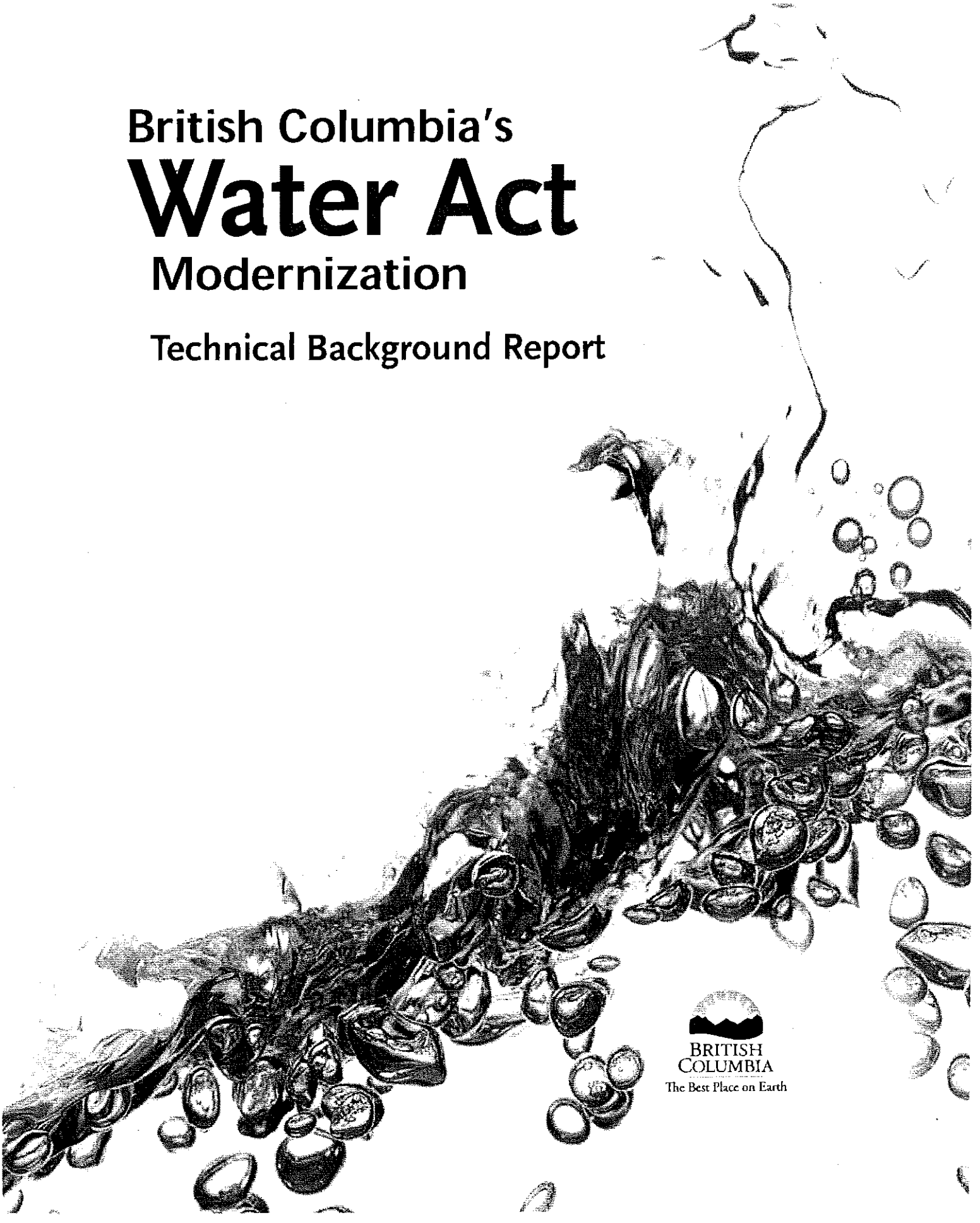
British Columbia's
Water Act
Modernization

Technical Background Report



BRITISH COLUMBIA
The Best Place on Earth

"British Columbians are proud of our rivers, lakes, streams and watersheds and recognise that keeping them healthy is important to all of us. A plentiful amount of clean water is needed for our growing communities, economic growth, healthy food, clean energy and our beautiful environment. As a finite resource, water's limits must be recognized, which means that the days of taking our 'unlimited' supply of water for granted have passed."

Premier Gordon Campbell
Living Water Smart

Contents

Introduction

This *Technical Background Report* is a companion document to the *Water Act Modernization Discussion Paper*. The discussion paper outlines opportunities for using, sustaining and managing water resources in a changing environment and was developed to encourage dialogue on ways to modernize water law. It proposes principles to underpin a modernized *Water Act* and presents goals, objectives and describes possible solutions. The purpose of this Technical Background Report is to review historical background, technical information and leading thought and practice that will inform discussion about modernizing British Columbia's *Water Act*.

Water Act modernization (WAM) background information including and details on the process, along with the discussion paper are available on-line at www.livingwatersmart.ca/water-act/.

How To Use This Paper

The information in this report was one of the inputs that aided development of the objectives and possible solutions outlined in the discussion paper. The two documents are complementary and should be considered together.

This report has four sections. Following the introduction, sections one through four align with the four goal areas identified in the Water Act Modernization discussion paper. The four sections in this paper are as follows:

1. Protecting Stream Health and Aquatic Environments (aligns with Goal 1)
2. Improving Water Governance Arrangements (aligns with Goal 2)
3. Introducing More Flexibility and Efficiency in the Water Allocation System (aligns with Goal 3)
4. Regulating Groundwater Extraction and Use (aligns with Goal 4)

Sections 1 through 4 of this report are each structured around the following themes:

- introduction and overview;
- current regulatory arrangements in British Columbia;
- pressures for change;
- how the pressures are being addressed; *and,*
- leading thought and practice from around the province and the world.

Like the discussion paper, this report does not present any preferred options, positions or provide definitive changes to specific provisions of the existing *Water Act*. This document includes information relevant to BC and is not an exhaustive investigation of all techniques and practices for water management and governance. It provides extra information to aid discussions on modernizing the *Water Act*.

This document can be read electronically and has live hyperlinks to additional resources. Additional information on *Water Act* modernization is also provided through the *Living Water Smart* website at www.livingwatersmart.ca. For more information on *Water Act* modernization background, scope, and process please see the discussion paper and the web site identified above.

The Study Approach for This Technical Background Report

The first phase of *Water Act* modernization initiative involved gathering and synthesizing information from a broad range of sources including:

- review of science and monitoring information regarding BC's watersheds;
- review of academic, government and other literature;
- review of national and international best practices; and
- case studies, interviews with practitioners and technical staff, and working group sessions.

Specific consideration was given to local academic thought and work. Studying experiences and best practices from other jurisdictions also provides an opportunity to assess and adopt effective techniques in BC that have already been tested elsewhere.

Similar trends and issues in water management face jurisdictions around Canada and the world. Commonalities exist in international legislative and institutional reforms launched to address these issues. Government staff looked at emerging local, national and international best practice through review of online resources, published documents, key legislation and phone interviews with technical staff in other places. A successful model needs to draw on best practices while giving due regard to adaptations that accommodate local history, geography, economy, and public preferences.

This report synthesizes much of the information obtained through this research and analysis phase of the WAM process and was used to inform the development of the objectives and possible solutions for a modernized *Water Act* as set out in the discussion paper.

Many of the studies and reports used to inform this work are available online in the "Resources" section of the Living Water Smart website at: www.livingwatersmart.ca/resources/publications.html.

PART ONE

Protect Stream Health and Aquatic Environments

"A river is the report card for its watershed."
Alan Levere

1.1 What is Stream Health

Healthy streams are vital for British Columbia's social and economic well being. This section explores how the *Water Act* relates to stream health in the context of current legislative arrangements and the measures that are being taken to address existing and future pressures. Possible solutions for protecting stream health in a modernized *Water Act* are discussed.

To many, a healthy stream is one that supports healthy fish populations and has good water quality. Stream health may be defined as the combined measure of a stream's ecological integrity and function. This includes flow variability between seasons, the stream's ability to provide environmental services, water quality and resilience to disturbance.

Stream health assessments employ multiple measures, including water chemistry, biological monitoring and stream flow information. The concepts of stream health and how different measures can be used to interpret stream health have been discussed extensively in the literature (see Boulton, 1999; Frey, 1977; Karr, 1999; and Norris and Hawkins, 2000).

Although stream health is influenced by all the activities within a watershed, *Water Act* modernization is focusing on activities regulated under the Act and how they influence stream health. The primary function of the *Water Act* is to allocate and regulate the diversion, storage and use of water. The main influence of these activities is on the quantity and timing of water flowing in streams. Another role of the *Water Act* is regulating changes in and about a stream. As a result, the scope of the stream health discussion in this document is limited to environmental flows and changes in and about a stream.

1.2 What Is an Environmental Flow?

Environmental flows are the time dependent flows or level of water in a stream required to protect stream health (Annear, et al., 2004). The flow required to maintain stream health varies from stream to stream depending on the needs of fish, other wildlife, or riparian vegetation. Each species has specific water flow requirements for different life history stages. If the required flows are not provided, the life cycle is broken and, cumulatively, stream health will be degraded. The flows required in a narrow steep mountainous stream to protect a fish population will be different than those required in lower elevation streams to maintain riparian health and connection to wetlands. In addition to biological values, environmental flows are also maintained for recreation, navigation, or dilution of permitted discharges.

Environmental flow requirements are determined using established methods and communicated in a summary format referred to as instream flow requirements (IFR). The selection of method depends on the values or interests to be protected, the potential impact of the proposed water development, and the time and resources available. The level of detail set out in an IFR will vary from a simple minimum flow to very detailed daily flow requirements specifying minimum and maximum flows, as well as rates of change in flow. In the past many people viewed minimum flows as being synonymous with an environmental flow requirement. However, minimum flows have limited application as healthy streams require variable flow over time (Figure 1a). There is a tension between having simple methods that can be easily communicated and methods that use the best science available. As a result of efforts to strike a balance between these objectives, many different methods for setting IFRs have been developed. In general the more interests and values at risk, and the more intensive a proposed development, the more time and resources will be required to develop the IFR and the more effort that will be required to communicate the results clearly.

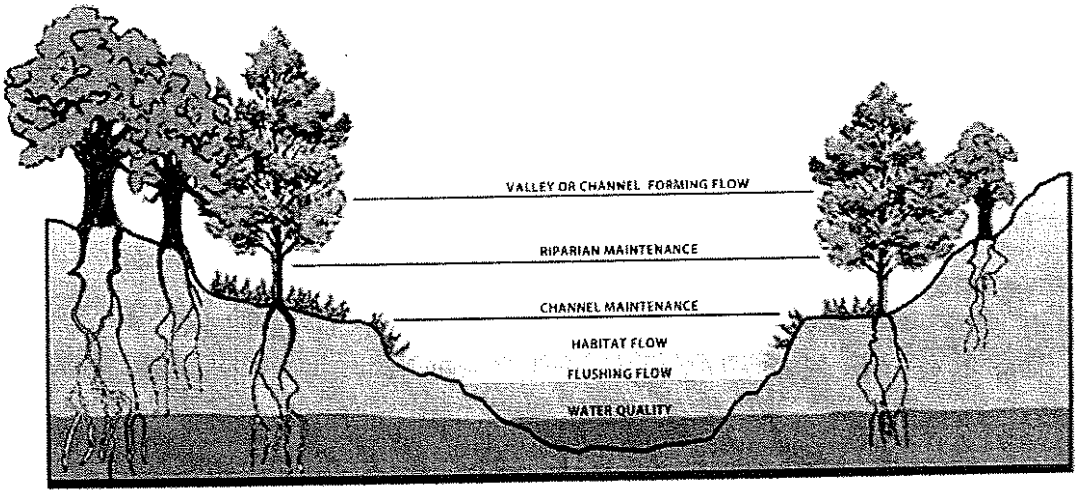


FIGURE 1a Function Of Different Stream Flows In Maintaining Stream Health

Source: Instream Flow Council (Annear, et. al), 2004[1].

1.3 What Are Current Regulatory Arrangements in British Columbia?

The current *Water Act* performs three functions that relate directly to stream health:

- consideration of adequate water flows to maintain stream health;
- protects habitat in and adjacent to streams; and,
- reduces water quality impacts by prohibiting dumping of debris and other material into streams.

Water allocation decisions made under the *Water Act* have a direct influence on the availability of environmental flows and consequently stream health. The framework of the *Water Act* was developed at a time when the value of environmental flows was not widely recognized. As a result, there is no explicit requirement to consider environmental flows in water allocation decisions. Since the advent of the Act, the principles of water governance and our understanding of stream health have advanced significantly and there is broad support from stakeholders and the public for environmental flows to have a greater profile in decisions. The Comptroller of Water Rights and the Regional Water Manager, the decision

1 The Instream Flow Council (IFC) is an organization that represents the interests of state and provincial fish and wildlife management agencies in the United States and Canada dedicated to improving the effectiveness of their instream flow programs. It consists of a Governing Council of ppointed instream flow representatives of these jurisdictions www.instreamflowcouncil.org.

makers under the *Water Act*, have responded to this by using discretion to include environmental flows in their decision making processes.

The protection of habitat in and adjacent to streams is provided by the provisions of Section 9 of the *Water Act* and Part 7 of the Water Regulation, these provisions ensure that changes in and about a stream are made with consideration to stream health (e.g., installing culverts, bridges, pipelines, erosion protection works, or removing beaver dams). They apply to streams not under jurisdiction of the *Forest and Range Practices Act*, the Riparian Areas Regulation of the *Fish Protection Act* or when a person holds a permit under section 10 of the *Mines Act*. Higher risk activities require approval from the Ministry of Environment, while low risk activities are permitted without an approval under conditions specified in the regulation, provided that notification is given to the Ministry.

For more information about the Water Regulation for activities in and about a stream see:
www.env.gov.bc.ca/wsd/water_rights/legislation.html and
www.env.gov.bc.ca/wsd/water_rights/licence_application/section9.html

The *Water Act* restricts the dumping of material into streams. The authority is provided by Section 88 allowing designated provincial engineers to "order a person to cease putting or not to put any sawdust, timber, tailings, gravel, refuse, carcass, or other thing or substance in a stream." The engineer may also "order a person to remove from a stream any substance or thing that the person has put or permitted to get into a stream." Although this authority can be useful for the protection of stream health, it is reactive because an order from an engineer is required to first prohibit the dumping. It is not well harmonized with the federal *Fisheries Act*, which prohibits the dumping of deleterious substances into water frequented by fish. There is, however, Section 21 in the *Fish Protection Act* which has not been brought into force that would amend the *Water Act* to prohibit the dumping of debris into streams and give the authority to require stream remediation. Debris in this context includes: clay, silt, sand, rock, or similar material; or any material, natural or otherwise, from construction or demolition.

The *Water Act* is only one law within an ensemble of environmental laws and policies that protect components of stream health in British Columbia. Other legislation includes:

- the *Environmental Management Act* protects stream health by regulating direct discharges to streams and setting codes of practice that reduce diffuse impacts from land based activities;
- the *Forest and Range Practices Act* addresses forestry activities and stream health, including timber harvesting, road building, silviculture, and range practices;
- the *Environmental Assessment Act* requires comprehensive reviews of major projects that exceed specified thresholds, and results in protective measures being attached as conditions of provincial approvals to protect stream health;
- local governments' authorized by the *Local Government Act* influence stream health through their role in land use planning, zoning, approval of developments, and establishing bylaws; and,
- the *Public Health Act* regulates on-site sewage systems that can negatively affect stream health by introducing excessive nutrients.

Federally, the *Fisheries Act* includes a number of strong provisions for protecting stream health. Some key provisions include prohibitions from causing a harmful alteration, disturbance or destruction of fish habitat (HADD) and from depositing deleterious substances into waters frequented by fish. Fisheries and Oceans Canada also has a number of key policies related to the protection of stream health including the Wild Salmon Policy and the Policy for Management of Fish Habitat. The

consideration of stream health in *Water Act* decisions in many cases also supports implementation of the federal *Fisheries Act*. The effectiveness of stream health is improved when there is coordination among these laws and proactive protection measures taken.

For more information on the federal *Fisheries Act* see:
www.dfo-mpo.gc.ca/oceans-habitat/habitat/policies-politique/act-acte_e.asp

1.4 What Are the Pressures for Change?

Population growth, increased water demand, and changes in land use can all impact stream health. Climate change is also expected to have significant effects such as changes to stream flow patterns. The rain that replenishes our streams, lakes and reservoirs in the winter and spring may fall within a short period in the winter and not later in the year when we need this water to irrigate crops and for other important uses. Other predicted effects include many areas experiencing growing water shortages and increased competition among water uses, including municipalities, irrigation, industry, power generation, fisheries, recreation and aquatic ecosystems. These pressures, combined with existing water use, and changes that have already occurred in watersheds highlight the need to modify the way we protect stream health (Rodenhuis, et. al., 2009).

There are already a number of streams in BC, small and large, that show clear indications that environmental flows are not sufficient to protect stream health (e.g., Nechako River). In some small streams we are seeing seasonal low flows that are lower and longer due to the withdrawal of water for consumptive uses. The effect on stream health is showing in reduced success of fish populations. In some systems flow has been altered to such a degree that some environmental requirements are not being met, such as flows and temperatures for fish migration or channel and riparian maintenance. As a result, stream health is degrading. A case study of two streams demonstrating degraded health as a result of inadequate environmental flows is provided by Rossenau and Angelo (2003). If not addressed, these pressures combined with others may have a cumulative effect and result in wide spread degradation of stream health. Figure 1b illustrates the potential for stream health conflicts by displaying regions of the province where summer low flows are naturally flow sensitive with an overlay of water licensing restrictions.

Developing new hydro power project provides the opportunity to create clean, sustainable sources of energy for British Columbians. It is important that this be done in a way that does not negatively impact stream health. Stakeholders will insist that agencies develop clear processes to determine environmental flow requirements to evaluate proposed projects and to ensure residual flows maintain stream health.

The summer 2009 drought that occurred in many regions of BC has also raised the profile of stream health. The low flows that were experienced demonstrated that reliance on direct withdrawal from streams without adequate supporting storage can put both the water user and the stream at risk during times of water scarcity.

There is growing awareness that healthy streams provide a wide range of economic and social benefits. Accompanying this increasing appreciation of the goods and services provided by healthy streams is a willingness to improve stream health protection. British Columbians have a strong history of stream stewardship and want to better protect stream health. This is evident in the variety of community based water management planning initiatives that have been started across the province.

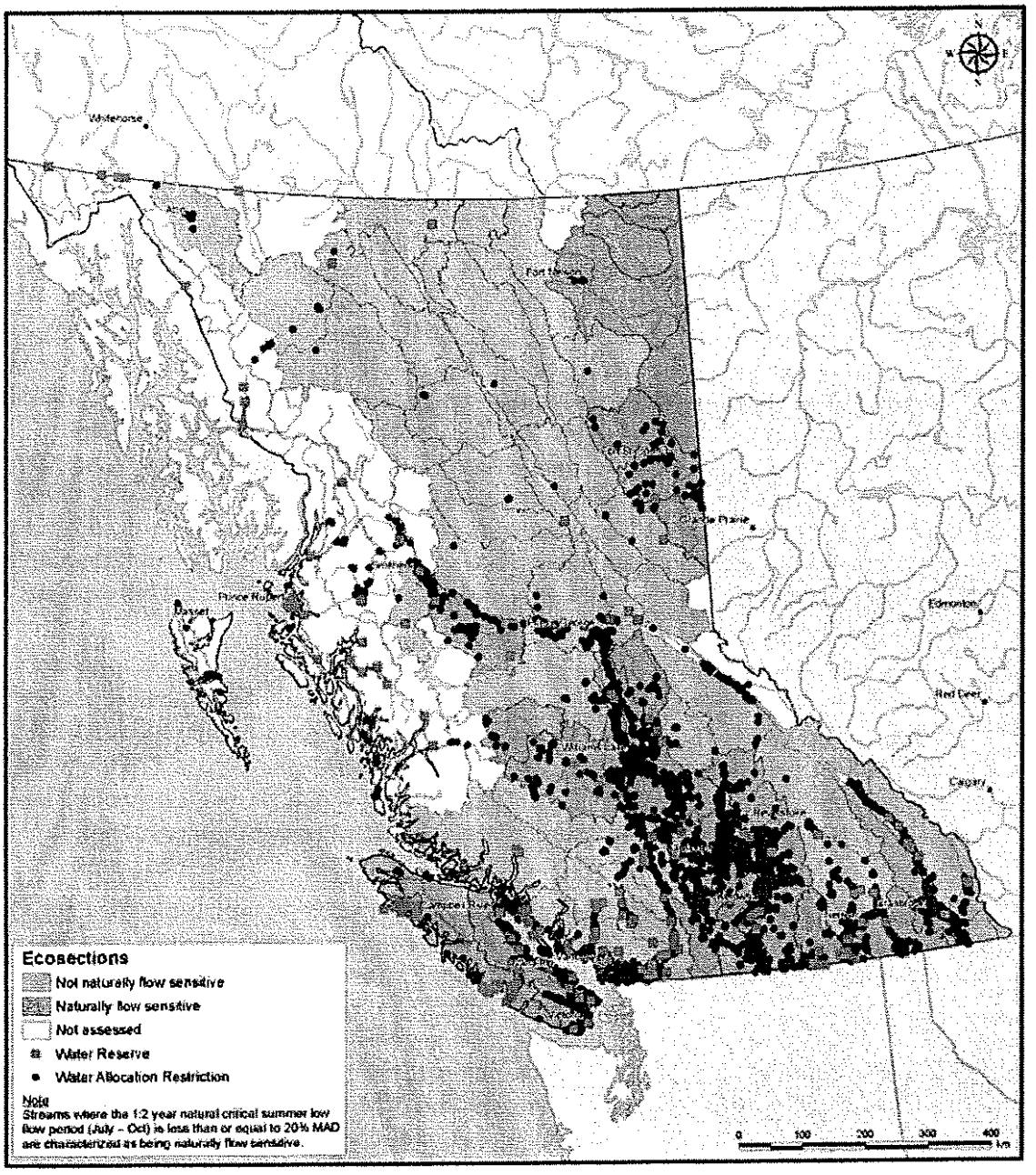


FIGURE 1b Ecosections that are naturally flow sensitive are displayed with an overlay of water reserves and water allocation restrictions to illustrate the potential for water use conflicts in British Columbia.

1.5 How Are Pressures Being Addressed?

The consideration of environmental flows in water allocation decisions has evolved with our understanding of the water needs of fish and healthy streams. A key reason for considering environmental flows in water allocation has been to avoid fish-flow conflicts by protecting fish and fish habitat. *Water Act* decision makers are working more closely with fisheries managers to better inform allocation

decisions. The evolution of environmental flows in water decisions can be seen in various reports on hydrology, water use and conservation flows for fish (for example, Rood 2001).

Examples of important recent developments by the provincial government include: the development of environmental flow guidelines; Water Stewardship Division - Vancouver Island instream flow policy; enactment of the *Fish Protection Act*; the BC Hydro Water Use Planning process; water allocation and water management plans; and improvements to regulations for changes in and about streams. Each of these developments is discussed briefly below.

As the understanding of environmental flow requirements has evolved, different guidelines and policies have been developed to assist decision making. The 1986 water allocation policy on instream flow stated that the decision maker may refuse an application, or include conditions in a water licence, to protect the stream where a water allocation decision would significantly impact instream uses. Vancouver Island Region developed policy which went beyond the general direction of the 1986 policy to provide guidance to decision makers and incorporated a modified Tennant method for determining flows (Tennant, 1976. see pages 11-12). There was more work conducted through the 1990's and early 2000's on selected environmental flow setting methods which resulted in the interim flow thresholds for fish and fish habitat (Hatfield, et al., 2003). *The Independent Power Producer Guidebook* (Province of British Columbia, 2008) provides information for proponents to consider when preparing a water licence application. These policies and guidelines have contributed to environmental flows being more consistently included in decision making in British Columbia.

The introduction of the *Fish Protection Act* in 1997 marked a major shift in water allocation and the protection of fish. In 2000, the Sensitive Streams Regulation was introduced. This regulation requires recovery plans to be considered for select streams named (currently 15) in the regulation. Section 5 of the *Fish Protection Act*, which has not been brought into force, would provide explicit authority for considering fish and fish habitat in water allocation decisions. Although all the provisions of the *Fish Protection Act* have not been brought into force, this Act is indicative of the changing value British Columbians put on fish and stream health.

The BC Hydro Water Use Planning (WUP) process was important for advancing the understanding of environmental flow requirements in British Columbia. The WUP process applied leading thoughts and practices to setting environmental flow requirements in water systems that may be affected by BC Hydro's facilities. Discussed in more detail in section 4, WUPs are technical documents defining the proposed operating parameters to be applied in the day to day operations of hydroelectric facilities. The WUP process has provided a wealth of experience for understanding environmental flow requirements in BC's water systems. The ongoing monitoring programs that have been created as a result of these processes will continue to build the provincial knowledge base. In addition to the scientific knowledge gained, there is substantial practical knowledge regarding how to communicate IFRs and incorporate them into water allocation decisions.

Experience gained from including environmental flows in water allocation decisions shows that selecting appropriate methods requires a balance of interests and a good understanding of the underlying uncertainties. Generally, increasing the confidence that the IFR will protect stream health requires a greater investment of resources, from both the applicant and agencies. The methods selected need to be efficient enough not to become a bottleneck in processing applications.

The Vancouver Island Water Allocation Policies developed by the regional Water Stewardship office, provide an example of a system that has struck a balance among competing interests. The policy adopts

a rules based approach that flags water-short streams with limited capacity for water diversions. The output of this assessment describes when water may be diverted from the stream and what quantity is available. This rules based method can be applied to most common water applications and referrals.

In addition, the simplicity of the method and conditions has helped implementation. Applicants that propose water use that is not consistent with the output of the rules based IFR may undertake more detailed assessments.

Water allocation plans are watershed scale supply and demand studies that can determine the amount of water that is available for allocation while ensuring environmental objectives are met. By conducting water supply and demand studies in advance of receiving applications, water availability is clear to applicants and they understand the conditions that may be attached to decisions. Table 2a summarizes common components of a Water Allocation Plan. To date they have mostly been assembled for Vancouver Island, where they are shown to be successful, and there is growing interest in using water allocation plans in other areas of the province. Water allocation plans are currently developed within government to guide decisions. In addition to agency led water allocation planning processes there are a number of community based initiatives that are examining water allocation plans (e.g., Nicola Water Use Management Plan). A modernized *Water Act* could change the conditions for initiating and using water allocation plans in decision making.

PURPOSE	■ Quantify water available for allocation and how much is already allocated ■ Describe environmental flow recommendation for stream health ■ Reduce time required to process applications ■ Increased transparency in water allocation decisions
PRIMARY ATTRIBUTES OF THE PLAN	■ Description of watershed hydrology (plus any projected changes to stream flow changes) and water quality (surface & ground) ■ Summary of existing water uses and instream flow requirements (e.g., aquatic life, effluent dilution, navigation, or recreation) ■ Evaluation of water required for ecosystem needs and potentially available for allocation ■ Description of possible conditions to be included in water allocation decisions ■ Defines specific results for stream flows to determine if stream health outcomes are being achieved ■ Sets out possible responses if stream flow results are not met.

TABLE 1a Components of a Water Allocation Plan

For more information on Water Allocation Plans see www.env.gov.bc.ca/wsd/water_rights/wap/.

Water Management Plans were introduced into the *Water Act* in 2004. These plans are initiated by an Order of the Minister of Environment in response to conflicts among water users, conflicts between water users and instream flow requirement, or risks to water quality. When completed Water Management Plans are implemented by regulation which may affect how decisions are made under the *Water Act* and other provincial enactments. Water Management Plans may not affect the *Forest and Range Practices Act*. Water Management Plans have the potential to be a powerful tool for integrating land and water management to protect stream health outcomes. The Township of Langley Water Management Plan is the only plan that has been initiated to date. Lessons learned in the Township of Langley planning process will assist the development of future plans. These plans provide a powerful tool

for improving land and water management in cases where there is a need to implement regulatory measures to better protect stream health or resolve conflicts.

The process for issuing approvals and authorizations under Section 9 of the *Water Act* and Part 7 of the Water Regulation has helped streamline administrative processes and provide consistency for practices in the field. Prior to the introduction of Part 7 of the Water Regulation all changes in and about a stream required an authorization. With Part 7 in place there are many routine, low-risk, activities that may occur in accordance with specified conditions after the ministry has been notified. These activities are set out in Section 44 of the Water Regulation and include installation and maintenance of culverts, clearspan bridges, fish fences, and stream flow measurement devices. In addition, time periods when instream work may be done are provided to assist applicants in planning their work. The introduction of this regulation has helped streamline workload and allowed resources to be focused on higher risk activities.

In 2008 the Province made a number of commitments respecting stream health through Living Water Smart: British Columbia's Water Plan (see Text box 1a). Some of those commitments may require statutory changes, such as the commitment to recognize water flow requirements for ecosystems and species and will be advanced through the *Water Act* modernization process. The Province will continue to pursue non-regulatory measures, such as improved water use efficiency and conservation, with stakeholders.

TEXT BOX 1a Living Water Smart Actions that Relate to Protecting Stream Health and Aquatic Environments

- By 2012 all land and water managers will know what makes a stream healthy, and therefore be able to help land and water users factor in new approaches to securing stream health and the full range of stream benefits.
- By 2012 water laws will improve the protection of ecological values.
- Legislation will recognize water flow requirements for ecosystems and species.
- Government will require all users to cut back their water use where stream health is threatened.
- Wetland and waterway function will be protected and rehabilitated.

In this context, through the *Water Act* modernization, the Province hopes to achieve a number of results, including establishing environmental flow requirements in water allocation; and improving understanding among agencies and stakeholders regarding water requirements to keep streams healthy. As noted above in sections 3 and 4, a key component of an improved *Water Act* would also involve alternate water governance arrangements and improved efficiency and flexibility in water allocation.

Modernizing the *Water Act* would equip the Province, local governments, and communities to better understand how to protect stream health. Achieving the outcome of healthy streams will continue to provide environmental goods and services that are key to British Columbia's social and economic well being.

1.6 Leading Thought And Practice

Best practices from around the world and across Canada show that the protection of stream health includes explicitly recognizing its value and including regulatory measures to protect environmental flows. *Water Act* modernization provides an opportunity to review the inclusion of stream health in decision making, the methods used to determine environmental flow needs, and ways of improving the communication of information to applicants and the public.

1.6.1 Environmental Flows Are Considered In All Water Allocation Decisions To Protect Stream Health

Possible solutions for protecting stream health are discussed below. Solutions are premised on environmental flows being considered in all future water allocation decisions. A principle of good water governance identifies that decisions should be made with consideration of environmental, social and economic interests. Direction to consider environmental flows will address one of the key criticisms of the current *Water Act* - that it does not explicitly recognize stream health values. Additionally, considering environmental flows in water allocation decisions helps avoid potential conflicts with the federal *Fisheries Act*. Figure 1c provides a conceptual model of how environmental flows may be considered in water allocation decisions and the relationship to the methods used for determining environmental flow requirements.

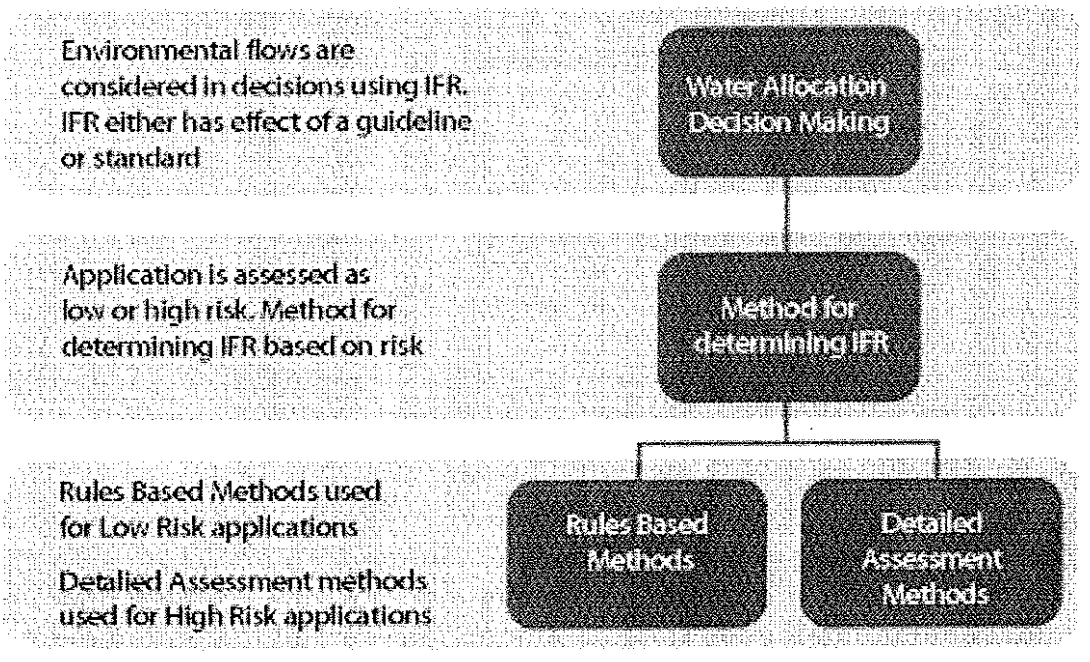


FIGURE 1c Conceptual Model For Consideration Of Environmental Flows In Water Allocation Decisions

In this section the discussion of:

- Guidelines or Standards refers to the weight the IFR carries in water allocation decision making (top row of figure 1c); and
- Rules based[2] or detailed assessment refers to the approach or method to determining the IFR (bottom row of figure 1c).

2 Rules based methods are also referred to in the literature as "Standards Setting" methods. For the purposes of this document the term "rules based" has been selected to clearly distinguish the discussion of IFR setting methods from how IFRs are used in decision making.

Environmental flow recommendations may affect the water allocation decision process , depending on whether the recommendation is given the status of a guideline or a standard. If the IFR is a guideline the decision maker would be required to consider it whereas if it was made a standard, the decision maker would be required to follow it. A combination of these approaches may also be considered.

A guideline approach allows the decision maker to consider applications on its social, economic, and environmental merits, including any mitigation proposals and other information supporting it. In this case the decision maker may deviate from the IFR if there are suitable grounds. Reasons for the decision would be provided to ensure decisions are transparent.

When considered as a standard, the IFR becomes mandatory criteria in decision-making. The ability to deviate from the IFR would be restricted though either approach needs to maintain some level of flexibility to respond to new information and changing circumstances.

The options have different implications on the flexibility and level of discretion in decision making and could influence the rigour that is required for the development of IFRs and the certainty for applicants and stakeholders .

Concern may be raised that the flexibility of considering IFRs as guidelines, rather than standards, may lead to incremental reduction of the IFR and result in degradation of stream health. Two important checks are proposed in the guideline approach to address this concern. One is a requirement that the decision maker openly provides reasons for the decision any time he or she deviates from the IFR. Providing reasons for the decision assures transparency in accordance with good governance and administrative fairness. The second assurance is the right to appeal decisions. An appeal system ensures accountability as those whose rights may be affected may appeal the decision if they feel they may be negatively affected. Under the current *Water Act*, the right to appeal is provided to water licensees, or applicants, on the stream and riparian land owners. A modernized *Water Act* may review the groups with the right to appeal decisions to ensure that the interests of environmental flows are represented.

Considerations when choosing flow methods

Choosing among flow determination methods is more than a trade off of economy vs. stream health. The following need to be considered:

Resources required to conduct evaluation

- Data and information requirements
- Time required to collect information
- Expertise and human resources to conduct assessment

Confidence in evaluation to protect stream health

- Is the instream flow requirement ecologically meaningful?
- Is the instream flow requirement relevant to management decisions?

Ease of communication Conditions on licensee/operator – ability to implement

- Is it economically feasible to implement the IFR (it may not be viable for a licensee with a small diversion to implement an IFR with multiple rules or one that with conditions that vary on measured inflow)

Flexibility for climate change adaptation

Regardless of which approach is selected – guidelines or standards – there is an expectation that an IFR will provide certainty to the approval process: that when an IFR is in place it will be adhered to and protect stream health. The 21st century allocation model proposed by Postel and Richter (2003) implies there is certainty in the protection of environmental flows. This suggests that IFRs provide clear parameters for decisions. In either approach, provincial laws should be adjusted to consistently support the use of environmental flow recommendations and federal legislation could also support the recommendations. Integration between provincial and federal laws could improve the application of environmental flows and streamline administration. To help resolve potential conflicts between

humans and the environment, further clarification of the priority of ecosystem needs and access for consumptive water users would be helpful.

The approach for including environmental flows in licence decision making will need to consider other potential changes proposed in Water Act Modernization. Two key areas of consideration are governance and water allocation efficiency and flexibility. The potential shifts in these goal areas will influence the context of decision making, planning and accountability for implementing the preferred approach. The chosen approach will also affect the criteria used for selecting either rules based or detailed assessments and the methods that are used (figure 1c). In addition to considering the effect of the preferred option on stream health outcomes, time and resources required to develop IFRs also need to be evaluated.

Methods Used To Determine Environmental Flow Requirements

The discussion of methods used for establishing environmental flows is premised on using a rules based method for low risk applications and detailed assessments for high risk applications[3]. Given the diverse landscape of British Columbia and different scales of water development it is not practical to adopt a single approach to determining environmental flow requirements. To do so would either not provide adequate protection in areas with projects that have a high risk of causing degradation or alternately would be prohibitively expensive and time consuming. Rules based and detailed assessment approaches to establishing environmental flows require different levels of expertise, data, and understanding to implement. They also provide different outputs, as summarized in table 1b. Rules based approaches are useful for evaluating water availability for low risk projects, such as domestic or small irrigation licences. Higher risk projects need to be assessed with detailed assessments using site specific information. Adopting a risk based approach to selecting methods for determining environmental flows provides efficiency, because resources are used to assess the projects that may have the greatest impact on stream health while low risk activities can be assessed more quickly.

RULES BASED	DETAILED ASSESSMENT[4]
■ Low controversy project	■ High controversy project
■ Reconnaissance level planning	■ Project-specific
■ Few decision variables	■ Many decision variables
■ Inexpensive	■ Expensive
■ Fast	■ Lengthy
■ Rule-of-thumb	■ In-depth knowledge required
■ Less scientifically accepted	■ More scientifically accepted
■ Not well-suited for bargaining	■ Designed for bargaining
■ Based on historical water supply	■ Based on fish or habitat

TABLE 1b Comparison Of Two Broad Categories Of Instream Flow Assessment Approaches

Source: Stalnaker et al. 1995

Various rules based approaches have been used in British Columbia. The most frequently used methods are based on the Tennant method (1976). The Vancouver Island instream flow policy uses a method based on the Tennant approach as does the BC Modified Tennant approach (alternately referred to as the Ptolemy method). This class of methods was developed to estimate flow requirements at a regional scale. It is based on assuming there are relationships between flow and ecological requirements. An example of flow criteria used in modified Tennant approach is provided in Table 1c.

3 Vancouver Island Region, Water Stewardship Division has already implemented a risk based approach for selecting the IFR setting method.

4 Instream flow practitioners refer to detailed assessments as "incremental methods" as they evaluate site characteristics at various flow states, or increments.

An additional flow retention method was introduced by Hatfield, et. al (2003). This method is based on protecting patterns of historic stream flow. The assumption is that by protecting the natural shape and variability of the annual hydrograph stream health will be protected.

Rules based methods are attractive because they are easy to implement due to the relatively low cost and effort required, but they do have limitations. A discussion of the limitations associated with rules based methods is provided by the Instream Flow Council of North America (Annear, et. al, 2004). Bradford and Heinonen (2008) discuss that there is uncertainty in making predictions of the impacts of flow reductions or diversions on stream health without collecting site specific data. As a result, they recommend a risk-based approach to decision making when using rules based methods. Even with the noted caveats, rules based methods are an essential tool for BC due to the efficiency and effectiveness they provide.

What does an IFR from a rules based method tell us?

The IFR provides:

- a summary of flow requirements for stream health;
- an account of the quantity and timing of water available for diversion;
- a useful tool to help different stakeholders communicate about varying flow needs.

The IFR does not provide:

- an operating plan;
- a drought management tool;
- a request for flow augmentation.

BIOLOGICAL OR PHYSICAL REQUIREMENT	PERCENT MEAN ANNUAL DISCHARGE	DURATION PER ANNUM
Short-term Biological Maintenance	10	days
Juvenile summer-fall rearing	20	months
Over-wintering	20	months
Riffle Optimization	20	months
Incubation	20	months
BIOLOGICAL OR PHYSICAL REQUIREMENT	**PERCENT MEAN ANNUAL DISCHARGE**	**DURATION PER ANNUM**
Kokanee spawning	20	days-weeks
Smolt Emigration	50	weeks
Gamefish Passage at Partial Barriers	50 to 100	days
Large Fish Spawning/Migration	148*MAD^-0.36	days-weeks
Off-channel Connectivity/Riparian Function	100	weeks
Channel Geomorphology/Sediment Flushing	>400	1 to 2 days

TABLE 1c BC Modified Tennant Method

Note: zero deviations from standards suggest no HADD will occur

Source: Ptolemy and Lewis, 2002

Methods based on Tennant's approach provide criteria usually expressed as a percent of mean annual discharge (MAD). The role of the criteria and relationship to MAD are sometimes not clear. MAD is a useful index of stream size. Percentages of MAD have been shown to be useful descriptors of flow requirements across streams of different scales at a regional level. For example, twenty percent MAD is a benchmark flow for riffle health. Below 20% MAD the function of riffles begins to degrade. However, it is natural in many streams for the flow decrease below 20% MAD. The ecosystems within these streams are naturally adapted to those conditions; diverting water from the stream at that time may further stress its health and result in lower productivity. Therefore the criterion of 20% MAD is used as an indicator that direct withdrawals of water from the stream should be avoided as stream

health can be radically degraded due to riffle dewatering. One result of riffle dewatering is reduced flow delivery to pools, leading to reduced fish production. Figure 1d illustrates how the criterion can be used as an indicator, showing that natural flows below 20%MAD occur from July 1 until September 29 in this particular system. This indicates that water is consistently not available for withdrawals from the stream during summer months.

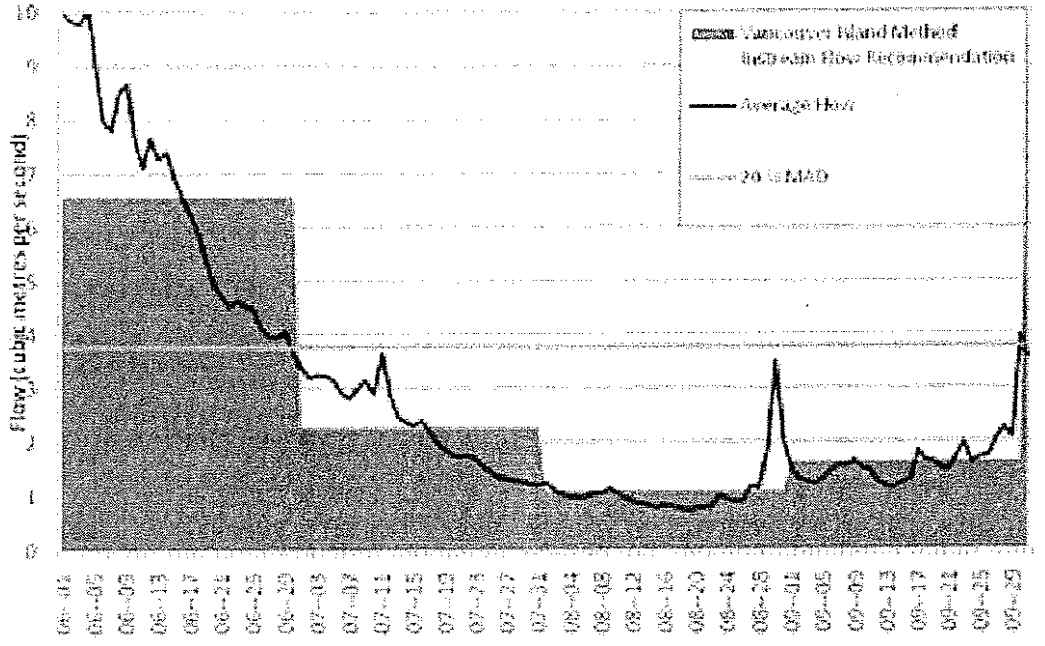


FIGURE 1d Chemainus River June 1 to October 1, Showing Instream Flow Recommendation From Vancouver Island Method,
Daily Average Flow and 20% MAD (MAD = 18.9 m3/s, 20% MAD = 3.78 m3/s)

Detailed assessment methods are informed by site-specific analyses which allow a range of management alternatives to be considered. While these habitat-flow models are quantitative, it is often unclear what the true biological consequence will be because the ecosystem response to flow changes may be non-linear. The Instream Flow Council (Annear, et. al, 2004) summarizes common detailed assessment methods, their applications and strengths. Data requirements and study duration vary among methods, as does the information they provide regarding questions of appropriate management alternatives to protect stream health. The selection of an appropriate method is determined by the study objectives and the project's associated environmental risks based on previous experience (empirical or results based). As each method addresses specific questions, multiple methods may need to be applied to evaluate the potential impacts of a complex project. This will go beyond the use of only hydrologic indicators of stream health and may include behavioural studies, such as the use of radio-tracking to observe the effect of different flows on migrating fish.

A common detailed method is the Physical Habitat Simulation (PHABSIM) system. This approach uses a computer program to evaluate the suitability of stream habitat at various discharge rates. It is most commonly used to evaluate potential impacts on fish. This method relies on hydrology, site specific habitat measurements, and information regarding habitat preferences of the local fish at

various life-history stages at the community level. This method allows the effects of different flow regimes to be modelled over time but does not allow for easy interpretation given unknown bottlenecks to production and different outcomes dependent on species and life stage of interest.

1.6.2 Watershed-Based Water Allocation Plans Include Environmental Flow Needs And The Water Available For Consumptive Use

A modernized *Water Act* could provide more direction regarding the use of water allocation plans. There are at least two key considerations. One is whether the development of plans remains optional or if water managers are required to develop them. The second consideration is what effect the plan has on a decision maker's discretion. The discussion about how water allocation plans will be implemented under a modernized *Water Act* regime also needs to be made with consideration of any changes to water governance arrangements, as discussed elsewhere in this document.

There are resourcing and capacity questions to consider when discussing whether water allocation plans are optional or required. The value of a water allocation plan in assisting decision making has been clearly demonstrated on Vancouver Island. It is a proactive way to incorporate environmental flow requirements into the water allocation process. However the development of a water allocation plan requires a significant investment of resources to assemble the required water flow information, undertake assessments, and work with other agencies and stakeholders to develop the plan. In areas with high water demand and limited supply, the benefit of the plan is clear. To determine the utility of a plan in areas without such clear pressure, the efficiencies that will be gained in comparison to addressing applications on a one-by-one basis need to be considered.

If optional, water allocation plans would be developed at the discretion of the Regional Water Manager. Criteria for initiating a plan could be established related to water demand, changes in water supply, changing environmental conditions, conflicts among users, or at the request of the community. This approach would allow the water managers to allocate resources as they see fit to either water allocation planning or reacting to applications. Without direction to managers regarding planning there may be uneven distribution of plans in the province.

If water allocation plans are required, an implementation scheme would be necessary to guide when and where plans are developed. This would have to be made in consideration of resources, capacity and timing. Direction may be to develop plans province wide and include a roll-out schedule. Alternately, priority areas may be identified and plans required for those areas. This option may be viewed as an alternate to developing, or a prerequisite to, developing Water Management Plans. A third option is to only require plans where ordered by the Comptroller of Water Rights. To provide transparency to the process, criteria could be developed for when an allocation plan would be ordered. The priority area or as ordered by the Comptroller approaches would not preclude a Regional Water Manager from initiating a water allocation plan if it was deemed there would be sufficient benefits from having a plan.

The role of water allocation plans in decisions also needs to be considered. When a water allocation plan is developed there will be an expectation by stakeholders that it be followed. The plan may take the form of guidance or as direction to the decision maker. The implications of treating a plan as guidance or as direction for decision making are similar to those discussed regarding the status of environmental flow requirements in decision making. That is, if the plan is considered to be direction to a decision maker, rather than guidance, it may increase the resources required to develop and

implement. As well, there will be implications to the flexibility that the decision maker has to address novel approaches to mitigation or compensation.

The Water Allocation Plan is a tool that can help improve decision making. Its role and function within a modernized *Water Act* should be considered in full view of changes to governance, flexibility and efficiency in allocation, and ground water management. The development of a plan provides an opportunity to explore issues and interests of stakeholders, ensure environmental flow requirements are met, and consider other regulatory requirements. The value and future direction for water allocation plans, whether they be required or optional, or guiding or directive, needs to be assessed in the context of the principles and objectives of *Water Act* Modernization.

1.6.3 Habitat And Riparian Area Protection Provisions Are Enhanced

Water quality and stream health can be degraded by the dumping of material into streams. Section 88 of the *Water Act* currently provides the authority to issue orders to prevent or stop the introduction of material (sawdust, timber, tailings, gravel, refuse, carcass, or other thing or substance). The power in the *Water Act* to prohibit the introduction of material into streams compliments the *Environmental Management Act* which prohibits the dumping of waste. The efficiency of the current system can be limited by requiring an order to make it an offence to dump material into a stream. A standing prohibition against dumping of material may assist in better resource management. This would improve consistency with the federal *Fisheries Act*. As discussed earlier, there is an existing provision in the *Fish Protection Act* that demonstrates how such a prohibition could be introduced.

Accompanying the prohibition of dumping, the authority to issue remediation orders in relation to the dumping would be required. The remediation order would need to be situation specific to ensure that any action taken does not cause more damage than the initial dumping incident.

The *Water Act* can maintain the current requirement for an engineer's order to prohibit dumping of materials into streams or amend the *Water Act* to include a prohibition against dumping a wider range of debris and materials into streams. Maintaining the status quo ensures that an engineer is involved in the assessment of any dumping or potential dumping which may aid in enforcement actions. Whereas introducing a prohibition would eliminate the need to issue and order and clarify requirements provincially. As well it would improve alignment with the federal *Fisheries Act*.

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PART TWO

Improving Water Governance Arrangements

2.1 What is Water Governance?

Governance is a broad concept that refers to the processes through which individuals and institutions manage their common affairs, take co-operative action and manage conflict. It includes the formal institutions and regimes that are put in place to ensure compliance as well as the informal arrangements that people and institutions believe to be in their interests (Commission on Global Governance, 1995). Governance also relates to networks of influence, including both formal and informal ways that authority is exercised (Ayre & Callway, 2005).

Governance is about the process of decision making: who makes decisions, what the decisions are about and how decisions are made. Effective governance includes more contributors than just governments. Participants may include, for example, First Nations, professional associations, business, industry, communities and citizens (Brandes and Curran, 2009).

Water governance refers to the institutions and processes relating to the delivery of water services and the development and management of water resources. Water governance also includes the way that science, and traditional and local knowledge inform the formulation of water laws, policies and decisions.

Much of the discussion about water in British Columbia typically concerns water management. Management focuses on the operational, day-to-day activities of regulating water extraction or discharges to water and the conditions we impose on using it. Governance, in contrast, underlies management and is a much broader concept. Good water governance is critical to sound environmental and economic sustainability (Brandes and Curran, 2009).

Water governance can be described using three dimensions, each made up of a number of elements:

- Laws, rules, agreements and financing arrangements - e.g. federal and provincial legislation, policies, processes, budgets, boundary and inter-jurisdictional agreements;
- Institutions, systems, roles and responsibilities - e.g. agencies, information bases and the determination of who does what and how; and,
- Operational management functions - e.g. planning, issues response, decisions, enforcement, outreach.

Table 2a compares these three dimensions and provides some examples in British Columbia.

	THIS INCLUDES	EXAMPLE
Laws, rules and financing arrangements	Laws, rules and regulations, policies, legislated processes	*Water Act, Fish Protection Act, Water Protection Act, Environmental Management Act*
	Financing and provision of budgets to undertake work	Government budgets, powers of taxation
	Structures to ensure cooperation among governments	First Nation treaties, McKenzie River Basin Board, Columbia River Treaty
Institutions, roles and responsibilities	Establish roles and functions and standards for water –related institutions at all levels of government and non government sectors	Science and information standards and systems, watershed agencies, role of government and non government actors
	Structures to ensure participation and transparent decision making	Watershed management plans, water licensing procedures, methods to set environmental flow needs
	Coordination mechanisms established at local scale	Watershed collaboration, agreements to work together, water budgets or models
	Financing ability of organizations	Taxing powers, development cost contributions, water pricing structures
Operational management functions	Watershed protection and planning	Watershed restoration, monitoring and implementing appropriate responses, climate change adaptation initiatives
	Water use regulation	Water allocation planning and decision making, licensing and enforcement
	Water infrastructure management	Water infrastructure planning, water demand management, education, water utilities, and dam safety
	Drinking water source protection	Drinking water source protection planning
	Flood and drought hazard management	Hydrometric network, water supply/flood forecasting, drought and flood responses

TABLE 2a Characteristics of a Water Governance Framework (adapted from Global Water Partnership and Network of Basin Organisations 2009)

Note: This table also appears in the Water Act Modernization Discussion Paper, p. 42.

2.2 What Are the Current Water Governance Arrangements in British Columbia?

Water plays a role in almost every facet of our lives. Governing water use and management is a complex challenge that affects many sectors of society. As a result, a number of federal, provincial and local institutions and agencies share powers and responsibilities around water.

Federal Role in Water Governance

The federal government has a number of different responsibilities related to water under the Canadian Constitution. These include authorities over international borders, international relations, trade and commerce, navigation and shipping, seacoasts and fisheries, criminal law, and a general authority to legislate in the national interest for "peace, order and good government". Environment Canada is the lead federal agency carrying out activities related to water management, but a number of other agencies also have responsibilities including Fisheries and Oceans Canada, Agriculture and Agri-Foods Canada, Natural Resources Canada, and others. Federal statutes relevant to water governance include:

- *Fisheries Act*: protects water quality and fish habitat Indian and Norther Affaris Canada through provisions providing for the prevention of the pollution of waters inhabited by fish;
- *Navigable Waters Protection Act*: protects the public right to navigation and protects the safety of mariners, including in freshwater;
- *International Boundary Waters Treaty Act*: provides for the protection of international waterways by requiring a licence to obstruct or divert boundary waters;
- *Canadian Environmental Assessment Act*: provides for environmental assessment where the proposed project is on federal land, under federal sponsorship or where a federal act applies;
- *Canadian Environmental Protection Act*: protects the environment and human health by managing toxic substances, marine pollution, disposal at sea and other sources of pollution. There are also provisions in this Act regarding international water pollution and the ability of the federal government to take action if the province is not addressing an issue; and,
- *Canada Water Act*: provides for the cooperative management of water resources and water quality. If an agreement cannot be reached with the province, the Act provides for unilateral action by the federal government, limited to federal waters and inter-jurisdictional waters of "significant national interest" or where the water quality has become a matter of "urgent national concern".

Local Governments' Role in Water Governance

In BC, there are regional districts, improvement districts and municipalities. The term local government will be used to here to include all three types of entities.

Local governments do not have explicit jurisdiction over any subjects under *Canada's Constitution Act*. Therefore local governments can only take action on water issues when explicitly authorized to do so by provincial governments. BC has delegated some water management responsibilities to local government, explained further below.

The *Community Charter* and the *Local Government Act* are the two key pieces of legislation for local governments in BC. The *Community Charter* establishes the legal framework for core municipal authorities such as taxation, corporate services, financial management, and regulatory and by-law enforcement powers. The *Local Government Act* establishes the legal framework for regional districts and improvement districts and contains other important local government authorities such as those around elections, planning and land use. Local governments are generally responsible for community and economic development which has the potential to impact water resources management as well as the protection of stream health.

Local governments can enact bylaws to assist in the stewardship of public assets and the environment to support the well-being of their communities. Local governments have responsibilities regarding the management of riparian areas, drinking water supplies, wastewater and stormwater management. Local Governments deliver local water conservation programs, are responsibile for land use planning on private lands, and together with diking authorities, are responsible for flood protection infrastructure. Some local governments are undertaking watershed and water supply planning and are interested in ways to protect stream health at a local level.

Climate change projections indicate droughts and floods will become more frequent in many areas of BC. The provincial government has delegated authorities to local governments around flood hazard management and has enabled them to develop flood hazard area bylaws. While the province has not formally delegated specific powers to local governments to deal with drought, it has encouraged them to develop and execute drought plans which can be implemented through bylaws.

Local governments have also contributed to water management planning through initiating, managing and participating in a variety of water governance actions, including:

- developing Official Community Plans and Regional Growth Strategies;
- preparing integrated watershed management plans;
- participating in, or leading multi-sector water planning;
- developing floodplain management plans;
- developing liquid waste management plans; and,
- developing integrated stormwater management plans.

First Nations' Role in Water Governance

First Nations across British Columbia have diverse and significant interests in water governance. They are one of the largest groups of water licence holders in the province, with over 700 active licences attached to Indian Reserves for all purposes, held either jointly by First Nations and Indian and Northern Affairs Canada or individually by bands. The provincial government also has legal and policy obligations to consult with First Nations over water use decisions that might affect them.

Many First Nations have also expressed interest in additional volumes of water available for community and economic development purposes. Treaty and other negotiations may include provisions for additional rights to use water and the right to fish.

In 2005 the Province and the First Nations Leadership Council entered into a New Relationship based on respect, recognition and accommodation of Aboriginal title and rights; respect for each others' laws and responsibilities; and for the reconciliation of Aboriginal and Crown titles and jurisdictions. First Nations have historical, cultural and spiritual connections with water. There are opportunities to reinforce some of these unique cultural interests and to promote the use of traditional knowledge in water stewardship and decision making.

Provincial Role in Water Governance

Provincial powers over water come from the *Canadian Constitution Act*. These include authority over municipalities, local works and undertakings, property and civil rights, provincially owned public lands and natural resources. In inland areas, most environmental laws that affect private activity are provincial. Provincial water governance arrangements in BC have evolved over more than 150 years.

The most important statute affecting water governance is the *Water Act*.It establishes that all water resources are owned by the Crown. Designated statutory decision makers are granted the ability to issue water licences and approvals, which allow people to divert and use water for beneficial purposes.

The *Water Protection Act*, passed in 1995, reaffirms Crown ownership of water. It also prohibits bulk removal of water to locations outside the province and prohibits large-scale diversion between major watersheds. Crown ownership will not be revisited under the *Water Act* modernization process and water will continue to be managed in the public trust for current and future generations.

The *Drinking Water Protection Act* provides the legal framework for drinking water protection in BC. It establishes requirements for emergency response, water monitoring, water source and system assessments, a process for preparing drinking water protection plans, and other protective measures for drinking water supplies.

The *Forest and Range Practices Act* governs how forest activities occur on Crown land. It authorizes regulations that set objectives for water protection that must be addressed by forest and range agreement holders. It also provides for the designation and protection of Community Watersheds, which are watersheds that provide sources of drinking water. There are currently 467 Community Watersheds in the province. This designation assists with protecting drinking water from the impacts of forest activities on Crown lands. Forest operators must meet drinking water quality objectives set by government in Community Watersheds.

These are only a few examples of the numerous provincial statutes that govern various matters relating to water. Others include:

- The *Drainage Ditch and Dikes Act*;
- The *Environmental Assessment Act*;
- The *Environmental Management Act*;
- The *Fish Protection Act*;
- The *Water Utility Act*; and,
- Oil and gas exploration and development legislation.

A summary of these Acts can be found online at:
www.env.gov.bc.ca/wsd/water_rights/overview_legislation/index.html.

The Ministry of Environment is the lead provincial agency on water management and administers the *Water Act*. However, given the important nature of water in the various parts of our lives, no one agency can fulfill all the related responsibilities. Table 2b lists some of the main provincial agencies that play a part in governing water and briefly describes the role that each fulfills.

AGENCY	WATER RESPONSIBILITIES
Ministry of Healthy Living and Sport Centre for Disease Control	Mandate for drinking water protection under the *Drinking Water Protection Act*. The Interagency MOU for the Protection of Drinking Water commits all provincial agencies to consider drinking water protection in their statutory decisions and approvals. Drinking Water Protection Officers have statutory authority to ensure Regional Health Authorities potable water supplies are protected.
Ministry of Agriculture and Lands	Supports agricultural industry water requirements used in the production of food and other agricultural products.
Integrated Land Management Bureau FrontCounter BC	Considers water in regional land and resource planning. Front Counter BC provides single-window service where clients can obtain information on water licences and approvals and also assists with processing their applications.
Ministry of Energy, Mines and Petroleum Resources	Develops energy policy and works to sustainably support industry water requirements.
Oil and Gas Commission	Issues approvals for short-term use and for changes in and about a stream in connection with authorizations for oil and gas development.
Ministry of Forests and Range	Manages and protects water as a forest resource under the *Forest and Range Practices Act*.
Ministry of Community and Rural Development	Provides water infrastructure and planning funding and supports regional growth strategies that consider future water supply. Oversees local government activities under the *Local Government Act*.
Ministry of Public Safety and the Solicitor General	Coordinates response to water related emergencies such as floods, and provides funding to mitigate those hazards.
Ministry of Aboriginal Relations and Reconciliations	Leads the negotiation of treaties that consider water as a resource of interest.
Ministry of Transportation and Infrastructure	Approves rural subdivision developments, including assessing potential risks and obstacles involving water supply and sewage disposal.
Environmental Assessment Office	Coordinates the assessment of proposed major projects under the Environmental Assessment Act to ensure they are conducted in a sustainable manner.

TABLE 2b Provincial Agencies with Key Water Responsibilities

Note: This list is not comprehensive and may not detail all provincial water stewardship activities of organizations.

Source: Province of British Columbia 2008.

Other Actors' Role in Water Governance

Citizens or non-state actors are looking for a greater role in decision making and environmental governance . Governments are acknowledging that the complexity of environmental management calls for different kinds of expertise (De Loe et al, 2009). Many businesses are displaying leadership in water stewardship and are setting an example for others to follow. Professional associations such as the BC Water and Wastewater Association and the BC Ground Water Association provide advice on water policy and facilitate discussion and knowledge sharing among water users and water resource professionals. Academic institutions and researchers conduct research and make recommendations on water quality and quantity, watershed functioning, groundwater and aquifer function, governance policy, demand management and numerous other topics. Community organizations, Non-governmental organizations

and individuals provide vital services through outreach, education, conservation, watershed restoration and advice to government on policy. Watershed councils such as the Fraser Basin Council and the Okanagan Basin Water Board work to advance sustainability across local and regional watersheds, help to resolve stakeholder conflicts and educate the public about water issues. New, collective shared stewardship approaches enable the public and stakeholder groups to take on greater responsibility for securing a sustainable water future.

In addition, a number of other formal and informal governance bodies and arrangements have been established around the province in the past several decades and there is a range of water management planning processes underway or completed. These are discussed in more detail in section 2.4 below and in Appendix 1.

The flow of water does not stop at provincial or national borders. British Columbia is a partner in a number of transboundary water governance arrangements including:

- the Mackenzie River Basin Board along with the governments of Canada, Alberta, Saskatchewan, Yukon and Northwest Territories;
- the Western Water Stewardship Council along with the other provinces of Canada's west and north;
- the North American Waterfowl Management Plan and its supporting Joint Ventures to ensure healthy wetlands and other aquatic habitat;
- the Columbia River Treaty, an international agreement between Canada and the United States of America on the development and operation of dams in the upper Columbia River basin; and,
- the International Osoyoos Lake and Kootenay Lake Boards of Control to ensure these lakes are regulated in compliance with Orders of the International Joint Commission.

2.3 What are the Pressures for Change?

British Columbians are increasingly aware of water issues as our understanding of the effects of human activities on watershed health increases. British Columbians care about keeping streams healthy and thousands of volunteers are helping to restore and maintain fish populations and aquatic ecosystems. Participants in the Water Governance Workshops thought that aquatic ecosystems are being eroded in many places and that uncoordinated decision making and governance systems are an important contributor (Wilkes, 2008). As a result there are greater demands and expectations for increased attention to ecosystem protection, stream health and water security.

There are complaints that current water governance arrangements are too fragmented and that planning processes are too ad hoc. For example the Pacific Salmon Forum in its final report (2009) argued that current governance arrangements in the province create a tendency for individual ministries and agencies to operate in separate 'silos', making uncoordinated decisions that can impact a single watershed. The result may be that the cumulative impacts of multiple decisions threaten stream health.

The myth of abundance, which refers to the perception that BC has unlimited supplies of water in all parts of the province, is still very prevalent. BC's per capita water consumption is high by national and international standards. However, there is a growing interest in water conservation and in the summer months many communities face water restrictions. As well, BC's population is growing rapidly, often in the places where there is already competition for water resources. Urban expansion, agricultural production, and natural resource extraction also contribute to increasing water demand. This means that, if current trends continue, our overall consumption will be much higher in the future than it is now.

British Columbians expect government to take measures to protect water supplies and ecosystems.

They also expect increased opportunities to participate in decision making. This may mean broader participation in watershed management planning with emphasis on involving First Nations, local governments and stakeholders with a major interest in the watershed. To respond to increasing demands and pressures on water, government is looking for ways to be more collaborative, flexible and adaptive. Governance arrangements should be able to take the accumulated effects of multiple resource decisions into account.

Nowlan and Bakker (2007) suggest that the opportunities to improve water governance in BC today include:

- providing clearer delineations of authority under an overall provincial water strategy;
- coordinating governance arrangements throughout the province;
- providing clearer and more transparent requirements for initiating planning provisions;
- eliminating regional inequities in water management;
- improving funding mechanisms available to local governments or regional bodies for water management activities; and,
- increasing public participation opportunities in general and with the water licensing allocation decisions in particular.

Reforming water governance may help improve ecosystem health and resilience to challenges such as climate change by streamlining planning and decision making and providing tools for adaptive management.

2.4 How Are the Pressures Being Addressed?

With an awareness of the water governance challenges facing the province, Living Water Smart: British Columbia's Water Plan commits to a range of new initiatives and arrangements, building on existing efforts to keep water healthy and safe. The plan draws on a variety of governance "tools" including planning, regulatory change, education and incentives such as economic instruments. Living Water Smart reaffirms that Government will continue to be accountable for the protection and management of water resources in the public interest. Living Water Smart commits to enabling and supporting local water stewardship initiatives that recognize the broad value of freshwater ecosystems. It sets a direction towards finding creative and suitable solutions to local water issues. Some of the actions relevant to improving water governance arrangements are listed in Text box 2a.

TEXT BOX 2a Living Water Smart Actions Relating to Water Governance

- By 2012, water laws will improve the protection of ecological values, provide for more community involvement, and provide incentives to be water efficient.
- Government will support communities to do watershed management planning in priority areas.
- By 2012 new approaches to water management will address the impacts from a changing water cycle, increased drought risk and other impacts on water caused by climate change.
- Government will work with other provinces to share ideas and resources to improve water conservation and collectively help communities adapt to climate change.
- Tools to incorporate traditional ecological knowledge into information and decision making will be developed by 2015.
- Government will publish a report on the state of our water by 2012 and every five years after that.

The Province also participated in the Water Governance Project in 2007 and 2008. This was a partnership between the BC Ministry of Environment, the Fraser Basin Council, Georgia Basin-Vancouver Island

Living Rivers, and Fisheries and Oceans Canada. Two reports were also prepared to support the Water Governance Project. Nowlan and Bakker of the UBC Program on Water Governance authored Delegating Water Governance: Issues and Challenges in the BC Context (2007). Brandes and Curran prepared Setting a New Course in British Columbia: Water Governance Reform Options and Opportunities (2009). These works provide important local insight into the issues and, along with other leading national and international thoughts and practice.

As part of this effort, the Fraser Basin Council facilitated four regional workshops in Langley, Prince George, Nanaimo and Kelowna in early 2008. These welcomed federal, provincial, local and First Nations government participants, along with those in industry, agriculture and stewardship groups who together explored current water governance challenges in BC and opportunities for change. The feedback from these events provided important input into the *Water Act* modernization project.

Summary reports from the workshops are available at the Fraser Basin Council's website at: www.fraserbasin.bc.ca/programs/water_governance.html.

Over time, the Province has also supported development of a number of alternative water governance initiatives, resulting in different local participation in the management of water across the province. These initiatives differ in a number of ways including: how they were formed; whether they are recognized in legislation; what their mandates are; what types of decisions they can make; their obligations with respect to reporting; their revenue raising powers; staffing; budgets; and organizational structure (Brandes & Curran, 2009).

For example, the Okanagan Basin Water Board (OBWB) was instituted in 1970 through a collaboration of the three Okanagan regional districts to provide leadership on water issues that span the entire valley. In 2006, in response to rising public interest in water sustainability and with the support of the regional districts, the OBWB put into action a water management initiative to promote coordinated water management throughout the basin. For more information on the Okanagan Basin Water Board see www.obwb.ca/.

In 1997, four orders of government, including First Nations, as well as community groups and business created the Fraser Basin Council (FBC). Its mandate is to ensure that decisions protect and advance the basin's social, economic and environmental sustainability into the future. The FBC was founded on the belief that the major river management priorities for the Fraser Basin cannot be effectively addressed by any one jurisdiction (Fraser Basin Council, 2010). For more information on the Fraser Basin Council see www.fraserbasin.bc.ca/.

The Columbia Basin Trust (CBT) was created in 1995 to promote social, economic and environmental well-being in the Canadian portion of the Columbia River Basin. The CBT works to create a legacy of greater self-sufficiency for present and future generations. For example, in 2010 it announced that it is partnering with 19 local governments to deliver the Columbia Basin Water Smart Initiative to address water conservation in the region. This ambitious project will attempt to reduce community water use across the Basin by 20 per cent by 2015 (Columbia Basin Trust, 2010). More information on the Columbia Basin Trust can be found online at www.cbt.org/.

Some corporations have established internal governance arrangements to improve how they manage water. In particular, BC Hydro has established Water Use Plans to define the parameters for the day to day operations of hydroelectric facilities. Developed through an inclusive consultation process, the overall goal of Water Use Plans is to find a better balance between power generation and competing

uses of water. Water Use Plans are discussed in more detail in section 4 and more information can be found online at: www.bchydro.com/planning_regulatory/water_use_planning.html.

As noted above, planning is an important facet of water governance. The Province acts as a catalyst and supporter of locally-led water planning and leads or participates actively in broader land use planning processes. As discussed in section 4, it has been a leading participant in the Okanagan Water Supply and Demand Project. It was a partner in the Township of Langley Water Management Plan process, completed in 2009, which was the first plan to be developed under the provisions of Part 4 of the *Water Act*. The Province also continues to support implementation of the Cowichan Basin Water Management Plan, completed in 2007. Once completed, water plans can help guide decision making, including water allocation decisions, and promote the integration of groundwater and surface water management.

More information about many of these and other unique water governance initiatives can be found in Appendix 1.

2.5 Leading Thought and Practice

2.5.1 The Global and Local Trend Towards Water Governance Reform

Various jurisdictions around the world have reformed water governance arrangements. Drivers include the desire to promote greater technical and administrative efficiency, the need to clarify responsibilities and reduce conflict, and growing recognition of the need for environmental protection. As mentioned above, there is also growing awareness that government can no longer be the sole source of environmental decision making and communities want more say in decisions that affect them. Through a range of new arrangements, corporations, non-governmental organizations, and quasi-governmental boards are playing a key role in governance (de Loë, Varghese, Ferreyra, and Kreutzwiser, 2007), often with better "triple bottom line" outcomes (i.e. social, economic and environmental).

The literature reviewed suggests there are common trends that coincide with changes to governance, most of which exist in British Columbia. These include:

- public demand for additional regulation of water to promote higher standards for drinking and quality of water sources;
- shifts in the role, mandate and size of governments;
- understanding that climate change impacts will dramatically affect the water cycle and require significant shifts in water allocation and management;
- stakeholder expectations for new approaches to participation and citizen involvement in natural resource decisions;
- new legal requirements, particularly for consultation with Aboriginal people around water management and allocation decisions; and,
- increased understanding of the need to adopt an ecosystem based approach to integrated water resources management.

Jurisdictions that have recently reformed water governance include Alberta, Australia, New Zealand and South Africa. Some places have engaged in large scale, national or even international reform efforts, notably Europe through the EU Water Framework Directive process. Others have made more incremental changes over longer timeframes or at smaller scales such as the state or provincial level.

Brandes and Curran (2009), note that these governance reforms follow similar patterns and have common characteristics including:

- striving for improved coordination and accountability among water users, government managers, public and private institutions and businesses;
- an emphasis on developing collaborative engagement with a variety of stakeholders;
- a focus on the watershed as the appropriate scale for water management and governance;
- allocation of resources to crucial activities such as monitoring, compliance and enforcement, protection and restoration of ecosystems and investment in green infrastructure; and,
- development of new conflict avoidance and resolution mechanisms.

Recognition of the benefits of broadened participation and collaboration has become an internationally recognized paradigm. Meaningful decentralization and participation at appropriate levels of governance, known as the principle of subsidiarity, is also increasingly accepted around the world as a goal of reform efforts. The contribution of different kinds of expertise is an important but less frequently recognized benefit from the participation of multiple actors.

As de Loë et al. (2009, p 26) note, the value in drawing from multiple sources of knowledge, including knowledge from formally trained scientists, policy makers and managers as well as resource users (agriculture producers, fishers, hunters, etc.) has been established empirically. However, rather than using knowledge of diverse groups to generate information and understanding through reductive mechanism, emphasis is placed on using multiple sources of knowledge to build a holistic, integrated or systems–orientated understanding. This represents a new approach, where non-state actors are no longer simply recipients of knowledge, but also knowledge generators.

Governance reform involves clarifying roles and accountabilities. Accountability means that organisations and individuals acknowledge and assume responsibility, legitimized by those subject to their actions. Some of the factors that contribute to effective assignment of accountability include clearly defining responsibilities, having consequences for performance and effectiveness, checks and balances, transparency and free flow of information.

Citizens, businesses and non-governmental organization are asking for a greater role in water management. By explicitly recognizing the importance of non-state actors, and by providing a clear role, government agencies can improve the collective capacity for environmental governance and recognize the value of different kinds of expertise in decision making. This broadened notion of governance challenges traditional, highly structured and centralized approaches to decision making and management, and is increasingly recognized both globally and nationally as helpful for addressing modern water challenges.

Yet another trend in water governance is based on the assumption that the watershed or river basin is the appropriate ecological scale at which to make sustainable water decisions. International examples include the EU Framework Water Directive, which mandates watershed councils for all rivers (including trans-boundary watersheds) within the EU. For example, France is divided into 6 watershed basins. South Africa is divided into 19 water management areas. New Zealand is divided into 16 regions primarily dictated by watershed boundaries. Many US and Australian states also follow a watershed based model. Canadian examples include Alberta's Watershed Planning and Advisory Councils, Quebec's Basin Organisations, and Ontario's 36 Conservation Authorities.

As Brandes, Ferguson, M'Gonigle and Sandborn (2005, p 18) note, watershed management has a local bias. Because it involves local people who are aware of neighbouring conditions, management at this level is more responsive and results in tailored solutions. When local level decision making is coordinated by higher level institutions and participation in larger collective action is also possible, the result can be decentralized, but co-ordinated, multi-tiered governance systems that apply the principle of subsidiarity. Subsidiarity means responsibilities are allocated to the lowest level of government or social organization capable of undertaking effective management (Hunter et al., 2002).

Water governance reform also has the potential to increase the flexibility and responsiveness of decision making systems and management arrangement. Decision makers should be able to adapt or respond efficiently and effectively to changing circumstances. With the unavoidable time lag associated with major policy, legal and governance reform, changes today must not only be sensitive to the current provincial situation, but must also be able to respond to future emerging challenges (Brandes and Curran, 2009).

As de Loë et al. (2009) note, "it is generally recognized that human-environmental systems are characterized by uncertainty and change and an adaptive approach involving continuous monitoring and feedback will be needed to provide the needed flexibility to deal with future change. In an adaptive governance framework, policies are viewed as experiments which will require modification as new knowledge and understanding is gained."

2.5.2 Spectrum of Water Governance Options for BC

Government's traditional role has been that of regulator, ensuring compliance with laws through licensing, permitting and enforcement. While it must maintain this function, it could also foster and enable broader engagement in water stewardship. The *Water Act* modernization initiative is an opportunity to rethink the water governance arrangements in the province to take account of the pressures and also apply leading thoughts and practices implemented elsewhere.

When considering governance arrangements, it is useful to think about what decisions should be considered at the provincial level, and what decisions can best be determined at the local level applying local expertise. Setting environmental standards and environmental objectives should be consistent throughout the province. However, taking actions to meet the standards and objectives at the local level would benefit from knowledge of the local context.

A key consideration for *Water Act* modernization is whether greater delegation of governance and decision making authority to the watershed or some other local level is desirable. If it is, a secondary question is what types of mechanisms and institutions would need to be put in place to effect this transition. In BC, water resources vary significantly from watershed to watershed as do the human activities taking place in them. A 'one size' approach to governance does not fit all.

Applying leading thoughts and practices in BC, three approaches for water governance are raised for discussion; they reflect a wide spectrum of decision making responsibilities. At one end is the centralized approach; at the other end the delegated approach; and in between, the shared approach. In any approach the province would retain the ultimate responsibility for fulfilling the duty to consult with First Nations, although some procedural aspects of consultation may be shared. The appropriate scale of watershed, accountability and dispute resolution processes would need to be clear in any chosen approach. These three approaches are illustrated in Figure 2a.

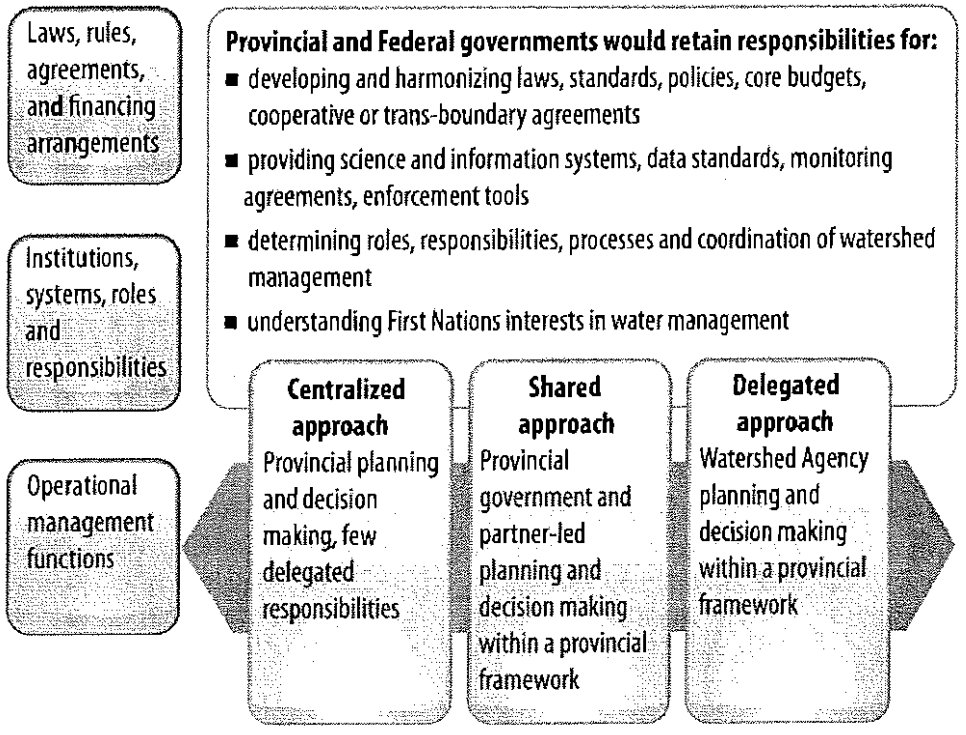

FIGURE 2a Water Governance Framework and Possible Solutions

The institutions that make decisions in these approaches are different, in particular about who makes decisions and undertakes operational management functions. For example in the centralized approach which is a modification of the current arrangements, the provincial government is the main decision making institution. In the shared approach, the province would share decision making responsibilities with a partner. In order to implement the delegated approach, new institutional arrangements would be required. A hybrid approach could also be enabled.

In any approach, decision making would be bound by and reflect objectives and outcomes set at the federal and provincial level. In all approaches First Nation traditional ecological knowledge could be better recognized and utilized in planning and decision making. The Province has committed to working with the federal government and First Nations to develop a process that will support the ability of First Nations to be full participants in watershed protection planning and implementation.

Clear criteria would be used to make governance changes so that the resulting mandates of government and other entities are predictable and consistent throughout the province. Essentially, the areas of potential change in governance are to the institutions and the operational management functions. This is discussed further under the three approaches below.

Centralized Approach

The provincial government would continue to make most water management decisions in the centralized approach. There would be improvements to the current arrangements through resource management coordination and unified processes for environmental assessment and permitting. Governance arrangements would not change significantly. Streamlined processes and computerized decision support tools can provide data standards, simplify and add transparency to decision making processes. Provincial government officials would continue to develop coordinated business plans,

communications, training and integrated service delivery. For example, government will facilitate a single consultation process for First Nations on applications that require permits from multiple agencies. This would help speed up government approvals and decision making times (especially for low risk transactions), reduce the consultation burden on First Nations, and ensure government remains accountable for the protection of environmental flow needs and stream health.

The modernized *Water Act* could require water allocation planning and the consideration of stream health in decisions. Provincial and federal agencies would need to agree on stream health objectives and how to report against them. Advice and participation from First Nations and other stakeholders in the watershed could be sought during the water allocation planning process. Increased provincial engagement in local government planning processes for land use could also improve the integration of water considerations into planning at the local level.

The role of licence holders may also change under this approach to motivate compliance and help prioritize enforcement activities. As appropriate, water users would be responsible to report actual water use and declare compliance with water licence conditions.

Shared Approach

The shared approach delegates specific water management functions and decisions to a First Nation or partner institution such as an existing Regional District, depending on their capacity or willingness to undertake responsibilities. The province would work with other partners to identify mutually beneficial solutions for water management. Any delegated decision making would rest with representatives from the community who are locally elected or appointed by government. The shared approach could improve local visioning and shared decision making for water, and could rely on existing institutions and planning arrangements for its implementation. If the management of water occurred on a watershed basis, then agreements to work collaboratively with other jurisdictions sharing the watershed would form part of the approach.

Partner institutions could lead regional visioning and planning processes for watershed planning, and extend current public education and outreach activities. This could include responses to drought or other climate change impacts, drinking water source protection planning and co-ordinating water use or state of watershed reporting. Land use plans, Regional Growth Strategies, Official Community Plans and watershed management plans could be used to articulate and help achieve the communities' water management values and priorities. Wider First Nations and stakeholder involvement could be enabled through advisory committees or consultation arrangements. The enabling provisions could allow for partner institutions to increase their responsibilities over time.

In the shared approach, the provincial government would continue to set strategic direction and policy. This would include guidelines, standards and regulations to help establish the policy and legal frameworks for the basin level to operate. Partnerships and collaboration would be crucial to implement and solve problems at the local scale, but accountability mechanisms would maintain the protection of the wider provincial public interest.

Delegated Approach

Under the delegated approach most water management functions and decisions would be delegated to a watershed or regional-scale agency which could be called a 'watershed agency'. Of the three approaches, the delegated approach represents the greatest potential change to the current governance arrangements. Watershed agencies would be new and, to implement this approach, they would need the ability to

influence land use planning and development activities. Watershed agencies would be a catalyst to build increased interest and capacity for community based planning. Existing entities (such as the Okanagan Basin Water Board or other basin-scale entity) could be designated as a watershed agency.

Watershed agencies would involve First Nations, lead public consultations for local visioning and value setting, and would be responsible for developing and implementing (provincially approved) watershed management and water allocation plans. Watershed agencies would be responsible for monitoring, reporting, and educating residents about the watershed. Decision makers in this model might represent a range of interests in the watershed and could be locally elected or appointed by government.

Regardless of whether and how authority might be decentralized, watershed agencies would have to fit or 'nest' within higher level institutions that hold such bodies accountable and co-ordinate larger collective action (Brandes, Ferguson M'Gonigle and Sandborn, 2005). This means that the provincial government will certainly need to continue to play a central role in the delegated approach. In addition, provincial agencies must be willing to help implement or take watershed planning outcomes into account when making decisions.

Watershed agencies could take on additional functions based on need, issues and risk, regional population, capacity and willingness. The scale of watershed agencies may be determined using the 26 existing 'water district' designations currently in the *Water Act*. Alternatively, other science-based means for determining watershed boundaries and groundwater aquifer and recharge areas may be identified.

There are important differences between the Shared and the Delegated approaches. The delegated approach would include:

- New agency or institution operating on a watershed or basin scale;
- Responsibilities for water allocation planning, water management planning with the province; responsible for setting the framework and stream health objectives;
- Decision making and enforcement under these plans;
- Responsibilities for including First Nations, stakeholders and communities in planning; and
- Responsibilities to integrate with or influence other land use planning initiatives in the watershed.

Implementation considerations of changing water governance

In all three approaches the provincial and federal governments would continue to be responsible for setting and coordinating the laws, rules, agreements and financing arrangements. The province would ultimately be responsible for deciding the institutions, systems and roles for any delegated responsibilities. The province would determine an enforcement framework that is consistent with other natural resource legislation, information standards, and stream health objectives and results to be met.

The provincial government would retain high risk, multiple-watershed or multi-agency decisions. Depending on the approach chosen, an oversight body may be needed to review practices, monitor effectiveness and investigate complaints. Solutions for funding water management, science and information requirements and capacity building would also need to be identified and enabled through other legislation.

There are many challenges associated with changing water governance arrangements. Many lessons can be learned from the jurisdictions that have moved away from a centralized model.

Watershed boundaries may not coincide with existing political or local government boundaries (such as municipalities, regional districts, water districts, improvement districts or other governments).

Depending on the watershed, such boundaries may involve areas within the jurisdiction of one or several local governments. Agreements for working collaboratively with other jurisdictions and organizations on common issues, such as land use planning and development activities would form part of the chosen approach.

Another challenge with changing the agencies that undertake planning or make decisions is the capacity and resources needed to implement. Institutions that take on additional responsibilities may not have the knowledge or experience needed to undertake them adequately. An assessment of funding or funding tools, as well as technical expertise and training would assist in any transition. Important financial considerations around new governance models include:

- the short- and long-term cost implications of each model;
- the degree of centralization or decentralization of funding responsibility;
- the responsiveness of water user behaviour to changes in fee and tax structures;
- the level of connection between taxation or fee impacts and local government and agency decisions; and,
- the potential value of in-kind contributions, particularly for education, monitoring and restoration (Brandes and Curran, 2009).

For a more complete discussion of funding and financial sustainability considerations see Brandes and Curran (2009, p 11).

Under a modernized *Water Act,* local governments will continue to play a role in how decisions about water are made. Localizing governance responsibilities should reflect community values and interests, especially those already identified through local planning. Any approach chosen needs to consider how provincial planning and decision making reflects local values and interests.

Local decision making can also be quite different across regions and is largely influenced by communities themselves. Without clear guidance, a range of governance approaches may result, leading to confusion or an unpredictable investment climate across the province. Provincial consistency needs to be balanced with local values when developing and implementing different approaches to water governance.

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PART THREE

Introducing More Flexibility and Efficiency in the Water Allocation System

3.1 Water Allocation in British Columbia

Water allocation refers to the system of rules and procedures that award access to water through the granting of licences or approvals. This system provides approval holders with the legal authority to divert and use surface water on either a short or long term basis.

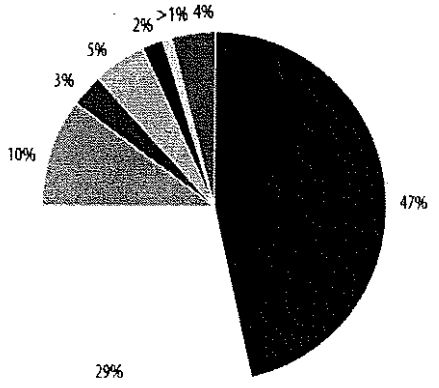
Water allocation systems have broad and important ramifications. As noted by de Loë, Varghese Ferreyra, and Kreutzwiser (2007), by establishing the availability and priority of access to water for consumptive uses (e.g., agriculture, manufacturing) and for non-consumptive uses (e.g., hydropower, recreation), water allocation systems influence economic productivity, social and cultural wellbeing and ecosystem quality.

Water in BC is a resource owned exclusively by the Crown on behalf of the residents of the province. More specifically, section 2(1) of the *Water Act* specifies that:

> *"the property in, and right to the use and flow of all the water at any time in a stream in British Columbia are for all purposes vested in the government, except only in so far as private rights have been established under licences issued or approvals given under the Act".*

Thus, surface water rights are *usufructuary* – one can use but not own water.

Long term water licences are granted for a broad range of purposes: irrigation, domestic, hydro-electric power generation, municipal water supplies, fish hatcheries and mining exploration to name just a few (see Figure 3a). There are currently approximately 44,000 active licences in the province, and about 300 to 500 new ones are issued each year.



GENERAL PURPOSE	WATER LICENSES AND APPLICATIONS	PERCENTAGE
DOMESTIC	24,347	47%
IRRIGATION	14,787	29%
INDUSTRIAL	5,097	10%
WATERWORKS	1,618	3%
STORAGE, NON-POWER	2,674	5%
WATERPOWER*	1,144	2%
STORAGE, WATERPOWER	116	<1%
OTHER	2,039	4%
TOTAL	51,822	

*** Note:** Waterpower includes all power purposes: general commercial and self-supplied residential.

The total shown here (51,822) is higher that the approximate number of active water licences (43,989), as it includes all purposes which may be authorized by a licence. For example, a single water licence may authorize up to 3 water use purposes. Figures also include applications in process.

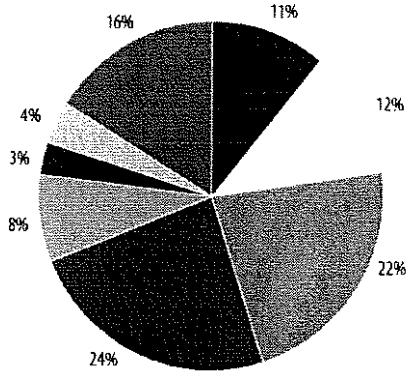
FIGURE 3a Water Licences and Applications by General Purpose (2008)

Source: Province of British Columbia, 2008.

Figure 3a illustrates how water licences are distributed by purpose. Domestic licences account for nearly half of all existing licences. However, this sector accounts for only a small portion of total water use, given that each individual domestic licensee tends to withdraw a low volume. *Source: WLIS Report 2500 (2008)*

Domestic licences account for nearly half (47%) of all active licences, but only a fraction of one percent of total water use. This is because each domestic user tends to withdraw only a very small volume compared to, for example, a municipal water utility. Hydro power accounts for the vast majority (about 98%) of allocated surface water by volume, bearing in mind that this is a non-consumptive use, in that water is not taken out of the stream for any extended period of time.*

Not surprisingly, non-hydro licences are spread around the province in a pattern that roughly mirrors the general population distribution. Figure 3b shows how water licences are dispersed spatially across BC's regions.



REGION	WATER LICENSES AND APPLICATIONS	PERCENTAGE
VANCOUVER ISLAND NANAIMO	4,819	11%
LOWER MAINLAND SURREY	5,315	12%
THOMPSON/NICOLA KAMLOOPS	9,595	22%
KOOTENAY NELSON CRANBROOK	10,750	24%
CARIBOO/CHILCOTIN WILLIAMS LAKE	3,340	8%
SKEENA SMITHERS	1,474	3%
OMINECA PEACE PRINCE GEORGE	1,544	4%
OKANAGAN PENTICTON	7,152	16%
TOTAL	43,989	

FIGURE 3b Active Water Licences in British Columbia by Region (2008)

Source: Province of British Columbia, 2008.

* An exception to this is the Kemano licence where water is diverted out of the Nechako River watershed through the Coast Mountains, into the Kemano River. There are also some smaller interwatershed diversions associated to smaller hydro developments.

A water licence is granted through the following process:

- a water licence application is submitted by the applicant to the Province;
- once the application meets completeness criteria it is checked to identify potential impacts on: existing licence holders or earlier applicants, minimum in-stream flow requirements, landowners or crown land tenure holders, other agencies, and the interests of First Nations;

- once notification of potentially affected licensees or other interests have been completed and comments or objections received, a technical assessment of the application is performed by government staff to determine if there is sufficient water available in the source to issue a new water licence;
- the Regional Water Manager or the Comptroller of Water Rights reviews the assessment of the application considering potential impacts and the availability of water and will either grant a water licence or refuse the application;
- all applicants, affected landowners and licensees whose rights may be affected have a right to appeal a licence decision to the Environmental Appeal Board.

In addition to water licences, the Province also issues short term water use approvals under section 8 of the Water Act, which can also result in significant water withdrawals. These are issued for periods of up to 12 months and may be for a variety of purposes including: road construction and maintenance; placer mining for exploration; and oil field injection and pressure testing. Several hundred short term use approvals are issued each year.

Another form of approval may be issued under section 9 of the *Water Act* to authorize specific changes in and about streams such as bank protection works, culvert placements and pipeline installations. A number of low risk activities that result in changes in and about streams can also be carried out under the Water Regulation, subject to specified criteria, notification to the Ministry of Environment and to following terms and conditions that might be set by designated ministry staff. Ministry of Environment staff typically processes several hundred section 9 approvals each year.

The Province also uses a number of regulatory and management tools to prevent water over-use. For example, a water reserve is a way to set priorities for future allocation of water from a stream, or within all or part of a drainage system. They are established by Order-in-Council and withhold all or part of the unrecorded water of a stream from being diverted and used under a water licence. A water reserve may be used, for example, to hold water for the use of the Crown for any purpose; to assist with treaty negotiation processes with First Nations; or, to make provision for a future water supply for a waterworks, irrigation or power purpose. More information on water reserves can be found at www.env.gov.bc.ca/wsd/water_rights/reserves_restrictions/index.html.

Government staff may also place water allocation restrictions on streams to alert other staff about current or potential water allocation concerns. Restrictions may range from including minimum fish flow clauses in a water licence to suspending the issuance of any further licences on a water body. This information is considered, along with all other relevant information, when making future allocation decisions.

Water licensees must also pay annual rental fees, which are an important source of revenue for the Crown. Water rental rates vary according to categories of water use. Corresponding to the great volumes of water it uses, the hydro-electric waterpower sector accounted for over 97% of water licence revenue in 2008 (Province of British Columbia, 2008).

As discussed further in section 4, the extraction and use of groundwater in BC is generally not regulated (although construction of wells and other aspects of well installation and management are). As a result, the Province does not currently issue licences for groundwater withdrawals. Projects that intend to extract very large amounts of groundwater (>75 litres/second) do, however, undergo a review under the *Environmental Assessment Act*. The contrast between the well developed system for surface water allocation and the current approach for groundwater is discussed in more detail below.

3.2 What Are the Current Regulatory Arrangements in British Columbia?

The *Water Act* is British Columbia's key water allocation statute. It provides for management of surface water by authorizing issuance of water licences and approvals, creation of reserves, development of water management plans, and establishment of water user communities. In a planning area, ground water development may also be regulated by requiring drilling authorizations. The Act also identifies offences and penalties.

The first *Water Act* was enacted in 1909, just over 100 years ago, in response to frequent disputes and litigation occurring over water rights in the province at that time. This first version of the Act mirrored a number principles first established by Governor James Douglas under the *Gold Fields Act* of 1859. This predecessor Act was enacted in recognition of the needs of miners in the Fraser River gold rush for an assured supply of water in places remote from streams and rivers. The *Gold Fields Act* introduced the concept of right of access across private land to procure water, similar to today's concept of expropriation. This allowed persons other than owners of property next to streams (riparian owners) to obtain rights to use water, an approach that remains a fundamental part of water law in the province today.

The *Water Act* continued to evolve throughout the 1900s and was last modified in 2004, when changes were made primarily to improve protection of drinking water. The 2004 amendments also provided the Province with new mechanisms to protect groundwater and established a process for water management planning to address or prevent conflicts between water users and protect water quality and ecosystem.

More detail on the evolution of the *Water Act* can be found in Appendix 2.

The *Water Act* establishes that licences are granted according to the doctrine of prior appropriation, often referred to as **first in time, first in right** (or FITFIR). Applications, upon payment of a fee, are dealt with one at a time and the date of the application generally establishes the priority date of the licence. The purpose for which the water is used has no bearing on its priority, except when two licences have the identical priority date. When water is scarce, the rights of "senior" licensees (i.e., those holding licences with earlier priority dates) take precedence over "junior" licensees. For example, a licence with the priority date of April 12, 1978 has a prior right to water over a licence with the priority date of September 15, 1983.

The Act also establishes the concept that water rights are **appurtenant to land**. This means that water licences are attached to specific parcels of land where the water is used and cannot be transferred without applying to the government. In order to acquire a licensee, you must be the owner of the land or have a similar major interest. Upon sale or transfer of the land, the rights and obligations under the water licence pass with the conveyance and become the responsibility of the new land owner.

Most licences have no expiry dates, with the exception of licences for power purposes, which have terms of 40 years, and short term use approvals, which are currently issued for up to one year. A few non-power licences also have expiry dates. Although there is authority in the current Act to attach a term, in practice licences are usually issued in perpetuity.

Various other terms and conditions will typically be attached to a licence including the following:

- the name and location of the stream from which water may be taken or stored;
- the location of the intake on the stream;
- the priority date of the licence;
- the purpose(s) for which the water may be used;
- the maximum quantity of water which may be used or stored;

- the time of the year during which the water may be used;
- the property where the water is to be used and to which the licence is attached;
- authorization to construct works to divert and convey the water from the stream to the place of use; and,
- other clauses that define the special conditions for a particular use.

Once a licence is issued, there is very little authority in the *Water Act* for government to unilaterally change terms and conditions or issue new ones except, for example, if an error was made in the original licence or if the owner consents to a change. This provides licensees with a great deal of security.

A licence may be suspended or cancelled if a licensee fails to pay rental fees, does not comply with terms and conditions or does not obey the *Water Act* and its regulations. A licence may also be suspended or cancelled if the licensee fails to make **beneficial use** of the water for the purpose and in the manner authorized. In practice cancellation for this reason does not often occur.

The *Water Protection Act* also plays a role in water allocation. Enacted in 1995, it reconfirms the ownership of surface water and groundwater in the Province. It also prohibits bulk removal of British Columbia's water to locations outside the province and prohibits large-scale diversion between major watersheds. More information on the *Water Protection Act* can be found at www.env.gov.bc.ca/wsd/water_rights/water_act_info/index.html.

The *Fish Protection Act* protects fish and fish habitat by prohibiting bank-to-bank dams on 17 protected rivers and authorizing designation of "sensitive streams" for fish sustainability. From a water allocation perspective, this Act is important because Section 9 allows the Minister of Environment to make temporary orders regulating the diversion and use of water from streams, regardless of precedence under the *Water Act*. These temporary reduction orders may be made if, during a drought, the survival of a population of fish is or may become threatened. The authority is subject to due consideration of the needs of agriculture. This section of the Act was first brought into force in 2009 in response to severe drought conditions prevailing that year.

Other legislation also influences how water is managed in British Columbia including the *Environmental Assessment Act* and the *Drinking Water Protection Act*. An overview of provincial legislation associated with water can be found at: www.env.gov.bc.ca/wsd/water_rights/overview_legislation/index.html.

In sum, the following principles are embedded in the current water allocation system and any or all may be perpetuated in modernized water legislation either in their current form or with modifications:

- **Crown ownership** – the Province owns all water in BC exclusively on behalf of residents of the province, and allocates water use via licences and short term use approvals;
- **Prohibition on bulk exports** – water must not be removed from British Columbia in large quantities and must not be diverted between major watersheds;
- **Doctrine of prior appropriation** – "first in time, first in right" means that security of water rights is determined by the priority date set in the licence;
- **Appurtenancy to land** – a licence is attached to the land and passes with conveyance - licences "run with the land" rather than the licence holder;
- **Mandatory beneficial use** – licensees must "use it or lose it";
- **Right of objection and appeal** – other licensees and landowners including riparian owners have a right to object to a licensing decision before it happens. These individuals and licence applicants also have the right to appeal decisions once made;
- **Security** – licensees are protected by the precedence of their use. The Province has only limited authority to attach new terms and conditions once a licence is issued.

3.3 What Are the Pressures for Change?

British Columbia's water allocation system has served the province well for over 150 years. It has established clearly defined access to water in an orderly and predictable way and has facilitated settlement, agricultural production and economic development. However, it was designed for a time when development patterns were different and water shortages were uncommon. A system that is more efficient, flexible, and adaptable to changing conditions, particularly as pressures on water supplies intensify, may help water users and managers more effectively cope with current and future challenges.

Over the next 25 years the population of BC is expected to grow by over one third from an estimated 4.45 to a projected 6 million (Province of British Columbia, 2009a). This growth is primarily expected to occur in areas where water demand is already intense, such as the Okanagan, Vancouver Island, and the Lower Mainland. Demand for water will increase not only for such consumptive purposes as residential, industrial, and agricultural purposes but also for hydro electricity which, in 2004, supplied over 92% of BC's energy needs (Province of British Columbia, 2007).

Water use in Canada is already high by international standards compared to other provinces. Canada ranks 15th out of 16 peer countries in terms of its gross water withdrawals. Canadians use nearly 1500 cubic metres per capita per year (Conference Board of Canada, 2008). Our water consumption is more than double that of the 16 country average, with industry as the largest water user.

Looking specifically at municipal residential consumption, Canada's average water use for a stand-alone home in 2006 was 328 litres per person per day, which is quite high compared to countries with similar lifestyles such as Australia or the United Kingdom. British Columbia's average in particular is much higher at 448 litres per person per day - over a third higher than the national average (Environment Canada, 2009). Conservation practices are beginning to register in public thought but there is still some way to go.

Already around the province, numerous surface water sources are experiencing shortages or have licensing restrictions. Some streams and water systems are already fully or close to fully allocated. Licensing systems must ensure that aquatic ecosystem needs are considered by developing a fair system for reducing water use, particularly during shortages.

The Province is also committed to strengthening relationships with First Nations. Although progress has been made on improving consultation processes around water allocation, there is more to be done. Concluding treaties and other lasting agreements that will facilitate improved social and economic outcomes for First Nations is also a priority. Importantly, these agreements often contain provisions to provide sufficient amounts of water for community, agricultural and industrial purposes in order to satisfy a realistic vision of the potential development of Treaty Settlement Lands.

Climate change and its anticipated impact on hydrology may be another key driver of the need for a more adaptive allocation system. Climate change impacts the timing, amount and type of precipitation and run-off experienced across the province. We might expect warmer and wetter winters, decreased snow accumulation, earlier, accelerated snowmelt, and longer, drier summers. Among other things, this will lead to reduced water storage in glaciers and winter snowpack. This in turn may contribute to reduced infiltration to recharge groundwater supplies and impact those communities that rely on spring snowmelt to sustain them through the summer. As discussed in section 2, we can also expect altered timing and magnitude of streamflow with changes in peak flows and more frequent low flows, which has significant implications for aquatic ecosystems.

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Our water allocation system is generally premised upon historical water availability. With increasing unpredictability and extremes, assumptions that were used in the past to inform granting of water rights may no longer be viable. As climate change causes future water availability to diverge from the past, new, more flexible allocation systems and conflict resolution mechanisms will be needed to deal with these new realities.

Changing climate means that drought conditions and low stream flows in summer will be more common and may increase conflicts among water users and between water users and the environment. Drought is a normal, recurrent feature of climate involving a deficiency of precipitation over an extended period of time, resulting in a water shortage for activities, communities or aquatic ecosystems. In British Columbia, drought may be caused by combinations of insufficient snow accumulation, hot and dry weather or a delay in rainfall. Drought can lead to reduced water availability for household and business use. Lower streamflows and warmer river temperatures will impact fish and other aquatic life. Drought can also affect the growth of agricultural crops and limit the water available for irrigation.

In the face of these pressures, water licensing activities must be informed and backed by adequate science and analysis and consider the needs and demands of other water users. These processes must also evolve to accommodate new applications while maintaining the integrity of aquatic ecosystems. The potential for user conflicts and challenges to regulatory decisions needs to be addressed through the use of transparent, fair and science-based planning and decision making.

3.4 How Are the Pressures Being Addressed?

Recognising the imperatives imposed by climate change and other pressures, the provincial government is pursuing a range of legislative and non-legislative reforms to improve the water allocation system. Collectively, these measures are intended to ease future water tensions in a way that is fair for everyone, including new users. The Province made a number of commitments directly or indirectly respecting water allocation through *Living Water Smart: British Columbia's Water Plan* (see Text box 3a). These actions are rooted in recognition that equitable allocation of water will improve the certainty of access for social, economic and environmental needs.

Text Box 3a: Living Water Smart Actions Relating to Water Allocation

- Government will require all users to cut back their water use in times of drought or where stream health is threatened.
- Government will limit all new licences to 40-year terms in areas where there is high demand and pressure on water.
- Government will support communities to do watershed management planning in priority areas.
- By 2020, water use in British Columbia will be 33 percent more efficient.
- By 2012, government will require all large water users to measure and report their water use.
- Government will require more efficient water use in the agriculture sector.
- Government will secure access to water for agricultural lands.
- By 2012 new approaches to water management will address the impacts from a changing water cycle, increased drought risk and other impacts on water caused by climate change.

The Ministry of Agriculture and Lands is working with agricultural producers to implement a range of measures to improve water efficiency in that sector. For example, the Agricultural Water Demand Model is now operational for the Okanagan Basin and a report on water use is being prepared. The Bonaparte and Nicola basins, the Salmon River Valley, and the Similkameen Valley's Agricultural Water Demand Models will be operational in 2010.

The Province has also worked with the Irrigation Industry Association of BC to make the Irrigation Scheduling Calculator operational (see www.irrigationbc.com). This tool helps irrigators apply the right amount of water to their crops by providing an irrigation schedule that uses real time climate data.

Provincial ministries are also working with local governments to implement a range of measures to improve water efficiency and to help communities be better prepared to deal with climate change and growing populations. The Okanagan Water Supply and Demand Project is a joint initiative of the Ministry of Environment and the Okanagan Basin Water Board in collaboration with other agencies and organizations. Bringing together data and models on surface and groundwater hydrology, water use, irrigation demand and in-stream flow needs with a regional climate model, the Okanagan Water Accounting Model estimates current and future water supply and demand under different scenarios. The outputs from this project are being used by communities and governments to develop policies and adaptation strategies and to inform local decisions and planning.

Another example is the recently released Water Conservation Calculator, from the Ministry of Community and Rural Development, that helps model how specific conservation measures can help save municipal water and money. Water purveyors can use the tool to assist in presenting their business cases for conservation to decision makers. That ministry also now requires that water purveyors have an approved and effective water conservation plan as a condition of its capital funding programs. The Water Conservation Calculator can be found online at www.waterconservationcalculator.ca/.

In addition, in September 2008, the Province introduced changes through the new Green Building Code requiring low-flow toilets and other water-saving plumbing fixtures and fittings in new construction and renovations.

Government also continues to support watershed planning processes in the province with information and resources. Government is working with the Cowichan Valley Regional District to implement the Cowichan Basin Water Management Plan. Government has also supported the Township of Langley Water Management Plan, which was completed in late 2009 and is the first plan developed under Part 4 of the *Water Act*. This important development sets out policies and regulations to protect local groundwater resources for community use and promotes healthy habitat. Regulatory tools include expanded water conservation initiatives and water quality protective measures.

As noted above, hydro electric power generation is the largest use of water in the province. Water Use Plans (WUPs) are an example of efforts underway at BC Hydro to more sustainably manage its activities. WUPs are technical documents that define the proposed operating parameters to be applied in the day to day operations of hydroelectric facilities. The overall goal is to find a better balance between competing uses of water, such as domestic water supply, fish and wildlife, recreation, heritage and electrical power needs. WUPs have been developed for most of BC Hydro's hydroelectric facilities through a consultative planning process involving participants such as government agencies, First Nations, local citizens and other interest groups.

More information on BC Hydro's Water Use Plans can be found at www.bchydro.com/planning_regulatory/water_use_planning.html.

Concurrently, the Ministry of Environment is continuously improving the efficiency of the water allocation process through initiatives such as the Water Allocation Streamlining Process (WASP), through which a range of administrative and policy enhancements were implemented between 2007 and 2009. The Province is also in the final stages of implementing an online licensing system which will enable more efficient processing of new licence applications and amendments.

Government is also working to improve the resilience of communities to drought and to respond more effectively when they occur. In 2009 it updated and released the "Dealing with Drought" handbook for water suppliers (Province of British Columbia, 2009b.). This handbook is designed to assist local water suppliers with drought management and water conservation planning. The Province is also working with Agriculture and Agri-Food Canada on the development of a drought response plan. This plan will outline the actions taken during and immediately following a drought to reduce its impacts. This work builds on existing tools and experience with previous droughts, including the summer of 2009 which saw extremely low flows for many streams in southern BC.

More information on Government's drought planning and response resources can be found at www.env.gov.bc.ca/wsd/public_safety/drought_info/.

More information on many of the projects and programs discussed above as well as other initiatives that improve the efficiency and effectiveness of water allocation can be found at www.livingwatersmart.ca/progress.html.

3.5 Leading Thought and Practice

Through *Living Water Smart*, the provincial government has set a course for reforming the water allocation system so that it more strongly emphasizes and encourages efficiencies in both water use and administration. Flexibility is also considered a key component: providing water users and decision makers with the means to quickly adapt to changing environmental, economic, and social conditions, including conserving water during drought or when stream health is threatened. Building on leading local and international thought and practice, a modified water allocation system in BC will also seek to more effectively integrate the management of groundwater and surface water resources.

In 2002, the Food and Agriculture Organization (FAO) of the United Nations completed a review of trends in the evolution of water law globally since the UN Conference on Environment and Development in Rio de Janerio in 1992 (The Earth Summit). Based on their finding, the FAO predicts that water lawmakers in the 21st century will continue to refine water allocation mechanisms, and seek to strike a dynamic balance between equity and efficiency in allocation and use. The FAO report foresees two major challenges for water allocation structures and policies in the future. They must:

- reflect the uncertainties of water availability under regulated and unregulated flow conditions, while at the same time accommodating the security and dependability of water rights sought by users and investors; and,
- reconcile the development of water resources with conservation and with protection of water quality, not just for further use but also for the survival of water-dependent habitats (Food and Agriculture Organization, 2002).

Efforts underway in BC, then, are not taking place in isolation, but rather are part of a broader trend towards reforming water allocation law in response to modern conditions and pressures.

It is useful to consider recent reforms internationally as a source of ideas for new directions locally. Some jurisdictions (e.g., the United States) have made changes incrementally, resulting in a somewhat complex legislative environment. Others have repealed and replaced their legislation, resulting in wholesale changes all at once (e.g., South Africa). Yet others are involved in "supra-national" initiatives (e.g., the European Union's Water Framework Directive) in which over-arching objectives for all member nations are established with each country then determining its own particular legislative scheme to comply with the initiative. These types of developments will be considered further below.

3.5.1 The Water Allocation System Emphasizes And Encourages Efficiencies In Both Water Use And The Administration Of Water As A Natural Resource

What is an "efficient" water allocation system? There are a number of different ways of looking at this question including economic (or allocative) efficiency, water use efficiency and administrative efficiency.

In strictly economic terms, **allocative efficiency** occurs where resources are used in a way that maximizes their contribution to the economy. The outcome of allocative efficiency is that no one can be better off without someone else being worse off and no resources are wasted (McTaggert et al., 1996). As demands for water increase and supplies become scarcer, more unpredictable, and more expensive to develop, allocative efficiency becomes a higher priority.

Inter-sectoral allocative efficiency is achieved by allocating water away from an economic sector or activity that has a lower economic return to one that has a higher return. For example, this might mean allocating water away from irrigating low value crops to supplying drinking water.

Intra-sectoral allocative efficiency is achieved by allocating water within a given economic sector, usually at the level of the production unit (farm or factory), in a similar manner. For example, this might mean allocating water away from irrigating hay to using water for vineyards or other fruit orchards.

According to Butcher (2002), if water is to be allocated efficiently then a number of criteria must be met. There must be:

- flexibility in the allocation of supply (so water can be shifted to better uses);
- a method of ensuring the real opportunity cost of providing the resource is paid for by the user;
- an ability to respond to changes in consumer needs or productive opportunities for water (i.e., dynamic efficiency);
- security of ownership for those with property rights (so that they can invest capital without undue risk);
- predictability of the outcome of the allocation process;
- equity of the allocation process and equitable impact when water deficits occur; *and,*
- political and public acceptability of the allocation process.

Closely related to the concept of allocative efficiency is the idea of **water use efficiency**, which can be defined as the accomplishment of a function, task, process, or result with the minimal amount of water feasible (Vickers, 2002). Water use efficiency also has economic benefits, but, along with the closely related concept of **water conservation**, also strongly suggests ecosystem protection goals.

A recent report completed for the Canadian Council of Ministers of the Environment (Kinkead Consulting, 2006) notes the following benefits of using water more efficiently and productively:

- prevents or reduces conflicts among water users who share a common resource;
- contributes to the protection of environmental flows and to the health of aquatic ecosystems;
- makes water resources available for further growth and development;
- avoids or defers the need to expand the capacity of water and wastewater infrastructure;
- eliminates the need to augment water supplies through potentially harmful or undesirable diversions from other watersheds;
- frees-up public funding for investment in other priorities including the renewal of outdated water and sewage infrastructure;
- increases the ability of water users to withstand the impacts of low-water conditions resulting from inherent weather variability and climate change;
- conserves energy, other resources and raw materials and improves business profitability;
- enhances wastewater treatment efficiency and reduces environmental emissions; and
- enhances leverage with other jurisdictions on issues relating to shared waters.

As noted above, the Province has led or participated in a number of initiatives to conserve water in various sectors including agriculture, municipal and industry. That said, there are currently few legislative requirements to use water efficiently.

The techniques and technologies for using water more efficiently across all sectors are by now well established (see, for example, Vickers, 2002; Brooks, Brandes and Gurman, 2009; BC Water and Wastewater Association, 2010). Some jurisdictions have begun to make moves towards codifying water efficient practices. For example, as part of its Water for Life strategy, Alberta is supporting development of Water Conservation, Efficiency and Productivity (CEP) Plans across various sectors including irrigation (agricultural), municipal, oil and gas and forestry. Although not a regulated requirement, the intent is that efficiency and productivity efforts resulting from this planning process will ensure the maximum use of existing infrastructure and will reduce new water infrastructure costs.

More information on Alberta's Water Conservation, Efficiency and Productivity planning process can be found on-line at www.waterforlife.alberta.ca/548.html.

Economic Instruments

Another option for encouraging efficiency is use of various types of "economic instruments" (or EIs). EIs include subsidies (e.g., interest-free loans to encourage investment in efficient irrigation systems), pricing (e.g., differential pricing to encourage water use efficiency), penalties and bonuses (e.g., fines for exceeding water allocation thresholds), rebates (e.g., for purchases of water conserving technology), as well as water markets and water trading.

Use of EIs can be controversial and requires careful attention to such concerns as restrictions under free trade agreements and social equity considerations. However, in their review of global water law trends discussed above, the FAO (2002) noted an increasing trend towards use of these instruments including increasing charges for water withdrawals as a key mechanism for controlling extraction and managing demand.

In the municipal setting, rebates are already provided in many British Columbian cities and towns for items such as low flow toilets and front-loading washing machines. Some water service providers

(e.g. Village of Tofino, the Regional District of Nanaimo, Kelowna and municipalities in the Capital Regional District) have moved to universal metering and charge for their water by volume.

However, consistent with the trend across Canada, the rate charged for municipal water services tends to be quite low relative to the cost of providing service and the benefits received (Renzetti, 2009). The price Canadians pay for municipal water services is also low by international standards (OECD, 2010).

Various jurisdictions in the United States, notably California and Texas, utilize volume-based pricing tools with good success to affect community water demand and are able to do so without undue hardship on low income members of the community (Brandes, Renzetti and Stinchcombe, in press). Senior governments have facilitated this transition by creating a regulatory environment in which water agencies have the opportunity to design and implement conservation-oriented pricing rate structures. Many public agencies in the United States have adopted tiered rate structures, which generally impose higher charges per unit of water (inclining block rates) as the level of consumption increases over a base level. BC Hydro already uses this approach in BC for electricity rates.

With respect to pricing water allocations at the provincial level, annual water rental rates in BC are generally already based on the volume of water authorized for withdrawal in the water licence. So, for example, an irrigator will pay more in water rentals than his or her neighbour if the volume permitted in his or her licence is greater. This provides some incentive for licensees to minimize the annual volume of water they request in their allocation. In the case of some large irrigation districts and municipalities, their total consumption is often metered and they are charged based on the actual volume they use (rather than simply the volume they are permitted to use).

The *Water Act* modernization process provides an opportunity to review the current approach to water pricing, other economic instruments and other conservation provisions to determine if the Act provides sufficient incentives for licensees to be efficient with their allocations. Issues around volumetric pricing are also closely linked with the issue of metering, which is discussed in more detail below.

Transfer of Existing Water Rights

Water Act modernization also presents an opportunity to review mechanisms for transferring existing water rights. As noted above, flexibility in this area is an important component of allocative efficiency, as it allows water to be shifted to better uses.

As discussed above, water rights in BC are tied to land rather than individual licence holders (the concept of appurtenancy). It is possible to shift a water allocation to another location or use it for another purpose under the existing legislative regime, but the process can be administratively burdensome and potentially slow in the eyes of licensees.

A more flexible system might allow users to transfer water rights from one appurtenance to another more easily by reducing the government decision making burden and streamlining requirements. Although there is existing flexibility in the Act in this area, moving to a more results based approach to licence transfers and changes could make the process more responsive and quicker. It might also allow for more easily extending rights to purposes other than the ones authorized in licence documents for both short and long time periods. This would enable reassigning water from "lower value" to "higher value" uses, including poteutially transferring rights to serve environmental goals such as stream health protection.

There are various mechanisms that might be used to promote this kind of flexibility. Frequently discussed options often fall under the heading of water trading or water markets[1]. Market approaches typically involve institutions that facilitate the trading of rights to water, either short-term (where rights are traded on a "spot market") or long-term (where rights are traded in perpetuity). Water may be allocated and reallocated through private transactions, exchanging rights in response to prices. Rights might be tied to land or transferred separately. Theoretically, voluntary transactions should direct water to more economically valuable uses, leading to increased water use efficiency and creating incentives for existing users to conserve water, simply because they can gain by selling or lending their surpluses to others.

Various jurisdictions have used water markets with varying degrees of success. California began implementing reforms to incorporate water transfers in the 1970s. Transfers are largely within the agricultural sector, but these arrangements are now an important part of that state's multifaceted approach to water resource management. In the US Pacific Northwest, a water transfer program uses market principles to increase in-stream flows in water-stressed streams. Closer to home, Alberta has implemented legislative changes that enable transfers of water allocations within the South Saskatchewan River Basin (see Horbulk, 2007 for a fuller discussion of the Alberta experience).

The main advantage of water markets is that they can increase total welfare by directing water to the users who value it most highly. A water market also has the potential to reduce the role of regulators in reallocations. If effectively designed, markets may also enhance ecologically beneficial water flow under certain types of water trading regimes (Brandes, Nowlan and Paris, 2008).

There are, however, many tradeoffs and implementation concerns to consider since markets have not always been successful. For example, different stakeholders may have different perspectives on what is "higher value". Some may see the highest value as fulfilling ecosystem functions, while others would use the dollar value of proposed water uses as the preferred measure. Some also object to the capitalization or monetization of historic or newly created entitlements that derive from a public resource (Horbulk, 2007, p. 210).

On their own, water markets cannot solve problems of over allocation and may even create incentives for further withdrawals in overburdened systems. Some also argue that the impact of water markets on rural agricultural communities and on third parties is not always well understood (see Brandes, Nowlan and Paris, 2008).

One potential impediment to water markets in BC is the long-standing principle of appurtenance. A water trader would need to be able to "lift" an appurtenance, or temporarily reassign it, if he or she wanted to transfer a particular allocation to a different parcel of land. This would likely involve a continued role by the Province, rather than purely private arrangements between, for example, a hay-grower and a grape-grower. Government would also need to provide guidance and audit transfers to ensure there is no increased impact on the environment or other users. Basic ground rules would need to be in place including mechanisms to protect third parties and ecosystems. This implies resource requirements for regulatory oversight, monitoring and enforcement.

Encouraging Administrative Efficiency

The efficiency of the allocation system could also be improved by changing the information required of applicants and licencees both before the licence is issued and on an ongoing basis afterwards.

1 Australia is one country that has more extensive experience with water trading. For a summary of different types of trading arrangements used there (not all of which involve permanent transfer of water rights) see Queensland, 2010. For a more complete discussion of water transfers in Canada, see Christensen and Lintner, 2007.

During the licence submission and approval stage, options include: requiring applicants to provide more detailed information about the proposed use and efficiency measures; requiring documentation of potential environmental impacts and effects on other users; and, requiring that applicants seek consent from, or undertake consultation with, parties affected by water extraction.

Naturally, the Province would need to use any new authorities in this area judiciously in order to ensure that the licensing process does not become unnecessarily onerous. However, this approach is consistent with direction being undertaken in other jurisdictions in Western North America. For example, applicants for licences in certain river basins in Idaho must, among other things, consult with local governments, tribal groups and irrigation districts and submit the comments received. Similarly, in Oregon there is a heavy emphasis on the proponents "working out the kinks" with affected parties before making an application (see State of Oregon, 2010).

After the licence is issued, another option for *Water Act* modernization includes requiring licensees to measure and report actual water use when demonstrating compliance with licence conditions. Many of the suggested measures for improving water use efficiency discussed above depend on accurately measuring water taken, for example the use of volumetric water pricing. Similarly, effectively implementing and enforcing some of the commitments made in *Living Water Smart* would also require good information on how much water is actually being used by licensees and, over time, building up a better appreciation of the variations in volumes taken. Examples of actions where this is relevant include the commitment to require all users to cut back their water use in times of drought or where stream health is threatened and the commitment to require more efficient water use in the agriculture sector.

In practical terms, measuring water use usually requires use of a meter, and rates of metering are currently quite low in BC. At the municipal level, only 32.6% of residential customers living in single family homes are metered, compared to a Canadian average of 63.1% and, for example, an average of 84.7% in Alberta (Environment Canada, 2009). At the water allocation level, only a small portion of the approximately 44,000 active licences in the province use a meter to measure use. Meters that are in place are usually restricted to larger municipal water service providers (of which there are over 350 accounting for approximately 1200 active licences) or irrigation districts (of which there are over 70 accounting for approximately 425 licences).

Based on the adage that "what gets measured gets managed", the Province committed in *Living Water Smart* to require all large water users to measure and report their water use. Fulfilling this action requires resolving a number of implementation issues, including defining who constitutes a "large user", what reporting requirements will be put in place, and how monitoring and enforcement will be undertaken. This includes reviewing current authorities in the *Water Act* in this area.

Internationally, the need to accurately measure the amount of water diverted is generally accepted as an important component of sound water management.[2] Measuring the amount of water that people use provides information that assists with managing supplies and helps us understand if water is available for new uses. It also helps water users understand their water use and improve efficiency. For example, they can identify leaks or account for how much water has been used in agricultural production relative to crop yields.

2 For background on recent efforts in New Zealand to require water users to measure the volume of water used under their "National Environmental Standard for Measurement of Water Takes" see New Zealand, 2008.

3.5.2 Flexibility Is Provided To Water Users And Decision Makers To Quickly Adapt To Changing Environmental, Economic And Social Conditions

As noted above, once a licence is issued there is very little authority in the *Water Act* for government to change terms and conditions or to issue new ones. Minor amendments may be made if an error was made in the original licence. More significant changes may be made if the licensee consents, but in practice this happens infrequently.

While this provides a great deal of certainty to licence holders, the ability to revise licences for environmental protection purposes would enable incorporation of evolving ecological knowledge and allow decision makers to act in the public interest (De Loë, Varghese, Ferreyra and Kreutzwiser, 2007).

Potential motives for reviewing and amending existing licences might include:

- new information arising about watershed issues, priorities or changes in supply (watershed, or aquifer based) including addressing over-allocation or climate change impacts;
- wanting the ability to use water differently (e.g. bringing more land into production, changing land appurtenance or use, or using water for a higher economic purpose);
- providing incentives to consolidate licences within a community or watershed to inspire collaborative or shared management of resources;
- preventing adverse impacts on aquifers or groundwater recharge zones; or,
- monitoring information showing stream health is deteriorating because of lack of water.

With respect to granting water rights, Abernathy (2005) identified the following list of attributes that should be considered:

1. **Quantity:** How much water may the holder of the right receive?
2. **Timing:** Are there restrictions on the time when this quantity may be taken?
3. **Location:** Is there a specific place where this water may be taken?
4. **Quality:** Is the holder of the right entitled to expect the water to be at or better than some specific standard of quality, either chemical or biological?
5. **Conditionality:** Is the right absolute, or is it subject to any conditions or variations? For example, will it be different in a year of drought?
6. **Duration:** Is the right permanent or will it expire after a specified time?
7. **Disposal:** How and where will the water be disposed of after use? Are there rules about the quality of used water for disposal?
8. **Ownership and transfer:** Can the owner of the right transfer it to another person, or another location? Can it be inherited? Can it be sold?
9. **Source:** From where does the right come? Who awarded the right?
10. **Security and enforcement:** Can anyone guarantee the implementation of the right? If the water in the river or aquifer decreases or becomes polluted, who will make sure that enough remains available for implementing this right?

Within reason, any of the attributes identified by Abernathy could conceivably be potential areas where new terms or conditions might be imposed in order to protect the public interest. Specific examples of new terms and conditions might include:

- new requirements to address or mitigate potential impacts on others;
- requirements for water quality analysis;
- introduction of adjustable extraction limits in response to seasonal or longer term climatic variations;

- monitoring and reporting;
- well metering; or,
- regulating discharge of water after use.

Internationally, various jurisdictions retain authority to change water rights once granted. In Germany, for example, the scope and content of water rights may be varied by the water administration after the right has become effective. In some Australian states, the volume of flow can vary annually. In New South Wales, Queensland and Victoria, for example, annual allocations are announced each year as a proportion of the entitlement of each water right. Water rights are effectively made up of two separate components, one of which specifies a fraction of the total flow that may be abstracted by reference to the overall flow rate of the water course. The proportion allowed can vary significantly from year to year depending on water availability during each irrigation season (Hodgson, 2006).

In Canada, De Loë, Varghese, Ferreyra and Kreutzwiser (2007) examined provinces' and territories' legislative authorities to incorporate evolving ecological knowledge into water allocation schemes. The most directly relevant examples they noted include:

- Alberta's *Water Act* (s.55) has provisions to suspend or amend licences based on new ecological knowledge, although compensation is to be provided for any ensuing losses in the case of licence amendments. This provision only applies to licences issued after January 1, 1999.
- *The Nunavut Waters and Nunavut Surface Rights Tribunal Act* (s.43), Yukon's *Waters Act* (s.16), and the Northwest Territories' *Waters Act* (s.18), have provisions to amend or cancel licences in response to water shortages or to protect the public interest.
- Newfoundland and Labrador's *Water Resources Act* (s.50) has established a statutory requirement for water users to report new ecological information even if it may result in a change in their allocation (De Loë, Varghese, Ferreyra and Kreutzwiser, 2007, p. 11).

Should British Columbia decide to move forward with changing powers to modify licence conditions after issuance, a number of implementation issues would require careful attention to ensure that environmental protection objectives are balanced against protecting sometimes long-standing rights of existing licence holders.

3.5.3 The Water Allocation System Integrates the Management of Groundwater and Surface Water Resources Where Required in Problem Areas

Section 4 below entitled Regulating Groundwater Use in Priority Areas and for Large Withdrawals deals with the complex issues around regulating the extraction of water from the provinces' aquifers. This section addresses some specific issues around possible allocation models that might be used to regulate groundwater extraction.

In British Columbia the most productive types of aquifers are shallow and occur adjacent to rivers and streams. Direct hydraulic connection between the stream and the aquifer commonly exists (see Text Box 3b). Groundwater and surface water are inextricably interconnected within the hydrological cycle and are essentially a single integrated source of fresh water (Bruce et al. 2009).

TEXT BOX 3b Surface Water/ Groundwater Interaction in the Grand Forks Aquifer

The aquifer at Grand Forks along the Canada-USA border is comprised of sands and gravels deposited by the Kettle and Granby Rivers from the last Ice Age. The aquifer is approximately 25 km2 in size, shallow and very productive, supplying high quality drinking and irrigation water to people in the area. Hydrogeologic mapping shows that the aquifer and the Kettle River are intimately connected. Where the Kettle River flows into Canada at Carson, it loses water to the aquifer; the Kettle River in this reach is a losing stream. However, approximately halfway between Carson and the confluence with the Granby River, groundwater from the aquifer generally discharges back to the Kettle River. The Kettle River downstream from this point is generally a gaining stream except during the freshet period where the reach may lose water to the aquifer and recharge it. This is because the aquifer at this point begins to thin out and there is nowhere in the aquifer for the water to go but back up to the surface to the Kettle River.

The hydraulic connection is even more evident during periods of well pumping. Without exception, all capture zones extend to the Kettle River. All water pumped from community wells appears to be derived from storage in the aquifer that ultimately comes from the Kettle River.

Rooted in English common law tradition, groundwater and surface water rights have evolved differently in North America. Groundwater has often been treated as an exclusive right. The law tends to look at these two sources of water differently, despite their interconnectivity as part of the same hydrologic system (Brandes, Nowlan and Paris, 2008). The result has sometimes been significant fragmentation. However, over the past several decades jurisdictions have come to acknowledge the need for better integration of groundwater and surface water management, an idea that has become widely accepted across North America (De Loë, Varghese, Ferreyra and Kreutzwiser, 2007).

In BC, extraction of groundwater is not currently regulated or licensed. However, the Province has committed to regulating groundwater use in priority areas and for large withdrawals in *Living Water Smart*. This means that in the future water managers may be able to regulate surface and groundwater as one resource in areas where groundwater is scare or there is a direct hydraulic connection between the two.

Through the current licensing and approval process, water managers protect existing users from the short and long term impacts of increased withdrawals. Water managers can already investigate and review surface water licences but in the future they may also need the ability to investigate groundwater specific issues or wells that are causing problems and require mitigation. 'Problem wells' could be causing adverse effects on the environment, human health, property or public safety, as well as other impacts. There is also an opportunity to more effectively deal with competition and conflict among groundwater users.

Considering the differences between surface water and groundwater, different information could be required from applicants and different rental rates may also apply.

The priority of a groundwater right in time or in purpose also needs to be considered. If groundwater extraction and use become regulated, most of the various issues around introducing more flexibility and efficiency in the existing surface water allocation system would apply equally to groundwater. For example, the "first in time, first in right" (FITFIR) allocation model that BC currently employs

for surface water could be extended to groundwater, where seniority of rights would be determined by length of use or the age of wells.

Alternatively, a priority of use approach might be employed where groundwater (and possibly new surface water allocations) is allocated based on priority of use. In this case, priority might be determined either by criteria set out in the *Water Act* or through community involvement in water allocation planning processes.[3]

In addition to issues around how groundwater and surface water allocation is integrated, the question of how both sources of water should be managed during times of drought or low flows also requires consideration. This issue is discussed in the next section.

3.5.4 Water Users Will Be Required To Conserve Water During Drought Or When Stream Health Is Threatened

Reducing Water Use During Drought

Being prepared to respond to droughts when they occur will help communities protect water for drinking, sanitation and fire protection. It will also support protection of fish and aquatic ecosystems. Preparedness also improves the chances of sustaining agricultural and other economic activity during dry periods.

Having a flexible and adaptive water allocation system is an important part of drought preparedness. For this reason, in *Living Water Smart* the Province indicated that it will require all users to cut back their water use in times of drought or where stream health is threatened. It also committed to find new approaches to water management that will address the impacts from a changing water cycle, increased drought risk and other impacts on water caused by climate change.

As discussed above, current legislation provides some limited authorities that enable meeting this commitment. The *Water Act* (s. 15 and 88) does allow certain provincial staff to order licensees to reduce or eliminate water uses. However, as discussed above, this must be done based on the date of precedence in licences, with junior licensees cutting their water use before senior licences, regardless of the purpose that the water is used for. The *Fish Protection Act* (s. 9) also allows the Minister of Environment to issue orders limiting water withdrawals, but only for the narrow purpose of ensuring survival of a fish population.

This means that, conceivably, a situation could arise in which a community's needs for drinking water would be treated as a lower priority than a non-critical purpose such as a non-essential industrial use, simply because the community's licence was issued at a later date. As well, current legislation provides limited authorities to protect non-fish bearing aquatic ecosystems.[4]

When droughts inevitably occur, difficult decisions about how to share water must be made, requiring transparent, simple and fair processes. Options include the following:

A. **Discretional:** The decision maker determines the approach on a case-by-case basis, balancing the effects on water users with the required environmental outcome (similar to existing *Fish Protection Act* authorities).
B. **Sharing:** All water users would reduce use on a proportional basis depending on the water supply forecast, for example if the supply forecast shows less water than normal, then allocations would be reduced on a pro rata basis. This approach could be influenced by water use efficiency, creating an incentive to employ efficient practices.

3 Currently, if water licences have the same priority date on the same stream, the Water Act (s. 15(2)) sets the following precedence (ordered from highest to lowest): domestic, waterworks, mineral trading, irrigation, mining, industrial, power, hydraulicking, storage, conservation, conveying and land improvement purposes.

4 It should be recognized, however, that in practice, during historical droughts in BC water users and provincial water managers are usually able to negotiate voluntary, mutually satisfactory agreements between licensees to share available water and reduce overall demand in order to protect ecosystems and the needs of users.

C. Hierarchy of uses: A hierarchy of uses guides how water use is reduced. For example, human and stock watering needs would be satisfied before landscape irrigation.
D. Priority date: This approach follows FITFIR, as contemplated by the current requirements of sections 15 and 88 of the *Water Act* but could be expanded to include the protection of ecosystem values.

Other jurisdictions have adopted diverse approaches to reducing water takes during drought. In South Africa, for example, different user sectors have various levels of assurance of supply. Different levels of curtailment are introduced as water levels decline. When water availability in any system drops below predetermined levels, water users must get together via a catchment management forum, where one exists, or a more ad hoc forum and negotiate restrictions. Typically, the result will be that different sectors will accept different levels of reductions. For example, if a 60% reduction is needed, the agricultural sector might cut use by 50%, municipal users might cut by 10% and key strategic industrial users might not reduce use at all (Perkins, 2003).

Ontario's Low Water Response Plan (2003) adopts a model that divides water uses into three classes: essential, important and nonessential. Essential uses include water to meet human life and health needs and to provide for basic ecological functions. Important uses include ones significant for social and economic well being such as agricultural production and commercial facilities.
Non-essential uses include ones that can be interrupted for the short term without significant impact such as vehicle washing. These classes are used to guide decision making about priority use when serious drought conditions prevail. The plan also stipulates that decisions regarding priority water uses should be facilitated with input from local stakeholders. Ultimately, the goal is to balance efficient use, protection of the resource, and equity among users during severe drought (Ontario, 2003).

Under a modernized *Water Act*, groundwater users may also be required to conserve water in times of drought or where stream health is threatened and there is a direct hydraulic connection to the threatened stream. This matter is discussed further in section 5.

Planning for Longer Term Water Scarcity

In terms of addressing longer term water scarcity, the trend in BC and around the world is towards more community involvement in managing water. Incorporating water considerations into planning processes offers the potential to better integrate management of groundwater and surface water, water quality and quality, and safer drinking water through effective source water protection. Planning processes also allow us to bring together interested agencies, First Nations, stakeholders and the broader community to find the solutions that will be most satisfactory to all. For these and other reasons, the Province committed in *Living Water Smart* to support communities to do watershed management planning in priority areas.

The current *Water Act* already contains some important provisions respecting water management planning. Part 4 of the Act allows the Minister of Environment to order completion of a water management plan in an area in order to prevent conflicts between water users, between users and instream flow requirements or risks to water quality. The scope of these plans may be broad and include considerations relating to surface water or groundwater.

Importantly, upon completion, water management plans completed under Part 4 of the Act may become legally binding under provincial regulations. This means that water managers may be required to restrict issuing or amending licences or approvals based on the plans. Decision makers

under other provincial statutes may also have restrictions placed on their decisions. Well drillers and pump installers may be restricted or prohibited from undertaking activities that affect groundwater in planning areas. As discussed above, in 2009 the Township of Langley in collaboration with the Province completed the first Part 4 water management plan.

Other water planning processes not under Part 4 of the *Water Act* are also underway or have been completed in various places around BC. Two examples of completed plans include the Cowichan Basin Water Management Plan, completed in 2007, and the Trepanier Landscape Unit Water Management Plan, completed in 2004.

Water Act modernization provides an opportunity to review current planning provisions to ensure that they will meet challenges that might be imposed by the threat of long term water scarcity. Options include:

- Mandatory water management planning processes, wherein the Province may, in some cases, require a planning initiative to address long term water scarcity, similar to authorities already provided for in Part 4 of the *Water Act.*
- Planning initiated at the request of water users or communities, wherein they may develop a plan that addresses long term scarcity on a watershed basis and provide recommendations for changes to supply and demand side management. Approved processes that include the wider community would need to be developed and followed.

Looking beyond our borders, the legislation of a number of jurisdictions requires the preparation watershed plans. For example, France's 1992 *Water Act* includes a complex water resources planning system based on General Water Plans covering one or more basins and detailed water plans covering one or more sub-basins or aquifers (FAO, 2002).

Other jurisdictions whose legislation requires the preparation of plans include Spain, Italy, Morocco, South Africa, Uganda, South Australia in Australia, and Texas in the USA. The European Community Framework Water Directive also requires preparation and periodic review of River Basin Management Plans, and this is mandatory for member states. Often the purpose of such plans goes beyond the simple allocation of water rights. They may set development and management priorities and specify the imperative to balance needs of water users and economic development and protection of aquatic ecosystems (Hodgson, 2006).

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PART FOUR

Regulating Groundwater Use in Priority Areas and for Large Withdrawals

4.1 Groundwater Use in British Columbia

British Columbia's groundwater is primarily found in one of two distinct types of aquifers: unconsolidated (e.g., sand and gravel) and fractured bedrock. BC's unconsolidated aquifers are some of the most productive in Canada and can yield thousands of cubic metres of water per day, despite their typically small size - on average they are usually a few square kilometres to a few tens of square kilometres in area. Many unconsolidated aquifers derive their productivity from their coarse, permeable sediments and large amounts of recharge from precipitation in the form of rain or snow. They also often occur adjacent to and immediately below rivers, further contributing to their high productivity, (figure 4a).

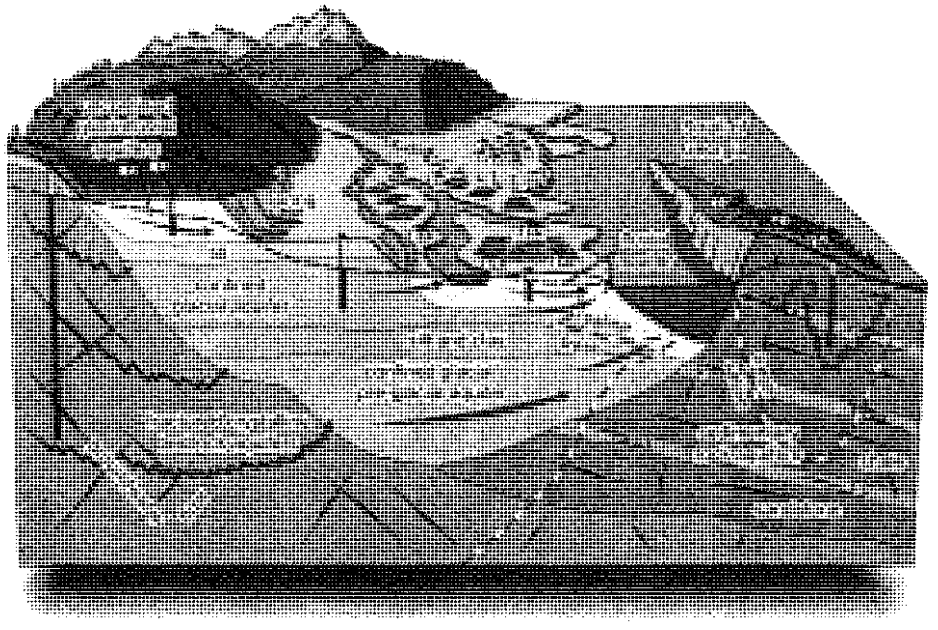


FIGURE 4a Water Governance Framework and Possible Solutions

Source: Geological Survey of Canada, in press.

It is estimated that over 1 million people in British Columbia use groundwater for their drinking water (Nowlan, 2005), accounting for approximately half the population outside Victoria and Greater Vancouver. This ranks as the 3rd highest in Canada behind Ontario and Quebec. Large volumes of groundwater are also used for industrial and agricultural purposes, vital to supporting the economy of the province.

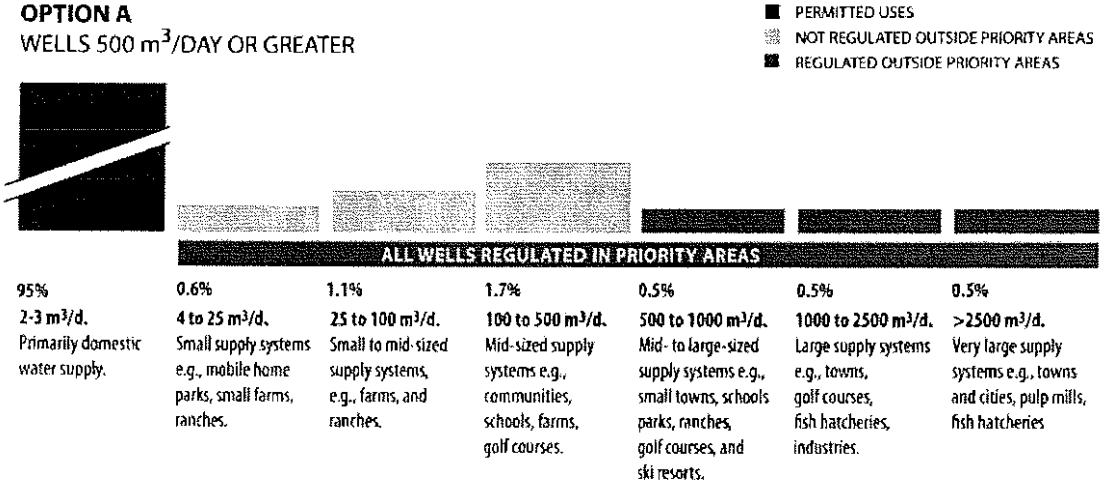
The Ministry of Environment's WELLS database can be used to infer the pattern of groundwater use in British Columbia. Approximately 95% of water supply wells are for single family homes. The remaining 5% (which still equates to thousands of wells) supply:

- community water supply systems ranging from small systems (e.g., churches, rural service stations) to large municipalities (e.g., the Township of Langley);
- industrial use (e.g., pulp mills);
- agricultural use (e.g., fish hatcheries, irrigation); and,
- other non-domestic uses (e.g., open-loop geothermal or geo-exchange heating systems).

TEXT BOX 4a The WELLS Database

The WELLS database is maintained by the Ministry of Environment. It is a repository of close to 100,000 water well records submitted voluntarily by drillers since the 1960s. These well records contain important information such as lithology, groundwater levels, estimated well yields, and intended use of the wells. But, they do not contain information on current actual use or actual volumes pumped. For a variety of reasons (e.g., submission of well records is voluntary; dug wells are generally not recorded), the database contains records for only approximately 50% of the wells that have existed in BC. Despite these limitations, the WELLS database provides important information regarding general patterns ogroundwater use and is a vital tool to help our understanding of aquifers in the province.

The largest groundwater users by volume tend to be municipalities that supply thousands (e.g. City of Grand Forks, Town of Merritt) or tens of thousands (e.g. District of Chilliwack, Township of Langley, City of Prince George) of residents and businesses, as well as fish hatcheries and pulp mills. Groundwater is used by towns and villages, lodges and camps, golf courses and ski resorts, ranches and farms, nurseries, schools, for irrigating urban parks and for many other uses (see Figure 4b).



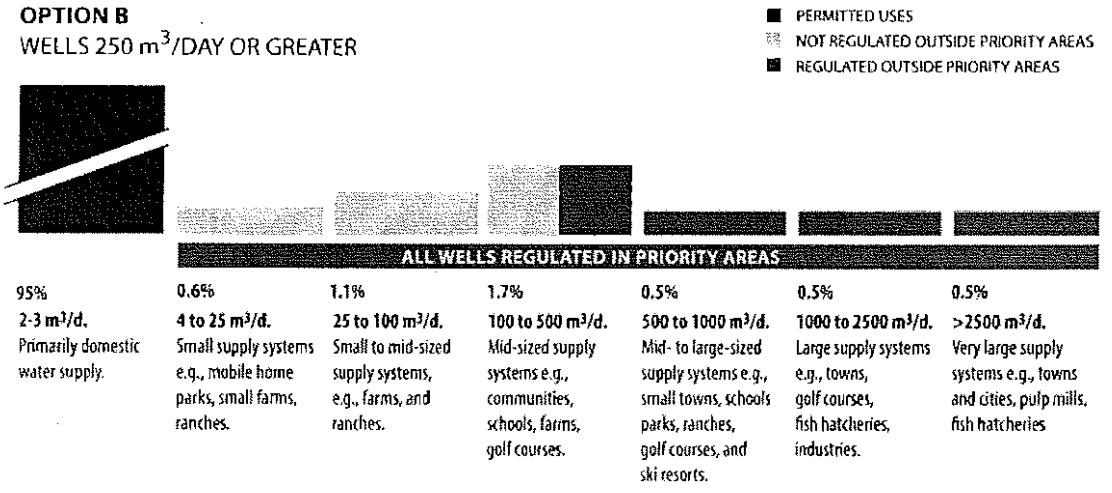


FIGURE 4b Volume And Purpose Of Use Supplied By Wells In British Columbia
Note: volumes and purpose of use are estimates only, inferred from WELLS database.

4.2 What Are the Current Regulatory Arrangements in British Columbia?

British Columbia's groundwater resource is vital for sustaining communities, industry, and agriculture. It is a source of low temperature geothermal energy. It provides the initial base flow that helps sustain stream flows and aquatic habit. It plays a role in maintaining temperature and levels in streams and lakes that provide critical aquatic habitat for fish and other species. Safe and assured groundwater supplies are important for supporting economic activity and security in BC.

The current system of regulating water use in BC provides for licensing of surface water allocation but excludes regulation of extraction of groundwater. This creates some challenges for government's ability to control its use. It can also be difficult to manage conflicts among water users and to deal with any concerns about reductions in groundwater quantity or quality.

It is worth noting, however, that while not yet utilized Section 1.1(2) of the *Water Act* does currently state that:

> "The Lieutenant Governor in Council may, by regulation, fix a day on and from which some or all of Parts 2 and 3 of this Act [both of which pertain to regulating use] apply to groundwater in British Columbia or in an area of British Columbia the Lieutenant Governor in Council designates in the regulation."

Other legislation and regulations affecting groundwater in BC include the:

- *Drinking Water Protection Act,* which requires that water supply systems must provide potable water and must have construction and operating permits. It also establishes qualification standards for operators, requirements for emergency response, water monitoring, water source and system assessments, a process for preparing a drinking water protection plan, and other protective measures for drinking water supplies;
- *Environmental Management Act,* which regulates prevention of pollution of groundwater and site remediation;

- *Environmental Assessment Act* (Reviewable Projects Regulation), which requires environmental assessments of wells having proposed extraction rates of 75 litres or more per second;
- *Water Protection Act,* which vests groundwater in the Crown and prohibits the removal of bulk water from the province; and the,
- *Water Utility Act and Utilities Commission Act,* which regulate utilities that extract groundwater.

Amendments to the *Water Act* in 2001 paved the way for introduction of the Ground Water Protection Regulation (GWPR) in 2004. The GWPR regulates how wells are constructed and significantly enhances groundwater protection. It includes requirements for installing effective surface seals around wells, securely capping and flood proofing wells, and permanently closing unused wells to protect groundwater quality. It also establishes the required qualifications for well drillers and well pump installers and provides for a provincial registry of those possessing the qualifications.

The GWPR applies to water supply wells (i.e., domestic wells and non-domestic wells, such as irrigation wells), monitoring wells, recharge and injection wells, dewatering or drainage wells, remediation wells and geotechnical wells that do not involve water transfer (i.e., boreholes, test pits, closed geo-exchange wells). The GWPR does not apply to geothermal wells, oil and gas wells, or wells used for coalbed methane extraction, all of which are already regulated under other statutes, like the *Geothermal Resources Act,* the *Mines Act,* and the *Petroleum and Natural Gas Act.*

Enactment of the GWPR in 2004 was an important development. Prior to this there was no regulation in British Columbia focussing specifically on groundwater nor standards for well construction, maintenance, well closure and qualifications for well drillers and well pump installers. When the regulations were announced, the Province also indicated that it would look at further improvements to groundwater regulation through a phased approach, discussed further below. More information on the GWPR can be found at www.env.gov.bc.ca/wsd/plan_protect_sustain/groundwater/index.html.

The Province also employs a number of non-regulatory tools for managing and protecting groundwater. Among other things, this includes operating groundwater level and ambient groundwater quality networks, collecting data on well drilling, and conducting surveys and assessments to characterize and understand aquifers in British Columbia.

4.3 What Are the Pressures for Change?

High demand due to population growth, agricultural intensification and industrial uses can all place this resource under stress (Bruce et al. 2009). Human activities over highly vulnerable aquifers and water quality impacts related to hydrocarbon production and other factors have also contributed to increasing pressures.

1 See Nowlan, 2005 and Nowlan, 2007 for a discussion of groundwater regulation across the country.

Over the past number of decades, other Canadian provinces and territories have progressively introduced new regulatory requirements to govern groundwater.[1] This has created a situation in which BC is now the only jurisdiction in Canada that does not regulate the extraction and use of this resource (see Figure 4c).

When extraction and use of groundwater is not controlled a variety of challenges can arise. For example, in basins where surface water is limited or fully allocated, land owners might bypass the surface water allocation process by drilling wells, often adjacent to streams, to obtain water. Since groundwater provides critical base-flow to streams, unregulated use may directly affect the quantity and quality of water and existing rights, particularly in basins with limited amounts. Based on these and other concerns, various stakeholder groups and thought leaders have become increasingly critical of British Columbia's

perceived "straggler" status when it comes to regulating groundwater extraction (see, for example, Christensen, 2007).

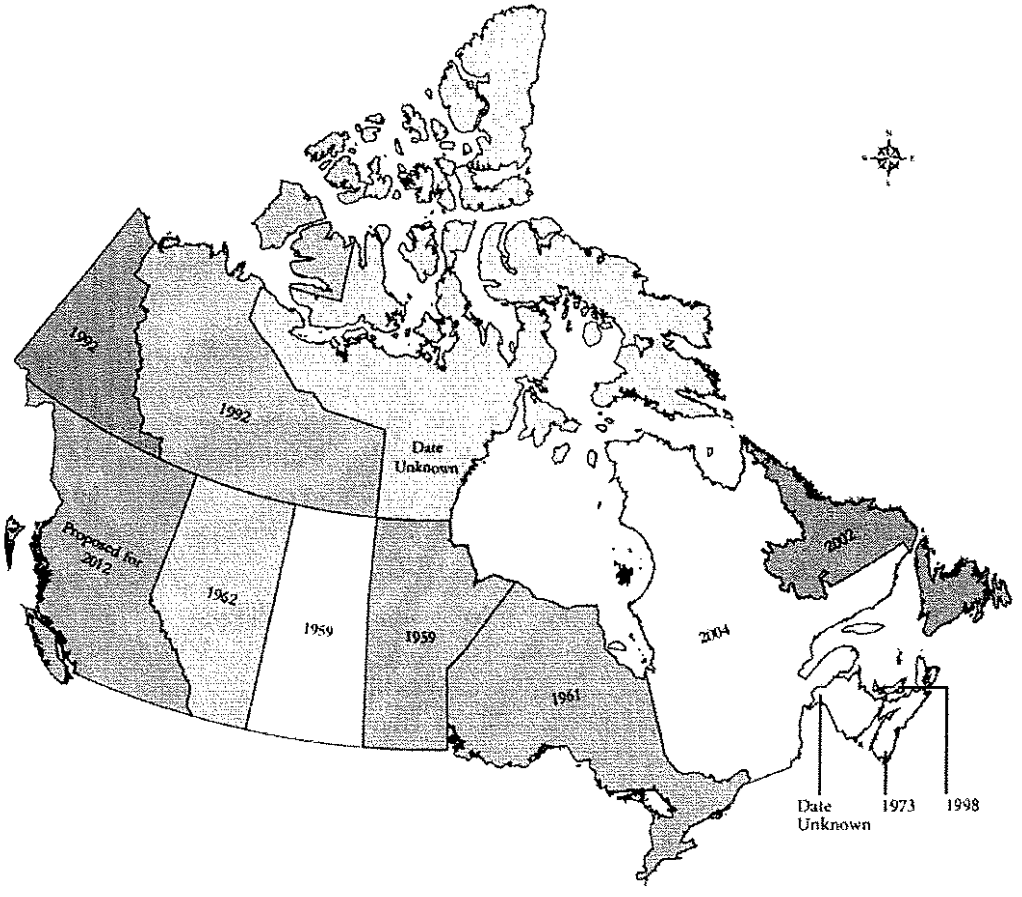


FIGURE 4c Date Licensing was Applied to Groundwater in Canadian Provinces
Source: Government of Manitoba, based on Nowlan, 2005.

British Columbia is also beginning to see reduced water levels in some aquifers. In the 2007 State of Environment report, 35% of the observation wells monitored by the Ministry of Environment showed a declining water level as a result of pumping during the period of 2000-2005. This is a higher percentage than previous reporting periods (see Figure 5d). Notably, the areas experiencing these declines are those where groundwater withdrawals and residential development have been intensive. Among the observation wells showing water level declines in 2000–2005, 17 (39%) are in the Vancouver Island-Gulf Islands region; 16 (36%) are in the Okanagan region; 3 (7%) are in the Interior Plateau region (Williams Lake-Quesnel-Clinton); 3 (7%) are in the Kamloops-Merritt-Cache Creek areas; and 5 (11%) are in other regions of the province (1 observation well each in Whonnock, Tumbler Ridge, Powell River, Castlegar, and Salmon River) (Ministry of Environment, 2007).

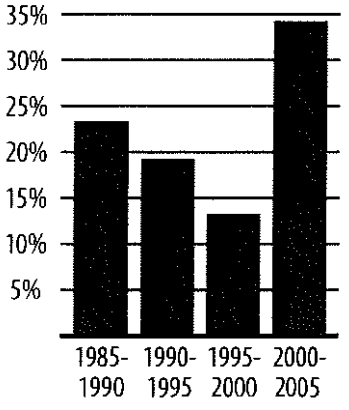


Figure 4d Percentage Of Observation Wells That Have Declining Levels Due To Human Impacts

Declining groundwater levels may:

- decrease the available drawdown and yield of wells;
- increase conflicts and disputes between neighbours;
- increase costs and use of energy related to pumping;
- threaten fish and other aquatic habitat;
- decrease base-flow to nearby streams; and,
- in coastal areas, lead to intrusion of saltwater inland into the aquifer.

While some of these potential problems have been recognized for many years (see, for example, Ministry of Environment, 1993), they may become more severe and widespread with continued population and industrial growth and if climatic conditions continue to change.

4.4 How Are the Pressures Being Addressed?

As noted above, the Province has committed to progressively improve groundwater regulation over time, starting with the enactment of the Ground Water Protection Regulation in 2004.

In 2005, the Province commenced work on additional improvements to the GWPR (commonly referred to as 'Phase 2'). The intent is that Phase 2 will address:

- well siting;
- flow testing;
- water quality analysis and reporting;
- well pump installation;
- controlling flow from artesian wells;
- additional standards for well construction; and
- storage of toxic substances (e.g., gasoline and fertilizers) near wells.

The objectives of Phase 2 are to increase protection of wells and groundwater, minimize conflicts, and allow increased understanding of the resource. Technical consultations were undertaken in 2007 and early 2008 with stakeholders including local governments, the groundwater industry, the BC Groundwater Association, the Drinking Water Leadership Council and others. Before the regulation is enacted there are outstanding technical, legal and resource matters that need to be resolved. Government must ensure that it complements any new regulatory framework for surface and groundwater under Water Act modernization. In 2008 the Province made a number of commitments to safeguard groundwater through Living Water Smart: British Columbia's Water Plan (see Text box 4b).

TEXT BOX 4b Living Water Smart Actions that Relate to Groundwater

- By 2012, government will regulate groundwater use in priority areas and large groundwater withdrawals.
- By 2012, water laws will improve the protection of ecological values, provide for more community involvement, and provide incentives to be water efficient.
- Legislation will recognize water flow requirements for ecosystems and species.
- Government will support communities to do watershed management planning in priority areas.
- By 2012, government will require all large water users to measure and report their water use.

In this context, through the *Water Act* modernization, the Province hopes to achieve a number of results, including measuring and reporting water use by large volume users (including groundwater users); enhancing data and information; recognizing the contribution of groundwater to base flows; minimizing conflicts between well owners and other users and uses; and supporting community driven area-based management planning in priority areas. As noted in the previous section, a key component of an improved *Water Act* would also involve the effective integration of surface water and groundwater management.

4.5 Leading Thought and Practice

In May, 2009, the Council of Canadian Academies' Expert Panel on Groundwater released its report entitled *The Sustainable Management of Groundwater in Canada.* Therein, the Expert Panel proposes five sustainability goals (depicted in Figure 4e) for managing groundwater:

1. protection of ecosystem health;
2. protection of groundwater supplies from depletion;
3. protection of groundwater quality from contamination;
4. achievement of economic and social well-being; and,
5. application of good governance (Bruce et al. 2009).

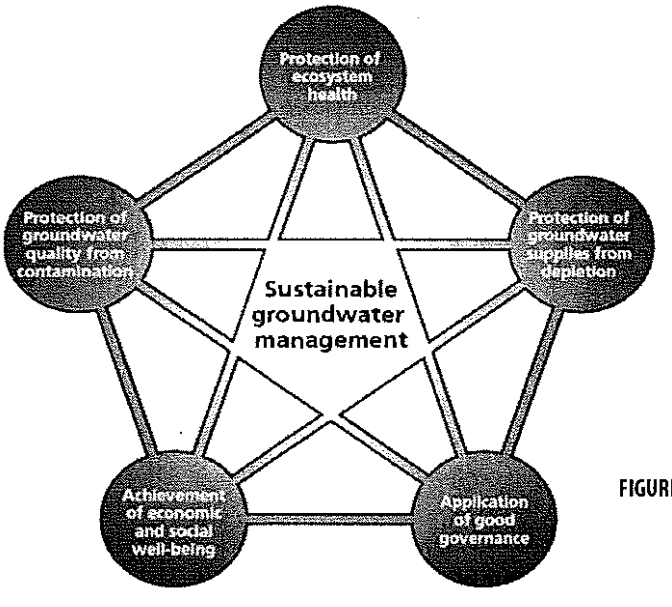


FIGURE 4e Sustainable Groundwater Management Framework
Source: Bruce et al. 2009.

With these goals in mind, water, whether in a stream or in the ground, should be considered the same resource. Any reformed legislation would be designed so that impacts on other water users and watershed health is considered before significant additional extraction of groundwater is approved. And, as discussed above and in *Living Water Smart*, groundwater extraction in critical areas and where large withdrawals are occurring would be regulated.

Achieving such objectives will require answers to at least four questions:
1. what is a "large groundwater withdrawal"?;
2. what is a "priority area"?;
3. how would new provisions apply to existing wells?; and,
4. should drilling authorizations or notifications also be required?

This section will address each of these questions in turn.

4.5.1 What is a "Large Groundwater Withdrawal"?

To inform discussion of reforming groundwater laws in British Columbia, Ministry of Environment staff competed a survey of systems and processes in other leading jurisdictions across Canada and internationally.

All provinces and territories in Canada regulate extraction and use of groundwater above a certain threshold or for non-domestic use (see Table 4a, adapted from Nowlan, 2005). Different thresholds from one jurisdiction to another are a result of historical practices, water use demographics, and relative water abundance. No jurisdiction in Canada regulates groundwater withdrawals for normal, single family, domestic use.

JURISDICTION	THRESHOLD *Volume Pumped*	EQUIVALENT THRESHOLD *m3/day*	NOTES
Alberta	6,250 m^3/year	17	All groundwater withdrawals must have licences except: domestic use <1,250 m^3/year *and* camp water supplies <1,250 m^3/year
Saskatchewan	5,000 m^3/year	14	Domestic uses are exempt
Manitoba	25,000 L/day	25	All groundwater withdrawals must have licences except domestic use, <25,000 L/day
Ontario	50,000 L/day	50	*no comments*
Quebec	75 m^3/day	75	*no comments*
PEI	4 L/second	346	*no comments*
Nova Scotia	23,000 L/day	23	*no comments*
New Brunswick	50 m^3/day	50	*no comments*
Newfoundland	N/A	N/A	All groundwater withdrawals must have a licence except domestic uses
Yukon	100 m^3/day	100	Specific exemptions are listed in regulations. Industrial 200 m^3/day, placer mining 300 m^3/day, quartz mining 300m^3/day,

JURISDICTION	THRESHOLD *Volume Pumped*	EQUIVALENT THRESHOLD *m3/day*	NOTES
NWT	100 m^3/day	100	Specific exemptions are listed in regulations
Nunavut	100 m^3/day	100	Specific exemptions are listed in regulations

TABLE 4a Thresholds For Regulating Groundwater Withdrawals in Canadian Provinces and Territories Jurisdiction

Source: Adapted from Nowlan, 2005.

In defining "large withdrawals" in British Columbia it may be useful to consider the characteristics of the two primary types of aquifers in this province. Unconsolidated aquifers are generally more productive than bedrock aquifers. Bedrock aquifers are generally more limited in yield. Impacts from well pumping may be greater for the same pumping rate. Consequently, the definition of a "large withdrawal" from a bedrock aquifer may need to be lower than for an unconsolidated aquifer.

In considering the unique geological conditions of the province, thresholds adopted across the country, and the population supported by various numbers of connections within a water supply system, the Province is considering a two tiered approach to defining "large groundwater withdrawals".

A large withdrawal could be defined as any amount over 500 m^3/day for wells drilled into unconsolidated, sand and gravel aquifers and any amount over 100 m^3/day for wells drilled into consolidated bedrock aquifers. Alternatively, a large withdrawal could be defined as any amount over 250 m^3/day for wells drilled in unconsolidated, sand and gravel aquifers and any amount over 100 m3/day for wells drilled into consolidated bedrock aquifers (see Table 5b). As discussed further below, these volumes might also be modified in areas where there is a Water Management Plan in place or in other places identified as "priority areas".

OPTION	AQUIFER TYPE	PROPOSED THRESHOLD*
Option One	Unconsolidated sand and gravel aquifers	500 m^3/day
	Consolidated bedrock aquifers	100 m^3/day
Option Two	Unconsolidated sand and gravel aquifers	250 m^3/day
	Consolidated bedrock aquifers	100 m^3/day

TABLE 4b Potential Thresholds For Determining a "Large Groundwater Withdrawal"

** Note: these thresholds might be subject to modification in areas with a Water Management Plan or that are identified as a "priority area".*

500 m^3/day would supply 200-250 single residential homes or 0.4 acre/foot of water per day. This threshold would capture mid to large sized water supply systems for small towns and larger communities, larger recreational enterprises like golf and ski resorts, larger irrigators, some nurseries, industries such as gravel pits and pulp mills, and mine dewatering wells (refer to Figure 5b).

250 m^3/day would supply more than 100-120 single residential homes[2] or 0.2 acre/foot of water per day. This threshold would provide greater extraction control and would capture all the users listed in the previous paragraph as well as some smaller enterprises but not small water supply systems. There would be a corresponding increase in regulatory costs with this approach.

2 Based on 2.3 m^3/day/household.

Referring back to the thresholds in other Canadian provinces and territories (see Table 5a), it is important to recognize that the proposed thresholds would be among the highest in Canada and, in the case of unconsolidated aquifers, the absolute highest if option 1 is selected. However, the proposed large withdraws thresholds are significantly lower than the current *BC Environmental Assessment Act* threshold of 75 L/s (equivalent to just under 6,500 m^3/day).

This approach may be viewed as appropriate by many industry professionals and technical experts in BC because of the comparative abundance of groundwater in some parts of the province. A lower threshold is appropriate for bedrock aquifers as they are less productive and their levels are impacted more by withdrawals due to their generally lower groundwater storage and groundwater flow properties.

And again, areas where groundwater availability is limited may be designated as "priority areas" and extraction may be regulated from a lower threshold to allow for better management of water availability a greater degree of control (discussed further below). These thresholds would be most relevant for wells outside of priority areas and would primarily be intended to prevent future conflicts and problems.

Types of Wells To Be Regulated

A modernized *Water Act* will also need to specify what kinds of wells will be subject to these thresholds. There are a number of different kinds of wells, including:

- water supply wells, which include:
- domestic water supply wells that provide water to single residences;
- domestic water supply wells that provide water to public places or multiple residences;
- non-domestic water supply wells the provide water for irrigation, open-loop geo-exchange, industrial processing, etc;
- dewatering wells, which are usually used to convey groundwater away from excavated sites, land, buildings, mines or other improvements with pumping;
- drainage wells, which are usually used to convey groundwater away from excavated sites, land, buildings or other improvements without pumping;
- remediation wells, which are usually used to improve the quality of groundwater in, for example, contaminated sites; and,
- water source wells used in oil and gas production processes.

Most jurisdictions exempt single family domestic and other small groundwater uses from licensing or permitting requirements, and certainly all truly single family domestic use would be exempt at any of the thresholds suggested above (an average home in BC uses under 1.2 m^3/day).[3] However, even for single family domestic and other small wells, related activities such as well construction would continue to be regulated through the Ground Water Protection Regulation (as they are now).

It is assumed that regulating extraction and use of groundwater would involve regulating larger water supply system wells and dewatering wells.

Estimates are based on an assumption of 448 litres/capita/day (Environment Canada, 2009) and an average number of persons in private households of 2.5 (Statistics Canada, 2010). Note also that many homes use much less than this volume.

Drainage wells typically serve to convey groundwater without pumping to facilitate land stabilization and to enable construction and property protection. Their impact on aquifers is generally localized.

3 Estimate based on an assumption of 448 litres/capita/day (Environment Canada, 2009) and an average number of persons in private households of 2.5 (Statistics Canada, 2010). Note also that many homes use much less than this volume

Since water pumped from remediation wells is usually contaminated and treated, the quantities extracted are typically small (<100 m^3/day) in order to minimize treatment costs. For these reasons regulating the withdrawal of groundwater from drainage or remediation wells may not be necessary.

Groundwater is used in the petroleum industry for hydro-fracturing oil and gas formations, for flooding oil and gas reservoirs, and as part of the process of extracting natural gas from deep coal beds. Construction and siting of water wells is regulated under oil and gas legislation but, like other kinds of wells, extraction and use are not currently regulated under the *Water Act.* Oil and gas activities can require significant amounts of water. Although the duration of water use for each well is often short, the total number of wells is expected to reach the thousands. Moreover, development of an oil and gas "play" may occur over several decades. Large volumes of water are also needed for reservoir floods and are used over a longer period of time. In some cases, the water used is saline and comes from deep formations, but freshwater is also used. This magnitude of extraction, particularly from fresh water-bearing formations that may have hydraulic connection with shallow aquifers and streams, could have impacts on local groundwater users and on base-flow.

An important question is whether the current situation is adequate or whether the withdrawal and use of water from wells for oil and gas exploration should also be regulated under the *Water Act.* Another important related question is whether requirements should apply only to fresh water or also to saline water, which is usually of negligible practical use and essentially isolated from shallower groundwater. Alberta, for example, only regulates groundwater extraction when salt concentrations are below 4000 mg/L total dissolved solid (Government of Alberta, 2009). Having a similar threshold in BC would have the advantage of creating a level regulatory setting between the two provinces.

4.5.2 What Is a "Priority Area"?

As discussed above, where groundwater is heavily used, the area may be designated as a priority area and be regulated from a lower threshold (i.e. to a higher standard). A priority area could be a geographic area or an aquifer:

- that is subjected to heavy extraction and use relative to the supply available;
- where there is know or suspected quantity concerns;
- that is at risk from salt water intrusion or natural depletion (e.g. due to insufficient recharge resulting from climate variability);
- that is believed to be in direct hydraulic connection with surface water and where over pumping may negatively impact either source;
- where the supply is used by many and groundwater is a sole or primary source of supply for drinking water;
- that extends into another province or crosses an international boundary (i.e. a transboundary aquifer);
- that is in a basin were surface water is at or near the allocation limit;
- where ecosystem health is considered to be vulnerable to additional groundwater extraction; or,
- any combination of the above.

The Province has taken a two stage approach to define and identify priority areas. First, Ministry of Environment staff assessed the inventory of classified and mapped aquifers, which consists of more than 900 aquifers across the province. Of these, more than half (492) are considered heavily or moderately developed. A prioritization scheme was then developed using the following criteria:

- the level of groundwater use relative to the supply, with the level of development estimated from the British Columbia Aquifer Classification System;
- whether there are known quantity concerns as indicated by the inventory of classified aquifers;
- whether the aquifer is shallow, unconsolidated (i.e. comprised of alluvial sediments) and is expected to be in direct hydraulic connection with surface water, based on its type[4];
- the estimated population reliant on the aquifer for drinking water; and,
- whether it is a transboundary aquifer.

4 The different aquifer types were proposed by Wei et al., in press.

Second, based on the above noted criteria, aquifers were ranked and a list of the highest priority ones was developed. From this, the thirty highest priority aquifers are listed in Table 4c.

TABLE4c Aquifer Priority List (Top Thirty Only)

AQUIFER NUMBER	DESCRIPTIVE LOCATION	AQUIFER MATERIALS	AQUIFER SIZE IN KM²	AQUIFER CLASSIF-ICATION	AQUIFER RANKING VALUE	RELIANCE ON GROUND-WATER RELATIVE TO SUPPLY	ESTIMATED POPULATION	EXTENT OF QUANTITY CONCERN	LIKELIHOOD OF SURFACE WATER-GROUNDWATER CONNECTION?	TRANS-BOUNDARY AQUIFER?
0035	Hopington (Langley)	sand & gravel	51	I A	21	Heavy	>50,000	Regional	Likely	
0015	Abbotsford	sand & gravel	91	I A	20	Heavy	>50,000	Local	Likely	Yes
0834	Savary Island, BC	sand & gravel	5	I A	15	Heavy	<2,000	Local	Likely	
0008	Vedder Crossing (Chilliwack)	sand & gravel	54	I A	15	Heavy	>50,000		Likely	
0092	Lower Nechako River Valley (Prince George)	sand & gravel	51	I A	15	Heavy	>50,000		Likely	
0158	Grand Forks	sand & gravel	39	I A	17	Heavy	2,000 – 10,000		Likely	Yes
0041	Langley / Brookswood	sand & gravel	39	I A	17	Heavy	>50,000		Likely	
0620	Village Bay to Horton Bay, Mayne Island	bedrock	8	I B	13	Heavy	<2,000	Regional		
0435	Whaling Station Bay	bedrock	4	I A	15	Heavy	<2,000	Local		
0217	Qualicum	sand & gravel	42	I B	14	Heavy	10,000 – 50,000	Local		
0216	Parksville	sand & gravel	25	I B	13	Heavy	10,000 – 50,000	Local		
0254	Osoyoos Lake to Tugulnuit Lake	sand & gravel	22	I A	16	Heavy	2,000 – 10,000		Likely	
0186	Duncan	sand & gravel	17	I A	14	Heavy	2,000 – 10,000		Likely	
0659	Near Houston; SE of Smithers	sand & gravel	12	I A	15	Heavy	2,000 – 10,000		Likely	
0255	Tugulnuit Lake to Vaseux	sand & gravel	11	I A	15	Heavy	2,000 – 10,000		Likely	
0172	Crofton - Chemainus	sand & gravel	8	I A	14	Heavy	2,000 – 10,000		Likely	
0074	Merritt	sand & gravel	7	I A	16	Heavy	2,000 – 10,000		Likely	
0431	Mackenzie	sand & gravel	2	I A	12	Heavy	2,000 – 10,000		Likely	
0346	Kalamalka Lake to Vernon	sand & gravel	1	I A	13	Heavy	2,000 – 10,000		Likely	
0393	At Whistler Creek between Nita Lake and Alpha Lake	sand & gravel	<1	I B	12	Heavy	2,000 – 10,000		Likely	

continued

AQUIFER NUMBER	DESCRIPTIVE LOCATION	AQUIFER MATERIALS	AQUIFER SIZE IN KM²	AQUIFER CLASSIF-ICATION	AQUIFER RANKING VALUE	RELIANCE ON GROUND-WATER RELATIVE TO SUPPLY	ESTIMATED POPULATION	EXTENT OF QUANTITY CONCERN	LIKELIHOOD OF SURFACE WATER-GROUNOWATER CONNECTION?	TRANS-BOUNDARY AQUIFER?
0259	U.S. Border to Princeton	sand & gravel	120	II A	14	Moderate	2,000 – 10,000		Likely	Yes
0134	Cache Creek to north of Maiden Creek	sand & gravel	15	I A	14	Heavy	<2,000		Likely	
0193	Osoyoos West	sand & gravel	13	II A	16	Moderate	2,000 – 10,000	Likely		Yes
0540	Wasa Lake	sand & gravel	11	I A	12	Heavy	<2,000		Likely	
0135	Semlin Valley	sand & gravel	10	I C	14	Heavy	<2,000	Local		
0619	Miners Bay to Bennett Bay, Mayne Island	bedrock	8	II B	13	Moderate	<2,000	Regional		
0706	Gabriola; Northern area	bedrock	6	I A	15	Heavy	<2,000	Local		
0737	West end of Saturna Island	bedrock	3	I B	11	Heavy	<2,000	Local		
0068	Belcarra	bedrock	2	I A	12	Heavy	<2,000	Local		

Note on table: *For an explanation of the aquifer classification and ranking value, see Berardinucci and Ronneseth, 2002*
www.env.gov.bc.ca/wsd/plan_protect_sustain/groundwater/aquifers/reports/aquifer_maps.pdf

The priority list shows that many of the top priority aquifers fall within four primary geographic areas (figure 4f):

1. The Lower Mainland (covered by the municipalities of Surrey, Langley City, the Township of Langley, Abbotsford, and Chilliwack);
2. The Okanagan Basin (covered by the regional districts of Okanagan-Similkameen, Central Okanagan and North Okanagan);
3. The East Coast of Vancouver Island (covered by the Regional District of Nanaimo and Cowichan Valley Regional District); and,
4. The Gulf Islands (covered by the Islands Trust and several regional districts).

These geographic areas have known concerns and, with the exception of the Gulf Islands, are areas with sizeable populations dependant on groundwater. The population of Gulf Islanders reliant on groundwater is low relative to the other high priority aquifers. However, the low yielding fractured bedrock, coastal setting, small recharge area, and other known concerns may elevate the islands to a priority area.

Existing administrative areas such as those defined by regional district boundaries may sufficiently encompass these priority aquifers and, if so, may be easier for the public to identify and understand. In this respect, it is possible that priority areas may not always need to be delineated by watershed or aquifer boundaries.

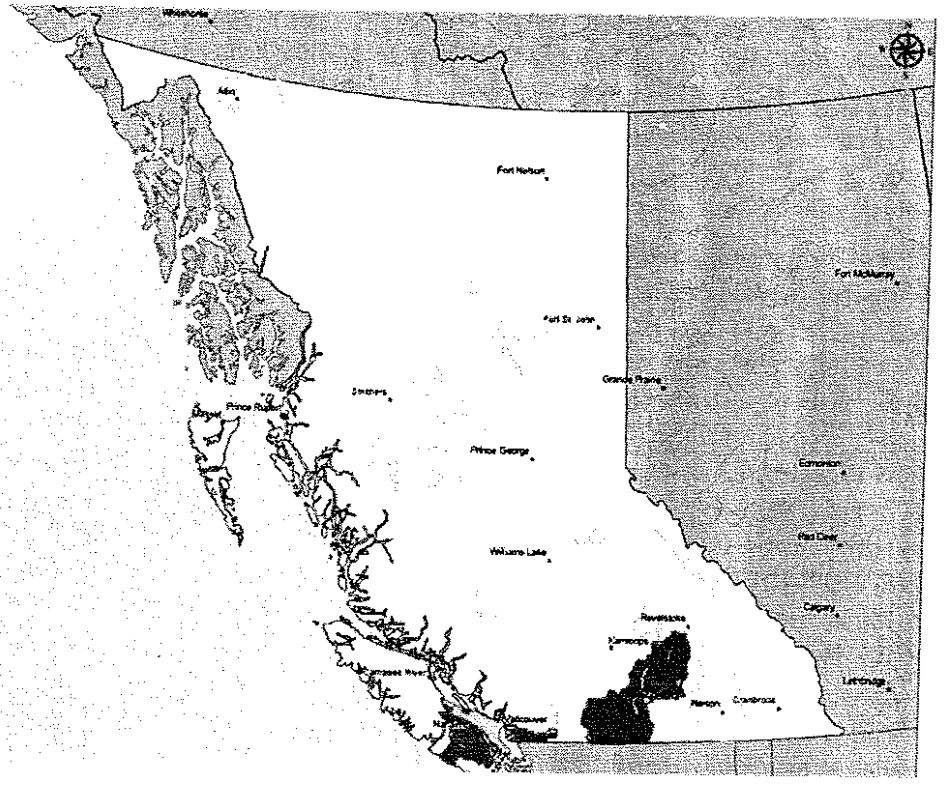


FIGURE 4f Potential Priority Areas for Regulating Groundwater Extraction and Use

The four key areas also include other aquifers with relatively high scores. For example, those at Cassidy, Cedar, and Mill Bay along the east coast of Vancouver Island, although not in the top ten, are in the top 50 list.

Thresholds in Priority Areas

Within a priority area, management of the resource should be comprehensive enough to ensure sustainability of the aquifer. As a result, the thresholds for when regulation of extraction commences would need to be lower. It may be appropriate to set thresholds on an area-by-area basis. Alternatively, a low, province-wide threshold could be set (for example, 20 m^3/day or 10 connections). Or, all groundwater extraction could be regulated in priority areas except for small scale extraction and use for purely domestic purposes (for example 2m^3/day). A benefit of this final option is that it is restricted to a specific and likely highest priority use, rather than just a quantity limit.

Once the priority areas are determined, accurate water budgets and aquifer assessment will need to be undertaken. This will allow regulatory staff to assess how much water can be withdrawn and used on a sustainable basis. It will also assist in decision making on whether the amount of use is exceeding supply.

Other Potential Priority Areas

As water use in the province increases, it may be necessary to designate additional priority areas. The criteria and process set out above, as well as additional information such as purpose and actual use, can be employed to identify additional areas for designation. Future groundwater priority areas could include:

- the river basins in the southern interior (Nicola River basin, Similkameen River basin, Kettle River basin) where the availability of surface water is limited and tighter controls on the extraction and use of groundwater may be desirable to protect the security of existing surface water licences and environmental flows;
- the Squamish to Pemberton area (Sea-to-Sky); and/or
- the East Kootenays.

Many of the remaining aquifers near the top of the list in Table 5c supply sizeable populations, but within more limited geographic areas (e.g., Prince George, Grand Forks, Merritt, Smithers and Whistler). Many of these aquifers are also expected to be in direct hydraulic connection to adjacent streams, providing an important function in maintaining surface water flows and temperature in streams with important fisheries values. However, much of the groundwater extracted from these aquifers comes from large capacity wells, so must be considered in the context of the discussion above about regulating large withdrawals. In other words, it may not be necessary to identify these places as "priority areas" at this time in light of the fact that groundwater withdrawals from large capacity wells can be captured under the parallel commitment to regulate large withdrawals, which may be sufficient to meet sustainability objectives.

4.5.3 How Would New Provisions Apply to Existing Wells?

There are already tens of thousands of wells in British Columbia. Applying new provisions to existing wells would prove a significant administrative undertaking, sometimes requiring application of regulation to groundwater use that has been ongoing for decades. However, regulating existing wells may be necessary if the Province is to manage water on a basin-scale, particularly in priority areas where use is approaching the limits of availability.

If licensing of groundwater or other forms of regulation are considered necessary, existing groundwater users would need to be provided with transitional time to apply for protection similar to a water licence for their existing extraction and use.

There would be some incentive to make this application in that licence-like protection would provide increased security for their existing use. Any groundwater extraction legislation would need to be designed so that impacts on other water users and watershed health is considered before additional extraction is approved. So, for example, existing users under this new regime might be better protected than they currently are from potential impacts, such as problems that might occur from new well drilling on adjacent property.

Transitional arrangements would need to be put in place that would likely include and an application deadline after which increased requirements to prove historic water extraction and use could apply. It is also worth repeating that regulating extraction from wells that supply normal, single family, residential dwellings is not contemplated.

4.5.4 Should Drilling Authorizations or Notifications Also Be Required?

As the name suggests, a drilling authorization is an approval to drill or alter a well and must usually be obtained before drilling commences or a pump is installed. Currently, under section 81 of the *Water Act*, drilling authorizations can only be required in areas that have a Water Management Plan approved by the Province or if a restriction has been imposed under the *Drinking Water Protection Act*.

Another consideration for *Water Act* modernization is whether drilling authorizations should also be required in priority areas or for large withdrawals. Drilling authorizations would add an additional layer to the permitting process of regulating groundwater withdrawal. Other jurisdictions (e.g., Manitoba, Ontario, Idaho) provide mixed views regarding the utility of their drilling permit or authorization processes.

Benefits of drilling authorizations include the ability to impose situation-specific conditions relating to:

- siting of the well;
- well depth;
- the need to conduct a pre-drilling assessment for flowing artesian conditions or potential cumulative impacts;
- limits on volume;
- seasonal use restrictions or other options such as limiting pump sizes or requiring flow restrictors; and/or,
- pumping test requirements.

Alternatively, it may be appropriate to establish a requirement for notification of drilling. This would provide provincial government technical staff with an opportunity to provide comment to well drillers (as opposed to setting conditions) and would eliminate the need for an additional permit layer. For example, in Washington State notification of well drilling is required 72 hours in advance to allow inspectors to be on site to inspect well construction to ensure well siting and construction standards are followed (Washington State Legislature, 2010; Washington Department of Ecology, 2010). Notification does not have to slow down drilling, particularly if it can be done via web-based tools. It would allow provincial staff to not only inspect but also to provide input and reduce the potential for having to deal with issues and problems after a well is drilled and in operation.

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Summary

In summary, British Columbians are interested in water and have increasing awareness of the water issues facing the province. As this report demonstrates, there is a lot progress in some communities, sectors and watersheds dealing with water challenges and protecting stream health. To supplement the *Water Act* modernization discussion paper, additional information and scientific evidence is provided on the pressures British Columbia's water resources are facing, and new challenges likely in the future. In addition, further information is provided about the legislative arrangements British Columbia's currently has to deal with issues.

It is clear from this report that British Columbia's is not alone in its water challenges. The sections on leading thoughts and practices provide insights for the reader to better understand other ways to manage challenges and facilitate changes to water governance and management. Lessons can be learned from other jurisdictions which are important when considering the methods or extent of change. It is hoped that this information may help others in the province understand the kinds of options available now, and the kinds of options that may be applicable in future to modernize British Columbia's *Water Act*.

Appendicies

Appendix One

Some Unique Water Governance Initiatives and Plans in BC

Modified from Nowlan, L. and Bakker, K. 2007. *Delegating Water Governance: Issues and Challenges in the BC Context*. Report for BC Water Governance Project. Program on Water Governance Vancouver BC: University British Columbia.

The initiatives and planning processes listed below are in alphabetical order. This list is not a comprehensive inventory of unique governance efforts in the province and is intended to provide a sample of the range of different kinds of initiatives underway.

Abbotsford-Sumas Aquifer International Task Force

The Abbotsford-Sumas Aquifer supplies drinking water to both Canadians and Americans. In response to contamination concerns, regular groundwater sampling and monitoring has been carried out since the mid 1970s, and monitoring efforts have intensified since the mid 1990s. A number of coordinating committees have been formed with representatives from federal, provincial and local government agencies, agricultural and industry groups, NGOs and Washington State participants from the City of Sumas, the regional board of health and the Department of Ecology. The mission of the Task Force is to coordinate efforts directed towards protecting the aquifer across the common border between Canada and the United States. These efforts establish a managerial approach, develop aquifer management strategies, and facilitate coordinated mechanisms to educate and involve the public in protecting the aquifer's water quality and water resource values. More information can be found at www.env.gov.bc.ca/wsd/plan_protect_sustain/groundwater/aquifers/absumas.html.

BC Hydro Water Use Plans

Water Use Plans are an example of efforts underway at BC Hydro to more sustainably manage its activities. Water Use Plans are technical documents that define the proposed operating parameters to be applied in the day to day operations of hydroelectric facilities. The overall goal is to find a better balance between competing uses of water, such as domestic water supply, fish and wildlife, recreation, heritage and electrical power needs. Water Use Plans have been developed for most of BC Hydro's hydroelectric facilities through a consultative planning process involving participants such as government agencies, First Nations, local citizens and other interest groups. Plans are developed in accordance with the process set out in the Provincial Water Use Plan Guidelines, developed by an interagency committee including the Province, DFO, and BC Hydro after two years of extensive consultation. More information can be found at www.bchydro.com/planning_regulatory/water_use_planning.html.

Clayoquot Sound Central Region Board

The Clayoquot Sound Central Region Board (CRB) was established in 1994 through an Interim Measures Agreement between the Hereditary Chiefs of the Nuu-chah-nulth Central Region and the Province of British Columbia and has responsibility for resource management and land use planning in Clayoquot Sound. The Board has the responsibility of reviewing plans produced by any BC agency or ministry empowered to make resource management and land use decisions. It ensures that First Nations and local perspectives are brought to bear in decisions regarding development in Clayoquot Sound. The CRB consists of 12 members: five appointed by the Province, five appointed by the Central Region First

Nations, one co-chair appointed by the Province, one co-chair appointed by First Nations, and one Elder Advisor. More information can be found at www.centralregionboard.com.

Columbia Basin Trust

The Columbia Basin Trust Act created the Columbia Basin Trust (CBT) in 1996. The Trust is governed by a 12-member Board of Directors, composed of an appointee from each regional government in the Basin (Five regional districts and the Ktunaxa/Kinbasket Tribal Council) and provincial appointees, all of whom must reside in the Columbia Basin. The Columbia Basin Management Plan has a unique status in BC water governance arrangements because decision makers under the Water Act must consider it when issuing water licences in the region. As an example of the CBT's work to protect water, in 2010 it the announced that it is partnering with 19 local governments in the Columbia Basin Water Smart Initiative to address water conservation in the region. This ambitious project will attempt to reduce community water use across the Basin by 20 per cent by 2015. More information can be found at www.cbt.org/.

Cowichan Basin Water Management Plan

The Cowichan Water Use Plan was finalized in 2007 in response to concerns about low flows and higher water temperatures in the summer months, and water quality impacts from reduced dilution of waste discharges into the Cowichan River. The plan was developed through a partnership with the Cowichan Valley Regional District, BC Ministry of Environment, Fisheries and Oceans Canada, Catalyst Paper Corporation, Cowichan Tribes, and the Pacific Salmon Commission. The Cowichan River is entirely contained within the Cowichan Valley Regional District boundaries, which simplifies the use of watershed based management. More information can be found at www.cvrd.bc.ca/index.aspx?NID=779.

Fraser Basin Council

The Fraser Basin Council (FBC) was established in 1997 and is a not-for-profit, non-governmental organization. It was preceded by the Fraser Basin Management Program created in 1992 by the federal, provincial and local governments. The FBC's governance model is a two tier structure consisting of a society and a 36 member Board of Directors. The Board is made up of federal, provincial, local and First Nations government representatives, as well as representatives from industry and the public. The Fraser Basin Council has played a leadership role in more than 50 major projects, has resolved conflicts, and has been a catalyst in helping to solve inter-jurisdictional issues affecting the basin. The FBC does not have any formally delegated decision-making powers. Once the FBC reaches consensus on an issue, the various government representatives work to implement those proposals that are within their jurisdiction. More information can be found at www.fraserbasin.bc.ca/.

Nicola Water Use Management Plan

The Nicola Water Use Management Plan (Nicola WUMP) has been developed at the local level by a diverse group of people seeking solutions to long-standing water issues in the Nicola watershed around Merritt. The planning process came about in response to a desire to ensure that future water supply would be divided equitably among all water users balancing the watershed's social, economic, traditional and ecological values. As of March 2010, a draft plan with 37 recommendations was being finalized following an extensive community consultation process.
More information can be found at www.nicolawump.ca/.

Okanagan Basin Water Board

The Okanagan Basin Water Board (OBWB) was originally created to coordinate the prevention of the spread of invasive weeds in the lakes in the Okanagan basin, and to provide grants to improve local

water waste treatment, but over time its focus has expanded. The overall objective of the organization is to undertake strategic projects and programs at the basin scale that meet the collective needs of Okanagan citizens for long-term sustainable water supplies while supporting the capacity of member jurisdictions to meet their own water management goals. The Board is composed of representatives from each of the three Regional Districts in the Okanagan Basin (Okanagan-Similkameen, Central Okanagan, and North Okanagan), First Nations, the Water Supply Association of BC, and the newly-formed Okanagan Water Stewardship Council. The Board is unique in its powers to tax and to pass bylaws, and is funded through annual property tax assessments on lands within the Okanagan Basin watershed. In 2006, in response to rising public interest in water sustainability and with the support of the regional districts, the OBWB put into action a water management initiative to promote coordinated water management throughout the basin. More information can be found at www.obwb.ca/.

West Coast Vancouver Island Aquatic Management Board

The West Coast Vancouver Island Aquatic Management Board is a forum for the coastal communities and other persons and bodies affected by aquatic resource management to participate more fully with governments in all aspects of the integrated management of aquatic resources in the management area. More information can be found at www.westcoastaquatic.ca/about.htm.

Salmon River Watershed Roundtable

In 1991, this organisation began as an environment committee of the town of Salmon Arm. It has grown to include representatives from provincial and federal governments, as well as the public. Several layers of watershed scale planning have been completed that follow an inclusive, consensus-based process using ecosystem objectives which address social, economic and ecological health of the watershed. Watershed restoration, monitoring and participation activities have been undertaken concurrently with planning. The Roundtable was a pilot project for Environment Canada for community based development of ecosystem goals, objectives and indicators. It continues to be active, and has partnered with the Canada-BC Environmental Farm Plan program to implement environmental farm planning from a watershed perspective. More information can be found at www.srwr.ca/.

Township of Langley Water Management Plan

The Township of Langley was designated in July 2006 as the first area in BC to undertake the preparation of a Water Management Plan under Part 4 of the Water Act. The plan was completed in late 2009 and has been submitted to the Minister of Environment. It is still subject to Cabinet approval.

The process was launched in response to concerns about declining groundwater levels and water quality protection in the Langley area. The goal of the plan is to identify measures to promote sustainable use of groundwater, protect aquifer recharge areas and the adequacy of recharge and preserve base flows in fish bearing streams recharged by ground water.

The plan was developed jointly by the Township of Langley, the Ministry of the Environment, and the Ministry of Agriculture and Lands. It was informed by an extensive public and First Nations consultation process and a stakeholder advisory group with local representatives from the residential, agricultural, industrial, environmental and health sectors.

Provincial components of the plan will be implemented by regulation. Key provisions include requirements for drilling authorizations that set conditions for new water supply wells, conservation measures to curb demand and overuse of water and locally enforceable agricultural practices to minimize the risk

of groundwater contamination. More information can be found at www.tol.ca/index.php?option=com_content&view=article&id=1078&Itemid=916.

Appendix 2

Evolution of the Water Act

Historically, water law in Eastern Canada followed the common law system of riparian law, whereby rights to water were attached to ownership of land adjacent to water bodies. Under this system, the riparian owner had an unlimited right to use water for domestic purposes, and a more restricted right to use water for secondary uses.

The inadequacy of the riparian law for British Columbia was recognized early in the Fraser gold rush days when miners required an assured supply of water at places remote from streams and rivers. It was also apparent that an equally assured supply was needed for hay-growers, cattle-ranchers, and fruit-growers in the Interior. A different approach to water law was required that would help promote economic development. A system based on security and certainty was needed to justify the very substantial investments settlers were making to develop their holdings.

In response, staking, or appropriation, of water and the right of access across private land to access water (similar to today's concept of expropriation), were introduced by Governor Douglas under the *Gold Fields Act* of 1859. This Act permitted the Gold Commissioner to grant exclusive rights to the use of defined quantities of water in return for a rental payment to the Crown. This enabled persons other than riparian owners to obtain rights to use water. Then, in 1865, the *Land Ordinance Act* was passed. This Act provided that every person living on and actually cultivating lands might divert any unrecorded water from a stream upon obtaining the written authority of the magistrate.

The *Water Privileges Act* (1892) was the first statute to deal exclusively with water rights. It explicitly declared that the right to the use and flow of all water in any stream was vested in the Crown. The *Water Clauses Consolidation Act* of 1897 brought together in one statute the provisions regarding appropriation of water. No person could divert water except in accordance with the provisions of provincial law. The obligation to make reasonable use of water for the purpose for which it was granted was also confirmed by this Act.

Up to the dawn of the 20th century, most rights to the use and flow of water were a matter of record in the books of officials scattered throughout the province. These records were often vague, and the rights granted were frequent causes of disputes and litigation. Hence, in 1909 the first *Water Act* of the province was enacted. This Act described the acquisition and control of water rights in great detail and created a tribunal, called the Board of Investigation. The Board travelled the province to conduct hearings with persons claiming to hold records of water or other water rights and to determine the terms upon which new licences would be granted. The Board also had authority to determine the priorities of the respective claimants to water from any stream and to assign the quantity of water to which each claimant was entitled.

Eventually the 1914 *Water Act* imposed a requirement for any person exercising riparian rights to file a record with the Board of Investigation prior to June 1, 1916. If such rights were not so recorded, they were subject to being cut down by a grant of water rights to another person. The provisions of the *Water Act* of 1914, and the work of the Board of Investigation over a period of more than 10 years, effectively abrogated any riparian rights to the diversion and use of water from streams in the province. This Act

solidified a unified scheme for acquiring and administering water rights based on the doctrine of prior appropriation: "first in time – first in right".

After some litigation, a period of relative stability in water law settled in. The Board of Investigation had completed its work and was abolished under the *Water Act* of 1939. The Comptroller of Water Rights remained as the statutory official charged with the powers of allocating water rights across the province. Elements of environmental protection first appeared in the *Water Act* of 1960 which allowed for the granting of approvals for making changes in and about streams and for short term use of water. In addition, provisions were made for the possible application of the Act to groundwater.

In 1995 the Province passed the *Water Protection Act* to foster sustainable use of British Columbia's water resources in continuation of the objectives of conserving and protecting the environment. That Act prohibited the bulk export and major inter-basin transfers of water. In 1997 the *Fish Protection Act* brought in additional mechanisms to strengthen the protection of fish and fish habitat from water allocations.

The most recent changes to the *Water Act* came into effect in 2004, driven primarily by growing concerns for protection of drinking water quality. The amendments also provided for important new statutory mechanisms to protect groundwater. And, it established a process for water management planning to address or prevent conflicts between water users, or between water users and instream flow requirements, and protection of water quality.

Water is everyone's concern

and we can all play a role in determining BC's water future.

We would like to hear from you and encourage you to to share your thoughts on the kind of future you envision for BC's water.

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