A POLICY REVIEW OF
WATER LICENSE RENTAL FEES IN
BRITISH COLUMBIA

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ABSTRACT

Water pricing is being touted by all levels of government as being an economic instrument that can be used to achieve a number of policy goals. For example, British Columbia subsidized water license fees for many years to support regional and economic development. In the early 1980's, the province began pricing licenses to recover the cost of administrating *Water Allocation and Regulation*. Recently, pricing has been proposed to promote conservation and sustainability objectives.

This paper describes the effect that four pricing policy options proposed by the provincial government would have if they were applied to license tariffs for irrigation or municipal water supplies in the Nicola basin in British Columbia. These policy options include recovering administration costs, recovering supply costs, reflecting the full value of water, and collecting economic rent. An additional option of providing a tradable market for water licenses is also reviewed. The study shows that major increases in water license fees are required in the Nicola River basin to achieve some of these policy objectives. License fees would need to be raised by 21 to 73 percent to recover administrative costs, while increases ranging from 7- to 58-fold would be required to achieve other policy objectives. The study demonstrates two methods for determining economic rent in the ranching industry. One method suggests that a water rental fee increase of 7- to 34-fold is required to capture economic rent, while the other suggests that little, if any, profit in excess of a normal rate of return on investment exists in the industry.

A number of perceptual, economic, and institutional barriers stand in the way of successfully implementing pricing and market policies to promote sustainable water use. Educating the public and soliciting support, balancing equity versus economic efficiency, devising new institutions, and writing new legislation and regulations will hamper the implementation of the proposed pricing policies for water licenses.

DEDICATION

This project is dedicated to the two women in my life: my very loving and understanding wife, Brenda, without whose support I could not have managed to complete this work, and to my daughter, Pamela, with whom I am looking forward to spending more quality time with now that this project is completed.

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I would like to express my appreciation to my committee members for guiding me through this project: to Chad Day, for the many hours we spent talking about water pricing and many other water resources problems that our society now faces, and to Mark Jaccard, who made me feel comfortable with many of the economics aspects of this study.

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1 INTRODUCTION

British Columbia is perceived by many to have an abundant supply of water. If water is required for agriculture or industry, it can be simply diverted from streams. If clean water is required for domestic use, the necessary water supply infrastructure is built. Waste water can be easily assimilated into receiving water bodies.

However, demand for water is growing. With increasing competition for a limited resource in many areas of the province, water is becoming scarce. Traditional engineering practice was to construct infrastructure to store water during times of excess for later use. However, simply building more capacity is no longer a viable option in some watersheds of the province because demand exceeds the supply capability.

Governments at all levels, therefore, are seriously looking to water conservation as an alternative to traditional supply-side solutions to water shortages. Conservation through demand-side management facilitates a less wasteful and more efficient and prudent use of this resource. At the municipal level, reducing the demand for water can delay the need to enhance water supply infrastructure. At the provincial and federal levels, water conservation can protect and preserve natural aquatic environments which support fishery and wildlife habitats, biodiversity, recreational opportunities, aesthetic values, and existence values.

Municipal water can be conserved in a number of ways. Low capacity shower heads and toilet bowls reduce water consumption. Greater public awareness about the scarcity of water and its implications for the environment can translate into a positive attitude toward conservation. This could result in voluntary reductions in lawn sprinkling, for example. Regulations, such as municipal bylaws, can require that water saving devices be installed in new developments. Municipalities can also require that water use be metered to help inform the user how much water is actually being consumed. To help delay storage capacity expansion, many municipalities today are adopting metering and pricing to reduce demand. At the *Conserv 96* water conservation conference in Orlando, FL, the most popular sessions were those dealing with the financial aspects of municipal water pricing. Although pricing often complements other demand-side measures, much of the literature on municipal water use indicates that pricing of unit quantities of water can be an effective conservation tool in its own right (Canada, 1987; Pearse et al. 1985; Rogers, 1993; van der Gulik, 1994; Willardson, 1995). Demand for water can be reduced by as much as 20 to 50 percent (United States, 1973).

The federal government, too, has supported pricing to conserve water and allocate the water resource (Pearse *et al.*, 1985; Canada, 1987). In a series of national workshops on water issues conducted by the Canadian Water Resources Association, the federal government's role in championing pricing was applauded (Bruce and Mitchell, 1995).

However, with the exception of the Northwest Territories, the federal government is restricted in its ability to adopt pricing policies because jurisdiction over water allocation rests with the provinces. Under the division of powers in the *Constitution Act*, the provinces have jurisdiction over natural resources, such as timber, minerals, and water. In British Columbia, natural resources are allocated to individuals for personal economic benefit through the issuance of various forms of property rights. Forest cutting permits, agricultural grazing permits, and water licenses are examples of these rights. A water license grants a right to use water subject to only a few conditions stipulated in S. 20 of the *Water Act*. These conditions include continued "beneficial" use of water and payment of annual rental fees. With few exceptions, all withdrawals of water from streams for consumption require a license.

The province can design tariff structures for water licenses to accomplish any number of objectives. Very high or very low prices can influence water use. Therefore, the province could charge high prices to curtail use to promote conservation objectives. Conversely, the province could charge low prices to stimulate economic development. The province could price water to maximize revenues. Or it could simply set prices to generate revenues to recover the cost of programs. The province could structure prices to promote equity between and among different user types. For example, it could charge industrial water users more than irrigation users, based on the ability-to-pay principle, or charge uniform prices within a particular user group.

British Columbia's historical water allocation policies supported economic development rather than conservation objectives. It did so in two ways. First, the province adopted California's prior appropriation doctrine into the *Gold Fields Act* (1859) and the *Lands Ordinance Act* (1865). Provisions of these acts were later incorporated into the *Water Act* (1909). The early success of mining and agriculture depended on the availability of reliable sources of water. Through the issuance of water licenses, the business risk for hydraulic mining, cattle ranching, or irrigation enterprises that were licensed first-in-time was greatly reduced because they had guaranteed access to water. Conversely, water availability was less reliable to those who were licensed later, and their resulting business risk was greater. Second, the province helped stimulate growth by subsidizing water use by charging only a small fee for water licenses. Fees generally constituted only a minuscule component of a licensee's overall operational costs.

In 1982, the province changed its policy and began to price nonhydroelectric generation licenses to generate revenue to recover the cost of administering *Water Allocation and Regulation.* Hydroelectric licenses were priced to recover a portion of generation revenues in an attempt to recover economic rent. Economic rent is revenue received above a normal rate of return on investment from the use of a resource.

The change in policy in 1982 resulted in the first fee increase since the inception of licensing (British Columbia, 1993c). Fees were subsequently raised in 1987, 1992, and 1993. The 1992 and 1993 fee structure and fee increases were based on Malkinson's (1991a, 1991b) studies of administrative costs. British Columbia's 1993 tariff structure, still in effect in 1997, has two components. The first is a license application fee (table 1). The second is an annual water rental which is based on the type of use, and applies to the licensed quantity of water, not the actual amount of water used (tables 2).

British Columbia, until now, has not priced water licenses to support environmental objectives. However, increasing competition for water is now restricting the amount available for some uses. For example, irrigation withdrawals can reduce instream flows below levels required to support aquatic ecosystems and habitats. There is a growing fear by the province that current allocation and pricing policies do not lend themselves to optimal resource allocation and will lead to increasingly unsustainable practices in the future.

Table 1

Water license application fees and miscellaneous charges

From Schedule A, Parts 1 and 3 of the Water Act, Water Regulations B. C. Reg. 204/88 O. C. 889/88
Deposited May 13, 1988

Note: Selected items only. Power purpose is not listed here, for example.

Part 1
Permit to occupy Crown land

Item		Application Fee
4	**Irrigation Purpose**	
	Water conveyed by a local authority	
	- up to 50 acre feet	$25.00
	- each additional 10 acre feet or fraction thereof	$2.00
	Private agricultural use	
	- up to 50 acre feet	$25.00
	- each additional acre feet or fraction thereof	$0.20
10	**Land occupied by a dam**	$25.00
	- each acre or fraction thereof	
	Land is flooded	
	- up to 10 acres	$25.00
	- each additional acre or fraction thereof	$0.50
	Land occupied by other works	
	- up to 2 acres	$25.00
	- each additional acre or fraction thereof	$2.00

Part 3
Other fees and charges

Item		Fee or charge
15	**Amendment of a water license**	$25.00
16	**Apportionment of any license**	$25.00
17	**Inspection of any file**	$25.00

Table 2

1995 British Columbia water rental rates

	Annual Rental	First Block	Annual Rental	Incremental Block
CONSERV.-STORED WATER	$ 14.00			
CONSERV.-USE OF WATER	$ 40.00	10 cfs	$ 4.00	1 cfs
CONSERV.-CONSTRUCT.WORKS	$ 19.00			
DOMESTIC	$ 19.00	1000 gal/day	$ 9.50	500 gal/day
ENTERPRISE	$ 28.40	2000 gal/day	$ 14.20	1000 gal/day
INSTITUTIONS	$ 24.00	10000 gal/day	$ 24.00	10000 gal/day
IRRIGATION	$ 22.00	40 AF	$ 1.10	2 AF
IRRIGATION LOCAL AUTH	$ 25.00	50 AF	$ 10.00	5 AF
LAND IMPROVEMENT	$ 38.00			
MINERAL TRADING-BOTTLED	$ 12.00	1000 gal/day	$ 1.20	100 gal/day
MINING-PROCESSING ORE	$ 253.00	100 000 gal/day	$ 253.00	100 000 gal/day
PONDS	$ 38.00			
POWER-RESIDENTIAL	$ 50.00			
PROCESSING	$ 14.20	20 000 gal/day	$ 7.10	10 000 gal/day
SNOW MAKING	$ 20.00	100 AF	$ 20.00	100 AF
STOCKWATERING	$ 30.00	5 000 gal/day	$ 30.00	5 000 gal/day
STORAGE NON-POWER	$ 11.00	2 000 AF	$ 5.50	1 000 AF
WATERWORKS (OTHER)	$ 70.00	25 000 gal/day	$ 2.80	1 000 gal/day
WATERWORKS LOCAL AUTH	$ 140.00	20 000 000 gal/yr	$ 0.70	100 000 gal/yr

BC Environment embraced the need to consider economic, environmental, and social values of water in all uses in its recent *Environmental Action Plan for British Columbia* (British Columbia, 1992b). BC Environment stated that environmental problems are not the responsibility of any one group. Rather, policies must be formulated and action taken in partnership with other government agencies, industry, and the public. The province agreed with Jacobs (1993), who contended that a change in attitude is required, one that recognizes that economic growth cannot proceed at the expense of degrading the quality of the environment. If future generations are to enjoy these resources, a more sustainable approach to resource use is required. To do so, environmental standards must be established and be rigorously and fairly enforced.

The action plan identified five priorities for reviewing provincial programs and policies: improving environmental assessment, preserving biodiversity and natural areas, reducing waste and preventing pollution, *improving water management,* and strengthening enforcement and compliance.

BC Environment subsequently reviewed its water management and allocation policies in the context of sustainability in its *Stewardship of the Water* paper (British Columbia, 1993d). In describing its vision of water management as a "sustained healthy water resource", the government of British Columbia (1993d, p. 7) defined sustainability and sustainable use as follows:

> *Sustainability* is "being able to maintain water in many uses and the integrity of the aquatic ecosystem indefinitely".
>
> *Sustainable use* requires that "water must not be allocated or used beyond its capacity to be naturally replenished, both in quality and quantity".

These definitions imply that the environment should be considered paramount when considering economic and social policies to ensure that resources are preserved, waste products safely assimilated, and environmental services provided (Jacobs, 1993).

Stewardship of the Water provided information, presented policy alternatives, and solicited input and response from the public related to improving water management. The paper consisted of a summary report and nine appendices:

- The summary report contained several key statements and definitions regarding sustainability.
- The first eight appendices discussed policies and alternatives related to groundwater management, *water pricing*, managing activities in and

about a stream, water management planning, allocation, floodplain management, water quality management, and conservation.

The last appendix provided background information on historical practices, current programs, and related legislation for water management in the province.

The province considered alternative objectives for pricing water licenses in *Stewardship of the Water*. In general terms, the objectives of the policies considered were to generate revenues to recover costs, to induce less wasteful and more conservative use of water to promote sustainable aquatic ecosystems, and to influence the reallocation of water to more economically beneficial uses. Specifically, the province proposed four policy alternatives.

1) *Generate revenues to recover administration costs:* The province applied the user-pay principle to most licenses in adopting this policy in 1982. The only exception are fees for hydroelectric power generation licenses which are designed to recover economic rent.

This policy implies that fees collected are used to directly fund water allocation programs. However, fees collected from licensees are currently deposited into general revenue. Funding for the water allocation program is determined through the government's budgetary process. To support the intent of this policy, revenues collected through license fees should be used directly to finance allocation programs.

2) *Recover supply costs:* The province would recover funds granted to municipalities and regional districts used to finance supply and waste water infrastructure. It would also recover the cost from those who benefit from such provincial facilities as dams and reservoirs.

The objective of this policy would be to reduce the water works infrastructure grant program to local authorities. Instead, a municipality would either be required to price its water supply appropriately to recover the cost of providing associated capital works, or provide a sinking fund to finance future improvements and expansions.

The rationale for the first two policy options is to generate revenues to recover average costs based on the user-pay principle. The objective is fiscally-based. Any water that might be conserved to promote sustainability objectives would be purely incidental. Clearly, the intent is not necessarily to reallocate water to more beneficial use or promote sustainability objectives.

3) *Reflect the full value of water:* The third policy proposed was to reflect the full value of water. The province proposes to account for externality and opportunity costs in water license fees.

Externalities occur when one economic actor affects a third party without bearing the full cost of doing so. Externalities can either have positive or negative impacts. An irrigator can withdraw water from a stream leaving insufficient flows for fish to survive, causing economic hardship on fishers and jeopardizing a fish stock. Alternatively, storing water in upstream reservoirs can enhance wildlife habitat surrounding an impoundment.

Externalities violate a number of assumptions made in neoclassical economics regarding optimal allocation of resources in an open market. As a result, externalities are a "market failure" (Jacobs, 1993: McGuigan and Moyer, 1993). However, the Coase theorem suggests that externalities can be accounted for in an open market. It states that if property rights can be clearly defined, and if they can be exchanged without cost, a market should achieve an efficient allocation of a resource, regardless of its initial entitlement.

Compensating the damage caused by an externality according to this theorem should be achievable provided the marginal cost of controlling the damage is not greater than actual damage. The "marginal" externality cost to fisheries caused by irrigation return flows, for example, is the incremental cost to fisheries caused by a unit decrease in water quality or a unit decrease in instream flow requirements.

Opportunity costs are equal to the benefits not received by allocating water to its next-best alternative use. For example, if an irrigator withdraws water from a stream, there will be an opportunity cost to fisheries because fisheries income would rise if water were managed instead for fisheries enhancement. Opportunity costs will be negligible when water is abundant. However, when private use limits the supply of water or degrades its quality, the opportunity to use water in some alternative way is diminished.

The rationale for a pricing policy that reflects the full value of water is to ensure that no one is unfairly disadvantaged by its allocation and that social welfare is maximized within the limits imposed by environmental and social constraints. The policy is also intended to promote sustainability objectives because opportunity costs to the environment are to be reflected in the price of water licenses.

4) *Capture economic rent:* The fourth provincial policy proposed was to collect unearned income derived from an economic activity through the privileged and free use of public resources. When natural resources are allowed to be freely exploited, inefficiencies associated with resource extraction or use and overcapitalization will result (Gunton, 1986).

Economic rent, which is the revenue above a normal rate of return that water adds to production, needs to be computed for each type of licensee. However, the amount of economic rent attributable to water must be differentiated from the rent attributable to other factors of production. For example, in a ranching operation, a rancher could enjoy economic rent through the use of water and the use of Crown land for pasture.

Unearned income above a normal rate of return on investment, while allowing for investment-risk considerations, has been the basis for collecting economic rent. Economic rent in other resource-based industries has been captured through corporate income tax, output and return-on-investment royalties, lease bidding, and nationalizing industries. For example, in the logging industry, stumpage fees are collected based on a producer's net revenue. In the mining industry, royalties are charged on the value of raw ore extracted prior to processing. In the hydroelectric industry, water rental fees collect economic rent associated with the energy produced each year. Hydroelectric generation is the only specific water use from which British Columbia collects economic rent at present. If other types of licensees are earning excessive profits through their water use, the government has a strong economic case for collecting all or part of economic rent from them as well.

The rationale for collecting economic rent, therefore, is for the province to encourage licensees to adopt better water use practices while, at the same time, allowing them to retain reasonable rates of return on their investments.

1.1 An alternative policy option: water banks

Rather than reflecting the full value in the price of water licenses as suggested by the province's third policy option, other jurisdictions have instituted markets for licenses, called water banks, that facilitate the transfer of water-use entitlements (MacDonnell, *et al.*, 1994). Some western states in the United States have formed banks that are operated and managed by either state or local officials and committees. Like brokers, these institutions are able to bring together buyers and sellers of licenses. Sellers "deposit" their water-use entitlements into the bank. The deposited entitlements can then be purchased by interested buyers. Banks established in the United States are given the authority to decide what kind of entitlements, and how much water, may be banked. They also determine who can purchase water and impose conditions for transferring water. These conditions generally ensure that any negative externalities associated with a transfer of entitlement are mitigated to the satisfaction of all involved and affected parties.

Therefore, the province could consider a fifth "pricing" policy option to reallocate resources to better use and support the sustainability of aquatic ecosystems:

5) *Reflect the full value of water by creating either local or provincial "water banks":* The province would not price licenses directly to account for externality and opportunity costs. Rather, the full value of water would be recognized in the market price of licenses in an open market.

1.2 Purpose

This paper has two main purposes. One purpose is to evaluate how the implementation of each policy suggested above will affect the fees for water licenses in the Nicola River basin. The other purpose is to assess the viability of policies to achieve their stated objectives.

The paper is organized as follows. It begins with a description of the Nicola River basin. Reasons for selecting the basin to evaluate pricing alternatives are discussed. Then, the impact that each of the province's four policy alternatives may have on license fees is evaluated using water license and other information recently gathered for the Nicola basin. The option of creating institutions for the exchange of water-use entitlements in an open market in British Columbia is further explored. The policies are assessed based on the degree to which fees must be increased and barriers that may hinder their implementation. Finally, recommendations are presented regarding pricing policies for provincial water licenses.

Although the hydrology of groundwater and surface water is integrally related, pricing of groundwater is not considered in this study because its use is currently not regulated in British Columbia's *Water Act*.

2 THE NICOLA RIVER BASIN

The Nicola watershed (fig. 1) covers about 7 280 square kilometers in the south central interior of British Columbia (British Columbia, 1983). Although Spius and Coldwater watersheds of the Cascade Mountains on the western flanks of the Nicola basin receive significant precipitation, most of the rest of the basin consists of a dry, rolling plateau landscape. Because of the uneven distribution of precipitation in the watershed, annual runoff throughout the basin varies dramatically (fig. 2).

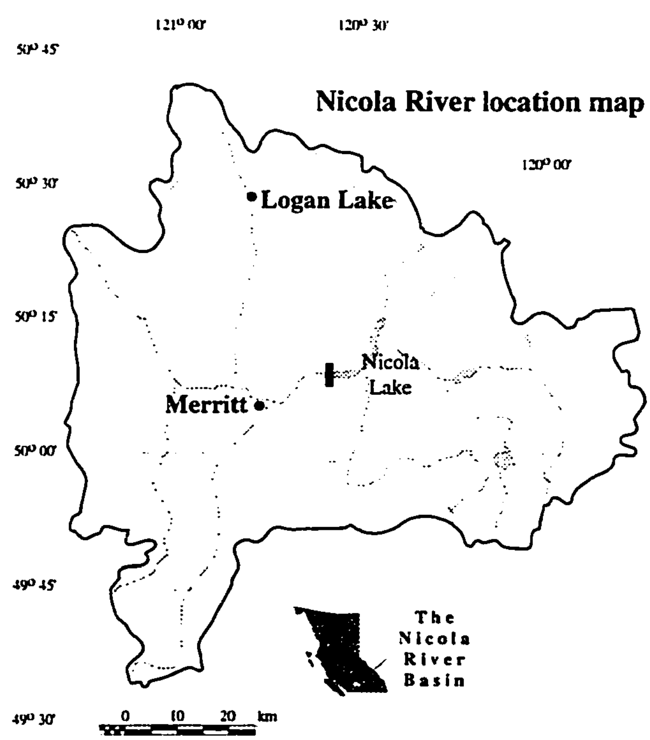
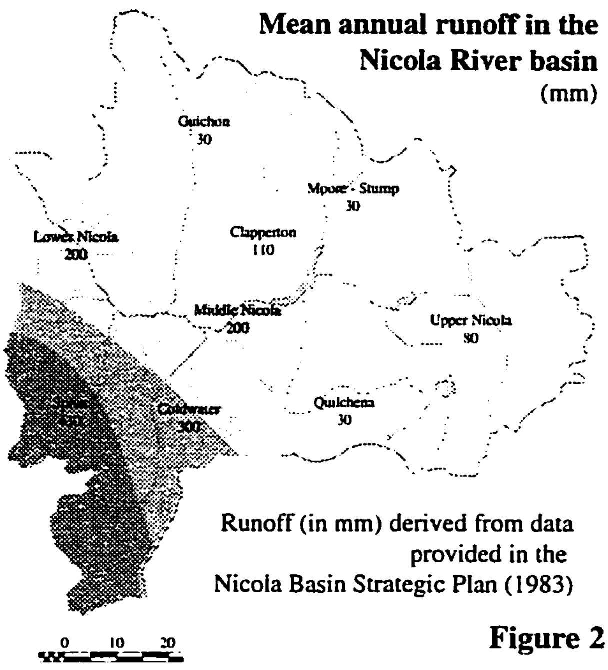


Figure 1



Mean annual runoff in the Nicola River basin (mm)

Runoff (in mm) derived from data provided in the Nicola Basin Strategic Plan (1983)

Figure 2

Ranching, mining, and forestry are the main sectors of the economy within the watershed. The watershed is also one of the major angling centers in the province. A service sector that supports tourism and recreation is growing, particularly since the Coquihalla Highway was completed in the mid-1980s. The major source of competition for water in the Nicola basin is between irrigation and fisheries interests. Irrigation accounts for 85 percent of the licensed water, by volume (fig. 3).

Relative water consumption, by volume, in the Nicola River basin: 1995

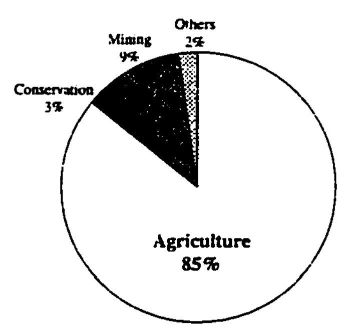


Figure 3

The Nicola River basin was selected for analysis for a number of reasons:

- Water is relatively scarce in parts of the watershed, compared to other areas of the province.
- There are only two major competitive uses for water in the basin, irrigation and fisheries, which simplifies analysis.
- Groundwater is not a viable substitute for surface water sources in most parts of the basin.
- The province funded water supply initiatives in the study area. The province granted funds to two municipalities in the basin for water supply works, and constructed a dam to impound water for irrigation and fisheries.
- Data required to undertake econometric analyses are relatively easy to obtain.

Water scarcity One reason for selecting the Nicola is that portions of the watershed are relatively water-scarce and demand for water is high. Implementing pricing for conservation objectives should only be considered for water-scarce areas. The mean annual surface water runoff (fig. 2) is about 30 millimeters in the Guichon, Moore, Stump, and Quilchena subbasins. Much of the runoff is generated by the spring freshet, leaving river levels low in the latter part of the summer. At the same time, the *Nicola Basin Strategic Plan* indicated that about 20 percent of the irrigation withdrawal in the Nicola watershed takes place within these subbasins (British Columbia, 1983).

Limited competition for water The number of types of water users within the basin are limited, which helps to simplify the computation of opportunity costs. Water licenses issued within the watershed are distributed among such uses as irrigation, mining, waterworks, domestic, and stored water for conservation.

Irrigators are the major water users, accounting for 85 percent of the consumptive demand in the Nicola basin. A review of the 1995 irrigation licenses in the Nicola watershed shows that 413 irrigation licenses are entitled to withdraw 74 700 million cubic meters (60 555 acre-feet) of water annually.

The Nicola River basin also has the potential to support a substantial fishing industry. Areas of the watershed that have the best anadromous fish potential were identified in the *Nicola Basin Strategic Plan* (fig. 4). The Nicola Watershed Stewardship and Fisheries Authority is currently attempting to define more precisely areas for potential fisheries habitat restoration and enhancement (Narcisse, 1995).

The major competition for water use exists between ranchers who irrigate forage crops for their herds, and fish that require instream flows for habitat (British Columbia, 1983). Because the competition for water is restricted to essentially irrigation and fisheries, problems associated with determining opportunity costs for water are simplified.

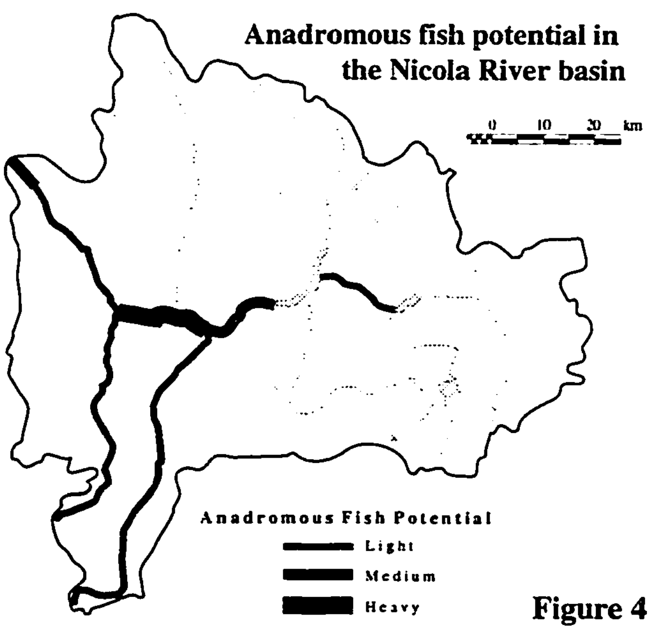


Figure 4

Lack of substitutable water Another reason for selecting the Nicola basin is that surface water provides the source for most agricultural water. Groundwater could potentially be used as a substitute and, therefore, could complicate the computation of opportunity costs. There are three aquifers in the Merritt area and a significant artesian aquifer in Highland Valley (Canada / British Columbia, 1994a). One-hundred-and-ten wells are drilled in bedrock and 132 wells are located in unconsolidated deposits. Thirty-one of these wells have yields between 6 and 128 liters per second. The higher yielding wells are located near Douglas Lake, Lower Moore Creek, and the north side of Nicola Lake and are used primarily for municipal water supply and mining. Because of generally low yields elsewhere, groundwater substitution might be considered in few parts of the watershed to irrigate small parcels in the 5- to 10-hectare range. Thus, it is unlikely that groundwater substitution on a relatively large scale could occur (Gervais, 1995).

Provincially-funded water supply projects The second pricing policy proposed by the government is to recover the cost of supplying water. The province grants funds to local authorities for water supply and waste water infrastructure, constructs actual physical works, and participates in such programs as the *Agriculture and Rural Development Subsidiary Agreement* (ARDSA).

Municipal grants and construction costs for the Nicola are used to demonstrate the effect of recovering supply costs through water license fees. Within the study area, the province provided municipal grants to the Municipality of Merritt and the District of Logan Lake to construct water supply and waste water facilities. Although water supply is normally provided by municipalities, regional governments, water utilities, and irrigation districts in British Columbia, the province reconstructed a dam at the outlet of Nicola Lake Dam near Merritt to increase storage for irrigation and fisheries purposes.

Data availability Both real property information, such as property assessments, land type, and land use, and water license information are required by one method used to compute economic rent. The method assumes that economic rent can be estimated by computing differences in the values of similar properties if the only difference is the appurtenancy of a water license. Real property information is available through BC Assessment Authority for areas delineated jurisdictionally. Water license information is available through BC Environment for areas delineated along watershed boundaries.

For the most part, regional boundaries delineated jurisdictionally, and by watershed, do not overlap well, making direct comparison of data difficult. One reason for selecting the Nicola watershed for analysis is that jurisdictional boundaries for the two ministries are approximately the same in the Nicola River basin. One of BC Assessment Authority's jurisdictional areas is delineated by School District 31, while BC Environment can easily isolate water licenses in the Nicola River watershed. There are approximately 625 square kilometers of School District 31 that lie outside the Nicola watershed and 1 480 square kilometers of the Nicola watershed that lie outside of School District 31. The area of overlap is approximately 5 800 square kilometers which comprises about 80 percent of the Nicola watershed (fig. 5).

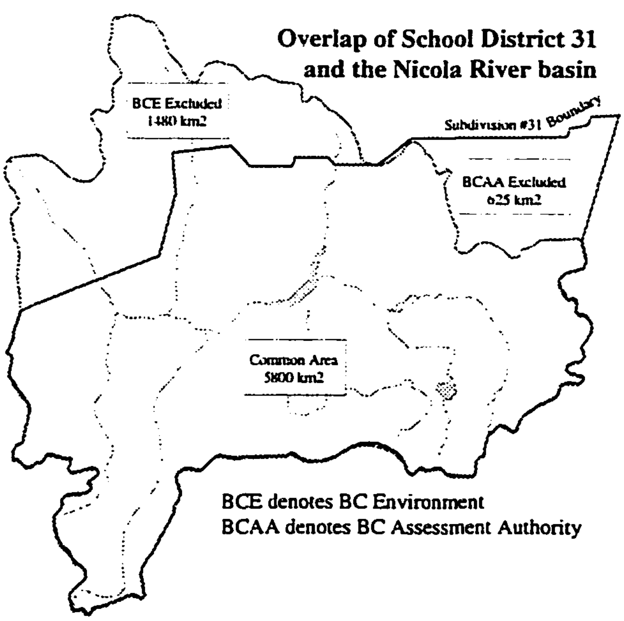


Figure 5

3 IMPACT OF POLICIES ON LICENSE FEES

The four pricing policies proposed by the province are applied to selected water uses in the Nicola River basin to determine their impact on license fees. In addition, the benefits of a fifth potential policy option of establishing a market for water licenses is explored.

3.1 Policy option 1: Recover administration costs

The first policy objective is to price water licenses to generate revenues to cover the cost of allocating water in British Columbia. Costs for some programs administered by the Water Management Branch of BC Environment will not be recovered because they do not directly support water allocation activities. The current pricing policy for water licenses, other than hydroelectric use, is to recover administrative costs of the water allocation program.

BC Environment's recoverable costs for administering its programs are determined as follows. Victoria and regional costs are prorated to determine costs that could be fairly recovered from water licensees in the Nicola basin. The latest breakdown of costs available from BC Environment is for fiscal year 1991 (Malkinson, 1991a). Recoverable costs were determined by:

- identifying programs that support water licensing activities.
- estimating recoverable costs, in 1991$, of administering water licensing activities out of Victoria.
- computing a portion of Victoria's recoverable costs that can be attributed to the Kamloops Subregion. The Nicola basin is located within the Kamloops Subregion.
- estimating recoverable costs, in 1991$, for the Kamloops Subregion and adding them to the prorated Victoria recoverable costs.
- determining a factor to prorate Kamloops Subregional costs to the Nicola watershed.
- estimating recoverable costs, in 1991$, for the study area.
- converting 1991 costs to 1995$.

3.1.1 Recoverable costs under the water licensing program

Recoverable costs include costs that can be directly or indirectly tied to water licensing activities within the Water Management Division. Malkinson (1991a, 1991b) reviewed these costs and divided all activities into recoverable and nonrecoverable costs (table 3). One could argue that water licensing fees should only recover costs associated with administering the water licensing program itself. Costs attributed to other programs, such as *Resource Quality* and *Resource Inventory and Planning*, should not be recovered even though some activities of those programs support the administration of *Water Allocation and Regulation.*

Two computations of recoverable costs are made in this study. Both recoverable costs within *Water Allocation and Regulation* alone, as well as the associated administrative

Table 3

Apportionment of BC Environment program costs

After Malkinson (1991a)

		Portion Recoverable	
Water Allocation and Regulation			
	Licensing	100%	
	Power licensing	100%	
	Appeals	100%	
	Community Water Supply	100%	
	Dam Inspection	100%	
Resource Quality			
	Surface Water Quality	25%	
	Littoral Resources	10%	
	Groundwater Quality Monitoring	100%	With groundwater licensing
	(used in this study)	0%	Without groundwater licensing
	Environmental Laboratory Services	25%	
	Ambient Water Quality		
	Surface Water	25%	
	Groundwater	100%	
Flood Damage Prevention		0%	
Resource Inventory and Planning			
	Referral	50%	
	Surface Water Hydrology	50%	
	Snow Survey Program		
	Not recoverable	35%	
	Surface Water	25%	
	Storage	15%	
	Power Generation	25%	
	Hydrometric Program		
	Not recoverable	35%	
	Surface Water	25%	
	Storage	15%	
	Power Generation	25%	
	Drafting and Mapping		
	Not recoverable	75%	
	Surface Water	10%	
	Storage	15%	
	Groundwater Quantity	100%	
Program Management			
	WLIS	100%	

Breakdown of recoverable costs for water allocation activities.

Recoverable costs $5,823,485

Nonrecoverable costs $9,031,428

costs for supporting activities outside of the program, are used to compare the sensitivity of tariff calculations based on these assumptions.

Management services costs are not treated as recoverable costs in this study. Regional administration costs were $7.5 million and management services within the Water Management Division, which include such things as rent, telephone, vehicles, salaries, material and supply costs, financial services, personnel, and system services, were $5.1 million in 1991. It is arguable whether these services, which are also required by programs not affiliated with water allocation, should be funded solely through water license fees. Rogers (1993) referred to a study by James and Lee (1971) that compared and contrasted 18 different methods which were meant to share joint costs equitably. No method was found to be satisfactory. Although computations made in this study do not account for management services costs, the analysis could easily be extended to include them if the province wished to do so.

3.1.2 Recoverable water management program costs

Costs incurred in Victoria are assumed to directly support activities in the regions. That is, Victoria provides specialized support to programs that is more efficiently and effectively provided centrally than through regional offices.

Victoria's budget figures for 1991/92 (Malkinson, 1991a) are used in conjunction with table 3 to provide estimates of recoverable costs for Victoria. They reveal that $9.0 million of the budget is nonrecoverable, while $5.8 million is recoverable (table 4).

The cost of administering hydroelectric power licenses is not considered in this analysis. Existing tariff fees for these licenses are designed to recover a portion of the economic rent associated with water use.

Table 4

Estimated recoverable costs for Victoria
After Malkinson (1991a)

Victoria Costs

Victoria Budget	**Recoverable costs**
Annual Licenses	$1,586,938
Consumptive Use - Surface	$1,345,996
Storage	$750,703
Power Generation	$723,613
Community Water Supply	$551,284
Consumptive Use - Groundwater	$864,951
Subtotal: Recoverables	$5,823,485
Subtotal: Non-recoverable	$9,031,428
Total	**$14,854,913**

Total Recoverables	
Without Power Generation and Groundwater	**$4,234,921**

Total Recoverables	
Water Allocation Only (Lic, Cons. Use, Storage)	**$3,683,637**

* Based on Malkinson's definition of recoverable shown in table 3

Groundwater costs are also excluded from analysis because groundwater use is not legislated in British Columbia. Until groundwater is legislated, costs associated with groundwater management are assumed not to be recoverable.

In summary, the recoverable costs for Victoria in 1991 are $4.2 million when costs of administering hydroelectric power generation and groundwater are excluded. Recoverable costs are $3.7 million when only costs incurred in the *Water Allocation and Regulation* are considered.

3.1.3 Prorate Victoria's recoverable costs

Administrative costs associated with Victoria are prorated to Kamloops Subregion 3A, based on regional and subregional budgets (table 5). Kamloops Subregion, in which the Nicola River basin is located, comprised 13.7 percent of the overall regional budgets in

Table 5

BC Environment's regional budgets: 1991
After Malkinson (1991a)

All Regional Budgets	Expenses	% of Total
Region 1	$727,330	12.8%
Region 2	$970,899	17.1%
Region 3A - Kamloops	$776,497	13.7%
Region 3B	$940,107	16.6%
Region 4	$736,591	13.0%
Region 5	$1,023,544	18.1%
Region 6	$493,462	8.7%
Total	**$5,668,430**	**100%**

Table 6

Estimated total recoverable costs in 1991 for Kamloops Subregion
Water Allocation Program only

Prorated Victoria costs		
0.137 of $3683637 ***	$	504,658
Regional Recoverable Costs (from table 8)		$314,352
Total	**$**	**819,010**

*** 13.7% from table 5
*** Total recoverable cost of $3683637 from table 4

the province in 1991/92. It is assumed that this percentage of Victoria's budget can be apportioned to the Kamloops Subregion. For *Water Allocation and Regulation* only, Victoria's prorated recoverable costs are $504 658 (table 6). Including recoverable costs for support programs outside *Water Allocation and Regulation*, Kamloops proportion would be $580 184 (table 7).

Table 7

Estimated total recoverable costs in 1991 for Kamloops Subregion
All recoverable programs within BC Environment

Prorated Victoria costs		
0.137 of $4234921 ***	$	580,184
Regional Recoverable Costs (from table 9)		$587,111
Total	**$**	**1,167,295**

*** 13.7% from table 5
*** Total recoverable cost of $4234921 from table 4

Table 8

Kamloops Subregion recoverable costs: 1991

—— - From Malkinson (1991a) ———

Kamloops Region 3A budget	▼	▼	▼
	Region 3A	**% Recoverable**	**Recoverable**
Water Allocation	**$314,352**	**100%**	**$314,352**
Water Act Approvals	$58,789	100%	$58,789
Water Supply Systems	$53,081	100%	$53,081
Dam Inspections	$58,811	100%	$58,811
Ambient Water Quality Monitoring	$9,260	25%	$2,315
Floodplain Development Control	$56,360	0%	$0
Surface Water - Referrals	$70,070	50%	$35,035
Operation of Nicola Lake Dam	$6,000	0%	$0
Snow Surveys	$17,060	50%	$8,530
Groundwater Quantity	$48,417	0%	$0
Program Management	$84,297	67%	$56,198
Total	**$776,497**		**$587,111**

Note: Groundwater, if licensed, would be 100% recoverable.

3.1.4 Total recoverable costs for Kamloops Subregion

The 1991/92 recoverable regional costs for *Water Allocation and Regulation* in Kamloops were $314 000. Including costs for support programs outside the *Water Allocation and Regulation*, the total recoverable costs were $587 000 (table 8).

When Kamloops Subregion's costs are added to the prorated costs for Victoria, the estimated total 1991/92 recoverable costs for Kamloops are $819 000 for *Water Allocation and Regulation*, and $1 167 000 for all recoverable programs within BC Environment (tables 6 and 7, respectively).

3.1.5 Prorate Kamloops Subregional costs to the study area

There are a number of possible ways in which one might prorate Kamloops Subregion's costs to the study area. Three methods are selected to demonstrate the sensitivity associated with the method used to allocate costs. These alternatives include prorating costs based on:

- the revenue generated for selected water license purposes in the Nicola versus that generated in the Kamloops Subregion. Purposes marked with an asterisk (*) in the list of purposes for the Kamloops Subregion shown below denote uses that are arbitrarily selected to simplify the task of selecting prorating factors.

  * Water works: Local authority
  * Water works: Other
  * Domestic
  • Domestic: Incidental
  * Processing
  * Irrigation: Local authority
  * Irrigation
  • Mining processing
  • Power: General
  * Conservation: Stored water

- the total number of licenses in the Nicola watershed versus the number in the Kamloops Subregion for selected uses, and

- the total volume of irrigation licensed in the Nicola watershed versus the licensed amount in the Kamloops Subregion. Irrigation is the major water use in the basin.

Three factors are used to prorate the Kamloops Subregion's costs to the study area (table 9). The billable revenue calculation is simplified by applying a constant fee schedule based on the 1995 rates to the total licensed use. Because rates do apply to partial increments on the fee schedule, the actual billable revenue should be slightly larger than calculated here. However, for the purpose of computing prorating factors, the difference will not significantly affect the outcome.

The applicable factor varies between 8 and 18 percent (table 9), depending on the assumption used to prorate the costs. The subsequent calculations of costs associated with administering the water licensing program in the Nicola basin should be considered with caution. For simplicity, the 'middle-of-the-road' prorating factor, 10 percent, which is derived by comparing billable revenues for selected purposes, is selected for subsequent calculations.

3.1.6 Recoverable costs for the study area

Based on the recoverable costs to the Kamloops Subregion (table 6), and a computed prorating factor of 10 percent (table 9), the recoverable cost for *Water Allocation and Regulation* alone is $819 010 * 10% = $81 900. Based on the same prorating factor, the recoverable costs for all recoverable Water Management Division activities (table 7), is $1 167 295 * 10% = $116 700.

Table 9

Factors used to prorate Kamloops Subregion costs to study area

Based on 1995 Water License Schedules and Quantities shown in First portion of this table

Total Quantity	Kamloops	Nicola
Waterworks Local Authority	15,633,929,200 GY	793,035,500 GY
Waterworks (Other)	1,298,500 GD	61500
Domestic	3,197,725 GD	230,850 GD
Processing	1,827,826 GD	33,000 GD
Irrigation Local Authority	43,612 AF	625 AF
Irrigation	290,361 AF	59,930 AF
Conservation Stored Water	69 Licenses	19 Licenses

1995 Water License Schedule	Kamloops	Nicola
Waterworks Local Authority	$ 0.000007	$ 0.000007
Waterworks (Other)	$ 0.002500	$ 0.002500
Domestic	$ 0.019000	$ 0.019000
Processing	$ 0.002530	$ 0.002530
Irrigation Local Authority	$ 2.000000	$ 2.000000
Irrigation	$ 0.550000	$ 0.550000
Conservation Stored Water	$ 14.000000	$ 14.000000

Simplified Revenue Calculation	Kamloops	Nicola	
Waterworks Local Authority	$109,438	$5,551	
Waterworks (Other)	$3,246	$154	
Domestic	$60,757	$4,386	
Processing	$4,624	$83	
Irrigation Local Authority	$87,224	$1,250	
Irrigation	$159,699	$32,962	
Conservation Stored Water	$966	$266	
Total	$425,953	$44,652	(10%)

Total Licenses	Kamloops	Nicola	
Waterworks Local Authority	129	8	
Waterworks (Other)	72	18	
Domestic	4,322	223	
Processing	22	2	
Irrigation Local Authority	75	3	
Irrigation	3,695	411	
Conservation Stored Water	69	19	
Total	8,384	684	(8%)

Total Acre Feet	Kamloops	Nicola	
Irrigation Local Authority	43,612	625	
Irrigation	290,361	59930	
Total	333,973	60,555	(18%)

3.1.7 Convert costs from 1991$ to 1995$

Figures for 1991 are used because a comparable breakdown of budgets is not readably available for subsequent years (Mattison, 1995). The 1991 costs should be inflated so that they are directly comparable to the 1995 water license tariffs.

To inflate the 1991$ to 1995$, average annual cost of living increases in British Columbia from 1992 and 1995 (Canada, 1997) are used;

$$Cost_{1995} = Cost_{1991} * 1.027 * 1.035 * 1.020 * 1.023 \text{ ....equation (1)}$$

The equivalent costs in 1995 are

$81 900 * 1.109 =	**$90 800**	for *Water Allocation and Regulation*
$116 700 * 1.109 =	**$129 400**	including support programs

3.1.8 Comparing estimated recoverable costs to billable revenues

Based on 1995 water license entitlement information available and the current water license tariff schedule (table 2), the billable revenue for the study area in 1995 is $75 000. Irrigation licenses represent $36 000 of this amount while the selected purposes noted above contribute $45 700.

Therefore, revenue needs to be raised from $75 000 to $90 800, or a 21 percent increase, to recover *Water Allocation and Regulation* costs for the Nicola basin. Revenue needs to be raised from $75 000 to $129 400, or a 73 percent increase, to recover the additional costs of support programs outside of *Water Allocation and Regulation*. The estimated increases in revenues, however, are sensitive to the method used to prorate costs to the Nicola basin. The results shown here are derived using prorating factors based on revenues for selected purposes. Prorating factors based on the number of water licenses or the total volume of licensed water would lead to different results.

The amount that license fees need to be raised to collect these revenues, however, depends on the price elasticity for the licenses. "Price elasticity" is defined as the percentage change in quantity demanded divided by the percentage change in price, assuming all other things remain unchanged. If the demand for licenses is elastic, meaning that a small increase in price would cause a significant reduction in demand, raising fees by 21 to 73 percent would not generate the anticipated revenues.

A qualitative assessment of price elasticity can be made by comparing the number of abandonments and cancellations before and after the 60 percent increase in fees imposed in 1992 and 1993. An abandoned license is one that is voluntarily returned to the province. A canceled license is one that is revoked by the province for noncompliance with the terms of the license. Licenses may be canceled when annual fees are not paid or water is determined to not be used beneficially. The province has not used a consistent procedure to compile the annual number of water license abandonments and cancellations (table 10), resulting in some missing data (Robinson, 1995). However, when water license fees were increased in 1993 by 50 percent, the available records show that there was an unprecedented number of water licenses, 1 098, that were either abandoned or canceled. Although there is no readily available estimate of the actual number of licenses abandoned, it is probable that the major part of this number resulted from abandonments due to the increase in water license rental fees. The large number of abandonments suggests that there is some elasticity to the demand curve. However, upon further inspection, the number of abandonments and cancellations returned to near normal numbers in 1994 and 1995 (fig. 6 and table 10). It appears that there was an immediate reaction to the increase in fees.

Table 10

Water license activity from 1965 to 1995

1965 to 1990 from Malkinson (1991a)
1992 to 1995 from Gary Robinson of BC Environment

	Applications Received	Licenses Issued	Applications Outstanding	Abandonments &Cancellations	Total Licenses
1965	1277	1034	1449	350	18192
1966	1333	1163	1701	254	18876
1967	1386	1122	1789	276	19785
1968	1624	1127	2019	296	20640
1969	1503	1103	2292	399	21471
1970	1767	1447	2554	340	22876
1971	1733	1343	2827	338	24167
1972	1515	1746	2522	359	25913
1973	1892	1131	3115	427	
1974	1708	1544	3156	356	
1975	1591	1074	3530	302	
1976	1451	1770	3026	685	
1977	1668	1686	2909	554	27017
1978	1448	1679	2323	448	28598
1979	1920	1518	2678		33012
1980	2245	1871	3132		34100
1981	1751	1208	3472		34341
1982	1417	1562	3327		34520
1983	972	1381	3185		35960
1984	931	1591	2504		36758
1985	996	1319	2252		37487
1986	924	843	2045	550	37963
1987	1003	897	2055	283	38220
1988	967	1054	2192	150	39063
1989	937	946	2484	58	39819
1990	940	918	2924	76	40217
1991					
1992	924		2997	496	40452
1993			3068	1098	40803
1994			3073	495	41052
1995			2883	417	41571
avg 65-90	1419	1311	2595	342	
avg 92-95			3005	627	

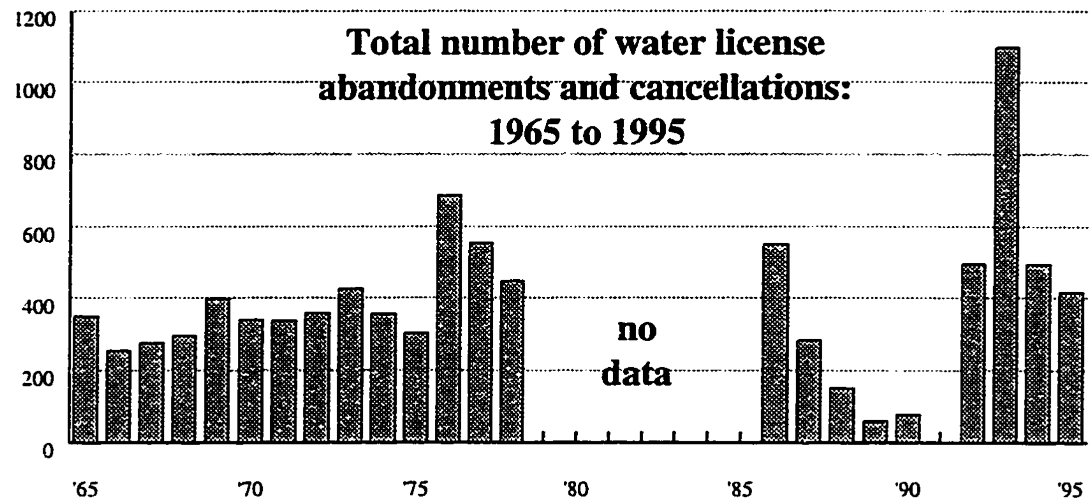


Figure 6

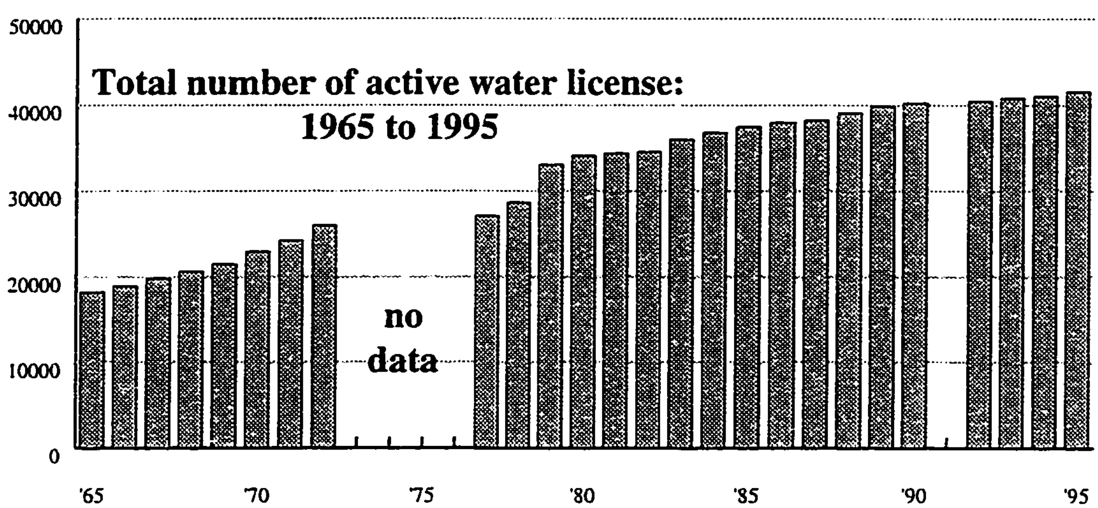


Figure 7

Total number of licenses can also be inspected to qualitatively evaluate price elasticity. The total number of licenses has continued to rise, which suggests that the number of new licenses being issued each year exceeds the number of licenses being abandoned or canceled (fig. 7 and table 10). The incremental increase in the number of licenses, although slowing since the increases in license fees in 1987, 1992, and 1993, indicates that demand for water continues to increase in spite of price increases.

The incremental number of licenses issued each year would be expected to decline further if fees were raised. However, unless the total number of licenses begins to decrease rather than increase each year, the province would increase revenue by at least 21 to 73 percent by raising license fees by a corresponding amount.

3.2 Policy option 2: Recover supply costs

The second policy objective is to price water licenses to generate revenues which offset the cost of municipal grants and provincial water supply infrastructure. The province has provided infrastructure grants to municipal and regional district governments, constructed a limited number of reservoirs, and cooperated with the federal government in undertaking ARDSA irrigation and drainage projects in the Nicola River basin. How these costs may be recovered through water license fees in the Nicola River basin is explored below.

3.2.1 Municipal grants

Regional districts and municipalities are eligible for sewer and water infrastructure grants through programs administered by the Municipal Financial Services Branch of BC Municipal Affairs. Within the Nicola River basin, the Thompson-Nicola Regional District, the District of Logan Lake, and the Municipality of Merritt are eligible. Although the Thompson-Nicola Regional District has not received any grants from the province, the District of Logan Lake obtained $3.2 million in grants while the Municipality of Merritt acquired $4.8 million (table 11).

Additional annual revenues required to recover the cost of the grants to the District of Logan Lake and Merritt could be computed by assuming various interest rates over a 25-year payback period (table 12). Amortized costs would range from about $245 000 to

Table 11

Summary of BC Municipal Affairs sewer and water infrastructure annual grant program

(Source: Drew McTaggart of BC Municipal Affairs)

	Old Program (to 1983)	New Program (1984 to present)	Total
Logan Lake	$4 523 288.	$254 308.	$4 777 596
Merritt	2 754 290.	421 250.	3 175 540
Total			$7 953 136
Provincial total	$1 876 969 000	$266 031 600	$2 143 000 000

Table 12

Amortized grants to Logan Lake and Merritt

Interest Rate	Logan Lake Grants	Amortization Term 25 years
2%	$4 777 596	$ 244 711
4%		$ 305 823
6%		$ 373 736
8%		$ 447 559
10%		$ 526 339

Interest Rate	Merritt Grants	Amortization Term 25 years
2%	$3 175 540	$ 162 653
4%		$ 203 273
6%		$ 248 412
8%		$ 297 481
10%		$ 349 843

$526 000 for Logan Lake, and $163 000 to $350 000 for Merritt, depending on assumed interest rates. If an interest rate of 8 percent is assumed, and if amortized costs were incorporated into the fees for Merritt's 793-million gallons per year local authority water license, the town's annual water rental would rise from $5 100 to $297 000, a 58-fold increase. It would be difficult to solicit political support to raise fees by this amount. The District of Logan Lake, on the other hand, has no license to extract surface water because it extracts its water supply exclusively from groundwater. Unless groundwater management and allocation is legislated in British Columbia, it is impractical to recover grants to Logan Lake through water license fees.

3.2.2 Nicola Lake Dam

The dam at the outlet of Nicola Lake was constructed privately at the turn of the century to provide storage for both irrigation and power generation. The owner, Nicola Stock Farms, had not generated power since the early 1950's (Doyle, 1996), but was using water from the 22,750 dam^3 impoundment for irrigation.

Reconstruction of the old Nicola Dam was a key recommendation of the *Nicola Basin Strategic Plan* (British Columbia, 1983). After considering various reconstruction options to improve water supply and enhance fisheries, British Columbia decided to replace the old structure in 1985. The replacement dam would provide 51 400 million cubic meters of storage, of which 12,335 million cubic meters were to support local fisheries and the remainder was for irrigation. The present worth of irrigation and salmon fishery benefits of the project, in 1982$, were estimated to be $4.6 and $2.2 million respectively. Flood control benefits were not discussed in the summary report of the plan. Regulation of Nicola Lake in high inflow years can only control flooding downstream to a limited degree. Replacement of the Nicola River Dam began in July 1985 and was completed in July of the following year at a cost of about $1.26 million (Crippen, 1985/86).

Although the strategic plan recommended that local ranchers who were to benefit from reconstruction of the project should contribute funding, no agreement was ever struck. The only signatories to the agreement to proceed with the dam's construction were the provincial minister of environment and the federal minister of fisheries and oceans (Canada / British Columbia, 1986). Attempts by the province to get local beneficiaries to agree to share the cost of reconstruction failed (Doyle, 1996). Similar government-constructed water resource projects in Canada have proceeded without buy-in from those who were to benefit from projects in the past. For example, Lake Diefenbaker was constructed partially to convert agriculture from dry to irrigated farming. Upon completion of the reservoir, however, the conversion was not made for many years, and benefits anticipated prior to its construction were never realized (Kulshreshtha and Brown, 1994: Steppuhn, 1996).

Two licenses are issued for storage in Nicola Lake. The Department of Fisheries and Oceans has a license for 12 300 million cubic meters in support of fisheries and the Water Management Branch holds a license for 39 100 million cubic meters.

The amortized cost of the project over 25 years ranges from about $85 000 to $368 000 (table 13), depending on assumptions regarding the average interest rates. Of the billable $75 000 water license rental fees in the Nicola, $36 100 is attributed to irrigation licenses. However, revenue generated from irrigation licenses with points of diversion on either the Nicola River itself or Nicola Lake are only $6 800 based on 1995 water license records.

The total cost of the dam, however, must be shared between the ranchers and fisheries. One way to apportion the cost is by the ratio of storage provided to each. Irrigators were

Table 13

Amortized cost of Nicola Dam

Cost of Dam in 1986$	Interest Rate	Cost of Dam in 1995$	Ammortization Term 25 years	1995$ O & M *	Total Annual Contribution
$1,260,000	2%	$1,535,933	$78,671	$6,367	$85,038
	4%	$1,865,108	$119,389	$6,749	$126,138
	6%	$2,256,468	$176,516	$7,146	$183,662
	8%	$2,720,245	$254,829	$7,558	$262,388
	10%	$3,268,115	$360,042	$7,986	$368,028

* $6 000 in 1992

to have been allocated 76 percent of the additional storage provided. Therefore, the amortized cost to irrigators who divert directly from Nicola River or Nicola Lake would be 0.76 * 262 000 = $199 100, assuming an 8 percent interest rate (table 13). This would represent a 30-fold increase in revenues generated; that is, ($199 100 + 6 800) / $6 800.

The qualitative assessment of elasticity made in the section on recovering administrative costs is restricted to price increase comparable to that applied to license fees in 1993. With 30- to 58-fold increases in fees, demand for licenses would undoubtedly be more elastic. However, there are insufficient data available to predict how much license fees would need to be increased to generate revenues to recover municipal grants and infrastructure costs.

3.3 Policy option 3: Reflect the full value of water

The third policy objective is to price water licenses to account for all costs. Externality and opportunity costs would be recovered to reflect the full value of water. Pricing water licenses to recover these costs would facilitate the province's objectives of creating a sustainable water resource, as well as for reallocating water to more efficient uses.

Although externality costs are not estimated in this study, the source of possible externalities are investigated. A procedure is proposed whereby externality costs could be evaluated in the Nicola River basin. Opportunity costs to the Nicola salmon fishery associated with irrigation are estimated.

3.3.1 Externality costs

How does one evaluate externality costs? For example, what are the economic, environmental, and social impacts of irrigation activities on fisheries interests? What are the costs to downstream domestic water users?

Both monetary and nonmonetary valuation can be made to assess externalities. For some externalities, monetary valuation may easily be made. This is particularly true where markets exist for the exchange of products. However, with some externality costs, other measures of valuation must be used. Contingent valuation attempts to create a hypothetical market for an otherwise nonmarket good. People are asked questions to determine their willingness to buy, willingness to sell, or willingness to be compensated for a resource. Other valuation approaches can be used to indirectly determine a demand curve from which allocation decisions can be made. These approaches include travel cost methods, indifference curve mapping methods, and hedonic price methods.

Often, there is a disparity between the estimates of externality costs made by water users and those impacted by water use. Users tend to underestimate externality costs, while those impacted are inclined to overestimate them. To overcome this disparity, multiparty evaluation processes have been attempted. For example, Reid (1996) discussed a participatory strategic planning experience carried out in Nevada's Truckee-Carson basin where stakeholders considered externality costs in developing a plan that integrated the management of water and other resources. Competing demands for water in the basin are similar to those in the Nicola watershed, with irrigation versus environmental issues at stake. Reid concluded that the process was time-consuming and did not lead to any agreement on what the externality costs of water use for various purposes were. But as a result of this process, she determined that the community was enriched with "social capital" in the form of interactions, linkages, networks, and trust that allow individuals in a community to coordinate and cooperate for mutual benefit.

In spite of Reid's example, agreement on compensation from users to those impacted may possibly be achieved through negotiation. Care needs to be taken, however, to establish a process that will lead to effective and successful negotiation.

A process for negotiations could comprise the following steps (Keeney, 1992; Wexelbaum, 1996; British Columbia, 1993c; BC Hydro, 1994).

- All stakeholders must first be identified. A stakeholder is any individual or group of individuals, who initiates an economic activity or who may be physically, ethically, or economically impacted by resource management decisions directly, or indirectly, as third parties. Both local groups, such as the Nicola Valley Round Table, and government bodies, can help identify and bring all players together.

Stakeholders involved with water management of the Nicola watershed can cover a broad range of individuals, groups, or agencies; ranchers who irrigate their forage crops for cattle production, groups such as fish and game associations interested in preserving the sport fishery and wildlife potential or Ducks Unlimited in preserving waterfowl habitat, a local community interested in preserving water quality and aesthetics, a Chamber of Commerce looking to stimulate the local economy, First Nations wanting to preserve their heritage and rights to the fishery, corporations representing the forestry and mining industry, those seeking to enhance recreational opportunities, a district government interested in regional development, and provincial and federal line agencies responsible for natural resources and social and economic development. Catering to Rawl's Theory of Justice, stakeholders can also include individuals that represent the rights of future generations in considering the management of natural resources today.

- All stakeholders need to participate in the negotiation process by explicitly articulating their values. Clearly stating values placed on water and other resources is an integral part of evaluating externality costs.

Rogers (1993) noted that the value of water can be determined through either its direct or indirect use (fig. 8). Water can be used instream for navigation, recreation, commercial use, hydroelectric power generation, or support of an aquatic ecosystem. Water can be diverted out of the stream for municipal water supplies, agricultural irrigation, or industrial and commercial uses. Water has indirect aesthetic values through enjoyment of water views. Similarly, intrinsic values exist for water in its natural, pristine state. It also has value in its potential use, or option value, in the near- or long-term.

Type of values associated with water projects
After Rogers (1993)

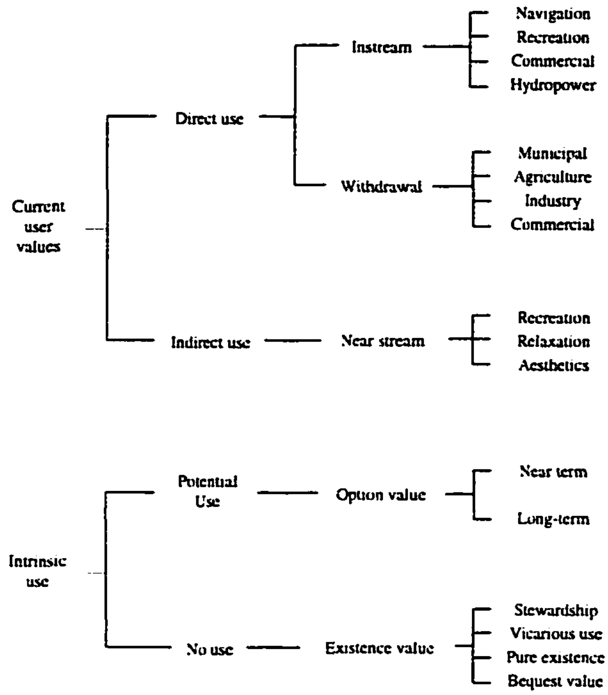


Figure 8

In the *Nicola Basin Strategic Plan*, BC Environment (1983) identified how water may be valued:

The economy

- Agriculture
- Mining. Guichon and Highland Mines are located in the basin
- Forestry
- Fishing
- Recreation

The environment

- Fisheries, particularly sport fishing success
- Waterfowl, particularly hunting success
- Wildlife values, such as nongame birds and such mammals as mule deer
- Flooding
- Surface water supply and ambient water quality
- Groundwater supply and quality
- Land use impacts

The community

- Aesthetics
- Existence values
- Heritage values
- Public preferences

Financial considerations

- Individual: ability to pay, equity
- Local: ability to pay
- Provincial

- The negotiation process should recognize that different stakeholders have different levels of political and financial influence which could affect the outcome. Some stakeholders can participate in the process through their normal paid work or funded advocacy activities, whereas those being directly affected by water use often participate on their own time. A major challenge is to equitably bring together all stakeholders, or their representatives, to ensure they have an opportunity for meaningful input to an allocation decision that affects them.

- All stakeholders should agree to the procedure and process used to estimate externality costs. How externality costs are computed, what forms of compensation will be allowed, and how costs might be implemented into water license fees, if required, need to be defined.

- An inventory of resource capability should be taken to identify current and potential resource use. This information can be used to assess externality costs and to identify possible compensation or other mitigation measures. Alternative measures to account for externality costs in the Nicola basin might include:

    - reallocating water, particularly from irrigation to fishery use
    - using alternative points of diversion
    - substituting groundwater sources for surface water sources
    - adopting such conservation measures as lining ditches or installing more efficient sprinklers, reusing water, or monitoring water use
    - purchasing feed from markets outside the Nicola Valley to reduce irrigation requirements
    - creating a market for the exchange of water licenses
    - pricing water licenses to reflect externality costs

  The results of an environmental scan were presented in the *Nicola Basin Strategic Plan.* Information on the resources in the basin needs to be updated to reflect current use, an improved information base, and changing values. For example, the Nicola Stewardship and Fisheries Authority is currently assembling up-to-date information on fisheries potential in the basin (Narcisse, 1995).

- Compensation and mitigation measures need to be implemented. An authority agreed to by the stakeholders should ensure that negotiated compensation is paid or mitigation measures taken.

- Stakeholders should meet routinely to evaluate whether the compensation and mitigation measures need to be updated. They should rely on ongoing monitoring of variables and indicators selected to measure the extent of externalities.

Undertaking the negotiation process suggested above is beyond the scope of this study.

3.3.2 Opportunity costs

An economic player computes opportunity costs to help make investment decisions. Before a company invests in a project, it should consider the opportunity of participating in alternative ventures. From a straight economic standpoint, an enterprise should direct resources to projects that yield the highest returns, provided the associated investment risk is acceptable to the company.

The province can be considered an economic actor that has the potential to "invest" its water resources in uses that will return the greatest economic and environmental benefits to British Columbia. Current provincial allocation policies, however, make it difficult for the province to reallocate water from one use to a more beneficial one. If a policy to price license fees to reflect opportunity costs were adopted, some licensees who are not using water to maximum benefit might be induced to abandon their entitlements, allowing the province to reallocate them to more beneficial use.

The *Nicola Basin Strategic Plan* contained information that can be used to provide a "ball-park" estimate of the opportunity cost to irrigators if they were to manage water for the Nicola salmon fishery instead. The 1982 value of the fishery was computed at $600 000 based on a total annual catch of 23 100 chinook, coho, and pink salmon. Assuming instream flows are maintained for fisheries, the optimal annual salmon catch was expected

Table 14

Value of the salmon fishery in the Nicola River basin

1982 versus Optimal Salmon Production
- *Nicola Basin Strategic Plan (1983)*

	1982	Optimal	Difference
Value (1982$)	$ 600 000	$ 970 000	$ 370 000

to be 38 800 fish. This catch would increase the value of the fishery to $970 000, an increase of $370 000 over 1982 market values (table 14). The figures would be larger if sport fishing for other species were included.

The value of the fishery in 1982$ can be converted to 1995$ by using average annual rates of inflation (Canada, 1997). The resulting value of the Nicola salmon fishery in 1995$ is $592 000, (370 000 * 1.601). Assuming that all of the lost benefits to fisheries are the result of irrigation activity, the revenue from the aggregated irrigation water rental fees in the Nicola basin would need to be raised from $36 000 to $592 000, or a 16-fold increase.

Such a drastic increase in license fees would likely cause a significant number of water license cancellations over the long run. These cancellations would reduce the ability to raise the computed $1.4 million. However, the returned entitlements would allow the province to reallocate water to take advantage of the opportunities available in the salmon fishery.

3.4 Policy option 4: Capture economic rent

The fourth policy objective is to return to the province excessive production revenue earned by a licensee that is directly attributable to water use. The excessive profit, or economic rent, is normally measured over the long-run by computing the excess of total market payments to a factor of production, such as water, above a normal rate of return on investment. For example, if a 10 percent return on investment will keep production viable, profit above 10 percent would be considered rent. Capturing economic rent would recover all or part of the "unearned" profit enjoyed by water licensees and return it to the province.

Isolating the benefit that irrigation water adds to the final profit statement for a ranching operation can be a difficult task. Irrigation is used to grow forage crops which, in turn, are used to feed cattle, which are then sold in the market. A rancher's net profitability is determined once final revenues are received from the sale of cattle, and all costs of production have been taken into account. The demand for water is, therefore, referred to as a "derived" demand. Water is only one factor of production for a rancher.

Economic rent for irrigation water in the Nicola basin is estimated using two methods. The first procedure differentiates the value of similar properties, where one property has access to irrigation water, and the other does not. The difference in land values is assumed to be a proxy for the economic rent of irrigation water. The second approach estimates the net profit of a ranching operation and determines if it exceeds a normal rate of return on investment. The oversimplification made in this study is that all profits above a normal rate of return are attributable to the use of water.

3.4.1 Differentiating property values based on irrigation

This method computes unit land values for agricultural properties. The unit land value is calculated by dividing the assessed value by the acreage of the parcel. The difference in unit values for properties with and without irrigation located in the study area can be assumed to be a proxy for economic rent.

Two techniques are used to calculate the difference in property values. The first is to use water license information and physical and economic attributes associated with agricultural land to make the estimates. The second method uses BC Assessment Authority's *Farm Land Valuation Schedule* to determine the difference in assessed unit land values.

Differentiating property values: method 1a Physical and economic attributes of properties required for this approach are available in a BC Assessment Authority data base, while license information is provided in the BC Environment Water License data base. The details of each file are described in appendix A.

Data from both sources are merged into one file in this study. Water license records are attached to the appropriate BC Assessment Authority records by matching the property description available in each data base.

A number of discrepancies as to which agricultural lands are irrigated and which are not arise when the data bases are merged. BC Assessment Authority cultivation classifications 1 through 3 indicate that land is irrigated, while cultivation classification 4 represents dry cropping. However, while there are 124 properties that are classed by BC Assessment Authority as being irrigated and which are supported by corresponding water licenses, 46 properties are classified as irrigated lands, but do not have supporting licenses. The source of this discrepancy was not investigated in this study, but is likely due, in part, to groundwater being the source of irrigation for some properties. At the same time, there are 36 properties that are designated as dry farming, but for which irrigation water licenses exist.

For this study, 206 agricultural properties are defined as irrigated (table 15):

- the 124 properties that are designated as irrigated in both data bases are considered irrigated.
- the 46 properties that BCAA shows as irrigated, but for which no licenses are issued, are assumed to be irrigated.
- the 36 properties that BC Assessment Authority designates as dry farming, but which have appurtenant licenses, are also assumed to be irrigated.

Nonirrigated agricultural properties are defined as those that are not irrigated according to either data base.

Because the sample of nonirrigated parcels (n = 33) is relatively small, grouped data are used to compute the difference in land values. No dry farms have soils with classifications 1 or 2. Therefore, irrigated properties with these soil types are excluded from analysis. All properties with soil types 3 and 4, regardless of cultivation type, are grouped for both irrigated and nonirrigated properties. The result is that all 33 dry land farms are used to compute average nonirrigated unit land values, and 147 properties with soil types 3 and 4 are used to calculate the corresponding value for irrigated land.

The hypothesis tested in this study is that irrigated unit land values are higher than those for similar land without irrigation. The difference in assessed unit property values for irrigated versus nonirrigated properties, but not differentiating between soil type,

Table 15

Unit land values for irrigated and nonirrigated agricultural properties: 1995

Land value ($ per acre)

	Irrigated according to water license information				Irrigated according to BCAA records		
Soil Class	Cult 1	Cult 2	Cult 3	Cult 4	Cult 1	Cult 2	Cult 3
Soil 1	$461	$715	$344	$96	$355	$243	$504
Soil 2	$647	$335	$119	$295		$508	$406
Soil 3	$437	$222	$172	$186	$453	$216	$238
Soil 4	$354	$186	$139	$109		$146	$104

Number of observations

Soil Class	Cult 1	Cult 2	Cult 3	Cult 4	Cult 1	Cult 2	Cult 3
Soil 1	4	3	3	1	2	1	6
Soil 2	13	13	2	1		9	1
Soil 3	15	22	6	9	3	7	5
Soil 4	3	26	14	25		7	5
Total	**35**	**64**	**25**	**36**	**5**	**24**	**17**

	Irrigated
Average of soil types 3 and 4	$206

cultivation classification, or whether properties were irrigated from surface or groundwater sources, is \$206 - \$105 = \$101 per acre (table 15). The difference in land value is statistically significant (α=0.01, one-tailed test) and supports the hypothesis that irrigated land is valued greater than nonirrigated land. Assuming that land is amortized over 25 years at an interest rate of 8 percent compounded annually, the increase in land value per acre is \$9.46 per year.

Differentiating property values: method 1b A simpler method to determine differences in land values would be to assume that the BC Assessment Authority designation of irrigated and nonirrigated lands is correct, and compare the corresponding assessed values per unit area directly from *Farm Land Valuation Schedule 23-1*. The schedule (table 16) applies to the Nicola River basin.

An increase in property value can be calculated by assuming that a property is converted from dry farming, which is cultivation classification 4 in Schedule 23-1, to irrigated land, which are classifications 1 through 3. For example, if an upper grassland with soil classification 2 were to be irrigated, the assessed land value would increase from \$480 to \$980 per acre. Assessed land values would rise from 40 to 155 percent if irrigation water were applied to cultivated land (table 17). Irrigating an upper grassland with a soil classification of 2, would increase the land value by \$500 per acre (tables 16 and 17). Assuming that the land value is amortized over 25 years at an interest rate of 8 percent compounded annually, the increase in unit land value is \$46.83 per year.

Table 16

Farm Land Valuation Schedule 23-1 Item Number 8900

Assessment Area: (23) Kamloops

Source: B. C. Reg. 276/84

Applies to School Districts 24, 29, 30 and 31

Cultivation Category			1		2		3		4			5		6		7		8		9	
			Cultivated-Irrigated						Cultivated-Dry			Grassland Grazing									
			3 crops/year		2 crops/year		1 crop/year		1 crop/year												
Soil Capability	Soil Type	Soil Phase	A $/ac	Rate Code	B $/ac	Rate Code	C $/ac	Rate Code	$/ac	Rate Code	Range Condition	Upper $/ac	Rate Code	Middle $/ac	Rate Code	Lower $/ac	Rate Code	Timber $/ac	Rate Code	Perm. Past Seeded $/ac	Rate Code
1	Clay, clay loam, silt loam, loam, sany loam muck	Level to undulating. Adequately drained.	$1530	8911	$1225	8921	$840	8931	$600	8941	Excellent	$90	8951	$80	8961	$70	8971	$50	8981		
2	Clay, clay loam, silt loam, loam, sandy loam, loamy sand, muck	Level to depressional. Imperfectly drained.	$1225	8912	$980	8922	$670	8932	$480	8942	Good	$80	8952	$70	8962	$60	8972	$40	8982		
	Clay, clay loam, silt loam, loam	Sloping to rolling. Well drained.																			
	Sandy loam	Level to undulating. Very well drained.																			
3	All soil types	Depressional. Poorly drained.	$980	8913	$785	8923	$540	8933	$385	8943	Fair	$70	8953	$60	8963	$45	8973	$32	8983		
	Clay, clay loam, silt loam	Sloping to rolling. Well drained, moderately stony.																			
	Sandy loam	Sloping to rolling. Very well drained.																			
	Loamy sand	Level to undulating. Very well drained																			
4	Muck (natural meadow)	Cropped regularly.	$750	8914	$600	8924	$410	8934	$300	8944	Poor	$60	8954	$50	8964	$25	8974	$25	8984	$245	[illegible]
	Clay, clay loam, silt	Steep, stony or gravelly.																			
	Loamy sand	Sloping to rolling.																			
5	Muck (natural meadows)	Cropped regularly.							$225	8945										$180	[illegible]
6	Muck (natural meadows) (Browse)	Grazed only.							$80	8946										$80	[illegible]
7	All types	Rough mountainous									Waste	$10	8957	$10	8967	$10	8977	$10	8987		

NOTES

Cultivation 1A > Lower and middle grassland zones, brown or dark brown soil zones. Areas capable of producing three crops of alfalfa annually.
Cultivation 1B > Upper grassland zones, black soil zone and all other areas capable of producing two crops of alfalfa annually.
Cultivation 1C > Timbered grazing zone. Areas generally unsuited to producing alfalfa, sub-irrigation hay land.
Cultivation 5 > Upper Grasslands between elevation 2600 and 3000 feet A. S. L.
Cultivation 6 > Middle Grasslands between elevation 2000 and 2600 feet A. S. L.
Cultivation 7 > Lower Grasslands between elevation 1100 and 2000 feet A. S. L.
Soil Capability 1-4 > Use Canada Land Inventory soil classifications
Soil Capability 5-7 > Natural meadows do not have a Canada Land Inventory schedules.

Table 17

Increases in unit land values due to irrigation based on Schedule 23-1

The benefit of adding additional irrigation water is assumed to raise the the cultivation category.
The amount of increase in land value will depend on the type of land - see table 16

For example,
if upper grasslands were irrigated, the value of land would rise from dry cultivation to category B.
Likewise,
if lower grasslands were irrigated, the value of land would rise from dry cultivation to category A.

Land Valuation
$ / Acre

	Land Classification			
	A	B	C	Dry
Soil Class 1	$1530	$1225	$840	$600
Soil Class 2	$1225	$980	$670	$480
Soil Class 3	$980	$785	$540	$385
Soil Class 4	$750	$600	$410	$300

Increase in Land Value due to Irrigation
$ / Acre

	Land Classification		
	A	B	C
Soil Class 1	$930	$625	$240
Soil Class 2	$745	$500	$190
Soil Class 3	$595	$400	$155
Soil Class 4	$450	$300	$110

Increase in Land Value due to Irrigation
Percent

	Land Classification		
	A	B	C
Soil Class 1	155%	104%	40%
Soil Class 2	155%	104%	40%
Soil Class 3	155%	104%	40%
Soil Class 4	150%	100%	37%

If an application for a water license to irrigate 200 acres of upper grasslands with a soil classification of 2 were received, the assessed land value per acre is assumed to increase by $101 by the first analysis, and $500 by the second method. Economic rent is assumed to equal $9.46 times 200 acres, or $1 900 using the first method and $46.83 times 200 acres, or $9 400, using the second method.

3.4.2 Economic rent based on excess profits

The second method of estimating economic rent is to equate it directly to net profit in excess of a reasonable rate of return on capital. BC Agriculture's *Planning for Profit* pamphlets (fig. 9) illustrate some direct costs and revenues in producing forage crops. One scenario illustrates a three-cut square bale enterprise which has a target yield of 5 tons of forage per acre. The pamphlet illustrates the contribution margin, which is defined as the difference between income and direct costs. Such indirect costs as building and fence repairs, land taxes, cash and share rent, labor, interest, service charges, and depreciation are not included in the pamphlets.

A normal rate of return on investment is also not considered in the pamphlet. Investments in a ranching operations typically range from $700 000 to over $1 million (British Columbia, 1991). Therefore, if a conservative rate of return of 10 percent were chosen, the minimum annual return should be approximately $70 000 ($700 000 * 10 percent).

The net crop enterprise income can be calculated as follows. The average total indirect cost for seven ranches studied in the north Okanagan and Kamloops area was $46 317 according to a business analysis report published by BC Agriculture (British Columbia, 1991). This figure included depreciation, interest, and service charges of $25 956. If these costs were replaced with a minimum rate of return on investment computed above, the indirect costs would be about $90 000 ($46 317 - $25 956 + $70 000). Dividing $90 000 by an average ranch size of 200 acres, the average indirect cost can be estimated at $450 per acre. However, all costs should not be applied to the crop enterprise of a ranch. Some expenses are more appropriate to cow-calf operations. For simplicity, the entire indirect costs are said to be attributed to the crop enterprise. Direct expenses are $116 per acre (fig. 8). Total unit costs are $566 (table 18). Thus, it appears that net income falls below the 10 percent normal rate of return on investment in the Nicola ranching industry.

ALFALFA HAY - 3 CUT, SQUARE BALE
Target Yield - 5 Tons/Acre

Contribution Margin
1 Acre of
Alfalfa Hay - 3 Cut
Kamloops

Income

	Yield	Price	Unit	Income
Alfalfa Hay #1	3.5	$110.00	ton	$385.00
Alfalfa Hay #2	1.5	90.00	ton	135.00
Total Income				$520.00

Direct Expenses

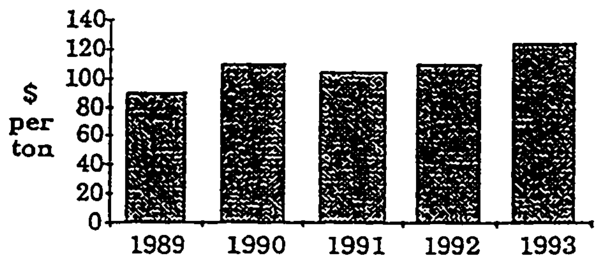
	Quantity	Price	Unit	Expense
Fertilizer				
11 - 52 - 0	100	$.23	lb.	$22.75
Herbicide				
Embitox	.9	15.94	litre	14.35
Machinery Costs				
Fertilizing				1.45
Spraying				.55
Irrigation				14.00
Harvesting				30.05
Crop Supplies and Service				
Twine	.3	28.74	roll	8.60
Irrigation Hydro	8	2.90	use	23.20
Water Rights	2	.55	acre foot	1.10
Total Direct Expenses				$116.05

Contribution Margin $403.95

Buildings & Machinery Replacement Cost
Total Farm Size - 200 Acres
Production - 166 Acres

Machine Shed & Shop	$25,000
Hay Storage	14,000
Power Machinery	57,000
Field Machinery	24,000
Harvesting Machinery	48,000
Irrigation	83,000
Small Tools & Other	8,000
Vehicle	18,000
Total	$277,000

Okanagan Alfalfa Hay



Contribution Margin - Sensitivity Analysis

The table below lists the changes to contribution margin as yield changes and price received varies.

Price $/ton	Yield Tons per Acre 3.0	4.0	5.0	6.0
80.00	124	204	284	364
90.00	154	244	334	424
104.00	196	300	404	508
110.00	214	324	434	544

This information is provided as a guideline only. Target yield indicates above average production. An individual crop plan should be developed by each producer. Planning forms may be obtained from your local office of the B. C. Ministry of Agriculture, Fisheries and Food.

FIGURE 9

Table 18

Net farm income computations for alfalfa hay - 3 cut, square bale
Target Yield: 5 tons per acre

		Analysis per acre		
Income				
	Yield	**Price**	**Income**	
Alfalfa Hay # 1	3.5 tons per acre	$110.00 per ton	$385.00	
Alfalfa Hay # 2	1.5 tons per acre	$90.00 per ton	$135.00	
				$520.00
Expenses				
Direct	**Quantity**	**Price**	**Expense**	
Fertilizer	100 lb per acre	$0.23 per lb	$23.00	
Herbicide	0.9 litres per acre	$15.94 per litre	$14.35	
Machinery Costs				
Fertilizing			$1.45	
Spraying			$0.55	
Irrigation			$14.00	
Harvesting			$30.05	
Crop Supplies and Service				
Twine	0.3 rolls	$28.74 per roll	$8.62	
Irrigation electricity	8.0 Applications	$2.90 per application	$23.20	
Water Rights	2.0 acre-feet	$0.55 per acre-foot	$1.10	
			$116.32	
Indirect Based on tables, 10, 15 and 23 of the *Cow-calf farm business analysis*			**$450.00**	
Indirect costs are $90 000 / 200 acres = $450 per acre				
Total				**$566.32**
Net Crop Enterprise Income				**($46.32**

In summary, the annual economic rent ranges from $101 to $500 per acre based on differences in property values. For a 200-acre irrigated ranching operation, the annual fees would need to be in the order of $1 900 to $9 400 to recover economic rent. The 1995 annual water rental fee is $275, assuming a license for 500 acre feet of water (table 2). Therefore, the current fee would need to be raised 7- to 34-fold to recover economic rent. However, based on a net crop enterprise income, the average rancher does not make a profit in excess of a normal rate of return on investment.

3.5 Policy option 5: Water banks

The province's third proposed pricing policy is designed, in part, to facilitate the reallocation of resources to increase social welfare in British Columbia. The policy does so by accounting for the province's opportunity costs in license fees.

Another way for the province to reallocate water more efficiently could be to adopt the Coase theorem by establishing a market for the exchange of entitlements. Driver (1986) was one of the first to champion the development of "water banks" or "water pools". A water bank is an institution where water can be allocated more effectively by directly accounting for opportunity costs. In addition to pricing and regulation, he asserted that allocation should consider this market approach as a means of allocating water more efficiently.

The opportunity costs would be treated from the perspective of the license holder, rather than from the perspective of the province. Therefore, a market would not directly generate revenues for the province. However, the objective of reallocation of water to more beneficial use from the province's perspective would likely occur. For example, if the value of water is greater to fisheries than irrigation, licenses could be exchanged from irrigation to instream use through the water bank. In this way, the province could promote sustainability objectives.

Some banks that have been established include provisions to consider externality costs. Externalities are accounted for through rules and regulations that determine conditions under which an exchange of entitlements is allowed. If an exchange of entitlement would create a cost to third parties, the bank must ensure that they are adequately compensated before approving the exchange.

Several jurisdictions have either instituted water banking, or are currently reviewing its possible implementation. Australia, for example, established an institutional framework to allow water banking. Alberta is considering water banking as a part of the review of its *Water Act* (Birch, Matlock, 1992: Thompson, 1994). Unfortunately, legislation to promote water banks has been allowed to die on the Alberta order paper of the legislature for two consecutive years (The Western Producer, 1996).

The greatest progress in establishing markets has been achieved in the western United States. MacDonnell *et al.* (1994) reviewed the status of water banks currently being operated in Idaho, Texas, Kansas, and the lower portion of the Colorado River. They also reviewed California's Emergency Drought Bank that was established in 1991, and reinstituted in both 1992 and 1994.

Based on their assessment of existing banks, the authors summarized the fundamental issues involved in designing a water bank. As a minimum, the following questions must be answered for each water bank:

What water may be banked?

- Can both groundwater or surface water be banked?
- Can only certain locations bank water?
- Can both flow supported and not support by storage be banked?
- Are public agencies, individuals, and private companies allowed to participate?
- Are limitations imposed based on type of use?
- Is evidence of ownership required?
- Are procedures required to determine bankable quantities?

Who may bank water?

- Who has priority among users?
- Does the purpose for which water is used matter?
- Is location of use important?
- Is evidence of need required?
- Are limitations on quantities to be set?
- Are limitations on timing of purchases established?

Detailed procedures

- Who sets basic policies?
- Who administers its operation? MacDonnell *et al.* contended that banks provide greater flexibility for reallocating water use. Flexibility is greater in local banks, which are established and directly operated by affected parties, than statewide banks.
- How are disputes handled?
- Can a bank buy and sell from its own account?
- How are prices determined?
- How long should a bank be in effect? Year-by-year? Permanent?
- What is the strength of a bank's authority?
- Do special rules apply during times of drought?

MacDonnell *et al.* discussed in detail externalities that might occur due to banking activity. Transfers of water use entitlements, whether temporary or permanent, may have impacts on other water users, on the local economy, or on the environment. Water banking activity can:

- alter the quantity or timing of water availability. Return flows from irrigation, for example, may be increased or decreased through a water right transfer. Idaho and Texas account for such impacts on other water-use rights at the time sales are approved, rather than at the time water rights are deposited into the bank.

- affect parties who derive their income from secondary sectors of the economy. These impacts can be either positive or negative. Estimating changes in net income to secondary sectors of the economy may be necessary to evaluate the appropriateness of some transfers. In Idaho, for example, this effect is minimized and generally avoided through a combination of irrigation preference and pricing mechanisms used by the bank. In some statewide banks, the administrator is given discretion in approving sales in order to protect public interest.

- have beneficial or adverse environmental impacts. Bird and wildlife forage and habitat, fisheries habitat, groundwater levels and quantities, and instream water quality for domestic or recreational use can be affected by water transfers. However, some transfers could be made for the sole purpose of improving aquatic habitat. Idaho, for example, provides instream flows from the bank to benefit fish.

Some existing legislation and regulations may need to be amended to facilitate the establishment and operation of water banks. Some considerations that MacDonnell *et al.* recommended were:

- cancellation of licenses for nonuse, or the "use-it-or-lose-it" provision required in prior appropriation law, should be removed. This would allow water license holders to place water in a bank on a temporary basis without fear of losing the right to it.

- water banks should be allowed to set rules governing bank transactions within a general framework of standards and requirements. The authority must establish procedures for determining the types of water-use entitlements that are eligible for banking, and for determining the quantity of water that may be banked.

- in the process of banking water, banks should be required to address injury to other water rights, either by disapproving a sale, or ensuring that affected third parties are adequately compensated. The authors favored a mitigation fee be levied on all transactions based on the sale price, while recognizing that any fee tends to discourage a transaction. Funds from the mitigation fee should be divided between two accounts: one to offset possible adverse impacts on the local economy, and one to mitigate detrimental environmental impacts. The authors suggested placing higher fees on out-of-basin users.

- bank members should be "representative" of water-based interests in the area in which a bank operates.
- a binding arbitration procedure should be provided to resolve disputes.

Most existing water banks only administer transfers of water stored in reservoirs. However, mechanisms can be put in place such that a bank could manage the deposit and withdrawal of water from reservoir storage, groundwater aquifers, and instream water not supported by storage.

The establishment of water banks in British Columbia would not necessarily affect pricing of licenses directly unless the cost of administering them were significant. Rather, opportunity costs would be reflected in the exchange price of entitlements. Externality costs would be compensated according to the rules which govern the operation of the banks.

4 POLICY IMPLEMENTATION PROBLEMS

The primary purpose of this paper is to evaluate how implementation of each pricing policy proposed by BC Environment would affect specific water license fees in the Nicola River basin. The impact that each pricing policy proposed by the province would have on license fee rates in the Nicola basin was presented in the previous chapter.

Patton and Sawicki (1993) stated that everything in the environment is interconnected, and that any resource management strategy faces a number of "wicked problems". These problems include not being able to: define problems well enough, balance technical and political issues, guarantee successful results, identify best or inexpensive solutions, adequately internalize dispersed externality costs, and find equitable ways to share the costs that economic activity might impose on the environment and society. Wicked problems will present barriers that will impede the implementation of alternative policies for pricing water licenses.

The feasibility of implementing each of the province's water pricing policies in the context of these wicked problems is explored in this chapter. The potential success of achieving each policy objective is assessed in light of its impact on license fees and on various barriers to implementation.

4.1 Recovering administration costs

Recovery of administrative costs is the province's current policy for pricing most water licenses: hydroelectric power generation licenses are priced to collect economic rent. A cost recovery policy will result in the lowest fee increases of the policies investigated in this paper (table 19). It is, therefore, likely to be the most palatable one to both the province and licensees.

Table 19

Summary: Recovering administration costs

Policy Option	Evaluation Approach	Results
Recover administrative costs.	Costs are determined from BC Environment budget data available for 1991. Recoverable costs are defined in two ways. First, only costs within *Water Allocation and Regulation* are considered. Second, additional costs of supporting programs are also included. Victoria and Kamloops Subregion costs are prorated to the study area.	Revenue needs to be raised by 21 percent to recover the cost of *Water Allocation and Regulation*. Revenue needs to be raised by 73 percent to recover costs of all supporting programs. These revenues can likely be generated by increasing fees by similar amounts because the demand for licenses appears to be relatively inelastic at current prices.

There are two flaws in the province's current implementation of the policy. First, the province does not apply revenue collected from hydroelectric power generation licenses to cover administration costs. Rather, the revenue generated is intended to collect economic rent. The British Columbia Energy Council (1994) reported that approximately $300 million are collected annually. Since administering hydroelectric power generation licenses accounts for a share of the administrative cost, a portion of the annual revenue collected should be included in the calculations to derive a pricing schedule for all licenses. It would be inequitable to other licensees not to do so.

Second, a potential exists for revenues generated from water license fees to be redirected to other programs and not be used to recover administrative costs as intended by the policy. Water license fees are currently deposited into general revenue. Cabinet allocates funds for *Water Allocation and Regulation* through its normal budgeting process. Although Cabinet funding has traditionally met the requirements of the Water Management Division, limited taxation revenue in the future may entice the province to redirect some of the revenue away from *Water Allocation and Regulation* and its supporting programs.

4.2 Recovering municipal grants

The methodology and results of analyzing the recovery of municipal grants through water license rental fees are shown in table 20. A policy to recover municipal grants relies on licenses being attached to water use. As shown in this study, not all municipalities or regional districts that receive grants necessarily have water licenses. If provincial grants to municipalities are to be recovered, another mechanism besides recovery through water licensing is required.

Table 20

Summary: Recovering municipal grants

Policy Option	Evaluation Approach	Results
Recover the cost of municipal grants.	Grants to the Municipality of Merritt and the District of Logan Lake are amortized to derive annual payments which might be recovered in water license fees to repay the grants.	The annual repayment of grants computed and used in this study are $297 000 and $448 000 for Merritt and Logan Lake, respectively. The fee for Merritt's local authority water license would need to be increased 58-fold to recover the grant money. Recovering grants from Logan Lake through water license fees is not feasible at present because the community extracts all of its supply from groundwater. Groundwater use is not currently legislated in British Columbia.

One such mechanism might be to replace municipal grants with a loan program. The province could determine the conditions under which repayments would be made.

Municipalities may not be able to afford to repay loans for waterworks infrastructure if their revenue-earning power is low. It is lower than it should be, however, because municipalities do not generally price domestic, commercial, and industrial water supply according to marginal costing principles. Almost all papers with economic themes given at the *Conserv 96* conference, for example, addressed appropriate pricing structures that public or private water utilities might adopt. If municipal water rates faithfully reflect the cost of providing infrastructure, municipalities would be better able to establish sinking funds to finance their own projects, or repay loans. Therefore, replacing the existing provincial municipal grant program with a loan program would undoubtedly induce local authorities to adopt marginal costing principles whereby the price of water would reflect the cost of providing additional water to meet demands. An added benefit is that marginal pricing at the municipal level may reduce demand enough to defer or forego the need to build additional infrastructure, leaving more water available for instream uses. BC Environment needs to formulate such a policy with other ministries, particularly BC Municipal Affairs and BC Agriculture, to ensure that other equally important provincial policy objectives, such as promoting regional and economic development through grants or subsidized Crown land use, are not being overlooked or undermined.

4.3 Recovering project costs

The methodology and results of analyzing the recovery of project costs through water license rental fees are shown in table 21. Why was Nicola Lake Dam reconstructed? Failure potential of the existing dilapidated dam may have influenced the province to proceed. However, the decision to reconstruct the dam was based primarily on the economics of the project described in the *Nicola Basin Strategic Plan* (British Columbia, 1983). The plan demonstrated that forage production would be improved due to increased irrigation.

It is unclear, however, why BC Environment implemented this project prior to negotiating a cost-sharing agreement with ranchers who would benefit, as recommended in the plan. It is equally unclear why local ranchers subsequently refused to participate in the funding.

Table 21

Summary: Recovering reconstruction costs for Nicola Lake Dam

Policy Option	Evaluation Approach	Results
Recover the cost of reconstructing and operating the Nicola Lake Dam.	The annual operating and amortized construction costs are estimated. The costs are to be recovered from beneficiaries of the project. Both fisheries and irrigation interests were to have benefited. This study evaluates costs which can be attributed to irrigation. The costs are allocated to 80 irrigation licensees having points of diversion on Nicola Lake or Nicola River and recovered through their license fees.	The amount needed to amortize reconstruction and operating costs is \$263 000 annually. Of this, \$199 000 can be attributed to 80 irrigation licensees who might have benefited from the project. This study shows that license fees for the ranchers would need be increased 30-fold to recover these costs, assuming the demand for licenses is inelastic.

BC Environment has not allocated the additional storage created in Nicola Lake to irrigation, largely because ranchers who were to benefit did not share the cost of the project. By nonallocation, the province implicitly allocated the additional water to instream use. A decade after completion of the project, there are approximately 50 irrigation license applications still outstanding for use of the additional water stored in Nicola Lake (Doyle, 1996).

The intended benefits of the new dam were not realized because the province did not allocate water to irrigation. Should the province apportion additional water provided to irrigation, even though no cost-sharing agreement was reached with the ranchers? If it does not, no irrigation benefits will ever be realized. If it does, the province would, in effect, treat the dam as a sunk cost and allow water to be used more efficiently, provided irrigation benefits still outweigh instream use.

Should the province attempt to recover project costs through an increase in license fees? A major problem of recovering these costs through license fees is equity. Is it fair to differentiate fees to such an extent that irrigation licensees who use the additional water stored by the project should pay 30 times the fees of other irrigators? Is it equitable to raise the fees for all irrigators to recover reconstruction costs, whether they are to benefit or not from a project?

One solution to recovering costs more equitably may be for the province to market the water available in Nicola Lake. Traditionally, water is allocated by the province on a first-come, first-serve basis. The province might try auctioning the additional storage in order to allocate it to more beneficial uses.

An attempt to achieve cost recovery at this time would be unlikely to be supported by local ranchers or local politicians. Thus, the province should use the Nicola Lake Dam as an example to demonstrate that funding arrangements need to be agreed to prior to implementation of projects, if cost recovery is an objective.

4.4 Reflecting opportunity costs

The methodology and results of analyzing the recovery of opportunity costs through water license rental fees are shown in table 22. The province can be viewed as an economic player. As such, British Columbia should possess the capability of reallocating its resources to achieve maximum returns on its investments. Water is a significant provincial resource. However, British Columbia is not able to easily reallocate it to more beneficial uses under existing legislation.

Table 22

Summary: Reflecting opportunity costs

Policy Option	Evaluation Approach	Results
To reallocate water to more beneficial use by reflecting opportunity costs to the province in license fees. Fees would encourage inefficient water users to return entitlements to their province for reallocation.	Potential benefits to the salmon fishery in the Nicola basin are used to estimate opportunity costs associated with irrigation use. Benefits estimated in the *Nicola Basin Strategic Plan* are used in this study. The creation of water banks is proposed that account for an individual's opportunity cost.	If water were reallocated to improve instream flows required to support fish and fish habitat, the increase in the annual value of the Nicola salmon fishery would be $592 000. Collecting the opportunity cost would require a 16-fold increase in irrigation rental fees. If irrigators abandon their licenses rather than pay the increased fees to cover opportunity costs, the province could reallocate water to instream use.

The province evaluated a number of alternatives to reallocate water to more beneficial use in its *Stewardship of the Water* paper. Section 5 discussed water allocation initiatives, one of which was the reallocation of existing water rights and compensation. Negotiation for reallocating the water resource is proposed as a first course of action, with expropriation being the last resort.

Another way the British Columbia promoted water reallocation was to incorporate the province's opportunity costs for water into license fees. The policy objective would be to encourage high priority licensees who are using water inefficiently to return their entitlements to the province for reallocation. There are a number of problems associated with incorporating opportunity costs into license fees. For example, evaluating opportunity costs can be a difficult, expensive, and controversial exercise, and as such, may not be universally accepted or politically endorsed. Existing licensees may argue that including opportunity costs in license fees would impinge on their perceived "property" rights. Also, opportunity costs associated with irrigation in one part of the province may be significantly different than other parts of the province. This could lead to pricing inequities throughout the province.

Other jurisdictions have instituted markets for water to account for the opportunity costs of individuals. The sale price of water licenses would reflect the opportunity cost of water, and therefore, the potential for reallocating water to more beneficial use would be improved.

The establishment of water banks could be facilitated in British Columbia with few changes to existing legislation. The "use-it-or-lose-it" clause in S. 20 (2)a of the act should be amended for two reasons. First, the current provision does not encourage licensees to conserve water. A minor amendment to the use-it-or-lose-it provision might be to continue to cancel licenses for nonuse. But where water is demonstrated to be conserved, part of the conserved water should be permitted to be applied to a new use and part returned to the province. Oregon adopted a similar policy for irrigation licenses (Willardson, 1995). Second, the beneficial use provision does not facilitate the potential implementation of water banks in British Columbia. MacDonnell *et al.* advocated dropping it, noting that irrigators will be reluctant to place water entitlements into a bank if their nonpurchase translates into a cancellation of licenses. Other sections of the act do not need to be amended. S. 15 (1)g already permits a license holder to transfer a license from one use to another. S. 16 of the act allows licensees to transfer the appurtenancy of a license from one property to another.

Rules by which a bank would operate could be drafted to embody the vision for water reallocation that the province, or local communities for that matter, have for achieving various conservation and other objectives. Rules could promote or constrain transactions to certain types of water uses. For example, to promote conservation objectives in an area, transfers from irrigation to conservation licenses would be allowed, even encouraged. At the same time, transactions from irrigation to industrial use may be prohibited because the province or region may want to stimulate agricultural growth in the area.

Drafting rules and regulations by which either a provincial or local bank must operate would be more difficult than amending existing legislation. The province could benefit from the experience of existing banks in other jurisdictions to help formulate provisions that would allow for transfers of entitlements and licenses that would not adversely affect third parties.

There are important perceptual problems which need to be resolved. For example, many feel that full-cost pricing is the only policy analysis tool required to rationally account for opportunity costs and allocate the water resource. Others, however, feel there are too many assumptions which are stretched, for practical purposes, in trying to optimally allocate resources. In other instances, the efficient allocation of natural resources and maximization of profits often conflict with equity considerations (Jacobs, 1993; Lebowitz, 1986; Kierans, 1987). Thus, the principles of economic efficiency provide a rational approach to resource allocation, but optimization of allocation needs to be constrained by environmental, social, and equity considerations.

4.5 Reflecting externality costs

The methodology that might be followed to account for externality costs through water license rental fees is shown in table 23. Accounting for externality costs in license fees would more fully reflect the full value of water. However, evaluating externality costs can be even more difficult and expensive than determining opportunity costs because stakeholders' values can vary greatly. Reid (1996) noted that after years of effort, committed stakeholders in Nevada were unable to agree on these costs.

Table 23

Summary: Reflecting externality costs

Policy Option	Evaluation Approach	Results
Reflect externality costs.	Negotiation among stakeholders to evaluate and account for externality costs. The creation of water banks that consider externalities before approving any water reallocation.	The valuation of externality costs in the Nicola basin is not made in this study.

Even if these costs could be agreed to, reflecting them in license fees is questionable. In some cases, the province might suffer the externality. If so, the province could attempt to evaluate these costs and collect them through license fees. Alternatively, it could consider policy instruments other than pricing, such as regulation, to mitigate externalities. In other cases, it is not the province, but individuals, who are negatively impacted by water use. Those who are negatively impacted by a particular water use should be compensated directly. In such instances, mechanisms other than pricing externalities through water licenses should be considered. For example, compensation for such externalities could be left to negotiation among the affected parties. If agreement on compensation cannot be agreed to, disputes could be resolved through arbitration or the legal system.

Alternatively, externalities could be accounted for in an open market, according to the Coase theorem. However, the assumption that initial entitlement does not matter has been criticized (Pearce and Turner, 1990). If someone obtains a first-in-time right, as in the case of prior appropriation, reallocating resources to competing interests is not trivial. Transaction costs are likely to fall on a party that does not currently have property rights.

Monetary compensation may not suffice in cases where externalities affect the sustainability of water or some other resource. If so, reflecting externality costs through pricing is not a viable solution. Rather, other policy instruments should be used to guarantee, not simply encourage, the sustainability of the resource.

One such policy instrument may be water banks. The rules by which banks operate must be drafted to ensure that those negatively impacted by a transfer of water entitlements are adequately compensated. Banks should also veto any transfer that threatens the sustainability of the water resource or an aquatic ecosystem, or threatens other important policy objectives.

In section 4 of its *Stewardship of the Water* paper, BC Environment proposed to accommodate more coordinated actions among agencies by advocating holistic watershed planning. A strategic planning process would involve all resource- and land-uses that affect, or are affected by, the water resource in a watershed. Stakeholders need to negotiate integrated resource use associated with forestry, mining, fisheries, hydroelectric power generation, and recreation on a watershed basis (Day and Affram: 1990).

Therefore, if water banks were to be established in British Columbia, regulations under which they operate might be tied to an overall strategic plan for integrated resource use within a watershed. For example, if a strategic plan supports a sustainable water resource for fisheries, minimum flows required to preserve the aquatic ecosystem should have first priority and be protected from competing uses. If instream flows cannot be guaranteed legally, licenses to support instream fisheries resources might be purchased through the bank by interested groups or by the government.

Another barrier that may obstruct the adoption of a meaningful stakeholder negotiation could be the reluctance of the provincial government to relinquish any of its power to local communities to manage resources within their regions. Negotiation could afford stakeholders the opportunity to express their values and to identify various externality and opportunity costs. Gunton (1986) suggested that institutional reforms are required to give rural areas more democratic participation in the management of resources and economy. However, it is unlikely that government will voluntarily alter its institutions. Rather, attaining greater regional autonomy will likely require "social mobilization", a term coined by Friedmann (1987), whereby institutional reform is spearheaded by rural people directly impacted by resource use.

4.6 Collecting economic rent

The methodology and results of analyzing the capture of economic rent through water license rental fees are shown in table 24. There are a number of problems associated with using property values to estimate economic rent. One problem is that variables other than water rights can account for differences in land values. Their effect should ideally be removed from the analysis in order to isolate economic rent based on water use. Such confounding factors as property location, elevation, road access, access to productive groundwater wells, and scenic views influence property values. Accounting for such factors in deriving fee schedules would be operationally unwieldy. These factors are assumed to be statistically randomized in this study. Another problem is that information available on the BC Environment and BC Assessment Authority data bases does not provide sufficient detail to easily summarize and validate data discrepancies between them. The Nicola River should have been a relatively easy basin to analyze since the areas to which the data bases apply closely agree. However, for other parts of the province, where jurisdictional boundaries do not overlap as precisely, the above analyses would be extremely difficult to undertake. Another problem is that the market value would likely be higher than BC Assessment Authority's assessed figure (Gervais, 1995). Too many complications were encountered and too many assumptions made to have assurance that the calculations reflect real-world conditions.

The second method of computing economic rent based on computing net profit has fewer problems. However, the methodology used in this study is oversimplified. Ranching involves both a crop and a beef enterprise. The average net profit for ranch enterprises in the North Okanagan - Kamloops region was $19 700 between 1989 and 1991 (British Columbia, 1991), which is below a normal rate of return on investment. Therefore, recovering $2 000 required by method 1a to capture economic rent associated with water use would reduce any small profit that an average rancher now earns. Thus, the economic viability of some ranching operations would be jeopardized. The difference in results between the two methods suggests that any economic rent has already been "captured" in the market price of land.

Table 24

Summary: Collecting economic rent

Policy Option	Evaluation Approach	Results
Collect economic rent to encourage more efficient and less wasteful water use.	Two methods are used to evaluate the economic rent associated with irrigation in the Nicola basin. Method 1 differentiates the value of similar properties, where one property has access to irrigation water and the other does not. The amortized difference in land values is assumed to be a proxy for economic rent. Method 2 defines economic rent as net profit that exceeds a normal rate of return. In this study, a rate of return of 10 percent is assumed.	The economic rent for a 200-acre ranch in the Nicola is estimated to range between \$1 900 and \$9 400 annually using method 1. Irrigation license fees would need to be raised 7- to 34-fold to recover economic rent from ranching activities, assuming the demand for licenses is inelastic. Method 2, however, suggests that ranching does not produce profit in excess of a normal rate of return on investment. Therefore, there is no economic rent to collect from ranchers.

The second method assumes that ranchers receive no subsidies. However, ranchers can be subsidized in a number of ways (Pearse, 1968). BC Crown Lands prefers leasing Crown land to agricultural rather than other land uses. Farmers and ranchers have special land purchasing rights and there are numerous fiscal concessions through property and income tax laws. For example, farm land is taxed at a low rate compared to other land uses, and gasoline is subsidized for onfarm use. The agricultural industry also receives technical and marketing assistance from government. Subsidies in the food industry are deeply rooted in many government initiatives and distort the economy (Canada, 1989b; Rogers, 1993).

Subsidies increase a rancher's net profit. Therefore, a policy to recover economic rent would, in effect, remove these subsidies. Since subsidies are used to promote other economic strategies and other policy objectives, BC Environment would need to carefully coordinate a new policy to recover economic rent associated with the use of public water with policies of other branches of government.

For example, agricultural policies have traditionally subsidized both prices and farm income to ensure that rural areas continue to grow and prosper (Crown and Heady, 1972; Kaldor, 1975). Farmers and ranchers have been subsidized through legislation, the establishment of marketing boards, and various government programs that are administered without cost recovery. Although many subsidies have been removed in British Columbia (Bomford, 1996), attempts to recover economic rent through water licensing needs to be carefully coordinated with agricultural and regional development policies. Other agencies might consider water pricing as infringing upon their policy domain, and institutional "turf wars" could result. The main casualty of these wars could easily be the failure to achieve the policy objectives BC Environment decides upon.

4.7 Additional barriers to implementation

Some barriers that the province would need to overcome when trying to implement a pricing policy were discussed in the preceding sections. This section describes some additional implementation problems that need to be overcome.

Obtaining public support Perhaps the greatest barrier to implementation is gaining the necessary public and political support to drastically raise fees to support conservation or economic efficiency goals. Fee increases in the order of 50 percent to recover administration fees may cause some resistance from licensees. Public rebellion would occur if BC Environment attempted to raise its water fees by 7- to 58-fold. This study demonstrates that such fee increases are necessary to achieve goals other than recovering administration costs. However other policy instruments, such as regulation, may provide less resistance to accomplishing the desired objectives.

Education Another hurdle that the province must overcome is the lack of understanding among the general public in relation to why water licenses need to be priced. Based on submissions to government in response to the *Stewardship of the Water* paper (British Columbia, 1994b), most people understood the user-pay pricing principle and appreciated the arguments for recovering administrative and supply costs. However, others believed that water is abundant and should be a free good. They would view any increase in water license fees as an attempt by government to create another "cash cow". Most respondents indicated that they generally support a participatory planning process among stakeholders that could result in cooperative natural resource management of an area. Few commented on pricing to collect economic rent, which suggests that the concept behind that policy option is not well understood. Nor did anyone suggest that a market for water licenses be instituted. Thus, a communication program is needed to educate the public on the implications of various pricing and marketing policies. BC Environment might then be better able to win public and political support for pricing policies that attempt to reflect the full value of water or capture economic rent.

Equity Any pricing scheme will raise questions concerning the perception of equity. Will pricing be consistent within a particular user group? For example, is it equitable to increase license fees for some ranchers, but not others, in order to recover provincial supply costs? If a municipality is granted funds to provide capital works to supply water to a residential community, should irrigators or mining operations expect to see this cost reflected in their water licenses? Will the relative fees that different types of water users pay be fair? For example, should unit usage rates be different for industry than for ranchers, based on willingness to pay or ability to pay? Is it fair to target only those groups that extract water from surface sources, and allow those that extract groundwater free access to supply? Is it appropriate to take an anthropocentric view and value human needs before the needs of ecosystems? Or is it fair to use resources today and pass future environmental and social costs along to our children?

The fear of disadvantaging the poor is not only a perceptual problem, but a financial one as well. Pricing schemes are often regressive, impacting the poor more than the rich. An unintended outcome of many historical agricultural policies was to force many marginal farmers to sell their interests to larger, more efficient holdings (Crown and Heady, 1972). Thus, the pricing structure for collecting economic rent needs to be coordinated with other government policy objectives and needs to consider the impact on marginal ranching operations.

Property rights The property right status of water licenses is a major constraint that will impede the implementation of any pricing policy aimed at achieving sustainability objectives. While a license does not bequeath ownership of water to the user, there are only a few conditions whereby an existing licensee loses the right to water use. The province has no intention of abandoning the doctrine of prior appropriation for some other form of water allocation policy (Mattison, 1995). Therefore, if the water resources in a region like the Nicola basin are already over-allocated, irrigators may need an incentive to support conservation measures. Otherwise, they would be extremely reticent to give up priority licenses, even if by doing so, they support such a noble cause as creating a sustainable water resource.

Externality and opportunity costs Pricing schemes that try to incorporate externality and opportunity costs will unlikely be accepted universally. The example of the Truckee-Carson planning process demonstrated that agreement on these costs is difficult, even when stakeholders are committed to finding a workable management strategy.

Water banks There could be resistance to establishing banks based on the notion that provincial control of the resource is being relinquished to the market place. Perhaps the best way to determine if water banks are right for British Columbia is to "test drive" the concept through a demonstration project over a specified period of time. Details of such a project could be left to the provincial and local governments of the demonstration area, the affected local communities, and interested resource users to decide upon. The Nicola may be a good demonstration basin.

The establishment of water banks will undoubtedly affect other policy decisions. For example, British Columbia recently prohibited interbasin water transfers, largely to put at ease a public concern that provincial water will be exported to the United States. In an open market, however, export of water should not necessarily be prohibited. Idaho, for example, uses a "last-to-fill" rule, which means that the storage of water destined to areas outside the local basin is always filled last, giving assurance that the local demand for water will be satisfied first in dry years (McDonnell *et al.*, 1995). British Columbia could profit from a policy of allowing water export in years when water is in surplus.

Collecting economic rent Before the province provides for the establishment of water banks, or incorporates economic rent or opportunity and externality costs into license fees, a more fundamental question should be asked: "Would allocating water more efficiently return the greatest benefit to the province?" Rogers (1993) noted that water may not be the limiting resource in achieving the greater objective of using all natural resources wisely. Because the demand for water is often a derived demand, allocating water without considering other natural resource allocation considerations may not yield the maximum social benefit to a region (Cullis and James, 1992). In this context, such water allocation policies as pricing should be considered together with allocation policies of other natural resource ministries. Agencies responsible for natural resource allocation in British Columbia and Canada need to work more closely than at present to coordinate policy objectives and to implement resource allocation plans. Notwithstanding political constraints, strategically planning multiple resource use on a basin-wide scale is one of the best means of ensuring that total social welfare is maximized.

Integrating water policies Sustainability implies that both water quantity and quality need to be preserved to support aquatic ecosystems. Therefore, while pricing licenses may influence the allocation of water, it does not address the quality requirements of natural systems. For example, return flows from agriculture or discharges from industrial processes can contaminate water below levels suitable for fisheries and wildlife. If sustainability of the water resource is the objective of a pricing policy, the policy needs to be coordinated with other institutional policies and combined with other policy instruments to ensure that water quality is preserved in addition to adequate quantity.

First Nations Treaty negotiations are underway between the province and First Nations regarding rights to land and natural resources. The provincial government, in trying to achieve its various objectives, needs to formulate policies that will be acceptable to future jurisdictional institutions that may have control over resources as a result of these negotiations.

Funding water management Water management needs to be adequately funded in order to achieve its various policy objectives. However, Premier Clark's recent announcement of budget and staffing cutbacks in BC Environment further accentuates the problem that there are not enough resources to do everything. Generally, social policies related to health, education, and regional development tend to win out over environmental policies. The result is that funding and resources are insufficient to pursue environmental objectives.

There are legitimate reasons why social programs may be treated preferentially to environmental ones. First, social programs tend to be anthropocentric, whereas environmental programs tend to be biocentric. Society today tends to favor human needs over environmental ones. Environmental needs will receive equal consideration with human needs when society is faced with catastrophic damage to the environment that threatens human values and existence. Second, many environmental policies are plagued by uncertainty because they are based on limited data, inexact science, and debatable models and modeling assumptions. Added to the variable nature of many natural phenomena, the uncertainty of success of a policy may cause a reluctance to throw money at projects from public coffers when less risky programs from the social-policy arena can be financed. Several studies exemplified the uncertain nature of environmental projects by showing that only 55 percent of stream habitat restoration projects in British Columbia were successful after two years, with similar results reported in Oregon, Washington, Alaska, and Alberta (Hartman and Miles, 1995; Kellerhals and Miles, 1996). Hume (1996), looking at the results of these studies, commented that "hubris begets nemesis, [and] that the greatest human effort, expense, and ingenuity may not be good enough to retrieve the mistakes made by rash meddling in a complex natural order".

Metering For pricing to be effective for conservation objectives, tariffs should be based on actual water use, not the amount licensed. This requires that water use be metered. Administering metered versus entitled water use would increase government costs, while purchasing and operating meters would increase ranchers' costs. The additional cost of metering would reduce social welfare, and there is always the risk that this reduction will more than offset the increase in social welfare achieved by more efficient use through metering. Whether metering is required needs to be determined through economic analysis on a case-by-case basis.

5 CONCLUSIONS AND RECOMMENDATIONS

The British Columbia government proposed that pricing of water licenses could be used to achieve four different policy objectives: recover administration costs, recover supply costs, reflect the full value of water, and capture economic rent. This study assessed the impact that pricing would have on water license rental fees for selected uses in the Nicola River basin. The increases in water license fees in the Nicola River basin required to achieve the objectives of each of the province's policy objectives are summarized in figure 10 and table 25.

Fee increases required to achieve the various policy objectives vary drastically (fig. 10). The province needs to articulate which of these policies it wishes to adopt. It can choose to adopt one, several, or all of them. If more than one policy objective is chosen, the fee increases noted above should be mostly additive.

As public acceptability of a pricing policy will play a major role in deciding which policy or policies to adopt, recovering administration fees may well be the easiest to implement. However, British Columbia needs to balance the potential acceptability of modest fee increases against its commitment to sustainability of the water resource, and its wish to reallocate inefficiently used water to more beneficial uses. It is in this context that the following recommendations are made.

Table 25

License fee increases in the Nicola basin for each policy option

Policy Option	Required Water License Fee Increase	Comment
Recover administration costs	21 - 73 percent	Applies to all licenses other than hydroelectric power generation.
Recover municipal grants	58-fold	Applies to Merritt's Local Authority water license.
Recover project costs	30-fold	Potentially applies to 80 irrigators who draw water from Nicola Lake and Nicola River
Reflect opportunity costs	16-fold	Applies to irrigation licenses.
Reflect externality costs	Not computed.	Would apply to water license uses that negatively impact third parties.
Collect economic rent	Method 1: 7- to 34-fold Method 2: No increase	Applies to irrigation licenses.

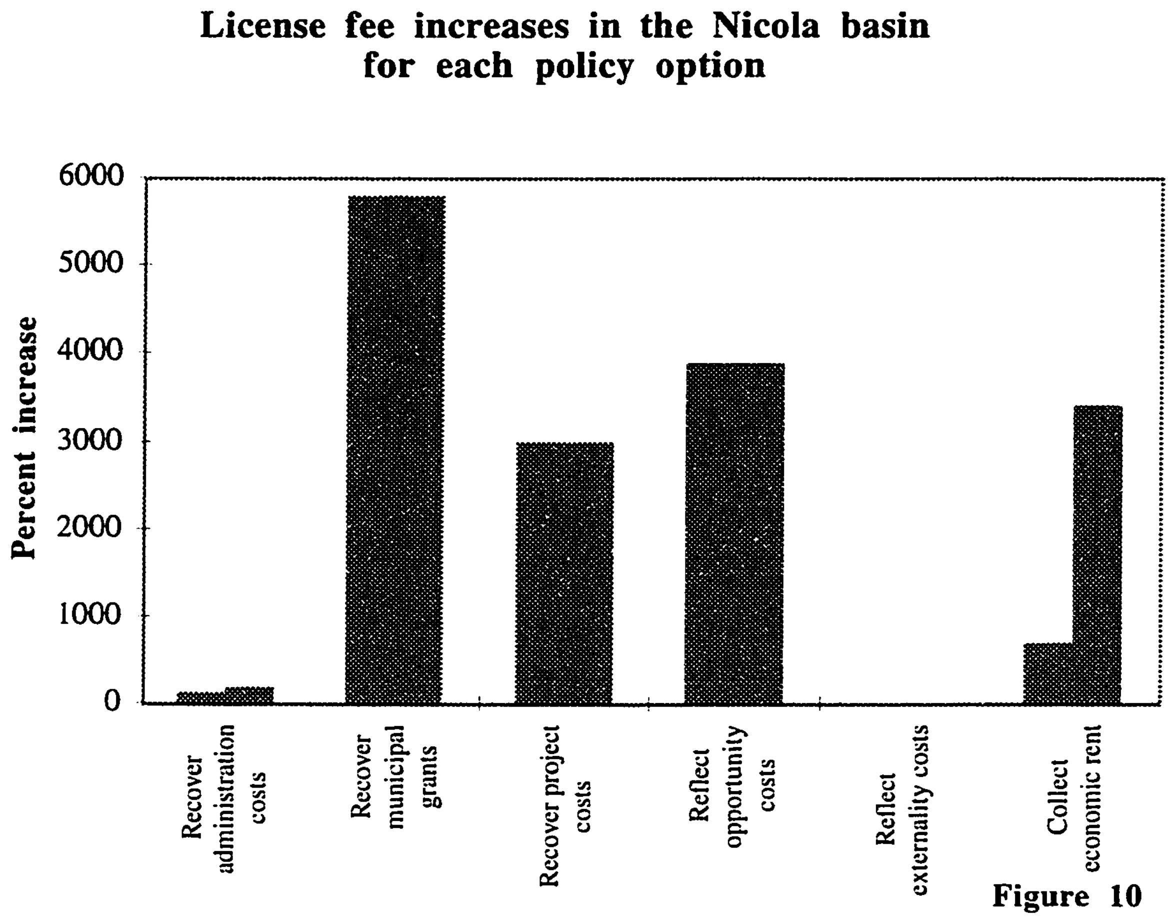


Figure 10

Recommendation 1 **BC Environment must rationalize its water license pricing policy, and articulate its intended purpose to the public.**

For most of this century, British Columbia subsidized water license fees to promote regional and economic development objectives. In the early 1980s, the province adopted a user-pay pricing policy aimed at recovering administrative costs. Most recently, British Columbia committed itself to reviewing more sustainable options for water management in its *Environmental Action Plan* and *Stewardship of the Water* initiatives. The province must now decide whether pricing water licenses will be a tool used to achieve sustainability objectives.

This study estimates fee increases that would result from implementing each policy option in the Nicola River basin. The province can use these estimates as decision support information in rationalizing its pricing policy. Once decided, the province should publicize its policy decision.

Recommendation 2 **If water license fees are collected to recover administration costs, any fees collected should be used directly to support *Water Allocation and Regulation*, rather than being deposited into general revenue.**

Recommendation 3 **The province should look for mechanisms other than pricing water licenses to recover municipal grants.**

Some municipalities obtain their water supply from groundwater. Since licenses are not required at present to extract water from groundwater, recovering grants through license fees would be impractical. The province should consider amending the grant program to a loan program to encourage municipalities to use water more wisely and institute marginal costing principles in their rate structures.

Recommendation 4 **BC Environment should ensure that whatever pricing policy is adopted does not counter policy objectives of other branches of government.**

BC Environment needs to check that policies and planning initiatives of other municipal, provincial, and federal agencies complement its own policy objectives. For example, both BC Agricultural and the federal Department of Fisheries and Oceans policies need to be harmonized with those of BC Environment to promote agricultural and fisheries practices that are compatible with the vision for a healthy sustained water resource. Similarly, BC Municipal Affairs water supply and waste water infrastructure grant policies need to be formulated and coordinated with BC Environment's policies.

BC Environment must consider the subsidies provided through other arms of government when pricing its licenses. If ranchers are being subsidized to promote the agricultural sector by BC Agriculture, is it appropriate for BC Environment to essentially neutralize that subsidy through its own tariff structure? Tate and Fortin (1990) recommended that subsidies for water use, if they are meant to support nonwater-related policy objectives, be channeled to users directly to defray water costs, rather than mask the subsidy by underpricing water. By explicitly acknowledging subsidies through direct payments, a more accurate price signal for the value of water can be sent to water licensees.

Recommendation 5 **If cost recovery is an objective of financing water supply works, cost sharing arrangements should be agreed to prior to implementation of projects.**

Recommendation 6 **BC Environment should consider water banks as an alternative for reallocating water to more beneficial uses and to account for opportunity and externality costs.**

Recommendation 7 **The use-it-or-lose-it provision associated with the prior appropriation doctrine should be amended if water banks are instituted.**

Recommendation 8 **BC Environment should consider setting the rules and regulations that govern the operation of water banks, if this strategy is adopted, to be consistent with strategic plans for integrated resource use within a watershed.**

Recommendation 9 **BC Environment should not use the capitalized value of water in land assessments as a proxy for economic rent. If economic rent is to be collected, a better method would be to compute it based on net profit above an acceptable return on investment.**

Although there is a statistically significant difference in assessed values between irrigated and nonirrigated properties, there are too many problems with the available data and with matching water license and property data to have confidence in the accuracy of the calculations. The procedure used in this study is time-consuming and cumbersome. It is not recommended for administrative use.

Recommendation 10 **Water license fees should reflect actual water use rather than licensed entitlement.**

If the province wishes to reduce water use to conserve water for the preservation of aquatic environment, metering in combination with pricing would provide an incentive to licensees to use less. The additional costs to licensees and government associated with metering must be weighed against the conservation benefits gained.

Recommendation 11 If economic rent is to be collected in water rental fees, the province should also begin to license groundwater use.

The province would have a difficult time rationalizing the equity issues of collecting economic rent from surface water users, but not groundwater users.

Recommendation 12 Once a pricing policy has been articulated, the province can then focus attention on a rate design.

A number of tariff structures can be used to recover costs. These structures include a fixed charge, constant unit rates, and block unit rates. A *fixed charge* is the most common municipal pricing method in Canada. A fixed charge does not reflect the incremental cost of water consumption. Generally other measures, such as water rationing and lawn-watering restrictions, are applied if the marginal cost of water consumption exceeds the revenue produced by the fixed charge. *Constant unit rates* apply to the price for each unit of water consumed. They reflect the marginal cost of water provision only if they are set equal to marginal cost. With *block unit rates*, the charge per unit is at one level up to a certain quantity consumed, and then at a higher or lower level for greater consumption. If the marginal cost is below average cost, then the second block should be priced below the first block rate. This is referred to as a declining block structure. Conversely, if the marginal cost is above average cost, then the second block should be priced above the first block rate. This is referred to as an inverted block structure.

The method of public financing that the government adopts will depend largely on the policy option chosen as the basis of any future rate schedule and rate structure. The government can collect revenues through general taxation. This option would be preferred when water is being used as a public good and no individual, or group of individuals, can be targeted for cost recovery. When water is used as a private good, however, user fees that are attached to water licenses would be more appropriate. The government can also choose not to collect revenues in full from a benefiting user of a resource, thereby providing an indirect subsidy to the user. Such a policy should be adopted to support other government policies and objectives for the economy of the province.

The province, therefore, needs to address a number of water license rate structure issues. Should rates continue to be based on a fixed charge and constant rate structure, or should the rates be designed with both a fixed charge and block rate structure? Should the block structure be declining, constant, or inverted? Similar to its application to municipal water supply, a two-tiered rate schedule, with fixed and variable components, would help to achieve the province's goal of cost recovery, and at the same time, help to promote more efficient water use (Canada, 1989b). To implement such a rate structure effectively, the rates should be applied to actual water use, not the quantity of water licensed. This would require metering which has its own cost implication.

APPENDIX A

BC ASSESSMENT AUTHORITY AND BC ENVIRONMENT DATA BASES

An Excel data base was generated that contained information required to estimate economic rent in chapter 3.4. The sources of the data were the BC Assessment Authority's property assessment data base, and BC Environment's water license data base. The fields that were used in the Excel data base were a subset of the information received from both ministries. The following sections outline which fields were used in this study.

The BC Assessment Authority Data File A computer file was generated from BC Assessment Authority's main data base. Some of the information on the properties located within School District #31 was not relevant to this study. Gervais (1995) suggested that useful fields to this study are:

- Jurisdictional area. Only School District #31 information was used.
- Actual use. Farm use properties were identified by extracting codes 110 to 190.
- The assessed land value. Farm land is generally assessed below equivalent market value. However, there are very few sales of agricultural property in the Nicola River basin. Most of the properties involve large tracts of land, especially in the Douglas, Guichon and Upper Nicola regions (Gervais, 1995). Few, if any, lands with water

licenses are sold. Properties that sell tend to be small and without water rights. Determining the difference between market and assessed values based on a market survey would likely be unproductive. Market value would likely be higher than assessed values.

- Rate type was used to differentiate the operational portion of the farm property from the residential component. Code 1A designates the operational farm component of the property and was used in this study. Code 2 represents the residential component of a property, and was excluded from the analysis.

- Rate code is comprised of a four digit number. The meanings of the numbers in the code are as follows: the first two digits refer to the schedule number for assessments, the third digit refers to the cultivation type, and the fourth digit refers to the soil classification.

  The first two digits always refer to the schedule number 89 for this study. This schedule includes classifies ranches in School Districts 24, 29, 30 and 31.

  The land cultivation classifications are:

Irrigated 1	Best lands at low elevation, assumed to have three annual alfalfa crops.
Irrigated 2	Average upper grasslands, assumed to have two annual alfalfa crops.
Irrigated 3	Timbered grazing zones, assumed to have one annual alfalfa crop.
Dry 4	Assume one alfalfa crop
Grasslands 5	Upper elevation
Grasslands 6	Middle elevation
Grasslands 7	Lower elevation
Grasslands 8	Timber
Past seeded 9	

The soil type classifications are:

Best 1	Irrigated - Best soil
Better 2	Irrigated - Better soil
Worse 3	Irrigated - Worse soil
Worst 4	Irrigated - Worst soil
5-7	Non-irrigated grasslands

- Acreage of the parcel.

- PID, a unique number associated with the parcel of land. This number was a common field in both the BC Assessment Authority and the BC Environment data bases. The PID was to be the sort key on which the two data bases could be merged. However, not all water licenses had a PID number entered into the data base. Also, there is only room for one PID number in the BC Environment data base for each water license and a complication arises when one water license applies to more than one parcel of land.

- Legal descriptions.

- Land owner. Knowing the owner was occasionally useful in matching records with the appropriate licensee on the BC Environment data base.

The BC Water License Data File A computer file was generated from BC Environment's water license data base. Some of the information on the licenses located in the Nicola River Basin were not relevant to this study. The fields of the data base that were used are as follows:

- District 21A, 21B, 21C and 21D, or the Nicola River Basin licenses.

- The name of the lake or stream from which water is extracted.

- Water license number. Only final and conditional water licenses were considered. Applications for water licenses, or license numbers beginning with the letter 'Z', were not considered. BC Environment's data base is designed such that the same water license number can be entered more than once if water is extracted from more than one source, or if more than one point of diversion exists and are shown on more than one map sheet. However, the legal description field contained a description of all parcels of land to which the license applies. Separate records are not kept for each distinct parcel of land.

- Point of diversion on the water source.

- Purpose of the water use. Only irrigation or irrigation use by a local authority were considered in the analysis in section 3.

- Quantity of water diverted or used, in acre-feet.

- Licensee. The licensee was often cross-referenced with the owner field in the BC Assessment Authority data base to try to match records more easily.

- Legal descriptions. If more than one parcel of land is associated with the license, they are all entered in this one field.

- PID number. Only one PID is entered per license. The data base contained an incomplete set of PID numbers. For example, when a water license applied to multiple land parcels, no PID was entered. Often, PID numbers were not entered for older licenses, even when they were associated with one parcel of land.

  The PID field in the data base were updated by cross-referencing the property descriptions for all irrigation licenses with property descriptions in the BC Assessment Authority data base. To do so, the number of PIDs that could be entered per license were expanded. All relevant PID numbers were updated where a water license applied to multiple properties.

- Irrigated area in acres.
- The duty was computed by dividing the licensed quantity by the area being irrigated.

BIBLIOGRAPHY

Adamowicz, Wiktor L. 1994. "Water conservation: An economic perspective", pp. 227-233. In **Every drop counts**, edited by Dann Shrubsole and Don Tate. Winnipeg, MB: Canadian Water Resources Association.

Beecher, Janice A. and Patrick C. Mann 1996. "The role of price in water conservation: Evidence and issues", pp. 53-58. In **Conserv 96 proceedings** of the Orlando, FL conference. Denver, CO: American Water Works Association.

Bernard, Jean-Thomas and Raymond W. Payne. 1987. "Natural resource rents and hydroelectric power: The case of British Columbia and Manitoba", pp. 59-87. In **Resource rents and public policy in Western Canada**, edited by Thomas Gunton and John Richards. Halifax, NS: The Institute for Research on Public Policy.

Birch, Alfred L. and R. Bruce MacLock. 1992. "Water conservation and transferable water rights: Australia and Alberta". **Canadian Water Resources Journal** 17(3):214-222..

Black, E. R. 1968. "British Columbia: The politics of exploitation", pp. 23-43. In **Exploiting our economic potential: Public policy and the British Columbia economy**, edited by R Shearer. Toronto, ON: Holt, Rinehart, and Winston.

Boadway, Robin W. and David E. Wildasin. 1984. **Public sector economics**, 2nd Edition. Boston, MA: Little, Brown and Co.

Bomford, Larry. 1996. Strategic Policy Advisor, Policy and Legislation Services Branch, BC Agriculture. Victoria, BC: Personal communication.

British Columbia. 1983. **Nicola basin strategic plan**. Victoria, BC: Ministry of Environment, Lands, and Parks.

____________. 1991. **Cow - calf farm business analysis: Summary report 1989 - 1991**, by G. R. Keay. Victoria, BC: Ministry of Agriculture, Fisheries and Food.

____________. 1992a. **British Columbia economic and statistical review**, 52nd Edition. Victoria, BC: Crown Publications.

____________. 1992b. **Environmental action plan for British Columbia.** Victoria, BC: Ministry of Environment, Lands, and Parks.

____________. 1993a. **Alfalfa hay production 3-cut square bale system.** Producer Management Information Series. Kamloops, BC: Ministry of Agriculture, Fisheries and Food.

____________. 1993b. **Alfalfa hay production 3-cut round bale system**, Revised edition (1986). Producer Management Information Series. Kamloops, BC: Ministry of Agriculture, Fisheries and Food.

____________. 1993c. **Multiple account evaluation guidelines**. Vancouver, BC: Crown Corporations Secretariat.

____________. 1993d. **Stewardship of the water of British Columbia: a review of British Columbia's water management policy and legislation**. Victoria, BC: Ministry of Environment, Lands, and Parks.

____________. 1994a. **Classification of aquifers in the Fraser River basin - 1994/1995**, by K. Ronneseth. Prepared for BC Ministry of Environment and Parks. Victoria BC: Fraser River Action Plan.

____________. 1994b. Summary of comments to "Stewardship of the water of British Columbia". Unpublished. Victoria, BC: Ministry of Environment, Lands, and Parks.

British Columbia Electric Company. 1948. Letter dated July 12 from Bruce Robertson (BC Electric) to A. J. Whitmore (DFO).

British Columbia Energy Council. 1994. **Planning today for tomorrow's energy: An energy strategy for British Columbia**. Prepared for the Ministry of Energy, Mines, and Petroleum Resources. Victoria, BC.

British Columbia Hydro. 1994. **Report on the electric system operations review**. Prepared for the Minister of Employment and Investment and the Minister of Energy, Mines and Petroleum Resources. Vancouver, BC.

____________. 1996. **Connection: BC Hydro Annual Report**. Vancouver, BC.

British Columbia Utilities Commission. 1994. **Kemano completion project review**. Report and Recommendations to the Lieutenant Governor in Council. Vancouver, BC.

Brooks, David B. and Roger Peters. June 1988. **Water: The potential for demand management in Canada**. Ottawa, ON: Science Council of Canada.

Brooks, David, Roger Peters and Paul Robillard. 1990. "Pricing: A neglected tool for managing water demand". **Alternatives** 17(3):40-48.

Bruce, James and Bruce Mitchell. 1995. **Broadening perspective on water issues**, Incidental Report Series No. IR 95-1. Ottawa, ON: Canadian Global Change Program.

Canada / British Columbia. 1986. **Agreement - Nicola Dam construction and operation**. Victoria, BC: Ministry of Environment, Lands and Parks.

___________. 1994a. **Groundwater resources of British Columbia.** Victoria, BC: Ministry of Environment, Lands and Parks and Environment Canada.

___________. 1994b. "Process for instream flow assessment". DRAFT. Fisheries Instream Flow Committee. Fisheries and Oceans and BC Ministry of Environment, Lands and Parks.

Canada. 1979. "Coordinated use and administration of rangelands", pp. 5-8. In **Range management handbook for British Columbia**, edited by Alastair McLean. Kamloops, BC: Agriculture Canada Research Station.

___________. 1986. **Policy for the management of fish habitat**. Ottawa, ON: Environment Canada.

___________. 1987. **Federal water policy**. Ottawa, ON: Environment Canada.

___________. 1989a. **Current practice and prices.** Cat. No. EN37-84/1989E, Ottawa, ON: Environment Canada, Minister of Supply and Services.

___________. 1989b. **Economic theory of water pricing**, by Roger McNeill. Vancouver, BC: Environment Canada.

___________. 1997. **Consumer price index**. Catalogue 62-001. Ottawa, ON: Statistics Canada.

Crippen Consultants. 1985/86. **Nicola Lake dam - Contract no. 1 Progress Reports**. Vancouver, BC.

Crown, Robert W. and Earl O. Heady. 1972. **Policy integration in Canadian agriculture**. Ames, IA: Iowa State University Press.

Cullis, John and Philip Jones. 1992. **Public finance and public choice: Analytical perspectives**. London, GB: McGraw-Hill.

Day, J. C. and J. A. Affram. 1990. **Toward sustainable water planning and management in British Columbia.** Prepared for the BC Round Table on the Environment and the Economy. Burnaby, BC: School of Resource and Environmental Management, Simon Fraser University.

Doyle, Paul. August 1996. Head of Engineering Section, Water Management Division, Kamloops Region. Kamloops, BC: Personal communication.

Driver, Bruce. 1986. **Western water: Tuning the system**. Salt Lake City, UT: Western Governors Association.

Due, John F. and Ann F. Friedlaender. 1981. **Government finance: Economics of the public sector**, 7th edition. Homewood, IL: Richard D. Erwin.

Dutton, Lee. 1995. "Tripartite fish flow agreements". Presented at the **Fish habitat in stream channels symposium**, sponsored by the Canadian Society for Civil Engineering. Simon Fraser University, Burnaby, BC.

Dybvig, Wayne and Dr. Suren Kulshreshtha. 1994. "The economic value of water: A perspective on its practical utilization", pp. 283-299. In **Water: A resource in transition**, Proceedings of the 47th annual conference. Winnipeg, MB: Canadian Water Resources Association.

Finnigan, Rheal. 1995. "Review of water intake designs for stream improvement projects. Presented at the **Fish habitat in stream channels symposium**, sponsored by the Canadian Society for Civil Engineering. Simon Fraser University, Burnaby, BC.

Fortin, M. 1985. **The economics of municipal water supply: Applying the user-pay principle**. Research Paper #21. Ottawa, ON: Inquiry on Federal Water Policy.

Fredrick, Kenneth D. 1986. **Scarce water and institutional change**. Washington, DC: Resources for the Future.

Freeman, Ruth E. and Terrence S. Veeman. 1993. "Economic aspects of transferable water rights in Alberta", pp. 261-278. In **Water and the Wilderness: Development, Stewardship, Management**, Proceedings for the 46th Annual Conference. Banff, AB: Canadian Water Resources Association.

Freshwater, D., D. F. Kraft and C. P. Framingham. 1981. "The economics of drought proofing agriculture", Annual Proceedings. St. Catherines, ON: Canadian Agricultural Economics Society.

Friedmann, John. 1987. **Planning in the public domain: From knowledge to action**. Princeton, NJ: Princeton University Press.

Gervais, Jack. November 1995. Regional Appraiser, BC Assessment Authority. Kamloops, BC: Personal communication.

Gunton, Thomas and John Richards. 1986. "Natural resources and economic development". Presented to the **Conference on Industrial Challenge and Transformation in Australia and Canada**. Simon Fraser University. Burnaby, BC.

____________. 1987. "Political economy of resource policy", pp. 1-57. In **Resource rents and public policy in Western Canada**, edited by Thomas Gunton and John Richards. Halifax, NS: The Institute for Research on Public Policy.

Gunton, Thomas I. 1982. **Resources, regional development and provincial policy: A case study of British Columbia**, Publication No. 7 Inaugural Conference Proceedings. Ottawa, ON: Canadian Centre for Policy Alternatives.

____________. 1986. "An economic strategy for British Columbia", pp. 56-78. In **After Bennett: A new politics for British Columbia**, edited by Warren Magnusson, *et al.*. Vancouver, BC: New Star Books.

____________. 1992. "Evaluating land use tradeoffs: A review of selected techniques". **Environments** 21(3):53-63.

Hanke, Steve H. 1985. **The user-pay principal and market socialism.** Research Paper #21. Ottawa, ON: Inquiry on Federal Water Policy.

Harris, Jeff. 1994. "Practical modifications to the theory of marginal cost pricing in municipal rate setting for water utilities", pp. 239-248. In **Every drop counts**, edited by Dann Shrubsole and Don Tate. Winnipeg, MB: Canadian Water Resources Association.

Hartman, G. F. and Miles, M. 1995. **Evaluation of fish habitat projects in British Columbia and recommendations on the development of guidelines for future work**. Unpublished. Victoria, BC: BC Environment, Fish and Wildlife Branch.

Hume, Stephen. 1996. **After disastrous meddling, time runs out for crucial salmon stream**. Vancouver, BC: November 4, 1996 Vancouver Sun.

Jacobs, Michael. 1993. **The green economy: environment, sustainable development, and the politics of the future**. Vancouver, BC: UBC Press.

James, Douglas L. and Robert R. Lee. 1971. **Economics of water resource planning**. New York: McGraw-Hill.

Kaldor, Donald R. 1975. "Rural income policy in the United States", pp. 143-163. In **Externalities in the transformation of agriculture: Distribution of benefits and costs from development**, edited by Earl O. Heady and Larry R. Whiting. Ames, IA: Iowa State University Press.

Keeney, R. L. 1992. **Value-focused thinking**. Cambridge, MA: Harvard University Press.

Kellerhals, R. and M. Miles. 1996. "Fluvial geomorphology and fish habitat: Implications for river restoration", In **Proceedings of the 2nd IAHR symposium on habitats and hydraulics**, edited by Leclerc, M. *et al.* Quebec, PQ: Ecohydraulics 2000.

Kierans, Eric. 1987. Forward pp. ix-xiv. **Resource rents and public policy in Western Canada**, edited by Thomas Gunton and John Richards. Halifax, NS: The Institute for Research on Public Policy.

Kulshreshtha, S. N. and J. A. Gillies. 1994. "The economic value of the South Saskatchewan River to the city of Saskatoon", Part III of the series "Value of Alternative Minimum River Water Flow", **Canadian Water Resources Journal,** 19(1):39-55.

Kulshreshtha, S. N. and W. J. Brown. 1994. "Adoption of irrigation: A review of the South Saskatchewan River irrigation district". **Canadian Water Resources Journal,** 19(2):125-140.

Lebowitz, Michael A. 1986. "Beyond right-wing economics: From absurdity to rationality", pp. 22-42. In **After Bennett: A new politics for British Columbia**, edited by Warren Magnusson, *et al.* Vancouver, BC: New Star Books.

MacDonnell, L. J., C. W. Howe, K. A. Miller, T. A. Rice and S. F. Bates. 1994. **Water Banks in the West.** Boulder, CO: Natural Resources Law Center, University of Colorado.

Malkinson, W. H. 1991a. **The development of a strategy for water resources pricing in British Columbia - Phase I final report**. Prepared by Western Economic Consulting. Victoria, BC: BC Environment.

____________. 1991b. **The development of a strategy for water resources pricing in British Columbia - Phase II final report.** Prepared by Western Economic Consulting. Victoria, BC: BC Environment.

Manitoba. Ministry of Natural Resources. 1994. **Applying Manitoba's water policies.** Winnipeg, MB.

Mattison, Jim. September 1995. Director of the Hydrology Section, Resource Inventory and Data Management Branch, BC Environment. Victoria, BC. Personal communication.

McCloskey. 1982. **The applied theory of price**. New York, NY: MacMillan Publishing.

McGuigan, James R. and R. Charles Moyer. 1993. **Managerial economics,** Sixth edition. St. Paul, MN: West Publishing Co.

Moore, Jenny. October 1996. Planning Department of the Greater Vancouver Regional District. Presentation to MRM Public Policy class at Simon Fraser University, Burnaby, BC.

Moore, Ted. December 1995. District Agrologist, BC Agriculture, Kamloops, BC: Personal communication.

Narcisse, Arnie. November 1995. Nicola Watershed Stewardship and Fisheries Authority. Merritt, BC: Personal communication.

Newbury, Robert. 1995. "Stream habitat restoration using pools and riffles". Presented at the **Fish habitat in stream channels symposium**, sponsored by the Canadian Society for Civil Engineering. Simon Fraser University, Burnaby, BC.

Ozog, Michael T. 1996. "Price elasticity and net lost revenue", pp. 485-489. In **Conserv 96 proceedings** of the Orlando, FL conference. Denver, CO: American Water Works Association.

Patton, Carl. V. and David S. Sawicki. 1993. **Basic methods of policy analysis and planning**. Englewood Cliffs, NJ: Prentice Hall.

Pearce, David W. and R. Kerry Turner. 1990. **Economics of natural resources and the environment**. Baltimore, MD: Johns Hopkins University Press.

Pearse, P. H. 1968. "Natural resource policy in British Columbia: An economist's critique", pp. 45-57. In **Exploiting Our Economic Potential: Public Policy and the British Columbia Economy**, edited by R Shearer. Toronto, ON: Holt, Rinehart and Winston.

Pearse, P. H., F. Bertrand and J. W. MacLaren. 1985. **Currents of change: Final report.** Ottawa, ON. Inquiry on Federal Water Policy.

Prillwitz, Marsha. 1996. "The water connection: The relation of water to sustainable agriculture", pp. 183-188. In **Conserv 96 proceedings** of the Orlando, FL conference. Denver, CO: American Water Works Association.

Quinn, Frank. 1973. Notes for "A national water policy", presented at G. I. R. M. S. 1973-74 Conference. Waterloo, ON: Wilfred Laurier University.

Reid, Mary E. 1996. "Increasing social capital involving citizens in complex water allocation decisions", pp. 671-675. In **Conserv 96 proceedings** of the Orlando, FL conference. Denver, CO: American Water Works Association.

Robinson, Gary. March 1996. Assistant Head, Analysis Unit, Water Act Support, BC Environment. Victoria, BC: Personal communication.

Rogers, Peter. 1993. **America's water: Federal roles and responsibilities**. A twentieth Century Fund Book. Cambridge, MA: MIT Press.

Rueggeberg, Harriet and Andrew R. Thompson. 1984. **Water law in Canada.** Research Paper #1. Prepared by Westwater Research Centre, UBC. Vancouver, BC: Inquiry on Federal Water Policy.

Russell, Denis S. O. 1996. **Review of the November 29, 1995 flood on the Alouette River**. Report to BC Hydro and Power Authority. Vancouver, BC.

Schwindt, Richard. 1987. "The BC forest sector: pros and cons of the stumpage system", pp. 181-213. In **Resource rents and public policy in Western Canada**, edited by Thomas Gunton and John Richards. Halifax, NS: The Institute for Research on Public Policy.

Shearer, R. A. 1968. "The development of the British Columbia economy: The record and the issues", pp. 3-20. In **Exploiting our economic potential: Public policy and the British Columbia economy**, edited by R Shearer. Toronto, ON: Holt, Rinehart and Winston.

Stephens, K. A., T Van der Gulik, and T. Heath. September 1992. **Water, water everywhere: Does British Columbia really need a water conservation strategy?** Vancouver, BC: BC Professional Engineer.

Steppuhn, Harold. August, 1996. Research Scientist and Plant Ecologist, Agriculture Canada. Swift Current, SK. Personal communication.

Stirling, Andrew. December 1992. "Regulating the electricity supply industry by valuing environmental effects". **Futures.**

Tate, Donald M. 1990. **Water demand management in Canada: A state-of-the-art review**. Social Science Series No. 23. Ottawa, ON: Inland Waters Directorate, Environment Canada.

Tate, Donald M. and Michel Fortin. 1990. **Water demand management: An application to the South Saskatchewan River basin in the Province of Saskatchewan**. Technical Report E 18. Prepared for the Canada-Saskatchewan South Saskatchewan River Basin Study. Moose Jaw, SK: Environment Canada and Saskatchewan Water Corporation.

Thompson, John P. June 1994. "The economics of water: An Alberta perspective", pp. 301-309. In **Water: A resource in transition**. Proceedings of the 47th annual conference. Winnipeg, MB: Canadian Water Resources Association.

Toner, T. P. and R. G. Rice. 1994. **Nova Scotia water license fee credit program**. Presented at the CEA Environmental Subsection Hydraulic Power Section , Engineering and Operations Division. Toronto, ON: CEA.

United States. 1973. **Water Policies for the Future.** Water Information Center Inc. Port Washington, NY: National Water Commission.

___________. 1980. **Designing and negotiating studies using instream flow incremental methodology**. Ft. Collins, CO: Fish and Wildlife Service.

___________. 1982. **A guide to stream habitat analysis using the instream flow incremental methodology**, by Ken D. Bovee. Ft. Collins, CO: Fish and Wildlife Service.

van der Gulik, T. W. 1994. "Developing an agricultural water conservation strategy for British Columbia", pp. 123-133. In **Every drop counts**, edited by Dann Shrubsole and Don Tate. Winnipeg, MB: Canadian Water Resources Association.

VanderZwaag, David. 1994. **CEPA and the precautionary principle/approach.** Hull, PQ: Environment Canada.

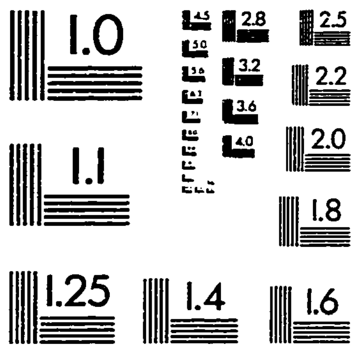
Warnock, John. W. 1986. "Agriculture and the food industry", pp. 150-168. In **After Bennett: A new politics for British Columbia**, edited by W. Magnussen, *et al.* Vancouver, BC: New Star Books.

Western Producer (The). 1996. **Water act called 'cave-in' to ag lobby**, June 27, 1996.

Wexelbaum, D. 1996. Workshop at **Conserv 96.** Orlando, FL.

Willardson, Tony. 1995. "State water conservation programs", pp. 1-9. Proceedings of the **Western Water Conservation Conference**. San Diego, CA: US Bureau of Reclamation and Western States Water Council.

IMAGE EVALUATION TEST TARGET (QA-3)



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