (WITHDRAWAL), CONSUMPTIVE USE & RETURN FLOW FOR OKANAGAN BASIN IN BRITISH COLUMBIA

(1970)

I. OKANAGAN LAKE DRAINAGE (Region north of Okanagan Lake Dam at Penticton)

Population 102,000
Ac. irrig. 46,000

MONTH	IRRIGATION Diversion 113,160 ac-ft Return Flow 56,580 ac-ft Consumptive Use 56,580 ac-ft					MUNICIPAL & DOMESTIC Diversion 22,760 ac-ft Return Flow 14,790 ac-ft Consumptive Use 7,970 ac-ft					INDUSTRIAL Diversion 26,500 Return Flow 22,320 Consumptive Use 4,180				TOTAL CONS. USE
	DIVERSION		RETURN FLOW		CONS. USE	DIVERSION		RETURN FLOW		CONS. USE		DIVERSION	RETURN FLOW	CONS. USE	
	%	ac-ft	%	ac-ft	ac-ft	%	ac-ft	%	ac-ft	ac-ft	%	ac-ft	ac-ft	ac-ft	ac-ft
Apr.	-	-	4	2260	-2260	6	1360	7	1030	330	7	1860	1570	290	-1640
May	15	16970	11	6230	10740	10	2280	9	1330	950	8	2120	1780	340	12030
June	25	28290	14	7920	20370	13	2960	10	1480	1480	9	2390	2010	380	22230
July	25	28290	15	8490	19800	16	3640	13	1920	1720	10	2650	2230	420	21940
Aug.	25	28290	14	7920	20370	16	3640	12	1770	1870	11	2920	2460	460	22700
Sep.	10	11320	12	6790	4530	8	1920	10	1480	340	12	3180	2680	500	5370
Oct.	-	-	9	5090	-5090	7	1590	8	1180	410	8	2120	1780	340	-4340
Nov.	-	-	5	2830	-2830	5	1140	7	1040	100	7	1860	1570	290	-2440
Dec.	-	-	5	2830	-2830	5	1140	6	890	250	7	1850	1560	290	-2290
Jan.	-	-	4	2260	-2260	5	1140	6	890	250	7	1850	1560	290	-1720
Feb.	-	-	4	2260	-2260	4	910	6	890	20	7	1850	1560	290	-1950
Mar.	-	-	3	1700	-1700	5	1140	6	890	250	7	1850	1560	290	-1160
TOTAL		113160		56580	56500		22760		14790	7970		26500	22320	4180	68730

NOTE 1. Irrigation volumes include a 10% allowance for conveyance losses.

NOTE 2. Consumptive Use is calculated from the amount diverted less the return flow, month by month

NOTE 3. No allowance has been made for minimum residual flows or fishery requirements in tributaries of Okanagan Lake

TABLE 7.1 (b)

DIVERSION (WITHDRAWAL), CONSUMPTIVE USE & RETURN FLOW FOR OKANAGAN BASIN IN BRITISH COLUMBIA

(1970)

II. OKANAGAN RIVER REGION (From Okanagan Lake Dam at Penticton to International Boundary at Osoyoos Lake)

Population - 10,980; Land irrigated - 14,000 acres.

MONTH	IRRIGATION Diversion 62,860 ac-ft Return Flow 31,430 ac-ft Consumptive Use 31,430 ac-ft					MUNICIPAL & DOMESTIC Diversion 2,110 ac-ft Return Flow 1,370 ac-ft Consumptive Use 740 ac-ft					INDUSTRIAL Diversion 1,500 Return Flow 1,270 Consumptive Use 230				TOTAL CONS. USE
	DIVERSION		RETURN FLOW		CONS. USE	DIVERSION		RETURN FLOW		CONS. USE		DIVERSION	RETURN FLOW	CONS. USE	
	%	ac-ft	%	ac-ft	ac-ft	%	ac-ft	%	ac-ft	ac-ft	%	ac-ft	ac-ft	ac-ft	ac-ft
Apr.	-	-	4	1260	-1260	7	150	7	100	50	7	110	100	10	-1200
May	15	9430	11	3460	5970	11	230	9	120	110	8	120	100	20	6100
June	25	15710	14	4400	11310	13	270	10	140	130	9	130	110	20	11460
July	25	15720	15	4710	11010	15	320	13	180	140	10	150	130	20	11170
Aug.	25	15710	14	4400	11310	13	270	12	160	110	11	160	130	30	11450
Sep.	10	6290	12	3770	2520	9	190	10	140	50	12	180	150	30	2600
Oct.	-	-	9	2830	-2830	6	130	8	110	20	8	120	100	20	-2790
Nov.	-	-	5	1570	-1570	5	110	7	100	10	7	110	90	20	-1540
Dec.	-	-	5	1570	-1570	5	110	6	80	30	7	110	90	20	-1520
Jan.	-	-	4	1260	-1260	5	100	6	80	20	7	110	90	10	-1220
Feb.	-	-	4	1260	-1260	5	100	6	80	20	7	100	90	10	-1230
Mar.	-	-	3	940	- 940	6	130	6	80	50	7	100	90	10	- 880
TOTAL		62860		31430	31430		2110		1370	740		1500	1270	230	32400

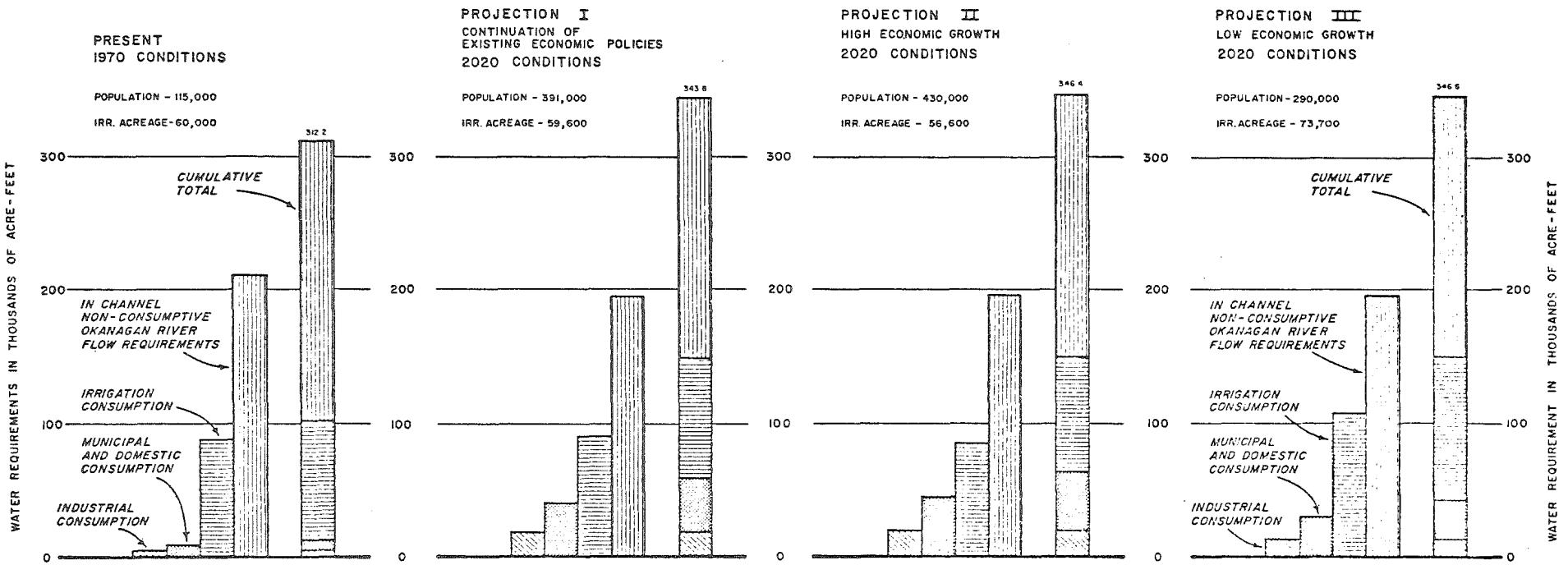
NOTE 1. Irrigation volumes include a 10% allowance for conveyance losses.

NOTE 2. Consumptive Use is calculated from the amount diverted less the retrn flow, month by month.

TABLE 7.2

PRESENT (1970) CONSUMPTIVE USE REQUIREMENTS IN OKANAGAN LAKE BASIN AND TOTAL WATER REQUIREMENTS OKANAGAN RIVER BASIN IN CANADA

	Acre Feet	Acre Feet	Percent of Total
1 OKANAGAN LAKE BASIN			
(a) CONSUMPTIVE USE from tributaries and directly from area adjacent to Okanagan Lake			
Irrigation	56,580		
Municipal & Domestic	7,970		
Industrial	4,180		
Total Okanagan Lake Basin Consumptive Use		68,730	22.0
2 MAINSTEM OKANAGAN RIVER			
(a) CONSUMPTIVE USE			
Irrigation	31,430		
Municipal & Domestic	740		
Industrial	230		
Total Okanagan River Consumptive use		32,400	10.4
(b) EVAPORATION LOSSES FROM SKAHA Vaseux and Osoyoos Lakes	49,120		15.7
(c) MINIMUM FLOW REQUIREMENTS			
Intake submergence, flushing, aesthetics addtional water to meet salmon fishery flows	122,660 39,320	161,980	51.9
Okanagan Lake Basin consumptive use and main Okanagan River water requirements		312,230	100.0



COMPARISON OF PRESENT AND FUTURE TOTAL WATER REQUIREMENTS
IN THE OKANAGAN BASIN FOR VARIOUS ECONOMIC GROWTH ASSUMPTIONS

Figure 2.1

in the study were not immediately suitable for predicting future water demands as the economic region on which these statistics were based covered a somewhat larger area than the Okanagan watershed, and included parts of the Similkameen Valley and the Shuswap watershed. Consequently, certain adjustments had to be made to enable the statistical data to be compatible with the purposes of the study. The adjusted forecasts of population, agricultural and industrial production, and available area for irrigation and other purposes were used to derive withdrawal and consumptive water demands for the several regions of the Okanagan.

7.4.1 Irrigation

For each region of the valley, projected irrigation acreage was multiplied by the appropriate duty to give future water requirements. The duty of water, both for withdrawal and for consumptive use estimation, has been observed to decline during recent years, and is expected to continue to decline. Most of the reduction can be explained by the gradual rehabilitation of irrigation systems which has involved a change from open ditch irrigation to sprinkler irrigation and the use of enclosed pressure pipes instead of open flumes for conveyance. Part of the decline can also be accounted for by the greater use of water scheduling procedures, though presently only about 15 percent of all farmers use some form of scheduling. Most of the irrigation systems are now rehabilitated and it is not anticipated that scheduling will be universally applied without further inducements or incentives except, as discussed eralier in Chapter 6 (Section 6.2.4), for those areas where urban subdivision encroachment on irrigation systems has resulted in pressure drop and inadequate hourly and daily peaking capability.

It must be recognized however, that there are trends towards more efficient use of water on the farm or orchard as, for instance, the trickle irrigation system described in Appendix B. Reductions may also be achieved through metering and changes in the pricing of water, not only in irrigation but perhaps more effectively in municipal, domestic and industrial applications. Such more efficient use of water, combined with possible metering and pricing control, may well reduce the per acre water demand in future, a trend that should be encouraged.

With these considerations in mind, the duties of water used for estimating future irrigation water requirements in the various regions and areas of the Okanagan, indicate a reduction as the study horizon year of 2020 is approached, as shown in the following Table (Table 7.3).

TABLE 7.3

DUTY OF WATER FOR IRRIGATION

(Duties shown include 10% allowance for conveyance losses)

REGION	DIVERSION DUTY ac-ft/acre		CONSUMPTUVE USE ac-ft/acre	
	1970-80	2020	1970-80	2020
1. Okanagan Lake & tributaries	2.75	2.36	1.38	1.18
2. Penticton Dam - Okanagan Falls Dam	3.30	2.90	1.65	1.45
3. Okanagan Falls Dam - SOLID Dam*	3.58	5.26	1.79	2.63
4. SOLID Dam - Oliver Gauge 8NM-085	4.40	5.06	2.20	2.53
5. Oliver Gauge 8NM-085 - U.S. Border	6.25	5.44	3.12	2.72

* Duties shown here for Region 3 are composite figures which allow for the 3,965 acres (1970) and 4800-5500 acres (2020 projections) in Region 4 but supplied from the SOLID canal which diverts water upstream of the SOLID Dam itself.

The irrigated acreage forecast for each of the three growth projections is shown in comparison with parallel 1970 irrigated areas for the several regions in Table 7.4. In similar fashion, Table 7.5 shows consumptive uses for irrigation and other purposes for the three 2020 Growth Projections and for 1970, for the Okanagan Lake Drainage and for the Okanagan River Region.

7.4.2 Municipal and Domestic Use

Municipal water uses include the total water diverted into municipal waterworks systems to supply small-scale industrial uses, commercial uses, residential uses, and the sprinkling of lawns, parts, gardens and golf courses plus any leakage in the system. Domestic withdrawal includes the amount of water supplied to households not located in incorporated areas for domestic use and sprinkling purposes.

Future demands in the municipal-domestic sector were estimated by multiplying urban per capita use per day by projected populations. In general, rural water use per capita is somewhat lower than urban water use per capita, but this difference it not considered to be significant because livestock watering will tend to reduce the differential and because in the long term, a relatively larger proportion of the Basin's population is expected to be supplied by municipal systems. At present about 67 percent of the Basin's population is served by municipal systems.

TABLE 7.4

IRRIGATED LAND BY REGION IN OKANAGAN BASIN
1970 AND PROJECTIONS TO 2020

Region	1970	2020		
		Growth Projection 1	Growth Projection 2	Growth Projection 3
	Acres	Acres	Acres	Acres
1. Okanagan Lake & tributaries	46,070	43,215	40,630	55,310
2. Penticton Dam-Okanagan Falls Dam	2,990	2,425	2,215	3,005
3. Okanagan Falls Dam - SOLID Dam				
a) Supplied from river, etc.	285	255	240	310
b) Land in Region 4 supplied from SOLID Canal	3,865	4,940	4,870	5,435
4. SOLID Dan - Oliver Gauge 8NM085 (except land in 3 (b))	4,270	5,455	5,380	6,000
5. Oliver Gauge 8NM085	2,590	3,310	3,265	3,640
Basin Totals	60,070	59,600	56,600	73,700

2020 Growth Projection 1 - Continuation of Present Policies

2020 Growth Projection 2 - High Economic Growth (Low Agriculture)

2020 Growth Projection 3 - Low Economic Growth (High Agriculture)

TABLE 7.5

CONSUMPTIVE USE REQUIREMENTS IN THE OKANAGAN BASIN

1970 AND PROJECTIONS TO 2020

	1970	2020		
		Growth Projection 1	Growth Projection 2 High Economic Growth (Low Agriculture)	Growth Projection 3 Low Economic Growth (High Agriculture)
Population	113,480	391,000	430,000	290,000
Irrigated Acres	60,070	59,600	56,600	73,700
	acre-feet	acre-feet	acre-feet	acre-feet
1. OKANAGAN LAKE DRAINAGE to Penticton Control Dam				
Irrigation	56,560	51,640	48,520	66,100
Municipal & Domestic	7,970	35,200	38,820	26,150
Industrial Use	4,180	17,870	19,710	13,260
Total - Okanagan Lake	68,730	104,710	107,050	105,510
2. MAINSTEM OKANAGAN RIVER from Penticton Control Dam to Int'l Boundary				
Irrigation	31,430	38,080	37,350	41,370
Municipal & Domestic	740	5,510	5,790	4,045
Industrial Use	230	250	300	170
Total - Okanagan River	32,400	43,840	43,440	45,585
BASIN TOTAL	101,130	148,550	150,490	151,095

Assuming the absence of significant water restrictions of the further introduction of domestic water metering systems, the per capita urban water use is expected to increase in the short term to about the year 2000. After 2000 however, per capita rates are expected to decline, especially in the Okanagan Lake region, where shortages of land will likely encourage the construction of condominium and apartment developments, which require less water due to a reduction in garden sprinkling requirements. Because of locational differences as well as differences in the timing of more intensive urban developments, per capita use trends will vary between sub-basins, (see Table 7.6).

TABLE 7.6

TRENDS IN DOMESTIC WATER WITHDRAWALS IN THE OKANAGAN BASIN, 1970 to 2020

REGION	YEAR					
	1970	1980	1990	2000	2010	2020
NORTH OKANAGAN	150	170	190	200	210	210
OKANAGAN LAKE	200	220	240	250	230	220
OKANAGAN RIVER	200	220	240	250	240	230

Consumptive uses for municipal and domestic requirements are shown for 1970 and the three growth projections for the year 2020 in Table 7.5.

7.4.3 Industrial Use

Base period (1970) estimates of industrial water use were developed from figures provided by the Pollution Control Board for industrial outfalls to the Okanagan system. Effluent flow figures were then expanded to water withdrawals by applying estimated return flow factors associated with each type of use. The return flows for washing-type uses were estimated at 80 percent, processing uses at 70 percent, and bottling uses at 60 percent. Thus, for washing-type industrial uses, for example, yearly effluent flows were multiplied by 100/80 to determine yearly water withdrawal. The consumptive use for each type of user could then be determined by subtracting return flows (effluent) from withdrawal use.

In preparation for projection of water demands, the list of industries with outfalls was divided into industrial classes (or sectors) amenable to be considered for long-term projections of growth. The following classes were distinguished in the Central Okanagan:

1) Services incidental to agriculture
2) Food and Beverage industries
   Sub-classes: fruit and vegetable canners
   wineries, soft drinks, and distillers
3) Wood industries
   Sub-classes: sawmills and planing mills
   veneer and plywood mills
4) Metal fabricating industries
5) Non-metallic mineral products industries

Only one class of industry was found in the North Okanagan economic region (food and beverage industries - sub-class: dairy products) and only one class in the Okanagan River economic region (services incidental to agriculture). No separate industrial water use forecast was made north of the SOLID Dam in the Okanagan River region since only small-scale, non-water-intensive industrial users were located there in the base period (1970).

Trends in water use to 2020 were then calculated for each sector by applying growth forecasts for selected years from 1980 to 2020 to water withdrawal and consumptuve use figures in the base period.

Growth forecasts for each sector were made on the following basis:

(a) Services Incidental to Agriculture

Growth in this sector in the Central Okanagan and Okanagan River economic regions is assumed to follow growth in tree fruit production in each region. Forecast figures for tree fruit production and acreage in tree fruits for 1980 and acreage only for 2020 were made by the British Columbia Department of Agriculture. Production was calculated from acreage figures interpolated from 1980 to 2020.

(b) Fruit and Vegetable Canners

It is assumed that the same proportion of the total tree fruit crop would be canned in the future. Therefore, the growth rate for tree fruit production was applied to this sector also.

(c) Wineries, soft drinks, and distillers

Wineries are assumed to process a constant proportion of projected grape production. It is assumed that soft drink production is related to the weighted average (75-25%) of population growth and growth of tourism in the Valley. On the basis of Economic Council of Canada predictions that consumer expenditures in Canada would rise 5.3 percent per year from 1967 to 1975, consumption of distillery products is expected to rise at the same rate to 1980. After 1980, demand should become less elastic and decline to 3 percent annually.

(d) Wood Industries: Sub-sectors-sawmills and planing mills; veneer and plywood

This sector's growth is generally related to trends in residential and non-residential construction in Canada and growth in real output in the principal export markets in Europe and Asia to 1980. From 1980 to 2000 and from 2000 to 2020, the rate of trowth was projected to decline to 3 percent and 1 percent respectively.

(e) Non-Metallic Mineral Products Industries

Since this sector supplies inputs to the construction industry, it is expected that the sector's growth would approximate the projected rate of growth of Canadian construction as a proxy for conditions in the Okanagan. A figure of 5.5 percent per year to the year 1990 was used. The growth rate to 2020 was anticipated to decline to 3 percent per year.

(f) Dairy Products

Growth in this sector was expected to be associated with population growth in the Valley.

Consumptive use requirements for industry for the Okanagan Lake Drainage and for the mainstem Okanagan River are shown for 1970 and the three growth projections for the year 2020 in Table 7.5.

7.4.4 In-Channel Water Requirements

In-channel requirements were discussed in Chapter 6 (Section 6.5) insofar as minimum flow requirements and fishery requirements in the mainstem Okanagan River are concerned. Looking to the future however, both minimum flows and fishery flows may be reduced in years of severe drought conditions in order to conserve available supplies of water in the Basin. The Okanagan Study examined the savings in water achieved by relocating water intakes along the Okanagan River so that minimum flows in the summer months could be reduced from 300 cubic feet per second (cfs) to 100 cfs; this and other structural changes would allow a reduction in minimum in-channel needs for intake submergence and flushing from approximately 107,000 acre-feet per year to 35,000 acre-feet per year under 2020 growth projections. However, an increase in additional water required for the salmon fishery from 39,000 acre-feet to 72,000 acre-feet annually would follow. The overall saving in minimum flow and in-channel fishery requirements would be approximately 39,000 acre-feet per year. It must be emphasized that minimum flow requirements would not be a factor of significance unless drought conditions were experienced. In many years, in-channel flows will be much greater.

7.4.5 Discussion of Future Water Requirements

Projections of water requirements for the entire Okanagan Basin to the year 2020 for the three economic growth projections are compared in Table 7.7(a) and (b) and illustrated in the bar diagrams of Figure 7.1. Only consumptive water

TABLE 7.7(a)

CONSUMPTIVE USE REQUIREMENTS IN THE OKANAGAN LAKE DRAINAGE AND TOTAL WATER REQUIREMENTS FOR OKANAGAN RIVER BASIN IN CANADA

A. PRESENT OPERATING CONDITIONS with 300 cubic feet per second minimum flow in the Okanagan River between April September inclusive, and 100 c.f.s. min. flow between October and March inclusive

	1970		2020					
			GROWTH PROJECTION 1 Continuation of Present policies		GROWTH PROJECTION 2 High Economic Growth (Low Agriculture)		GROWTH PROJECTION 3 Low Economic Growth (High Agriculture)	
Population	113,480		391,000		430,000		290,000	
Irrigated Acres	60,070		59,600		56,600		73,700	
	acre-feet	%	acre-feet	%	acre-feet	%	acre-feet	%
1. OKANAGAN LAKE BASIN								
(a) Consumptive Use from tributaries and directly from areas adjacent to Okanagan Lake								
- IRRIGATION	57,000		52,000		48,000		66,000	
- MUNICIPAL & DOMESTIC	8,000		35,000		39,000		26,000	
- INDUSTRIAL	4,000		18,000		20,000		13,000	
TOTAL CONSUMPTIVE USE - OKANAGAN LAKE BASIN	69,000	22.0	105,000	30.5	107,000	30.9	105,000	30.3
2. MAINSTEM OKANAGAN RIVER								
(a) Consumptive Use - Okanagan River	32,000	10.4	44,000	12.8	43,000	12.4	46,000	13.3
(b) Evaporation Losses from Skaha, Vaseux and Osoyoos Lakes and from Okanagan River channel	49,000		49,000		49,000		49,000	
(c) Minimum In-Channel Needs for intake submergence and flushing	123,000	67.6	107,000	56.7	108,000	56.7	108,000	56.4
(d) In-Channel Fishery Requirements additional to min.flows in (c)	39,000		39,000		39,000		39,000	
TOTAL CONSUMPTIVE USE, LOSSES, MINIMUM FLOW FOR OKANAGAN RIVER REGION	243,000		239,000		239,000		242,000	
TOTAL BASIN CONSUMPTIVE USE + MAIN OKANAGAN RIVER WATER REQUIREMENTS	312,000	100.0	344,000	100.0	346,000	100.0	347,000	100.0

TABLE 7.7 (b)

CONSUMPTIVE USE REQUIREMENTS IN THE OKANAGAN LAKE DRAINAGE &
TOTAL WATER REQUIREMENTS FOR OKANAGAN RIVER BASIN IN CANADA

B. MODIFIED OPERATING CONDITIONS with 100 cubic feet per second minimum flow the year round in the Okanagan River channel

	1970		2020					
			GROWTH PROJECTION 1 Continuation of Present Policies		GROWTH PROJECTION 2 High Economic Growth (Low Agriculture)		GROWTH PROJECTION 3 Low Economic Growth (High Agriculture)	
Population	113,480		391,000		430,000		290,000	
Irrigated Acres	60,070		59,600		56,600		73,700	
	acre-feet	%	acre-feet	%	acre-feet	%	acre-feet	%
1. OKANAGAN LAKE DRAINAGE								
(a) Consumptive Use from tributaries and directly from areas adjacent to Okanagan Lake								
- IRRIGATION	57,000		52,000		48,000		66,000	
-	8,000		35,000		39,000		26,000	
- INDUSTRIAL	4,000		18,000		20,000		13,000	
TOTAL CONSUMTIVE USE - OKANAGAN LAKE BASIN	69,000	25.5	105,000	34.5	107,000	35.0	105,000	34.2
2. MAINSTEM OKANAGAN RIVER								
(a) Consumptive Use - Okanagan River	32,000	11.8	44,000	14.5	43,000	14.0	46,000	15.0
(b) Evaporation Losses from Skaha, Vasuex and Osoyoos Lakes and from Okanagan River Channel	49,000		49,000		49,000		49,000	
(c) Minimum In-Channel Needs for intake submergence and flushing	50,000	62.7	34,000	51.0	35,000	51.0	35,000	50.8
(d) In-channel Fishery Requirements additional to min. flows in (c)	71,000		72,000		72,000		72,000	
TOTAL CONSUMPTIVE USE, LOSSES, MINIMUM FLOW FOR OKANAGAN RIVER REGION	202,000		199,000		199,000		202,000	
TOTAL BASIN CONSUMPTIVE USE + MAIN OKANAGAN RIVER WATER REQUIREMENTS	271,000	100.0	304,00	100.0	306,000	100.0	307,000	100.0

demands for agricultural, domestic and industrial use have been projected for the Okanagan Lake drainage area, but both consumptive and non-consumptive uses (total water requirements) are shown for the mainstem system.

By 2020, growth in population and irrigated acreage could change total Basin water requirements for both consumptive and non-consumptuve uses to between 344,000 and 347,000 acre-feet per year, compared to 312,000 acre-feet per year at present (1970), an increase of about 10 percent over the 50-year period. There is a lack of sensitivity between the various 2020 projections, as will be noted from Table 7.5 and 7.7. This is due to the balance in demand between land under irrigation for agriculture and land used for residential and urban development. Irrigation today makes up over 87 percent of total water consumptions in the Okanagan Basin. Under the 2020 growth projections, irrigation will take a lesser proportion of the total:

Growth Projection I - Irrigation, 60% of total consumptive use;
Growth Projection II - Irrigation, 57% of total consumptive use; and
Growth Projection III - Irrigation, 71% of total consumptive use

However, as the percentage for irrigation declines, the requirement for domestic and industrial uses increases proportionately, with the end result being that the total consumptive use for the entire basin is nearly the same under all three growth projections.

Reference to Table 7.5 shows the significant increase in municipal and domestic requirements between 1970 and 2020 under any projection, with a parallel increase in industrial requirements in the central portion of the Basin near Kelowna particularly. The industrial requirements in the southern portion of the Valley are forecast to remain about the same, the expectation being that the area will remain heavily oriented to tree fruit and grape production and that the recreational potential of the area around Osoyoos Lake, especially on Indian Lands, will be developed.

Table 7.7 and Figure 7.1 both illustrate that the in-channel non-consumptive requirements acount for over 50 percent of total water requirements in the basin under any projection, even under modified operating conditions with 100 cubic feet per second minimum flow the year round in the Okanagan River, and the impact under present (1970) conditions is even greater. Clearly, any economies in these non-consumptuve requirements along the Okanagan River will be beneficial generally.

REFERENCES

1 Runka, C.G., "Land Capability for Agriculture," Soil Survey Division, British Columbia Department of Agriculture, Kelowna, B.C., January, 1973.

2. Hirshleifer, J., DeHaven, J. & Milliman, J.W., "Water Supply: Economics, Technology & Policy", University of Chicago, Chicago, Illinois, 1969.

3. Wilcox, J.C. & Brownlee, C.H., "Sprinkler Irrigation Requirements for Tree Fruits in the Okanagan Valley", Publication 1121, Research Branch, Canada Department of Agriculture, July 1961

4. Stevenson, D.S. & Brownlee, C.H., "Some Estimates of Return Flows from Irrigation Water in the Okanagan Watershed", August 1970.

5. Leach, T.A.J., "Shuswap River - Okanagan Lake Water Supply Canal (A.R.D.A. Research Project 10031)", Report No. 1374, Water Investigations B Branch, B.C. Water Resources Service, Victoria, B.C., August 1966

6. Leach, T.A.J., "Okanagan Basin Inflow Determinations", Report No. 1714, Water Investigations Branch, B.C. Water Resources Service, Victoria, B.C., September 1970.

7. DeRemer, D. Dale, "Starting with Trickle Irrigation", Proceedings of the 1970 Conference of the Sprinkler Irrigation Association, Washington, D.C.

8. Kenworthy, A.L., "Trickle Irrigation . . . The Concept and Guidelines for Use", Research Report No. 165, Michigan State University Agricultural Experiment Station, East Lansing, Michigan, May 1972.

9. Miller, R.J., "General Information on Trickle Irrigation in B.C. for Raspberry Growers", Agricultural Engineering Branch, B.C. Department of Agriculture, Victoria, B.C., February 1973.

10. Associated Engineering Services, "Kelowna Water Study", Associated Engineering Services, Limited, Vancouver, B.C., October 1964

11. Doughty-Davies, J.H., "Okanagan Flood Control Works - 1963 Survey, Revised 1967", Report No. 1554, Water Investigations Branch, B.C. Water Resources Service, Victoria, B.C., February 1967.

12. Robertson, A.R.D., "Okanagan River Improvement Costs", Report No. 1775, Water Investigations Branch, B.C. Water Resources Service, Victoria, B.C., February 1967.

13. Fisheries Service, "Pacific Salmon: Population and Habitat Requirements", Fisheries Service of the Canada Department of the Environment, with assistance from the Washington State Department of Fisheries, Report prepared for the Canada-British Columbia Okanagan Basin Agreement, Penticton, B.C., January 1973.

14. Hall, G.D., "Water Demand Study, Canada-British Columbia Okanagan Basin Agreement," British Columbia Water Resources Service, Victoria, B.C., July 1972.

APPENDICES

APPENDIX A

BACKGROUND DATA TABLES - WATER DEMAND STUDIES
(From Preliminary Report No. 13)

TABLE

A.1 Estimated Water Use in the Okanagan Valley (in Acre-Feet)

A.2 Water Withdrawal and Consumption by Sub-Basin

A.3 Agricultural Water Use by Tributary

A.4 Agriculture Water Use from Non-Tributary Sources

A.5 Domestic Water Use by Tributary Source

A.6 Domestic Water by Non-Tributary Sources

A.7 Industrial Water Use by Sector

A.8 Regional Distribution of Industrial Water Use

TABLE A.1

ESTIMATED WATER USE IN THE OKANAGAN VALLEY IN ACRE-FEET

	LOCATION	AGRICULTURAL			DOMESTIC		INDUSTRIAL		TOTAL	
		Acres	Water Withdrawn	Water Consumed	Water Withdrawn	Water Consumed	Water Withdrawn	Water Consumed	Water Withdrawn	Water Consumed
1.	Sub-basin Creek	44,471	113,710	56,855	11,482	4,019	5,560	2,284	130,752	63,158
	Mainstem Lakes Okanagan River and Wells	15,599	64,030	32,015	13,382	4,683	22,440	2,116	99,852	38,814
2.	Organized Areas	42,199	122,424	61,212	20,472	7,165	4,200	840	147,096	69,217
	Unorganized Areas	17,871	55,316	27,658	4,392	1,537	23,800	3,560	83,508	32,755
3.	Okanagan Lake * Region	45,714	112,800	56,400	21,546	7,541	26,500	4,175	160,846	68,116
	Okanagan River Region	14,356	64,940	32,470	3,318	1,161	1,500	225	69,758	33,856
	TOTALS	60,070	177,740	88,870	24,864	8,702	28,000	4,400	230,604	101,972

* Includes North Okanagan

TABLE A.2

WATER WITHDRAWAL AND CONSUMPTION BY SUB-BASIN

	AGRICULTURE		DOMESTIC		INDUSTRIAL		TOTAL	
	Withdrawn (acre-feet)	Consumed (acre-feet)	Withdrawn (acre-feet)	Consumed (acre-feet)	Withdrawn (acre-feet)	Consumed (acre-feet)	Withdrawn (acre-feet)	Consumed (acre-feet)
Testalinden	-	-	2	1	450	45	452	46
Park Rill	2,100	1,050	8	3	20	10	2,128	1,063
Marron	1,500	740	2	1	-	-	1,502	751
Shingle	2,500	1,250	15	5	10	5	2,525	1,260
Trout	13,980	6,990	1,396	488	460	92	15,836	7,570
Eneas	1,340	670	3	1	-	-	1,343	671
Peachland	2,440	1,220	8	3	1,600	1,550	4,048	2,773
Trepanier	960	480	8	3	-	-	968	483
Powers	3,870	1,935	353	123	70	7	4,293	2,065
McDougal	1,000	500	4	1	-	-	1,004	501
Lambly	3,430	1,715	262	92	-	-	3,692	1,807
Shorts	700	350	1	1	-	-	701	351
Whiteman	360	180	3	1	-	-	363	181
Nashwito	210	105	1	1	-	-	211	106
Equesis	2,100	1,050	8	3	-	-	2,108	1,053
Irish	130	65	2	1	-	-	132	66
Deep	1,800	900	535	187	-	-	2,335	1,087
Vernon	27,200	13,600	2,610	914	1,000	200	30,810	14,714
Kelowna	9,110	4,555	258	91	50	5	9,418	4,651
Mission	25,380	12,690	1,169	409	100	10	26,649	13,109
Bellevue	900	450	50	18	-	-	950	468
Naramata	3,100	1,550	279	98	-	-	3,379	1,648
Penticton	4,500	2,250	4,475	1,566	1,800	360	10,775	4,176
Ellis	2,300	1,150	-	-	-	-	2,300	1,150
Shuttleworth	590	295	8	3	-	-	598	298
Vaseux	110	55	4	1	-	-	114	56
Wolfcub	500	250	8	3	-	-	508	253
Inkaneep	1,200	600	10	4	-	-	1,210	604
	113,310	56,655	11,482	4,022	5,560	2,284	130,352	62,961

TABLE A.3

AGRICULTURAL WATER USE BY TRIBUTARY

CREEK	ACREAGE IRRIGATED (acres)	FARM DUTY (ac-ft/ac)	FARM APPLICATION (acre-feet)	AMOUNT DIVERTED (acre-feet)	AMOUNT CONSUMED (acre-feet)
Testalinden	-	-	-	-	-
Park Rill	777	2.5	1,900	2,100	1,050
Marron	508	2.7	1,400	1,500	750
Shingle	755	3.0	2,300	2,500	1,250
Trout	4,418	2.9	12,730	13,980	6,990
Summerland Mun.	3,437	3.0	10,000	11,000	5,500
Meadow Valley I.D.	470	2.5	1,200	1,300	650
Trout Creek I.D.	270	3.0	810	890	445
Unorganized	241	3.0	720	790	395
Eneas	395	3.0	1,190	1,340	670
Summerland Mun.	323	3.0	970	1,100	550
Unorganized	72	3.0	220	240	120
Peachland	652	3.4	2,230	2,440	1,220
Peachland I.D.	614	3.4	2,100	2,300	1,150
Unorganized	38	3.5	180	140	70
Trepanier	262	3.3	870	960	480
Powers	1,428	2.6	3,650	3,870	1,935
Westbank I.D.	1,370	2.5	3,400	3,700	1,850
Unorganized	58	2.5	150	170	85
McDougall	302	3.0	910	1,000	500
Lambly	1,192	2.6	3,090	3,430	1,715
Lakeview I.D.	1,062	2.5	2,700	3,000	1,500
Unorganized	130	3.0	390	430	215
Shorts	213	3.0	390	430	215
Whiteman	151	2.2	330	260	180
Naswhito	64	3.0	190	210	105
Equesis	619	3.0	1,900	2,100	1,050
Irish	60	2.0	120	130	65
Deep	2,000	1.0	2,000	2,200	1,100
Vernon	12,733	2.0	24,670	27,200	13,600
Vernon I.D.	9,200	1.6	15,000	16,500	8,250
S. Vernon I.D.	240	1.5	360	400	200
Winfield I.D.	1,804	3.0	5,400	5,900	2,950
Wood Lake I.D.	870	3.0	2,600	2,900	1,450
Unorganized	619	2.2	1,400	1,500	750
Kelowna	3,992	2.1	8,300	9,110	4,555
Glenmore I.D.	2,029	1.5	3,000	3,300	1,650
Ellison I.D.	530	2.5	1,300	1,400	700
Scotty Creek I.D.	908	3.0	2,700	3,000	1,500
Bankhead I.D.	40	2.5	100	110	55
Unorganized	485	2.5	1,200	1,300	650
Mission	9,189	2.5	23,050	25,380	12,690
Black Mountain I.D.	3,642	2.5	9,100	10,000	5,000
S.E. Kelowna I. D.	3,580	2.5	9,000	9,900	4,950
Brent Davis I.D.	100	2.5	250	280	140
Unorganized	1,867	2.5	4,700	5,200	2,600
Bellevue	410	2.0	820	900	450
OK-Mission	270	2.0	540	590	295
Unorganized	140	2.0	280	310	155
Naramata	1,083	2.6	2,800	2,100	1,550
Penticton	1,620	2.5	4,100	4,500	2,250
Ellis	830	2.5	2,100	2,300	1,150
Shuttleworth	266	2.0	530	590	295
Shuttleworth I.D.	186	2.0	370	410	205
Unorganized	80	2.0	160	180	90
Vaseux	34	3.0	100	110	55
Wolfcub	151	3.0	450	500	250
Inkaneep	367	3.0	1,100	1,200	600
	44,471		103,330	113,710	56,855

TABLE A.4

AGRICULTURE WATER USE FROM NON-TRIBUTARY SOURCES

SOURCE	ACREAGE IRRIGATED (acres)	FARM DUTY (ac-ft/acre)	FARM APPLICATION (acre-feet)	AMOUNT DIVERTED (acre-feet)	AMOUNT CONSUMED (acre-feet)
Wood Lake	154	2.5	390	430	215
Kalamalka Lake	168	2.0	340	370	185
Okanagan Lake	1,911	2.4	4,410	4,890	2,445
Kelowna City	392	2.5	980	1,100	550
Naramata I.D.	100	2.6	260	290	145
Okanagan-Mission I.D.	270	1.0	270	300	150
Unorganized	1,149	2.5	2,900	3,200	1,600
Skaha Lake	1,041	2.6	2,750	2,990	1,495
Okanagan Falls I.D.	222	3.0	670	740	370
Kaleden I.D.	547	2.5	1,400	1,500	750
Unorganized	272	2.5	680	750	375
Vaseux Lake	-	-	-	-	-
Okanagan River	3,546	5.0	17,120	18,380	9,190
Westbench I.D.	318	3.0	950	1,000	500
Black Sage I.D.	170	4.0	680	750	375
SOLID pump #2	220	4.8	1,100	1,200	600
SOLID Pump #3	88	4.5	390	430	215
Unorganized	2,750	5.0	14,000	15,000	7,500
SOLID CANAL	4,051	4.7	19,100	21,100	10,550
Pump # 1	410	4.5	1,800	2,000	1,000
Pump # 4	949	4.7	4,500	5,000	2,500
Pump # 5	549	4.5	2,500	2,800	1,400
Pump # 6	441	4.5	2,000	2,200	1,100
Pump # 7	485	4.5	2,200	2,400	1,200
Unorganized	1,217	5.0	6,100	6,700	3,350
Osoyoos Lake	2,348	4.9	11,540	12,670	6,335
Boundary Line I.D.	96	5.0	480	530	265
Osoyoos I.D.	396	5.0	2,000	2,200	1,100
SOLID Pump # 8	861	4.6	4,000	4,400	2,200
SOLID Pump # 9	827	5.2	4,300	4,700	2,350
Unorganized	168	4.5	760	840	420
Groundwater	2,380	1.3	2,950	3,200	1,600
Oyama I.D.	380	2.5	950	1,000	500
Unorganized	2,000	1.0	2,000	2,200	1,100
	15,599		58,600	64,030	32,015

TABLE A.5

DOMESTIC WATER USE BY TRIBUTARY SOURCE

SUB-BASIN WITH ORGANIZED AREA	CONNECTIONS	ANNUAL WATER WITHDRAWAL (acre feet)	ANNUAL WATER CONSUMPTION (acre feet)
Testalinden	1	2	1
Park Rill	11	8	3
Marron	2	2	1
Shingle	20	15	5
Trout	1,862	1,396	488
Summerland Mun.	1,832	1,374	481
Meadow Valley I.D.	5	5	1
Trout Creek I.D.	12	9	3
Unorganized	13	9	3
Eneas	4	3	1
Peachland	11	8	3
Trepanier	12	8	3
Powers	455	353	123
Westbank I.D.	435	338	118
Unorganized	20	15	5
McDougall	6	4	1
Lambly	349	262	92
Lakeview I.D.	348	261	91
Unorganized	1	1	1
Shorts	1	1	1
Whiteman	3	3	1
Naswhito	1	1	1
Equesis	11	8	3
Irish	2	2	1
Deep	709	535	187
Armstrong	639	480	168
Unorganized	70	55	19
Vernon (includes B.X. Coldstream & Oyama Cr.)	3,419	2,610	914
S. Vernon I.D.	20	15	5
Vernon I.D.	320	240	84
City of Vernon	2,032	1,475	517
W. & OK. Centre I.D.	435	358	126
Wood Lake I.D.	50	38	13
Coldstream Dist.	551	476	166
Unorganized	11	8	3
Kelowna	344	258	91
Bankhead I.D.	5	4	1
Glenmore I.D.	280	210	74
Ellison I.D.	17	13	5
Scotty Cr. I.D.	31	24	8
Unorganized	11	8	3
Mission	2,109	1,169	409
Black Mtn. I.D.	610	456	160
S.E. Kelowna I.D.	183	136	48
Rutland	1,269	541	188
Brent Davis I.D.	30	23	8
Unorganized	17	13	5
Bellevue	200	50	18
Naramata	370	279	98
Penticton	5,914	4,475	1,566
Ellis	-	-	-
Shuttleworth	10	8	3
Vaseux	5	4	1
Wolfcub	10	8	3
Inkaneep	12	10	4
	15,853	11,482 ac-ft.	4,022 ac-ft.

TABLE A.6

DOMESTIC WATER BY NON-TRIBUTARY SOURCES

SOURCE	CONNECTIONS	ANNUAL WATER WITHDRAWAL (acre-feet)	ANNUAL WATER CONSUMPTION (acre-feet)
Wood Lake	20	15	5
Kalamalka	2,370	1,791	627
City of Vernon	2,037	1,600	561
Coldstream Dist.	323	184	64
Unorganized	10	7	2
Okanagan Lake	8,559	5,209	1,823
Bluebird Bay	10	53	19
City of Kelowna	5,954	4,425	1,548
Beachcomber Bay	30	23	8
Peachland Mun.	200	287	100
Okanagan Mission	200	100	35
Summerland Mun.	1,885	155	54
Delcliff Waterworks	10	8	3
Traders Cove	10	8	3
Unorganized	200	150	53
Skaha Lake	530	405	143
Okanagan Falls	220	170	60
Kaleden	200	150	53
Unorganized	110	85	30
Vaseux Lake	-	-	-
Osoyoos Lake	210	161	57
Boundary Line I.D.	10	8	3
Osoyoos I.D.	60	45	16
SOLID (part.)	130	100	35
Unorganized	10	8	3
Okanagan River	675	507	177
Westbench I.D.	250	188	65
Black Sage I.D.	20	15	5
SOLID (part)	380	285	99
Unorganized	25	19	8
Groundwater	4,479	5,294	1,853
Oyama I.D.	94	71	25
Osoyoos	455	428	150
Oliver	725	550	193
Larkin	50	35	12
Unorganized	3,155	4,210	1,475
TOTAL	16,843	13,382	4,685
Total for Tributary Sources	15,853	11,482	4,022
TOTAL FROM ALL SOURCES	32,696	24,864 ac.-ft.	8,707

TABLE A.7

INDUSTRIAL WATER USE BY SECTOR

SECTOR	NUMBER OF OPERATIONS	WATER WITHDRAWN (acre feet) Surface	Ground	Total	PERCENT CONSUMED	WATER CONSUMED (acre feet
1. Meat & Dairy Products	13	250	250	500	20%	100
2. Fruit & Vegetable Canners	11	500	negligible	500	30%	150
3. Wineries, Soft Drinks & Distillers	11	6,950	50	7,000	10%	700
4. Other Food & Beverage Industries	19	50	negligible	50	40%	20
5. Sawmills & Planing Mills	76	9,500	500	10,000	10%	1,000
6. Other Wood Industries	51	5,800	200	6,000	10%	600
7. Metal Fabricating & Transport Equipment	51	90	10	100	30%	30
8. Non-Metallic Mineral Products	25	300	100	400	10%	40
9. Other Manufacturing	80	150	50	200	20%	40
10. Logging	103	50	50	100	30%	30
11. Packing Houses	20	950	400	1,400	10%	140
12. Mining	6	1,750	negligible	1,750	90%	1,550
TOTAL	466	26,340	1,660	28,000	16% (av.)	4,400

TABLE A.8

REGIONAL DISTRIBUTION OF INDUSTRIAL WATER USE

REGION	WATER WITHDRAWN (acre-feet) Surface	Ground	Total	WATER CONSUMED (acre-feet)
North Okanagan	250	250	500	75
Okanagan Lake	25,090	910	26,000	4,100
Okanagan River	1,000	500	1,500	225

APPENDIX B

TRICKLE IRRIGATION

APPENDIX B

TRICKLE IRRIGATION

Trickle irrigation is the name given to a relatively new method of applying water to crops by a farm distribution system of pipes and fine tubing through which water "trickles" onto the ground. Trickle irrigation is based on the concept that the best use of available water resources and best plant performance may be realized through preventing moisture stress by maintaining favourable soil moisture conditions. This differs from the more usual method of irrigation in which larger quantities of water are applied after the trees or plants show signs of stress through wilting. In trickle irrigation, favourable soil moisture conditions are maintained throughout the growing season.

With trickle irrigation, only 10% to 50% of the orchard floor is irrigated for, with adequate soil moisture, 25% of the root system can supply enough water to prevent moisture stress of fruit trees. In newly planted orchards with small trees, as little as 1% or 2% of the orchard floor may be irrigated. With trickle irrigation, therefore, soil between rows may be quite dry, thus cutting down evaporation from the soil itself. Experimenters are optimistic that the trickle system will use less water than conventional irrigation systems. There is not yet enough experience to draw firm conclusions, but tests to date in various areas of Britsh Columbia indicate equal or better crop production with considerably less water applied per acre of planting. Tests are being continued to determine how little water is needed for production of satisfactory crops.

Trickle systems are individually designed for specific soil and topography characteristics and hence are not portable. Piping may lie directly on the ground surface; be buried; or be mounted above ground along support wires in the case of grapes or cane fruit. Small diameter polyethylene pipe is generally used for the orchard headers and laterals. Very small diameter tubing conducts the water from the plastic line to individual plants. These micro-tube drippers are of varying diameters, depending on the requirements of the soil and plants. In general, they vary from an inside diameter of 0.0025 inches to 0.045 inches in British Columbia practice.

Trickle irrigation requires a much lower pressure range (between 10 and 30 pounds per square inch) than sprinkler systems. This has the advantage of being less sensitive to differences in elevation, and rates of water application can be more accurately controlled.

Trickle systems can be fully automated, using conventional time-clock control-valve arrangements. Although systems can be designed to operate on a continuous basis, it has been found more practical to provide a greater flow for periods of say two to six hours per day. This allows an irrigator to use larger drip tubes at higher pressures, thereby reducing problems of plugging plugging and allowing the soil to breathe more easily.

The main concern with trickle irrigation is to provide clean water--that is, water free of solid particles. A filtration system must be used, either by the individual farmer or by the central distribution agency.

The capital cost of a trickle system appears somewhat higher than most conventional irrigation systems, as shown in the following Table:

TABLE B-1

COMPARATIVE COSTS OF FARM IRRIGATION SYSTEMS

Type of System	Estimated Capital Cost ($ per acre)	Est. cost of labour for moving portable or semi-permanent ($ / acre / season)
Trickle irrigation		
(a) above ground system	300 - 350	nil
(b) buried pipe	700	nil
Portable headers & laterals for sprinkler system	120	45
Permanent headers, portable laterals for sprinklers	120	30
Wheel-move/slide roll systems	150	15
Solid-set sprinkler system	500	nil

On the basis of this information, it would appear that the additional captial cost of an above-ground trickle irrigation system would be offset by the labour costs of moving the more usual portable or semi-portable spray irrigation system in the course of about ten years of operation, assuming amortization at prevailing rates of interest. It is perhaps of more significance that farm labour for performing such tasks as moving irrigation laterals is becoming scarcer, hence there is presently a trend to solid-set or permanent systems in which the capital or installation cost on the farm is greater even than the capital cost of above-ground trickle irrigation systems, and is approaching the more expensive buried-pipe trickle system.

With trickle irrigation, there are no problems of mildew or fungus because the leaves are not wetted. Leaching of minerals from the soil does not occur because of the much smaller application of water in a trickle system as compared to sprinkler or furrow irrigation systems. Plants grow continuously during the season because of more even water supply under trickle irrigation.

With all these factors considered, it is conceivable that trickle irrigation systems may become very popular in the years ahead.

REFERENCES

1. DeRemer, E. Dale, "Starting with Trickle Irrigation," Proceedings of the 1970 Conference of the Sprinkler Irrigation Association, Washington, D.C.
2. Kenworthy, A.L., "Trickle Irrigation....The Concept and Guidelines for Use," Research Report No. 165, Michigan State University Agricultural Experiment Station, East Lansing, Michigan, May 1972.
3. Miller, R.J., "General Information on Trickle Irrigation in B.C. for Raspberry Growers," Agricultural Engineering Branch, B.C. Department of Agriculture, Victoria, B.C., February, 1973.

APPENDIX C

WATER ALLOCATION IN BRITISH COLUMBIA: AN ECONOMIC ASSESSMENT OF PUBLIC POLICY

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WATER ALLOCATION IN BRITISH COLUMBIA: AN ECONOMIC ASSESSMENT OF PUBLIC POLICY

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and ANTHONY SCOTT †

INTRODUCTION

British Columbia is plentifully endowed with water. Abundance, however, is a matter of degree. If water were not scarce—in the economist's sense that some allocation mechanism is needed to distribute it among an excess of demanders—there would be no more need for public policy and machinery for allocating water than there is for air. The existence of a complicated framework of water law, institutions and procedures testifies to the economic scarcity of water, at least at certain places and times. The efficacy of this machinery for regulating the use of water resources is of considerable economic interest, and is the subject of this essay.

Title to all fresh waters in the province is vested, in the first instance, in the Crown, and so the statutory provisions relating to the acquisition of private rights to use water are the primary target of investigation. A substantial body of legal literature on water law and property rights already exists (although that pertaining to British Columbia in particular is meagre): the treatment here differs in so far as the central concern is with the economic aspects of water policy. Moreover, for present purposes an examination of the law alone is insufficient, because the framework of institutions, the administrative rules and procedures, as well as the economic structure of the province are important to an economic evaluation of water allocation practices.

The approach here differs also from that of many other economists whose concern with land and institutional economics leads them

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to emphasize the "political economy" of land and water, particularly the relationship between resource use and political and social institutions and behaviour. Our concern is primarily with the water allocation system and its effectiveness in distributing the available resource among users who often compete. While this study draws on some of the concepts that have been developed by the Wisconsin "institutionalist" school of land economists,[1] it is influenced more by the work of other economists, lawyers and political scientists who have recently advanced the techniques of benefit-cost analysis and studied institutions and procedures conducive to efficiency.[2]

The paper proceeds with an initial discussion of the concept of economic efficiency in relation to water resource use in order to provide a framework for the commentary on arrangements governing the use of water in British Columbia. This is followed by brief descriptions of the provincial, federal and other instruments of public policy, the administrative framework, and the means of alienating rights to use water. With this background, the paper turns to analyze first, the nature of water rights and second, the provisions relating to the use of water for waste discharge. The final section offers a summary evaluation of the policy framework in terms of its implications for economic efficiency.

ECONOMIC EFFICIENCY IN WATER USE

The concept of "economic efficiency", which is the touchstone of this essay, deserves brief comment. Given that the available supplies of productive resources—including not only water and natural resources but also labour, capital and technical expertise—are limited (or "scarce"), the economic problem is to allocate them among all the possible productive activities in such a way that the greatest possible benefit to society as a whole is generated. Whenever an opportunity exists to move some resources from one activity to another where they will generate greater value (*i.e.*, where they will be "more productive"), an increase in allocative "efficiency" is possible. Much economic enquiry is devoted to the search for and removal of obstacles to economic efficiency. Our present purpose is to investigate whether the water policies of British Columbia are such as to promote the

1 Eminent contributions to this literature have been made by John R. Commons, Richard Ely and George S. Wehrein among others, many of which have appeared in LAND ECONOMICS.

2 For oustanding examples, see Stephen C. Smith and Emery Castle (ed.), ECONOMICS AND PUBLIC POLICY IN WATER RESOURCE DEVELOPMENT (1964) (especially the pioneering essay contained therein by S. V. Ciriacy-Wantrup) and Jack Hirschliefer, James C. DeHaven and Jerome Milliman, WATER SUPPLY: ECONOMICS, TECHNOLOGY AND POLICY (1960) (especially Chapter 9).

efficient use not only of water but also of other resources such as labour and capital.

Economic efficiency is not, of course, the only end that is promoted by economic analysis. Alternatively, we might have directed our efforts toward assessing the fairness of the distribution of benefits and burdens of the water policy among categories of users, regions or income groups. We have set these "distributional" questions aside, not because they are unworthy of study, but because, in our judgment, they are less in need of rigorous economic diagnosis. Nor, it must be emphasized, are economic efficiency and distribution the only two criteria against which public policy should be evaluated. Natural resource policies in British Columbia reveal other, perhaps less fundamental, public objectives, such as the stimulation of development in the north in preference to the Lower Mainland, the utilization of hydro in preference to other energy sources, the growth of secondary processing within the province in preference to raw materials exports, and so on. Few statutes, Orders-in-Council or regulations are free from elements that reflect these additional, special economic goals.

In spite of the frequency with which governments invoke these various special policy objectives, we would argue that the test of economic efficiency is far too often ignored by those who design and administer governmental institutions and policies. If the other special objectives are to be pursued, information relating to the benefits and costs of the alternative means of achieving them is an obvious necessity, so that measures can be compared in terms of their costs—the efficiency losses that they involve.

Finally, we want to emphasize, with reference particularly to our discussion of pollution controls, that we are not concerned with the question of whether the current policy results in too much or too little expenditure on abatement, in the aggregate. We have not studied this empirical question. Our study is confined to analysis of the extent to which the system ensures the efficiency of expenditures among different locations and circumstances, and the implications for efficient use of complementary land, capital and other resources.

Analysis of the efficiency of resource allocation focuses attention on the critical but often misunderstood relationship between the value of a resource and the quantity of it available. Water, it has been argued, is indispensable to human life and its value in human consumption is therefore infinite. But recognition of this fact is of little help in assessing the efficacy of water policy. Our main concern is not whether one use of water is more important than another, *per se*.

It's whether greater benefit would be generated by devoting somewhat more water to one use at the expense of others: the question of the optimum balance between more or less. Ideas about absolute values have no relevance to this question, which explains why people use (or waste) their "indispensable" water as though it were worthless.

In each possible use, the value of another gallon of water depends upon how much is already being used; its value is generally lower the more is available. Maximum efficiency is reached when its value at the margin is equal to that in each other possible use. In the economists' model of competitive markets for all goods and services this optimum outcome would be brought about through the emergence of a single price for water just high enough to ration the available supply among competitive demanders. Market rationing undoubtedly can allocate water acceptably, and in many places is relied upon to do the job. That we do not depend wholly on markets to allocate water in British Columbia reflects, in part, our concern for goals other than economic efficiency, and our recognition that there are many inherent obstacles to efficient allocation by competitive markets, as we shall observe below. But regardless of the allocation mechanism used, the criterion of economic efficiency rescues us from the necessity of evaluating the system on the basis of such clumsy and ambiguous notions as "social necessity" or "public priority". We need not direct unlimited quantities of water to domestic consumption simply because some water is essential for life, and we are not concerned whether one use is more valuable than another in an absolute sense. Rather, we are concerned whether a user who is in a position to put more water to productive use can obtain this additional amount at the expense of other users who have so much that its value to them at the margin is lower.

The problem of efficiently allocating water, or its capacity to assimilate wastes, would be simplified if its incremental value in every use was observable in comparable money terms. This, however, is seldom the case. In many circumstances prices, rentals or other values would emerge if they were allowed to—if users bid for water on a single watercourse, or polluters competed for the assimilative capacity of a stream—but governmental involvement usually precludes the appearance of prices. We argue below that more reliance on such market-allocation processes might increase the efficiency of some water use in British Columbia. In many cases of competing uses, however, reliable price-indicators of value are impossible because

some benefits are not marketable—as with waters of aesthetic and recreational value. Economic efficiency must take account of all social benefits, not just commercial values. When price indicators are lacking, it falls to public decision-makers to determine relative social values and to provide machinery for the efficient allocation of water among both marketable and "intangible" uses.

The uses of water for different purposes or at different geographical locations along a watercourse or river basin are more or less interdependent. To the extent that the water diverted by one user does not return after use, the flow is unavailable to downstream users; and to the extent that he uses the stream for waste disposal, he is likely to raise the cost of, or even preclude, using the downstream waters for certain purposes. An efficient resource-allocation system must take account of and make the best of these interdependencies, which are likely to be more numerous, indirect, subtle and complicated the larger and more intensively developed the river basin involved.

Two issues—the comprehensiveness of the management unit and the existence of external effects—limit the capability of private ownership and competitive markets to efficiently allocate water resources. It is not impossible to conceive of an efficient allocation of water resulting solely from a market mechanism—for example, if one user had complete control of the watershed. He would be sensitive to his alternative uses for quantities and qualities of water and, by balancing the benefits to be gained from each use—including those not marketed—against those in alternative uses, he could achieve the best aggregate result to himself. However, this situation seldom occurs: first, the size and physical complexity of many water systems preclude single ownership, at least under current political attitudes and institutional arrangements; second, the benefits of all uses of water are not marketed, making it difficult for the competing uses of several independent decision-makers to be reconciled. For private property rights to lead to an optimum result there must be sole ownership and complete accounting of all costs and benefits. The absence of these conditions severely limits the capability of private ownership and competitive markets to efficiently allocate water resources. A public agency with control over all water uses is in a much stronger position to overcome these obstacles. The rapidly expanding literature on river basin planning emphasizes the necessity of wide consultation, interdisciplinary study and innovative decision-making in order to achieve the most beneficial pattern of

resource use. As total demands on water grow, and scarcity becomes more acute, the need for efficiency in the system of allocation becomes even more critical.

It is instructive to examine the implications of the opposite extreme—that of no property rights at all. As implied earlier, common property in water might be consistent with efficiency if its quality and quantity were more than sufficient to serve the useful purposes of all demanders everywhere. But wherever this is not the case—wherever demands are competitive or interdependent—common property leads to inefficiencies not only in the use of water but of other resources as well. One source of economic inefficiency would result from distortions in the location of users. In order to secure their flows, users would tend to locate close to water sources rather than at sites which would otherwise be more suitable, and the potential benefits of efficient utilization of the streamflow over its full extent would be dissipated in competitive expenditures to achieve geographical advantage. More capital and other resources would be expended in securing quantities and qualities of water than would be necessary under an orderly allocation arrangement. Moreover, with no rights other than the rule of capture, utilization efficiency would be frustrated by uncertainty.

Certainty of supply is an important determinant of the efficiency with which any resource can be put to use, and so, in the following discussion, we put heavy emphasis on the security enjoyed by those who hold rights to use water. Moreover, the most efficient pattern of distribution of water or its assimilative capacity among users obviously changes through time. Thus our examination of policy is concerned not only with the manner in which rights to water are allocated in the first instance, but also with their transferability among users.

The value of water in many consumptive and productive purposes for which it is diverted and used in its physical form is affected by its quality. But the devices for regulating water quality are almost entirely separate from those that deal with the diversion and physical alteration of flows in British Columbia. The statutory powers and government practices with respect to these two general forms of water use can therefore be reviewed in turn.

REGULATION OF DIVERSION, STORAGE, AND ALTERATION OF FLOW

The arrangements for water use in British Columbia combine public ownership of the resource with a system of private rights to its use. The Crown is passive, in so far as it only responds to users' demands.

But it provides exclusive rights to flows of water through licences which eliminate, to a great extent, the inefficiencies that arise from uncertainty of supply.

A. Policy Instruments

The British Columbia Water Act[3] declares the Crown provincial to be *prima facie* entitled to the right to the use and flow of fresh water in the province, and is the principal instrument for allocating the resource among users. It is not the only source of regulation, however. The federal Parliament, under the B.N.A. Act, exercises exclusive jurisdiction over significant aspects of water use. Other matters, while lying within the ambit of provincial legislative competence, have either been left to common-law procedures or are dealt with under other provincial legislation.

Federal jurisdiction predominates over water use for navigation purposes—the federal Parliament having chosen to preserve the public right to use inland waters for navigation, developed at common law.[4] Navigable waters may be obstructed only with the permission of officials charged with administering the Navigable Waters Protection Act.[5]

A related area of federal jurisdiction is the protection of fish migration routes, the importance of which derives from the very large coastal salmon fishery that depends upon inland spawning grounds. The Fisheries Act[6] provides the Minister of the Environment with discretion to require anyone who obstructs fish streams either to provide fishways around the obstruction or to construct and operate hatcheries.

Two other federal statutes relate to the geographical impact of water use rather than the purpose for which it is being used. First, the International Rivers Improvement Act[7] regulates water works in Canada which interfere with existing or potential use of water in the United States by altering the natural flow of an international river.[8] A federal licence is required to construct and operate all international

[3] R.S.B.C. 1960, c. 405, as amended by S.B.C. 1961, c. 65; 1962, c. 68; 1965, c. 57; 1966, c. 54; 1968, c. 53, s. 27. Its development is outlined by H. A. Maclean, *Historic Development of Water Legislation in British Columbia* in EIGHTH B.C. NATURAL RESOURCES CONFERENCE, PROCEEDINGS, 243; *cf.* M. Ormsby, BRITISH COLUMBIA: A HISTORY (1958) 180.

[4] *Fort George Lumber Co. v. G.T.P. Ry.* (1915) 9 W.W.R. 17, 24 D.L.R. 527 (S.C.C.). The common law includes the right to float timber: *Upper Ottawa Improvement Company et al. v. Hydro-Electric Power Commission of Ontario* [1961] S.C.R. 486, 28 D.L.R. 276. But to enjoy this right many users must comply with the vessel registration provisions of the Canada Shipping Act, R.S.C. 1970, c. S-9.

[5] R.S.C. 1970, c. N-19.

[6] R.S.C. 1970, c. F-14, s. 20. However, the Minister could require neither fishways nor hatcheries so that it is possible that fish runs may be sacrificed.

[7] R.S.C. 1970, c. I-22.

[8] *Id.*, s. 2.

works not excepted.[9] Second, all waters coming within the exclusive jurisdiction of the federal Parliament are subject to regulation under the Canada Water Act.[10] For example, the waters within National Parks in British Columbia could conceivably be allocated according to plans and projects implemented under that statute.[11]

These federal legislative enactments designate features of water resource management which are beyond provincial control. But both federal and provincial legislation often applies to the same waters, and the uses to which waters of a particular stream are put under the two management regimes could conflict. The Canada Water Act is designed in part to facilitate federal-provincial cooperation in some areas of water allocation: in cases in which "a significant national interest" turns upon the allocation of a stream the federal authorities may enter into agreements with the province to establish and implement joint water resource management plans.[12]

Still other water allocation functions, while lying within the ambit of exclusive provincial legislative competence, are nonetheless excluded from the water licensing scheme outlined in the Water Act. Groundwater appropriation, for example, is still governed by the common law rule of capture: any occupier of land may take water from the ground without regard to any effect that this may have on either the groundwater or the surface-water supplies of others.[13] Moreover, some uses of surface water—the nominal target of the Water Act—are not regulated in that statute. Aesthetic use and waste disposal are notable examples. Waste disposal is regulated under a separate Act[14] (discussed *infra*) which does not deal with competing uses of water, and a water licence does not itself entitle its holder to

[9] *Id.*, s. 4; s. 7 provides that works constructed pursuant to federal statute, those situated on the boundary waters defined in the CANADA-UNITED STATES BOUNDARY WATERS TREATY, (1909) and those used for consumptive purposes (for example, for domestic, sanitary or irrigation purposes) are excepted. See also, Canada Water Act, R.S.C. 1970 (1st SUPP.), c. 5, s. 5, which gives federal authorities the power to formulate water management plans, design projects and implement plans and projects if a significant national interest turns upon the management of international or boundary waters. See La Forrest, *Interprovincial Rivers* (1972) 50 CAN. B. REV. 39.

[10] *Supra*, note 9.

[11] The National Parks Act, R.S.C. 1970, c. N-13 provides for water allocation regulations, but those proclaimed to date appear to be designed to regulate works systems rather than to supervise primary diversion activities: SOR 68/440, s. 7. See also, B.N.A. Act, 1930, Schedule 4, outlining the Canada-British Columbia resource transfer, under which the federal Parliament has the right to determine the use of the waters in the original parks; provincial authorities may not authorize the impairment of the waters in the parks through their policies: Article 18. See also Laskin, *Jurisdictional Framework for Water Management*, CONFERENCE BACKGROUND PAPERS, RESOURCES FOR TOMORROW CONFERENCE, 211; D. Gibson, CONSTITUTIONAL JURISDICTION OVER ENVIRONMENT IN CANADA, prepared for Government of Canada, June, 1971 (mimeo).

[12] Canada Water Act, *supra*, note 9, s. 4.

[13] The application of the Water Act to groundwater awaits proclamation: Water Act, *supra*, note 3, s. 4. For prevailing common law rules see *Embrey v. Owen* (1851) 6 EXCH. 353; GALE ON EASEMENTS (13th ed.) 177-218.

[14] Pollution Control Act, S.B.C. 1967, c. 34, as amended S.B.C. 1968, c. 38; 1970, c. 36; 1972, c. 45.

106

water of any specific quality. No water licence is required to use unallocated water for prospecting, firefighting or for domestic purposes by a riparian owner.[15]

The position of riparian domestic users is significant, although somewhat clouded by an unresolved controversy. On the one hand, it is argued that the Water Act and its predecessors have removed all riparian rights; that unlicensed domestic users may use water upon sufferance only, and that in no case do they have exclusive rights to water.[16] This view supports the notion that water can be allocated and regulated only through actions of the Crown provincial. On the other hand, authority exists for the proposition that the legislation has not *per se* abrogated riparian rights, and only through allocation of streamflow through licensing are they eliminated.[17] The outcome of this controversy is not likely to be crucial to efficient water allocation in the province: only a very small proportion of water used is accounted for by unlicensed domestic riparians. Furthermore, these users normally obtain water licences once the security of their supplies is threatened by licensees.

In short, the Water Act confines itself to the surface waters of the province, and to uses which might impair the accessibility or usefulness of water to others. There are exceptions in this scope, however: unallocated water used for firefighting, prospecting and by domestic riparians is unregulated; certain works on international rivers and all flows in national parks are subject to federal authority; and waste disposal is controlled through a separate statute. Uses which do not impair the usefulness of the watercourse and which are not dealt with in the Water Act include navigation, fisheries, recreation and aesthetic uses. Thus the Water Act is primarily the instrument for regulating the physical diversion, storage or alteration of streamflow.

B. Alienation of Water Rights

The Water Act details an alienation procedure whereby certain classes of users requiring water for specific purposes may obtain from the Crown rights to the exclusive use of future flows, rights to stabilize seasonal and annual fluctuations through water storage, and rights to otherwise alter the physical nature of watercourses.

Persons may hold water licences if they have some property

[15] Water Act, *supra*, note 3, s. 42.
[16] See W. S. Armstrong, *The British Columbia Water Act: The End of Riparian Rights* (1962) 1 U.B.C.L. REV. 583.
[17] *Johnson v. Anderson* (1935-37) 51 B.C.R. 413, [1937] 1 D.L.R. 762, 1 W.W.R. 245 (S.C.); *Chasemore v. Richards* (1859) 11 E.R. 140 (H.L.); and A. R. Lucas, *Water Pollution Law in British Columbia*, (1969) 4 U.B.C.L. REV. 56.

interest in land or mines; public utilities and other public and quasi-public organizations may hold licences without that qualification.[18] Licences may be issued only for purposes specified in the Act.[19] They may authorize activities—excluding waste discharge—which have the potential of altering physical streamflow.[20]

The Water Act outlines procedures and details officials' powers and functions which enable the Crown to grant and administer exclusive rights to the use of water. Relatively wide discretionary powers are vested in the Comptroller of Water Rights and in (District) Engineers. The Comptroller has the power to issue water licences; in practice, he is generally guided by the recommendations of the (District) Engineer.[21] The legislation provides a detailed appeal procedure from decisions of both the Engineer and the Comptroller.[22]

Two basic conditions must be met before the Crown will grant a water licence: unallocated water must be available at the applicant's proposed point of diversion, and he must be in a position to put the water applied for to "beneficial use".

available flow

The policy is to avoid granting a larger flow than that naturally occurring in a stream—this despite a precedence provision under which those who acquire their licences first have a right to their full flow before junior (later) licensees are entitled to any of theirs.[23] The available flow is affected, of course, by the return flows of users, which means that the gross sum of allowed diversions may exceed the natural flow.

The fact that allocations involve alienation of *future* flows creates a need for streamflow measurement and forecasting. Reliable information of this kind is not always available, and licences must

[18] Water Act, *supra*, note 3, s. 6. Significant is the fact that riparian land ownership is not a requirement, a feature of the common law which resulted in a bias in favour of water use on riparian land. Licensees, under section 24, may expropriate necessary interests in land.
[19] *Id.*, ss. 2, 6.
[20] *Id.*, s. 5. Purposes that involve collective consumption and "public goods" that depend on maintenance of flows—such as aesthetic, wildlife and recreation benefits—are not licensed. While they could conceivably be classed under the catch-all "industrial purpose", the policy is to use licensing as a means of authorizing changes to or withdrawals from natural flows. It is becoming increasingly common to attempt to protect the values dependent upon natural flows by restricting licence allocation or adding provisions respecting the maintenance of minimum flows, etc. Interviews with H. D. DeBeck, Comptroller of Water Rights, Department of Lands, Forests and Water Resources, March 15-17, 1972, Victoria, B.C. The point to be emphasized here is that no specific rights are conferred in respect of purposes which depend upon maintenance of flows.
[21] H. D. DeBeck, *Present Use of British Columbia's Water*, SEVENTEENTH BRITISH COLUMBIA NATURAL RESOURCES CONFERENCE, PROCEEDINGS, (1967) 42-43.
[22] *Id.*, s. 38 (1)(b), s. 38 (1)(a), s. 39.
[23] V. Raudsepp, *Some Observations on Water Management in British Columbia*, British Columbia, Department of Lands, Forests and Water Resources, Water Resources Service, Water Investigations Branch, Victoria, 1967 (mimeo). Streamflow information is sparse and expensive.

often be granted without adequate streamflow data.[24] Several provisions of the Water Act serve to compensate for this uncertainty. The applicant is required to post a copy of his application on his proposed site and to serve a copy to each licensee or prior licence applicant who maintains or proposes to construct a diversion work at or below his point of diversion on the same stream.[25] Moreover he may be required to publish a copy of his application in a local newspaper.[26] Any licensee, riparian owner or applicant may then object to the issue of the licence if he considers that it will prejudice his rights.[27] In this way incomplete streamflow information may be supplemented by submissions made by other users interested in the flow of a stream who are perhaps in a better position to assess the impact of another user upon streamflow. Deputy Ministers of Agriculture and of Recreation and Conservation and the Deputy Attorney-General are also entitled to notice of application and to object. (The role in the allocation procedure of the Departments of Agriculture and of the Attorney-General is usually much less important than that of the Department of Recreation and Conservation).[28] Finally, as already mentioned, the Comptroller is permitted to exercise the safeguard of under-allocating the streamflow.

There is no provision in the Act by which an applicant or licensee can demand, or be required to provide himself, the information that would provide a full and certain allocation. The Comptroller's outlays on data gathering seem to be independent of the Act. Furthermore, the Comptroller is left free to decide how much flow to allocate, rather than having to depend on the seniority or precedence provisions of the Act in cases of uncertain or changeable flows.

The Act provides that the Lieutenant-Governor may by Order-in-Council reserve any unrecorded water in the province.[29] A reservation has the effect of rendering unavailable for alienation by licence the flows reserved, except for domestic or land-improvement purposes.[30] Water reservations are used to protect the future requirements of the Crown and its agents (for example, the British Columbia Hydro and Power Authority), to safeguard future municipal needs, and to impose moratoria upon the allocation of alternative water sources for a proposed industrial development pending the completion of studies and formal licence application for a specific source. In addition, reservations are used to withhold flows whose use the Crown deems not to be in the "public interest".[31] This latter provision might be invoked, for example, in response to an objection to an application by the Department of Recreation and Conservation which protects the amenities of provincial parks and acts in conjunction with the federal Department of the Environment and its own Fish and Wildlife Branch in protecting or developing fisheries populations. Reservations provide a device for serving two important allocation functions, *viz*, the protection of some uses (such as fish, wildlife and public amenities), by preventing their appropriation by private enterprises; and the allocation of water over time, by safeguarding supplies for expected future uses.

beneficial use

The concept of "beneficial use" is central to both the alienation procedure and the tenure of licensees. The Water Act gives Engineers (and the Comptroller) the power to determine what constitutes the beneficial use of water,[32] but the Act neither defines the term nor gives guidelines for its interpretation. Officials currently interpret it to mean the actual use of water for one or more of the purposes authorized in the legislation and for which a licence has been issued.[33]

The requirement that the applicant be in a position to make "beneficial use" of the water appears to be designed to discourage trading or speculation in water rights—an objective which pervades Crown water policy. A licence application must specify a proposed use of the water and section 6 of the Water Act delegates to the Comptroller the power to issue licences for "any one, two or three of the purposes defined in section 2".[34]

Numerous provisions of the Water Act touch on the "beneficial use" requirement—provisions which describe both the granting procedure and the nature of licence tenure. Section 5(1) delimits the

[24] It is a fair estimate that half of all licences are granted without reliable streamflow information: Interviews with H. D. DeBeck, *supra*, note 20.
[25] Regulations under the Water Act, Orders-in-Council 2771/60, 277/62, 2649/63, 4143/70 and 3425/71, ss. 2.02, 2.04. S. 2.04(a) requires the applicant to serve "every owner of any land or mine that will be affected physically by the proposed works or by the operation or utilization thereof". This requirement is presumably designed to alert persons whose property may be flooded or expropriated under ss. 24-26.
[26] *Id.*, s. 2.05.
[27] Water Act, *supra*, note 3, s. 9 (1).
[28] *Id.* In addition, the Minister of Health must approve all applications for waterworks and mineral-trading (selling mineral water) purposes; Health Act, R.S.B.C. 1960 c. 170, ss. 21, 23.
[29] Water Act, *supra*, note 3, s. 45; under the Ecological Reserves Act, S.B.C. 1971 c. 16, s. 5, no Water Act allocations may be made within an area designated as an ecological reserve; and in the Park Act, S.B.C. 1965 c. 31, s. 18, a park use permit is required in addition to a water licence to flood any part of a park, or to impound, divert or distribute water in a park.
[30] *Id.*, s. 45 (6).
[31] Interviews with H. D. DeBeck, *supra*, note 20.
[32] Water Act, *supra*, note 3, ss. 36, 37.
[33] Interviews with H. D. DeBeck, *supra*, note 20.
[34] Water Act, *supra*, note 3, s. 6.

108

functions which may be authorized by a licence, and with respect to diversion, it specifies that

> 5(1) A licence entitles the holder thereof to (a) *divert and use beneficially* for the purpose and during or within the time stipulated the quantity of water specified in the licence. . . .[35]

Moreover, it is an offence for a licensee to divert water he does not use beneficially.[36]

These sections are further buttressed by the granting procedure itself. If the application is accepted, the applicant is issued a conditional licence, which typically authorizes him to construct the waterworks necessary for his proposed water-using activity and to begin using the water for that purpose.[37] The conditional licence stipulates a period of time within which the applicant must complete construction of his works and begin beneficial use of the amount of water allocated. If such use has not begun by the end of this term, the conditional licensee's rights may be terminated. The Comptroller, however, has discretion to extend the term of a conditional licence.[38]

Beneficial use having begun during the term of the conditional licence, the licensee is eligible for a final licence.[39] This procedure ensures that relatively permanent rights to the exclusive use of water are not granted to persons who have no immediate use for the resource: thus speculation in water rights is somewhat restricted.

The final licence is relatively permanent. It is usually issued for an indefinite period,[40] but is cancellable for a number of specific reasons. Some of these relate to the enforcement of the Water Act and of the terms of the licence itself.[41] Cancellation is not often used as a punitive device however: the typical official response to non-compliance is the Comptroller's use of his power to suspend licences.[42]

More significant is the possibility of cancellation for failure to

[35] Emphasis added.
[36] *Id.*, s. 41 (n).
[37] *Id.*, s. 10 (g).
[38] *Id.*, s. 15 (1)(a).
[39] *Id.*, s. 11. Final licences may also contain conditions; for example, hydro-electric power licences are often issued with the following provisos: flows may be re-allocated to consumptive users located either up- or downstream from the site (such was the case of the licences issued to the B.C. Power and Hydro Authority on the Peace and Columbia Rivers); the licensee may not interfere with fisheries migrations; storage licensees must clear their reservoirs of debris, as directed by the Comptroller; Interviews with H. D. DeBeck, *supra*, note 20.
[40] Interviews with H. D. DeBeck, *supra*, note 20; in recent years a policy of issuing licences to be effective on a yearly, renewable basis was discontinued in favour of issuing final licences with indefinite tenure. Exceptions are mines and hydraulic mining works, which receive conditional licences effective for the duration of the productive life of the mine, or until beneficial use ceases.
[41] Water Act, *supra*, note 3, s. 20 (2); for example, failure to pay rentals to the Crown, or failure to comply with orders of the Comptroller or an Engineer or with the terms and conditions of a licence.
[42] *Id.*, s. 20(2).

make beneficial use of the allocated flow, for three consecutive years, for the purpose and in the manner specified in the licence. Should licence rights not be exercised for three years they may be cancelled to the extent of non-utilization.[43] Thus, just as final licences may not be issued in the absence of an established use for a specific purpose, so licences may be withdrawn from licensees for water they no longer use. However, the extent to which licences are withdrawn for non-use is not known.

precedence

Once a licence is granted, the rights it confers are subject to those of all other licences which take "precedence" over it.[44] That is, should at any time the streamflow be insufficient to supply all licensees' allocations the licensee whose rights take precedence from the earliest date is entitled to exercise all of the rights conferred by his licence before any other "junior" licensee can exercise any of his.[45]

The power to determine the precedence date of a licence is given to the Comptroller, who establishes the application date as the precedence date in most cases.[46] The rare exceptions usually involve back-dating licences of hitherto unlicenced domestic users of water originating on their land, to enhance their standing vis à vis a new applicant; to licensees who join with others in a common waterworks venture; and to municipalities seeking relatively secure tenure.[47]

Precedence between two licences taking effect from the same date is determined by the respective purposes for which they are being used. Purpose ranking, from highest to lowest, is: domestic, waterworks, mineral trading, irrigation, mining, industrial, power, hydraulicking, storage, conservation, fluming, conveying and land improvement.[48] Although this hierarchy of purpose is sometimes alleged to play an important role in water alienation, it is significant only in rare cases. Date of application is the usual criterion (although various Comptrollers may have used purpose as a guide in giving precedence dates).[49] In any case, two or more licences for use of the same stream rarely bear the same date of precedence. Two licences

[43] *Id.*, s. 20(2)(a).
[44] *Id.*, s. 12. Whatever the rights of domestic riparians they are always subject to those of licensees: *Cook v. City of Vancouver*, [1914] A.C. 1077, 6 W.W.R. 1492, 83 L.J.P.C. 53, 28 W.L.R. 801 (P.C.). A licensee may sue on his licensed rights: *Kenworthy v. Bishop* [1925] 3 W.W.R. 183 (B.C.C.A.).
[45] Water Act, *supra*, note 3, s. 12.
[46] *Id.*, s. 10(e); interviews with H. D. DeBeck, *supra*, note 20.
[47] The Comptroller usually restricts the use of his discretionary power to manipulate precedence dates to cases in which a collective or public interest can be served thereby. Thus a licence of Fish and Wildlife Branch for fisheries installations might be back-dated. Interviews with H. D. DeBeck, *supra*, note 20.
[48] Water Act, *supra*, note 3, s. 12(2).
[49] Interviews with H. D. DeBeck, *supra*, note 20.

taking precedence from the same date authorizing the use of the same stream for the same purpose have equal precedence in law.[50] As between members of this category the rule of capture presumably applies.

These precedence provisions were designed ostensibly to rationalize problems that might result from incomplete streamflow information. Should a flow prove to be over-allocated because of either unforeseen drought or inadequate streamflow data the rights of licensees *inter se* are relatively clear.

One further provision of the alienation arrangements should be noted. For some temporary water uses a licence is not required even though the use does not fit within the domestic-firefighting-prospecting exception. Approval of the Comptroller under section 7 of the Act is all that is required to sanction a non-recurring use of water for a maximum 90-day period, stream bed alteration activities, and munipal waterworks, dyking, land reclamation and bank protection operations. This abbreviated approval procedure is used with respect to activities which are normally expected to exert only a minor impact upon streamflow, and approval is not withheld unless the applicant's operation will interfere with licensees' allocated supplies.

In 1967, some 167,280 cubic feet per second (cfs) were licensed under the Water Act in British Columbia. About 99 per cent of this total was licensed for power purposes; but because this use is "non-consumptive", the flow remains available for some other uses as well. Irrigation accounted for more than two-thirds of the remaining "consumptive" uses: roughly 5000 cfs were licensed to provide water for 300,000 acres of agricultural land.. Many streams in the agricultural areas of the dry interior are now "fully recorded" (*i.e.* totally assigned to licensees). Most irrigated land is serviced by private, individual waterworks: less than 15 per cent of the acreage is serviced by improvement district works.[51]

The third largest category of licensed use is "industry" which accounted for 1500 cfs or 20 per cent of "consumptive" use in 1967. The reported allocation for this purpose is misleading, however, because many industrial users are supplied by municipal waterworks. Moreover, "industrial purpose" is a catch-all category for a wide variety of uses not otherwise specified.[52]

In addition to domestic licensees, the remainder includes municipalities, improvement districts, water users communities and public utilities, which accounted for 780 cfs or 11 per cent of the "consumptive" category.[53] These are the middlemen, through whom most water users in the province obtain supplies under contractual arrangements rather than under individual licences.[54]

[50] Water Act, *supra*, note 3, s. 12(3).
[51] DeBeck, *supra*, note 21, at 47-48.
[52] *Id.*
[53] *Id.*

C. *Nature of Water Rights*

The alienation procedure outlined above defines three characteristics of water rights in the province: that they authorize the use of water of a particular stream at a specified rate and at a designated location; that the rights may be exercised only in pursuing some defined water-using purpose(s); and that relative security of tenure in almost all cases is determined by date of application. Other features of water licences can be best explained under other headings: fees and rentals payable to the Crown, and the transferability of rights to use water.

Crown charges

Fees upon application for water rights and annual rentals throughout the duration of tenure are payable to the Crown.[55] Both charges vary with the purpose for which the rights are granted and with the volume of water allocated. For example, the holder of a "domestic purposes" right to 1000 gallons per day must tender $5 upon application; the application fee for a pulp mill is $100 for each cubic foot per second; and in both cases an amount equal to the application fee must subsequently be paid annually as a rental. In the case of rights for power purposes, the annual rental depends upon installed capacity. Failure to pay annual rentals for three successive years results in licence cancellation in whole or in part.[56]

The legislation does not indicate the criteria to be followed by the Governor in Council in setting the fee and rental schedule. They are not based solely on the volume allocated, but vary widely among purposes, and for some purposes the rate per unit varies with the amount allocated. For example, the annual rental per cfs licensed for fluming timber is $1; for use in a pulp mill it is $100; for domestic purposes $2,700 (for 1000 gallons per day, which is fairly typical); and in mineral trading $21,551 (for 500 gallons per day).

[54] Public Utilities Act, R.S.B.C. 1960, c. 323, ss. 8, 12, 16; Municipal Act, R.S.B.C. 1960, c. 255, s. 581 (1); Water Act, *supra*, note 3, ss. 32, 62(1), 63(1). We confine our attention here to the allocation of the resource at the primary level.
[55] Water Act, *supra*, note 3, ss. 8(1), 46, 47; Regulations, Schedule A. Excepted are licences appurtenant to Indian lands, where the water is being used by native Indians; those held for fish hatchery purposes by the Crown, or those held by the Minister of Lands, Forests and Water Resources.
[56] *Id.*, s. 20(2)(c).

Thus the rental payable per unit of water licensed varies significantly according to the purpose and the amount allocated.

The functions of the annual rental fees have been said to be two-fold: first, to make the licensee aware of his "continuing responsibility" to the Crown, by emphasizing to him that water rights involve duties as well as benefits; and second, to help defray the costs of administering the resource.[57] The schedule of rates used appears to be somewhat random, however, even as a means of raising revenue. From an economic standpoint, it is significant that the degree of water scarcity in any situation appears to play no role in the fee structure. The Water Rights Branch does not attempt to use the pricing mechanism either to capture the full value of the Crown resource or as a means of allocating its scarce supply among users, efficiently or otherwise.

transferability

Because the pattern of demand for resources constantly changes through time, economic efficiency requires an allocation system that provides for the transferability of rights among users and locations. Water licences provide rights to specific quantities of water for specified purposes to be used at specified locations. The Water Act provides that the rights under a licence are automatically vested in the transferee of the land, mine or undertaking to which the licence is appurtenant.[58]

This latter provision introduces two important features. First, a licence is not the personal property of its applicant, but is tied to the appurtenant property, and its precedence is unchanged by changes in ownership. Second, this provision is not merely facultative: it is mandatory. A licensee may not sell his operation and still retain the rights held under the water licence, for then he is no longer in a position to make beneficial use of the allocated supply at that location. This feature is also consistent with the policy of discouraging trading or speculation in water rights.

Does the Act permit a licensee to transfer his water rights to a different location? This question raises problems relating to the availability of return flows. Some portion of most withdrawals is returned to the stream either directly through waste discharges or indirectly through seepage. This return flow is available for re-use downstream,

[57] The annual rental also serves a useful administrative purpose in that non-payment provides an unambiguous basis for cancellation, which is much less arguable than is non-use of the water allocated: Interviews with H. D. DeBeck, *supra*, note 20.

[58] Water Act, *supra*, note 3, s. 13.

and is in fact often allocated under downstream licences.[59] If a licensee relocates both the point of diversion and return flow downstream, less water may be available to junior users at points between the old and new sites. This is because the senior user who has relocated will still be entitled to receive his full flow unimpaired. Whereas his return flows were available to downstream junior users before his relocation, after relocation they will not be. It is obvious, then, that as long as a senior user returns less than his entire allocation, his relocation downstream will diminish the flow available at any intermediate point. Thus the security of junior users' supplies depends upon regulation of the activities of senior licensees.

Provision for a licensee to relocate his point of intake on a stream is made in the Water Act. The Comptroller is given the power, in section 16, to authorize a change of appurtenancy (*i.e.* the land on which the water is beneficially used) of any licence, and in practice he does not withhold his consent to the transfer unless other users or the public interest would be adversely affected.[60] An individual requesting a transfer thus may have to contract with several users on the stream in order to complete his move. He may have to bargain individually with other users in order to obtain transfers of rights to those rates of flow which represent a diminution in their supplies. This procedure, along with the provisions relating to changes in the ownership of the operation outlined above, may be used to transfer rights between persons and between operations within any given purpose.

While licences authorize use only for specified purposes, the Comptroller may also sanction changes in purpose.[61] Rates of return flow vary among different uses, however, so that if an upstream senior user changes his use to one with less return flow, any downstream junior user who depends on the return flow may be prejudiced. The Comptroller's practice is to grant approval only if the change in purpose will not adversely affect other licensees.[62] When he withholds approval, the applicant may have to deal privately with the affected parties to obtain transfers from them of the dimunition in their flows that result from his alteration, or abandon sufficient of his own rights to leave their supplies undiminished. The Comptroller approves changes whenever the affected parties reach mutually acceptable arrangements, as long as the public interest is not affected.

[59] Interviews with H. D. DeBeck, *supra*, note 20.

[60] The Comptroller sees this discretionary power as a means of allowing market forces to play a role in reallocating water to higher uses.

[61] Water Act, *supra, note* 3, s. 15(1)(g).

[62] Interviews with H. D. Debeck, *supra*, note 20.

A change in the rate of return flow can occur without a change in the purpose for which the water is used as a result, for example, of a change in production equipment (other than in water "works", which require approval)[63] or technology. In such cases no change in the licence or approval is required, and junior users have no recourse.

As a rule, then, transfers of water rights may be accomplished through private contract, subject to the approval of the Comptroller. One exception arises from special powers given to municipal and improvement district licensees. They may expropriate the licence of any user on any stream, but must pay compensation to expropriated parties. These users need not come to private agreement with licensees for their rights.[64]

REGULATION OF WATER QUALITY

Water's capacity to assimilate wastes is scarce in the economic sense that it cannot always be used without reducing the capacity available or otherwise impairing its usefulness to others. Thus economic efficiency also requires a system for restricting the use of waterways for waste disposal to a level consistent with maximization of overall benefits, and for allocating this absorptive capacity among individual users.

A. Policy Instruments

The use of water for waste disposal is not one of the authorized purposes mentioned in the Water Act, nor does a water licence issued under that statute give any promise of water of a particular quality. The Act does not require a licence for discharging foreign material into watercourses.[65] Moreover, water licensees *qua* licensees may not complain of inconvenience they may suffer as a result of upstream discharges. In spite of the obvious interdependence of water quality and quantity, the provincial statutory and administrative arrangements relating to the regulation of water quality are quite separate from those permitting diversion and interruption of streamflow.

[63] Water Act, *supra*, note 3, s. 15(1)(d).
[64] *Id.*, s. 74. The municipality, as successor to the licensee, is not bound by water supply contracts which may oblige the latter: Municipal Act, *supra*, note 54, s. 560(b). Others enjoy the privilege of expropriation as well: see British Columbia Hydro and Power Authority Act, S.B.C. 1964, c. 7, ss. 18(a), 21, 24; Department of Highways Act, R.S.B.C. 1960, c. 103, ss. 9(1), 10, 16; Department of Public Works Act, R.S.B.C. 1960, c. 109, ss. 9(1), 10, 14; Drainage, Dyking and Development Districts Act, R.S.B.C. 1960, c. 121, ss. 7(3), 50(3).
[65] However, the Water Act does provide that Engineers and Water Recorders may prohibit persons from polluting streams: s. 41(k); it is unlikely that "industrial purposes", defined in s. 2 to include all purposes of use other than those specifically defined, includes use for waste disposal.

Pollution Control Act

The Pollution Control Act, 1967[66] regulates waste discharges onto land and in air and provides the principal mechanism for water quality control in British Columbia. It is similar to the Water Act in that it abolishes most traditional private procedures that would otherwise be used by parties along the rivers and lakes, and sets up a system of permits. However, the permits are simply a means of administering a set of restrictions on freedom to discharge, and have not developed into transferable rights to assimilative capacity. Instead, the Director of Pollution Control uses his power to withhold licences somewhat as a government may use its power to withhold a driver's licence, a passport or a social insurance number, to bring about a desired form of private behaviour.

The Director of Pollution Control, who is responsible for the administration of the Act, heads the Pollution Control Branch of the Water Resources Service, Department of Lands, Forests and Water Resources.[67] Pollution Control Engineers throughout the province are charged with field administration—to make decisions defining environmental impairment, and to order persons to repair, alter, improve, remove or make additions to sewage works.[68] Engineers' powers relate to the application of predetermined effluent standards to individual operations in the field.

The powers of the Director are more basic, and can most easily be described in functional terms. He has the power to establish effluent standards and to determine those qualities and properties of water constituting a polluted condition. He may then prescribe sewage works systems necessary to prevent "pollution", as he has defined it. He also has the power to conduct research to determine the degree to which polluted environmental conditions exist in the province and to notify those who are responsible for discharging contaminants in excess of the prescribed standards. Moreover, he may order dischargers to improve their waste treatment or to alter their manner and point of discharge. In default, he may order the cessation of waste discharge altogether.[69]

The Director's powers are crucial in two respects. First, his power to decide what constitutes a polluted condition may determine the total extent to which the waste assimilative capacity of a water-

[66] *Supra*, note 14; See Lucas, *supra*, note 17, at 62-71 for a comprehensive description of the background of the Act.
[67] *Supra*, note 14, s. 9.
[68] *Id.*, s. 11.
[69] *Id.*, s. 10.

course can be utilized, and also the degree to which dischargers can, in effect, avoid the costs of their waste disposal by imposing damages on others who may be adversely affected. Significantly, the Director's defining of "polluted condition" does not appear to require his investigation of the alternative uses of the relevant water course. Second, his power to prescribe effluent standards and waste processing techniques appears to indicate two important features of policy: that emphasis is placed upon effluent quality and that the effluent standards are applied equally on all streams. This is important, because the adverse effect of any discharge depends not only upon its contained contaminants but also upon the volume and other characteristics of the receiving waters and other uses of them.

The Director of Pollution Control is responsible to the Pollution Control Board. Appeals lie from Engineers' orders to the Director, and from all orders of the Director to the Pollution Control Board. Board decisions may be appealed to either a cabinet committee or to the Supreme Court of British Columbia.[70]

The Board performs a supervisory function in so far as it reviews orders of the Director. Furthermore, it shares the Director's responsibilities in determining the qualities of water that shall be deemed to be a polluted condition and in prescribing effluent standards. The Board may seek the counsel of advisory or technical committees and must, upon the request of the Lieutenant-Governor in Council, conduct enquiries into the causes and remedies of pollution. In the case of such a reference the Board may be asked to report to the Lieutenant-Governor in Council, who may direct the Board to take specific remedial action, or to take such remedial action as the Board itself deems necessary in the public interest.[71]

riparian rights

At common law, riparian landowners have certain natural rights to water use, including the right to receive the water flowing past their land substantially undiminished in quality.[72] They are not entitled to pure water: the riparian rights doctrine recognizes that economic production near watercourses may be undertaken only at the expense of some degree of water impurification. But the extent to which each riparian must suffer impurity is difficult to predict. He is required to tolerate "reasonable" changes in water quality, and the definition of "reasonableness" will depend upon the facts of each

[70] *Id.*, s. 12.
[71] *Id.*, ss. 3(3), 4.
[72] See, for example, *John Young & Co. v. The Bankier Distillery Co.* [1893] A.C. 691 (H.L.); ample additional authority is listed in Lucas, *supra*, note 17, at 59.

case. For present purposes it is sufficient to indicate that the common law provides private remedies for riparians injured by waste discharged by others: damaged litigants may receive monetary compensation and/or injunctive relief preventing recurrence.

At present it is uncertain whether these remedies are available to all or any riparian proprietors in the province. Against the availability of common law remedies to riparian owners it is argued that pollution control permits confer statutory authority to their holders to discharge waste, in derogation of any rights at common law. If this argument is valid (and strong authority supports its validity),[73] permittees discharging pursuant to their permits are immune from suit. However, two classes of dischargers are clearly not immune if they pollute to an "unreasonable" level: those who have not obtained pollution control permits and those who have exceeded the terms of their permits.[74] However, it has been said that the Pollution Control Act, 1967 has not affected riparian rights at all, and that any unreasonable discharge will attract civil liability regardless of whether the person responsible holds a permit, or whether damage is the inevitable result of discharge pursuant to permit.[75] If this view is valid, the legislation has not diminished riparian rights at all.

None of these arguments has been tested in British Columbia in the context of the Pollution Control Act. To a greater or a lesser degree, they offer the possibility of private remedies to riparian owners who have suffered injury as a result of waste discharge. But they cannot, in any event, provide a general mechanism for preventing injury from waste discharging activities. Even as between riparians, they do not permit a full accounting of possible damage. The standard of water quality outlined in the riparian rights doctrine is not an absolute one: to be actionable a discharge must cause an "unreasonable" alteration in quality. And while water licences may be issued to riparians and non-riparians alike, these procedures would be available only to riparians.

other legislation

Protection for some interests and in some areas may originate outside both the Pollution Control Act and the common law. Fisheries, which lie within the competence of the Federal Parliament,

[73] See Armstrong, *supra*, note 16, at 584-87.
[74] Even stronger positions for riparians have been proposed; it has been suggested that permittees may be immune from suit only to the extent that their permitted discharges "inevitably" result in damage to riparian owners, while discharges which do not have this "inevitable" effect, and which are also "unreasonable" are vulnerable; see Lucas, *supra*, note 17, at 83-84.
[75] *Id.*

receive high priority in the use of water through the Fisheries Act.[76] Discharges "deleterious" to fish populations are absolutely prohibited: in no case may a pollution control permit or the common law authorize an individual to deposit wastes which will be deleterious to fish.[77] In theory this provision could preclude the sacrifice of fisheries to any other activity which results in waste discharge.

Geographical location determines some rules with respect to water quality. International and boundary waters, and waters within the national parks are subject to federal jurisdiction, and provision in the Canada Water Act is made for these aspects of water quality.[78] The Minister of the Environment is empowered to enter into agreements with provincial governments having an interest in the management of the quality of any of these waters, and to establish water quality control agencies.[79]

Finally, municipalities may play a role in water quality management through the power of municipal councils to pass by-laws prohibiting persons from "fouling" watercourses within municipalities. By-laws imposing more permissive standards than those enforced by the Pollution Control Branch are of no effect, but more rigorous standards may in some instances prevail over Branch policy.[80]

Municipalities play an additional role in providing waste treatment facilities. Legislation empowers councils to establish sewage disposal systems,[81] but they may not submit money by-laws to the electorate for their approval of financing without first obtaining the permission of the Minister of Lands, Forests, and Water Resources who must approve the plans.[82]

B. Permits for Waste Discharge

A pollution control permit represents permission of the Crown to discharge foreign materials into watercourses, and is required by any person who begins to discharge "sewage or other waste material" into any water after January 1, 1970.[83] Those who began discharging prior to that date need obtain a permit only if required to do so by

[76] Fisheries Act, R.S.C. 1970, c. F-14, ss. 33, 33A. Excepted are deposits authorized by regulation through the Fisheries Act or any other federal Act: s. 33(4).
[77] *Id.*
[78] *Supra*, note 9.
[79] *Id.*, ss. 9, 11; and see La Forrest, *supra*, note 9.
[80] Municipal Act, *supra*, note 54, s. 519(c); Pollution Control Act, *supra*, note 14, s. 5B.
[81] Municipal Act, *supra*, note 54, s. 531(1).
[82] Pollution Control Act, *supra*, note 14, s. 21(5-9); and see Health Act, *supra*, note 28, ss. 24-28. The Municipal Treatment Plant Assistance Act, S.B.C. 1969, c. 25, provides for per capita grants to municipalities, based upon expenditures and mill rates. For fiscal 1972-1973, some portion of $13,236,000 was allocated for this purpose; per capita grants for "policing and parks" are also included: Province of British Columbia, Budget Speech, 1972, delivered by Hon. W. A. C. Bennett, February 4, 1972.
[83] Pollution Control Act, *supra*, note 14, s. 5(1).

the Director.[84] Certain dischargers are specifically exempt from the permit requirement.[85]

Those required to obtain pollution control permits to discharge waste must, in addition, obtain a works construction permit from the Minister. Municipalities may not submit money by-laws to the electorate for the purpose of financing sewage works until at least provisional approval is obtained under this section.[86]

granting procedure and criteria

Numerous provisions in the permit-granting procedure relate to the identification of interests on a watercourse by the decision makers. Copies of permit applications are sent to the Comptroller of Water Rights and to the provincial departments of Agriculture, Health, and Recreation and Conservation.[87] The Comptroller and the Deputy Ministers of these departments may make recommendations to the Director respecting any application.[88] Water licensees, persons interested in the land to which a licence is appurtentant, and water licence applicants may file formal objection to any permit application. Others may object if the Board decides that the public interest requires their interests to be considered. The Director in his discretion may decide whether a hearing ought to be held to assist in his consideration of the application.[89]

Upon receiving an application the Director has discretion to grant the permit in whole or in part (upon such terms and conditions as he may wish to prescribe), amend the application and grant the permit, or refuse to grant the permit.[90] Chief among the criteria he uses in deciding is the degree to which the applicant conforms to the standards (referred to as "objectives") for control of wastes established for the relevant industry. The Pollution Control Branch has undertaken to formulate, through public enquiries, minimum standards of performance for broad industry groups. To date, separate hearings have been held for the forest products, chemical, mining, mine-milling and smelting industries for the purpose of establishing performance objectives in disposing of wastes into the air, water and on land.

[84] *Id.*, s. 5(1a).
[85] Pollution Control Regulations, Orders in Council Nos. 1185/67, 1302/67, and 748/09, s. 2.09; 464/68.
[86] Pollution Control Act, *supra*, note 14, s. 21.
[87] *Id.*, s. 5(4).
[88] *Id.*, s. 5(5).
[89] *Id.*, s. 13; and see *Western Mines Ltd. (N.P.L.) v. Greater Campbell River Water District* (1967) 58 W.W.R. 705, 61 D.L.R. (2d) 221; *Re Pollution Control Act, 1967; Re Hooker Chemicals (Nanaimo) Ltd.* (1970) 15 W.W.R. 354; *Piatoka v. Director of Pollution Control et al.* [1971] 5 W.W.R. 626, 21 D.L.R. (3d) 87; *Hogan v. Director of Pollution Control* [1972] 3 W.W.R. 519.
[90] *Id.*, s. 7; see also the new s. 5C under which the Director may grant an "approval".

The objective of formulating uniform industry-wide criteria has been said to be that of providing an "equitable and consistent" water quality policy; one which would

> . . . have the confidence of industry since all must meet the same rules and regulations (*i.e.* no alleged favouritism) and enforcement of the regulations by regulatory personnel would be strengthened with a given accepted and consistent set of rules.[91]

At the time of this writing, only the objectives for the forest products industry have been made public. The approach that appears to be developing is to specify three sets of objectives—A, B and C in order of stringency.

> It is recommended that generally all new or proposed discharges meet Level A objectives. It is expected that nearly all existing discharges are meeting, or soon will be meeting, Level C, and it is recommended that these discharges be upgraded to interim Level B. Ultimately, it is recommended that where feasible within the limits of available technology, all existing discharges be upgraded by means of planned staged improvements to Level A.[92]

The emphasis on industry-wide standards of performance is crucial. Although the ultimate purpose is ". . . to satisfactorily ensure pollution will not be caused . . ."[93], the concern remains that the greatly varying assimilative capacity of the waters of the province, the other demands put upon them and the varying benefits and costs of discharges into different watercourses—considerations which are crucial to optimizing the use of labour and capital as well as water—are not directly provided for. A given standard of performance might be insufficient to prevent pollution of waterways which have low assimilative capacity, where other dischargers are numerous and large, or where aesthetic, recreational and other uses are important; whereas in other circumstances it may be unduly stringent, resulting in excessive use of resources for pollution abatement on large and remote watercourses where other uses are insignificant. In other words, uniform standards of performance within industries cannot ensure uniformity in pollution control. Nor does uniformity of water quality ensure an optimum pattern of water use in all circumstances.

The problems arising from this emphasis on discharge standards rather than on the quality of receiving waters are mitigated to the extent that the standards are prescribed as minimal, and the Director

[91] British Columbia, Department of Lands, Forests and Water Resources, Water Resources Service, Pollution Control Branch, A PROCEDURE FOR ENQUIRIES INTO MATTERS RELATED TO POLLUTION CONTROL, (1971) (mimeo), 2-3.
[92] Director, Pollution Control Branch, POLLUTION CONTROL OBJECTIVES FOR FOREST PRODUCTS INDUSTRY, (1971) (mimeo) 4.
[93] Director of Pollution Control, "Notice of Public Enquiry," Victoria, April 21, 1970.

may require higher levels of performance. The private objection hearing procedure, the recommendations of the Water Rights Branch and other government departments, and the Director's investigation of a "polluted condition" suggest means through which the absorptive capacity and other demands on a watercourse might be considered in approving individual permit applications. However, the extent to which, if at all, these ought to be considered is not defined in the legislation: for example, the Act does not stipulate that the Director may not issue a permit the effect of which will injure a water licensee, or be detrimental to a fishery.[94]

It is also possible that a discharger of waste into a watercourse will be required to obtain a pollution control permit, but not be required to process his outflow. The possibility arises from the definition of "polluted condition" adopted by the Director and the Board. While everyone who begins to discharge "sewage or waste material" after January 1, 1970 (and who is not otherwise exempted) must obtain a permit,[95] the effluent standards fixed by the Director and the Board need apply only to "prevent pollution of water",[96] and a restrictive interpretation of the Director's "polluted condition" could result in exemption of some discharges. His definition is therefore critical to the range of application of effluent standards, and it is important to note that he may define it without considering other water uses, or differences in water use patterns in different localities.

A related issue is the practice of prescribing discharge standards in terms of the concentration of deleterious substances in the effluent itself, or in relation to the unit of output, rather than in terms of the total quantity of pollutants discharged. The objectives for chemical pulping, for example, prescribe standards for acidity, temperature, settleable solids, colour and toxicity of the effluent, while suspended solids and biochemical oxygen demand are prescribed per ton of pulp produced. The quantity of pollutants discharged is thus not directly controlled because the concentration in the effluent depends upon the degree of dilution, and the rate of production influences the total amount of waste discharged at a fixed rate per unit of output. However, the Branch's surveillance of the technology used in the production processes of applicants may help to ensure that pollution abatement is not avoided by dilution.

The objectives established for the forest products industries

[94] The Director has emphasized that the scope of his concern is limited to "technical" considerations for discharge control: Vancouver Province, June 11, 1971.
[95] Pollution Control Act, *supra*, note 14, s. 5(1).
[96] *Id.*, s. 10(d).

include some objectives for receiving waters and where ". . . receiving water objectives are set concurrent with effluent discharge objectives, the more restrictive requirement will take precedence."[97] Only a few characteristics of quality are prescribed, however, because it is suggested that others are not readily susceptible to measurement and the quality of receiving water often depends upon complex interaction between individual contaminants in any event. Much is left to consideration of individual cases and the results of monitoring.[98]

security of rights

Permits are appurtenant to specified "discharging works", and give relatively secure rights of discharge. The legislation anticipates a two-stage granting procedure. The Director may issue a provisional permit, conditional upon the completion of discharge works.[99] Final permits[100] confer rights to discharge waste for an indefinite period of time. However, they may be terminated for a number of causes, chiefly failure to proceed with the development for which the works specified in the permit were intended, failure to discharge for three years, failure to construct the approved works on time (under a conditional licence), and non-compliance with the Act, with the terms of the permit, or with any order of the Director or of an Engineer.[101] Besides the power to cancel permits, the Director has the power to suspend them at any time—a function which presumably is designed to provide an emergency discharge abatement mechanism.[102]

Unlike British Columbia water licensees, permit holders are not accorded positions of precedence *inter se* upon a watercourse. This distinction follows from the nature of the granting procedure: under the Water Act the prevailing notion is that, as a rule, only the natural flow of a stream is available for allocation; under the Pollution Control Act, 1967, however, because the quality of the receiving water is not the primary consideration, officials are not explicitly allocating a resource in a fixed supply. The primary aim appears to be to place restrictions upon individual operations, rather than maintaining acceptable levels of stream quality. Hence, as the number of permittees on a stream increases, the quality of water must be expected to deteriorate, and there is no possibility of permittees having "conflicting interests" that require some precedence-ranking, or sharing mechanism. The Director may, on issuing a permit, require performance more stringent than the established industry standard, and his power of suspension may be used in "emergency" situations to reduce or eliminate permittees' rates of discharge. But if these powers are to be used also to allocate scarce assimilative capacity among permittees no rules delineating the manner in which it should be done are evident in the legislation.

Pollution control permits may be amended by the Director for a number of reasons; amendments may recognize additional or other works, changes in discharge quality that are not deleterious, and increases or decreases in discharge rates.[103] Amendments may also transfer permits to others, but only to successors in title of the discharge works. Permits are not transferable to other locations.[104]

distribution of benefits and costs

The Act provides that fees may be levied in respect of permit issue,[105] but to date no schedule has been proclaimed and thus no fees have been levied. Once a final permit is issued, the value of the assimilative capacity of water is granted to the discharger, and nothing more is payable to the Crown.

The discharge permit system does not ensure that the costs of waste disposal are borne entirely by those who discharge the wastes. To the extent that adverse effects are felt by others, either through an increase in the cost of others' production (by necessitating purification, for example) or by diminishing the value to them of the aquatic environment (through aesthetic or recreational deterioration, for example) the cost of producing the product of the discharging enterprise is partially transferred to them. The legislation does not prohibit the Director from issuing a permit when its probable effect will be to cause injury to others, nor does it provide for payment of compensation to water users who are injured as a result of permitted discharges. Moreover, there appears to be little scope for other legal means to obtain compensation or injunctive relief to mitigate the imposition of costs on others.

EVALUATION

The unifying theme of this essay is scarcity—the *raison d'être* of resource allocation systems. An efficient water allocation system is one which ensures that the water supply in a given location is apportioned among competing users in a fashion that will generate maxi-

[97] POLLUTION CONTROL OBJECTIVES FOR FOREST PRODUCTS INDUSTRY, *supra*, note 92, at 5.
[98] *Id.*, 36-37.
[99] Pollution Control Act, *supra*, note 14, s. 5(3).
[100] *Id.*, s. 7.
[101] *Id.*, s. 7A(2)(a-f); and see s. 6(a), (b).
[102] *Id.*, s. 7A(2); and see P. Good, *Anti-Pollution Legislation and Its Enforcement: An Empirical Study* (1971) 6 U.B.C.L. REV. 271.
[103] *Id.*, s. 6(h), (i).
[104] *Id.*, s. 6(g).
[105] *Id.*, s. 19(a).

mum social value. This cannot be accomplished by ascribing relative priorities to different uses *per se*: it demands attention, rather, to how much is allocated to each use. The greatest aggregate social value results when each user obtains just that amount of water whose value in that use, at the margin, is equal to the value it can generate in other uses. To economists, efficiency requires that a resource be used to the extent that its marginal benefit equals its marginal cost, where the latter is its value foregone in other uses.

This basic criterion applies to all productive resources—land, capital and labour—as well as water. Since they are also scarce, efficiency requires that all be combined in water-using projects and other activities in proportions which reflect the alternative opportunities for their use. Thus an "inefficient" water allocation system may lead not only to a waste of water, but also to a waste of other productive resources.

The social value—or benefits in excess of costs—that we seek to maximize encompasses the usual private gains in the form of profits, rents and other incomes, but includes also the "external" gains and losses mentioned earlier which are so often inadvertently produced outside commercial and industrial channels. Although such benefits and costs do not pass through markets, and are enjoyed free of charge or are borne without compensation to third parties, they nevertheless are taken into account in this basic efficiency criterion (although effects that are not registered in market prices complicate the practical problems of measurement and implementation).

The efficiency criterion also applies regardless of whether resources are allocated and used directly by governments or by private individuals in our economy. The way that resources are used is decided mostly by individuals in the private sector in their quest for increased enjoyment or profit from their homes, occupations and industries. To the extent that their benefits coincide with what society in general would also consider to be benefits, the pursuit of private gain is a source also of social welfare. This is usually the case, as when one merchant sells an article or service to another: both agree, both gain, and their respective profits are each a net gain to society. But if one person gains at the expense of another, as when he poisons water, catches fish, or reduces the water table, the private market system has failed to bring about mutual benefit, and government must intervene either directly to prevent such a distorted allocation of resources or indirectly through laws and institutions to ensure that the private sector will bring about a more efficient result. Thus, the

policy might be either to irrigate certain acres, or to set up laws, fees, rights and property institutions that will permit the private sector to carry out the irrigation. It is this combination of direct government actions and indirect restraints and incentives that we have referred to in this essay as "policy".

Successful resource policy requires that the governments establish strong and flexible laws and procedures. But it does not require either that the government take over all allocation itself, or that it turn the whole business over, along with private property rights, to the private sector. Many arrangements for government ownership and private use are possible, through systems of rights, permits, taxes, fees, subsidies and regulation of private behaviour. What is demanded are arrangements which avoid internal contradictions, inefficient use of water, and wasteful expenditures on complementary capital, land and labour.

In particular, government must see to it that the following functions are somehow performed, at a low economic cost, to:

(i) provide information about the amounts and quality of water resources, and about the technical means of adding to these amounts or improving these qualities;

(ii) ensure that the quality of rivers and lakes, however regulated, can later be adjusted down or up to obtain greater net benefits as conditions change;

(iii) ensure that water not yet allotted to any use, or allocated only in low-value uses, can be systematically allocated or re-allocated to higher-value uses as opportunities arise;

(iv) reduce the natural variability of supply or quality of water to the extent that the benefits of doing so (including environmental benefits) exceed the costs (including environmental costs) of the necessary works;

(v) prevent, discourage or constrain water uses that degrade the quality of water or its value to others through adverse "external effects";

(vi) conversely, encourage activities that generate benefits to others by enhancing the quality of water or its value to others through beneficial "external effects";

(vii) pursuant to all the above, provide a system of prices, fees or rentals for rights to water or its assimilative capacity that will encourage or permit their efficient use;

(viii) establish secure and well-understood rights for the con-

sumption, diversion or impoundment of water, and for the use of its assimilative capacity;

(ix) similarly, prevent collective users of water (such as water-supply utilities or irrigation cooperatives) and collective managers of water quality (such as sewage systems) from levying charges that invite over- or under-investment in private systems or lead to wasteful use of the water or its assimilative capacity.

This list of functions of an efficient allocation system provides a framework for evaluation of water policy in British Columbia.

resource supply information

Mention has been made of circumstances in which the Comptroller must make decisions about granting water rights without full information about the quantity available to be allocated. In such cases, he may either refuse an application, or grant it even if it means possibly over-allocating the available flow. He can deal with the possibility of inadequate flows to meet all licence allocations by making the new licence "junior" to those already issued so that their precedence is clear. His practice of over-recording flows thus enables him to ration effectively supplies in the face of uncertainty, and in a way that is clear and (at least by the criterion of "first come—first served") equitable. Given uncertain flow information, this practice is above criticism. But would it not be desirable to collect the missing information?

When a junior licensee is faced with the possibility (or probability) of interruptions in his supply from time to time, he has to take precautionary measures. Several options are open to him: he can contract to purchase some of a senior licensee's entitlement (if the Comptroller concurs); he can construct stand-by facilities for storing water or for obtaining supplies from elsewhere; he can attempt to reduce his requirements; he can move his operations; or he can simply plan to shut down when supplies fail. All of these entail costs or loss of income. More seriously, since he remains uncertain about the frequency, degree and duration of low flows, he will under-invest or over-invest in precautionary facilities compared with what he would spend if he had better streamflow information.

Similar comments can be made about the variability of water quality. Changes in water flows or its capacity to absorb additional wastes may mean that dischargers face the possibility of periodically creating unacceptable pollution. They are likely to take precautionary measures through reducing discharges, storage or shut-down. And water consumers are likely to protect themselves from sharp changes

in the quality or safety of the water they draw. Better information on variability would lead to more economical precautionary planning.

Finally, unreliable information on streamflow and its assimilative capacity may sometimes lead to erroneous decisions to refuse applications for water licences or discharge permits. In this case, the loss is the potential value of the unused water.

Obviously, the collection of complete information on all watercourses is not justified. At some point, the cost of obtaining more information will exceed its value. The positive or negative error in investments in precautionary measures, plus the potential value of usable water unallocated is a measure of the amount that could gainfully be spent in improving streamflow information, in the interest of more efficient utilization of water and capital.

Without empirical study, it is impossible to assess the losses attributable to inadequate hydrologic information. We suspect, however, that the Water Resources Service has not even been able to investigate whether enough is spent on streamflow measurement, and that too much of the problem is dealt with by excessive precautionary spending by licensees.

security of rights to flows

While uncertainty about natural flows is thus an important economic consideration, so is the licensees' security of tenure over the available flow.[106] Uncertainty about the security of the right to a licensed flow arising from the possibility that other users might interrupt the streamflow or alter its quality would induce licensees to take the same kind of costly precautionary measures as would uncertainty about the streamflow itself.

A particularly strong feature of the British Columbia Water Act and the way it is administered is the extent to which such legal uncertainty is reduced. Licensees—particularly "senior" licensees—hold rights to flows that must be considered both less ambiguous and more secure than the rights enjoyed by users in most other jurisdictions, especially where more reliance is placed on common law. Certainty of tenure avoids waste in precautionary measures, enhances the value of available water (which frequently is manifest in the market price of transferred rights), and enables more efficient use of resources generally.

There is, however, one respect in which a licence holder is vul-

[106] Distinctions between the certainty possessed by a licensee against (a) physical variability, (b) legal interception of his supplies by other licensees, and (c) illegal interception, is made by S. V. Ciriacy-Wantrup, in *Concepts Used as Economic Criteria in a System of Water Rights* (1956) 32 LAND ECONOMICS 295.

nerable to unrestrained action on the part of other licensees. As described earlier, junior licensees are sometimes dependent upon upstream senior licensees' return flows, and these return flows may be diminished in quality or quantity if an upstream user alters his production techniques or agricultural practices within the terms of his existing licence. The licensing system offers the junior licensee no protection against such threats to his supply.

In principle, the remedy to this problem is simple: licences should specify net (instead of gross) withdrawals. Whether such a change would yield gains through increased security that exceed the extra costs of metering and enforcement is a question that deserves investigation.

While this appears to be the only significant interference with security of rights that results from permitted actions of other licensees, other uncertainties arise from activities that fall outside the ambit of the Water Act. First, federal statutes may restrict the freedom of licensees to carry out activities that the Water Act permits, and also allow interruptions of flows to which they are entitled under the Water Act.

Second, licensees are vulnerable, as are other property owners, to expropriation.

Third, and of greater importance, is the absence of a groundwater allocation policy in the Water Act. While this omission may not have given rise to conspicuous problems yet, it could prove to be one of the most serious defects of the system as demand for groundwater grows.[107] It is possible that unrestricted groundwater use already reduces surface flows available for licensing in some watersheds. More obvious, however, is the threat to one user's right to underground water posed by the absence of regulation of other users.

In addition to seasonal fluctuations in the water table resulting from natural causes (on some islands and in some interior valleys it literally runs dry every year), the underground water level may be lowered by withdrawals. Where this occurs, each user, by contributing to the general subsidence of the water table, imposes higher costs of pumping on every other user, and perhaps causes lower

[107] Current demands on groundwater and the outlook for its future use in British Columbia are reviewed by E. Livingston, *Groundwater as a Water Resource in British Columbia*, PROCEEDINGS OF THE 17TH BRITISH COLUMBIA NATURAL RESOURCES CONFERENCE, (1967) 17-27. In 1965, 37 per cent of the population in communities with a population of 1,000 or more (but excluding Vancouver and Victoria) were served by systems using partly or exclusively groundwater. In addition, groundwater is used in a number of smaller systems, by about 50 per cent of the rural population with individual supplies, and by several large industrial complexes. Current trends suggest growing demands on groundwater, not only to supplement surface flows but also to dispose of liquid wastes: *Id.*

quality water and higher costs of precautionary works as well. Dramatic cases of lowering of the water table through excessive withdrawals have occurred in the western United States, and the problem has attracted a good deal of investigation. Similarly, in British Columbia, "[a]s groundwater use becomes more intensive, we must expect this to happen."[108]

There is an optimum rate of groundwater withdrawal in each locality, beyond which further reduction in underground stocks causes aggregate pumping costs to rise above the value of the water withdrawn. Without regulation, independent users ignore the impact of their actions on other users, and this optimum rate may well be exceeded. That there has been so little outcry over reduction in groundwater accessibility in British Columbia can probably be attributed to (i) the abundance of supply relative to the demands on it, (ii) the availability of convenient surface water alternatives in critical periods, and (iii) a public failure to realize that it is possible to make better use of groundwater than under the practice of unrestrained individual pumping. The first two of these sources of complacency are likely to diminish as demands on water grow through time. In so far as the second and third are valid, it is obvious that a link between surface and groundwater regulation is desirable.[109] A strong case can therefore be made for extension of the licensing system to groundwater resources to forestall the costs associated with excessive aggregate withdrawals and water table lowering, to encourage economy in groundwater use and to promote security of supplies so that precautionary expenditures can be minimized.[110]

security of rights in quality control

Although they involve the same users and government departments, the system for regulating water quality differs so radically from that for regulating flows that they must be discussed separately. The

[108] *Id.*, at 27.

[109] Groundwater licences might be granted locally instead of provincially, as in Colorado and Oregon. These states have ground-water systems similar to their appropriation systems of water law, which are similar to the B.C. system of water rights. They actually rely to a large extent on district organizations, although the powers of administration and control may be vested in the local state engineer. "In these states the main attempt has been to rely on administration of property rights [to groundwater] to give adequate ground water management through regulation of draft. Rights may be granted up to the administratively determined 'full' appropriation of the ground water reservoir. If a reduction in draft is called for, reduction would proceed [in reverse order of precedence, from junior to senior]. Accordingly, the impact of cyclic fluctuations would fall upon the junior appropriators and would affect their security of investment. As their groundwater problems become more acute with increased reservoir development, it may become necessary to adopt other management techniques such as artificial recharge, disposal and reuse of return flows. . . ." Stephen C. Smith, *The Role of the Public District in the Integrated Management of Ground and Surface Water*, in ECONOMICS AND PUBLIC POLICY IN WATER RESOURCE DEVELOPMENT, (S. C. Smith and E. N. Castle, ed.) (1964) 344.

[110] As mentioned earlier, the Water Act already encompasses groundwater, although its application to these sources awaits proclamation: Water Act, *supra*, note 3, s. 4.

fundamental difference between the two approaches to regulation deserves emphasis: the licensing system under the Water Act provides licensees with rights to the available flows; the discharge permit system under the Pollution Control Act does not provide permittees or anyone else with private rights, but merely gives statutory licence to do whatever the permit allows (which is usually to use certain works and abatement equipment). While streamflow capacity provides the Water Comptroller with a limit to feasible licence allocations, its counterpart in quality control—the assimilative capacity of receiving waters—does not play a primary role in the discharge performance required by the Director of Pollution Control. While water licences provide licensees with a right to a share in a scarce resource (the flow), discharge permits simply require a specified standard of industrial performance.

In designing its pollution control machinery, the province chose the permit approach, which is in use in many other North American jurisdictions (and is the approach of most of our building, public health and municipal law). It thus rejected the "rights" approach of the Water Act, which is undoubtedly a superior system for regulating private resource use in the public interest. The result is the discharge permit system, characterized by requirements for abatement works which are either excessive or inadequate to control the quality of differing waters, absence of incentives to innovate in pollution abatement, and uncertainty. The effectiveness of the system in controlling pollution is an *incidental* result of the apparent primary objective of the system, which is to force dischargers to meet specific performance standards regardless of environmental or economic considerations. The system is directed more toward ensuring that the "best available technology" is adopted everywhere, than toward correct allocation of the assimilative capacity of water resources.[111]

Thus the administration of the permit system depends more on information about the technical means for controlling wastes than on data relating to flows, variability and estuarial hydrology; and the standards prescribed, for the most part, ignore the condition of the relevant watercourse. This is not to say that permits are granted in complete ignorance of the local hydrology, but rather that the permit system is ill-suited to achieving the socially desired balance between capacity and water quality on each watercourse.

This general shortcoming is aggravated by some of the specific

[111] For an illuminating chronicle, see A. R. Lucas and P. A. Moore, *The Utah Controversy: A Case Study of Public Participation in Pollution Control* (forthcoming).

features of the system. Because effluent standards are specified mostly on the basis of industrial performance, the system does not prevent an increase in the total amount of waste discharged, in proportion to an increase in the size and number of dischargers. Similarly, standards specified in terms of a ratio of pollutants to industrial output do not prevent total discharges from increasing with productive capacity, regardless of the natural limits of assimilative capacity.

Thus neither water consumers nor dischargers can be certain that the Act will preserve any given level of water quality. The discharger's position is uncertain in that he has no property right or guaranteed share in the assimilative capacity of the watercourse; only a permit to install and operate certain works. He faces the possibility that increasing discharges into the waterway will lead to future demands that he discharge less or move away. In the meantime, he has no incentive to improve the quality of the receiving waters beyond the requirements of his permit. Consumers of water, who have no right to water quality, are induced to undertake a variety of precautionary and adjustment measures, such as industrial and municipal purification devices, artificial fish hatcheries and alternative recreational facilities.

Any system, of course, must deal with overall uncertainty about future abatement requirements, if only because of growing public demands for environmental quality, and population growth. Under a property-rights system, for example (wherein dischargers hold transferable rights to discharge specified amounts of pollutants, corresponding to water licences), improvement in water quality can be accomplished by reduction in rights, which might be done by simply buying out a sufficient number of the allocated rights.[112] Under an effluent-fee system (wherein dischargers are charged according to their actual discharges, corresponding to a bridge toll) the same result could be achieved by gradual increases in the fee.[113] To the polluter, these processes would be analogous to a gradual rise in land values, rentals or property taxes: he would be able to anticipate them and adjust to them, knowing that at least his share in the assimilative capacity is secure, and operating under strong economic incentives to economize on his use of a resource of increasing scarcity. But the discharge-permit system in British Columbia offers no means of *gradually* altering the demands on dischargers. The polluter, having

[112] See, for example, J. H. Dales, POLLUTION, PROPERTY AND PRICES (1969) 93.
[113] See, for example, Allen V. Kneese and Blair T. Bower, MANAGING WATER QUALITY: ECONOMICS, TECHNOLOGY, INSTITUTIONS (1968) chapter 7.

no long-run rights, has an incentive only to use political and other means to resist changes in environmental standards.

Another potential problem is the uncertain relationship between federal pollution controls (based largely on the Fisheries Act) and the provincial permit system. Although the Canada Water Act offers means for co-ordination, there is at present only minor consultation and informal coordination of the decisions of the two jurisdictions.[114] It is possible for the provincial Director to issue a permit for actions that the federal Minister could deem (and claim in court to be) "deleterious" to fish, subject to prosecution. The uncertain requirements of both systems may more than double the uncertainty about a discharger's required performance.

efficiency in water allocation among uses

Efficiency in water use, as emphasized earlier, requires that users be able to obtain water, or additional supplies, from others when they are in a position to put it to more productive use. In general, it appears that the water rights system in British Columbia permits a high degree of efficiency in this respect. In spite of the priorities of purpose, and of precedence based on time of application in original allocations, the combination of the provisions in the Act, the practice of the Water Rights Branch, and the market in properties to which rights are appurtenant, makes it possible to transfer rights from lower to higher uses. Indeed, this transferability is undoubtedly one of the most valuable characteristics of the whole system.

There are, however, some impediments to efficient reallocation of water. First, as revealed in the review of the Water Act and its administration, there is a degree of systematic solicitude for domestic (and farm) uses, so that even some unlicensed users obtain special protection. This special protection rarely protects large users, however, and so may be of negligible allocational importance.

Second, and of greater significance, is the non-neutrality of the system toward certain unlicenseable uses, for which some unsystematic protection is provided by other agencies:

(i) fisheries, navigation and trans-boundary interests are covered by federal Acts which prevent, *inter alia,* unauthorized obstruction or damage to fish. The chief defect of these separate arrangements is that they tend to require an all-or-nothing transfer of water among uses as demands and other conditions change through time.

[114] An exception, in the spirit of the Canada Water Act, is the joint federal-provincial study of the water resources of the Okanagan basin: see Timothy O'Riordan and Jonathan O'Riordan, *Okanagan Water Decisions,* (1972) 4 WESTERN GEOGRAPHICAL SERIES 158. H. D. C. Hunter, *Preliminary Report No. 23, "Institutional and Financial Studies"*, prepared for the Okanagan Study Committee.

(ii) the protection of recreation, wildlife and aesthetic uses of water is left to the cabinet committee under the Environment and Land Use Act, the Ecological Reserves Act, the reservation provisions under the Water Act or the internal procedures of the Water Rights Branch and the Pollution Control Board. Regardless of whether these mechanisms result in enough water being allocated to these public, non-consumptive purposes, they provide no specific rights to amounts or quality, or flow regime. The result is general inefficiency through excessive expenditure on precautionary and supplementary measures; and the need for continual vigilance against encroachment, which generates suspicion and conflict.

(iii) responsibility for flood control measures appears to be distributed among federal, provincial and municipal bodies, and while control dams must be licensed under the Water Act, the body responsible for taking the initiative in this area is unclear. In fact, few dams have been justified on grounds of flood prevention, and flood control is usually relegated to local bodies with senior government assistance. The unproductive career of the joint federal-provincial Fraser River Board is evidence of the futility of treating flood control as a "use" of water parallel with storage, diversion and consumptive uses.

(iv) use of water's waste assimilative capacity is not a use which is recognized in the Water Act, and in the absence of internal government coordination (as envisaged in the Environment and Land Use Act), the Comptroller may allow uses or alteration of watercourses that would aggravate a polluted condition, the correction of which would depend upon actions under the Pollution Control Act or the federal Fisheries Act.

(v) moreover, there is no clear responsibility for comprehensive examination of the impact of dams or other water projects associated with the granting of a licence for them. Such questions as the best location and scale of a dam in the light of its effects on agriculture, transportation, wildlife, recreation, fisheries, urbanization, and international flows have been considered by the appropriate international, federal or provincial agencies; but applications and hearings have usually dealt with limited questions, and participants have tended to promote their special interests in obstructing or expediting the project. There is no requirement for the use of comprehensive benefit-cost analysis techniques familiar to students of law

and economics.[115] Indeed, most large dam projects in the province have been studied once, by those proposing them. Neither the Water Rights Branch, the Pollution Control Board, the Public Utilities Commission, the Energy Board, the International Joint Commission, the federal Fisheries Service, the International Pacific Salmon Fisheries Commission, nor the provincial Departments of Lands, Forests and Water Resources and Recreation and Conservation has had the power to do more than comment on proposals for particular and minor reasons (from the point of view of overall efficiency in the use of water, land, capital and human resources).

In short, the Water Act provides for a clear allocation of water among many specified uses in most circumstances, and procedures exist for reallocation, chiefly through private markets in licences or appurtenant properties. The coverage of the Act is not complete, however, and certain water uses are provided for, if at all, less systematically through a miscellany of other legislation. The neutrality of the whole system, which is necessary to allow water to be transferred to its highest use, is obstructed to the extent that uses outside the Act are not likely to be treated in a way comparable to those that fall within it, and to the extent that the marketing of licences and appurtenant properties presents administrative difficulties (and hence high costs) of transactions in water rights.

The priority ranking of purposes and the precedence of rights based on chronological order of applications, which are found also in certain United States and other western Canadian appropriation water laws, give the superficial impression of other obstacles to the optimum economic use of water. But our analysis suggests that these provisions are of little practical significance, except to the extent that the specification of licenseable purposes may obstruct the allocation of sufficient water to unlisted purposes.

With respect to the licensing system, the Comptroller's power to reserve water for future public purposes offers some means of providing for certain future requirements. However, the official policy of preventing "speculation" (by requiring continued "beneficial use", etc.) makes it difficult for smaller or private users to obtain comparable long-term reservations for expected future uses. This may result in inflated applications or wasteful installations designed simply to establish a legal claim to water in anticipation of needed future

[115] At one time certain private dam projects did get examined by the Public Utilities Commission, but this is no longer required. Even this commission had no independent engineering or environmental capacity, and certainly was not prepared to ask whether a proposed project made the best use of a river, or was the best way of obtaining domestic water or energy.

flows. There is undoubtedly a case to be made for preventing excessive private monopolization of water supplies, but the threat to the public interest of small private reservations for future needs is easily exaggerated.

rights, permits, price-rationing and subsidies: scope for reform

To conclude this essay, it is appropriate to summarize the advantages and disadvantages of the alternative approaches to regulating the use of water resources, and to comment on the scope for improvement of the policies in British Columbia. We have examined the efficacy of a system of water rights in the context of the licensing provisions of the Water Act, and of a system based on permits for specified actions in the context of the Pollution Control Act. An alternative approach that has received a good deal of attention in the literature involves price-rationing of the available flow, or assimilative capacity, among users. Under this latter system, the regulatory authority would simply set a price for water (or for effluent discharges) at whatever level is required to ration out the capacity of a particular watercourse. Each of these approaches offers particular advantages and problems relating to efficiency, difficulty of administration and distribution of benefits.

We have already criticized the permit system governing pollution on grounds of efficiency, and the criticisms would apply equally if such a system were used to allocate water flows. The inherent limitation of permits that authorize specified behaviour is that, since they carry no certain, transferable rights to the scarce resource, they do not enable its allocation and reallocation to its highest use or the efficient use of complementary labour, capital and land.

We have emphasized the importance for efficiency of both security of supplies and flexibility over time. These are not conflicting requirements. The water rights system, as we have suggested, achieves a large measure of both; while the waste discharge permit system fails in both respects.

Permittees under the Pollution Control Act hold no secure rights to the assimilative capacity of water, nor do those who benefit from the maintenance of high quality. Moreover, the discharge regulation system provides no systematic means for easy reallocation of uses of assimilative capacity or for responses to changes in the relative demands for waste discharge and high water quality.

On grounds of administrative simplicity, the permit approach has the advantage of requiring relatively little hydrological information (under the Pollution Control Branch's practice, at least) but it

demands much more information about abatement technology than would the obvious alternative approaches. With respect to recapture and redistribution of the benefits, the approach is amenable to the incorporation of fees or rentals payable to the Crown for the use of water or its assimilative capacity. But because of the inefficiencies it causes, the scope for such revenues is inevitably reduced.[116] No charges reflecting the economic value of the waste disposal capacity of water are levied in the discharge permit system described here, and so the benefits accrue to dischargers.

In theory, both a property rights system and a price-rationing system can be consistent with full economic efficiency. The latter requires no rights or permits: the regulatory authority need only set the price of water, or the price of discharging a unit of pollutant, just high enough to allocate the available capacity among demanders in order to reach whatever stream standard has been selected. The price-rationing (or "charges") approach has been widely advocated for pollution control by economists in the United States on grounds that it:

(i) ensures that the available assimilative capacity is distributed optimally, because those who can make the most valuable use of it will be able to bid the highest price for it;

(ii) permits any chosen level of water quality to be achieved by the simple device of raising or lowering the price for discharges, and thus the quality can be readjusted through time;

(iii) ensures that society's total cost of maintaining the chosen level of water quality will be minimized because each discharger, faced with the choice of increasing abatement or paying the price, will strive to strike the least-cost balance between the two;

(iv) enables the authorities to regulate with very little information, because they can simply raise or lower the price until the desired quality is obtained; and

(v) tends to place the whole burden of abatement on the polluters and his customers while the regulating authority collects, in revenues, the full "economic rent" for the assimilative capacity used.

While these arguments are unassailable on theoretical grounds, we believe that the advocates of this approach have underestimated the practical difficulties it would involve. First, it would require

[116] In fact, the full distributional implications of the discharge permit system are complicated. Discharges incorporate the cost of required abatement with their other production costs, but they bear only random relation to the pollution they alleviate because the requirements are not directly related to the condition of the watercourse. Hence unknown and changing shares in the costs are divided between producers, consumers of the products and those who suffer from degradation of water quality. The effect of uncertainty and distortions in the location of operations for them complicate the picture.

separate management of each river or water system; but beyond this, since hydrologic conditions and the synergistic interaction of pollutants vary along any watercourse, the pricing system necessary to achieve the desired quality at different locations would become exceedingly complex. For these reasons, too, a good deal of hydrologic information would be required. Second, the argument that discharge fees—that would be regarded by polluters much like taxes—can be easily raised or lowered to suit the circumstances of different places and times (or simply for experimentation) seems to reflect political naïveté.[117] The likely compromise of setting the same fee over wide areas would defeat the regulatory value of the system. It is perhaps not surprising that in spite of its strong advocates, the price-rationing system of regulating effluents is not employed anywhere in the world; and the few jurisdictions that have attempted it (such as France and Vermont) have retained it only as a means of raising revenue.[118] In our opinion, the price-rationing system would be an improvement over the permit system in British Columbia, but is less attractive than a gradual conversion of the present system to one based on effluent rights.

For completeness, we should mention the negative counterpart of charges for pollution, namely subsidies on abatement. Instead of charging a discharger a price per unit of effluent discharged, he might be subsidized for every unit he does not discharge. If the subsidy per unit was set at the same level as the charge, the effect on the behaviour of the polluter should, theoretically, be identical. But the practical problems of regulation would be at least as great under this alternative; and while the price-rationing system places all abatement costs on the discharger, the subsidy tends to shift most costs onto taxpayers. The anti-pollution subsidies actually received by dischargers in British Columbia (under the property, income and sales tax provisions, in low interest loans under the Central Mortgage and Housing Corporation[119] and in per capita grants to municipalities) are not, of course, of this type. They do not allocate limited access to assimilative capacity, but merely lower the cost of achieving permitted levels of effluent discharges.

[117] Similar reservations about the price-rationing approach are held by our colleagues Professor Irving Fox and Anthony Dorcey—both experts in this field. Fox argues that changing the price charged is not only difficult, but it also imposes heavy information costs on dischargers. Dorcey's research suggests that abatement costs are approximately constant per unit of effluent; so that firms would not divide their outlays but move to either complete abatement or complete discharging.

[118] A modified approach has been adopted in the Ruhr, in Germany, where the least-cost system of total abatement through treatment facilities and an equitable sharing of costs is agreed to by the parties along the river. See Allen V. Kneese and Blair T. Bower, *supra*, note 113, chapter 12.

[119] National Housing Act, R.S.C. 1970, c. N-10, Part VI B.

The advantages of property rights in water have already been suggested. They can function, for water, like property rights in land—they can be purchased, held, transferred among uses and users; they offer certainty of tenure, and provide incentives to use water, land capital and other scarce resources efficiently. The particular defects in British Columbia's water rights system have been reviewed—its incomplete coverage of uses, the inability of private users to obtain rights in anticipation of future needs, its minor biases among purposes, and certain administrative obstacles associated with transfers. On balance, these imperfections in the policy covering provincial jurisdiction are not critical to efficient performance and could be overcome through minor extensions and revisions of the current arrangements. The most significant shortcomings relate to the lack of comprehensive coverage of the licensing arrangements—especially with respect to groundwater, waste disposal and public uses—and the system of Crown charges.

Extension of the existing licensing system to groundwater does not appear to present formidable practical difficulties. Incorporation of rights for collective public uses of water, such as amenity, wilderness and wildlife preservation, flood control, etc. raises more complex issues. Who is to apply for and hold the licences? Individuals have no incentive to provide unmarketable public goods and services, and even private associations and local governments are unlikely to encompass all the beneficiaries. Moreover, many such benefits are enhanced by other uses of water, or at least can be enhanced by the multiple-use design of projects. Such problems undoubtedly explain the present divided jurisdiction over water and the unsystematic means of providing these unmarketed services. The inherent conflict will undoubtedly be accentuated as demands on water grow, and suggests the need for two changes: systematic use of comprehensive evaluating techniques in assessing proposed projects, and extension of licences to collective consumption purposes. Ideally, all water would be recorded for either private or public purposes, to ensure unbiased allocation among all uses.

The recapture and re-distribution implications of the present licensing system raise the question of Crown charges. It is clear that the application fees and rentals bear little relation to the economic value of the water licensed, and serve no allocation function other than, perhaps, discouraging the retention of unused allocations. In particular, they cannot be credited with any of the allocation functions performed by price-rationing, because they provide no incentives to licensees to make efficient reallocations of water. Apart from these unsystematic payments to the Crown, the value of the water allocated is capitalized in the licensee's right—it tends to accrue to original licensees and is manifest in the market value of the licence or incorporated in the value of the appurtenant property.

It must be emphasized that efficiency in the allocation of water is independent of whether the value of water rights is captured by private licensees or recaptured by the Crown. The appropriate distribution of the gains from Crown resources is a politically important question, however, and while economists, *qua* economists, can make no claim to superior judgment on this question, it is nevertheless central in any examination of public policy. (The same distributional issue is often raised in connection with land values: whether the increasing value of the resource that results from growing demand for it should be allowed to accrue as windfalls to private owners, or be appropriated by taxes or other means for the public at large.)

It must be pointed out, also, that the apparently negligible Crown revenues from water under-represent the actual returns to the Crown. Since the value of water licences is incorporated in property values or added to incomes, some of the gains are picked up in revenues from property and income taxes. On the other hand, since property taxes are very uneven across different kinds of property, and do not attempt to capture full "economic rents", and because many other taxes are levied on "equitable" or "progressive" bases, they cannot be depended upon to appropriate the net value of water resources.

Thus, if the objective were to appropriate for the Crown a greater share of the "economic rent" or value of water, this could best be accomplished in two ways. First, original allocations might carry a charge that reflects, as much as possible, the current competitive market value of water (much like the "upset stumpage" on Crown forests). Where there exists water in excess of demands, the initial charge would be nominal. Again, it must be noted that the method by which initial allocations are made will not affect the efficiency of allocations over time, as long as rights are readily transferable.

In a static economy, the Crown's initial competitive sales of water allocations would tend to capture the present value of all future economic rents. If an annual rental were also levied on water rights, the initial values would simply be reduced by the present worth of the future rentals. However, if future growth and develop-

ment are uncertain and changing, increasing water values will not all be capitalized into the initial value of water rights. Instead, there will be windfall gains (and losses) to licensees as the pattern of demand changes. Such windfall gains can be captured for the Crown to any extent desired, either by a special property tax on licences, or by an annual rental.

We would advocate more fundamental reform of the existing quality-control arrangements, directed toward achieving the efficiency and distributional advantages of a rights system. Indeed, in view of British Columbia's long experience with various forms of licensing arrangements for Crown water, forests, minerals, and agricultural land, it is unfortunate that an inferior approach to the allocation of the assimilative capacity of waters was adopted.

The advantages of a property rights system have been described in our review of water licensing, and its application to pollution control has been examined in the notable work of Professor John Dales.[120] In addition to all the efficiency benefits of a price-rationing system, it offers unique practical advantages: it can be developed from the existing permit system without dislocation; it can be introduced piecemeal, river by river; it makes it possible for those who benefit from higher quality to reduce pollution by purchasing discharge rights; it is easier to administer and to effect changes; it offers security to dischargers and incentives to economize on use of assimilative capacity; and it permits Crown appropriation of the rents attributable to the waste disposal capacity of water resources.

The transition from the existing arrangements might proceed as follows. First, all existing dischargers might be given licences for their current discharges. These licences, like water licences, could be transferable, and their market value would respond to the demand for discharge rights on the particular waterways and to the degree that Crown charges are levied on them. Where the degree of pollution of a watercourse is excessive (or becomes excessive as the demand for quality grows) discharge rights might be purchased by groups who demand high quality, or by the government. Where there exists scope for increased discharges, additional licences might be granted on the same basis that we have suggested for water licences.[121] Similarly, initial charges and an annual property tax or

[120] J. H. Dales, *supra*, note 112. See also Anthony Scott and C. B. Bramsen, *Guiding Principles for Transfrontier Pollution* (Forthcoming in the proceedings of O.E.C.D. seminar on International Pollution Problems, Paris, 1972).

[121] Water quality management inevitably involves complex technical problems relating to the quantification of different kinds of pollutants and their synergistic interactions. Thus licences would have to specify quantities of particular pollutants or classes of pollutants. These difficulties are common to any form of quality controls.

rental on discharge licences would permit Crown appropriation of the value of assimilative capacity used, to whatever extent is desired.

The property value of discharge licences would respond to the demand for scarce assimilative capacity just as the value of rights to water and land responds to demands for them. Dischargers would enjoy secure rights, and have incentives to achieve the socially-desired degree of abatement in the face of the alternative cost of retaining valuable discharge rights. Differences between the prices of discharge licences in different waterways would also promote efficient industrial and municipal location decisions.

Thus the regulation of quality might become symmetrical with the present system for allocating flows. Indeed the two systems would interlock very closely if our suggestion about the licensing of return flows were adopted. However, we do not recommend that the administrations of the two systems be integrated, for each has functions that are irrelevant to the other. The pollution-control administration, in particular, now encompasses the regulation of waste discharges onto land and into the air as well as into water; and this broad scope is desirable to prevent dischargers from simply disposing of their wastes in other media. Instead of integration, close liaison should be sought to assure that the agency which is controlling effluents has, both through the market and through official channels, an opportunity to participate in the regulation of a stream's assimilative capacity.

APPENDIX D

INSTITUTIONAL AND FINANCIAL STUDIES

(REPRINT OF PRELIMINARY REPORT No. 23: TASK 203)

BY

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TASK 203

Institutional and Financial Studies

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N O T I C E

This report was prepared for the Okanagan Study Committee under the terms of the Canada-British Columbia Okanagan Basin Agreement. The information contained in this report is preliminary and subject to revision. The Study Committee does not necessarily concur with opinions expressed in the report.

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ABSTRACT

This report documents the various legislation and administrative organizations affecting water resource management in the Okanagan Basin. It also examines the operation of administrative organizations, the jurisdiction of different levels of government, and the rights of individuals.

The examination of water management opportunities will be carried out as part of the final evaluation process under Task 204 'Define Water Management Opportunities and Alternatives'.

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May 31, 1972

Coordinators,
Socio-Economic Task Force
Okanagan Basin Study Group

Dear Sirs:

re: Task 203
Institutional and Financial
Studies

I have pleasure in submitting herewith my report on the Legal and Administrative framework affecting water resource management and development in the Okanagan Basin.

Yours faithfully,

H. D. C. Hunter

HDCH:jh

INDEX

		i
INTRODUCTION		1
SUMMARY AND CONCLUSIONS		3
SECTION I	Principles	7
SECTION II	Laws Affecting the Use and Management of Water Resources	12
SECTION III	Administration of Water and Related Resources	42
SECTION IV	Powers, Duties and Responsibilities of Those Concerned with Water Resource Management	47
SECTION V	Financial Powers and Constraints in Water Resource Management	59
SECTION VI	Problems Appearing in the Okanagan Basin	65
SCHEDULE I	Relevant to Canadian Statutes	I-1 to I-14
SCHEDULE II	Relevant to B.C. Statutes	II-1 to II-14
SCHEDULE III	Okanagan Flood Control Project	III-1 to III-14

SCHEDULE I

Relevant Canadian Statutes

Agriculture and Rural Development Act (RSC 1970, Ch. A-4)

Canada Water Act (SC 1969-70, Ch. 52)

Fisheries Act (RSC 1970, Ch. F-14)

International Boundary Water Treaty Act (RSC 1970, Ch. I-20)

International River Improvements Act (RSC 1970, Ch. I)

Municipal Improvements Assistance Act (RSC 1970, Ch. M-16)

National Housing Act (RSC 1970, Ch. N-10)

Navigable Waters Protection Act (RSC 1970, Ch. N-19)

SCHEDULE II

Relevant B.C. Statutes

Agricultural Rehabilitation and Development Act (SBC 1962, Ch. 2)

Canada - British Columbia Joint Development Act (RSBC 1960, Ch. 40)

Ditches and Watercourses Act (RSBC 1960, Ch. 117)

Drainage, Dyking and Development Act (RSBC 1960, Ch. 121)

Ecological Reserves Act (SBC 1971, Ch. 16)

Environment and Land Use Act (SBC 1971, Ch. 17)

Fisheries Act (RSBC 1960, Ch. 150)

Health Act (RSBC 1960, Ch. 170)

Land Act (SBC 1970, Ch. 17)

Local Services Act (RSBC 1960, Ch. 224)

Municipal Act (RSBC 1960, Ch. 255)

Municipal and Improvement District Rehabilitation and Development Act (RSBC 1960, Ch. 201)

Municipal Finance Authority of B.C. Act (SBC 1970, Ch. 30)

Municipal Treatment Plant Assis ance Act (SBC 1969, Ch. 25)

Municipalities Assistance Act (RSBC 1960, Ch. 260)

Municipalities Enabling and Validating Act (RSBC 1960, Ch. 261)

Okanagan Flood Control Act (SBC 1949, Ch. 47)

Pollution Control Act (SBC 1967, Ch. 34)

Public Utilities Act (RSBC 1960, Ch. 323)

Regional Parks Act (SBC 1965, Ch. 43)

River Bank Protection Act (RSBC 1960, Ch. 342)

Soldier's Land Act (RSBC 1960, Ch. 366)

Village Municipalities Assistance Act (RSBC 1960, Ch. 401)

Water Act (RSBC 1960, Ch. 405)

INTRODUCTION

The purpose of this study is to examine the legal and administrative framework affecting water resource management and development in the Okanagan Basin.

The framework includes the potentials and the restraints on the use of the resource and also the powers and restrictions on various public and semi-public bodies which use or could use the resources.

The pattern which will be followed will be first to discuss legal principles and problems which permeate the whole question of water resource management. Then consideration will be given to the laws affecting the actual use of the water resources, federal and provincial, and areas of conflict. The third section will assess various administrative organs which control the uses of water resources. The fourth section will describe the powers, duties and responsibilities of various persons, corporations or groups in relation to the use of the water resources. Then there will be a section to outline various financial restrictions or potentials for the persons or corporations who do or could make use of the water resources. Finally, there will be a section relating these theoretical problems to some of the practical problems in the Okanagan Basin.

The same Act may be mentioned or considered in several sections and only the important sections or matters will be referred to. For example, the Water Act provides for the use of water; it establishes an administrative organization to carry out the principles of the Act, and it also provides for the establishment of Improvement Districts and Water Users Communities to permit the inhabitants of an area to take advantage of the water resources available to them.

Schedules contain analyses of the principles in various statutes and of the more important and relevant provisions of them. The Schedules are divided into Canadian and Provincial Statutes.

SUMMARY AND CONCLUSIONS

The ability to manage the water resources in any area depends on the old common law rights of individuals, overlain by rights and duties imposed by statute. An individual, unless forbidden by statute, may do what he likes with his own property, with very little concern for anyone else. This concept has been largely buried by laws and government, which is intended to be for the benefit of the people, has been placed in the hands of various creatures of statute such as municipalities or government departments. These creatures of statute only have the powers given them by statutes; in some cases the powers are not in tune with life today, in others the statutes create overlaps or gaps. In most cases the laws have a single purpose in view and therefore do little to help in comprehensive planning or management.

Institutional and financial aspects of water resource management in the Okanagan Basin fall into three main divisions:

(a) The control of the water resources in its broadest concept,

(b) The framework of government,

(c) The financial powers and constraints available to various entities.

The control of the resource is divided between the Federal and Provincial Governments. This division is established by the British North America Acts which form the Canadian constitution. Unfortunately the only way, other than by agreement, in which disputes over constitutional issues can be resolved is by recourse to the Courts. The Federal Government has jurisdiction over Fisheries and Navigation as well as over Indian Affairs; the Provincial Government has jurisdiction of the use

of resources, pollution in local situations, and in local government. Water resource management, however, does not fit into any one neat category, but spills over into many other categories and has an impact on almost every facet of life. The Okanagan Basin poses some problems from an international viewpoint because it flows into the United States of America.

The use of water is controlled by the Province through the issue of Water Licences by the Comptroller of Water Rights. This is on a quantitative basis. Quality comes under the purview of the Pollution Control Board and the Director. No one may deposit "sewage or other waste materials" in water or on land without a permit from the Director. It is doubtful how far this can prevent "pollution", although this is plainly the intent of the prohibition.

The Federal Fisheries Act also has rules and regulations about water quality and interference with water resources which are designed to protect fish life. Equally, no one may interfere with navigation or a potential right to navigate without a permit from the Federal Government.

Some of the Provincial Government's responsibility within the area has been delegated to local government corporations established under provincial laws. These local government corporations range from cities through Regional Districts to Water Users' Communities. The degree of autonomy and the powers of these corporations vary widely. However, they are all managed by boards of locally elected representatives; periodic elections are mandatory so that the boards reflect the wishes or assumed wishes of the people, at least over a period of years.

Government always costs money. The ways of raising money for capital or operating purposes are closely defined by statute. For capital

expenditures the approval of a Minister or official of the Provincial Government is almost invariably required as well as the specific approval of the people in the area who will have to pay back the borrowed money and pay the operating costs. Elector resistance to higher taxes is an element of increasing importance.

The whole legislative framework for the Basin, as indeed for the whole Province, is permissive. The initiative for development must come from individuals; such individuals may be acting on their own or through commercial corporations or they may be prodding their elected local government board into action. The Provincial Government agencies, such as the Water Rights Branch or Director of Pollution Control, cannot issue orders except to someone who has applied for a licence or permit or who is doing something active which is recognized by the laws to require control.

Resource management, like any other management, involves planning: planning is based on data. The Provincial Government, assisted in some cases by the Federal Government, is responsible for collecting and making available data on water resource potential and fishery potential. Regional Districts are required to prepare land use plans, with which water resources are inextricably woven. The result will be a blueprint of what can be done or should be done. But then the planner must wait for someone else to initiate the development. Inevitably a developer will suggest something slightly, or totally, different from the blueprint. Someone must then decide whether to say "NO" and insist on strict compliance with the blueprint or to say "YES" - because the proposed development at the present time appears to be preferable to no development, until the exact plan is proposed - if ever.

The inevitable result of this situation is that planners, government officials at all levels and even elected representatives are cast in a negative role: they can always say "NO"; they can often say "YES - provided you do this"; they can very, very rarely take the initiative and say "Do this".

Even this negative planning and control is rendered less effective by reason of jurisdictional problems. The Provincial Government and its departments are not bound by rules of local governments, the Federal Government is not bound by the rules of a local government either. Neither Federal nor Provincial Government is bound by the rules (if any) of the other in a matter within its own jurisdiction under the constitution. One Regional District is not bound by the rules of another Regional District.

If every entity stood firmly on its legal rights and cared nothing for any other entity, chaos would quickly follow. Fortunately, no entity can function without people and people are basically reasonable. In fact, there is a large amount of cooperation and interchange of opinion and information. Most instances of frustration or problems of a jurisdictional nature appear to spring from lack of communication, failure to appreciate another's viewpoint or problems, or unfortunately, personality clashes.

SECTION I

PRINCIPLES

The relationship of persons to each other and the ability to call a thing one's own depend on some framework of custom or law. The legal framework which governs the rights, duties and responsibilities of individuals, groups of persons or corporations in this Province at this time has its origin in the unwritten common law of England.

The unwritten common law has been modified from time to time by legislation or even by changing customs. However, no legal right, legal system or law can exist in a vacuum; people are always required to exercise the rights and restraints or to administer the laws.

From this it follows that no study of a legal and administrative framework can be meaningful without a knowledge of history to indicate why and how the existing situation has been attained. The law is often called stupid - or worse - but very frequently this is due to the law failing to keep pace with human and social development.

135

Common Law

The legal system in British Columbia is developed from the legal system which developed over centuries in England. There are certain basic concepts which are now so overlain with modification as often to be overlooked; however, they are still there. First is the concept that all land belongs in the first place to the King, but he can give it to whomsoever he wants; however, whatever has not been granted remains in the King, or the Crown in modern parlance. Another concept is that a person may do whatever he likes with his own property, provided he does not

thereby unreasonably harm his neighbour. The last concept to be mentioned here is the comparatively modern one that the Crown is a trustee for the people of its possessions. A political idea still apparently held in British Columbia, but under attack in many areas, is that the Crown should not actively undertake commercial developments if the same end can be obtained by private enterprise.

Legislative Changes

These factors have all exercised their influences over the years of British Columbia's growth so that the legislation is almost entirely negative or permissive. A person may not use his property unless he takes steps to avoid damages to others or to the community. Municipalities and similar entities are set up by law with rights, duties and powers to provide services to people or to provide an atmosphere or situation in which individuals can live in a way which causes the least total harm or discomfort to others. There is no legislation which requires a person or entity to do anything, unless inaction will of itself cause serious harm.

The Water Act itself is an example of this situation. One section takes away from land owners their age old right to use the water on or at the boundary of their property. However, even this was done by saying in effect that whenever anyone acquires land from the Crown, which owned it all originally, he will not get any right to water. The Act left untouched those existing rights to water which were being used when the Act was passed. The Act does not require or authorize the Crown or its agents to take the initiative in respect of its water rights; it provides that almost any person can have a water right on terms set out in the Act.

There is another important principle to be remembered when considering the right and powers of persons. A natural person can exercise all rights of which he is capable unless some statute or rule of law says he cannot. An artificial person, such as a company or a municipality, or any other corporation set up by or under any act of a parliament has only the powers and rights specifically provided in the Act, or those indispensable to the exercise of those powers and rights.

Jurisdiction

The final legal principle, which affects fundamentally any consideration of water resource management anywhere in Canada is constitutional and involves the problem of jurisdiction. The Canadian constitution is contained in the British North America Acts which are Acts of the Parliament in Westminster. They can only be amended in Westminster. Canada is established by these Acts as a federal state, with powers divided between the Federal and Provincial Governments. Section 92 contains the matters referred to provinces and Section 91 those referred to the Federal Government. Each is supreme in its designated area and the Federal Government has no power to interfere in a provincial matter. Even the overall assignment to the Federal Government of the right "to make laws for the Peace, Order and Good Government of Canada" is qualified by excluding those matters specifically within provincial jurisdiction.

The British North America Acts were passed over 100 years ago; they were intended to be flexible enough to cover any situation. However, as problems arose they were referred to the Courts for a ruling; "how should the Act be construed in the light of these facts?". The Courts had to make a decision and in making that decision they were bound, or at least the

Courts paid lip service to the idea of being bound, by previous decisions. The result over the years has been an increasingly rigid and inflexible attitude to the provisions of the Acts, with a corresponding lack of clarity.

Furthermore, until 1952 appeals from Canadian Courts could go to the Privy Council in London. As constitutional problems were always treated very seriously, many appeals ended up in London. Almost all of the judges in the Privy Council were trained in England or Scotland, where there has been only one supreme parliament for over two centuries so that problems of jurisdiction were somewhat strange in concept. The tendency was to build up the authority of the provinces at the expense of the authority of Canada. Since 1952 appeals have stopped at the Supreme Court of Canada and there may well be a reversal of that tendency. There have not been enough constitutional cases since 1952 to indicate any tendency.

There are certain facets to this jurisdictional situation which are clear in principle, if not always in application: matters of navigation are federal; problems with fisheries are federal; the right to use water is a property right and is therefore provincial. Other areas are less clear; pollution is not mentioned in the British North America Acts (no one thought about it then); is this a matter of health affecting much of Canada and therefore federal? Or is it a question of property or a purely local character, in which case it is provincial? The Okanagan flows across the boundary into the U.S.A. and may therefore be affected by the Boundary Waters Treaty of 1909; how far, if at all, does this fact give the Federal Government power to control the use of the river, which is otherwise clearly a provincial matter?

There is a further field of jurisdiction which is important in the context of water resource management between provincial and municipal entities and between different entities below the provincial level.

It is against this background of partially obscured principles and jurisdictional difficulty that the legal and administrative situation has to be considered. It is further confused by laws which appear to overlap or which, while they appear on the statute book, have never been implemented or have been allowed to become ineffective.

SECTION II

LAWS AFFECTING THE USE OF AND MANAGEMENT OF WATER RESOURCES

The nature of water is such that, except in artificial containers, it is rarely still: it is always flowing by gravity, falling as precipitation or rising as evaporation. The law has never considered water as a thing capable of being owned: the right to use water has long been recognized a a property right, and in most legal systems this property right has been annexed to the land through or past which the water flows. From this it follows that a right to use water comes under the heading of "Property and Civil Rights" which is assigned to provincial jurisdiction under the terms of the British North America Acts.

B.C. WATER ACT

The fundamental law affecting water resource use in the Okanagan Basin, as in all British Columbia, is the Water Act. The present Act is a direct descendent of water laws and ordinances going back to 1859. The key to the law is contained in Section 3. This section reads:

> "The property in and the right to the use and flow of all the water at any time in any stream in the Province are for all purposes vested in the Crown in right of the Province, except only in so far as private rights therein have been established under licences issued or approvals given under this or some former Act. No right to divert or use water may be acquired by prescription."

This section requires some comment. In the first place "in any stream" includes, by the definition of 'stream' in Section 2, lakes, sources of natural water supply, whether normally containing water or not, and groundwater, which is subterranean water. Secondly, previously obtained rights must be evidenced by some official record. Finally, actual use for however long a period or for whatever purpose gives no rights whatever nor priority in the obtaining of a licence.

Water Licences

The effect is to retain in the Crown all rights to use water except in so far as the Crown may have granted these rights to some person. The remainder of the first twenty-seven sections of the Act describe how rights may be granted by licence, for what purpose and what rights a person granted a licence may exercise. The right is granted by and described in a Water Licence issued by an official called the Comptroller of Water Rights. The Comptroller's position and the organization established to help him are described in subsequent sections in the Act.

The Act contains no restrictions on the purposes for which a licence may be issued. Section 6 limits the persons who may apply for a licence, but this list is wide. An amendment in 1968 defined a Regional District as being a Municipality for the purposes of the Water Act. Such a District is therefore entitled to apply for a licence.

A licence will only be issued to a particular person, for a particular purpose, with a particular source of water and where applicable for a specified quantity. This is designed to prevent a licence having any

intrinsic value; it only has value as a part of some kind of undertaking which makes use of the water. On the transfer of the land, mine or undertaking to which the licence is appurtenant the licence is automatically transferred. Apart from this the rights may be apportioned by the Comptroller on a subdivision of land, or a transfer of a licence may be approved.

In both these two cases there is no absolute right to demand an apportionment or a transfer; the decision is entirely within the Comptroller' discretion.

Amendments to a Licence

Once a licence has been issued, there is only a very restricted right to change it. The owner can of course surrender it and apply for a new licence, but in so doing he may lose priority; if the licensee commits certain faults, such as failure to make beneficial use of the water for three successive years or non-payment of the rentals, the Comptroller may cancel the licence.

The powers to amend a licence are set out in Section 15 and are restricted generally to correcting errors, extending the time for making use of the water, changing the use of the water or authorizing additional works. There is no power in this section to increase the amount of water authorized to be used or to change priorities nor is there any power to cancel a licence completely unless the licensee is in some default. Under Section 20, the Comptroller has authority to cancel a licence 'in whole or in part' for various reasons, all of which are related to some failure on the part of the licensee. The Comptroller can reduce the amount of water licensed to a licensee if for three consecutive years the licensee fails to

make beneficial use of the licensed amount of water. If a dispute arose as to quantities, the proof of the amount which had not been used for three years would appear to be on the Comptroller and could be a heavy burden. The Comptroller has the right under Section 19 to require licensees to keep such records of diversion and use as he may require; he has not made extensive use in the past of this power so that actual evidence of use is often incomplete.

Applications

A person wishing to obtain a Water Licence makes an application as required by the regulations. The Act and the regulations require notice to be given to all persons whose rights will be affected if the licence is granted. These persons include all persons having a Water Licence in respect of a point of diversion downstream of the applicant's proposed point of diversion and any person whose lands will be affected by the works (e.g. by flooding).

139

Certain persons have a right to object to the application being granted: these are limited by Section 9 to "any licensee, riparian owner or applicant for a licence who considers that his rights would be prejudiced" - and certain Deputy Ministers, including that of Recreation and Conservation who is responsible for fish and wildlife. No one else has a right to object, but there is nothing to prevent the Comptroller accepting, considering or acting on objections from others. If any person having a right to object does so, the Comptroller must consider such objections but he does not have to act on them. He may hold "a hearing" - not necessarily "a public hearing" - if he wishes, but is not obliged to do so.

There can be some problem from the definition of 'stream' particularly with regard to licensees downstream "on the same stream". When one water course joins with another, is the lower course the 'same stream' as either or both of the upper water courses? A change in flow in a tributary can have a marked effect on the quantity available in the mainstream lower down, but where is the line to be drawn? The problem has been met to date by the administrative practice of the Water Rights Branch which, when in doubt, requires notice to be given.

Finally, in Section 10, the Comptroller is given wide discretion in dealing with the application: he may grant a licence in the terms of the application, he may refuse the application, he may amend the application or he may issue the licence "upon such terms as the Comptroller considers proper". He may also "determine the precedence and appurtenancy of the licence to be issued".

Priority

The question of "precedence" is of great importance. Under Section 12 "the respective rights exercisable under any two licences authorizing the diversion of water from the same stream have precedence in law according to the respective priorities of the dates from which the licences take precedence as set out therein". It is only if two licences take precedence from the same date that the purpose for which the water is used may affect priority.

It is a fundamental rule of our law that a person's rights cannot be taken away by statute without a very clear intention in the statute. It is therefore probably the law that the Comptroller, under his power to "determine the precedence" of a licence, cannot issue a licence to take

precedence over an earlier licence, although he can issue one subject to having its precedence reduced by subsequent licences. A licence once issued cannot be reduced in effectiveness.

There is provision in this portion of the Act to permit a licensee to expropriate land, so that he cannot be prevented from exercising his rights under a licence by the inability to purchase land or land rights at a fair price. Expropriation is subject always to the payment of fair compensation. By Section 18 a licensee is also placed under strict liability for any damage he causes to property of others by the use of his licence.

Omissions

Having described the major points which the Act accomplishes, it is necessary to consider some of the things it does not do. The Comptroller cannot take the initiative to use water in any particular way. The Crown may apply for a licence and may then take the initiative. The Crown as licensee will obtain no rights other than those which an ordinary person would have as a licensee. As owner, the Crown may do what it likes and the Act does not bind it. The Crown operates the Okanagan Flood Control Project without a licence, and is therefore not subject to the restraints in Section 18.

The Comptroller can amend an application or issue a licence subject to conditions and thus impose burdens on the licensee which he either accepts and carries, or he refuses to accept the licence. There is no possibility of the Comptroller requiring any person other than the applicant or licensee to carry any burden, nor can a licence be issued except to an applicant.

The Act at present imposes no controls over the use of groundwater, although the Act provides for such controls upon proclamation. Any person can develop groundwater resources on his property to the detriment of his neighbours and no effective complaint can be made if he does.

There is no assurance of there being any quantity of water available and, in the absence of adequate data, licences may be issued for total volumes in excess of the volume available. The rules as to precedence provide that, in theory, the priority licensee may demand his full licensed amount without any diminution in priority to subsequent licensees; subsequent licensees may be deprived of their entire water supply before the prior licensee gives up one drop. There is no provision for any proportional reduction on any basis by any official or tribunal, whatever justice or equity may require. Practice and theory undoubtedly diverge in many cases so that proportional reductions do occur.

An applicant for a licence for irrigation purposes will show how much water he wishes to have and where he will take it from. He does not have to show where the unabsorbed water, if any, will go. Although the Comptroller could require arrangements to be made under his power to impose terms, there is no other requirement. Such a return of unabsorbed water will however materially affect the amount of water available downstream for other licensees.

The Act makes no reference to quality; it is solely concerned with quantity and use. A person has no right to object under the Act if a licensee's actions will reduce the quality only, but not the quantity, of the water available to him. This is not to say the person may not have a remedy at law, but the remedy will be entirely independent of the Water Act.

Until quite recently the only control over pollution in water was the common law right of a property owner to sue in court for damages, any person who damaged his property. Clearly it is very difficult to prove damage from pollution and usually even harder to prove who is responsible for the damage. Public conern has grown even faster than the growth of population, but public concern does not give any legal right to resort to the Courts, only a person who has suffered personal damage can do this.

B.C. POLLUTION CONTROL ACT

The Provincial Government has sought to rectify this unacceptable situation by passing the Pollution Control Act. The Act as it now stands covers air pollution and pollution to land as well as water pollution. The Act of 1968 has been extensively amended and is now far from clear in layout or contents.

Like the Water Act, the Pollution Control Act establishes an organization to administer the Act, under the Director, as well as attempting to define pollution and what is to be done to control it.

Requirements for a Permit

The key to this Act is in Section 5(1) which reads in part, "on from and after the first day of January 1970, no person shall, directly or indirectly, discharge or cause or permit the discharge of sewage or other waste material on, in, or under any land or into any water without a permit or approval from the Director".

There is no definition in the Act of "sewage or other waste material". "Other waste material" may well be interpreted by the Courts to be of the

same general type as sewage and therefore carry a restricted meaning.

Section 5(1a) contains transitional provisions to bring the many existing facilities under control. This section uses the words "effluent, sewage or other waste materials"; effluent is defined to mean "deleterious material flowing in or out of a drain, sewer, outfall, sewage disposal system or works". This definition is an improvement but the adjective "deleterious" is vague and imports some idea of danger or damage.

Under this Section 5 (1a) a person who was, prior to January 1, 1970, now amended to March 1, 1972, discharging effluent sewage or other waste materials must notify the Director and, when ordered by the Director, must apply for a permit. He appears not to be in default until a permit is actually issued, then he must comply with the permit.

Sections 6, 7 and 7(a) make provisions for a permit very similar to those for a licence under the Water Act.

Director's Discretion

The Act is designed to give the Director extremely wide powers to exercise his discretion in any situation and any interference by the Courts is prevented by Section 24. The Courts have made it clear that they will require the Director to consider all the information placed before him and not to make up his mind in advance, but they cannot interfere in the exercise of his discretion.

The nature of pollution is so varied and the standards of what is in fact pollution will vary so widely from place to place and time to time that great flexibility is required. Flexibility in a statute is very difficult to

achieve without providing for some person to have discretion.

Applications

Like the Water Act, the Pollution Control Act contains some provision for public notice of an application for a permit and for the filing of objections. The requirements are much less onerous than in the Water Act, and applications for pollution permits may pass unnoticed more easily. The class of people who can object as of right is very restricted. It includes the holder of a licence under the Water Act "who claims that ... any interest under such ... licence would be affected by the granting of a permit" (Section 13(2)). In view of the apparent lack of any warranty of quality in a Water Licence there is room to doubt how much right a licensee under the Water Act really has to object.

Other persons who do not have the right to object may lodge an objection with the Pollution Control Board and the Board decides whether the Director is to consider such objections. If the Board says so, the Director must treat the objector as if he had the right to object. The Director only has to "consider" the objections, he does not have to act on them.

The Director has authority under the Act to hold public hearings for "the proper determination of any matter" within his jurisdiction. The Comptroller of Water Rights has similar authority under the Water Act. Among the Director's powers are those of determining what constitutes a polluted condition, of prescribing standards of effluent discharge and to conduct tests.

The Act requires any municipality or person, before starting to construct or alter any sewage disposal works, to obtain a permit. This ensures that the Director's hand cannot be forced by finding a partly built system which he wishes to have changed. This is not a new provision as a similar provision has been in the Health Act for some time. It is now in both Acts.

This Act clearly provides some control over sewage disposal, but there is room to question how far it is effective, legally, to control any other kind of water pollution. It very clearly is of no value in preventing pollution from such sources as an excess of fertilizer on farmlands or the pollution of streams by cattle or other livestock. There is in fact a wide exemption for discharges of plant and animal waste emanating from "traditional farming operations".

Act is Permissive

Like the Water Act, this Act gives no power to the Director or anyone else to take the initiative other than a restricted power to order a person to apply for a permit. An applicant for a permit can be ordered to do whatever the Director requires, subject to a right of appeal. The Director cannot order any other person to contribute to the applicant's costs.

A person who fails to apply for or obtain a permit when he should or who does not comply with its terms may be fined. Unless the person is required by Section 5(1) or 5(1)(a) to apply for a permit, the Director is powerless to require him to do anything. Thus a person who takes water from a stream, passes it through a heat exchanger and returns it to the

stream at a higher temperature, but otherwise of the same chemical quality, is apparently not required to apply for a permit under the Pollution Control Act. The warmer water may cause many undesirable or damaging changes in the environment but it is probably not discharging "sewage or other waste materials".

In matters within the Act, the Director has very wide discretion in the standards he permits. Appeals from his decisions lie to the Pollution Control Board. The members of the Board are at present nearly all civil servants although this is not a statutory requirement. Appeals from the Board lie to the Cabinet or to the Courts. The necessity of giving discretion to the Director must inevitably lead to accusations against the Director and the Board of being arbitrary and of being unduly influenced by political, economic or other pressures. It is however difficult to devise any other system which will provide the essential flexibility while providing adequate control.

Other provincial statutes have some connection with water resources, but they are permissive. They authorize some person or organization to carry out specific kinds of work such as construction of dykes or drainage works. Some of these statutes state they are subject to the Water Act; others do not, but in the absence of a clear provision that they override the Water Act, they are still subject to its provisions. None apparently is expressed to override the Water Act.

The Water Act and the Pollution Control Act are provincial Acts and are supreme in their field. However, under the British North American Acts, matters of "Navigation and Shipping" and "Sea Coast and Inland Fisheries" are equally clearly Federal matters.

FEDERAL ACTS - NAVIGATION

In most parts of the world, the right to navigate on water is a common right totally separate from any right to use the water for other purposes. In Canada, where much of the early exploration and development depended on the use of water for navigation, the right to navigate has been equated to the right to use the highways.

If the right to navigate is being exercised by a person, only an act of the Federal parliament can take away the individual's right. If the right is not being exercised, there is only a potential right; no private person can complain at the loss of a potential right, only the Government can do this.

The right to navigate is only the right to use what is there: there is no obligation on anyone, Crown or otherwise, to maintain a waterway in a navigable condition.

The Federal Act in this regard is the Navigable Waters Protection Act. It provides that no one may place wires, pipes, bridges or other obstructions over, in or under a navigable water without permission from the Federal Government. "Navigable waters" are not defined and the situation is unclear, but the Courts have held that any water capable of floating logs commercially is navigable. If the crossing will provide adequate clearance for boats there is no problem. If, however, there will be interruption in navigation such as by a dam on a river where boats in fact do navigate, a permit will not relieve the obstructor of liability for any loss he causes.

The Act also forbids the dumping of sawdust or wood debris in a manner likely to interfere with navigation or the dumping of stone or similar material in navigable waters less than twenty fathoms deep.

FEDERAL ACTS - FISHERIES

Administration

Another important federal statute is the Fisheries Act. This statute applies to all kinds of fish including kokanee and trout. The Federal Fisheries Department*1 has always concerned itself with commercial fish, on the West Coast particularly with salmon. In the 1930's by agreement, which appears to have been undocumented, the Federal Department handed over to the B.C. Provincial Fish and Wildlife Branch the administration of the Federal Act in so far as sport fishing*2 was concerned. This situation still exists and in the Okanagan Basin the Federal Department*1 is concerned with the sockeye run in the southern end of the valley. As long as the Provincial Fish and Wildlife Branch continues to administer the Federal Act in respect of other fish in the Basin, the Federal Fisheries Branch*1 is unlikely to interfere.

Pollution

The Federal Act forbids the placing of any "deleterious substance" where it can get into water frequented by fish. Deleterious substance is extremely widely defined. Regulations can be made under the Fisheries Act or any other federal Act authorizing the placing of such substances in prescribed amounts and under prescribed conditions. This has reference particularly to provisions in the Canada Water Act.

*1 Now Federal Fisheries Service, Department of the Environment

*2 Freshwater sport fishing only.

The Act also enables the Minister to demand plans and specifications of proposed plants which might discharge deleterious substances and even to veto the plant entirely. Persons operating plants must provide information and samples when required.

These provisions are backed up with power to impose fines and imprisonment for violations.

The Act and the Federal jurisdiction are related to fish and only to fish. Federal regulations could not be introduced under this Act which are relevant only to humans or matters not connected with fish. "Deleterious substance" under the Fisheries Act which uses the same adjective as the Provincial Pollution Control Act does not necessarily have the same meaning. Deleterious, as has already been mentioned, connotes "damaging" or "dangerous". In the Fisheries Act it must mean damaging or dangerous to fish life.

As these two Acts are directed to two different ends, they can exist side by side and can both be effective in their own particular sphere.

Obstructions

The Fisheries Act also contains provisions relating to the interference by dams or other obstructions with the free passage of fish. The Minister (now the Minister of the Environment) may order the owner of a dam to construct fishways to his satisfaction. If such steps are impractical, the owner may be required to pay for the construction, operation and maintenance of a fish hatchery establishment to maintain the annual return of migratory fish.

In addition, the Minister can require the owner to release sufficient water for the safety of fish and for the preservation of spawning grounds. Section 48 provides that "the Minister may authorize to be set apart any river or other water for the natural or artificial propagation of fish". Although under Section 71, the Act is made binding on the Crown in right of Canada and of each province and their agencies, Section 48 contains many legal difficulties in any attempt to carry it out unless there is complete agreement. Neither the Minister nor the Federal Government own the water or the bed of the river, nor do they have the right to interfere with a right to navigate. Naturally, by agreement with the province, most things are permissible; without agreement this Section is of doubtful effectiveness. The Federal Fisheries hold a water licence covering almost the whole flow in Big Qualicum River on Vancouver Island, but in that case there was no competition for the water from other interests. Even here the licence permits the Comptroller to issue, at a later date, other licences for consumptive use having priority over the Fisheries Licence.

B.C. Fisheries Act

There is also a Provincial Fisheries Act. This deals mainly with fish processing plants, but a section requires a permit before a dam or similar obstruction is started on any 'fish river'. The Order in Council which defines 'fish rivers' specifically excludes the whole Okanagan Basin above the "S.O.L.P. Dam" (McIntyre Dam). The constitutional validity of this section is doubtful.

INTERNATIONAL PROBLEMS

Certain international aspects of water resource use are within Federal jurisdiction, but not all.

Boundary Waters Treaty

The Okanagan River flows from B.C. into Washington near Osoyoos; it is clearly an international river within the ambit of the International Boundary Waters Treaty of 1909. This Treaty was negotiated by England on behalf of Canada in 1909. Section 132 of the British North America Acts refers the implementation of such Treaties to the Federal Government. Consequently, the Federal statute of 1911 which confirmed such treaty and which contains the following ... "The laws of Canada and of the provinces are hereby amended and altered so as to permit, authorize and sanction the performance of the obligations ..." appears to be valid. The result is to forbid a province acting in a way which is contrary to the Treaty.

The Treaty clearly prevents the U.S.A. from raising the level of the river at the border without the consent of the International Joint Commission and the approval of the governments of Canada and U.S.A. Equally clear is the right of the upstream state, province or country to divert and use any water which naturally flows across the border. There is however, a requirement that injury on the other side of the line "shall give rise to the same rights and entitle the injured parties to the same legal remedies as if such injury took place in the country where such diversion or interference occurs". What "rights" are available in B.C. are not entirely clear, so that any regulation of the Okanagan, which was duly authorized by licence, would be unlikely to give rise to large claims for damage from persons south of the border.

Osoyoos Lake is in a different category from the Okanagan River. It is a "Boundary Water" in that the International Boundary passes across

the middle of the lake. In Boundary Waters the rights of navigation must be maintained free for both parties; nothing must be done to change the levels of a Boundary Water, up or down, without the consent of the International Joint Commission and of the two national governments.

As rather an afterthought, there is added to Article IV of the Treaty "It is further agreed that the waters herein 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". It is difficult to see how this can be effective except in cases of gross pollution where there would probably be a common law right to claim damages in any event.

International Rivers Improvement Act

In 1955 the Federal Government passed the "International Rivers Improvement Act". This Act requires a special licence from the Federal Government before changes can be made in the flow of an international river at the border. However, the Act expressly does not apply to projects for "domestic, sanitary or irrigation purposes or other similar consumptive uses". The Act therefore is unlikely to be significant in respect of the Okanagan Basin, except perhaps for flood control.

The Boundary Waters Treaty is concerned with quantity of water and to a small degree with pollution: it is in no way concerned with fish. The Pacific Salmon Fisheries Convention does not apply to the Columbia River and its tributaries. Nevertheless, while there therefore appears to be no legal obligation on Canada or British Columbia to be in any way concerned with the effects which changes in the Okanagan River may have on migratory fish in the Columbia River, the Federal Department of Fisheries does

take an active interest in the preservation of the salmon run into the Southern Okanagan.

FEDERAL ACTS - CANADA WATER ACT

The Federal Government recently passed "The Canada Water Act". The long title is "An Act to provide for the management of the water resources of Canada including research and the planning and implementation of programs relating to the conservation, development and utilization of water resources". This Act raises serious questions of jurisdiction, but before these are discussed, the contents of the Act will be discussed, as if there were no doubt that it is constitutionally valid.

The Act is in four parts:

Part I - "Comprehensive Water Resource Management"
Part II - "Water Quality Management"
Part III - "Nutrients"
Part IV - "General"

For the whole Act, "water resource management" is defined as meaning "the conservation, development and utilization of water resource and includes, with respect thereto, research, data collection and the maintaining of inventories, planning and the implementation of plans, and the control and regulation of water quantity and quality"; "water quality management" is defined as meaning "any aspect of water resource manage ment that relates to restoring, maintaining or improving the quality of water".

The Act is also expressed to be binding on the Crown in right of Canada or of any province and any agent thereof.

Water Resource Management

Part I of the Act provides for the establishment of joint federal-provincial bodies for planning and for the coordination of policies and programs. This may be on a national, provincial, regional, lake or river basin basis.

It also contains provision for joint bodies to go much beyond planning and coordination, into detailed data collection, detailed planning and the implementation of plans "with respect to any waters where there is a significant national interest".

Section 5 goes much further still and allows the Federal Government to take sole control of such matters in cases including implementation where waters flow from one province to another or in cases of international or boundary waters. This power is limited to cases "where there is a significant national interest" and to cases where efforts to reach a reasonable agreement with a province or provinces have failed.

Water Quality Management

Part II, concerning water quality, contains provisions for joint federal-provincial bodies to be established. These bodies, called water quality management agencies, are to plan, initiate and carry out programs to restore, preserve and enhance the water quality level in specified areas.

There is also a section permitting the Minister to establish such an agency unilaterally where efforts to reach a reasonable agreement with a

province or provinces have failed. A water quality management agency can only be established where the water quality is "a matter of urgent national concern" and furthermore, the compulsion clause can only be invoked in respect of waters which flow out of a province either internationally or to another province or territory.

Where a water quality management area has been established there is provision for permitting certain standards of effluent discharges on payment of fees. These fees are partly intended to contribute to the costs of centralized waste treatment facilities to be established and managed by the agency. The provincial Pollution Control Act contains no such provision.

General

Part III: The sections in this Part permit the control of certain nutrients in cleaning agents or water conditioners to be manufactured in or imported into Canada.

Part IV provides for inspections, offences and public information programs.

JURISDICTIONAL PROBLEMS

Canada Water Act

It was stated at the beginning of this section that water rights come under provincial jurisdiction. Pollution, at least in most cases, is a matter of local concern, and thus also comes under provincial jurisdiction. The Canada Water Act recognizes these points and is careful to deal only with waters which are not exclusively local to a province and also are

"of urgent national concern".

There is no doubt that the Federal Government has an overriding jurisdiction in any matter which is of "urgent national concern". However, the Courts in the past have been very slow to accept situations as being of urgent national concern. It has been held on more than one occasion that, just because two or three provinces are involved, it is not thereby a national concern.

The Okanagan Basin empties over the boundary into U.S.A., it is therefore an interjurisdictional water within the purview of the Canada Water Act. The size of the Basin and the volume of water crossing the border would not seem to be large enough under any reasonable view to make its fate "a matter of urgent national concern".

If this opinion is correct, the Act only authorizes a water management agreement for consultation, advice and coordination. The section providing for actual management programs would not apply, still less the Federal Government's power to act unilaterally. There appears to be no jurisdiction to establish the Okanagan Basin as a water quality management area.

The Provincial Pollution Control Act contains specific authority for the Director to carry out studies and to prescribe standards of waste discharges. The Provincial Water Act contains no specific authority for the Comptroller of Water to carry out studies. The Department of Lands, Forests, and Water Resources Act says that "the Deputy Minister of Water Resources has jurisdiction over ... all matters pertaining to the water resources of the Province". This is certainly wide enough to authorize

planning for water resource management and use in all its aspects, and a branch of this Department is established for this purpose and carries on extensive work in this field. The Federal Government cannot move into an area where the province is validly exercising jurisdiction.

There are some other legal problems or situations which can have an effect on water resource management. There are statutes which could cause conflict, and there are some problems which arise from inherent jurisdiction.

Indian Affairs

One most important problem concerns Indian Reserves. The British North America Acts refer to the Federal Government matters concerning "Indians, and lands reserved for Indians". The grants of land to constitute reserves appear to have retained in the Provincial Crown the rights to water. The Water Act therefore applies to water in reserves to the same extent as outside reserves. The provincial Pollution Control Act does not apply within Indian Reserves. The courts in B.C. have recently ruled that even when Indian Reserve land is legitimately leased out to non-Indians, provincial rules still do not apply, even to the leased lands. There are regulations designed to safeguard the health of Indians on the reserves, but there appears to be none which safeguards the health of others nor are there any which seek to control pollution as such.

Parks

The Provincial Department of Lands, Forests and Water Resources Act provides in Section 4, "The Department of Lands, Forests and Water Resources has charge of the public lands, forests and water rights, and

all matters connected therewith, except those matters connected with parks of which the Department of Recreation and Conservation has charge under the Park Act".

Under Section 4 of the Park Act, the Parks Branch "shall manage and administer all matters concerning parks and recreation areas and particularly (a) the rights, property and interests of Her Majesty the Queen in right of the Province in parks". The Act also provides in Section 18 that "Except as may be authorized by a valid and subsisting park use permit, no person shall ... (d) flood any part of a park, or impound, divert or distribute water in a park".

From this it would appear that the Parks Branch overrides the Comptroller of Water Rights and Water Licences in respect of any water in a park. Administrative procedures have prevented any conflict to date but the Parks Branch cannot prevent the use of the surface of water for navigation or for landing seaplanes; these matters are within Federal jurisdiction. As long as the Federal Government does not directly regulate sport fishing matters, the Provincial Government probably can do so; but once the Federal Government comes in, provincial jurisdiction would be ousted. At present, the province exercises control through the Provincial Fish and Wildlife Branch.

Forestry

Water quantity and quality are heavily dependent on such factors as ground cover in the watersheds, or the use of the land in such areas. Control of these matters lies outside the water resources branch. Logging in a watershed will change the runoff characteristics in the stream; it may cause erosion and silting, it may affect the value of the stream for fish life. Logging or land clearing on privately-owned land can only be controlled with difficulty because an owner can do what he likes with his property. On Crown land, it is controlled by the Forest Service.

The Forest Service is dedicated to obtaining the best use of the timber resources in the province. If there is a conflict between the interests of the Forest Service in obtaining the best return and the Water Resources Service in protecting the water resources, how is the conflict to be resolved? In reality the damage is probably done before either service realizes there is any problem or conflict.

Grazing by cattle on Crown land is under the jurisdiction of the Forest Service. They are concerned with obtaining the maximum sound return in money from the grass resources of the land. Such cattle may foul up a stream used for water supply. Cattle have to drink, so fencing them off from the water may be impractical; in any event who is to pay costs of fencing? There is no machinery to resolve this conflict.

Financial Contributions

One of the biggest problems in water resource management has already been mentioned in reference to the Water Act, but its importance must be emphasized. This arises from the limitation that the Comptrolle can issue no orders except to a licensee or an applicant and although he can issue a licence subject to such terms as he thinks proper, the terms are only binding on the applicant. The applicant either accepts the licence subject to the conditions or he declines to accept and discontinues his application. The whole concept is geared to single purpose developments not to multi-purpose uses.

Examples from other parts of the province illustrate the problem. In 1955 the B.C. Power Commission (as it was then) applied to store and divert water from Upper Campbell and Buttle Lakes for hydro electric purposes. The licence was granted on terms which required the Commission to construct some miles of expensive road into Buttle Lake, to clear the whole reservoir of ground cover, with particularly high standards in Buttle Lake, and to operate the reservoir so that the level of the water was kept up during the tourist season. None of these expensive works was of any value to the Commission and the restriction on water levels can mean a loss of power when it is needed. The people who benefit are tourists. There was and still is no way in which the Commission could collect the costs, or any contribution to the costs, from the persons who benefit from tourists, or from the tourists themselves, nor could the Comptroller order anyone else to contribute to the costs.

There is nothing to prevent a joint application for a licence for different purposes from two or more qualified persons and any agreement between them as to cost or benefit sharing could be incorporated as a term of the licence. But in the absence of such agreement the Comptroller cannot without gravely stretching his jurisdiction compel one. To do so would produce very much of a shotgun wedding.

The laws in force in the U.S.A. permit a project to be authorized for construction if and only if specified contributions are paid by entities such as agencies or counties representing areas or people benefitted by the project. With such authority, multiple purpose projects can be planned and implemented with the costs being shared equitably.

In the same way, the Pollution Control Act contains no realistic method of making persons benefitted contribute to the costs of control. may be that interests in an area will benefit if an unusually high degree control is demanded from a polluter or potential polluter. There is no way that the persons who will benefit can be required to pay or even to contribute to the costs involved in the unusually high degree of control.

Water Licences and Pollution Permits

From a study of the statutes, there is an apparent lack of coordination between the Water Rights and Pollution Control Branches in respect of licences. Both Branches are in the same Department and administrative procedures have been adopted to ensure that, in practice, there is coordination. This coordination is improving.

An applicant under neither Act is required to notify licensees unde the other unless under the Pollution Control Act he is instructed to do so although a licensee under the Water Act has a right to object on an application for a pollution control permit. The Director is required to notify the Comptroller of an application for a permit; the converse is not true.

A holder of a pollution control permit has no right to object to an application for a Water Licence. However, if the Water Licence results in a significant reduction in flow at the point of discharge by the pollution control permittee, the basis on which this latter permit was granted may have gone. If this happens and the Director orders a higher degree of pollution control before discharge, it is very doubtful if the permittee has any redress against the water licensee.

Waterfront Property

There is a totally different type of problem which has an impact on water resource management and use. This concerns the rights of access to water and problems of waterfront property. Here again there are certain fundamental principles of law involved.

Originally, all land in the province belonged to the Crown, and land includes land covered with water. When the Crown sold land to a person a deed was prepared which described the nature of the rights granted and the area over which these rights were effective. A record was kept of these grants and a copy of the document was given to the person to whom the land was granted. As more and more land was divested from the Crown, the Land Registry Office system was introduced. Land presently owned by the Crown is called Vacant Crown Land and where no rights have ever been granted by the Crown there will be no record of such land in any Land Registry Office.

As soon as the Crown makes a grant of land the Crown Grant document is registered in the Land Registry Office and the name of the new owner appears on the records of the Land Registry Office. The Crown Grant still describes the nature of the right granted and the area of the land. This area is always described by reference to a survey plan. Until the Registrar of Titles changes his records, the person shown as owner is considered by the law to be the owner.

An owner cannot give someone else rights which are not his to give; so while he may carve up his land and his interest to any extent permitted by law, he cannot expand his area or his rights beyond whatever he has.

One of the principles in the land tenure system is that the survey plans are correct and no one has or can have any rights which are not described in the records of the Land Registry Office.

The Land Act sets out what rights the Crown may dispose of and to whom. It was amended in 1961 to provide that the Crown cannot have and never has had the right to sell the beds of rivers and lakes. There are certain technical exceptions, but the effect of this amendment has been to make clear that persons cannot own land below the "natural boundary" of any water. The Land Act defines "natural boundary" and it means in effect the normal high water mark.

There is one important exception to this rule: where the original Crown Grant was of a large area and the survey plan did not show by colouration any lake or stream, the bed of any lake or stream within the boundaries of the Grant was part of that Grant and can be conveyed (or retained) by the person on subsequent dealings with the land.

Once the Grant has been made and the plan filed, changes in the land do not alter the rights. If a river changes course, erodes and covers the land, the ownership is not thereby affected. If the lake level is dropped artificially and a strip of land becomes dry land between the new shoreline and the old boundary, the land owner will not acquire any right to that land thereby. However, if land is gradually built up by the action of the water and extends beyond the "natural boundary", the neighbouring owner may be able to claim title to it by legal action. Until he registers a Court Order in the Land Registry Office he does not own this land.

Where the Crown owns the bed of the lake, it is a trespass for anyone to put a mooring in the lake or to anchor a wharf to the bottom without the Crown's consent. Any encroachment on the Crown's land by placing fill or putting any construction without consent is also a trespass.

The Land Act authorizes the Minister to seize any trespassing structure or to order the offender to restore the land to its former state and also to charge a user fee in such amount as he thinks fit. Failure to comply with an order following a trespass is punishable.

A person wishing to make use of Crown Land may apply for a use permit; armed with such a permit, for which a user fee is payable, he ceases to be a trespasser and has sufficient right to prevent other people using his facility, whatever it may be, unless the permit requires him to share it with others.

It does not matter that the trespass has been enjoyed without question for a long period of time. It always was and remains an unlawful use of the Crown's property.

In many cases it will be very difficult, or indeed almost impossible, to trace out on the ground where an old boundary along a river or lake shore runs. This does not affect the legal rights of the owner, only the proving of them.

SECTION III

ADMINISTRATION OF WATER RESOURCES

The B. C. Water Act is administered by the Comptroller of Water Rights who is a senior official in the Water Resources Department. To assist him he has District Engineers and Water Bailiffs with statutory executive authority. He has, of course, in addition, a normal departmental staff.

There is a District Engineer in Kelowna with jurisdiction which includes the Okanagan Basin. Water Bailiffs are appointed each year for the orrigation season as may be required. Normally about ten are appointed, with jurisdiction over those areas where two districts or entities have rights on the same watershed or where for any other reason a provincial officer with adequate powers of enforcement is desirable.

Applications for Water Licences go to the Water Recorder of the area; this is usually the Government Agent. He posts one copy of the application on the official notice board in his office and sends the other copy to the Comptroller. The District Engineer is called on for a report on the quantity of water available to the applicant, and on the engineering aspects of the application. He also investigates and reports on all objections and usually calls on the objector in the process. The Engineer is also called on to check on the exercise of their rights by lecensees and he also investigates complaints of misuse in his district.

Under Section 30, members of the Water Rights Branch as well as Improvement District and municipal personnel employed on water use business have rights of access to land. Under Section 33 additional powers are given to ensure that the Act can be properly administered.

Municipal waterworks departments and improvement districts and other licensees control their operations with their own officials and employees. Such officials and employe es, whatever title they may be given, apart from the powers set out in Sections 30 and 33, do not have any powers other than those given to them by their employer; such powers cannot exceed the powers of the licensee or employer.

Pollution control is a modern concept and therefore the administration of the Act is still relatively young. The Comptroller of Water Rights is concerned with water quantity and engineering safety; neither of these fields is new. The Director of Pollution Control is concerned with matters of a harmful nature to human or other animal life and to the environment in general. Not only is this whole concept of extremely wide scope, but it involves sciences which are often still unsure, particularly with respect to cause and effect.

The administration of the Pollution Control Act is more centralized than that of the Water Act, partly because there are fewer trained persons available for administrative and executive positions. Applications go direct to the Director; he has technical staff in the field who can and do report on technical aspects concerned with applications. Once the permits are issued, the field staff will check on the operations and will take samples of effluent to ensure that the permittee carries out the terms of the permit.

With the control so much centralized to the Director and the shortage of trained staff, compounded by the complicated nature of problems, it is inevitable that there should be complaints about delays in obtaining permits.

A third very important branch in the Department of Water Resources is the Water Investigations Branch. This Branch includes the Water Supply and Investigations, the Groundwater, Hydrology, and the A.R.D.A. and Construction Divisions.*

The Water Supply and Investigations Division as its name implies is concerned in investigating and planning for water supplies for Improvement Districts and others. The Division carries out surveys but also prepares construction specifications for projects and supervises construction. Much of the construction work is carried out in furtherance of the A.R.D.A. program. An inventory has been made of existing and potential water storage reservoirs in certain areas of the province, including the Okanagan Basin.

The Groundwater Division maintains records of operating wells and establishes and records data from test or observation wells. Many such wells have been established in the Okanagan Basin.

The chief task of the Hydrology Division is to forecast runoff conditions in the rivers. The main tool for this forecast is the network of snow sampling stations throughout the province. Each year the Division publishes six issues of the Snow Survey Bulletin, forecasting the total runoff for the following season.

The A.R.D.A. Projects and Construction Division has the object of investigating water project proposals and preparing submissions under the A.R.D.A. program. Once approval is given, this Division is often concerned in the supervision of the construction; much of this work is in the Okanagan Basin.

* Other sections of the Water Investigations Branch not detailed here are the Basin Planning and Power Division, the Projects Division and the Ecology Division.

Federal water resource administration is within the Department of the Environment. This Department has only recently been established and the organization within the Department is still somewhat fluid. At the present time the administration is part of the Water Management Service. Within this service one Directorate is that of Inland Water. This Directorate contains three Branches: Water Quality, Water Resources and Water Planning and Management Branches. The first two are concerned with data collection and research in their particular fields. Quantity surveys have been maintained by the Federal Government for many years; these surveys are now made in cooperation with the Province. Several gauging stations have been established within the Okanagan Basin and will be maintained either by the Federal or Provincial agencies.

Water Quality is a new concept and although work in the Okanagan is being carried on as part of the present studies, there is no firm decision yet whether they will be continued or by whom.

154

The Water Planning and Management Branch is concerned with planning, administration of the Canada Water Act and research in various forms. There are no water management areas or water quality management areas in British Columbia at this time, so that this Branch in B.C. is mainly involved with the Okanagan Basin Study.*1

Federal jurisdiction over fisheries is exercised through the Federal Department of Fisheries. By an old agreement between the Federal and Provincial Governments, the administration in British Columbia concerning fish*2 other than salmon is carried out by the Provincial Fish and Wildlife Branch.

*1 The Water Planning and Management Branch is currently undertaking other planning and research studies on a less comprehensive basis in several river basins in British Columbia, including the Fraser and Columbia.

*2 freshwater fish only.

This Branch has two main functions: policing to ensure that breaches of the Act and regulations do not occur, and investigations and advice as to the probable effects of operations to be licensed under the Water Act or permitted under the Pollution Control Act.

Administration of the licensed water resources by the Improvement Districts cannot be described in detail as the variations are very wide. At one end of the scale is a district like the Vernon Irrigation District. It covers a large area, draws water from several different sources and has the financial resources to provide full time professional management. At the other end are small Improvement Districts which have practically no paid staff and no financial resources. The management will be carried on by the trustees, with a part-time secretary/treasurer, and perhaps one maintenance man/bailiff. The problems and requirements are known to the trustees who are users themselves and the users are also aware of the situation. Such a district manages with toleration, if not with highly efficient management.

Some districts merely pump water from a lake and are therefore concerned only that the pump continues to operate and that the intake remains submerged. Others have a stream system as their supply; these districts are bound by hydrological facts, but have to be concerned with storage, safety of structures and intakes, and forecasting water quantities and requirements.

There can be no set pattern of administration for these widely disparate Districts. Much will depend on the personalities of the trustees and employees.

SECTION IV

POWERS, DUTIES AND RESPONSIBILITIES OF THOSE CONCERNED WITH WATER RESOURCE MANAGEMENT

Powers of Persons

It has already been mentioned that a natural person, i.e. an individual, can do anything of which he is capable unless some law or rule of law prevents him. An artificial person created by or under the authority of the competent parliament or legislature has no such powers. In B.C. there are very few artificial persons created by the Crown, where the strictness of the rule is relaxed, and they can be ignored for the purposes of this study.

In most cases artificial persons in B.C. are created by or under authority of the legislature. In this section the word "individual" refers only to a natural person, the word "person" includes natural and artificial persons, and the word "corporation" means and includes all kinds of artificial persons.

155

Individuals pose no problems. They can do whatever they can persuade the Comptroller of Water Rights or the Director of Pollution Control or other controller to permit, subject to zoning or other relevant bylaws.

Companies

The problems arise from the rule that a corporation can only do those things expressly permitted by the legislation, which incorporates them. A limited company has certain powers given to it by the Companies Act, which can be expended in some directions by the company if it takes

the proper steps to do so. These powers given to a limited company are wide enough to ensure that it is unlikely to be faced with any problem of powers in connection with water resource management or use.

Municipal Corporations

The purpose of a municipal government is to provide, within a defined area, common services to the people in order to make conditions of life better. These governments may cover many situations from a small number of landowners running a communal irrigation system to the management of a large city like Vancouver. These municipal governments are corporations formed under different statutes and with widely differing powers. However, the powers and geographical areas over which they have jurisdiction are strictly defined, either in the incorporating statute or in the document evidencing their incorporation or both.

Such municipal governments are sometimes called "local governments". This name indicates clearly that such governments are matters exclusively within provincial jurisdiction and the Federal Government has no rights to interfere. Nevertheless, Federal agencies are usually not subject to the rules and regulations of such local governments and provincial agencies will not be so subject unless some provincial statute says they are. These exceptions appear to be of small importance in the management of water resources in the Okanagan Basin at this time but can be of some importance in the planning of administrative organizations for the future.

Municipal Act

The prime provincial statute affecting local government is the Municipal Act. This Act provides for several types of municipal corporations; such as City, Town, District, Village, Regional District or Improvement District. Each of these has different powers and duties and is subject to different degrees of control from the government acting through the Minister and Department of Municipal Affairs. Improvement Districts may be incorporated under the Water Act; other Districts may be formed under special acts or under the Drainage, Dyking and Development Act for specific or restricted purposes.

The Municipal Act provides fairly fully for the rights, duties, responsibilities and restrictions of Cities, Towns, Districts and Villages. These rights apply to all such municipal corporations within the boundaries of the municipality. "Instant Villages" may have somewhat smaller rights than other villages for a fixed period, but an Order in Council can grant any further rights or responsibilities which may be deemed desirable.

The Municipal Act, like most of the provincial legislation, is permissive: it sets out what the relevant corporation may do and what steps are to be taken in order to do it. It contains very few things which the corporation must do other than hold regular elections. Even the Minister has very limited powers of requiring the corporation to do anything. The emphasis throughout is on the Council taking the initiative, either on their own or from the prodding of electors.

Under the Health Act, a municipal corporation can be ordered to do certain things to preserve the health of the people, and if the Council fails

or refuses to carry out the orders, the Minister of Health may have the work done and charged to the municipality. Apart from the health aspects, which are admittedly most important, there is no obligation for any municipal corporation to put in a water supply system or a sewage system. The initiative must come from the elected Council.

If the elected Council decides to provide such a system, it will have to comply with the Water Act to obtain a licence unless it relies entirely on wells, or the Pollution Control Act for the sewage disposal project. Section 74 of the Water Act gives any municipality the right to expropriate, subject to paying compensation, any licence and works constructed under the provisions of that Act which are suitable for municipal waterworks purposes.

The real limiting factor is finance. The principles involved in financing are elaborated in a subsequent part of this report. It is sufficient to say here that not only must the approval of the taxpayers be obtained, but in many cases also the approval of the Minister of Municipal Affairs; furthermore, there are statutory limitations on the amount of debt any municipality may incur in total.

There are few legal difficulties in the way of any City, Town or District in managing water resources and pollution within its boundaries if its citizens wish to and there is money available.

A Village has to have every bylaw approved by the Municipal Affairs Department before it is effective. It is also limited in the purposes for which it may borrow money, but these purposes include waterworks and sewage systems. However, the financial limits on borrowing powers may

be more serious for a Village than a larger municipality as a smaller water or sewage system is often relatively more expensive than a larger system.*

A District Municipality is one which covers a large area with a certain minimum population and a low population density. A District is given certain powers to treat areas within its overall boundaries in different ways for levels of services and consequently levels of taxation. It is also granted certain additional powers in respect of drainage and dyking which are not available to other types of municipalities.

Regional Districts

Regional Districts also obtain their powers and duties under the Municipal Act. They are a relatively new level of government. Regional Districts cover large areas which may include several municipalities. The main purpose of Regional Districts was, originally, to carry out land use planning and control. However, the powers which can be granted to a Regional District are now very varied.

It is difficult to generalize about Regional Districts because each one has only the powers and duties specifically granted to it by Letters Patent. These powers and duties therefore vary widely between Districts but no District in the Okanagan Basin has water management powers. A further item of practical confusion arises from the complicated formula laid down for membership on the Regional District Board. Any municipality within the area of the Regional District has weighted representation and voting powers in proportion to its population. Areas outside municipal boundaries are represented by members directly elected by property

* (Smaller systems are more expensive on a per capita basis as there are fewer people to pay for such systems).

owners in these areas. A Regional District can divide up its total area into specified areas for specific purposes such as zoning or fire protection. The representation and voting formula appears to produce a tendency for the Board to be too large to be able to make decisions easily and for members of the Board to take rather a parochial view of problems than a regional view. Again Regional Districts vary widely in this aspect also.

Improvement Districts

Improvement Districts are incorporated under the Water Act. Their original purpose was to facilitate cooperative use of water resources in areas outside municipalities. By degrees the purposes for which they could be incorporated, expanded beyond the use of water to such matters as fire protection or provision of hospitals. They were and are simple organizations very close to grass roots with adequate powers to carry out their specified purposes. However, because they are meant to be simple and run very much on a part-time staff, their powers are very largely subject to the approval of the Comptroller of Water Rights. There is now provision in the Municipal Act whereby any Improvement District incorporated under the Water Act, which does not have among its objects, drainage, dyking, flood control or irrigation, may be transferred from control by the Comptroller of Water Rights under the Water Act to control by the Inspector of Municipalities under the Municipal Act.

An Improvement District incorporated under the Water Act, whose objects include irrigation, automatically on incorporation, takes over all Water Licences for irrigation purposes appurtenant to land within the District; such takeover does not change the procedure of the licences. Similarly, a district with the operation of water works among its purposes

takes over any licences for domestic or water works purposes. In addition, an Improvement District which has provision of water works among its objects may expropriate any Water Licence issued for any purpose and the works constructed thereunder which are required for water works purposes. Such expropriation must be paid for.

An Improvement District raises its revenue for operating purposes and for repayment of its capital borrowings from landowners or water users in the District. The availability of water will increase the value of land and this land value is the basis for all taxation. Although the levies by the District are treated as 'taxes' they may be calculated in different ways such as a flat charge per acre of irrigated land, a flat charge for domestic use or a use charge of so much per volume of water used or a combination. In most cases simplicity in calculation and collection is preferred, so flat rates are charged: this encourages wasteful use. Charges for water consumed encourage economy, but require the installation and reading of meters, which costs money and requires frequent billing and collection charges.

Water Users' Community

The simplest form of organization under the Water Act is the Water Users' Community. Such a community is a corporation, but it has rather the characteristics of a partnership. It is formed by the Comptroller from six or more licensees. Upon incorporation, the licences are pooled and voting power among the members is proportional to the quantity of water licensed to the members.

The powers of assessment and collecting contributions are not extensive, and there is no power to treat assessments or dues as taxes.

The members must appoint a manager to run the affairs of the community, but his powers in matters of finance are closely supervised by the Comptroller.

Drainage Districts

Like Improvement Districts, drainage districts were established as simple but effective corporations for purposes of flood control or drainage. The corporation was established by Order in Council, after that it became almost completely autonomous for its defined purposes; it appears not to be a municipality within the definition of the Municipal Act and is therefore not required to obtain any consent before exercising its extensive borrowing powers. The power to incorporate drainage districts in the old Act has been repealed. Drainage districts are now incorporated as improvement districts, with power to undertake drainage, under the Water Act.

Jurisdiction

The powers of these various municipal corporations to carry out water resource management or use are adequate, but there is one qualification. This qualification is of greater importance in connection with water resource management than in other fields of municipal concern. This arises from problems of jurisdiction.

The powers of a municipal corporation are closely confined to the geographical boundaries of the municipality unless there is some special provision by statute or in the incorporation documents extending powers outside these boundaries.

An Improvement District under the Water Act appears to have no power to provide any service whatever outside its boundaries, although

it can go outside its boundaries to obtain water.

A municipal corporation under the Municipal Act is fundamentally in the same position. However the Act itself authorizes a municipality to make agreements with adjoining municipalities to provide services outside its boundaries for certain specified purposes which include provision of water supplies or sewage systems. Where the extension is into an area which is not within any municipality, approval by Order in Council is required. It must be remembered that a Regional District is not a municipality.

Apart therefore from Improvement Districts under the Water Act, there appears to be little difficulty for local government entities providing water and sewer services outside their boundaries provided there is approval by the electors and the government.

Planning

A major part of water resource management is in planning and in scheduling developments. Any municipality has the power, and indeed some responsibility to plan for the future. However, this planning is restricted to the future of the municipality in a self-centred way.

It was this inadequate planning function which was in large part responsible for the introduction of Regional Districts. A Regional District while planning for its own area automatically embraces a much wider geographical area than any city, village or other municipality. Planning without any powers of enforcement tends to become an exercise in frustration so that the powers of many Regional Districts have been increased to provide some controlling functions. There are however many gaps and inconsistencies in these planning functions.

Planning requires the expenditure of much time and money in the acquisition of data before any planning can be done. Money and time have both been in short supply. Many developers find that planning restrictions interfere with their ability to make the profit they desire. The pressures have therefore been and undoubtedly still are most hostile to adequate and effective planning.

Furthermore, a plan by any municipality is essentially passive or even negative. It does not create anything other than an atmosphere. It depends entirely on others taking an initiative, and then, provided there are teeth in the regulations and a willingness to use them, it only ensures that the initiative is not contrary to the plans.

Yet again these planning bodies and municipalities run headlong into problems of jurisdiction. If there is agreement, the plans of differing levels of municipality or between neighbouring Regional Districts can be coordinated. If there is no agreement, there is no one with authority to compel coordination.

These jurisdictional problems go much further than this as soon as large areas become involved. No corporation can control the Provincial Government or its agencies unless there is some specific statutory power to that effect. The allocation of water resources is under the control of the Comptroller of Water Rights; other natural resources such as forests, minerals or lands are similarly under the control of Provincial Government officials. These officials cannot be compelled to have regard to any plans or wishes of any municipality.

The same situation exists with the Federal Government. In matters within its jurisdiction, the Federal Government can ignore provincial legislation. In the result, Indian Reserves or defence establishments are not subject to provincial, let alone municipal control. The situation works in the reverse direction too; a municipality can ignore the wishes of a Federal department or agency in respect of any matter under provincial jurisdiction.

Land Use

Water resource management, particularly in a water-short area, is inextricably bound up with land use. Land use in turn is involved with land ownership. The control or lack of control over subdividing land is therefore of prime importance.

Subdivision is governed by the Land Registry Act and this Act puts the onus of approving subdivisions on "Approving Officers". For land within a municipality, the approving officer is an official of the municipality and he is permitted to refuse approval if the proposed subdivision does not comply with bylaws. These bylaws may require that a sewage collection system be installed where the municipality already has such a system. By an amendment in 1972 there may be a bylaw requiring the subdivider to install a community water supply system or to connect it with an existing system or requiring that each parcel in the subdivision have a proven source of potable groundwater.

If the land is not within a municipality, the approving officer is an employee of the Department of Highways. He may refuse to approve if the proposal is contrary to a Regional District bylaw, but is not bound to

do so. For land in an irrigation district, the approving officer must notify the district that the plan has been tendered for approval. He has no obligation to wait for comments or to act on any comments he may receive. The only grounds for refusing approval other than breach of bylaw, which the approving officer can consider, are road access, no "adequate drainage installations", or public interest in a very narrow sense.

In conclusion therefore, it appears that the powers of the different levels of local government entities are adequate on a narrow and parochial view of their responsibilities. There is no adequate machinery to resolve jurisdictional problems between different levels of government or between different entities at the same level. There are areas which are not adequately covered at all.

SECTION V

FINANCIAL POWERS AND CONSTRAINTS IN WATER RESOURCE MANAGEMENT

Developing the use of water resources and providing for pollution controls cost money. In both cases there are the capital costs in providing the facilities and the operating and maintenance costs in providing the service.

Commercial Borrowing

An individual or a company has the right to borrow any amounts it can persuade lenders to provide and the terms of borrowing are subject to negotiation. If the individual or company is providing a monopolistic service such as power or water supplies, the Public Utilities Commission will control, at least to some extent, the borrowing because the Commission will limit the charge made to the users.

Pollution control not only costs money but there is seldom any return value to the polluter from such outlay. There is therefore considerable pressure on the part of a polluter or possible polluter to cut corners in the control measures. There is no source at present for assistance in the capital costs of pollution control facilities for commercial or industrial persons. There is a form of assistance under the Federal Income Tax Act whereby the costs can be written off, as a depreciation allowance at an accelerated rate. This allowance, as provided at present, is only available in respect of equipment purchased before 1974, and for plant or operations started before 1973.

The operational and maintenance costs are simply a business expense and are therefore fully chargeable against income for tax purposes.

Municipal Borrowing

In contrast to this comparative freedom, any local government corporation is severely restricted in its borrowing powers and in its sources of income. Under the British North America Acts a province (and therefore any creation of a province) is restricted to raising money by "direct taxation". The province has restricted the powers of local government corporations, with exceptions which are not material to this study, to a percentage tax on the value of land and improvements and to direct charges for specific services.

In addition to these methods, local government corporations are permitted to borrow money, subject to very strict controls from the Provincial Government and to mandatory approvals by the voters in the local government area concerned. The monies borrowed have to be repaid eventually out of tax revenue or from the sale of services furnished with the borrowed money.

The borrowing powers of a corporation under the Municipal Act are restricted to a percentage of the assessed values of properties within the municipality. Exceptions are made for self-liquidating debts such as those for utility services, but otherwise the limit applies to the total indebtedness for all purposes. This limitation is a greater restriction on rural areas with low property assessments than on urban centres, but the limit is in fact a lower percentage for villages than for cities.

A further restriction which is becoming of great importance is that any borrowing, other than short term, must be approved by the voters. The money must be repaid eventually out of the taxes and the voters are not easily persuaded to increase their own tax burdens.

An Improvement District under the Water Act appears at first glance to be in a more fortunate position. There is no limitation in the Act to the amount which can be borrowed, nor is voter approval required before borrowing can occur. All that is required is a bylaw passed by the trustees. However, no bylaw is effective until approved and registered by the Comptroller. Furthermore in an Improvement District, the trustees are much more susceptible to the comments and opinions of the taxpayers. An Improvement District has access to government guarantees under the Improvement Districts Assistance Loans Act.

Regional Districts are not municipalities and they only have the functions granted by Order in Council or Letters Patent. They have no inherent power to borrow capital funds for any other purpose and the limitations in respect of each function are set out in the Order in Council or Letters Patent.

Special Borrowing Powers

In the past, each municipality had to borrow money on its own; the result was often a high effective interest rate. In 1970 the legislature passed the Municipal Finance Authority of British Columbia Act. This sets up a central authority to borrow money for water, sewer, and pollution control and abatement facilities for Regional Districts and their

member municipalities. This Act does not affect the powers or limitations on borrowing but it provides cheaper money for these purposes to Regional Districts. These centralized borrowings can be guaranteed by the province and because the Authority itself is expressed to be a municipality, the bonds rank as municipal bonds for trustee and similar purposes.

There are additional reliefs available for sewage disposal projects. The Provincial "Municipal Treatment Plant Assistance Act" provides that the province will contribute to a municipality 75% of the annual cost over a 2 mil tax levy for the costs of the treatment plant and some of the trunk intake system. The Minister of Finance determines what part of the total system qualifies.

The Central Housing and Mortgage Corporation, under the National Housing Act provides financial assistance for sewage disposal schemes and under some circumstances makes a grant by way of forgiveness of up to 25% of the amount borrowed. These loans are only available to municipalities as defined in the National Housing Act; this is interpreted to include a Regional District in British Columbia. The provisions for forgiveness of 25% is only available up to 31 March, 1975.

There are no apparent ways of assisting in the establishment of water schemes except for the Municipal Financing Authority. Water however, normally is or can be sold to the users. Water services thus become at least to some extent, self-liquidating and therefore, more easily financed and less subject to the statutory debt limitations.

Borrowing for Planning

For planning functions in a municipality, the financing must come out of tax revenue. There is therefore no incentive to undertake large scale planning. A Regional District will probably have a ceiling on the amount it can spend on planning; the ceiling is based on a mil rate against the assessed values.

Planning under these circumstances is likely to be confined to zoning regulations or to influencing developers to comply with the Council's wishes.

Under the latest amendments to the Municipal Act, a municipality can pass a bylaw which requires a subdivider to install a water system or guarantee that each lot has adequate potable groundwater. If there is a municipal sewage system, a subdivider can be forced to install a connecting system for the subdivision. These provisions throw the costs onto the developer and through him onto the purchasers of the lots; this in turn will increase the assessed value of the lands. Improvement districts have for a long time had the power to pass subdivision bylaws with similar requirements, and many have exercised these powers.

There is no way in which the Comptroller of Water Rights or the Director of Pollution Control can make anyone other than an applicant for a licence or permit pay any costs. This situation either imposes an unfair burden on the licensee or permittee or will, inevitably, result in lower standards than could be required if the persons benefitting directly could be made to contribute to the costs.

The same situation affects fish protection systems. The Federal

Fisheries Act provides for a possible contribution by the Federal Government for the provision of fish ladders or fishways. There is no provision for a contribution from any source to offset the loss caused by releasing water for preservation of spawning grounds or assisting fish.

Restrictions on borrowing and elector resistance to higher taxes undoubtedly hinders constructive planning of water resources at the municipal and lower level. Reliance has to be placed on the negative approach of restrictive zoning and opposition to applications for Water Licences and pollution control permits.

An improvement district is not subject to statutory limits on borrowing or to statutory requirements as to the consent of landowners. Administrative by the Comptroller of Water Rights, whose approval is always required, has placed adequate restraint on undesirable, uneconomic or unpopular projects.

SECTION VI

PROBLEMS APPEARING IN THE OKANAGAN BASIN

The public participation program will undoubtedly reveal many problems which concern local government corporations at all levels, and individuals.

However, without waiting for further comments from this program, certain of these local problems are known. These problems are varied and it is difficult to put them into meaningful categories; they are set out as affecting water resource use, pollution control or general and planning, but in some cases the problem overlaps into other categories.

These problems may seem picayune to some; to others they are not. The description of them does not attempt to show the opposite side, and so they may indicate callousness or inefficiency, but there is little doubt that there is a reason for them. In fact, most of them do not concern water resource management as such, but the impact of other aspects of life on water resource use or management. They spring in the main from insufficient communication, and the fact that they are not more in number and in severity indicates that communication between various levels of authority is well established. Where so much is left to discretion at some level, personalities are of equal importance as rules.

164

Water Use

Licensees taking water from a stream have no control over the watershed. Events in the watershed can affect both quantity and quality of the water. Cattle grazing under lease on Crown land may foul the water

and may necessitate additional chlorination equipment. Logging practices may affect the runoff characteristics in the river affecting the adequacy and perhaps even the safety of storage or diversion structures. Some logging practices may permit erosion from the faster runoff and this can cause turbidity in the water; this in turn can affect the degree of chlorination required.

Grazing leases and forestry practices are under the control of the Provincial Government Forest Service. There are no regulations or requirements that the Forest Service has to consult with water users, let alone carry out any requests. Members of the Forest Service are required from the nature of their service to concentrate on logging or grazing practices to obtain the best long term return from the forests or grazing resources. There is little direct communication between this service and water users. Recently, administrative procedures have been introduced to ensure a better exchange of information on water users and water uses.

The maintenance or development of fish resources may require water users to divert water for fish purposes which would otherwise be used for irrigation or domestic purposes. An irrigation district or municipal water supply system is organized to provide water to its users. It is supported entirely by the users who naturally expect to receive adequate water at the lowest cost. Diverting water for fish purposes may run the system short of water at critical periods, or may necessitate costly extensions to the system to augment the supply of water.

The Provincial Fisheries Act does not give the fish interests any power to demand water from licensees. The Federal Fisheries Act clearly does so, but the Federal Department of Fisheries has not yet attempted to enforce its rights although it has made requests for water diverted from

the Shuswap and has voiced complaints about the lack of water. In some parts of the province it has persuaded licensees to release water for fishery purposes, whether this 'persuasion' was accompanied by threats of a big stick is not known. The Act does contain some provisions for financial contribution from the Federal Government towards the cost of fishways, but none for the provision of water. The Provincial Fish and Wildlife Branch cannot enforce any demand for water except in the name of the Federal Minister of the Environment. This is the situation with the older licences; licences issued in recent years usually contain a provision whereby the Licensee can be required by the Comptroller to provide water for fish life.

Some of the irrigation districts suffer from lack of resources. In the past much of the work required for maintaining the systems could be done by the users with equipment available in slack periods. With the advent of pressure spraying, more sophistacated equipment is needed and maintenance is required on a year round basis. This increases the need for a cash income; this need has been severely aggravated by the increased cost of everything. The projects undertaken by A.R.D.A. have provided much more efficient systems but they have raised the annual costs significantly. Some districts appear to be unable to operate efficiently without placing an unacceptable burden on their members.

There is no control over groundwater. This appears to be more of a concern for the future than a present problem. There is little or no information on groundwater reserves. There seems to be a fear that groundwater reserves may be reduced or damaged before any control on their use is instituted.

Pollution Control

There is no adequate coordination between pollution control and water

use. An irrigation district complains that a water intake is in danger of pollution from a municipal sewage lagoon. Assuming that this is correct, the Health Department cannot take action until there is a proven danger of pollution. This Department can then order the irrigation district to stop using its intake. However, the source of the trouble is the municipal sewage lagoon which is properly licensed. How was this situation permitted to arise and who should pay the costs of rectifying the conflict?

Pollution from an Indian Reserve may contaminate a recreational area outside the Reserve. The Reserve supports various establishments owned and managed by non-Indians. Even where the establishments are on valid leases, the local municipality has no control outside its boundaries, nor can the Provincial Government interfere, except perhaps to close the recreational area outside the Reserve as being unsafe from the health point of view. There appears to be no health hazard on the Reserve itself, so the Federal Health Authorities cannot intervene effectively.

Federal Government installations do not comply with local bylaws. One installation is alleged to have installed a sewage disposal system which would not be approved under provincial rules because of the high water table. There is no way of compelling the Federal Government to conform to local standards.

There is severe pollution emanating from Indian Reserves along lakeshores. The Indians have in many cases made agreements with non-Indians under which non-Indians erect and use summer beach homes on Indian Reserves. These agreements are not made in accordance with the Indian Act and are therefore illegal. However, these agreements bring in very substantial sums of money each year into the Reserves; it is not

practical to forbid such agreements or remove the homes. But, if the Department tries to control these homes and their sewage disposal arrangements, it is immediately recognizing these illegal agreements.

The Pollution Control Act in its latest regulations exempts from the Act completely "all discharges of plant and animal wastes emanating from traditional farming operations ...". Some feed lots place the midden over a stream which obviously results in gross pollution of the water. Is this a "traditional farming operation"? Is it to get rid of the exreta, which is not protected, or is it to facilitate the spread of manure on the land - which is protected?

This exemption, in its vague generality, makes any control of pollution from farming operations extremely difficult, yet farming operations appear to contribute significantly to the nutrient volumes in water.

Pollution problems are not necessarily considered in approving or disapproving of subdivisions. If a municipality has a bylaw regulating subdivisions and requiring minimum percolation standards, the approving officer can refuse to approve a subdivision which does not comply. If there is no such bylaw, the approving officer apparently has no power to refuse approval on such grounds.

A Regional District is not a municipality and has no power to approve or disapprove subdivision plans; this is done by the Highways Department. The approving officer "may" refuse to approve if the plans do not comply with a Regional District bylaw, but he does not have to disapprove.

Municipalities and Regional Districts are not recognized objectors to pollution control permits.

For air pollution, a municipality which is "immediately adjacent" has the right to object. For other types of pollution permits, no municipality is recognized. A municipality can always apply to the Pollution Control Board to be recognized, but it is considered that they should be entitled to object as of right. A right to object is not the same as a right to veto.

Planning and General

There is no real control over subdivision and land use. The approving officer outside a municipality must notify an irrigation district that he has received a subdivision plan for approval covering land in the district. He does not have to wait for comments, still less to act on them. The district can pass bylaws controlling the size of lot or area they will serve with water, but this is apart from subdivision control. There is no way the approving officer or the district can control the use to which the land is put. The Regional District can control the use through zoning bylaws, but not otherwise. Land use has a very great influence on demands for water and on production of possible pollutants.

Irrigation districts are not represented on Regional District Boards. An irrigation district is not a municipality so the only way it can have representation is to have one of its representatives elected as the Director for its area. This lack of representation hinders adequate exchanges of views and information.

Regional Districts cannot object to applications for Water Licences or pollution permits. Even when they are permitted to object, their opinions do not carry much weight. In any event their views are negative

because they have no power to undertake projects.

The Okanagan Basin Water Board has representation from Regional Districts only and has no authority. It can do planning and can make comments, but it cannot enforce any wish. It cannot even compel one of its constituent Regional Districts to do anything, let alone a municipality in the area. It performs an excellent function of exchanging information, opinions and ideas among its Regional Districts and the other representatives who attend as observers.

The Technical Planning Committees of the Regional Districts provide an excellent forum for exchanging ideas between various government departments and the Regional District staff. It is unfortunate that the Pollution Control Branch is not directly represented but relies on the Water Rights Branch for its representation.

The single purpose nature of the Water Act and Pollution Control Act and others may make proper investigations difficult. The distillery at Winfield takes water from Okanagan Lake and discharges it into Wood Lake. The volume of water has changed the flow characteristics of Wood and Kalamalka Lakes and Vernon Creek. It was not the responsibility of any one particular official to investigate all the side effects of this change, even if the possibility had been fully appreciated when the applications were being processed.

Changes in the aquatic environment are matters over which the Water Comptroller is primarily responsible; they are not necessarily the concern of the Director of Pollution Control as "pollution" need not be involved. Although notices of Water Licence applications usually reach the Federal Department of Fisheries, there is no statutory requirement to this effect, nor do they have to go to the Director of Pollution Control.

There is no one responsible for sounding an alarm.

The A.R.D.A. program was designed to assist agriculture, and districts receiving assistance have had to agree to try to maintain agricultural acreage, with requirements for repayment of funds if land is taken out of agriculture and subdivided. Other programs such as the Regional Incentives Programs equally encourage the transfer of lands from agriculture to industry. They appear to cause a conflict of interest.

It thus appears that there is some conflict in the legislation covering water resource management arising from the conflicting jurisdictions under the constitution; this conflict is between water use and the interests of navigation and fish. Similarly in pollution matters, the safety of fish is under Federal jurisdiction, while all other aspects are under Provincial jurisdiction. It is now recognized that water is a fundamental factor in the economic development of the region. There are many apparent conflicts in those areas of impact between water resource management and economic and regional planning. These conflicts can be greatly mitigated by an adequate exchange of information between all interests and all levels of government.

SCHEDULE I

RELEVANT CANADIAN STATUTES

AGRICULTURE AND RURAL DEVELOPMENT ACT

RSC 1970 Ch. A-4

This is a general Act authorizing joint projects between Canada and provinces.

Section 3: authorizes the Minister, with the approval of the Governor in Council entering into agreement with the provinces for joint undertakings or for contributions to projects for development of rural lands.

Section 4: is similar to Section 3 but is in respect to projects to develop rural income and employment opportunities.

Section 5: covers "soil and water conservation projects".

Canada is authorized to enter into agreements with a province to provide:

(a) "the undertaking jointly with the government of:

(i) projects for the development and conservation of water supplies for agricultural or other rural purposes";

(b) the payment to the province of contribution in respect of the costs of such projects.

The Minister may, directly or in cooperation with the government of a province or any agency thereof, undertake programs of research and investigation for the development and conservation of water supplies.

Section 6: specifies certain terms of any agreement, but the relative proportion of costs is not specified in the Act.

THE CANADA WATER ACT

SC 1969-70 C. 52

The purposes of this Act are set out in a preamble to the Act, a somewhat unusual form at the present time. It is intended to provide greater knowledge of the water resources of Canada, to provide for pollution control, and to cooperate with provincial governments. The Act itself, after the definition section is divided into four parts each with a title.

Part 1 (Sec. 3-7) - Comprehensive Water Resource Management

Section 3: permits the Minister with Cabinet approval to make arrangements with one or more provincial governments to establish intergovernmental agencies to maintain consultation, give advice or facilitate coordination and implementation of policies.

Section 4: permits the Minister with Cabinet approval to enter into more executive arrangements 'with respect to any waters where there is a significant national interest in the water resource management thereof'.

These arrangements may include the provision of programs to obtain data, to conduct research, to formulate comprehensive management plans, to design projects and to implement any plans.

It also provides for establishing joint boards to direct such programs.

Section 5: provides similar powers to Section 4, in respect of waters under purely Federal jurisdiction, those which "significantly affect the quantity or quality of waters outside" one province, or 'international waters'

which flow in either direction across the international boundary.

In this case the power is in the Minister to act directly, without joint action with a province but only when the Cabinet is satisfied that the Minister has tried to reach agreement with a provincial government and has failed.

Section 6: authorizes the Minister to conduct or provide for the conduct of any research work for water resource management purposes.

Section 7: sets out administrative and cost sharing matters which are to be in any agreement with a province.

Part II - Water Quality Management (Sec. 8-16)

Section 8: contains a very qualified prohibition on depositing waste in any waters in a "water quality management area". The qualifications include permits to discharge wastes and to pay permit fees for this purpose.

Section 9: is confined to waters exclusively under Federal jurisdiction or to waters whose quality management "has become a matter of urgent national concern".

In these cases the Minister may make agreements with provincial governments to designate a water quality management area, to provide management programs and to incorporate an entity to act as Manager or to use an existing government agency for this purpose.

Section 10: sets out matters to be covered by any agreement under Section 9.

Section 11: is restricted to waters which significantly affect waters outside a province and of which the water quality management "has become a matter of urgent national concern". It is further restricted to those cases where agreement with a province has not been possible or the Minister and a province have failed to agree on a plan presented by the managing agency of a water quality management area.

In these cases the Minister, with Cabinet approval, can undertake all the tasks unilaterally.

The Minister's rights are similar in respect of waters under Federal jurisdiction.

Section 12: sets out the powers and responsibilities of a Federal agency.

Section 13: contains the objects of a Water Quality Management Agency. These are to obtain data and to plan for ensuring water quality standards are maintained or improved. Such plans, after advertisement and approval by the appropriate Ministers, may be executed by the agency.

Sections 14 and 15: provide for the employment of staff and financial control.

Section 16: allows for regulations to be made by Order in Council with a list of items which can be covered.

Part III - Nutrients (Sec. 17-22)

These sections limit manufacture or import of cleaning agents or water conditioners with too high a level of nutrients.

Section 19: permits regulations to be made to specify what are nutrients and what are permissible levels.

Sections 20 and 21: permit seizure of any cleaning agents or water conditioners suspected of being in contravention of Section 18 and provide for its subsequent handling.

Part IV - General (Sec. 23 - 40)

These sections cover the powers of inspectors, for the establishment of advisory committees and public information programs, and offences.

FISHERIES ACT

RSC 1970 Ch. F-14 as amended

This Act governs matters relating to the protection of fish.

The first several sections contain matters relating to specific types of fishing.

Section 20: is headed 'Construction of Fishways' and contains ten subsections.

The section requires the owner or occupier of any 'slide, dam or other obstruction across or in any stream' to construct, maintain and operate a fishpass when required to do so by the Minister.

There is a provision that where spawning beds are to be destroyed or fishpasses are impractical, the owner must pay the Minister the costs of establishing and operating fish hatcheries.

Under Subsection 4, the Minister is authorized to pay half the costs of fishpasses. Once such passes have been built and approved, the Government pays the costs of any changes. Any unused obstruction may be ordered removed and may be removed by the Minister at the expense of the owner.

In addition, adequate water may be required to pass over the obstruction to permit descending fish to do so, and adequate water may be required to be released below the obstruction to protect spawning grounds. There is no provision for paying for such water.

Section 28: applies to certain provinces only, of which B.C. is one. It requires any person taking water from a lake or river for most purposes to provide a fish guard to prevent fish entering the intake whenever the Minister requires it.

Section 33: has been recently extended by the addition of Sections 33.1 to 33.4:

33(2) provides "Subject to Subsection 4 no person shall deposit or permit the deposit of a deleterious substance of any type in water frequented by fish or in any place under 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".

33(3) forbids logging slash or similar debris to be put into water frequented by fish or in water which flows into such water.

33(4) permits regulations to be made under any other Act (specifically the Canada Water Act is here relevant) or this Act defining types and quantities and conditions when deleterious substances may be placed in water.

33(5) to 33(12) define deleterious substances and make breaches of this Section criminal offences.

Section 33.1(1): The Minister may require a person who proposes to construct any works which may result in a deleterious substance entering water frequented by fish, to provide him with copies of plans and specifications.

Section 33.1(2): After review the Minister may, with Cabinet approval, require modifications or forbid the work altogether.

Section 33.1(3): A person operating a plant which the Minister suspects is causing the deposit of any deleterious substance must on request provide the Minister with information and samples.

Section 33.2: permits the Minister to appoint inspectors and gives such inspectors power of entry.

Sections 33.3 and 33.4: forbid interference with an inspector and provide penalties for failing to provide plans and information when required or to act in contravention of the Minister's approval or orders.

Section 34: permits regulations to be passed by Order in Council covering many matters including:

(h) respecting the obstruction and pollution of any waters frequented by fish,

(i) respecting the conservation and protection of spawning grounds.

Section 48: authorizes the Minister to set apart "any river or other water for the natural or artificial propagation of fish".

Section 52: makes it an offence to fail to provide or operate fish-passes when called on to do so.

Section 53: repeats some parts of Section 20 with regard to cost in respect of a fish hatchery.

Section 71: makes the Act binding on the Crown Federal, the Crown Provincial and all agencies of either.

INTERNATIONAL BOUNDARY WATERS TREATY ACT

RSC 1970 Ch. I-20

The Treaty confirmed by this Act was made in 1909 between England, acting on behalf of Canada, and the United States of America. Because of this situation the Act and the Treaty override other provincial rights under the British North America Acts.

The Okanagan River flows from Canada into the United States and is therefore within the provisions of the Treaty confirmed by this Act.

No uses, obstructions or diversions may be constructed in Canada which would affect the natural level or flow of water in the United States without the consent of Canada and of the International Joint Commission established under the Treaty.

Under Article II any use or diversion of water in a river flowing across the international boundary which causes damage or injury gives the injured party the same rights as he would have in the location where the use or diversion is situated.

As an apparent afterthought in Article IV, the Treaty provides that water flowing across the boundary "shall not be polluted on either side to the injury of health or property on the other".

There is no provision for enforcing this no-pollution provision, no remedy is provided for an injured party and there is no definition of what constitutes "injury of health or property". The result is that the Treaty has little effective bearing on pollution.

INTERNATIONAL RIVER IMPROVEMENTS ACT

RSC 1970 Ch. I-22

This Act imposes Federal control on International River Improvements in addition to any controls imposed by the provinces. The definition of such an improvement requires it to "increase, decrease or alter the natural flow of the international river and to interfere with, alter or affect the actual or potential use of the international river outside Canada".

Under Section 4: No person may construct, operate or maintain such an improvement without a licence.

Section 7: exempts from the Act an improvement "(c) constructed, operated or maintained solely for domestic, sanitary or irrigation purposes or other similar consumptive uses".

MUNICIPAL IMPROVEMENTS ASSISTANCE ACT

RSC 1970 Ch. M-16

Section 3: This Act authorizes Federal loans to almost any level of municipal government to assist in the construction of self-liquidating works including a waterworks system and "other municipal project".

Section 3(2): sets out conditions for such loans including assistance in relief of unemployment, approval of the Provincial Government for the loan, and a provincial guarantee of payments.

Section 4: Interest is at 2%.

Section 5: Municipal debentures must be given to the Federal Government.

Section 6: Total amount authorized under the Act is $30 million.

Section 8: Order in Council may provide a terminal date for loans.

NATIONAL HOUSING ACT

RSC 1970 Ch. N-10

Part VIII is headed "loans for Municipal Sewage Treatment Projects".

Section 51: authorizes loans to a province, or a municipality for the purpose of constructing or expanding sewage treatment projects. The loan is up to 2/3 of the cost of the project (which is limited to the main trunk line and treatment plant, excluding laterals), for up to 50 years, repayable on terms agreed between the borrower and C.M.H.C.

Section 52: If the project is completed prior to 31st March 1975, C.M.H.C. may forgive 25% of the principal and 25% of interest during construction.

If the project is not completed prior to 31st March 1975, C.M.H.C. may forgive 25% of capital then advanced and 25% of the interest then accrued.

NAVIGABLE WATERS PROTECTION ACT

RSC 1970 Ch. N-19

The purpose of this Act is to prevent obstructions to navigable waters. The Act does not define navigable waters although such waters are expressed to include 'a canal and any other body of water created or altered as a result of the construction of any work'. The expression is 'navigable waters' - which can be navigated, not 'waters which are used for navigation'.

The Act therefore covers almost any water which can be used by boats - even canoes - or could be used to float logs. It is doubtful if rapids which only carry the canoes of 'white water sport' enthusiasts would be included.

Part I (Sec. 3 to 11 inclusive) governs the placing of bridges, booms, piers, pipes or wires over, under or in navigable waters. A permit is required before such work is undertaken.

Section 5(2): provides a general exemption for a work except for a bridge, boom, dam or causeway "that in the opinion of the Minister does not interfere substantially with navigation".

A permit is merely permissive and binds the Federal Government, it does not authorize the interference without compensation in established rights of navigation.

Part II deals with wrecks, but Section 19 forbids any person dumping sawdust, slabs and similar material which is liable to interfere with navigation in any navigable water or any stream flowing into navigable water.

Section 20: forbids any person dumping any stone or material likely to sink in any navigable water where there is not at least twenty fathoms of water at all times. These sections are clearly aimed at interference with navigation and not at pollution.

Part III provides for regulations covering cable ferries.

SCHEDULE II

RELEVANT B.C. STATUTES

AGRICULTURAL REHABILITATION AND DEVELOPMENT (BRITISH COLUMBIA) ACT

SBC 1962 Ch. 2 as amended

This Act is a general authority for the Minister of Agriculture, with the consent of the Lieutenant-Governor in Council, to enter into and carry out agreements with the Federal Minister of Agriculture under the Federal Agriculture and Rehabilitation and Development Act (A.R.D.A.).

Agreements are limited to:

(a) projects for the alternative uses of land

(b) rural development projects

(c) soil- and water-conservation projects.

The Province will match advances from the Federal Government.

Amendments in 1969 allow the Province to make agreements with "any corporation" to assist in the carrying out of any agreement.

If there is an agreement with a corporation, the Improvement District Rehabilitation and Development Act does not apply. (This Act is designed to prevent speculation in land benefitted by A.R.D.A. programs.)

CANADA - B.C. JOINT DEVELOPMENT ACT

RSBC 1960 Ch. 40 as amended

This Act gives a standing authority, with the consent of the Lieutenant-Governor in Council to any Minister by himself or with any Improvement District, Municipality, B.C. Dyking Authority or Greater Vancouver Sewage & Drainage District to make an agreement with a Federal Minister or authority:

> "respecting water and land development, highway construction or improvement, flood control ... and other matters in the Province and to implement such agreements"

There is power to acquire lands, etc. to carry out the project and to operate any works.

DITCHES AND WATERCOURSES ACT

RSBC 1960 Ch. 117 as amended

This Act provides a summary method for a landowner to be able to drain his lands by constructing ditches over the lands of others. The word 'watercourses' applies only to watercourses for taking water away from land for drainage; it has no application to bringing water to lands.

Where lands affected by a proposed watercourse are within a municipality (other than a local district municipality) the Clerk has administrative functions and the municipality becomes bound just like any other landowner in respect of its own lands and roads.

A 1962 amendment restricts the effect of the Act on a municipality to one designated by Order in Council for a specified scheme extending into unorganized territory.

177

This amendment can be construed to mean either a municipality cannot be bound unless the ditch extends into unorganized territory or if the ditch extends into unorganized territory, a municipality is only bound by Order in Council. It apparently has not been used in the Okanagan Basin.

The Act does not apply to ditches costing over $3,000 unless approved by Order in Council on the recommendation of the Minister of Lands, Forests & Water Resources.

The Act provides for apportionment of costs, both capital and maintenance, among persons benefitted. The decision is by the Engineer

(therein defined) subject to appeal to a County Court Judge.

The purpose is to provide a summary and economical method of procedure among landowners.

DRAINAGE, DYKING AND DEVELOPMENT ACT

RSBC 1960 Ch. 121

The Act is designed to permit the establishment of Districts to plan, construct and operate drainage or dyking works.

A District is established by Order in Council, and is run by Commissioners, appointed initially by Order in Council, but subsequently elected by the landowners.

The purpose is to establish the powers and responsibilities required to provide flood protection or to drain land or to reclaim land.

The Act authorizes the expropriation of land and the preparation of plans. The District can enforce the decisions of the majority in value of landowners on the minority.

178

Costs are considered as taxes and there is provision for Courts of Revision and sale of land for non-payment of taxes. The costs of protective works are charged to the lands benefitted by the works, in proportion to the benefits. The "Engineer" who must be a civil engineer approved by the Minister of Lands, Forests and Water Resources, is primarily responsible for establishing costs and benefits, areas to be benefitted and also the plans for the works.

ECOLOGICAL RESERVES ACT

SBC 1971 Ch. 16

This Act provides for the establishment of ecological reserves over Crown lands. In so far as the beds of lakes and rivers are retained by the Crown, such reserves could apparently be established on lakes or streams.

Once an ecological reserve has been established by Order in Council, the area is withdrawn from any disposition of any right under different statutes including the Water Act and the Water Resources Act. (The Water Resources Act has not in fact yet been passed.)

A reserve can be cancelled as easily as it is established by Order in Council.

There is power to make regulations:

(a) respecting the control, restriction, or prohibition of any kind of use, development, or occupation of the land or of any of the natural resources in an ecological reserve;

(b) respecting the control, restriction, or prohibition of the exercise of any power granted by any other Act or regulation by a Minister, Department of the Government, or agent of the Crown specified in the regulation;

(c) respecting the control, restriction, or prohibition of the dumping, deposit, or emission within an ecological reserve of any substance; and

(d) respecting, generally, any other matter or thing necessary or incidental to the protection of an ecological reserve.

This power to regulate appears to be derogatory from the wide prohibition in other parts of the Act. Regulations will apparently permit actions which would otherwise be banned.

ENVIRONMENT AND LAND USE ACT

SBC 1971 Ch. 17

This Act authorizes the establishment of an Environment and Land Use Committee.

The size is unspecified but its membership is limited to Cabinet Ministers.

It is required to:

(a) establish and recommend programs designed to foster increased public concern and awareness of the environment;

(b) ensure that all the aspects of preservation and maintenance of the natural environment are fully considered in the administration of land use and resource development commensurate with a maximum beneficial land use, and minimize and prevent waste of such resources, and despoliation of the environment occasioned thereby;

(c) if considered advisable, make recommendation to the Lieutenant-Governor in Council respecting any matter relating to the environment and the development and use of land and other natural resources;

(d) inquire into and study any matter pertaining to the environment, or land use; and

(e) prepare reports, and, if advisable, make recommendations for submission to the Lieutenant-Governor in Council.

It is advisory to the Cabinet, but Orders in Council can be issued to give effect to its recommendations. The Committee, being composed of busy Cabinet Ministers, is unlikely to have time to deal in specifics.

FISHERIES ACT

RSBC 1960 Ch. 150 as amended

Most of this Act deals with the licensing of fishermen and fish processing plants.

Part IV however, which consists only of one long section, is designed to supplement the Federal Fisheries Act in respect of any "dam or other hydraulic project that will use, divert, obstruct, impound or change the natural flow or course of any river or stream or otherwise utilize any of the water of the Province.

Before construction begins a permit must be obtained from the Minister of Recreation and Conservation and he must be satisfied as to the adequacy of "fishpasses, fish ladders, fishways or other fish-protective devices".

This part of the Act applies to such rivers as may be designated by Order in Council.

Order in Council No. 1663 of 1954 exempts from the restrictions of this Act "the Okanagan River above the S.O.L.P. Dam".

There is room to argue that Part IV of the Act is unconstitutional as an invasion of the Federal jurisdiction over Fisheries.

HEALTH ACT

RSBC 1960 Ch. 170 as amended

The Act is a general one covering the provision and control of health services in the Province.

Sections 21 to 28 inclusive provide for control by the Minister of sewage disposal schemes.

Prior approval is required for construction and maintenance of a sewage disposal scheme and this is required before a municipality may put a borrowing bylaw to the electors.

The general powers of the Minister are exercised through Local or Union Boards of Health, but only the Minister can approve a sewage disposal scheme.

LAND ACT

SBC 1970 Ch. 17 as amended

This statute covers the rules and procedures for obtaining rights to Crown land.

The definition of Crown land includes the words "whether or not any waters flow over or cover the same".

Section 14 provides that, except by Order in Council, no Crown land, filled or otherwise, lying below the natural boundary of a body of water shall be disposed of by Crown Grant under this Act.

Sections 52 and 53 provide in effect that the Crown never has granted lands below the 'Natural Boundary' (which is defined) of any lake or stream, unless the Grant or plan attached thereto makes specific provision to include such lands in the Grant.

The Definition of Natural Boundary in Section 2 reads "Natural Boundary" means the visible highwater mark of any lake, river, stream or other body of water where the presence and action of the water are so common and usual, and so long continued in all ordinary years, as to mark upon the soil of the bed of the lake, river, stream, or other body of water a character distinct from that of the banks thereof, in respect to vegetation, as well as in respect to the nature of the soil itself.

Procedures are set up to permit an escape from this restriction in some closely defined situations. Exclusions from this restriction will, in general, depend on whether in the original plan, the lake or stream is shown as coloured in some colour other than red.

LOCAL SERVICES ACT

RSBC 1960 Ch. 224 as amended

This Act is to provide for the establishment of unorganized territory into local areas for certain specific purposes.

Two purposes may be relevant:

The preparation of community plans, and the provision of real or personal property for pleasure, recreation or community uses of the public.

In effect the Minister of Municipal Affairs runs the area and his expenses are charged as taxes to the property owners in the area.

The value of this Act has been very much reduced by the widespread use of Regional Districts under the Municipal Act.

MUNICIPAL ACT

RSBC 1960 Ch. 255 as amended

This statute is a very large complicated document setting out the responsibilities, powers, duties and restrictions of municipal organizations in some 878 sections.

Section 19: classifies different types of municipalities into which areas may be incorporated:

(a) cities with a population in excess of 5,000

(b) towns with a population between 2,500 and 5,000

(c) villages under 2,500

(d) District where the area is over 2,000 acres and the population density is under 2 per acre.

Once incorporation has occurred, a change in status is not automatic on a change of population.

For the purposes of this study the powers and duties of a City and Town are similar:

> A District has the powers and duties of a Town but has certain additional ones also.
>
> A Village has smaller powers and duties than a Town, and in general requires the approval of the Minister of Municipal Affairs to most of its bylaws.

A Regional District or an Improvement District are excluded from the definition of "municipality" and therefore have only those powers and

duties specifically granted in those Sections of the Act which refers to them, or which are specifically given by Letters Patent.

Section 248: permits borrowing for capital purposes including for waterworks and sewerage projects. This permission is carefully hedged with approvals.

Part XIII of the Act deals with public works. Division 3, starting with Section 517, concerns "Wharves and Waterways". The whole of the Division is, by Section 517, made "subject to the applicable provisions of the Water Act".

Section 519: authorizes a bylaw to:

(a) prohibit any person from fouling, obstructing, or impeding the flow of any stream, creek, waterway, watercourse, waterworks, ditch, drain, or sewer, whether or not the same are situate on private property, and may provide for the imposition of penalties for any contravention of such regulations;

(b) require the owners of dykes to maintain them according to standards prescribed in the bylaw;

(c) make any watercourse, whether upon highways or upon municipal or privately owned land, into part of the drainage system of the municipality;

(d) construct works through, under, or over any land adjoining any highway for the protection of such highway from damage by water, subject, however, to Division (4) of Part XII.

Section 520: allows a Council to purchase, construct and use:

(a) works for, and do work for, maintaining the proper flow of water in any stream as defined by the Water Act, ditch, drain, or sewer in the municipality;

(b) dykes;

(c) works for the reclamation of any portion of the land mass of the municipality or for the protection of any portion of the land mass of the municipality from erosion by action of the sea, a lake, or stream as defined by the Water Act, or any other cause.

Section 521: authorizes a Council to define the confines of a stream and to protect the banks of such stream.

Sections 522 - 526: provide authority and procedure for a Council to plan for drainage and water control in a municipality and in a surrounding area. With the approval of the Lieutenant-Governor in Council, works may be constructed.

Sections 527 - 530: give a district municipality additional powers to drain highways. The Sections provide freedom from legal action for the results.

Section 530 "A to K": grant district municipalities additional powers to construct ditches. This is on the application of landowners or on Council's initiative.

The costs of construction and maintenance are divided among owners benefitted, including Council; the costs are collected as taxes.

Section 531: Councils are authorized to construct and operate sewage collection and disposal systems. These systems may extend to outside areas including neighbouring municipalities.

Section 549: Council may make agreements with others for river works to provide flood protection.

Sections 551 - 572 inclusive: Cover utilities.

Sections 551 - 558: A municipality has authority to regulate utilities operated by others including water supply.

Section 559: authorizes a municipality to provide its own municipal services, including water.

Section 560 (2) and (3): These subsections allow a municipality to expropriate utility waterworks. This includes land and as a Water Licence is annexed to land, the Licence could be expropriated also. (This is additional to a provision in Section 74 of the Water Act.)

Section 566: prevents the extension of an irrigation water system to additional land to the disadvantage of established users.

Section 567: includes the power to provide drainage for irrigation works.

Section 568: allows a municipal utility rate to supercede a previous company rate when the municipality takes over the utility system.

Section 581: is in Part XVI "Local Improvements". It defines a local improvement as including a water or sewer system.

Section 581 (2): prevents a village from treating water or sewer systems as local improvements.

Section 623: authorizes a Council to acquire land for park purposes. This includes Crown land (Crown land includes land covered with water).

Sections 695 and 696: permits the preparation of Community Plans which is defined as meaning:

> "an expression of policy for (a) any use or uses of land, including surfaces of water; or (b) the pattern of the subdivision of land".

Part XXIV - Special Areas

Sections 765 - 798 FA: contain the powers and duties of Regional Districts.

Section 766: restricts the functions of Regional Districts to those contained in Orders in Council establishing the Regional District or amending its functions.

Section 770: provides for weighted voting on a Regional Board by appointees of municipalities within the Region. These votes are based on the size of the populations to prevent the inhabitants of thinly populated areas imposing their wishes on the inhabitants of municipalities.

Section 793: provides that an Improvement District wholly or partly within a Regional District may be dissolved by Order in Council.

Section 795: requires a Regional District to prepare a Regional Plan (in contrast to a Community Plan which is a permissive thing, not a requirement).

Section 798B: requires a Regional District to establish a Technical Planning Committee which consists of representatives of government.

Sections 798 G-J: These sections provide for the transfer of control of Improvement Districts from the Comptroller of Water Rights to the Inspector of Municipalities under the Municipal Act. This cannot be done when dyking, drainage, flood control or irrigation are among the objects for which the District was established.

(This is in contrast to Section 793 where the Improvement District is dissolved and the assets transferred to a Regional District.)

Section 866: permits a Council to acquire and use a seaplane harbour and a marina for small boats, whether within or without the boundaries of the municipality.

MUNICIPAL AND IMPROVEMENT DISTRICT REHABILITATION AND DEVELOPMENT ACT

RSBC Ch. 201 as amended

This Act is intended to prevent speculation in lands in areas rehabilitated with government funds.

It is applicable to those municipalities and Improvement Districts granted assistance under the Canada - B.C. Joint Development Act and the Agricultural Rehabilitation and Development Act.

A diminishing charge is assessed on an acreage basis on all land within the area rehabilitated. This charge is collectible only on a transfer of the ownership of the land or at the end of a fixed period of years.

The Land Registry Office is forbidden to register any transfer of or a charge against such lands without proper approvals.

MUNICIPAL FINANCE AUTHORITY OF BRITISH COLUMBIA

SBC 1970 Ch. 30 as amended

This Act establishes an Authority to borrow money for water, sewer and pollution control facilities for Regional Districts and municipalities.

There is provision for a municipality to opt out, but this was a once and for all election, the time for which expired in July 1970. Certain Districts are excluded, but none with which this study is concerned.

The Authority comprises representatives of Regional Districts and the Authority reviews outstanding requests for financing and authorizes the issue and sale of debentures for this purpose.

The actual work is carried on by seven trustees.

The money raised and made available is repaid from the tax revenue of the Regional Districts concerned. Repayment is fixed by the Authority and the Collector of Taxes.

The Authority itself is defined as a municipality. This permits the Province to guarantee its bonds under the Municipalities Assistance Act and also qualifies its bonds as Municipal Bonds on the bond market. Projects financed from this source are eligible for Federal assistance.

MUNICIPAL TREATMENT PLANT ASSISTANCE ACT

SBC 1969 Ch. 25 as amended

This Act provides assistance to a municipality which has borrowed money for a 'treatment plant' as therein defined.

The repayment must be amortized over not less than 20 years. The Government then contributes 75 percent of the cost of amount by which the annual cost exceeds a 2 mil levy on all taxable land and improvements.

The treatment plant is limited to the land and equipment actually used for treatment of sewage to control and prevent pollution including that part of the intake system "necessary to consolidate the movement of effluent to an approved plant as opposed to discharge at an agreed and available natural outfall, as determined by the Minister".

The Minister in this case is the Minister of Finance.

MUNICIPALITIES ENABLING AND VALIDATING ACT

RSBC 1960 Ch. 261

This Act was passed partly to remove anomalies created by the repeal of the old Municipal Act in 1957 and the enactment of the new one. It has Sections dealing with different municipalities in the Province.

Only the following are relevant to this study:

Section 59: The City of Penticton is to have all the powers of a district municipality under Division 2 of Part XVI of the Municipal Act (Sections 616 - 619A) for the purpose of supplying sewerage and sewage disposal services.

This power allows the City to treat different areas in different ways and to charge different tax rates between areas.

Section 62: The Township of Spallumcheen is authorized to collect and disburse revenues and keep the books for any Improvement District under the Water Act or any district under the Drainage, Dyking and Development Act and have ancillary rights.

Section 63: The District of Summerland is authorized to undertake irrigation works for special areas and to charge the costs partly to the special areas and partly to the District as a whole. Certain specified approvals of electors are required.

MUNICIPALITIES ASSISTANCE ACT

RSBC 1960 Ch. 260

This Act merely authorizes the Government to guarantee Municipal Bonds with the Provincial Guarantee.

As the Municipal Finance Authority has been created a Municipality, this Act allows the Provincial Guarantee to be given to the Authority's bonds.

OKANAGAN FLOOD CONTROL ACT

SBC 1949 Ch. 47 as amended

This statute authorizes the Province, with or without agreement with Canada or municipalities to carry out flood protection measures in the Okanagan or to obtain agreement from the Federal Government for the payment of part of the costs.

The rest of the Act provides for borrowing money for the purposes of the Act. These borrowing provisions have been rendered inoperative by the Loan Authorization Cancellation Act.

Works are constructed and operated by the Minister of Lands, Forests and Water Resources.

POLLUTION CONTROL ACT

SBC 1967 Ch. 34 as amended

This Act is to provide machinery for the control of pollution; it governs not only water pollution, but also air, and to some extent, ground pollution. The form of the Act, owing to extensive amendments is somewhat involved and the powers and duties of the officials are described in somewhat sweeping terms.

Section 2: contains definitions: 'effluent' means deleterious material flowing in or out of a drain, etc.; 'deleterious' is a descriptive adjective without definition; 'municipality' includes Regional District, Improvement District, dyking, sewerage and drainage districts. This is important with respect to sewage systems and to objections to air pollution.

'Pollution' means ... "the introduction into a body of water, or storing upon, in or under land or discharging or emitting into the air such substances or contaminants of such character as to substantially alter or impair the usefulness of the land, water, or air".

'Waters' includes groundwater.

Section 3: establishes the Pollution Control Board. Its members are appointed by and hold office at the pleasure of the Cabinet. The Cabinet may order the Board to hold inquiries and to take remedial action or to report back.

Section 4: sets out the powers and duties of the Board; these in summary are:

(a) to determine what is pollution;

(b) to prescribe standards for effluent discharge;

(c) to appoint advisory or technical committees.

Section 5: is a key section for pollution other than air pollution.

After 1 January, 1970 "no person shall discharge sewage or other waste materials on, in, or under any land or into any water without a permit from the Director".

"Other waste materials" is not defined and under rules of construction could well be limited to waste materials similar to sewage.

When an application for a permit is made the Director has an exceedingly wide discretion in handling the application from an outright refusal, through amendment to granting it as requested; included is the power to demand security.

189

Copies of applications for a permit in this regard are sent by the Director to the Comptroller of Water Rights, Deputy Minister of Agriculture, Deputy Minister of Health and Deputy Minister of Recreation and Conservation.

These persons have thirty days, or longer, to file recommendations with the Director who must consider the recommendations but does not have to act on them.

Section 5 A: covers air pollution.

Section 5 B: makes the Pollution Control Act and regulations or permits thereunder take precedence over any other Act, municipal bylaw, etc. Bylaws may be more severe than permits or regulations.

Section 6: contains a limited right to amend a permit. These rights to amend go further than the equivalent rights to amend a licence under the Water Act.

Section 7: permits the issue of a final permit in place of a provisional permit.

Section 7 (a): allows for suspension of a permit at any time by the Director, but permits cancellation of a permit only in certain defined circumstances which involve fault on the part of the holder or statutory termination of the holder's title to the land or works.

Section 8: authorizes classification of operations and the exemption by the Board, with approval of the Lieutenant-Governor in Council, of any class or classes. Regulations have exempted domestic sewage discharge from single or double-unit dwelling and all domestic sewage of less than 5,000 gallons per day, other than into a surface water course or body of water. "Traditional Farming Operations" are excluded from the Act.

Section 9: makes the Director and staff civil servants.

Section 10: The Director has all the powers necessary for carrying out the intent of this Act and has power:

(a) to determine what qualities and properties of water, land, or air shall constitute a polluted condition;

(b) to prescribe standards regarding the quality and character of the effluent, other waste materials, or contaminant which may be discharged or emitted into water, land, or air;

(c) to conduct tests and surveys to determine the extent of pollution of water, land, or air;

(d) to examine into all existing or proposed means for the disposal of sewage, waste materials, or contaminants, and to approve the plans and specifications for such works as are deemed necessary to prevent pollution of water, land, or air;

(e) to notify all persons who discharge effluent or waste, or emit contaminant into water, land, or air when the effluent, waste, or contaminant fails to meet the prescribed standards;

(f) to order any person to increase the degree of treatment of the effluent, waste, or contaminant or to alter the manner or point of discharge of the effluent or waste or emission of contaminant being discharged or emitted by that person on and from a date specified in the order;

(g) to order any person who fails to comply with an order issued under Clause (f) to cease discharging effluent or waste into any water or on, in, or under any land or emitting any contaminant into air, on and from a date specified in the order;

(h) to determine his own procedure; and

(i) to exercise any of the powers or duties conferred or imposed upon an engineer under this Act or the regulations.

Section 11: gives powers to an engineer appointed under the Act.

Section 12: provides for appeals from the engineer to Director to

Board. From the Board the appellant has a choice of going to the Cabinet or to the Supreme Court of B.C. This alternative choice appears to be without precedent.

Section 13: covers objections: the manner and timing of objections is covered by regulations.

The class of persons granted a right to object is severely limited. It covers the landowner or an applicant for or holder of a permit or licence under the Act or the Water Act who claims that the land or interest under the permit or licence would be affected.

The Director has complete discretion whether to hold a hearing or not; but if he decides to hold one, the applicant and objectors must be notified.

Persons other than those authorized to object, may do so, but their objection goes to the Board, not to the Director; and the Board decides whether the Director should hear them. The Board's decision is final.

Section 14: At any time the Board or Director may hold a public or other inquiry.

Section 15: The Board, Director, engineers or other officers have right of access to property at all times.

Sections 15A to 18: are administrative only.

Section 18A: The Canada-British Columbia Joint Development Act extends to agreements for prevention or amelioration of pollution.

Section 19: Regulations and fees may be established by the Lieutenant-Governor in Council.

Section 20: exempts from civil liability the Board, Director, any engineer or other person in carrying out the Act in good faith.

Section 20A: provides for penalties for contraventions of the Act or interfering with works.

Section 21: This Section is reprinted from the Health Act and requires a municipality to obtain permits before constructing sewage works or even passing a money bylaw for such works. The equivalent Section has not been repealed in the Health Act so two permits are required.

Section 24: ousts the jurisdiction of the Courts to interfere with any decisions of the Board or Director or others.

Section 25: The Act binds the Crown and agents of the Crown, but not perhaps B.C. Hydro.

PUBLIC UTILITIES ACT

RSBC 1960 Ch. 323 as amended

This statute is intended to control, in the public interest, the provision of services which are likely to be monopolistic, such as water supply. A Public Utilities Commission is set up to approve all plans to construct, operate, extend or close down a public utility and to approve the rates charged to the public for the services offered.

Section 2: defines a public utility to include:

(5) the diverting, developing, pumping, impounding, distributing, or furnishing of water to or for five or more persons or any corporation for compensation.

The Section further excludes a municipal system within its own boundaries; an Improvement District or a Water Users' Community under the Water Act; or a Regional District where it provides water in bulk to a member municipality or to consumers in a municipality which is participating in such service.

Section 3: exempts from control under the Act an industrial corporation which uses water for its own purposes and incidentally provides water to others, provided it is not in competition with a public utility which is capable and willing to supply the service and if it does not utilize more than fifteen percent of the water pumped by it for services to the public.

Section 5: imposes an obligation to maintain equipment adequately.

Section 6: requires a public utility, on reasonable notice, to furnish suitable service without discrimination or delay to all persons reasonably entitled.

Section 7: Once a public utility has been granted a Certificate of public convenience and necessity or has started to provide service, it cannot cease without permission.

Section 8: requires rates to be fair, reasonable and uniform. The Commission is the sole judge of what is fair and reasonable.

Section 9: A public utility must comply with the orders of the Commission.

Sections 10 and 11: A public utility must furnish all information required by the Commission and must keep its records and accounts within the Province.

92

Section 12: This Section forbids a public utility to obtain any franchise from a municipality until the Commission has approved. A hearing must be held.

Furthermore, no one may begin construction or operation of a public utility system until a "Certificate of public convenience and necessity has been granted".

Section 13: relaxes the constraints in Section 12 for extensions of an existing system.

Section 14: sets out the procedure for applying for a Certificate.

Section 15: The Commission, after a hearing, may cancel or suspend a Certificate where service is not provided.

Sections 16 to 21 inclusive: concern rates. The Commission approves the rates to be charged; they must be open to inspection and must be used. An "unduly preferential or discriminatory contract may be cancelled by the Commission".

Sections 22 to 26: give the Commission some control over the borrowings and capital transactions of a public utility.

The balance of the Act (to Section 133) contains the administrative provisions setting up the Commission and detailing its procedures and so on.

There are provisions which permit the Commission to settle disputes between a public utility and a municipality over the use of streets and such like.

Information supplied to the Commission is not to be divulged except on the order of the Commission.

Rates and Certificates are not valid until approved by Order in Council.

REGIONAL PARKS ACT

SBC 1965 Ch. 43 as amended

The purpose of this Act is to permit Regional Districts to combine into a regional Park District for the purpose of establishing parks. It sets out the powers and restrictions on such a park district. As the definition of lands includes water, such a district could establish a marine park.

RIVER BANK PROTECTION ACT

RSBC 1960 Ch. 342 as amended

This Act provides a procedure whereby landowners may apply for Government assistance in river bank work to protect their properties.

The initiative must come from landowners who must show they are a majority in interest and that public interest is involved.

The Lieutenant-Governor in Council may then have plans and specifications and a cost estimate prepared. An assessment roll of benefitted lands is also required. This is all done by the Chief Engineer or another Engineer specially appointed by the Minister of Highways.

There is provision for appeals from assessments to a County Court Judge.

The work is carried out as Highway work and is paid for out of Government funds. The final costs are then assessed against the landowners in accordance with the assessment rolls and these costs are registered in the Land Registry Office as a charge. The actual collection is done by the Collector of Taxes.

SOLDIERS LAND ACT

RSBC 1960 Ch. 366 as amended

This Act permits the Government to acquire or to set aside lands for the purpose of settling ex-servicemen and their widows.

It also provides that the Southern Okanagan Lands Project could take over any Improvement District adjacent to its boundaries.

The Government can pay the costs of installing, renewing or repairing any works in any Improvement District operated by the project, but the costs are to be charged to the lands within the District.

The scheme is to be managed by the Minister of Lands, Forests and Water Resources. He is empowered to levy water rates and tolls and such rates and tolls must be sufficient to pay for irrigation and domestic water.

194

In 1964 the Act was widened to permit persons other than ex-servicemen and their widows to acquire lands and by an amendment in 1971 the Minister is authorized to dispose of all lands and undertakings of the project.

VILLAGE MUNICIPALITIES ASSISTANCE ACT

RSBC 1960 Ch. 401

The Act provides for a village to obtain a Provincial Guarantee on bonds issued for water or sewer purposes or for hospital purposes.

The need for this Act, in so far as water and sewer purposes, is now doubtful in view of the Municipal Financing Authority Act.

WATER ACT

RSBC 1960 Ch. 405 as amended

This is the prime statute dealing with the use of water in the Province. The Act is divided in reality into three parts. The first part (Sec. 3 - 27) covers the obtaining and exercise of rights to the use of water; the second part (Sec. 28 - 52) covers the administration and enforcement of the Act; the third section (Sec. 53 - 88) covers the establishment of communal organizations for the use of water and Improvement Districts or Water Users Communities.

Section 3: contains the fundamental principle in water use in the Province. "The property in and the right to the use and flow of all the water at any time in any stream in the Province are for all purposes vested in the Crown in right of the Province, except only in so far as private rights therein have been established under licences issued or approvals given under this or some former Act. No right to divert or use water may be acquired by prescription".

"Stream" is defined to include "any natural watercourse or source of water supply, whether usually containing water or not, groundwater, and any lake, river, creek, spring, ravine, swamp and gulch".

Section 4: excludes groundwater from the controls of the Act until a date to be fixed by Order in Council. No such Order has yet been made.

Section 5: permits a holder of a licence to use water in accordance with the terms of his licence but (in Subsection 2) always subject to the provisions of the Act and regulations, the terms of the licence, the orders

of the Comptroller and the Engineer and 'the rights of licensees whose rights have precedence'.

Section 6: specifies who may apply for a licence such as landowners, a municipality, a person having charge of government property.

Section 7: permits the Comptroller to authorize diversion and use without a licence for certain specified purposes.

Section 8: requires an applicant to use the procedure set out in the regulations and to pay the fees. In Subsection 2 the Comptroller is required to notify the Deputy Ministers of Agriculture and Recreation and Conservation of all applications for licences.

Section 9: permits objections by licensees, applicants for licences or riparian owners. The Comptroller has absolute discretion whether to hold a public hearing or not.

Section 10: provides how the Comptroller may treat an application. The possibilities go from acceptance or rejection to making it subject to "such terms as the Comptroller considers proper". This is an extremely wide discretionary power.

Section 11: provides for final licences in place of conditional licences, when the conditions - usually referring to construction - have been fulfilled.

Section 12: is another vital section providing for precedence strictly in order of the date set out in the licence. Only if two licences have the same date of precedence does the use enter into priority.

Section 13: makes a licence which is appurtenant to land, mine or undertaking pass automatically with a transfer of the land, mine or undertaking.

Section 15: gives the Comptroller a restricted power to amend a licence.

Section 16: provides for the transfer of a licence with the consent of the Comptroller.

Section 17: provides for apportionment of the rights and obligations of a licence among various landowners on subdivision.

Section 18: imposes strict liability on a licensee for any damage he causes, but also permits him to remove dangerous trees, rocks, etc.

Section 19: requires a licensee to keep such records as the Comptroller may require.

196

Section 20: sets out the grounds for cancelling a licence; they all entail failure or fault on the part of the licensee or by statutory termination of the licensee's rights to the land or mine where the water is used.

Section 21: permits a licensee to abandon the whole or part of his licence.

Section 23: permits the Minister to issue to a licensee a "permit to flood" Crown lands.

Sections 24, 25 and 27: give a licensee the right to expropriate lands which may be required to obtain the benefit of his licence. The procedure is set out in the regulations.

Sections 29 to 52: provide for the administration of the Act by the Comptroller of Water Rights, engineers and others. They have the power to enter property and to take all steps necessary to ensure that licensees comply with the terms of their licences and the Act; penalties are provided for disobedience.

An appeal lies from any order to the next senior official up to the Cabinet. An appeal lies direct to the Court of Appeal from an order cancelling a licence.

Section 45: permits a reservation of any 'unrecorded' (unlicensed) water for the purposes of allowing investigations to proceed. This forbids any application for a licence being received.

Sections 46 and 47: permit the establishment of fees for use and of regulations by Order in Council.

The other Sections in this part limit legal actions in respect of water matters and require claims against Improvement Districts for water matters to go to arbitration instead of to Court.

Sections 53 to 75: provide for the establishment of Improvement Districts. Such Districts become corporations and are established by Letters Patent. The purposes of the District and its areas are set out in the Letters Patent.

The affairs of the District are managed by trustees who are elected, normally for three years. The trustees can appoint officers and officials as necessary, subject always to being answerable to the landowners for the costs and wisdom of their decisions.

Section 59: specifies that the trustees may carry out certain things by bylaw - such as making other than routine short term contracts, borrowing money, levying taxes and other important matters.

Section 60: provides that bylaws are not valid until accepted by and registered with the Comptroller.

Other matters are handled by the trustees by resolution.

Sections 62 to 67: provide machinery for assessing, imposing and collecting taxes by the District. They are basically similar to those for any municipality: the provincial taxation department is required to carry out much of the routine work.

Section 72: transfers to an Improvement District the rights under any licence which is held by anyone for irrigation of any lands in the District or for domestic purposes in the District. The precedence of these licences ceases to be operative and the District has complete control over the distribution of all water available under the licences. The rights revive to the original licensees if the District is dissolved.

Section 73: relieves a District of any obligation to service any person or property in the District, but a person refused service may appeal to the Comptroller.

Section 74: authorizes a District or any municipality to expropriate any licence and all works and real property used in connection therewith, where the licence is required for waterworks purposes. Compensation is payable in accordance with the provisions of the Municipal Act.

Section 75: authorizes a District to expropriate interests in land for its purposes. Compensation is payable, with the amount settled by arbitration under the regulations.

Sections 76 to 86: provide for Water Users Communities.

Such a community is established by the Comptroller who issues a Certificate of Incorporation, to any group of six or more licensees.

Such a community is a corporation and is controlled by the majority vote of the community. All licences are pooled and the water distributed to the members.

The community appoints a manager; the manager has the duty of preparing assessment rolls for paying the debts of the community. The assessment roll must be sent to the Comptroller and any member may appeal to the Comptroller. The debts in effect become a charge on the land and each member is liable for his share only while he owns the land.

Section 87: makes provision for a holder of a licence for river improvement purposes to collect tolls from persons who float timber in the river. The toll is fixed by any two of the Comptroller, Chief Forester and Superintendent of Lands. It is an offence to float timber without paying the toll so fixed.

Section 88: requires an Improvement District to set aside funds for renewal of the works and to raise taxes or tolls for this purpose as directed by the Comptroller. Such funds may not be used for any other purpose.

OKANAGAN FLOOD CONTROL

The Okanagan Flood Control project has its origins in a report dated 1946 by the Joint Board of Engineers, Okanagan Flood Control. This report was submitted to the Federal and Provincial Governments. The report recommended certain works be undertaken between the outlet of Okanagan Lake and Osoyoos Lake.

Following the submission of this report the two governments entered into an agreement dated August 8, 1950 regarding the construction of certain works and the sharing of costs. This agreement was originally to expire in 1953 but was extended by various agreements up to 31st March 1959. This agreement also provided that the Federal Government would maintain and supervise the operation of the works when constructed under a cost sharing arrangement to be agreed.

There was then another agreement between the governments dated March 16th, 1960 which provides that the Province will operate the project with a division of costs for operation and maintenance between the two governments.

The provincial Okanagan Flood Control Act authorised the original agreements and by an amendment in 1964 puts the responsibility under the Minister for Lands, Forests and Water Resources.

The agreement of August 8, 1950 has terminated and is no longer relevant. The 1960 Agreement provides in Section 1 that the Province will operate the project.

Section 2 reads "The manner of operating the Project will be at the sole discretion of the Province, but the Province will give full consideration to flood control, irrigation, fisheries, industries and other affected interests and shall be operated in accordance with the intent of the Report of the Joint Board of Engineers, Okanagan Flood Control, 1946".

This section is so worded that the Province can do almost anything it wishes. There is no attempt to fix priorities between the interests, such as between flood control and irrigation and, in any event "shall give full consideration to" only strengthens the words "sole discretion". The province must not act arbitrarily and must give thought to effects on interests, but apart from that, its decision cannot be challenged.

The requirement that the project be operated "in accordance with the intent of the Report..." is unenforceable. The 'intent of the Report' is a vague term. Most of the recommendations are for capital construction or reconstruction; the only one referring to operations is the first one regarding "the normal range of control of water levels of Okanagan Lake". High water is to be 1123.2, Normal Low Water 1119.2 and Emergency Low Water 1118.2. This emergency Low Water is actually intended to provide extra water for irrigation in drought years, not additional flood control.

However, recommendation 6. calls for a control dam capable (inter alia) of "controlling the level of Okanagan Lake up to elevation 1125.7". This is some 2.5 ft. higher than "high water".

It thus appears that there is no intent in the Report that the high water should never exceed 1123.2 at any time.

Even if it were to be assumed that the agreement meant that the recommended limits were rigidly fixed whatever happened, a breach of the agreement would not of itself give rise to any claim by any person other than the other party to the agreement, the Federal government. No individual is party to the agreement and therefore no individual has the right to complain of a breach of contract.

If the water levels exceed the normal high water or are allowed to drop below the "minimum" there may be damage to property. A licensee under the Water Act is responsible (by Section 18.) for any damage caused by his operations; to escape liability he must prove that the damage would have been as great or greater if he had not operated under his licence. This burden of proof can be very onerous.

In the absence of the provision in the Water Act, the person suffering damage has to prove that the damage is caused by the operation of the licensees works. This is an even more onerous burden of proof for the claimant, than the reverse is for a licensee.

199

The Okanagan Flood Control Project is operated by the Province; there is no need for the Province to obtain a licence as it already owns all the water rights under Section 3 of the Water Act.

If the Province or a Department had taken out a licence to operate the Flood Control Project, there would be an interesting point of law, whether the licensee in that case could be sued in Court. However, it is quite clear that in the absence of a licence, no action can be launched in Court agains the Province or its Ministers, without the consent of the Attorney General.

The Agreement of March 16, 1960 also contains detailed provisions on the mechanics of accounting for the costs in order toobtain the Federal contribution. There is also some particularity in the costs to which the Federal government will contribute. The Federal government contributes 50% of the following costs:

a) the repair, maintenance and reconstruction of;
   (i) Okanagan Lake Control Dam
   (ii) The Skaha Lake Control Dam
   (iii) The Okanagan River Channel
   (iv) Drop Structures
   (v) Creek Mouth Stilling Basins
   (vi) Culverts

   but excluding the dykes upstream of Vaseaux Lake to the site of the existing (in 1960) C.P.R. bridge.

b) the operation of the Okanagan and Skaha Lakes Control Dams

c) the field administration and operation of the project

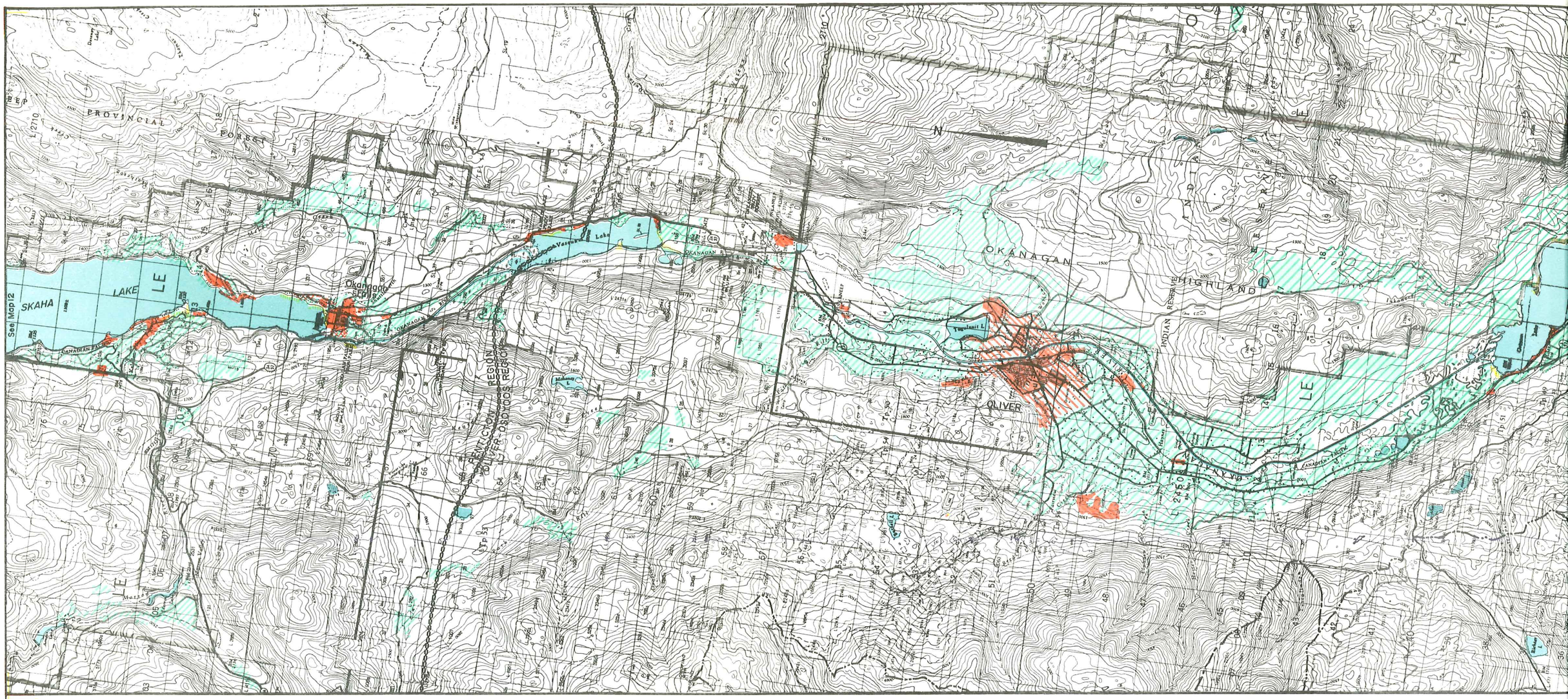
d) the reconstruction of the various railway slips "remaining to be done" under one agreement between the governments and C.N.R. and C.P.R. This is a capital cost and has presumably been completed.

The Federal government does not contribute to other costs: one such element excluded is probably the costs of any damage caused by misoperation or inability to control floods. Such costs could hardly be called "field administration and operation of the project", without distortion of the language.

If any right of way provided jointly by the governments under the earlier agreement become surplus, the proceeds of sale are divided equally between the two governments.

The present situation appears to be that, as a matter of law, the Province is not restricted in any way in the operation of the flood control project, provided it gives consideration to the interests affected: it cannot be held legally liable for any damage which may be caused by the operation whether from over high water or from too low a water level.

If any damage ensues and the Province decides to pay the costs or any part of them as a matter of grace, the Province cannot demand any contribution from the Federal government under the agreement of March 16, 1960.



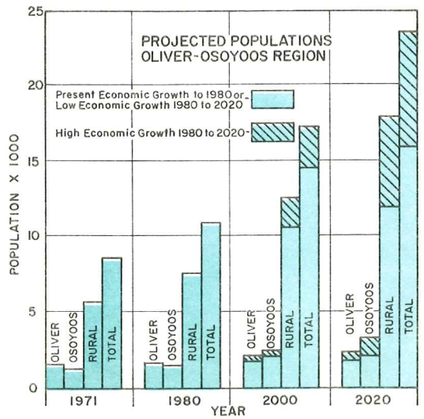
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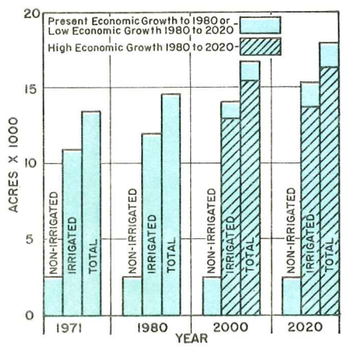
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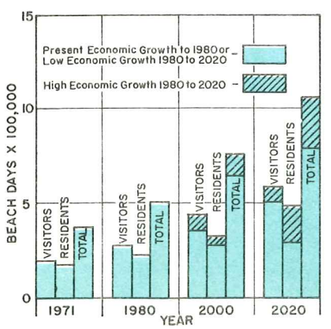
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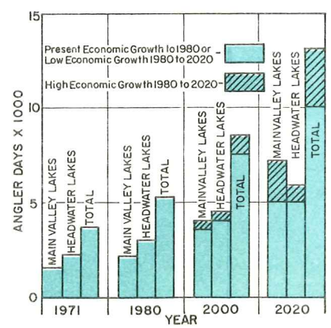
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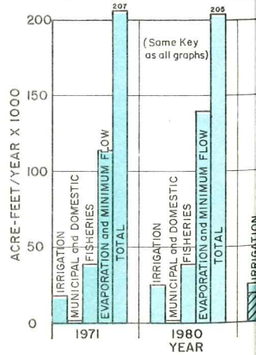
- Existing Agricultural Development (1971).
- Potential Agricultural Development to 2020. (Maximum for All Projections)
- Existing Urban Development (1971).
- Potential Urban Development to 2020. (Low Economic Growth Projection III, Minimum).
- Potential Urban Development to 2020. (High Economic Growth Projection II, Maximum).
- Existing Recreational Development (1971).
- Potential Recreational Sites
- Okanagan Watershed Boundary
- Economic Regions
- Lakes

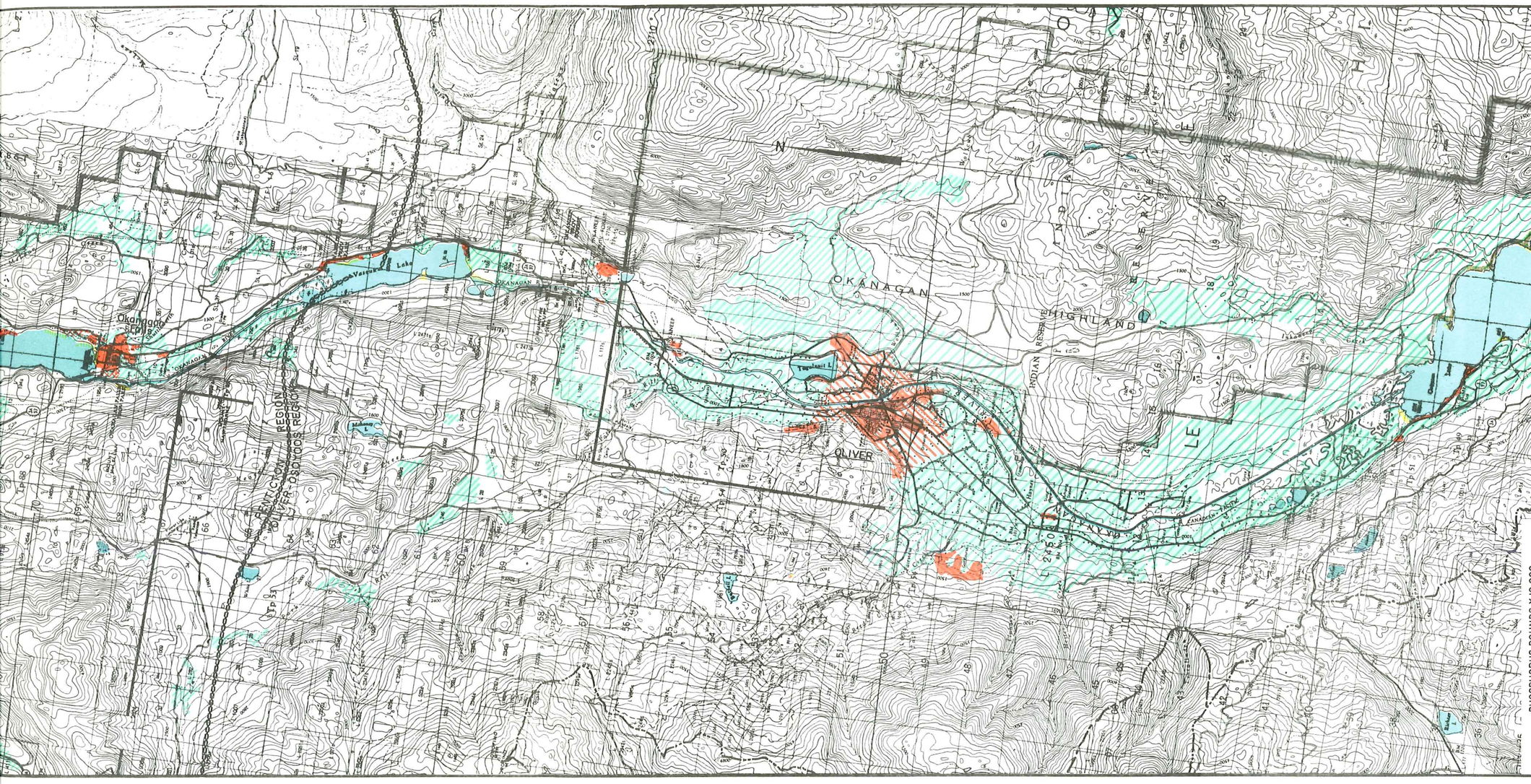




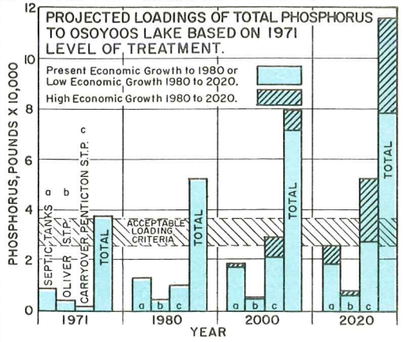


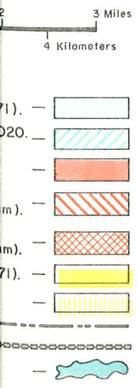




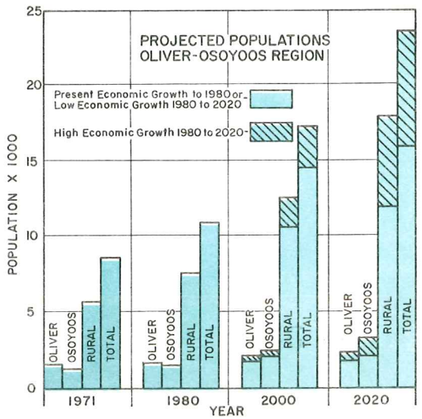


PROJECTED LOADINGS OF TOTAL PHOSPHORUS TO OSOYOOS LAKE BASED ON 1971 LEVEL OF TREATMENT.

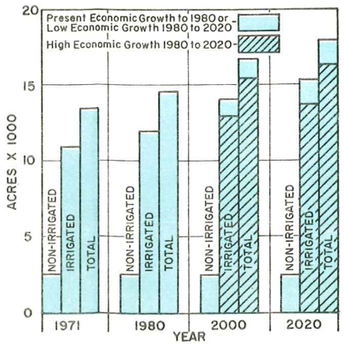




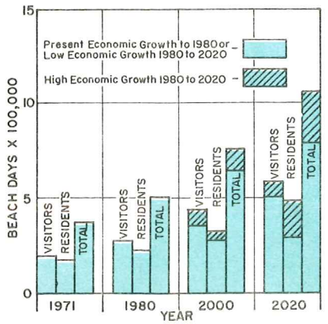
PROJECTED POPULATIONS OLIVER-OSOYOOS REGION



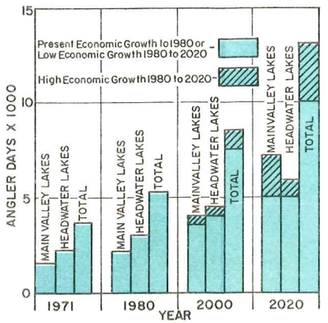
PROJECTED AGRICULTURAL LAND USE OLIVER-OSOYOOS REGION



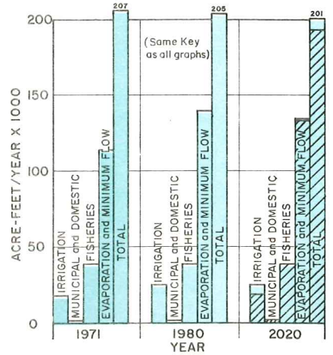
PROJECTED BEACH DAYS OLIVER-OSOYOOS REGION



PROJECTED ANGLER DAYS OLIVER-OSOYOOS REGION

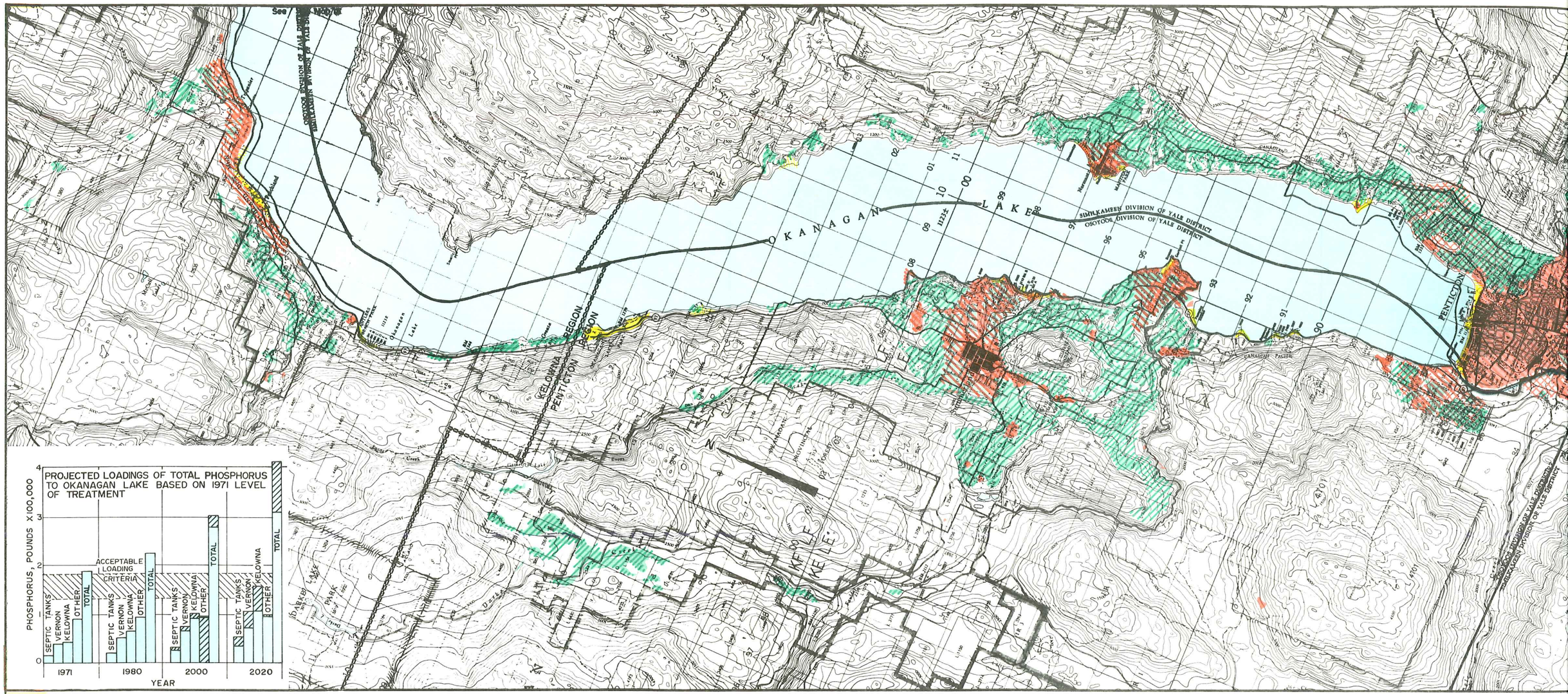


WATER REQUIREMENTS FOR THE OKANAGAN RIVER REGION FROM THE S.O.L.I.D DAM TO THE BORDER.



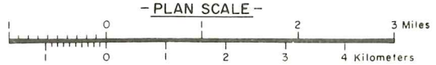
EFFECT OF PROJECTED GROWTH ON WATER AND WATER RELATED RESOURES IN THE OLIVER-OSOYOOS REGION, 1971 to 2020.

Map 11



PROJECTED LOADINGS OF TOTAL PHOSPHORUS TO OKANAGAN LAKE BASED ON 1971 LEVEL OF TREATMENT

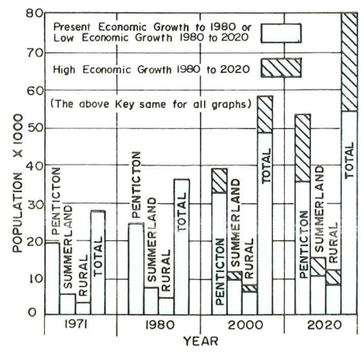
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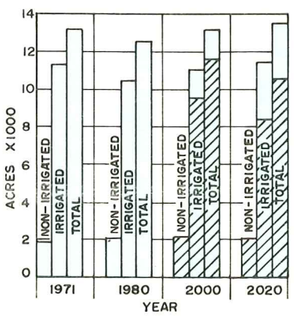
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- Potential Agricultural Development to 2020. (Maximum for All Projections)
- Existing Urban Development (1971).
- Potential Urban Development to 2020. (Low Economic Growth Projection III, Minimum).
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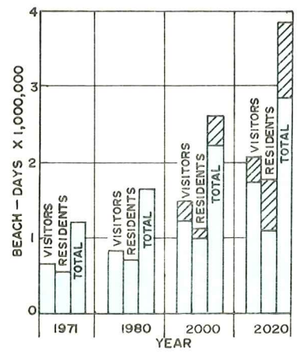
PROJECTED POPULATIONS, PENTICTON REGION



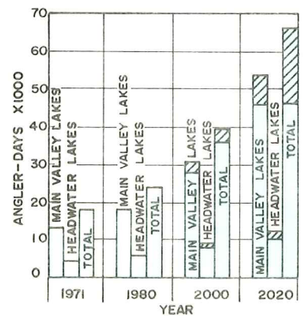
PROJECTED AGRICULTURAL LAND USE, PENTICTON REGION.



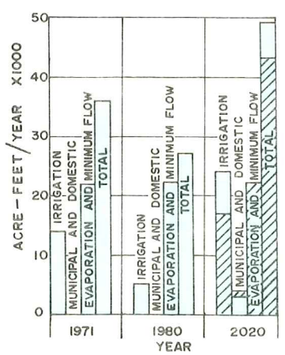
PROJECTED BEACH DAYS, PENTICTON REGION.



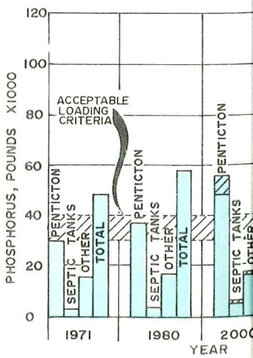
PROJECTED ANGLER DAYS PENTICTON REGION

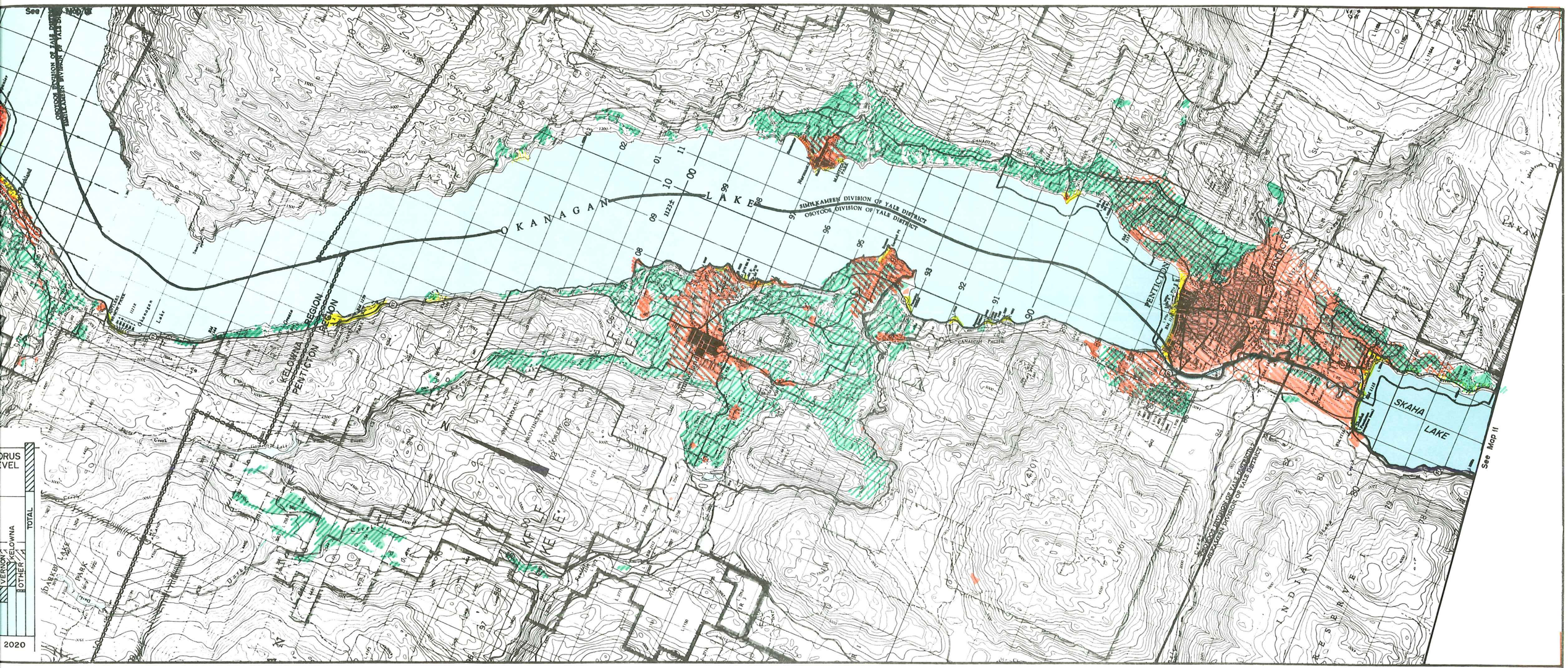


PROJECTED WATER REQUIREMENTS FOR THE OKANAGAN RIVER REGION FROM PENTICTON TO S.O.L.I.D. DAM.

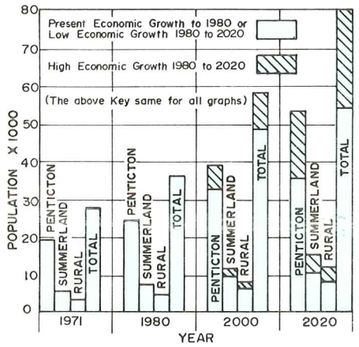


PROJECTED LOADINGS OF TOTAL SKAHA LAKE BASED ON 1971 LEVE

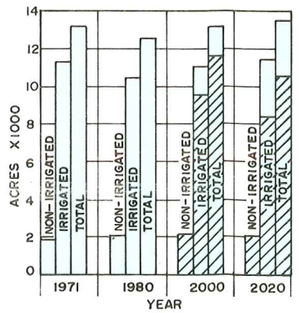




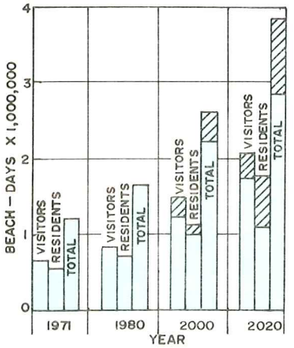
PROJECTED POPULATIONS, PENTICTON REGION



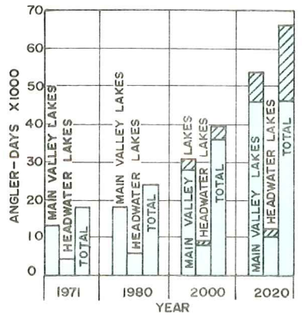
PROJECTED AGRICULTURAL LAND USE, PENTICTON REGION.



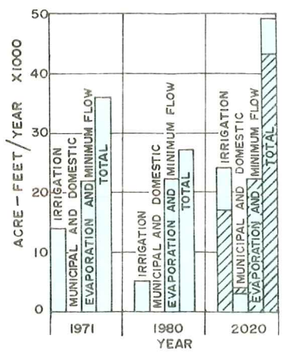
PROJECTED BEACH DAYS, PENTICTON REGION.



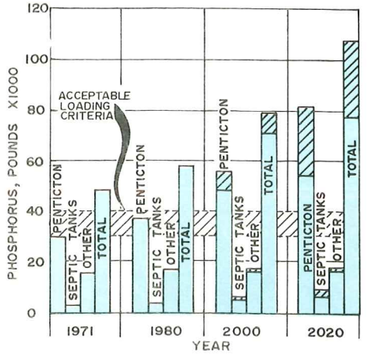
PROJECTED ANGLER DAYS PENTICTON REGION.



PROJECTED WATER REQUIREMENTS FOR THE OKANAGAN RIVER REGION FROM PENTICTON TO S.O.L.I.D. DAM.



PROJECTED LOADINGS OF TOTAL PHOSPHORUS TO SKAHA LAKE BASED ON 1971 LEVEL OF TREATMENT



EFFECT OF PROJECTED GROWTH ON WATER AND WATER RELATED RESOURCES IN THE PENTICTON REGION, 1971 to 2020.

Map 12

See Map 14

See Map 14

KALAMALKA LAKE

WOOD LAKE

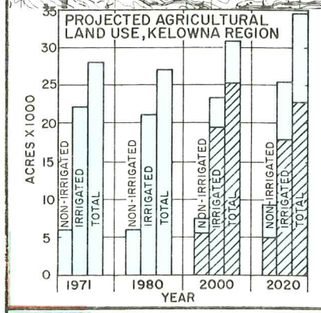
OKANAGAN LAKE

ELLISON LAKE

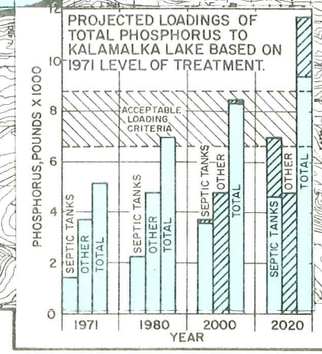
VERNON REGION

KELOWNA REGION

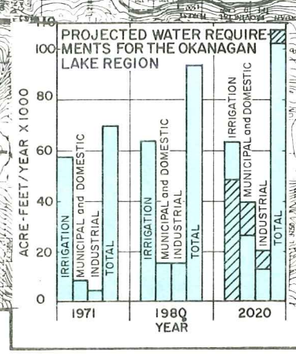
PROJECTED AGRICULTURAL LAND USE, KELOWNA REGION



PROJECTED LOADINGS OF TOTAL PHOSPHORUS TO KALAMALKA LAKE BASED ON 1971 LEVEL OF TREATMENT.



PROJECTED WATER REQUIREMENTS FOR THE OKANAGAN LAKE REGION



-PLAN SCALE-

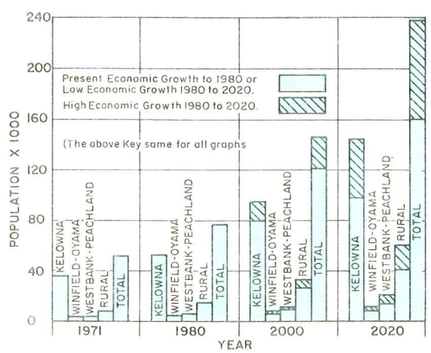
0 1 2 3 Miles

0 1 2 3 4 Kilometers

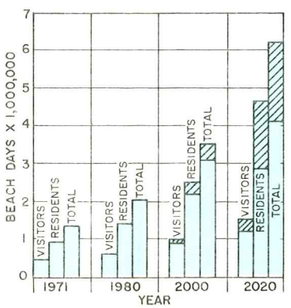
-LEGEND-

- Existing Agricultural Development (1971).
- Potential Agricultural Development to 2020. (Maximum for All Projections)
- Existing Urban Development (1971).
- Potential Urban Development to 2020. (Low Economic Growth Projection III, Minimum).
- Potential Urban Development to 2020. (High Economic Growth Projection II, Maximum).
- Existing Recreational Development (1971).
- Potential Recreational Sites
- Okanagan Watershed Boundary
- Economic Regions
- Lakes

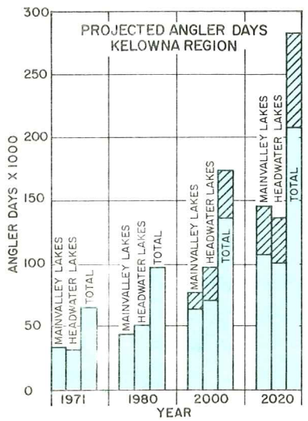
PROJECTED POPULATIONS KELOWNA REGION



PROJECTED BEACH DAYS KELOWNA REGION

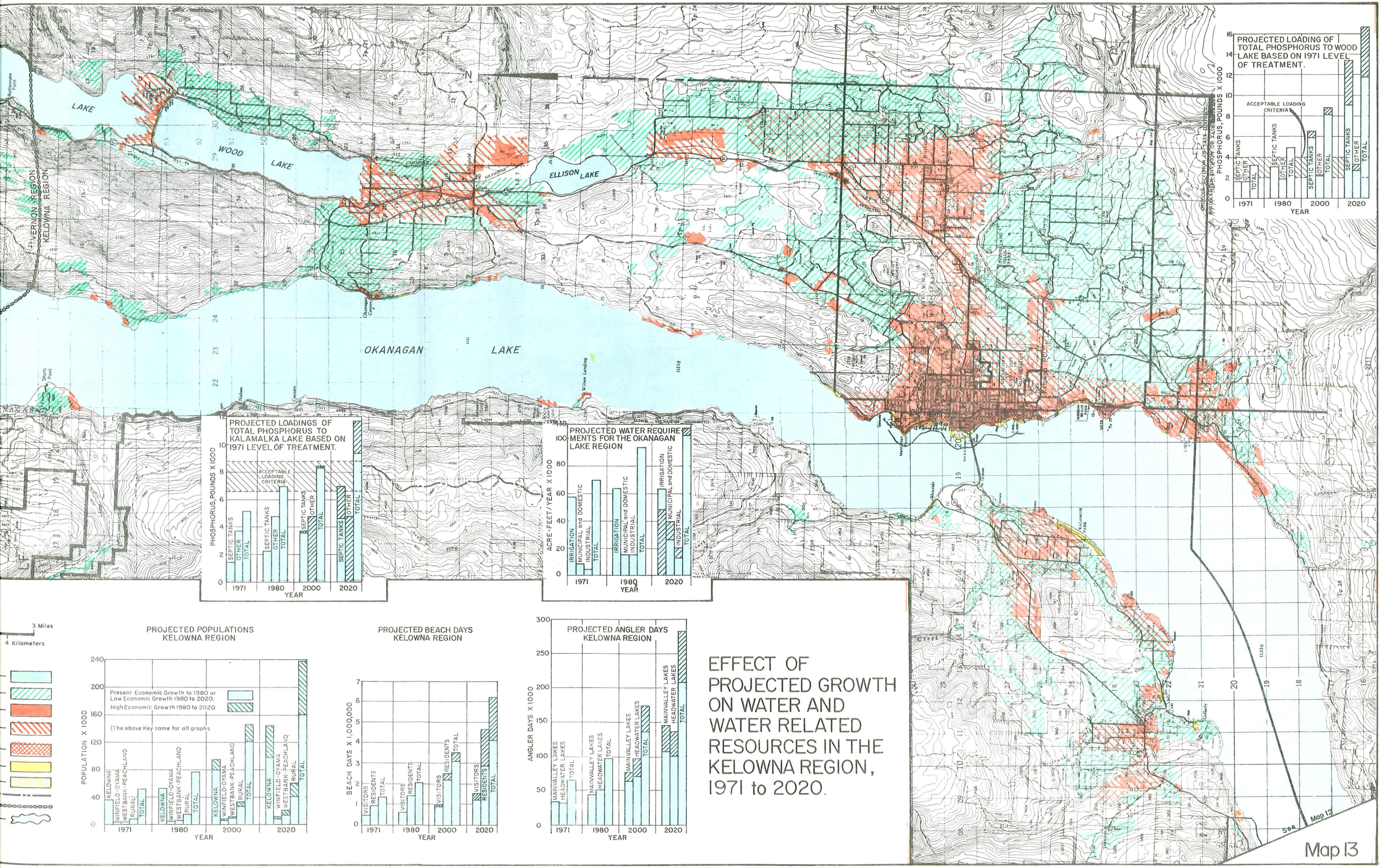


PROJECTED ANGLER DAYS KELOWNA REGION



EFFECT OF PROJECTED GROWTH ON WATER AND WATER RELATED RESOURCES IN THE KELOWNA REGION, 1971 to 2020.

EFFECT OF PROJECTED GROWTH ON WATER AND WATER RELATED RESOURCES IN THE KELOWNA REGION, 1971 to 2020.



PROJECTED LOADING OF TOTAL PHOSPHORUS TO WOOD LAKE BASED ON 1971 LEVEL OF TREATMENT.

PROJECTED LOADINGS OF TOTAL PHOSPHORUS TO KALAMALKA LAKE BASED ON 1971 LEVEL OF TREATMENT.

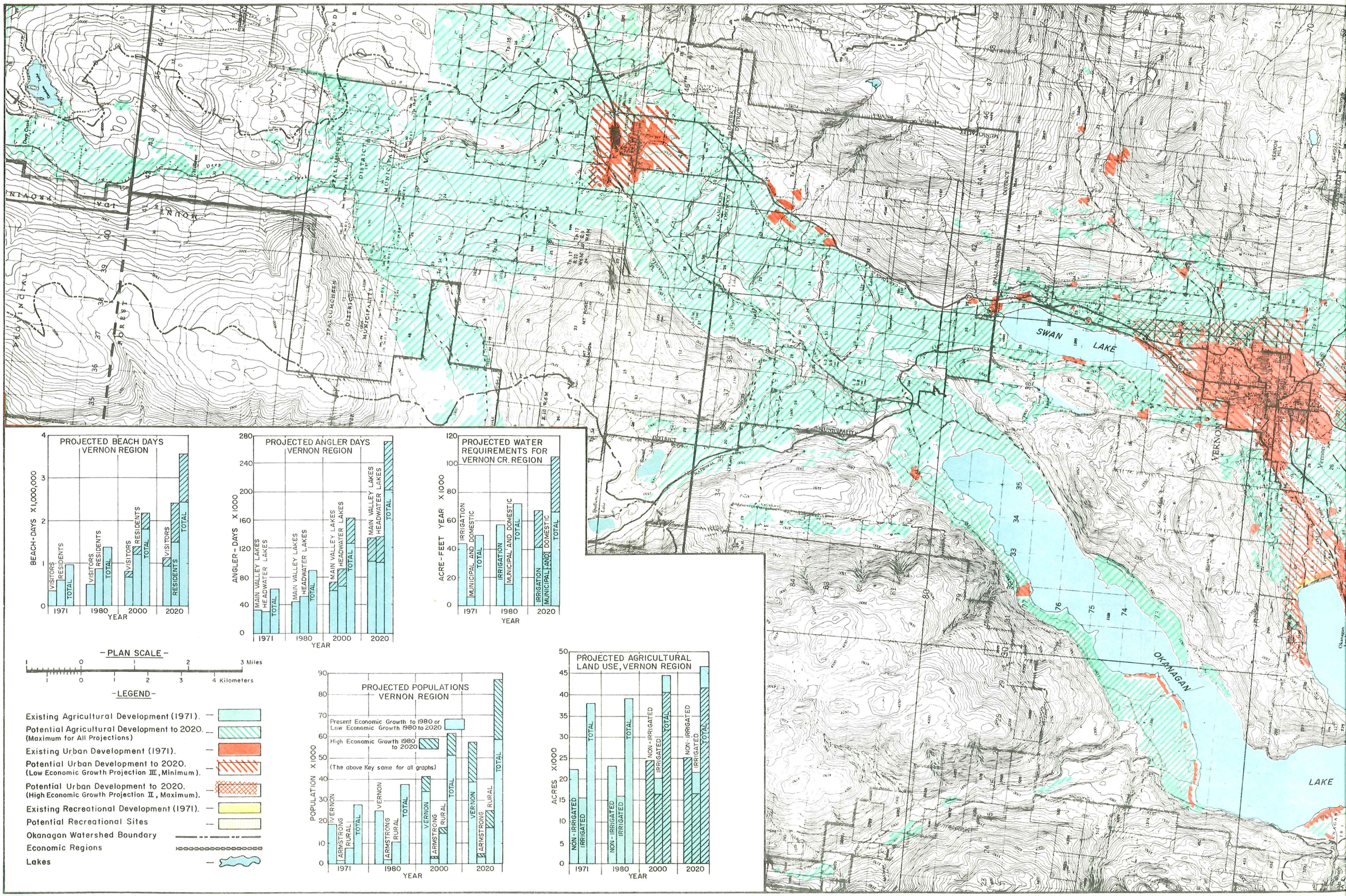
PROJECTED WATER REQUIREMENTS FOR THE OKANAGAN LAKE REGION

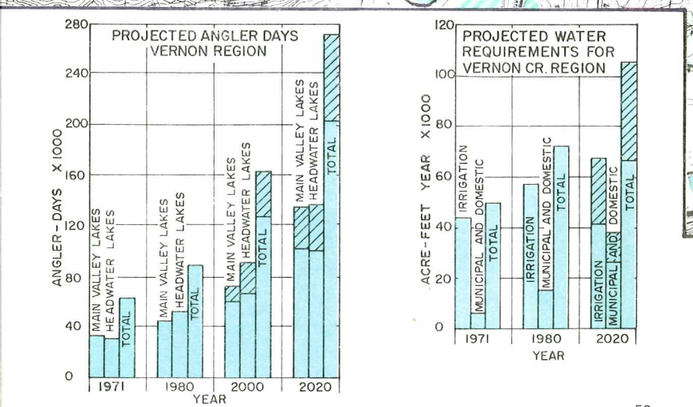
3 Miles
4 Kilometers

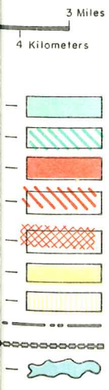
PROJECTED POPULATIONS KELOWNA REGION

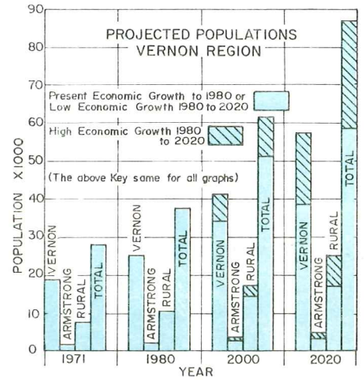
PROJECTED BEACH DAYS KELOWNA REGION

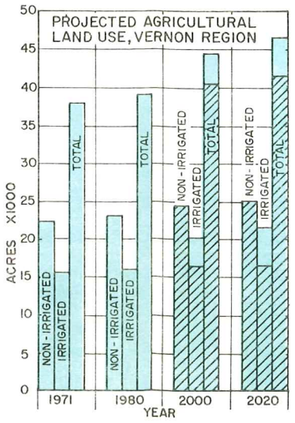
PROJECTED ANGLER DAYS KELOWNA REGION


SWAN LAKE
OKANAGAN LAKE
SPALLUMCHEEN DISTRICT MUNICIPALITY
VERNON HILL
PROVINCIAL FOREST
MOUNT TOM
Deep Creek
MT ROSE
MT ALLISON
KAMLOOPS DIVISION YALE DISTRICT
VERNON MUNICIPAL WATER DISTRICT
PROJECTED BEACH DAYS VERNON REGION
BEACH-DAYS X1,000,000
VISITORS
RESIDENTS
TOTAL
1971
1980
2000
2020
YEAR
PROJECTED ANGLER DAYS VERNON REGION
ANGLER-DAYS X 1000
MAIN VALLEY LAKES
HEADWATER LAKES
TOTAL
PROJECTED WATER REQUIREMENTS FOR VERNON CR. REGION
ACRE-FEET YEAR X 1000
IRRIGATION
MUNICIPAL AND DOMESTIC
PLAN SCALE
3 Miles
4 Kilometers
LEGEND
Existing Agricultural Development (1971).
Potential Agricultural Development to 2020. (Maximum for All Projections)
Existing Urban Development (1971).
Potential Urban Development to 2020. (Low Economic Growth Projection III, Minimum).
Potential Urban Development to 2020. (High Economic Growth Projection II, Maximum).
Existing Recreational Development (1971).
Potential Recreational Sites
Okanagan Watershed Boundary
Economic Regions
Lakes
PROJECTED POPULATIONS VERNON REGION
POPULATION X1000
VERNON
ARMSTRONG
RURAL
Present Economic Growth to 1980 or Low Economic Growth 1980 to 2020
High Economic Growth 1980 to 2020
(The above Key same for all graphs)
PROJECTED AGRICULTURAL LAND USE, VERNON REGION
ACRES X1000
NON-IRRIGATED
IRRIGATED









EFFECT OF PROJECTED GROWTH ON WATER AND WATER RELATED RESOURCES IN THE VERNON REGION, 1971 to 2020.

Map 14