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FRESHWATER FOR FISH AND PEOPLE: MOVING TOWARDS "LIVING WATER SMART"

JULY 2009

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PRECIS

In British Columbia, and elsewhere, water managers are faced with the challenge of balancing competing demands for water. Limits in supply or high demand create situations of water scarcity where not enough water is available for both human (out-of-stream) and ecological (instream) needs. As well, governing laws, institutions, or managers often do not to recognize that instream needs have a prior, or at least equal, right to water comparable to other users. In some situations water is allocated to out-of-stream users first, with instream needs being an afterthought or only if "excess" water exists. Current trends in B.C. suggest that balancing needs for water will become increasingly difficult in the future: the population is growing; rates of water consumption are among the highest in the country and the world; water use is currently in conflict with instream needs in many locations; climate change is increasing water scarcity; and populations of freshwater reliant fish species, such as Pacific salmon, are in decline.

In 2008, the Province of British Columbia released Living Water Smart, a plan of action for improving water management. This plan has the promise to address some of the water use challenges that lie ahead, though details are limited on how existing laws and approaches to managing water will change. Given the opportunity presented by Living Water Smart, this report clarifies options for resolving conflicts between out-of-stream and instream uses and draws insights from case studies and other sources about the strengths and weaknesses of these options for B.C.'s citizens, water users, water managers, and policy makers.

Leading approaches to resolve water use conflicts suggest focusing solutions on a few core issues. Foremost, existing provincial laws need to be clear in their intention to satisfy instream needs for water and these laws need to be consistent with federal responsibilities. Establishing rights of the environment for water, prioritizing them relative to other users, and ensuring long-term security are part of providing this clarity. It is also essential to recognize that rivers require both surface water and groundwater to sustain their health and reductions in human uses can benefit instream needs. Water use planning is an integral part of resolving conflicts which must consider surface water and groundwater interactions as well as land use activities in periods of both water abundance and drought. To balance competing demands, government policies need to be supported by sufficient resources (time, people, and money) to ensure their success. As well, the public needs to be educated about the challenges of managing water for competing demands and engaged in developing lasting solutions. Resolving conflicts also requires good and timely information, which a strong science program can provide. Lastly, all water users need to adopt practices that help them do more with less and help them minimize impacts of water use on freshwater ecosystems.

With these issues in mind, policy makers have several tools to resolve existing and future problems:

Information campaigns, education, and moral suasion are voluntary approaches to helping resolve water use conflicts. Voluntary approaches are not sufficient on their own; they need to be accompanied by some of the mandatory options described below. Priority topics for education include informing the public about the effects of climate change on water supplies and raising awareness about links between groundwater and surface water supplies and the impacts of wells on this interconnected resource.

Financial incentives include tax breaks, credits, grants, loans, rebates, or direct subsidies to support desirable approaches to managing water. A caution, however, is that incentives to encourage water use efficiency can be more expensive and less effective than other solutions. In some instances, efficiency gains may be absorbed by activities that offset the benefits. In other situations, incentives may be directed to people who would have taken action regardless of whether the incentive existed.

Market-oriented regulations use prices to shift behaviour of water users, recognizing that the current cost of water does not reflect its true value. Increasing prices will help reduce demand and improve efficiency. Determining the right price is challenging, given desires to both promote economically efficient uses and maintain equitable access for some users. Due to the related political challenges, it is important to involve the public when deciding on appropriate prices of water.

Financial disincentives include deterrents (fines, charges, or legal action) that penalize individuals for undesirable behaviour. They are generally regarded by government as a reactive, confrontational, and costly approach to resolving conflicts. Though in some cases, the threat of a penalty can motivate restoration and protection of instream flows.

Water licenses are a means by which managers can allocate rights to use surface water and groundwater. The current approach to allocate water is based on "first in time, first in right" which has led to situations where uses are not the most socially, economically, or environmentally beneficial. Changes to the current licensing regime should consider: a new form of license to support long-term protection of instream flows; defining sustainable limits on allowable water withdrawals; restricting water takings in periods of drought; and allowing users to "trade" water to ensure it is being dedicated to the most socially, economically, and environmentally beneficial uses.

Water planning provides a process for resolving competing demands for water. To be effective, planning processes need to consider interactions between surface water and groundwater; integrate land use planning with water use planning; be supported by strong science and monitoring; and be sustained by adequate resources.

Flow standards describe the amount of water needed to protect fish and fish habitat and are set using rigorous scientific approaches. To be effective flow standards need to be mandatory (as opposed to voluntary) and supported by a legal framework that clarifies the rights and priority of allocation for instream and out-of-stream needs.

Zoning and designations can be help water managers and water users make better decisions by recognizing that supply and demand are not evenly distributed across seasons, years, and watersheds. This option can be used to identify locations of sensitivity and periods of vulnerability which require different actions by water managers and water users. Critical to their success is a need to use criteria that are transparent and scientifically defensible.

Water efficiency measures can help minimize consumption or improve efficiency of water use. If used to protect instream flows, it is important to include mechanisms that ensure gains of water conservation are transferred to instream needs otherwise they may be lost to out-of-stream uses.

Though an independent understanding of these tools is helpful, they are not mutually exclusive. There are many benefits to developing them in a coordinated way. It is also critical to ensure that mandatory measures, not voluntary ones, are at the foundation of coordinated action. By supporting the above solutions and navigating the related concerns, policy makers, water managers, water users, and the public can facilitate the transition from the current situation to the one envisioned under Living Water Smart, thereby helping British Columbia better manage freshwater for people and fish.

REPORT SUMMARY

THE ENVIRONMENTAL CONTEXT

Challenges in managing water supplies to balance human and ecosystem needs can be traced to two root causes. First, water scarcity—limited supply or high demand—creates situations where not enough water is available for both out-of-stream (human) and instream (ecosystem) needs. Second, laws, regulations, institutions, or managers often do not recognize that instream needs have a prior, or at least equal, right to water comparable to other rights holders. In such situations water is allocated among priority rights holders first with instream needs being allocated as an afterthought or only if "excess" water exists.

In B.C., a currently unfolding storyline is one of converging trends in population growth, water consumption, climate change, and the status of freshwater ecosystems, suggest greater conflicts between human and ecosystem needs for water in the future. Due to the impact of human activities (including water use) on Pacific salmon, population growth has been recognized as one of this species' greatest threats. Inherently high rates of water consumption enhance water scarcity and water use conflicts by increasing pressures on surface water and groundwater resources. Current patterns of water use illustrate that conflicts between out-of-stream and instream uses currently exist in many parts of the province. Moreover, current evidence illustrates that climate change has significantly affected water availability in the past, and is expected to further reduce the capacity of watersheds to store water in the future (through declines in snowpack and glaciers). Overlaid on top of these human and physical changes is the troubling status of some freshwater reliant species, such as Pacific salmon.

In 2008 the government of British Columbia released Living Water Smart, a plan of action for improving water management in the province. This plan has the promise to address some of the water use challenges that lie ahead, though details are not currently available on how existing water laws and approaches to managing water will specifically change. Given the above environmental context and opportunity presented by Living Water Smart, the purpose of this report is to clarify options for resolving conflicts between out-of-stream and instream water uses and draw insights from case studies and other sources about the strengths and weaknesses of these options for B.C.'s citizens, managers, and policy makers.

To do so we first develop a **general** framework that describes the core policy elements needed to resolve conflicts between instream and out-of-stream users and as a result help protect instream flows for fish. We then use this general framework to assess the current situation in B.C. and the one being proposed by Living Water Smart. Next, we use a case study approach to review relevant laws and supporting instruments at a jurisdictional scale and watershed / basin scale to understand some **specific** examples and their success (or not) in helping resolve water use conflicts elsewhere. Lastly, we synthesize key findings using the general framework and specific insights from the case studies (supplemented by other research) to facilitate development of a more effective policy.

THE POLICY CONTEXT

For effective policy, our general framework outlines a need for greater clarity around three core elements. A clear definition of the **problem** is needed to ensure policy makers and managers are focused on priority challenges and that solutions are addressing these challenges. A description of **goals and objectives** provides greater transparency by articulating what a policy is trying to achieve and clarifying strategic priorities for addressing problems. **Policy instruments** are the specific tools or solutions being proposed to address the problems as consistent with stated goals and objectives.

We define the problem of conflict between out-of-stream and instream water users as being related to three main issues. **Water scarcity** presents the need for either increasing supply (storage) or reducing demand (water conservation or improved efficiency) to reduce conflicts and provide water for all users, including ecological needs. Existing **water rights** do not tend to recognize that instream users have a prior, or at least equal, right to water comparable with out-of-stream users. Consequently, a strengthening of instream rights or changes in the priority of out-of-stream rights may increase conflicts if new priorities are different than the current situation. Lastly, the natural variability of water supplies across watersheds, seasons, and years and the uncertain effects of climate change suggest a strong need to maintain **flexibility** when designing today's policies to avoid making existing conflicts worse or creating additional ones in the future.

Though not described explicitly within Living Water Smart, we draw guidance about goals to minimize water use conflict from the recent Okanagan Sustainable Water Strategy which seeks to "*ensure our limited water resources are coordinated and well managed—working towards a future for the Okanagan where water does not compromise human health and well-being, the environment, or the economy*". To provide clarity around policy objectives we draw guidance from the Instream Flow Council[1], which takes a holistic view of water management similar to the above goal (i.e., freshwater for people and fish). Using their identified ecosystem components and policy issues, we identify nine policy objectives which highlight the core elements and more specific details required for a successful instream flow program. These objectives include:

- Ensuring clear **legal responsibilities** for protecting instream values;
- Developing effective laws for protecting **water rights** of instream needs;
- Recognizing appropriate **water uses** for protecting instream values;
- Conducting comprehensive **planning** of instream flow programs;
- Ensuring effective **implementation** of instream flow programs;
- Supporting **public education**;
- Enabling **public engagement**;
- Establishing credible **science** to support decision making; and
- Implementing effective **management practices** for protecting instream values.

Instruments represent the solutions that will help policy makers achieve their goals and objectives, and provide those responsible for policy implementation with the tools to deal with on-the-ground challenges. We use a generic five category classification of instruments to draw insights for B.C.:

- **Command and control regulation** defines acceptable boundaries or prohibitions on particular activities (e.g., limits on groundwater withdrawals or restrictions on surface water licenses);
- **Financial disincentives** are deterrents that penalize individuals or organizations involved in undesirable behaviour (e.g., fines if violating the prohibitions of a water license);
- **Market-oriented regulations** use pricing or market systems to encourage desired behaviour (e.g., volumetric charges in which per unit rates increase with the volume consumed);

[1] The Instream Flow Council is an organization representing state and provincial agencies dedicated to improving protection of instream flows across North America (http://www.instreamflowcouncil.org/).

- **Financial incentives** include tax breaks, credits, grants, low-interest loans, rebates, or direct subsidies to encourage desirable behaviour (e.g., subsidies to support uptake of higher efficiency irrigation technologies or water infrastructure improvements); and
- **Information and moral suasion** includes a suite of voluntary approaches—information campaigns, education, and moral suasion—to help resolve water use conflicts (e.g., educating the public about the impact of climate change on water supplies).

A REVIEW OF OTHER JURISDICTIONS

Murray and Darling Rivers, Australia

Australia is currently a nation with acute water shortages and many water use conflicts, which has led the country to pursue urgent and high profile efforts to resolve these problems. While the focus has been on increasing water availability for domestic and agricultural purposes, aquatic ecosystems are also in crisis. River health is declining due to a combination of extreme water scarcity related to climate change and too much water being extracted from rivers and aquifers in many areas. Australian States and Territories are in charge of water management, while the federal government (i.e., the Commonwealth) provides guidance and incentives. Water laws vary among States / Territories but important aspects are becoming more coordinated.

The Murray-Darling Basin lies within southeastern Australia, covering one-seventh of Australia's land mass. It is the nation's 'breadbasket' supplying 40% of the nation's food crops and supporting 85% of Australia's irrigated agriculture. The Basin has also suffered greatly in an ongoing and unprecedented drought, now in its 12th year. Drought in the Basin has intensified existing over-allocation of water, water shortages, management shortfalls and conflicts, and been a major impetus to change how water is allocated for both human and ecological needs. The Basin is of particular interest to water managers elsewhere because it has been the focus of many reforms in water laws.

Given the water crisis presented by climate change, Australia and the Murray-Darling Basin are seen as leaders in dealing with water use conflicts. Surface water and groundwater allocations are under restriction, a market-based cap and trade system for water is being implemented, and billions of dollars are being invested to improve irrigation efficiency and buy-back water entitlements for environmental needs. The government has also invested heavily in sophisticated water balance modeling to better understand surface water and groundwater linkages.

Walla Walla River, United States

Oregon has similar topography and climate to British Columbia and similarities in the way water has historically been allocated. The State also has a long history of agricultural water use with many areas under irrigation for over a century. Water conflicts are most acute in the drier areas of the State and during dry summer months. Within the State there is a strong culture of volunteerism and grassroots action for land management. The priority of water rights in Oregon is based on the date of application for a license such that senior water users have first rights in times of scarcity. In addition, Oregon's water code provides for beneficial use of water without waste, and declares that water rights must be used as licensed at least once every five years. Oregon water law also includes certain protections and restrictions on water extraction within major watersheds or groundwater areas.

The Walla Walla River drains into the Columbia River, with headwaters that originate in both Oregon and Washington. The watershed is a highly productive agricultural area with waters that have been oversubscribed for more than a century—sections run dry each season. Bull trout and steelhead were listed as endangered under the *Endangered Species Act* (ESA) in 1998 and 1999, respectively. Since 2001, however, the river has remained wetted

due to a flow agreement among major irrigators in large part due to ESA designations. The cooperative resolution of this conflict is seen as a model of success for other areas. For the most part, actors in the basin have worked together to develop successful flow agreements that have involved many planning processes—Basin plans, Habitat Conservation Plans, Comprehensive Irrigation District Management Plans, Oregon Plan for Salmon and Watersheds, and ESA recovery plans. Involvement in this planning has been supported by the Oregon Watershed Enhancement Board which funds local Watershed Councils. Other related activities in the State include investments in a Conserved Water Program to encourage irrigators to conserve water, the ability of the State to hold water rights for instream needs, and designation of groundwater administrative areas that are vulnerable to groundwater takings.

Oldman River, Canada

Alberta lies in the rain shadow of the Rocky Mountains. The province has been affected by serious droughts in the past and an increase in water scarcity in the prairies has been identified as one of the most serious threats from climate change. In the south, many rivers have been fully allocated to industrial, agricultural, and municipal uses, while in northern basins more than half of the allocated water is for energy production. Alberta's water management challenges are driven by transboundary passage, water scarcity, population growth, and large economic demands for water.

Water licensing decisions represent the most significant tool for maintaining instream flows. This tool is supplemented by other instruments including, a "water conservation holdback" which allows for retention of up to 10% of a water allocation when transferred between entities and "water conservation objectives" which describe the volume of water required to protect instream values. Other useful instruments include water management plans, involuntary license amendments, crown water reservations, and funding for research in technology and innovation. Alberta Environment oversees water use. Irrigation districts are also authorized to allocate water to farmers or implement other measures, such as water use efficiency, while municipalities have the authority to restrict municipal water users. In 2003, the government released *Water for Life* a non-binding plan that focuses on providing: (i) safe and secure drinking water; (ii) reliable quality water supplies for a sustainable economy; and (iii) healthy aquatic ecosystems.

The Oldman River originates in the Rocky Mountains flowing east through the foothills and onto the prairies before joining the Bow River to become the South Saskatchewan River. Given high temporal variability in flow, dams have been developed as a tool to moderate runoff and maintain storage. The watershed is highly subscribed with approximately 65% of natural flows already allocated. Irrigation Districts draw water using a series of reservoirs, canals, pipes, and sprinklers to irrigate the watershed. In times of scarcity water is rarely managed for instream needs. Management is further complicated by perceptions that water is wasted if it flows unused downstream. The construction of dams in the watershed has been accompanied by benefits to local water users and conflicts among First Nations and environmental organizations. The most notable example is the Oldman River Dam. The South Saskatchewan River Basin Water Management Plan represents one of the most advanced planning efforts in the province. To protect instream flows it includes some of the instruments described above. Despite the Plan's desire to balance human and ecosystem needs, it isn't clear whether these actions will be effective in protecting instream flows in the long term. Managers are unable to amend licenses in over-allocated systems or where instream needs are not being met.

Although there are many innovative approaches being applied in Australia, Oregon, and Alberta the success of these approaches at resolving water use conflicts in the long-term is still unknown. It takes time for new approaches to be implemented and understand the consequences of these actions. Regardless, there are many useful and specific insights from the case studies which can inform the generic framework and help understand opportunities and challenges for resolving conflicts between instream and out-of-stream users in B.C.

FACILITATING THE PATH FORWARD

Using the general framework we synthesize key findings from the case studies and other supporting research to facilitate transition from the current situation in B.C. to the one envisioned under Living Water Smart. In particular, a discussion about policy objectives helps highlight priorities and potential gaps with Living Water Smart. A discussion about instruments provides an understanding of options for reducing water use conflicts and relevant considerations when strengthening existing or developing new tools for water managers. We also recognized that there are benefits to designing and implementing instruments in a coordinated fashion and to being aware of the potential for unintended (and adverse) consequences on water resources.

To facilitate the path forward, the broader list of objectives and related issues was compared to Living Water Smart and prioritized. An initial comparison showed that Living Water Smart reflects all objectives in some way. However, underlying several policy components are issues that represent some of the greatest challenges to resolving water use conflicts and protecting instream values. Among the many activities proposed by Living Water Smart, the following represents those issues that we believe are the highest priority for developing instruments:

- Legally recognize instream rights to water;
- Provide long term certainty of water rights for instream needs;
- Prioritize instream rights relative to other water users;
- Enable private owners to hold instream rights for water;
- Manage surface and groundwater conjunctively;
- Encourage water use efficiency;
- Ensure efficiency gains can be transferred to instream values;
- Conduct comprehensive (water and land) water resource planning; and
- Enable public input in decision making processes.

Using the five category classification of instruments and drawing insights from the case studies, we delve deeper into clarifying what specific options are available and understanding some of the specific considerations that make these instruments successful (or not).

(1) Command and Control

Water licensing: Water licenses are the means through which the BC government allocates rights to divert and use surface water. The western doctrine of prior allocation/appropriation has been called a "lord of yesterday," in that it shapes and governs modern attitudes and actions but is rooted in the beliefs, values and goals of the past. The challenge in reforming the water licensing system in BC is to balance a number of competing and sometimes conflicting objectives: providing security and predictability of supply for users; protecting instream and ecosystem values; ensuring water is put to the most socially valuable purpose; providing information to decision makers about water use and water needs; and maintaining flexibility to respond to new knowledge and changing circumstances. Finding an appropriate balance among these objectives is difficult, especially when changes to water licensing affect vested rights and strongly entrenched attitudes. Based on the case studies, some changes that should be considered include: a new form of license specifically for instream flow protection, combined with provisions to allow existing water rights to be transferred and amended to protect instream flow; a cap on water rights allocations based on an instream flow standard which sets a limit on the total amount to be

allocated; temporary reductions in allocations, when required, based on annual assessments of the total amount of water available in the system for the year; and allowing more open trading of water rights to ensure rights go to where they are most highly valued.

Water planning: Planning involves the "scientific, aesthetic and orderly disposition of land, resources, facilities and services with a view to securing the physical, economic and social efficiency, health and well-being of urban and rural communities." In the context of the problems facing water managers, planning can provide a process for resolving conflicts between instream and out-of-stream water users. Several insights emerge from our research that are consistent with Living Water Smart and would help water planning instruments be more effective. First, both surface water planning and groundwater planning are necessary, and they should be undertaken together (conjunctive planning). Second, conjunctive water planning should be integrated with land use planning. Third, water planning should take place at multiple scales where large-scale planning reflects broad social interests and concerns, and small scale planning provides the local understanding and ability to respond to local ecosystem conditions and social needs. Fourth, good planning requires reliable scientific information, a recognition of uncertainty, and the flexibility to adapt to change. Finally, plans are of limited value unless they are supported by adequate resources and an effective strategy for implementation and monitoring.

Flow standards: Instream flow standards describe the timing and magnitude of stream flows needed to protect fish habitat in the absence of detailed biological and physical habitat information for a stream. Flow standards are generally not entrenched in regulation. Though the use of instream flow standards can not directly reduce conflicts between instream and out-of-stream water users, they can describe basic water needs for fish and provide consistency in approaches for identifying those needs. Four related insights affect their usefulness. First, flow standards have not yet been set within existing provincial and federal regulatory context. Given the potential for conflict with overriding and potentially less stringent laws, it is important to ensure that provincial laws be adjusted to support the use of flow standards and wherever possible federal laws be aligned with this objective. Second, instream flow standards that are optimal for fish may be sub-optimal for other uses. To help resolve conflicts it is important that flow standards be supported by a legal framework that clarifies the rights of different users for water and the priority of access for those users. Third, development of scientifically defensible flow standards requires a strong monitoring program. Lastly, given the many assessment approaches, many jurisdictions using flow standards, many years over which flow standards have been developed, and lack of a clear and easy solution, policy makers and managers can expect a variety of challenges when using this instrument.

Zoning and designations: Water laws in western provinces tend to ignore or underemphasize environmental factors in water licensing decisions. This omission seems unusual given that surface water and groundwater supplies are directly related to climate, physiography, and geology among other variables, and that instream flow needs for fish are a direct function of hydrological, geomorphological, and biological variables. A failure to recognize such variation has implications on the effectiveness of regulatory / policy instruments in resolving conflicts between instream and out-of-stream users. To account for this variation others have advocated for a water classification system that stratifies rivers on the basis of hydrological and biological data, thus allowing for a greater consideration of regional differences. A formal system that classifies human needs and water availability across regions and years can help resolve conflicts because it would help policy makers and managers tailor instruments to inherent environmental conditions and human demands. Critical to their success is ensuring the criteria and indicators used to support delineations are transparent and scientifically defensible. Given the nature of water use conflicts, these criteria should help distinguish spatial and temporal differences in water supply, instream needs, and human demands. It is also important that there is clarity and support for the different management approach being applied in different zones / designations.

Water efficiency: Water efficiency refers to a variety of strategies designed to minimize the amount extracted from water systems by reducing demand or improving the efficiency of extraction, delivery and use. Three main paradigms exist in water management: supply side management, demand side management, and the soft path for water management. Supply side management focuses on developing sufficient water infrastructure to provide supplies of water to meet forecasts of demand. In contrast, demand side management attempts to reduce the amount of water extracted from water sources by improving the efficiency with which water is delivered and used, and reducing societal demand (e.g., improved irrigation practices, high efficiency water fixtures, and information programs to encourage less wasteful water use). The soft path to water management is a new approach promoted by conservation advocates, which involves rethinking how water is used by focusing on the services that water provides, and considering whether those services could be provided by other mechanisms that do not require water. An important caution for any water efficiency strategy is to ensure that the potential gains from water conservation are used to achieve the intended goals, such as instream flow protection, and not lost due to perverse incentives and unintended consequences.

(2) Financial Disincentives

This group of instruments includes deterrents that penalize individuals involved in undesirable behaviour. They include fines, charges, or legal action if applied reactively after an environmental incident occurs. Alternatively, they can include fees, bonds, or security deposits that are applied proactively and retained only if an incident occurs. Financial disincentives are not used in isolation of other instruments. Usually they are reactive and confrontational, suggesting they may not be an ideal solution for resolving water use conflicts in the long-term. In some instances, though, the threat of charges can motivate restoration of flows. Non-governmental organizations are supportive of financial disincentives to support conservation objectives implied by provincial and federal legislation, while government agencies are less supportive, in part due to the costs associated with compliance monitoring and enforcement, preferring greater stewardship, self-regulation, and results-based monitoring.

(3) Market-oriented Regulations

The cost individuals and organizations pay for water does not reflect its true value to society. The difference between "typical pricing" and the "full social value of water" can be termed a "value gap". Adjustments in water pricing and market-oriented approaches represent ways of closing this gap. A key challenge with this instrument is determining what constitutes the right price. A variety of methods can be used to structure a water pricing system, with some evidence suggesting that changes in water demand are more sensitive to price structure than the price itself. Economists tend to use four criteria to evaluate the appropriateness of alternative prices and pricing methods: financial soundness, efficiency, environmental sustainability, and equity. Recommendations for applying this instrument include most importantly moving water prices in the right direction to close the "value gap". It is also important to be transparent and include the public when deciding on appropriate price levels and pricing methods given challenges related to their political feasibility. Lastly, this group of instruments is one of the easier to implement through experimentation—rigorous experiments should be used to test alternative price levels and pricing methods before broad-scale application.

(4) Financial Incentives

This group of instruments includes tax breaks, credits, grants, low-interest loans, rebates, or direct subsidies that are provided by governments to encourage desirable behaviour. Incentives have a role in helping reduce water use conflicts given that they support activities that neither market, nonprofit, nor voluntary actions would normally provide. A caution when using incentives to encourage water use efficiency stems from research in energy conservation which shows that subsidies can be potentially more expensive and less effective than other instruments. The reasons for these concerns are related to the "rebound effect" (e.g., efficiency gains due to

investments in improved technology are absorbed by other activities that offset the benefits) and "free riders" (e.g., a portion of incentives are directed to people who would have taken action regardless of whether the incentive existed).

(5) Information and Moral Suasion

Information campaigns, education, and moral suasion represent useful, though voluntary, approaches to helping resolve water use conflicts. Such instruments can raise awareness about important problems, provide training to improve people's skills, or enable social change through voluntary actions. Through the case studies, two insights emerged about the use of voluntary instruments in helping resolve water use conflicts. First, voluntary measures need to be accompanied by regulatory measures to have their greatest effect—they are not sufficient on their own. Second, education campaigns are needed to inform water users and the broader public about key water issues, including the effects of climate change on water supplies and greater awareness about links between groundwater and surface water supplies and the impacts of wells on this interconnected resource.

Though an independent understanding of instruments is helpful, we believe they are not mutually exclusive. There are benefits to designing and implementing them in a coordinated fashion where several are used to achieve a common objective. The value of greater coordination is supported by economic studies that show the additive benefits of applying multiple policy instruments in achieving water conservation.

When designing policy, it is also recognized that situations can arise where well intentioned laws, policies, and regulatory instruments can have unintended consequences that lead to adverse effects on the water resources. In other words, affected stakeholders may find ways to avoid being subject to a particular law / regulation or take advantage of a subsidy / incentive which leads to actions that have adverse effects on the environment, sometimes termed perverse incentives. In particular, cases have been documented where policies to improve water conservation in irrigation have actually resulted in reductions of instream flow. For example, improvements in water use efficiency have resulted in less leakage from irrigation infrastructure, a corresponding smaller amount of water available for groundwater infiltration, and a related decrease in the amount of water entering back into streams. Another example has been observed in B.C. and Australia where restrictions on surface water allocations have increased pressures on groundwater because water users have avoided surface water restrictions by tapping into less stringently regulated groundwater supplies. These and other examples show how some solutions can fail to resolve conflicts between instream and out-of-stream users or protect instream values. Overcoming these failures will not be easy, but recognizing they exist when substituting, adjusting old, or designing new instruments is an important first step.

1.0 THE ENVIRONMENTAL CONTEXT

Managing water supplies to balance human and ecosystem needs has been a long standing challenge in resource management that has received increasing attention from water managers in recent years (e.g., Richter *et al*. 2003; Rosenau and Angelo 2003; Arthington *et al*. 2006; King and Brown 2006). Although the reasons for on-the-ground difficulties are varied, many challenges can be traced to two root causes. First, challenges emerge when water managers are faced with water scarcity—either limited supply or high demand—leading to situations where insufficient water is available for both out-of-stream (human) and instream (ecosystem) uses. Second, challenges emerge when laws, regulations, institutions, or managers do not recognize that instream values have a prior, or at least equal, right to water comparable to other rights holders. In such situations water is allocated among priority rights holders first with instream needs being allocated as an afterthought or only if "excess" water exists. The future of water management is expected to become increasingly difficult, exacerbating these historic challenges. A currently unfolding storyline is one of converging trends among population growth, water consumption, climate change, and the status of freshwater ecosystems (e.g., Naiman *et al*. 1998; OWSC 2008). These converging trends suggest an increase in the vulnerability of water supplies and reliant freshwater species, such as Pacific salmon, and the potential for greater conflicts between human and ecosystem needs in the future.

Due to the effects of human activities (including water use) on Pacific salmon from local to global scales, population growth has been recognized as one of this species' greatest threats (Hartman *et al*. 2000). From 1976 to 2006, British Columbia's population grew by 70% and is projected to increase an additional 30% from 2006 to 2031, with increases ranging from 20 to 50% in the five highest density Regional Districts—Greater Vancouver, Capital, Nanaimo, Central Okanagan, and Fraser Valley (MOE 2007). More broadly and in the longer-term, the population of the Canadian and U.S. Pacific Northwest is estimated to increase 200–600% by the end of this century (Lackey 2001).

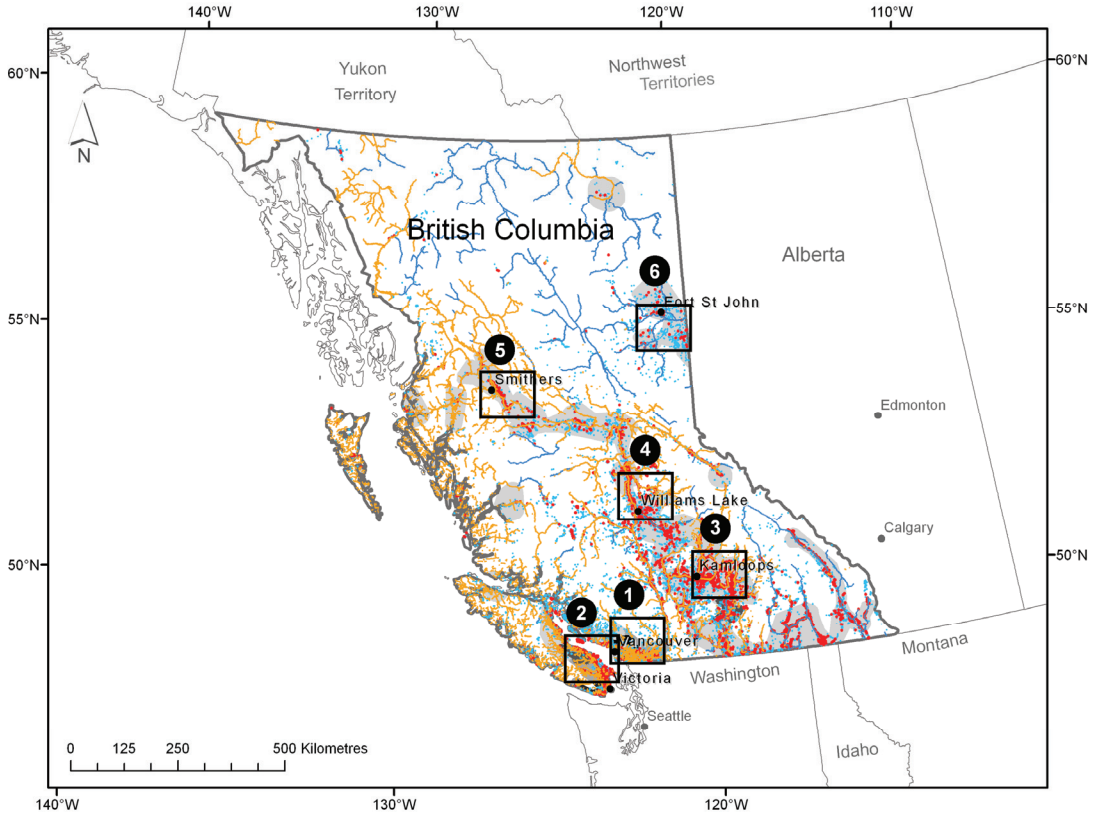
Taken together, population growth and high rates of consumption will invariably lead to increasing scarcity, increased pressures on surface and groundwater resources, and greater difficulties in sustaining instream flows for freshwater ecosystems. Although Canada and British Columbia (B.C.) are home to large supplies of standing freshwater (20% of total freshwater supplies), a much smaller portion (7%) is renewable (Statistics Canada 2008). The disparity between non-renewable quantities and renewable supplies available as a sustainable long-term source for consumption has contributed to a myth of freshwater abundance in Canada (Sprague 2007). As a result, we are one of the largest per capita consumers in the world with Canada's per capita freshwater withdrawals across all sources among the top 15 nations (3,797 litres / person / day, Gleick *et al*. 2007). Although declining in recent decades (MOE 2007), British Columbia's daily rate of residential water consumption is fourth highest among provinces and territories (426 litres / person), well above the Canadian average of 335, and markedly higher than the 50 litres needed to support basic human needs (Gleick 1996).

The current pattern of groundwater and surface water use in B.C. illustrates some of the existing challenges with water scarcity and conflicts between out-of-stream and instream uses. Between 2000 and 2005, 35% of groundwater observation wells showed declines due to human activities. This value was up from 14% between 1995 and 2000 (MOE 2007). In 2002, about 28% of licensed stream length in the province was restricted from further water allocations (WLAP 2002). Figure 1 and Figure 2 illustrate current restrictions in water allocations. Across most of the province there is an association between population density and water license restrictions, and a clear overlap with salmon distribution. Of existing consumptive licenses, the top three types of license holders are industrial and commercial, waterworks, and agriculture, with 36%, 34%, and 27% of the annual

allocation by volume, respectively.[2] For agricultural users in B.C., the most important water issues are limited supply, limited uptake of water conservation, competition with other users (including environmental uses), and a lack of information on supply and demand (AAFC 2003).

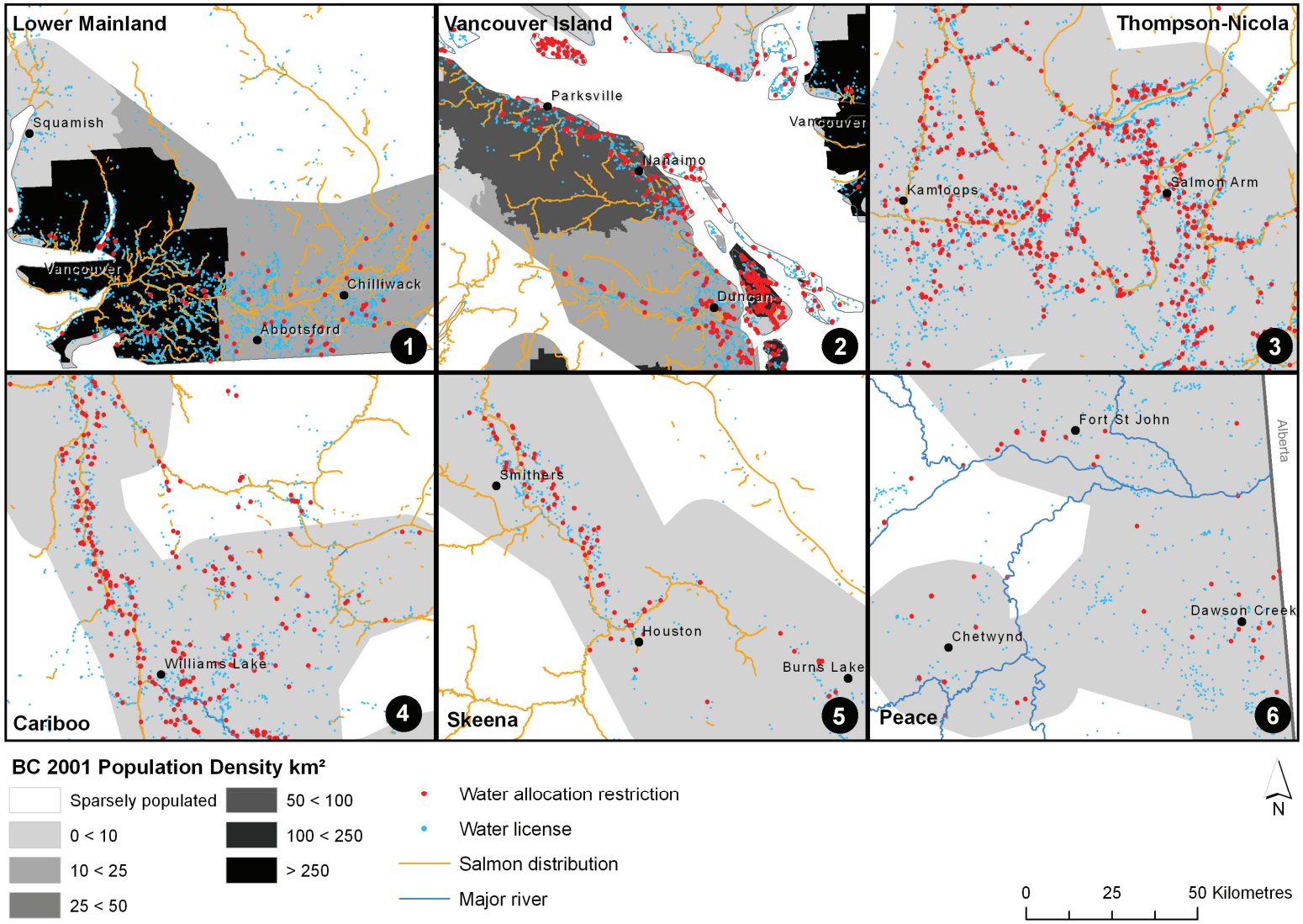
Not surprisingly, historic evidence shows that climate has governed water availability (e.g., Pike *et al*. 2008). In British Columbia, analyses of historic datasets report increases from 0.5 to 2.0 ˚C in annual average air temperatures and a 22% increase in average annual precipitation from 1900 to 2004 (Rodenhuis *et al*. 2007). Changes in precipitation have been highly variable with increases of up to 50% in the northern interior during the spring and winter (Rodenhuis *et al*. 2007), and declines at some locations most noticeably in the winter (Zhang *et al*. 2000). The short-term (snowpack) and long-term (glaciers) capacity of watersheds to store water has also been declining. Snowpack has declined from 15 to 50% in a majority of basins from 1956 to 2005 (MOE 2007), while the rate of glacier loss in coastal mountains has doubled in recent decades (Schiefer *et al*. 2007). Such changes have likely led to changes in hydrology, though limitations in the availability of long term data sets have made it difficult to detect significant trends (Pike *et al*. 2008). In some regions, analyses suggest an earlier timing of peak flows and exacerbated low flows in the late summer (Leith and Whitfield 1998; Whitfield and Cannon 2000).

FIGURE 1. Overlay of water licenses, water allocation restrictions, population density, and salmon distribution at a provincial scale.
Inset boxes refer to the six locations illustrated at a finer resolution in Figure 2.



[2] Ministry of Environment. "Consumptive and non-consumptive use" Available from: http://www.env.gov.bc.ca/wsd/water_rights/surface_water/consumptive_nonconsumptive.pdf

FIGURE 2. Overlay of water licenses, water allocation restrictions, population density, and salmon distribution at six locations across British Columbia.
Missing from these images is the Okanagan Basin which is another heavily allocated region. A provincial overview of these locations is provided in Figure 1.



Climate induced changes in precipitation and air temperature are expected to extend into the next century, which will continue to affect the timing and availability of water supplies. The largest increases in air temperatures are projected in the north and during the winter, while precipitation patterns are expected to be drier in the south and during the summer, with northern latitudes projected to receive more precipitation (Rodenhuis *et al*. 2007; Pike *et al*. 2008). In the Okanagan Basin, Global Climate Models predict an increase in winter temperatures from 1.5 to 4.0 ˚C and winter precipitation from 5 to 20% by the 2050s, as well as a decrease in precipitation of 20% during summer (Merritt *et al*. 2006). By comparison, models applied to the Georgia Basin indicate warming of 1.5 to 2.0 ˚C by the 2050s and little change in total annual run-off. Other changes in flow are expected, however, with a 50% reduction in snowpack and a possible 60% increase in December runoff (Leung and Qian 2003). Such changes increase the level of complexity and uncertainty associated with balancing human and ecosystem needs for freshwater, in part because it is no longer valid to assume that past observations of the timing and availability of freshwater will hold into the future (Milly *et al*. 2008).

Another troubling consideration is the status and trends of freshwater reliant species, such as Pacific salmon. Although the reasons for declines include changes in both marine and freshwater environments, the condition of freshwater environments has played a contributing role (e.g., Bradford and Irvine 2000). The first broad-scale assessment of the status of Pacific salmon in B.C. found that 20% of 5,487 reviewed stocks were associated with some level of conservation concern (i.e., high risk, moderate risk, special concern, or extirpated, Slaney *et al*. 1996). Likewise, a comparison of 19th century to recent run sizes showed that British Columbia's salmon stocks are at 36.2% of their historic abundance (Gresh *et al*. 2000). A more recent assessment of Pacific salmon across the north Pacific showed that most salmon ecoregions in B.C. contain a significant portion of stocks at high risk (2–33%, 3–31%, 0–31%, 7–23%, and 3–9% of sockeye, chum, chinook, coho, and pink stocks across ecoregions respectively, Augerot 2005). A closer examination of individual populations confirms these broader concerns. In the Fraser River, recent sockeye salmon escapements have been the lowest in 30 years, and Interior Fraser coho salmon have been at historically recorded lows despite drastically reduced harvest rates (FBC 2009). Other weak stocks are distributed across the province (English *et al*. 2008).

The convergence and interaction of the above trends in human populations, climate, water use, and freshwater ecosystems is additionally supported by high profile news events from communities across B.C. During the dry and hot summer of 2003, the town of Summerland in the Okanagan was required to release additional storage in Trout Creek and restrict water use by farmers to maintain flows for fish.[3] During the same summer, a 5-day period of de-watering in the Cowichan River brought conflict between local mill operations and Fisheries and Oceans Canada (e.g., Nelitz *et al*. 2007). In the summer of 2006 the town of Tofino was forced to close its businesses due to dwindling water supplies.[4] And more recently, in the spring of 2008, efforts to use surface water for run-of-river power in the upper Pitt River led to a variety of concerns among local residents, including anxiety about impacts on fish populations.[5]

The observations above provide telling evidence that human and ecosystem demands for freshwater are in conflict today and will become increasingly so in the future. These trends also indicate a clear need for solutions from governments and communities to help resolve both existing water use conflicts, and new conflicts that can

[3] Waterbucket. "Water use plan helps Summerland resolve water use conflict" Available from: http://www.waterbucket.ca/aw/index.asp?type=single&sid=65&id=89

[4] CBC News. August 30, 2006. "Visitors scramble as water shortage shuts Tofino businesses" Available from http://www.cbc.ca/canada/british-columbia/story/2006/08/30/tofino-water.html

[5] *The Vancouver Sun*. March 28, 2008. "Power producer seeks to tunnel under wilderness park" Available from: http://www.vancouversun.com/Power+producer+seeks+tunnel+under+wilderness+park/1438776/story.html

be expected if current patterns continue. In 2008, the Government of British Columbia released *Living Water Smart* (LWS), a plan of action for improving water management in B.C. (Government of British Columbia 2008b). This plan has the promise to address the water use challenges that lie ahead, though details have not be provided on how existing water laws and approaches to managing flows will be changed.

In other jurisdictions across North America, instream flow programs have commonly identified a need for "more supportive regulations and policies" (Annear *et al*. 2009). The purpose of this report is to clarify options for resolving conflicts between instream and out-of-stream water uses and draw insights from a variety of sources to highlight the strengths and weaknesses of these approaches for B.C.'s citizens, managers, and policy makers involved in implementing Living Water Smart. Section 2.0 "The Policy Context" begins by describing a framework for identifying important components required for effectively protecting instream values. The framework is then used to understand current provincial / federal legislation and regulatory mechanisms that are currently available in British Columbia and set our province in the context of other jurisdictions across western North America. Next, it is used to assess the comprehensiveness of actions being proposed under Living Water Smart. Section 3.0 "A Review of Other Jurisdictions" reviews approaches for resolving water use conflicts at different scales in three locations. Relevant laws and enabling instruments are examined at a jurisdictional scale (Australia, Oregon, and Alberta) with a closer inspection of how those laws and instruments are successful (or not) at a basin scale (Murray-Darling Basin, Walla Walla River, and Oldman River). Section 4.0 "Facilitating the Path Forward" provides a synthesis of key findings to enable development of effective regulatory and policy instruments through Living Water Smart. The hope is that the insights gained from this research can help us develop approaches to better manage freshwater for people and fish.

2.0 THE POLICY CONTEXT

2.1 AN ENABLING FRAMEWORK

Three core elements are required for designing effective policy: **defining the problem** that requires a policy solution, **articulating goals** (and objectives) that set the direction for a particular policy, and **designing policy instruments** to achieve the intended goals (Pal 2001). A clear definition of the problem is helpful to ensure policy makers and managers are focused on priority challenges and that solutions are addressing challenges. Setting clear goals and objectives provides transparency by articulating what a policy is trying to achieve and clarifying strategic priorities for addressing problems. Policy instruments are the specific tools or solutions being proposed to address the problem, consistent with stated goals and objectives. An explicit consideration of these elements is helpful for identifying important gaps and weaknesses in the current situation in B.C. (Section 2.2), understanding how B.C. compares to other jurisdictions (Section 2.3), evaluating the comprehensiveness of actions being proposed by Living Water Smart (Section 2.4), and developing solutions to resolve conflicts between instream and out-of-stream water uses (Section 4).

In regards to the first core element, problem definition, Living Water Smart does not explicitly describe the specific problems it has been designed to resolve. We infer, however, that one of the priority challenges facing British Columbia water managers is balancing human and ecological needs for freshwater. This inference is based on existing evidence of water use conflicts between instream and out-of-stream uses (as illustrated in Section 1.0) and actions under LWS which specify the desire for "*recognizing water flow requirements*" that "*sustain aquatic ecosystems and maintain proper ecological function*". More specifically, current water use conflicts can be related to three main issues. Inferring backwards from the solutions proposed by Thoyer (2006), existing water use conflicts can be traced to problems of: (i) **water scarcity** and the need to either increase supply (storage) or reduce demand (conservation or improved efficiency) to provide water for all users, including ecological needs; and (ii) **water rights** and a limited recognition that freshwater environments have a prior, or at least equal, right to water comparable with other users. These problems will continue to be a challenge in the future. Lastly, the natural variability of water supplies across watersheds, seasons, and years and the uncertain effects of climate change mean that we can not manage water supplies in the future on the basis of our historic understanding (e.g., Milly *et al.* 2008). As a result, there is a strong need to maintain **flexibility** when designing today's policies so as to avoid making existing conflicts worse or creating additional conflicts in the future.

To resolve these problems, Living Water Smart describes a set of actions, strategies, and themes (see Appendix A) which are related to particular underlying policy goals and objectives—the second core element. Though not described explicitly, the intended goal of Living Water Smart appears to correspond with the goal of the Okanagan Sustainable Water Strategy—one of the most recent, proactive, and advanced water action plans in B.C. It seeks to "*ensure our limited water resources are coordinated and well managed—working towards a future for the Okanagan where water does not compromise human health and well-being, the environment, or the economy*" (OWSC 2008).

Though revealing, goals are broad, conceptual, and visionary statements describing the direction and intent of a particular policy. Policy objectives are more informative for understanding the specific solutions that are needed. Of particular relevance are means objectives which describe the general approaches (e.g., recognize instream rights to water) needed to achieve some desirable future state (e.g., provide instream flows to sustain a target abundance for a particular fish population). Again, Living Water Smart is largely silent in describing its intended objectives.

The Instream Flow Council[6] provides guidance on this topic. Of relevance are 8 ecosystem components identified for successful instream flow programs: legal, institutional, public involvement, hydrology, geomorphology, biology, water quality, and connectivity (Annear *et al*. 2004). These components provide a holistic view of water management (i.e., for people and fish). Legal-institutional components define *what can be done and how it can be done*, public involvement components convey *what the public wants to be done*, and riverine components (i.e., hydrology, geomorphology, biology, water quality, and connectivity) provide the technical information about *what should be done* to protect or restore rivers. Accompanying these components is a set of 46 policy issues to guide effective design and implementation of instream flow programs (see Appendix B). These ecosystem components and policy issues are combined into a set of 9 objectives (Table 1) and arranged in a hierarchy (Figure 3 and Figure 4). Though many may seem obvious, they highlight the core elements (objectives) and more specific details (policy issues) required for a successful instream flow program.

TABLE 1. Policy objectives emerging from Instream Flow Council ecosystem components and policy statements (Annear *et al*. 2004).

Ecosystem component	Objective	Description
Legal	Ensure clear legal responsibilities for protecting instream values	An effective instream flow program should ensure a clear legal basis for protecting instream needs, that advocacy plays a role in protecting instream needs, that the lines of responsibility between federal and provincial / state authorities are clear, and that legal counsel is available to advocate for benefits to instream values.
	Develop effective laws for protecting water rights of instream needs	Both public and private holders should be able to hold water rights for instream flow protection, rights should be protected in the long-term, and rights should have priority and legal standing to protect freshwater resources.
	Recognize appropriate water uses for protecting instream values	Recognize that rivers use water to sustain ecological functions and processes, that both surface and groundwater play a role in sustaining those functions and processes, that non-consumptive uses provide a public benefit, and that reductions in consumptive uses (through conservation or improved use efficiency) provide opportunities to benefit instream values.
Institutional	Conduct comprehensive planning of instream flow programs	Water use planning is an essential part of managing instream flows which requires a consideration of land use activities and should anticipate periods of drought or water shortages.
	Ensure effective implementation of instream flow programs	Effective implementation of an instream flow program requires a clear process for quantifying instream flow needs, a good monitoring and evaluation program (i.e., adaptive management), an interdisciplinary team, and sufficient funding to support instream flow assessment.
Public involvement	Support public education	Participatory mechanisms are needed for meaningful discussion and negotiation of allocation trade-offs among water uses. Such participation requires support for education and processes to engage stakeholders and the public.
	Enable public engagement	
Hydrology, geomorphology, biology, water quality, connectivity	Establish credible science to support decision making	Gathering good quality information / data (related to hydrology and riverine systems) is crucial for making good decisions about water use and implementing best management practices to protect instream values.
	Implement effective management practices for protecting instream values	A range of best management practices can be employed to avoid, mitigate, or compensate for impacts of flow management, habitat management, and consumptive uses on instream values.

[6] The Instream Flow Council is an organization representing state and provincial agencies dedicated to improving protection of instream values across North America. For more information see: http://www.instreamflowcouncil.org/.

FIGURE 3. Relationship among ecosystem components (dark grey boxes), objectives (light grey boxes), and policy issues (white boxes) as related to Instream Flow Council policy components (adapted from Annear *et al*. 2004). Full policy statements are provided in Appendix B.

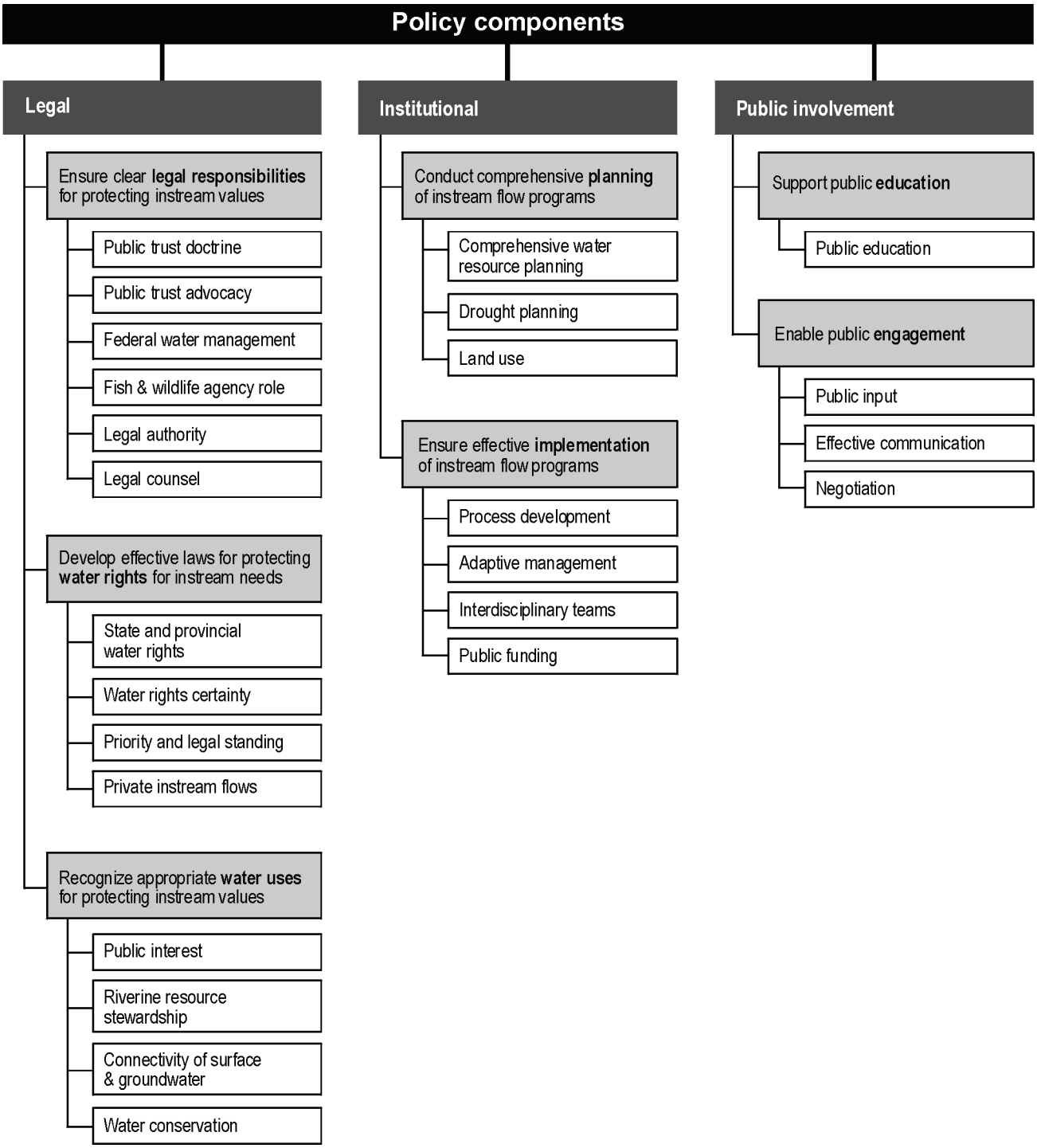
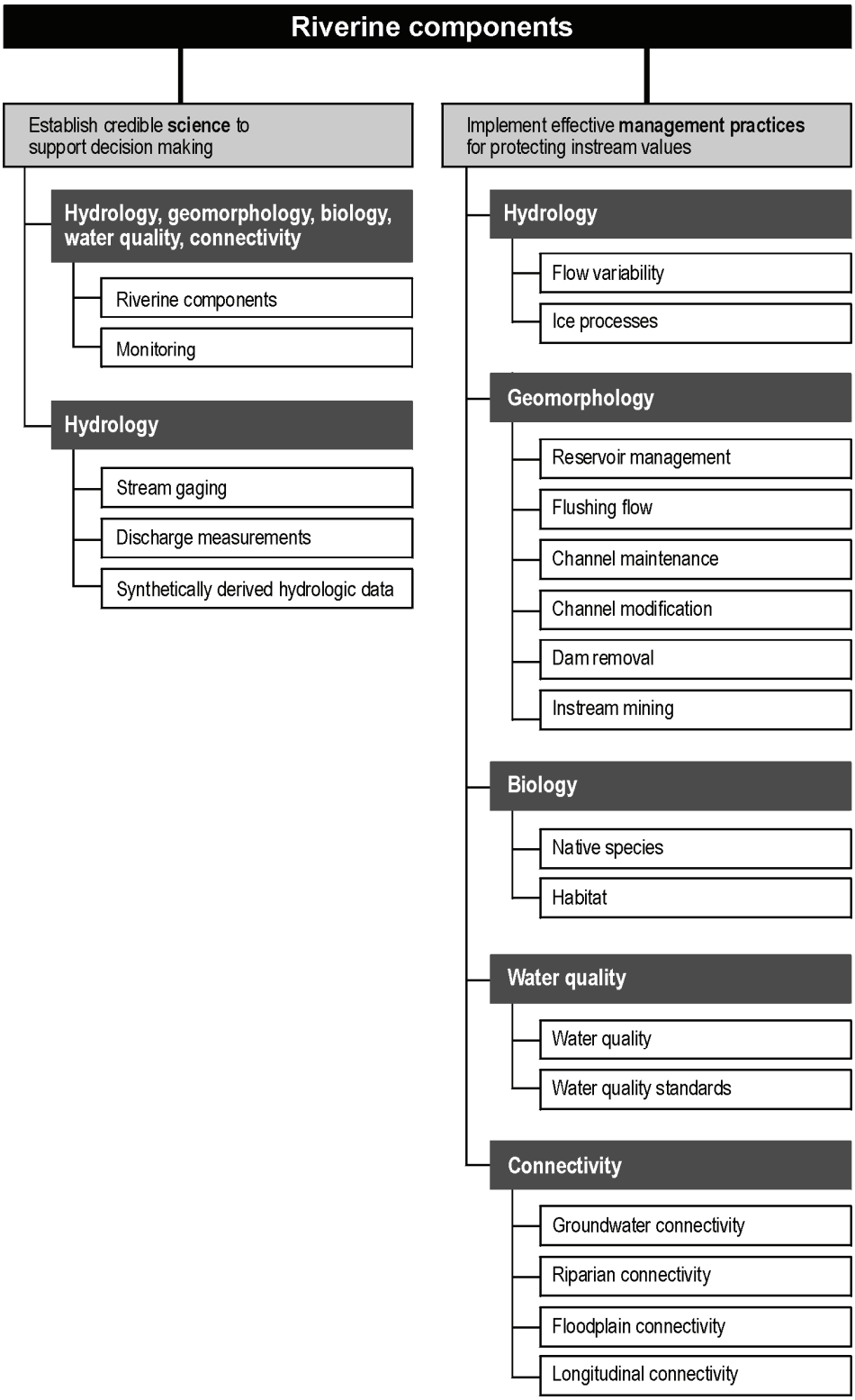
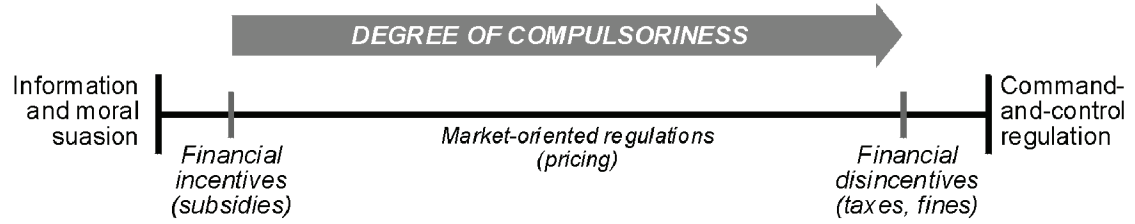


FIGURE 4. Relationship among ecosystem components (dark grey boxes), objectives (light grey boxes), and policy issues (white boxes) as related to Instream Flow Council riverine components (adapted from Annear *et al*. 2004). Full policy statements are provided in Appendix B.



The last core element of effective policy requires a description of instruments that will help policy makers achieve their goals and objectives, and provide those responsible for implementing policy the tools to deal with on-the-ground challenges. Although a range of categorizations of instruments exist (see Bardach 1996; Bemelmans-Videc *et al*. 1998; Pal 2001), we propose a classification where five generic types of regulatory / policy instruments line up along a continuum of compulsoriness (Figure 5): (i) **command and control regulation** defines acceptable boundaries or prohibitions on particular activities (e.g., restrictions on new surface water licenses or limits on groundwater withdrawals); (ii) **financial disincentives** impose penalties to those demonstrating undesirable behaviour (e.g., fines if violating the prohibitions of a water license); (iii) **market-oriented regulations** use pricing or market systems to encourage desirable behaviour (e.g., volumetric charges in which per unit rates increase with the volume consumed); (iv) **financial incentives** provide money to support desirable changes in behaviour (e.g., subsidies to support uptake of higher efficiency irrigation technologies or water infrastructure improvements); and (v) **information and moral suasion** seeks to educate people about desired changes in behaviour (e.g., educating the public about the impact of climate change on water supplies). This classification scheme can be used to gain insights about strengthening existing tools in B.C. and learning from other jurisdictions.

FIGURE 5. Illustration of the five types of policy / regulatory instruments available for achieving environmental policy objectives as shown along a continuum of compulsoriness (from Jaccard *et al*. 2002).



These groups of instruments differ in many ways and such differences will likely drive policy makers' preferences among them. Level of compulsoriness is a key difference because it determines an instrument's political feasibility—governments may prefer voluntary measures (information campaigns) over compulsory ones (regulations) (Dale 2001; Simpson *et al*. 2007). Each instrument will also vary in its ability to address the objectives listed in Table 1. For instance, financial disincentives would not be appropriate for encouraging comprehensive planning. Other considerations include the fairness of the effects of an instrument on different stakeholders, the efficiency with which institutions can implement and enforce them, and the effectiveness in achieving desired targets / outcomes.

2.2 THE CURRENT SITUATION IN BRITISH COLUMBIA

Below we describe existing provincial and federal legislation related to the protection and management of instream flows. This summary is a similar, though updated, version of that which is provided by others (e.g., Hatfield *et al*. 2002; Angelo and Roseneau 2003). We have included it again here to set the context for understanding weaknesses with the current system and proposing more tangible solutions that could be implemented through Living Water Smart (see Section 4.0).

2.2.1 PROVINCIAL LEGISLATION

Water Act: The B.C. *Water Act* is the primary legislation dealing with the allocation of rights to divert and use water in the province. Originally enacted in 1909, the Act confirms that all water in streams, lakes and other waterways in the province belongs to the provincial government. The Act establishes a "prior allocation" water licensing scheme based on the principles of "first in time, first in use" and "use it or lose it." The *Water Act's* licensing provisions do not apply to groundwater, which is still governed by common law rules that allow landowners to withdraw as much groundwater as they wish from beneath their lands.

For surface water, licenses issued under the *Water Act* are tied (appurtenant) to land or an undertaking and cannot be transferred separately. Licenses have priority based on the time of issue: earlier licenses take priority over later licenses for the full quantity licensed, even in times of shortage when there may not be enough water to satisfy the junior licenses. License holders are required to put the full quantity of water included in their licenses to beneficial use for the purposes specified in the license or they risk having the license suspended or cancelled. These license conditions provide incentives to develop and use water rather than to conserve water or maintain instream flow. Also, licenses issued for purposes other than power generation do not expire and water managers have little authority to reduce the amount of water allocated under existing licenses. Licenses for power generation have a term of 40 years.

When making decisions about whether to issue new water licenses, water managers can give consideration to the need to maintain a minimum level of instream flow, but the *Water Act* does not require them to do so, and practices in this regard vary across water districts (Brandes and Curran 2008). The purposes for which licenses can be issued include conservation, but only if associated with use and storage of water or the construction of works for conserving fish or wildlife. All licensees must pay annual rental for the amount of water licensed (although the rental rate is substantially lower for conservation purposes than other purposes). The Act does not provide for licenses to be issued specifically for instream flow.

The province has the power to restrict the issuance of new licenses if there are concerns about water supply, and has done so for many water sources in the province. In addition the Act authorizes Cabinet to reserve unrecorded (unlicensed) water for the use of the Crown for any purpose, and the government has used this power to reserve water in some watersheds for conservation purposes.

Under Part 4, which was added to the *Water Act* in 2004, the Minister may designate an area for the purpose of developing a Water Management Plan, if it will assist in dealing with conflicts between water users, conflicts between users and instream flow requirements, or risks to water quality. Water Management Plans are subject to approval by Cabinet and require Cabinet orders to be effective. Only one official Water Management Planning process has been designated in B.C., for groundwater planning in Langley. However, numerous other regional water planning processes and water allocation planning processes have been undertaken in various areas of the province by local governments and community groups, and the resulting plans provide some guidance to water managers when they make decisions about issuing new licenses. The Columbia Basin Management Plan is one

regional water planning process that water managers are explicitly required to consider under the *Water Act* when determining whether to issue a new license.

The provincial government has also developed a multi-stakeholder Water Use Planning process associated with *Water Act* licenses, and this planning process has been applied for BC Hydro's hydroelectric facilities (Rosenau and Angelo 2000). BC Hydro describes the goal as finding "*a better balance between competing uses of water, such as domestic water supply, fish and wildlife, recreation, heritage and electrical power needs, which are environmentally, socially and economically acceptable to British Columbians*" (BC Hydro 2009). The resulting Water Use Plans for BC Hydro's facilities were reviewed by the Comptroller of Water Rights and implemented as conditions on the renewal or amendment of water licenses, or through engineers' orders under the *Water Act*. Rosenau and Angelo (2000) argue that the water use planning process could be more broadly applied for other license holders in B.C., and that it shows "great promise in dealing with conflicts amongst owners of water licenses and non-licenced users of water, such as fish and aquatic resources."

The *Water Act* also requires provincial approval for "changes in and about a stream," including modifications to the stream or construction in the stream channel.

In summary, although there are several ways in which instream flow concerns can be considered and addressed under the *Water Act*, the current legislation falls short of providing adequate mechanisms to ensure protection. A recent assessment by researchers at the University of Victoria concluded that:

> *"This review of the principles of the water use regime in BC show that water licensing does not adequately address instream flows and focuses on reacting to water licence applications rather than planning for long term ecosystem health. Currently the Ministry of Environment has little ability to revoke or decrease the amount of water in a licence outside of the Water Management Plan process. The Water Act does not require decision-makers to take into account instream uses or water quality, and there is no process to update licences as new standards for conservation become the norm." (Brandes and Curran 2008: 18)*

Fish Protection Act: The *Fish Protection Act* was passed in 1997 with the goal of providing better protection for fish and fish habitat in freshwater systems in B.C. Under the Act, 15 river systems have been designated as "protected." The main effect of this designation is that no new bank-to-bank dams can be constructed on these systems. In addition, 15 streams have been designated as "sensitive," due to concerns about low flows for fish or degradation of fish habitat. Before issuing a new water license on a sensitive stream, water managers must be satisfied that adverse impacts on flows for fish will be insignificant, or that adequate mitigation or compensation will be provided. New licenses on sensitive streams can also be refused if reasonable alternative sources of water exist. The Minister can require the development of a recovery plan for protected fish in a sensitive stream.

In 2001, Cabinet added the *Riparian Areas Regulation* to the *Fish Protection Act*, establishing riparian buffer zones in specified regional districts, in which development is restricted to protect fish and fish habitat. Local governments cannot approve development in these buffer zones unless the potential impacts on fish habitat are assessed by a qualified environmental professional as not being harmful, or are approved by Fisheries and Oceans Canada or a regulation. Considerations include protecting fish habitat, wildlife habitat, biodiversity, and stream bank and channel integrity.

Unfortunately, some of the most important provisions of the *Fish Protection Act* for protecting instream flow have not been proclaimed in force. Unproclaimed sections would authorize: explicit consideration of instream flow in licensing decisions; conditions in licenses to protect instream flow, including monitoring requirements; instream flow licenses to community organizations; orders to reduce withdrawals under licenses during drought;

and explicit consideration of instream flow in Water Management Plans, including reductions of up to 5% of the quantity covered by an existing license upon transfer or reallocation of the license. The simple step of proclaiming these sections into force would greatly expand the available tools for protecting instream flows in B.C.

Forest and Range Practices Act: The *Forest and Range Practices Act* (FRPA) establishes a results-based forest management system for crown forest lands in B.C. The *Forest Planning and Practices Regulation* to the FRPA sets out broad objectives for forest management, some of which entail protection of instream flow, such as maintaining and improving water resources, conserving fish and aquatic ecosystems, protecting water quality and quantity in designated Community Watersheds, and conserving water flow and hydrological conditions in designated Fisheries Sensitive Watersheds. The potential scope of these objectives is limited, however, by the requirement that they "not unduly reduce the supply of timber from British Columbia's forests." In addition to the results-based objectives, the *Forest Planning and Practices Regulation* sets out requirements for Forest Stewardship Plans, including standards for matters such as soil disturbance, roads, drainage, forest health, and reforestation. The regulations also set standards for riparian management and reserve zones and require forestry activity to take place in a manner that is unlikely to harm fish or destroy, damage or harmfully alter fish habitat. The regulations provide for special precautions for designated Temperature Sensitive Streams.

Drinking Water Protection Act: Although the *Drinking Water Protection Act* focuses on ensuring the quality of drinking water and avoiding health hazards in the province, Part 5 authorizes the Minister to designate an area for the development of a Drinking Water Protection Plan, which could be used to deal with concerns about water quantity as well as water quality. To trigger the Minister's powers under Part 5, a provincial health officer must decide that such a plan would assist in addressing or preventing a threat to drinking water that could result in a health hazard, and be satisfied that no other practicable measures under the Act are sufficient to address or prevent the hazard. The plan is subject to Cabinet review and approval, and is implemented by regulations. Several regions have requested that the Minister consider their water sources for planning under Part 5, but no area has been designated.

Environmental Assessment Act, Water Protection Act, Environmental Management Act: The B.C. *Environmental Assessment Act* establishes a process for assessing the environmental, economic, social, heritage and health effects of major projects in B.C. Assessments often consider the effects of projects on instream flow and can make recommendations concerning mitigation, monitoring and ongoing management of such effects.

The Water Protection Act was enacted in 1994 in response to concern about bulk water export from B.C. The Act generally prohibits the removal of bulk water from the province except in small bottles or containers from licensed operations. It also prohibits transfers or diversions of water between any of the major watersheds in the Province.

The *Environmental Management Act* includes a blanket prohibition against introduction of waste into the environment without authorization, but does not explicitly deal with quantity of instream flows.

2.2.2 FEDERAL LEGISLATION

Fisheries Act: The Canadian *Fisheries Act* is considered by many to be the strongest environmental legislation in B.C. The *Fisheries Act* establishes the framework for management and protection of fish, marine mammals, and other aquatic species in Canada. Key provisions include a prohibition against harmful alteration, disruption or destruction of fish habitat (HADD), unless authorized by the Minister or regulations, and a prohibition on deposit of deleterious substances in water frequented by fish, unless authorized by regulations. These provisions are reactive rather than proactive, but it is common for proponents to approach Fisheries and Oceans Canada to request review and authorization before commencing an activity that may cause HADD. The Act also specifies that the Minister can require that plans and other information be provided for a proposed activity that may result in HADD or deposit of a deleterious substance, and the Minister can require modifications or additions to the proposal, or restrict or close the activity. Another important provision for instream flows is that the Minister can require the owner or operator of an obstruction to provide for the escape of enough water to ensure fish safety and adequate flooding of spawning grounds, and can require sufficient flow of water over an obstruction to permit the safe and unimpeded descent of fish.

Species at Risk Act, Navigable Waters Protection Act, Canadian Environmental Assessment Act: The *Species at Risk Act* applies to all aquatic species and most migratory birds; for other species its protection is limited mainly to federal lands. The Act prohibits direct harm to species designated as endangered, threatened or extirpated. It also protects the residences of such species and requires recovery strategies and action plans identifying critical habitat. The primary mechanisms for protecting critical habitat are voluntary measures and stewardship agreements, but if these are insufficient there is a prohibition in the Act against the destruction of critical habitat.

The *Navigable Waters Protection Act* requires federal approval for works constructed on navigable water in Canada. The scope of protection has historically been very broad, as navigable water has been interpreted as any water navigable by canoe. However, recent amendments to the Act authorize exemptions from the approval process for classes of works or waters specified by regulation.

The *Canadian Environmental Assessment Act* provides for a federal impact assessment when a federal entity undertakes a project, issues an approval, or provides funding or land for a project. Like the B.C. process, federal assessment simply provides information to decision makers about effects of proposed projects. In the past, CEAA has been triggered for many projects that affect instream flow, because of the requirement for a permit under the *Navigable Waters Protection Act*. The recent amendments to the latter Act will likely lead to fewer federal assessments of such projects.

As the above discussion reveals, a variety of regulatory and policy instruments are available to water managers for resolving conflicts between instream and out-of-stream uses (see Table 2). Table 3 summarizes some of the weaknesses of this current system relative to the objectives described above.

TABLE 2. Examples of instruments being applied in B.C. to enable protection of instream values.

Instrument	Examples
Command and control regulation	• Water Management Planning under the *Water Act* • Drinking Water Protection Planning under the *Drinking Water Protection Act* • *Water Act* prohibition against the withdrawal of surface water without a water license • *Water Act* prohibition against changes in and about a stream • Power to reserve unrecorded (unlicensed) water for the use of the provincial Crown for any purpose • Designation of Protected Rivers or Sensitive Streams under the *Fish Protection Act* • Unproclaimed provisions of the *Fish Protection Act* that would require explicit consideration of instream flow in water licensing decisions, and would attach conditions to water licenses to protect instream flow, including monitoring requirements • Unproclaimed provisions of the *Fish Protection Act* that would allow community organizations to hold instream flow licenses
Financial disincentives	• Fines for violating prohibitions in the *Water Act*, *Drinking Water Protection Act, Fish Protection Act*, and other legislation
Market-oriented regulations	• Water metering and use charges by local governments
Financial incentives	• Provincial funding for the Columbia Basin Trust • Provincial funding for BC Hydro's Water Use Planning Process • Provincial funding for the Living Rivers Trust Fund to preserve and restore rivers • Local government funding for conversion to low flow plumbing fixtures
Information and moral suasion	• Water Use Planning process (voluntary agreements supported by command and control water licensing conditions) • Provincial Water Sustainability Action Plan, and www.waterbucket.ca portal for information about water sustainability in BC • Green Bylaws Toolkit for local government • Numerous local government water conservation initiatives

TABLE 3. Weaknesses of the current system for instream flow management in British Columbia, organized according to the ecosystem components and objectives described in Table 1.

Ecosystem component	Objective	Current weaknesses in British Columbia
Legal	Ensure clear legal responsibilities for protecting instream values	• Mixed and overlapping federal, provincial and local jurisdiction over instream flows can lead to competition and conflict (e.g., disputes between Fisheries and Oceans Canada and BC Hydro over dam operations under provincial water licenses) • Poor coordination among multiple federal, provincial and local planning processes • Local governments complain that they are excluded from some decisions (e.g., approval of hydro facilities) • Lack of formal channels for advocacy to support instream flow values
	Develop effective laws for protecting water rights of instream needs	• Water licenses have priority based on time of issue—instream flow needs do not have precedence • Water licenses are tied to land or undertakings and are not freely transferable • Limited ability for private entities to acquire water licenses for conservation purposes, and such licenses must be associated with use and storage of water or construction of works • Licenses do not expire (except licenses for power purposes, which have a 40 year term) • Conservation licenses must pay annual rental fees • No licenses explicitly for instream flow • No licensing system for groundwater withdrawal
	Recognize appropriate water uses for protecting instream values	• "Use it or lose it" conditions of water licenses do not encourage conservation • Water managers are not required to consider instream flow in water licensing decisions, except for the few streams that are designated as sensitive • Little integrated management of groundwater and surface water • Water pricing schemes do not sufficiently encourage conservation
Institutional	Conduct comprehensive planning of instream flow programs	• Water licensing system is reactive to license applications rather than requiring proactive ecosystem planning • Water Act provisions for water management planning require a ministerial order and have only been used once • Drinking Water Protection Act provisions for drinking water protection planning process requires a ministerial order and are only available where there is no other practical means to address a health hazard • Only major projects trigger the provincial environmental assessment process, and cumulative effects assessment is not mandatory
	Ensure effective implementation of instream flow programs	• Little authority to reduce or cancel the amounts covered by existing water licenses if circumstances change • Poor monitoring and enforcement of licenses • No standard requirement for licensees to monitor instream flow
Public involvement	Support public education	• Notice of new water license applications is only given to other license holders, riparian owners and other applicants—no broad public notice requirements or public participation requirements • Limited opportunity for public participation in most decisions about tradeoffs among competing water uses
	Enable public engagement	
Hydrology, geomorphology, biology, water quality, connectivity	Establish credible science to support decision making	• Limited assessment and monitoring of instream flow needs • Little data on groundwater extraction, aquifer capacity and recharge rates, or links between ground and surface water systems
	Implement effective management practices for protecting instream values	• No standardized set of provincial best management practices for protecting instream values

2.3 BRITISH COLUMBIA IN THE CONTEXT OF OTHER JURISDICTIONS

In addition to understanding the current situation, it is helpful to set British Columbia in the context of other jurisdictions across western North America. Below, British Columbia is compared to 15 jurisdictions across western North America (Figure 6): 3 provinces (Manitoba, Saskatchewan, and Alberta), 2 territories (Yukon Territory and Northwest Territories), and 10 states (Alaska, California, Colorado, Idaho, Montana, Nevada, Oregon, Utah, Washington, and Wyoming). Though not exhaustive, Table 4 compares laws from these jurisdictions and how they relate to elements of two law-related policy objectives: (i) developing effective laws for protecting **water rights** of instream needs (e.g., priority and legal standing, transferability and ownership of water rights to protect instream values, and duration of water licenses), and (ii) recognizing appropriate **water uses** for protecting instream values (e.g., allowable beneficial uses for instream flow allocation).

FIGURE 6. Jurisdictions across western North America against which B.C.'s water laws are compared (i.e., shaded jurisdictions are included in Table 4).

TABLE 4. Comparison of water laws for instream flow appropriations across western North America.
(Information extracted from BLM no date; Bakker 2007; de Loë et al. 2007; Locke et al. 2008; Johnson 2009)

Jurisdiction	Water rights doctrine	Allowable ownership for instream flow appropriation	Allowable uses for instream flow allocation	Transfer of water rights
Alberta	Prior allocation	Public or limited private[a]	Wildlife management Habitat enhancement Conservation	Yes, with approval
British Columbia	Prior allocation	Public or very limited private[b]	Limited conservation of fish and wildlife[c]	Limited, with transfer of appurtenancy, approval of license amendments
Manitoba	Prior allocation	Public or private	No limits on purpose of license	Only if conditions are the same and Minister approves
Northwest Territories	Public authority management	Not applicable	Not relevant[d]	Yes, with board approval
Saskatchewan	Prior allocation	Public or private	No limits on purpose of license	Groundwater, only with approval and payment of fee
Yukon Territory	Public authority management	Not applicable	Not relevant[e]	Yes, with board approval
Alaska	Prior appropriation	Public or private	Protection of fish and wildlife habitat	Yes
California	Hybrid	Public or private	Fish and wildlife Wetlands habitat	Yes
Colorado	Prior appropriation	Limited public[f]	"To preserve the natural environment"	Yes
Idaho	Prior appropriation	Public or limited private[g]	Fish and wildlife Aquatic life	Yes, temporary[h]
Montana	Prior appropriation	Public or limited private[i]	Fish and wildlife	Yes
Nevada	Prior appropriation	Public or private	Wildlife	Yes
Oregon	Hybrid	Limited public[j]	Conservation Fish and wildlife Ecological values	Yes
Utah	Prior appropriation	Limited public[k]	Propagation of fish Enhancement of natural stream environment	Yes
Washington	Hybrid	Limited public[l]	Fish and wildlife	Yes
Wyoming	Prior appropriation	Limited public[m]	Only fisheries	Yes

a. Instream licenses must be tied to a parcel of land. Only crown may hold instream license for water conservation.

b. Provisions of the Fish Protection Act allowing for instream flow licenses to community based organizations have not been proclaimed.

c. Only if associated with the use and storage of water or the construction of works for conserving fish or wildlife.

d. Consumptive licensing decisions consider minimum instream flows for fish. Water taking guidelines describe maximum proportional withdrawals from watercourses, which are in place to protect fish and fish habitat. No license would be granted if it affected subsistence uses in any way (i.e. fishing).

e. The Yukon Water Board reviews proposed water uses. If fish are present and proposed uses will substantially impact fish, the Board may deny the application or require changes in the requested use. Conditions on licenses may also be applied to protect fish.

f. Colorado Water Conservation Board

g. Private ownership is only possible on a temporary basis through water banks or other leases.

h. Transfers are limited to temporary transfers of storage rights through water banks.

i. Private holdership can only be established through transfers.

j. Oregon Water Resources Department

k. Division of Wildlife Resources and Parks and Recreation

l. Washington Department of Ecology

m. State of Wyoming

The prevailing **water rights doctrine** provides an overriding structure for how limited water supplies are allocated and prioritized across water license holders (including those rights that may be related to protecting instream values). B.C. and the prairie provinces use a prior allocation scheme, which is very similar to the prior appropriation doctrine that applies in many western states. Prior allocation/appropriation is the dominant approach in 11 jurisdictions across western North America. This approach is referred to as the "first-in-time, first-in-right" system, which uses the age of a license to determine its priority for allocation. During times of water scarcity, older licenses have the right to take their full allocation before junior license holders (Locke *et al*. 2008). Prior allocation/appropriation is typically accompanied by a requirement for "beneficial use," which means that the full amount licensed must be put to the use specified or the license can be cancelled. Though dominant, prior allocation / appropriation and beneficial use are problematic for protecting instream values because they encourage a "use it or lose it" mentality, and environmental values are not generally assigned priority relative to other uses given historic allocation decisions. Three jurisdictions apply a hybrid approach—a mix of prior appropriation and riparian rights doctrines. These areas officially recognize riparian rights doctrines because this approach pre-dated more recent prior appropriation approaches. In general, a riparian rights doctrine provides riparian landowners with rights and priorities for the reasonable use of water that flows through or past their land. In some areas nonriparian uses may either be restricted completely or allowed with conditions if they do not affect riparian uses (Johnson 2009). The two Canadian territories apply public authority management, which uses local water boards to make decisions about water license allocations (Christensen and Lintner 2007).

Allowable ownership for instream flow appropriation describes whether public (i.e., government agencies) or private entities can hold a water license for the purpose of protecting instream values. Across jurisdictions the types of ownership vary from narrow (e.g., limited public) to broad (public and private). British Columbia presently allows public and limited private ownership of licenses to protect instream values. To have the greatest benefit, it is better to have the broadest range of options available to hold these types of water licenses. Across western jurisdictions, 5 allow limited public ownership, 3 allow public or private ownerships with some limitations, and 5 allow public or private ownership with no limitations.

Allowable uses for instream flow allocation describe the uses for which water licenses can be assigned for the benefit of instream values. In most cases water licenses can only be issued if the water allocations are put to beneficial uses. To ensure adequate protection of instream values, water laws at a minimum should explicitly

include fish and wildlife protection, ecological values, and aquatic life in their definition of beneficial uses. All jurisdictions consider (to varying degrees) environmental aspects as representing a beneficial use of water. Though difficult to discern from Table 4, Wyoming has one of the most restrictive provisions for allowable uses of instream flow appropriation, while Oregon, Utah, and Washington have fairly broad provisions (Locke *et al*. 2008). British Columbia has some restrictions on how it defines allowable instream flow appropriations. As described in Section 2.2, British Columbia water managers have the ability to maintain a minimum level of instream flow, but water laws do not require they do so. As well, licenses can be issued for the purpose of conservation, but only if associated with the use and storage of water or the construction of works for conserving fish or wildlife. Finally, "sensitive" streams can be designated within which new licenses can be refused or restricted (requiring mitigation or compensation) if additional licenses are deemed to have adverse impacts on flows for fish.

One approach for dealing with challenge of prior allocation / appropriation schemes and the accompanying constraint on acquiring instream flows for fish is to allow transfers of water rights between license holders (e.g., transferring rights of senior consumptive water users to non-consumptive users such as fish). **Transfer of water rights** compares allowances for such measures across western jurisdictions. British Columbia, like most other jurisdictions, allows for transfers of water licenses though there are many varied conditions associated which such transfers. Alberta is the only western Canadian province to have incorporated a less restricted market for water transfers into its water laws (Christensen and Lintner 2007).

The **duration of water license** can provide an indication of the flexibility (or lack of flexibility) for managers to deal with future complexities and uncertainties related to water management. Generally, longer term licenses will have less ability to adapt in the future relative to licenses with shorter terms. British Columbia has no expiry for most existing water licenses, though recent changes have limited licenses for power generation to 40 years. As well, Living Water Smart proposes terms of 40 years in areas that have high demand and pressures on water supplies. Under the current and LWS situations, British Columbia has license terms that are longer than all other jurisdictions in western Canada. The western provinces and territories tend to have maximum terms between 20 and 25 years (de Loë *et al*. 2007).

2.4 THE FUTURE WITH LIVING WATER SMART

Implementation of Living Water Smart is in its infancy and the potential benefits are uncertain at this time. Most recent efforts have focused on public consultation about water governance (WGPT 2008). Many of the other proposed actions have the potential to either reduce or amplify conflicts between instream and out-of-stream users. For instance, the potential for conflict can be reduced by actions that improve water use efficiency and help decrease water scarcity. Alternatively, conflicts can be intensified by actions that strengthen water rights for ecosystems or agriculture. Despite its infancy, five highlights represent major advancements towards objectives related to water rights, water use, planning, and public engagement. These highlights include:

1. **Recognizing that freshwater ecosystems have rights to water:** A range of LWS actions identify the importance of maintaining freshwater ecosystems and the requirements for having good scientific information and enabling laws to support protection of instream values.

2. **Securing agricultural access to water:** Agricultural production is a valuable resource that contributes to local economies and requires an abundance of water (e.g., agricultural users represent almost a third of the annual allotment of consumptive water licenses[7]). However, securing access for agriculture users has the potential to set up conflicts with ecological uses. Currently, LWS doesn't provide clarity about the priority of water rights for agricultural users as compared to ecosystem needs, which is important to help resolve trade-offs between these uses.

3. **Regulating groundwater withdrawals:** Groundwater and surface water are connected. B.C. needs to develop a regulatory system to manage groundwater takings given current pressures and effects on freshwater ecosystems. A caution, however, is that groundwater regulation is only being contemplated under LWS in "priority areas" and for "large groundwater withdrawals", which are currently undefined.

4. **Becoming more water efficient:** Actions to promote improvements in water use efficiency in agriculture, industry, and homes (sectors with the largest annual allotment of consumptive water licenses) are invaluable in helping reduce demand and making more water available for other users, including freshwater ecosystems.

5. **Encouraging community involvement in water management:** Good water management should engage the public to help resolve water use conflicts—dialogue among stakeholders is essential. Living Water Smart commits to seeing greater community involvement in watershed planning and water management processes, though details are limited.

These highlights, among other actions, mark the first comprehensive attempt to reform water laws and policy since government conducted a review of water policy and legislation in 1993, as described in "*Stewardship of the water of British Columbia: A review of British Columbia's water management policy and legislation*" (MELP 1993). Since that review, changes in water policy and law have been intermittent and piecemeal (see Nowlan 2008). Living Water Smart provides a clearer timeline for implementing major changes (Table 5). Milestones for action have been established at several points over the next decade—2010, 2012, 2015, and 2020. A critical year is 2012 when the most significant changes can be expected (e.g., reforms in water laws to protect ecological values, regulation of groundwater, improved monitoring and reporting of water use, and changes in water management approaches to deal with climate change).

[7] Ministry of Environment. "*Consumptive and non-consumptive use*" Available from: http://www.env.gov.bc.ca/wsd/water_rights/surface_water/consumptive_nonconsumptive.pdf

TABLE 5. Subset of LWS actions and the timeline over which they will be implemented.

Year	Priority actions
2010	• A strategy to set the direction for water science in B.C. will be implemented. • Government will mandate purple pipes in new construction for water collection and reuse.
2012	• Water laws will improve the protection of ecological values, provide for more community involvement, and provide incentives to be water efficient • Government will regulate groundwater use in priority areas and large groundwater withdrawals. • 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. • Government will require all large water users to measure and report their water use. • Government will publish a report on the state of our water, and do so again every five years after that. • 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. • All students in B.C. will have completed at least one stream-health assessment.
2015	• Tools will be developed to incorporate traditional ecological knowledge into decision making. • Government will cooperate with Canada to ensure the quality of drinking water in all Aboriginal communities will meet the same provincial standards applied across B.C.
2020	• Water use in B.C. will be 33 percent more efficient. • Fifty percent of new municipal water needs will be acquired through conservation.

The list of actions proposed under Living Water Smart is much broader than the highlights discussed above. Though the effectiveness of this suite of actions cannot be evaluated at this time (others provide critical comments, see Nowlan 2008), their comprehensiveness can be assessed by using the framework described in Section 2.1 to compare the 46 LWS actions (see Appendix A) against the 9 core policy objectives emerging from the Instream Flow Council (see Table 6). Where details are lacking, or actions are ambiguous, policy makers can strengthen actions by explicitly supporting the objectives identified earlier.

TABLE 6. Alignment of Living Water Smart actions (Appendix A) against core policy objectives (Table 1).
Actions with grey shading are indirectly related to protecting instream values.

Themes	Strategies	Actions	Responsibility	Water rights	Water uses	Planning	Implementation	Education	Engagement	Science	Management
Doing business differently	Modernizing our Water Laws	Reviewing the Water Act	X	X	X						
		Recognizing water flow requirements	X	X	X						X
		Improving water governance	X			X	X		X		
	Protecting Nature's Needs	Developing regulatory tools	X	X	X						
		Training those who work with the Water Act					X				
		Cutting back in times of scarcity				X					
	Protecting our Groundwater	Developing the Groundwater Protection Regulation			X						
		Regulating Groundwater Use			X						
	Water for Agriculture	Securing access to water for ALR lands		X							
		Requiring more efficient water use			X						
		Helping farmers manage water demand			X						
	Becoming Water Efficient in B.C.	Requiring all large water users to measure & report water use								X	
		Requiring more efficient water use in agricultural sector			X						
		Encouraging Green Infrastructure									
		Choosing to be water smart									
		Celebrating our water smart choices							X		
Preparing communities for change	Adapting to Climate Change	Preparing for floods									
		Working with other provinces									
		Creating community development strategies				X					
		Developing new approaches to water management									X
	Conserving and Restoring Our Watersheds	Conserving and restoring stream function									X
		Protecting and rehabilitating wetlands									X
		Supporting specific restoration projects									X
	Planning with Water in Mind	Supporting watershed planning				X					
		Creating community development strategies				X					
		Leading the way									
		Encouraging and fast tracking green development									

Themes	Strategies	Actions	Responsibility	Water rights	Water uses	Planning	Implementation	Education	Engagement	Science	Management
	Protecting Our Drinking Water	Improving drinking water source protection									
		Ensuring First Nations communities have safe, clean water									
		Protecting our groundwater			X						
Choosing to be water smart	Being Water Smart at Home	Creating stronger water conservation targets									
		Funding household evaluations of water, energy, and transportation use									
		Requiring water-conserving plumbing fixtures such as low flush toilets									
		Mandating purple pipes for water collection and reuse									
		Labeling efficient water consuming products									
	Getting Smarter with Science	Implementing a water science strategy for B.C.								X	
		Expanding hydrometric and climate-related networks								X	
		Reporting on the state of our water								X	
		Improving modelling and analysis								X	
	Youth and Water	Teaching our youth about healthy streams						X			
		Rewarding youth excellence in science							X		
		Providing summer jobs to help out our environment						X			
	First Nations Traditions and Knowledge	Ensuring a clean and plentiful water supply on reserves									
		Preserving cultural and social practices									
		Consulting with First Nations									
		Facilitating knowledge sharing									

This comparison shows that many actions contemplated under LWS align with the core policy objectives—each objective is represented in some way. Related to **legal** objectives (i.e., legal responsibility, water rights, and water uses), LWS actions are focused on ensuring provincial laws recognize instream flow requirements, and that the regulatory tools and governance structures are in place to support protection of instream values. These actions explicitly recognize the rights of freshwater ecosystems to water, though their priority relative to other uses (e.g., agriculture) is unclear. This ambiguity sets the stage for potential conflicts between agricultural users and environmental needs and may create challenges when making tradeoffs between users. Importantly, these actions also recognize the need to manage surface and groundwater conjunctively to support environmental and human uses and that water use efficiency can play a role in improving water availability for other uses (including instream values).

From the perspective of **institutional** objectives (i.e., planning and implementation), LWS actions do well by supporting watershed planning for both land and water uses, community development strategies, plans for periods of water scarcity, and implementation through improved water governance and training for those working with the *Water Act*. The strategies and actions are ambiguous, however, about the process for quantifying instream flow requirements, ensuring sufficient funding for instream flow programs (including quantifying instream flows), and supporting adaptive management, including monitoring and evaluation, as a tool for addressing critical uncertainties and improving water management.

For **public involvement** objectives (i.e., public education and engagement), actions are focused on educating youth to better understand the importance of healthy streams and providing opportunities to work in stream restoration. Actions related to enabling public engagement are focused on celebrating water smart choices and rewarding youth excellence in science. Though implied through development of improved water governance mechanisms, more deliberate actions to educate and engage the public in water use decisions are not specified. These elements are crucial because it is commonly recognized that resolving water use conflicts requires bringing together stakeholder groups and management entities to make more transparent and broadly supported water allocation decisions (e.g., Lamb and Lord 1992)

From a **science** perspective, LWS actions support development of improved monitoring and reporting of water availability, water use, and climate data. Monitoring is supported by development of a water science strategy, which includes modeling and analysis of stream flow availability and future vulnerabilities. Missing from this list of actions are requirements for monitoring other riverine attributes (e.g., fish populations) and a reliance on monitoring the largest water users only.

Lastly, some LWS actions are related to improving **management practices**, though these actions are focused on improving water use efficiency, adjusting water allocations across users, and water use planning. On-the-ground actions are concentrated on protecting / restoring streams and wetlands.

3.0 A REVIEW OF OTHER JURISDICTIONS

3.1 MURRAY AND DARLING RIVERS, AUSTRALIA

Australia is currently a nation with acute water shortages and many water use conflicts, which has led the country to pursue urgent and high profile efforts to resolve these problems. While the focus has been on increasing water availability for domestic and agricultural purposes, aquatic ecosystems are also in crisis; 'environmental flows' are a major concern. River health is declining due to a combination of extreme water scarcity related to climate change and too much water being extracted from rivers and aquifers in many areas (Working Group on Climate Change and Water 2008).

Australia is naturally the driest inhabited continent, which has been affected even more by drought in recent years. Though rainfall varies greatly across the continent, from year to year and decade to decade, southeast Australia (which includes the Murray-Darling Basin) has now missed out on the equivalent of an average year's rainfall over the past 11 years. The current drought is one of Australia's most severe on record (Australia Bureau of Meteorology 2008). Despite the cooling effect of La Niña in 2008, temperatures were warmer-than-average for the seventh year in a row. Consistent with changes around the globe, Australia experienced a background warming of about 0.9 °C over the last century (Australia Bureau of Meteorology 2009). This increase has resulted in major changes for Australia. The Bureau of Meteorology's head of climate analysis warned in 2008 that the current extreme conditions might be the new climate.[8] Exceptionally hot years, which used to happen every two to three decades, might now occur much more frequently, which would make drought a permanent part of the Australian environment.[9] As in other jurisdictions, more frequent fires are predicted as a result of climate change. In February 2009, a severe and exceptional heatwave coincided with the worst bushfires in Australia's recent history which led to at least 209 deaths.[10]

Ephemeral watercourses, wetlands, and lakes are widespread, particularly in certain areas. Groundwater dependent ecosystems are common. Depending on location, Australia's highly weathered, ancient soils retain little water and influence how runoff occurs. Evaporation rates are also high. For example, in the Murray-Darling Basin, only 4% of rainfall ends up in the rivers, compared to North America where 52% of rain reaches watercourses. Australian rivers are also uniquely vulnerable to climate change.[11] Salt water intrusion is a concern for some irrigated soils and aquifers.

Climate is the ultimate driver of water cycles in Australia. A new Australian report on climate change (Garnaut 2008) says that, without mitigation, urban water supplies will be stressed and agriculture will be affected within the next two decades. By mid-century irrigated agriculture in the Murray-Darling Basin will be halved. These kinds of concerns contributed to a change in government in 2007, removing a government that had resisted the findings of climate scientists, and giving power to a party that promised to reduce greenhouse gas emissions.[12]

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[8] *Sidney Morning Herald*. January 4, 2008. "This drought may never break". Available from: http://www.smh.com.au/news/environment/this-drought-may-never-break/2008/01/03/1198949986473.html

[9] Grist Environmental News and Commentary. February 4, 2008. "It's getting wicked". Available from: http://www.grist.org/news/2009/02/04/AustraliaHeat/index.html

[10] British Broadcasting Corporation. February 22, 2009. "Australia mourns bushfire victims". Available from: http://news.bbc.co.uk/2/hi/asia-pacific/7904103.stm

[11] *The Australian*. November 8, 2008. "Garnaut's grim reality here to stay". Available from http://www.theaustralian.news.com.au/story/0,25197,24546508-11949,00.html

[12] *Energy Bulletin*. April 2, 2009. "Warming takes center stage as Australian drought worsens". Available from: http://energybulletin.net/node/48533

Within this context, Australian water laws have evolved very differently than British Columbia and Canada. Regardless, there are parallels in cultural approaches to water use and management and lessons to be learned. Water allocations have historically been provided with limited knowledge of water availability and ecosystem requirements, and with little recognition of surface water and groundwater connectivity. Groundwater use is becoming the greatest challenge to sustainable water use in Australia (Beeton *et al*. 2006). The Australian Government National Water Commission (2007a) has stated that urgent work is required to address groundwater over-allocation, surface water connectivity, and inadequate measurement and monitoring. Current failures in groundwater management are affecting water security, environmental flows of surface waters, and groundwater-dependent ecosystems (Australian Government National Water Commission 2007a).

3.1.1 AUSTRALIAN WATER MANAGEMENT, LEGAL AND POLICY REFORMS, AND SUPPORTING INSTRUMENTS

Australian States and Territories are in charge of water management, while the federal government (i.e., the Commonwealth) provides guidance and incentives. Important resource management decisions are often made via meetings of the Council of Australian Governments. Water laws vary among States / Territories but important aspects are becoming more coordinated. Below we describe current federal approaches to water management and recent changes in related laws.

Management of surface water and groundwater: Australia does not apply the prior appropriation doctrine. All users have equal rights to water based on amounts specified in water licenses. The surface water allocation system is problematic, however, with entitlements in many areas exceeding available supplies (Australia Department of the Prime Minister and Cabinet 2007). In reality, most users extract less than their entitlement due to limited water availability. In dry years, surface water users are restricted to a percentage of their entitlement based on forecast availability (Neville 2009).

Groundwater licensing does not yet exist in all of Australia and effectively began in some parts in the 1970's. Groundwater use has been steadily increasing over the last 40 years, with major growth during the droughts of 1967–1968, 1982–1983 and 2002–2003 (Evans 2007a). Groundwater entitlements are issued by state and territorial governments and are typically separated from land and property rights (Goesch *et al*. 2007). Entitlements generally specify the annual volume of extraction, with pumping rates sometimes being specified. In some cases, entitlements specify extra volumes that can be extracted during droughts (Natural Resource Management Standing Committee 2002 as cited in Goesch *et al*. 2007). Total groundwater use by the agricultural sector was equivalent to 40% of total groundwater entitlements in 2004–2005 (Goesch *et al*. 2007), suggesting the entire licensed amount is not necessarily used or available. Groundwater licensing, until very recently, has been completely separate from surface water licensing.

Historically, water managers in Australia have generally not given adequate consideration to the connections between groundwater and surface water. In more recent times, State and Territory policies assume no connection unless demonstrated by way of an assessment. In highly connected water systems, measures are occasionally taken to manage the resource in an integrated manner (Evans 2007a). Australian hydrologists (Fullagar *et al*. 2006; Evans 2007a) have identified a problem of double allocation, whereby an available unit of water is essentially allocated twice—once as surface water and again as groundwater. It is generally recognized that groundwater consumption increases during times of drought due to limited availability of surface water supplies. The ongoing allocation of groundwater resources has resulted in an unintended transfer of development pressure from surface water to groundwater (Evans 2007b).

Water reforms: The government of Australia is attempting radical and permanent changes in water management in the face of increasing demand, protracted drought, and the prospect of long-term climate change. Water scarcity is a major challenge as water demand continues to grow (Beeton *et al*. 2006). Australia's water use efficiency and water reuse rates need to rise from their current levels to at least those of other developed countries (Radcliffe 2003 as cited in Beeton *et al*. 2006). Currently, Australians are the third highest per capita users of water in the world (Radcliffe 2003). Two-thirds of water is used in irrigated agriculture (Beeton *et al*. 2006), feeding water-hungry rice and cotton crops for export. Water scarcity is also exacerbated by drought which has elevated water management issues to a higher priority. Such concerns have resulted in a $10 billion strategy for national water security (Australia Department of the Prime Minister and Cabinet 2007), new government bodies with responsibilities in the National Water Initiative (e.g., the National Water Commission and a new Murray-Darling Basin Authority), as well as other various overlapping spending programs and policies.

Current reforms have roots in past initiatives. In 1994, the Council of Australian Governments (comprised of State, Territory and Commonwealth representatives) developed a Water Reform Framework which was followed by National Principles for the Provision of Water for Ecosystems (ARMCANZ and ANZECC 1996). The 1994 Water Reform Framework resulted in requirements for environmental flow provisions in State laws and policies. Provisions varied depending on the jurisdiction and effective implementation has been less than complete (Neville *et al*. 2001; Working Group on Climate Change and Water 2008).

In large part, recent efforts address issues identified in prior reforms, though requiring more stringent measures that reflect the escalating crisis and the need to take more effective action. The National Water Initiative (NWI) was created in 2004 to provide direction for water reform in Australia and is implemented, in part, via the $13 billion Water for the Future Policy. Its implementation is overseen by a National Water Commission. The Initiative is seen as the 'road map' for water planning and management across Australia (Australian Government National Water Commission 2008). Among other things (see Box 1), the NWI recognizes connectivity between surface and groundwater and seeks to manage connected systems as a single resource (Fullagar *et al*. 2006). However, in a 2007 assessment of progress, the National Water Commission expressed concern about the management of groundwater (Australian Government National Water Commission 2007a). Key concerns included over-allocation, failure to manage surface and groundwater as a connected resource, lack of established measurement standards, and inadequate monitoring. A coordinated research effort was recommended to advance groundwater reforms (Australian Government National Water Commission 2008), however no budget for reforms has yet been allocated outside of the $82 Million for research.

In addition to the NWI, the $10 billion National Plan for Water Security (Australia Department of the Prime Minister and Cabinet 2007) represents further action by the federal government. Ongoing policy development is a reflection of the difficulty Australia has had in implementing the necessary changes. Jurisdictions have made efforts to implement NWI-consistent planning processes, but the completion of water plans has been slow and no jurisdiction can yet claim a fully effective water planning system (Australian Government National Water Commission 2007a).

Box 1: Elements of Good Water Planning

- Achieve a shared understanding of **sustainable levels of water extraction** so that over-allocation is both rectified and avoided in the future.
- Improve our **knowledge of groundwater-surface water connectivity**, with significantly connected systems to be managed as one integrated resource.
- Factor in the **impacts of climate change** and the effects of interception activities (e.g., farm dams and forestry) on future inflows and recharge.
- Ensure **environmental outcomes** are clearly specified, decisions are based on best available information, and environmental managers have adequate resources.
- Increase inputs from **socio-economic analyses** and incorporate **consultation** to improve the quality of decisions and build community confidence in the fairness of outcomes.
- Give higher priority to ensuring that **the values and interests of Indigenous people** are considered.
- Be better **integrated** with regional natural resource management planning and urban water supply planning.
- Provide **adequate resources** to develop and implement water plans, and evaluate their outcomes.
- Improve **monitoring and compliance** of water use.

from Australian Government National Water Commission (2008)

Water laws: The Commonwealth *Water Act 2007* is critical to implementing the National Water Initiative. The Act was passed in January 2007 to support the National Plan for Water Security. It refers water management powers in the Murray-Darling Basin from the States to the Commonwealth and establishes a new Basin Authority with more power and accountability. At the national level, it provides the legal basis for implementing instruments to improve water management and protection of instream flows (Table 7) which includes: water trading, better record keeping of water availability and use, and establishing the Commonwealth Environmental Water Holder to manage water holdings for instream flows (Australian Department of the Environment, Water, Heritage and the Arts 2009a).

Under the *Water Act 2007*, the new Murray-Darling Basin Authority has responsibility for developing a Basin Plan, which requires an integrated, sustainable, and enforceable cap on water extractions. Other aspects of the Basin Plan include: (i) the amount of water that can sustainably be extracted from surface water and groundwater supplies; (ii) identification of risks to water resources; (iii) an environmental watering plan to optimize environmental outcomes; (iv) a water quality and salinity management plan; and (v) rules about trading of water rights (Australian Government Water for the Future Program 2008). The Act also has provisions for accrediting State water resource plans for consistency with the Basin Plan (Working Group on Climate Change and Water 2008).

Passing the Act was controversial as it required four States and the capital Territory to devolve certain powers of management to the Commonwealth. This change of power was necessary to manage the Murray-Darling Basin in the national interest as the existing Murray-Darling Basin Commission was dysfunctional and without powers to influence State water allocation and management decisions (Australia Department of the Prime Minister and Cabinet 2007).. The Act was amended by the *Water Amendment Act 2008,* to continue reforms and address specific concerns. Among other things, the amendment provides the Commonwealth with a range of powers to ensure compliance in relation to diversion limits, trading and charging rules, and provision of water information (Australian Department of the Environment, Water, Heritage and the Arts 2009b).

TABLE 7. Summary of regulatory / policy instruments being used to manage water and enable protection of instream values in Australia.

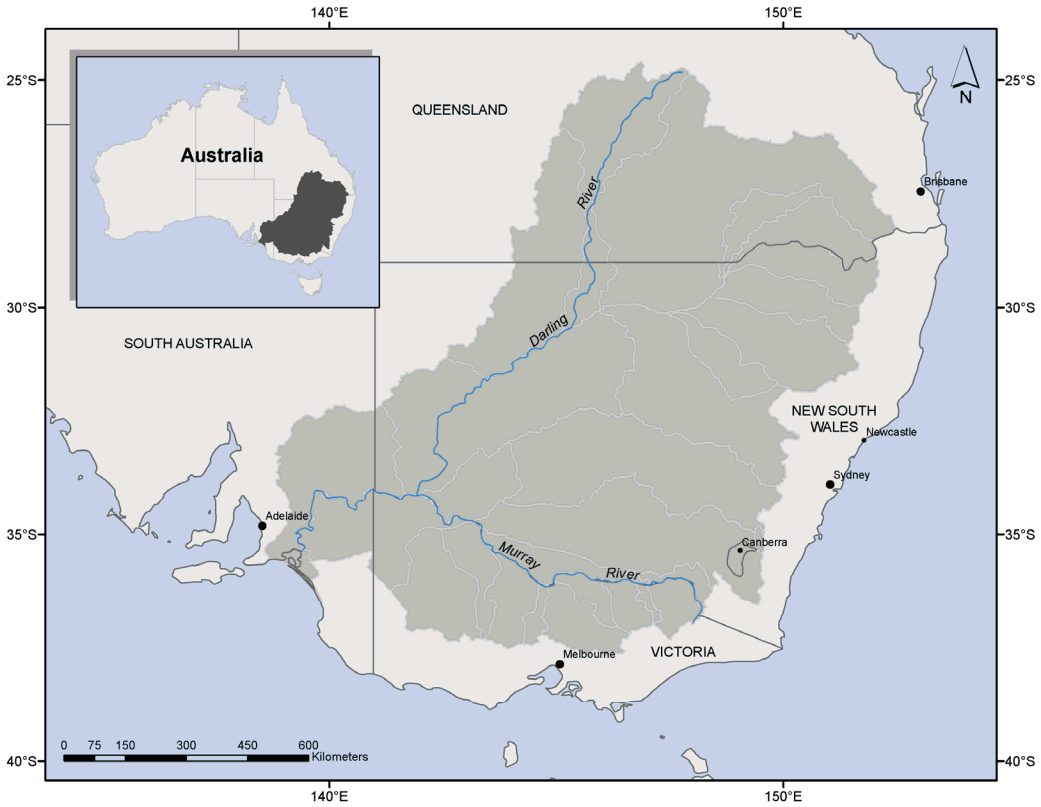
Instrument	Description of instrument
Surface water allocations	Surface water allocations are seasonally adjusted on the basis of available water and water use. Australian state governments usually make water allocation announcements or available water determinations on a monthly or bi-monthly basis. Allocations are then distributed in proportion to security/reliability (e.g., type of crop or whether it is for household use) and size of each entitlement (i.e., total licensed amount). Owners of entitlements may not necessarily receive licensed amounts in any given year. In some years, depending on entitlement class, they may receive no water at all (Waterfind 2008). For example, in part of the Murray-Darling system in irrigation year 2007–2008, the total allocation was 24% of entitlements, and individual allocations ranged from 0 to 100 percent (Waterfind 2008).
Ground-water allocations	Following the approach to seasonal adjustments of surface water allocations, some groundwater management units are managed under Annual Announced Allocations (Evans 2007a). These allocations give all groundwater users a certain percentage of their total entitlement, which may take place in recurring years. This approach represents a good way of responding to the effects of climatic variation and can avoid politically unpopular decisions associated with reducing licensed entitlements in overdeveloped groundwater management units (Evans 2007a).
Water cap	A limit on extraction has been used to protect ecological and human needs, where a 'cap' bans new water uses and restricts existing uses. A cap placed on surface water use in the Murray-Darling Basin in 1995 has led to greater groundwater extraction (MDBC 2003; Young and McColl 2003).
Water trading	Australia is creating a free market system for water, combined with a cap on extraction, as a centerpiece of water reform (Working Group on Climate Change and Water 2008). The government believes open and robust water markets will provide numerous benefits, including reallocation of scarce water. Water trade has expanded, but the hoped-for outcomes have not yet been realized (Australian Government National Water Commission 2007b). Adverse consequences include cities and farmers competing for water and increases in inter-basin transfers of water. State and federal governments are subsidizing extensive water pipelines to enable trade.
Metering and monitoring	The government is investing in metering and monitoring and introducing legal standards for data collection and reporting (Australian Department of the Prime Minister and Cabinet 2007). Mandatory national metering standards are being introduced so water diverted for irrigation more accurately matches entitlements. The Bureau of Meteorology is being expanded to provide water data necessary for good and transparent decisions and to enable evaluation of progress being made in water reform (Australian Department of the Prime Minister and Cabinet 2007). The *Water Act 2007* gave the Bureau this responsibility, which includes holding and managing all water data. Work on a national water accounting system is due for completion in 2010, which includes standards for water markets and environmental water accounting. This initiative is part of the National Plan for Water Security and will cost the federal government $480 million over 10 years with additional investments from state governments. Groundwater is included in plans for metering, and this will take time to roll out; currently only 20–40% of major users are metered (Goesch *et al*. 2007).
Investments in irrigation efficiency	Common irrigation practices include unlined ditches and delivery channels, flood irrigation, and other inefficient uses. Improving efficiency includes investments in pipes and lining for delivery channels and improving irrigation technology. Australia is investing in these measures under their National Plan for Water Security (Australia Department of the Prime Minister and Cabinet 2007). To ensure savings are retained for the environment, they are shared equally between irrigators and the Commonwealth. The government can then better manage for instream flows and irrigators get increased water security for existing or expanded uses.
Environmental water holder	The Commonwealth Environmental Water Holder is a program under the Environmental Flows Initiative. It was established under the *Water Act 2007* to manage water entitlements the Commonwealth acquires for instream flows. Entitlements are acquired from willing sellers and from a share of irrigation water savings. The amount available will depend on entitlements acquired and seasonal water allocations (Australian Department of the Environment, Water, Heritage and the Arts 2009d). A panel of scientists has been appointed to advise government on uses of environmental water. In the Murray-Darling, water will be managed according to a not yet available environmental watering plan. Interim objectives include avoiding the loss of threatened species, avoiding irreversible damage or catastrophic events, and providing refuges to allow recolonization following the current drought (Australian Department of the Environment, Water, Heritage and the Arts 2009d).

Instrument	Description of instrument
Buy-back of water entitlements	In an attempt to restore instream flows, the Australian government is buying water entitlements in the Murray-Darling Basin over 10 years at a cost of $3 billion. In 2008, $50 Million was spent to acquire entitlements in the Murray River system for instream use (Waterfind 2008). Purchased entitlements are still subject to the same drought restrictions as other types of licenses. In dry years entitlement holders (depending on entitlement class) only receive a proportion of their entitlement based on projected availability (Waterfind 2008). The socio-economic consequences of water buyback in rural areas are unclear; large changes in land use may affect local economies. The effectiveness of the buyback program for instream flows is also unclear. Reasons for lack of clarity include the type of licenses being purchased and cooperation of states involved. While the Commonwealth has control of basin management, state river plans continue to operate until their expiry. Existing state plans and new basin plans are potentially in conflict, as in the state of Queensland, where impending buybacks may be negated by a new agricultural development allowed under the existing plan. As well, the proposed development in Queensland would cancel out water savings from the Commonwealth's $24 million purchase of a cotton farm.

3.1.2 MURRAY-DARLING BASIN

The Murray-Darling Basin lies within southeastern Australia, covering one-seventh of Australia's land mass, spanning four States (Queensland, South Australia, New South Wales and Victoria) and the capital Territory (Figure 7). It is the nation's 'breadbasket' supplying 40% of the nation's food crops and supporting 85% of Australia's irrigated agriculture. It is home to two million people and supplies water to a further one million in the city of Adelaide (Australia Department of the Prime Minister and Cabinet 2007).

FIGURE 7. Overview map of the Murray-Darling Basin in Australia.



The Murray-Darling has suffered greatly in an ongoing and unprecedented drought, now in its 12th year. Over that time irrigation has effectively been halved.[13] In 2007, the Basin experienced its warmest year on record (Australian Bureau of Meteorology 2008). In 2008, rainfall conditions were average to above-average across the continent, except for the southern Murray-Darling Basin where low rainfall further exacerbated the long dry spell (Australia Bureau of Meteorology 2009). The current and forecasted rainfall, river flow and temperature conditions are so severe that some are saying it is time to accept that the climate has changed forever, and to consider abandoning parts of the basin.[14]

Ecological conditions were recently studied across the Basin. Of the 23 locations studied, only one was in good condition, two were in moderate condition with the remainder rated as very poor to poor (MDBC 2008). Across the Basin, 90% of wetlands have disappeared or been seriously damaged. The river does not have enough flow to reach its mouth in the southern ocean near Adelaide, 40% of the time.[15] Such a lack of flow would only happen 1% of the time in the absence of water extraction[6]. A lack of water is also related to problems with acidification of lakes and wetlands. Some lakes in the lower part of the Murray system are in peril due to drying of acidic sulphate soils on their beds. When lake beds go dry and are then re-wetted, oxygenated sulphates form sulfuric acid which reduces pH (Fitzpatrick *et al*. 2008). Low pH can permanently alter the aquatic ecosystem and make the water unusable for consumption. Emergency measures to respond to this problem include pumping water from other water bodies, though more desperate measures are also being contemplated—flooding the lower lakes with seawater—which also have serious ecological implications (Australian Government 2009). Buying back water entitlements is one potential remedy, but competition and water scarcity makes this option difficult.

Over-allocation of water has long been recognized as an issue of concern in the Basin. This situation arose as a result of State and Territory governments issuing more entitlements than could be delivered and a failure to set sustainable levels of extraction in water sharing plans (Australian Department of the Prime Minister and Cabinet 2007). Another failure was a lack of conjunctive management of surface and ground water resources. This failure is illustrated by the 'cap' placed on surface water extractions in 1995. The cap was implemented to address the eroding security of supply to existing irrigators and to deal with declining river health (Sinclair Knight Merz 2006). No provisions for groundwater were included, however, effectively transferring development pressure from surface water to groundwater (Sinclair Knight Merz 2006).

Drought in the Murray-Darling Basin has intensified existing water shortages, management shortfalls and conflicts, and been a major impetus to change how water is allocated for both human and ecological needs. The Basin is of particular interest to water managers elsewhere because it has been the focus of many of the reforms of the Australian *Water Act 2007*. The 2007 National Plan for Water Security recognized that the goals under the National Water Initiative to reduce over-allocation problems could not likely be achieved (Australian Department of the Prime Minister and Cabinet 2007). This concern led to the significant changes under the *Water Act 2007*, in particular a new Basin Authority with powers to audit state water plans. Until the *Water Act 2007* was passed, water management in the basin was coordinated by the Murray-Darling Basin Commission and managed by individual States. This arrangement was changed due to shortcomings of the governance arrangements, which often reflected parochial interests. The Commission had not been managing water resources proactively and had not been following guidance provided by the National Water Initiative (Australia Department of the Prime

[13] *The Australian*. November 8, 2008. "Garnaut's grim reality here to stay". Available from http://www.theaustralian.news.com.au/story/0,25197,24546508-11949,00.html

[14] Australian Broadcasting Corporation. September 3, 2008. "Call to abandon parts of Murray". Available from: http://www.abc.net.au/news/stories/2008/09/03/2354694.htm

[15] *Energy Bulletin*. April 2, 2009. "Warming takes center stage as Australian drought worsens". Available from: http://energybulletin.net/node/48533

Minister and Cabinet 2007). The surface water cap was not being recognized with two states ignoring it and a third regularly in breach. States were acting unilaterally and without sanction and the consensus-based structure of the Commission meant that difficult decisions were being avoided. A lack of basin-wide information made decision-making difficult (Australia Department of the Prime Minister and Cabinet 2007). For these reasons, management authority was transferred to a new Murray-Darling Basin Authority, which was given powers to effectively manage the resource. To achieve this outcome, the Australian government persuaded States to devolve certain powers to the Commonwealth. The Basin Authority was then set up as a Commonwealth Government agency with authority for a new Basin Plan that took groundwater into consideration. Enabled by amendments to the *Water Act* in 2008, state water sharing plans now have to be revised to satisfy new planning specifications which include making provisions for the effects of climate change and certain land uses (Australia Department of the Prime Minister and Cabinet 2007).

Further changes under the National Plan for Water Security include government investments to modernize irrigation systems. Government is also buying back water entitlements and giving incentives to irrigators in less viable areas to exit the industry. Water savings are being transferred to the environment with the option of allocating some water to irrigators. New investments in data collection are expected to support adjustments in allocations across the Basin. A water metering and monitoring and compliance system is being implemented and operation of a water trading market is expected to allow further adjustments (Australia Department of the Prime Minister and Cabinet 2007).

To help address problems with over-allocation, the Australian government asked the Australian Commonwealth Scientific and Research Organization (CSIRO) to develop a water balance model for the entire Basin. This project provided a rigorous hydrological assessment of the Basin that integrated the effects of climate change, future development, and groundwater extraction (CSIRO 2008). The study projected decreasing water availability due to future climate change with the majority of adverse effects being borne by the environment. Additionally, groundwater use was found to be unsustainable in several management units with a projection that 25% of all groundwater use will eventually be sourced from induced streamflow leakage. Findings highlighted the need to bring all groundwater uses into the water entitlement system and indicated that increased groundwater use was likely to affect baseflow in small tributaries, turning many into ephemeral streams (CSIRO 2008). This study provided a strong basis for determining a new sustainable diversion limit for surface and groundwater use across the basin.

3.1.3 OUTCOMES IN AUSTRALIA AND THE MURRAY-DARLING BASIN

The social, economic, and environmental effects of climate change and drought are serious issues in Australia. Historic over-allocations of water and a lack of science in decision-making have exacerbated these problems. Management structures have not yet caught up with the intent of current policies, in part due to problems translating these policies into action. Therefore, it remains to be seen whether the National Water Initiative and the National Plan for Water Security will lead to expected outcomes—whether large scale purchase of instream water rights will be effective or sufficient and whether the initiative will be in conflict with human needs for scarce water resources. The government hopes that water conserved through irrigation efficiencies will be one way to provide more water for the environment as well as people, as the savings will be split 50:50. It is too early to comment on the success of water conservation efforts, as actual water savings are still being evaluated. Nevertheless, Australia's efforts to realize irrigation efficiencies are very important and efficiencies are one of the best mechanisms to provide more instream water.

Current progress in securing instream flows suggests that environmental water objectives of the National Water Initiative (NWI) will not likely be met without significant intervention (Australian Department of the Environment, Water, Heritage and the Arts 2009c). There are significant concerns among communities about the lack of tangible on-the-ground results. Nonetheless, all jurisdictions remain committed to the NWI as the basis for water reform (Australian Government National Water Commission 2008).

The NWI has marked a major shift towards conjunctive groundwater and surface water management, and this shift is in the process of being incorporated into state water management and hundreds of individual water plans. While progress is uneven, these changes are essential and are a great stride forward. It will take time to make this transition, which may be seen as a generational shift—the new paradigm of conjunctive management is very different from the historical approach to water management (Dr. Richard Evans, Sinclair Knight Merz, pers. comm.).

The federal government now has authority for planning and management within the Murray-Darling Basin, which allows the kind of integrated decision making authority needed to solve water issues. However, state water sharing plans continue to operate until their expiry, and most arrangements for providing environmental water under these plans do not reflect the intent of the National Water Initiative (Australian Government National Water Commission 2008).

A free market for water is proposed as a solution for better allocation and valuation of scarce water resources, but the full potential of water markets has not yet been realized (Australian Government National Water Commission 2008).

Better science and data collection are recognized as critical to improving water management in Australia. There has been significant investment in developing the capacity of the Australian Bureau of Meteorology to support water management decisions. The national science research institute (CSIRO) has also been involved in developing a detailed hydrologic model in the Murray-Darling Basin to determine sustainable yields. This successful and ambitious study represented a first in the world given its scale and scope. More studies such as this are being recommended for other regions in Australia (Working Group on Climate Change and Water 2008).

3.2 WALLA WALLA RIVER, UNITED STATES

The State of Oregon has similar topography and climate to British Columbia, and similarities in the way water has historically been allocated. However, Oregon has a stronger culture of volunteerism and grassroots action for land management which may be due, in part, to the greater proportion of private land ownership.

Oregon has a long history of agricultural water use. Many areas have been under irrigation for over a century and there has been tremendous growth in the amount of land brought under irrigation in recent years.[16] Water conflicts are most acute in the drier areas of the State and during dry summer months. Water shortages occur almost every year and by the end of summer in some streams there is often only enough water to supply users with rights established in the late 1800's (Oregon Water Resources Department 2009). In addition to channel and riparian alterations, fish using these rivers have been significantly affected by low flows which have cumulatively led to some runs being extirpated. In recent years, changes to water laws and management practices have attempted to improve instream flows for fish, especially in waterbodies used by species listed under the *Endangered Species Act* (ESA). Tribal treaty rights provide another mechanism to improve flow conditions for fish, as these rights apply to extirpated runs of fish that are no longer governed under the ESA (Bob Bower, Walla Walla Basin Watershed Council, pers. comm.).

[16] Western Regional Climate Centre. Climate of Oregon. Available from: http://www.wrcc.dri.edu/narratives/OREGON.htm

3.2.1 OREGON WATER LAWS AND SUPPORTING INSTRUMENTS

Water law in Oregon, Washington, and other western States is based on the doctrine of prior appropriation and water rights are tied to land ownership (i.e., appurtenancy). The priority of water rights is based on the date of application for a license such that senior water users have first rights in times of scarcity. In addition, Oregon's water code provides for beneficial use of water without waste, and declares that water rights must be used as licensed at least once every five years. Oregon water law also includes certain protections and restrictions on water extraction within major watersheds or groundwater areas (Oregon Water Resources Department 2008).

Groundwater regulation was brought into the prior appropriation framework in the 1950's, though not all groundwater uses are regulated. Under Oregon's Water Code, some surface water and groundwater uses are exempt from permitting. In particular, single domestic, industrial, and commercial uses, as well as group domestic uses are exempt from groundwater permitting (Oregon Water Resources Department 2008). These uses may be cumulatively significant and have become an increasing concern in the State (Odell 2008).

Though State laws support instream flow conservation, the federal *Endangered Species Act* and *Clean Water Act* play important roles in protecting and restoring instream flows. The *Endangered Species Act* has been in place since 1974. Since that time, Oregon, Washington, and California water users have developed unique approaches to meeting ESA requirements. Among other reasons, such approaches are developed to avoid lawsuits initiated by environmental groups pressuring for compliance with the Act. The *Clean Water Act* is often applied in conjunction with *Endangered Species Act* by the same federal agencies. In an attempt to address non-point source issues, the Act allows for specification of standards or Total Maximum Daily Loads for stream temperature and water pollution in individual waterbodies (US EPA 2009). Due to the strong correlation between stream temperatures and flows, actions to improve instream flows are a common focus of both the *Endangered Species Act* and the *Clean Water Act.*

In 1995, Oregon passed a law (House Bill 3441) allowing for the creation of Watershed Councils as a way to address stream habitat and water quality issues on private land. Their creation was motivated, in part, by concerns about habitat for coho salmon, which were being considered for listing under the *Endangered Species Act* in the Pacific Northwest. This action was further supported by legislation to create the Oregon Watershed Enhancement Board in 1999 (Progressive Policy Institute 2003). Watershed Councils are voluntary groups formed by local governments that are required to represent all interests in a basin in a balanced way. They are supported financially and logistically by the Oregon Watershed Enhancement Board (Oregon Watershed Enhancement Board 2009).

A summary of instruments associated with the above laws is provided in Table 8.

TABLE 8. Summary of regulatory / policy instruments being used to manage water and enable protection of instream values in Oregon.

Instrument	Description of instrument
Basin plans	Under Oregon water law, planning is done at a large watershed scale, termed 'basin programs'. Such planning provides administrative rules for 18 of 20 major river basins in the State. Any new water uses are based on basin-specific considerations that allow water management to address local needs. Some surface waters and aquifers may have restrictions or be closed to new water appropriations. With the exception of critical groundwater areas, restrictions do not affect existing water uses (Oregon Water Resources Department 2008).
beneficial use	One of the provisions of Oregon's Water Code is the principle of beneficial use without waste for users of both surface and ground water. This provision pertains to the management of water use authorizations in particular and could be a tool for conservation. However, waste is generally subjective and has very little enforcement history to define it (Tony Justus, Oregon Water Resources Department, pers. comm.). If further defined it may be a much more effective tool in the context of where groundwater use is fully managed and audited.
Conserved Water Program	The Conserved Water Program[17] provides incentives to water rights holders to conserve and use water more efficiently. Water saved through conservation can be used for new uses including irrigation of new fields under a specific authorization process. A percentage (75%) of conserved water may be re-allocated and the percentage (25%) returned to the environment can increase dependant upon the percentage of public money the state or federal governments have contributed towards the conservation project (Tony Justus, Oregon Water Resources Department, pers. comm.).
Instream water rights	Since 1987, the Oregon Departments of Fish and Wildlife, Environmental Quality, and Parks and Recreation can legally apply for instream water rights. Instream rights have a priority date and are regulated in the same way as other water rights. Holding instream water rights does not, however, guarantee a certain quantity of instream flow. In many watersheds, such as the Walla Walla, water is over-appropriated by rights dated before 1987, meaning that instream water rights won't provide benefits for ecological needs. Nevertheless, as part of the process for determining instream water rights, Oregon has designated appropriate monthly flows for each month of the year in specific stream reaches (Oregon Water Resources Department 2008).
Water trading	Water trading is enabled by the Oregon non-profit Freshwater Trust whose mandate is to preserve and restore freshwater ecosystems. In certain watersheds, water rights are bought or leased to return flows to streams.[18] Oregon law allows water right holders to sell, lease, or donate water rights that can be used to protect instream water rights.
Groundwater administrative areas	Groundwater administrative areas have been designated in Oregon at 23 locations covering < 4% of the state; 7 are "Critical Groundwater Areas" where use is restricted to stabilize declines in groundwater, 14 are "Classified" where new water rights are restricted to a few designated uses, and the remaining 2 are "Withdrawn" where no new groundwater rights are allowed. These areas were created to address groundwater supply and/or interference concerns by order of the Oregon Water Resources Commission (Grondin 2007). Critical groundwater areas must be designated by law when groundwater pumping exceeds natural long-term replenishment. As part of subsequent restrictions, some water users may get preference regardless of priority date. Critical groundwater areas can also be designated if there is interference between wells and senior surface water users or deterioration of groundwater quality. The final order may restrict both existing and future withdrawals to stabilize declines (Oregon Water Resources Department 2008). Establishing critical ground water areas has been an important initiative but can generate significant public opposition. Part of the resistance may relate to a lack of understanding about the role and function of groundwater.
ESA recovery plans	Under the ESA, recovery teams are formed to address conservation concerns of individual listed species. Teams develop recovery plans and critical habitat designations. Plans and designations are not legally binding except for actions undertaken by federal agencies; rather they serve as templates to guide fish, water, and habitat management. (Walla Walla Basin Watershed Council 2003).

[17] Oregon Water Trust. "Improving Streamflow—The Tools We Use". Available from: www.owt.org/solutions.html

[18] More information on buying, leasing, and trading instream water rights can be found at: http://www.thefreshwatertrust.org/projects/oregon-water-trust

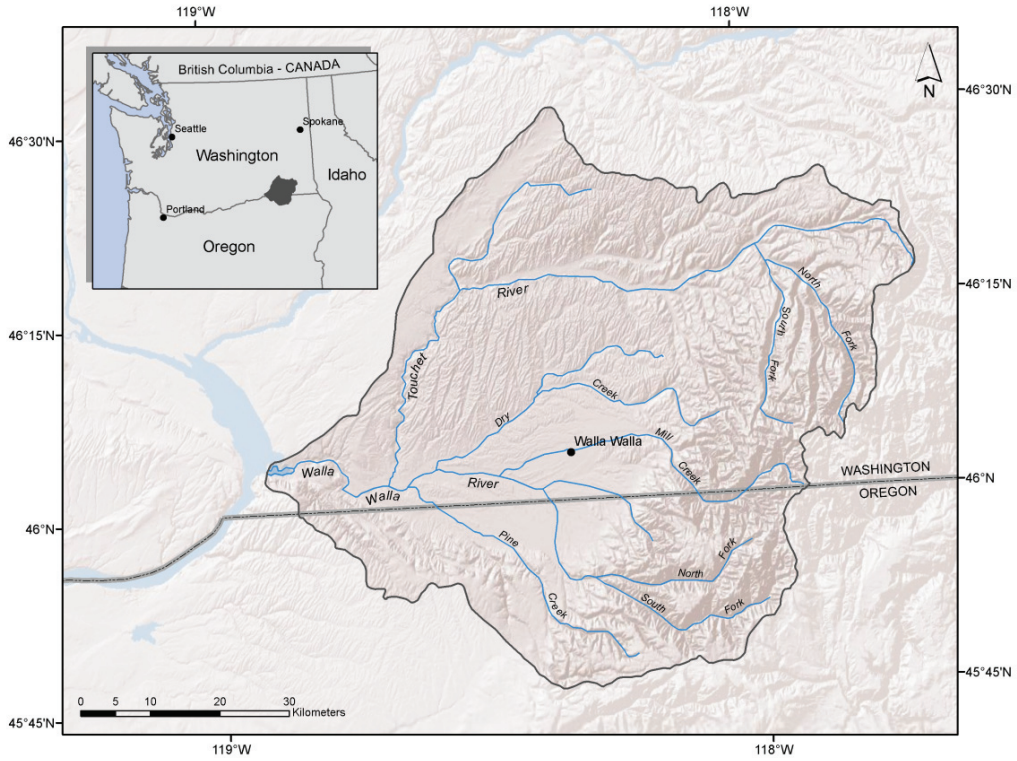
Instrument	Description of instrument
Habitat Conservation Plans	Habitat Conservation Plans (HCPs) identify actions to minimize the potential 'take' (death or harm) of Endangered Species Act (ESA) listed species. Participation is voluntary. If irrigators and land users comply with the agreements reached under HCPs and obtain incidental take permits, they will then not be liable for 'take' of a species under the ESA. Habitat Conservation Plans are not unique to Oregon, and are part of a federal program for management of endangered species (USFWS and NMFS 1996). The process is collaborative with all sectors. A HCP is intended to encourage long-term conservation and restoration plans that will benefit the ecosystem while providing economic stability to landowners and water users (Walla Walla Watershed Planning 2009).
Comprehensive Irrigation District Management Plans	Comprehensive Irrigation District Management Plans (CIDMPs) are a useful and voluntary tool with great promise to improve ecosystem health and compliance with the Endangered Species Act and Clean Water Act. They represent a Washington State mechanism that was developed collaboratively and adopted for the Oregon portion of the Walla Walla Basin (Walla Walla Basin Watershed Council 2009a). A CIDMP provides guidance for water management and establishes requirements for some practices. It is meant to serve an important part of Habitat Conservation Planning and as a baseline reference for ensuring all reasonable steps to minimize species 'take' under ESA (Walla Walla Basin Watershed Council 2003). Currently, they are not as successful as hoped. Individual irrigators fear that by forming an irrigation district or joining together to complete a CIDMP, they would become a target for federal agencies under the ESA, who to-date have only pursued actions against larger irrigators (Bob Bower, Walla Walla Basin Watershed Council, pers. comm.).
Oregon Plan for Salmon and Watersheds	This plan was founded in 1997 as a 'homegrown' response to listings of coho and other salmon species under the federal Endangered Species Act. It has evolved and expanded into an unprecedented statewide program to preserve and profit from Oregon's natural legacy. In many watersheds, implementation is led primarily by watershed councils, as well as soil and water conservation districts. It is based on voluntary and coordinated actions, monitoring, and strong scientific oversight by the Independent Multidisciplinary Science Team (IMST) (State of Oregon 2009). Evaluation of the scientific basis of programs by IMSTs provides the public, the Governor, and the Oregon legislature with a frame of reference when struggling with policy decisions affecting the Plan's implementation.[19] The Plan is intended to avoid regulatory actions and rely on a spirit of volunteerism and stewardship that is seen to be characteristic of Oregon (State of Oregon 2009). The Oregon Watershed Enhancement Board and local watershed councils are part of these efforts.
Groundwater fees	In the last several years, many new wells have required metering. Well head fees, water right fees, or other user pay structures may be used in the Umatilla Basin, an area that has been planning to recover and conserve critical groundwater supplies into the future (Umatilla County 2008).
Watershed councils	Oregon supports local watershed councils in law as a response to water conflicts, and in recognition that it is essential to enlist private property owners as part of multi-stakeholder efforts for managing water. According to Oregon State statute, a watershed council is "a voluntary local organization designated by a local government group convened by a county governing body to address the goal of sustaining natural resource and watershed protection and enhancement within a watershed." (Oregon Watershed Enhancement Board 2009). Watershed councils are bodies enabling public involvement and coordinating activities, including management of water for the protection of instream values. Councils are also registered charities. The Walla Walla Basin Watershed Council is one example of this grassroots approach, which is seen to be an effective way of managing non-point source issues. The primary mission of watershed councils is to develop trust among landowners and to help them collaborate on scientifically sound plans to restore salmon and improve water quality (Progressive Policy Institute 2003). An independent analysis describes watershed councils as helping demolish the bureaucratic silos isolating State agencies and suggests that watershed councils have become as much a part of the State's culture as the salmon they work to protect (Progressive Policy Institute 2003).
Oregon Watershed Enhancement Board	The Oregon Watershed Enhancement Board (OWEB) provides significant funding for watershed efforts. The Board was created in 1999 as an independent State agency with members from State and Federal authorities, Tribes, academia, and the public. OWEB awards approximately $25 million annually for watershed assessments and watershed improvement efforts, as well as salaries for watershed council coordinators and staff. It also provides watershed councils and landowners with technical assistance and data. Revenue is largely from state lottery funds, a federal salmon recovery program, and a salmon license plate program (Progressive Policy Institute 2003).

[19] More information on the Independent Multidisciplinary Science Team can be found at: http://www.fsl.orst.edu/imst/

3.2.2 WALLA WALLA RIVER WATERSHED

The Walla Walla River drains into the Columbia River, with headwaters that originate in both Oregon and Washington (about 1/3 of the watershed is in Oregon, Figure 8). The watershed spans a highly productive agricultural area, with waters that have been oversubscribed for more than a century—sections run dry each irrigation season. Until enforcement of the *Endangered Species Act* triggered actions to release more flows, every summer bull trout, steelhead, and other species were being salvaged from pools isolated by low flows.

FIGURE 8. Overview map of the Walla Walla River watershed spanning Oregon and Washington.



Since 2001, the river has remained wetted due to a flow agreement among major irrigators. Bull trout and steelhead were listed as endangered under the ESA in 1998 and 1999, respectively. In 2000, the US Fish and Wildlife Service and National Marine Fisheries Service began enforcing their endangered species protection policies and brought action against three major irrigation districts. At the same time, environmental groups expressed intentions to use provisions under ESA to bring legal action against the irrigation districts. Districts responded proactively by working with all parties to develop a successful flow agreement. The cooperative resolution of this conflict is seen as a model for other areas. It is noteworthy, however, that the irrigation districts are not responsible for all irrigation in the basin (Filippi 2000). Other users, particularly individuals, have not yet agreed to similar measures. There is also an unresolved concern about Washington water users taking their entitlements from water released for instream use by irrigation districts.

Habitat Conservation Planning under the ESA is an ongoing bi-State (Washington and Oregon) process that involves major water users. The primary focus is to increase flows to reduce water temperatures and resolve low flow concerns. Many groups are also involved in efforts to improve poor habitat conditions—many habitat issues have been addressed while others could still be improved (Bob Bower, Walla Walla Basin Watershed Council, pers. comm.).

Stakeholders have been very involved in ongoing efforts to develop solutions for the watershed. In both Oregon and Washington, stakeholder involvement is supported by the State. The Walla Walla Basin Watershed Council[20] was established in Oregon in 1994 as one of many councils authorized by law. Under Washington law, planning units[21] have been convened for various watersheds. As in Oregon, these planning units are collaborative multi-stakeholder groups supported by scientists and public servants. Washington has also been pursuing changes in its regulatory environment (Siemann and Martin 2007). As well, both States have been increasing research and monitoring to provide the information needed to better manage surface water and groundwater within the basin.

The Watershed Plan developed by the Walla Walla Watershed Planning Unit in May 2005 is one of Washington State's responses to addressing flow needs in the basin. In the Watershed Plan, recommendations guide future instream flow appropriations, modifications of existing stream closures, and use of winter and spring high flows for water storage projects that improve conditions for salmon production (Washington State Department of Ecology 2009). As a result of this planning, a revised 'rule' (Washington Administrative Code 173-532) was adopted by the Department of Ecology that established instream flow water rights and protective measures to avoid injury of existing water rights from future appropriations.

Both Washington and Oregon exempt numerous wells from permitting which may collectively contribute a significant cumulative impact on water resources. In response to this concern, existing Washington rules were amended in 2007 to regulate wells on gravel aquifers that were previously exempt. The rule disallows new commercial and industrial groundwater uses, and describes new restrictions on livestock watering (Cronin 2008). An additional component is a program for water trading among new and exempt well owners. New well users now need to become involved in mitigation efforts to provide an instream water equivalent for the amount they extract for outdoor use. The Washington Water Trust is involved in and designed the mitigation plan (Cronin 2008).

In Washington, the Walla Walla has been a trial area for a 'flexibility for flows' initiative being spearheaded by the Director of Ecology. If water users can commit to delivering prescribed flows and design an approach for achieving those flows, the State will seek the needed authority to allow water to be managed locally and more flexibly (Walla Walla Watershed Planning Unit 2008). This approach is using alternative legal tools, collaboration, and science to remove existing disincentives and provide new incentives that ultimately give local water users greater flexibility. As part of these changes, stakeholders hope Washington will support a basin-wide governance body that will improve integrated management (Walla Walla Watershed Planning Unit 2008). Recent news suggests legislation may be passed in 2009 to support this new governance body.[22]

In Oregon, the work of the Watershed Council has allowed for many innovative pilot projects, such as aquifer recharge, that could be applied at a larger scale. Other projects are investigating water balance, water efficiency, storage, pulsing flows for migration, and conjunctive management.

Managers and stakeholders are still learning about the importance of conjunctive surface water and groundwater management. For instance, after implementing improvements in irrigation efficiency and conservation projects, instream flows were augmented in the main river but reduced / eliminated in a tributary (Bower and Petrides 2009). In the past, aquifer recharge was primarily accomplished through irrigation inefficiencies. When irrigation efficiency increased, surface water gains for fish in the main tributaries were generally due to a net loss of aquifer recharge. In other words, the significant amounts of water that used to infiltrate into aquifers due to

[20] More information on Oregon's Walla Walla Basin Watershed Council (http://www.wwbwc.org) and Washington's Walla Walla Watershed Alliance (http://www.wwwalliance.org/) can be found at these web sites.

[21] See www.wallawallawatershed.org for the Washington Planning Unit

[22] Walla Walla County Watershed Planning. April 2009. Newsletter. Volume 7, Issue 2. Available from: http://www.wallawallawatershed.org./_acrobat/newsletter/news_Apr09.pdf

wastage from inefficient irrigation practices were flowing directly into the river and the once perennial springs that returned cooler groundwater to the river were flowing only intermittently or were nearly dry. This change led to a loss of off-channel rearing habitat and likely a net increase in river temperatures (Bower and Petrides 2009). To address such concerns, a pilot aquifer recharge program has been established. This experience is beginning to shift thinking about salmon recovery efforts from a surface water only mindset to one in which surface water and groundwater interactions are taken into account. Such projects contribute important insights and provide the potential to address long-term declines in groundwater resources that have been evidenced in the Walla Walla valley for many decades (Bower and Petrides 2009), if done together with management of groundwater uses.

The 'Walla Walla Way' is cited as a model of cooperation among a range of groups and individuals in both Oregon and Washington. People representing disparate interests are working together without a requirement to agree. This situation is in contrast to the 'water wars' seen in Oregon's Klamath River basin (Doremus and Tarlock 2008). There are many overlapping groups and jurisdictions involvement in water and habitat management in the Walla Walla. In fact, so many groups are involved that they are sometimes working inefficiently or at odds with each other.

It is noteworthy that the intensive bi-State efforts to improve conditions in the Walla Walla seem to be driven largely by species listings under the *Endangered Species Act*, and the requirements of the *Clean Water Act*; though some actions to restore extirpated species are motivated by protection of treaty rights. Much is being learned in the basin and in some cases current efforts are pushing up against existing laws. For instance, Washington State is confronted with this situation as they make efforts to institute their 'flexibility for flow' program and explore new governance options.

3.2.3 OUTCOMES IN OREGON AND WASHINGTON

Both Washington and Oregon are working towards solutions to address difficult challenges around protecting instream values. In the Walla Walla River watershed, instream flow orders have ensured that some level of stream flow is maintained year-round, while bi-State Habitat Conservation Planning and other efforts continue. A variety of other tools are available, but not enough time has passed to assess their effectiveness. It will be interesting to compare the different approaches in the two States over time. Washington has strong institutional and financial support, and a high level of public understanding and engagement (Victoria Leuba, Washington State Department of Ecology, pers. comm.), while Oregon supports a strong culture of watershed councils, and has a history of less regulatory involvement than Washington.

At the same time that flow conditions are being improved in the Walla Walla, habitat conditions are being addressed by the various watershed councils and planning units. The rewatered system has come to life, with kingfishers, beavers, salmon and other fish species returning. Better irrigation district management has helped to make up for the water left instream, and the collaborative process has attracted innovation and funding, and fostered trust among the basin partners (Bob Bower, personal communication).

Groundwater is not yet managed conjunctively in Oregon or Washington, but there is a growing recognition of the need to do so. Both states have exemptions for wells used for domestic and other purposes. These wells are essentially unregulated and unmetered, their numbers are growing, and managers are increasingly recognizing the significance of their effects. In Washington, more restrictions are being applied to these wells in the Walla Walla. In Oregon, groundwater and surface water are still managed separately though connectivity is well understood. New groundwater rights for non-exempt purposes are issued only when it can be shown there will be no significant impact on surface waters, or when evidence proves there is sufficient water available in the

aquifer. However, limitations in staffing and funding restrict collection of the necessary data for making timely management decisions. (Bob Bower, Walla Walla Basin Watershed Council, pers. comm.).

In Oregon, legislation has recently been tabled to address concerns about well exemptions. The proposal lowers single domestic use thresholds to 5,000 gallons per day from 15,000 and allows the Oregon Water Resources Department to require permits in limited and critical groundwater areas. A $250 fee for certain uses was also proposed (Odell 2008). A stakeholder dialogue was convened by The Oregon Consensus to seek consensus on what to do with the State's policy on groundwater exemptions. Participants did not come to agreement about extensive changes, but did recommend the Water Resources Department collect more information in locations with new exempt wells and increase funding for more studies on groundwater resource management (Oregon Consensus 2009).

3.3 OLDMAN RIVER, CANADA

Canada's western prairie provinces (Alberta, Saskatchewan, and Manitoba) lie in the rain shadow of the Rocky Mountains. Due to their geographic location and the surrounding topography, they are the driest large area in southern Canada (Schindler and Donahue 2006). Regions such as the western prairie provinces have been identified by the Millennium Ecosystem Assessment[23] as "hot spots" for future degradation due to the coupled effects of climate change and human pressures (Schindler and Donahue 2006). Alberta has been afflicted by serious droughts in the past[24] and an increase in water scarcity in the prairies has been identified as one of the most serious threats due to climate change (Sauchyn and Kulshreshtha 2008). Currently, the southern part of the prairie provinces receive on average 30 to 40 cm of rain per year and suffer from chronic water shortages (Percy 2005).

Alberta's water management challenges are driven by transboundary passage, water scarcity, population growth, and large economic demands for water. These challenges have parallels to water use in the oil and gas sector of the Peace and the irrigated agricultural sector of the Okanagan in B.C. Alberta is divided into seven major transboundary basins which flow into adjacent jurisdictions: the Milk River (through Montana into the Mississippi River), South Saskatchewan, North Saskatchewan, and Beaver Rivers (through Saskatchewan and Manitoba into Hudson Bay), and the Peace/Slave, Athabasca, and Hay Rivers (through Northwest Territories into the Mackenzie River)[25]. Consequently activities in Alberta, such as the oil sands development in the Athabasca River Basin, have the potential to adversely affect communities and freshwater ecosystems in downstream jurisdictions (e.g., Holroyd and Simieritsch 2009). Decreasing annual flow in some of Alberta's southern rivers has also become a significant concern (Rood *et al*. 2005). The majority of Alberta's population lives in the south, while the majority of the province's water tends to flow north (Wilkie 2005). This geographic disconnection between human needs and natural availability creates occasional water shortages during times of heavy water use (Alberta Environment 2004 as cited in Wilkie 2005). In many parts of Alberta, particularly in the southern regions, rivers have been fully allocated to industrial, agricultural, and municipal uses (de Loë 2008). In northern basins, more than half of the allocated water is for energy production (i.e., to extract and upgrade bitumen, and to use as cooling water for power plants, Griffiths and Woynillowicz 2009). Alberta supports 60% of Canada's irrigated cropland (Harker *et al*. 2004 as cited in Sauchyn and Kulshreshtha 2008), and as a result this sector is the largest consumer of water. In 2007, the majority of water in the province was allocated for irrigation, commercial (cooling), and municipal uses (42%, 24%, and 12%, respectively, Griffiths and Woynillowicz 2009). Pressures on groundwater are also high with 23% of Albertans acquiring their potable water from wells (Environment Canada 2004 as cited in

[23] Millennium Ecosystem Assessment. "Guide to the Millennium Assessment Reports". Available from: www.maweb.org

[24] In the1930s drought conditions created the "dust bowl" of the mid-west. Again in 1998-2004 drought conditions led to severe water shortages in the southern portion of the province, particularly in 2000-2001 (de Loe 2008).

[25] State of the Environment—Water. "Alberta's Water Resources". Available from: http://www3.gov.ab.ca/env/soe/water.html

Sauchyn and Kulshreshtha 2008). Compounding the above situation is the fact that the areas currently undergoing the most rapid growth and economic development are not located in areas where the majority of Alberta's freshwater supplies are found (Wilkie 2005).

3.3.1 ALBERTA WATER LAWS AND SUPPORTING INSTRUMENTS

Responsibility for water management was transferred from the federal government to Alberta in 1931. The provincial *Water Resources Act* (1931) carried forward the system of water management established by the federal government in 1984 under the *Northwest Irrigation Act*. This historical legacy is why Alberta water law is based on a "first-in-time, first-in-right" doctrine, and this legacy of priorities and uses continues to affect water laws and regulations today (Rush *et al*. 2004).

As with many other jurisdictions, water licensing decisions represent the most significant water management tool for maintaining instream flows in Alberta (Wenig *et al*. 2006). Relatively recent changes in Alberta's water allocation system have attempted to improve water management in the province given increasing conflicts. For instance, in 1991 creation of the South Saskatchewan River Basin Water Allocation Regulation (1991)[26] effectively limited expansion of irrigation projects in this Basin (see further discussion below). In 1999, the *Water Resources Act* was officially replaced by the *Water Act*[27]. Currently, this Act provides the legal foundation for water management in Alberta and governs allocation and management of water and requires individuals, corporations, and municipalities. In particular, it sets out the requirements for a water license and authorizes the diversion or use of a specific amount of surface water or groundwater. Compared to preceding laws, the *Water Act* greatly increases the flexibility of Alberta's water allocation system, such that water licenses can now be transferred to existing, new, or alternative uses (Rush *et al*. 2004; Percy 2005).

Major changes under the *Water Act* include provisions that allow temporary and permanent transfers of water (Section 82). Prior to the *Water Act*, water licenses could not be transferred separately from the land to which they were attached. To safeguard public and environmental interests, the *Water Act* only allows the consideration of a water allocation transfer if it has been authorized in either an approved water management plan or by an order of the Lieutenant Governor in Council[28] (Percy 2005). All water transfers are voluntary in nature whether they be for a portion or an entire allocation (i.e., there can be no compulsory transfers of water, dictated by the Province, under the current *Water Act*). Another change to Alberta's water law is that applications for water allocations now require an evaluation by the provincial environmental protection and environmental assessment regimes (Section 5). The implication is that applicants are required to provide public notice of the application for a new license, and any person that may be directly affected is allowed to submit a statement of concern (Percy 2005). In the event that a license is granted, individuals who submitted a statement of concern can file an appeal to the Environmental Appeal Board. These procedural requirements result in an increase in the probability that environmental concerns are heard and help guide water licensing decisions (Percy 2005).

A Director is appointed by the Alberta Minister of Environment to administer all or part of the *Water Act*. The Director holds tremendous discretionary powers and maintains responsibilities to develop a Water Management Plan for the region they are appointed to administer (Rush *et al*. 2004; Percy 2005). They can issue water management orders, dictate water management areas, prioritize water use in the event of disputes (with the exception of household uses), and issue license transfers (Sections 81, 84, and 30; Rush *et al*. 2004). With

[26] Refer to Appendix E in Alberta Environment (2002) for the regulation. Available from: http://environment.gov.ab.ca/info/library/7472.pdf

[27] The *Water Act* was passed by Cabinet in 1996, but did not come into force until 1999.

[28] The Lieutenant Governor in Council can only issue approval on the advice of the provincial Cabinet. Likewise, water management plans must be approved by the provincial Cabinet.

respect to license transfers, the Director must apply the principle of no net harm, wherein the transfer of the license must not result in any harm to the aquatic environment or impair the rights of other users (Percy 2005). Under the *Water Act* the Director also has the ability to hold back up to 10% of the water being transferred between entities. This action is known as a "water conservation holdback" and is designed to protect aquatic environments by enabling implementation of water conservation objectives (WCO; Section 83). However, unless water conservation objectives (or any other environmental objectives) are documented in an approved water management plan, there are no guarantees they will be fully addressed (Percy 2005).

Alberta Environment is the principle authority overseeing water use in the province and administering the *Water Act* (e.g., approving licenses, enforcing water takings, etc.). However, other organizations have authority over certain aspects of water use (Rush *et al*. 2004). For example, irrigation districts are authorized to allocate water to farmers based on their assigned role or agreements they may have with individual farmers. Irrigation districts can also implement broad and special measures, such as the efficiency measures put forth by the Lethbridge Northern Irrigation District (see Table 9), and can assert authority to enter into water sharing agreements. Similarly, municipalities have the authority to restrict water use by users connected to municipal systems by implementing water restriction by-laws and other conservation measures (Rush *et al*. 2004).

Most recently, the provincial government released *Water for Life: Alberta's Strategy for Sustainability* in 2003 as a means to address current and future water management challenges (Alberta Environment 2003b). *Water for Life* is a non-binding strategic plan that outlines the province's vision for water management. The plan centers around three primary goals: (i) safe and secure drinking water; (ii) reliable quality water supplies for a sustainable economy; and (iii) healthy aquatic ecosystems (Alberta Environment 2003b). To achieve these goals, *Water for Life* highlights the need for greater involvement of local stakeholders in water management at the watershed scale (Rush *et al*. 2004), as well as focusing on research and monitoring, implementation of water conservation measures, and the establishment of partnerships. It is important to note that these partnerships have no regulatory power, however, and have limited ability to offer financial or other types of incentives to encourage sustainable water use (Rush *et al*. 2004).

A summary of instruments associated with the above laws and strategies is provided in Table 9.

TABLE 9. Summary of regulatory/policy instruments being used to manage water and enable protection of instream values in Alberta.

Instrument	Description of instrument
Water management plans and guidelines	The *Water Act* requires the Director to create a water management plan and water guidelines. The water management plan establishes water management principles for various areas in Alberta, and the guidelines set out how these principles will be implemented.
Southern Alberta Sustainability Strategy (SASS)	SASS[29] will involve Albertans in developing a vision of the future of Southern Alberta and the desired environmental, social and economic benefits for the region. The first phase of the SASS—*Defining the Agenda*—will evaluate the current state of the region, identify a vision, goals, and principles for sustainable development, make policy recommendations and identify the key issues that need to be addressed and in their order of priority. The plan developed under SASS will address water resources in relation to local economic development (Rush *et al*. 2004).
Water allocation transfer	The *Water Act* allows for the temporary and permanent transfer of water to existing, new, or alternative water uses (Section 82). Water allocation transfers must be approved by either an approved water management plan or by an order of the Lieutenant Governor in Council. To be approved, water transfers must follow the principle of no net harm, wherein transfers of licenses must not result in any harm to the aquatic environment or impair the rights of other users.
Involuntary license amendments	The *Water Act* enables the Director to amend a water license to address adverse effects on freshwater environments that were not anticipated upon issuance of a license. Licensees require compensation for losses and this provision only applies to licenses issued after January 1, 1999. Thus, the effectiveness of this tool is limited given the recent date at which it can applied (Wenig *et al*. 2006)
Water reservations	The *Water Act enables* the Environment Minister to "reserve" unallocated water for a specified use. Protection of instream flows could be considered an appropriate use. This tool is only appropriate in areas that are not fully allocated (Wenig *et al*. 2006).
Water Conservation Objectives (WCO)	WCOs relate to the volume and quality of water to remain in rivers for the protection of a natural water body and its aquatic environment (Wenig *et al*. 2006). More specifically, a WCO describes the amount and quality of water established by the Director that is necessary for the: (i) protection of a natural water body or its aquatic environment; (ii) protection of tourism, recreational, transportation or waste assimilation uses of water; or (iii) management of fish or wildlife, and may include water necessary for the rate of flow of water or water level requirements (Percy 2005). WCOs are flow targets under the "*first-in-time, first-in-right"* priority water allocation system and will apply to all new licenses and existing licenses with a retrofit provision.
Water conservation holdbacks	The *Water Act* permits the Director to hold back a portion of water (up to 10%) during a license transfer. A "water conservation holdback" is designed to protect aquatic environments and facilitate implementation of WCOs (Wenig *et al*. 2006). Where the Director withholds water from a transfer, the *Act* creates three options: (i) the withheld water may remain instream for the purpose of providing or maintaining minimum flow requirements; (ii) the water may be reserved from the general allocation scheme; or (iii) it can be allocated to the government under a license. Under the third option, the license would retain the same level of priority as the original license from which the holdback was taken, thereby creating the possibility of allocating water to instream flows with a senior water license (Percy 2005).
Water diversions	The *Water Act* prohibits water diversions between the province's 7 river basins, though special Acts of Legislature can grant basin-to-basin transfers. There is no formal policy on water diversions within river basins, however. Applications for diversions within a basin are dealt with through the existing water licensing regime, despite concerns about the adverse environmental, socio-economic, and cumulative impacts of such activities. To-date, water shortages have resulted in approvals of 3 cross-basin and 5 within-basin diversions of water (Beveridge and Droitsch 2008).

[29] For more information on the Southern Alberta Sustainability Strategy (SASS) see: http://www3.gov.ab.ca/env/regions/southern/strategy.html

Instrument	Description of instrument
Multi-stakeholder partnerships	Three types of partnerships were created under Water for Life: (i) Provincial Water Advisory Council (aka the Alberta Water Council); (ii) Watershed Planning and Advisory Councils; and (iii) Watershed Stewardship Groups. These partnerships allow water issues to be addressed at different scales (provincial, watershed, and local), and allow multiple perspectives to come together and discuss specific issues (Alberta Wilderness Association *et al*. 2007).
Wetland compensation	In "white zones" of the province (i.e., settled portions), the *Water Act* requires proponents of a project to obtain approval before undertaking a construction activity in a wetland. Construction activities include, but are not limited to, disturbing, altering, infilling or draining a wetland. Wetland compensation is achieved through restoration of a drained wetland and should take place within the same watershed as the impacted wetland, or in a watershed close by (Alberta Environment 2005). Where appropriate, compensation can require applicants to pay into a fund established for wetland restoration.
By-laws and regulations for irrigation efficiency	Irrigation districts have taken measures to promote water conservation and efficient use of water at both district and landholder scales. Several irrigation districts have worked to develop strict scheduling guidelines, so water is not diverted through ditches or pipes when not needed. All districts have by-laws or policies that limit spillage. For instance, the Lethbridge Northern Irrigation District has a policy that limits the annual volume of water distributed within the district based on known availability. In early spring the district publishes an estimate of available water supplies so irrigators are better able to make water use decisions (e.g., selection of crop variety, irrigation schedule, etc, Rush *et al*. 2004). Several irrigation districts are also considering improvements in water distribution technologies, and by-laws limiting the amount of water available to an irrigator in any given year (Rush *et al*. 2004).
Funding for research in technology and innovation	Several governmental and non-governmental organizations are involved in efforts to improve water conservation and reduce water use, mainly in the energy sector. The Alberta Water Research Institute (in part through the Alberta Ingenuity Fund[30]) and Alberta Energy Research Institute are conducting research around water treatment and recycling in the oil and gas sector and water conservation in the electricity sector. Similarly, the Institute for Sustainable Energy, Environment and Economy at the University of Calgary, the Alberta Research Centre, CANMET Energy Technology Centre, and Petroleum Technology Alliance of Canada have been involved in research to stimulate water use efficiency, innovation, and the transfer of knowledge within Alberta's energy sector (Griffiths and Woynillowicz 2009). Despite this research some have stated that the pace of energy development and water use has been much faster than the pace of research to support greater conservation and protection of water resources (Rosenberg International Forum on Water Policy 2007).

[30] Alberta Ingenuity Fund. October 3, 2007. "Water Institute to fund innovative, practical water research." Available from: http://www.albertaingenuity.ca/node/163

3.3.2 OLDMAN RIVER WATERSHED

The headwaters of the Oldman River watershed originate in the Rocky Mountains flowing east through the foothills and onto the prairies before joining the Bow River to become the South Saskatchewan River (Figure 9). The watershed is one of four sub-basins within the South Saskatchewan River Basin in Alberta. Seasonal and year-to-year flows are highly variable with about 60% of the annual flow passing in June and July, and inter-annual changes from extreme highs in one year to extreme lows the next. Given the high temporal variability in flow, dams (such as the Oldman River Dam) have been developed as an important tool for water managers to moderate flows and maintain storage across seasons and years (Glenn 1999). The cooler headwaters are populated with trout (including a limited distribution of bull trout) and mountain whitefish, while warmer downstream reaches are populated with pike and walleye. The shorthead sculpin is a threatened fish species occupying the watershed. Water scarcity is currently affecting instream resources. In a recent assessment of the riparian and aquatic condition in the South Saskatchewan River Basin, 31 of 33 reaches were deemed as having near, approaching, or below acceptable conditions. Further, planners within the Basin conclude it is impossible to maintain instream flow needs in low flow years (Alberta Environment 2003a).

FIGURE 9. Overview map of the Oldman River watershed in Alberta.

Human activity and water use in the Oldman River watershed have evolved over a long, complex, and unique history (see Glenn 1999). Of particular relevance is a water sharing agreement (*Master Agreement on Apportionment*) following the Second World War which established flow obligations on the South Saskatchewan River among Alberta, Saskatchewan, and Manitoba. As part of this agreement, Alberta was allowed to meet its downstream flow obligations using water from the Red Deer, Bow, and Oldman River sub-basins. Consequently, changes in water takings in one sub-basin have implications on withdrawals and instream flows in the others.

The Oldman River is a highly allocated system with approximately 65% of natural flows already allocated (Government of Alberta 2006 as cited in Sauchyn and Kulshreshtha 2008). Irrigation districts, industries, and municipalities are the largest users of surface waters, with irrigated agriculture being the single largest consumer. Few communities draw upon groundwater to supplement surface water takings (Rush *et al*. 2004). Low summer rainfall and high summer temperatures mean the agriculture in the region is largely reliant on irrigation. Nine Irrigation Districts draw water from the watershed using a series of reservoirs, canals, pipes, and sprinklers to irrigate 16% of the watershed (Glenn 1999). Of these, five are the largest users, with the Lethbridge Northern Irrigation District drawing from a reservoir created by the Oldman River Dam. The remaining four draw from reservoirs in the tributary St. Mary, Belly, and Waterton Rivers (i.e., St. Mary's, Park Lake, and Waterton Reservoirs)[31]. In times of scarcity, dams, reservoirs, and diversions are rarely operated for purposes other than out-of-stream uses. Water management for instream needs is further complicated by perceptions among irrigators that water is wasted if it flows unused downstream to the Hudson's Bay (Glenn 1999).

The construction of dams in the watershed has been accompanied by benefits and conflicts. The most notable example is the Oldman River Dam, constructed in 1992 primarily to mitigate the adverse effects of drought on farmers in southern Alberta. Benefits of construction included increasing diversity and capacity of agricultural production, providing a reliable and local source of hydroelectric power, and new recreational opportunities on the reservoir. Two sources of conflict accompanied its construction. First, the Piikani (Peigan) Nation was not sufficiently consulted when the dam was built despite the creation of a large reservoir within their traditional territory and construction of the dam infrastructure a few kilometers upstream of their reserve through which the Oldman River flows. Conflict came in the form of on-the-ground resistance and years of litigation and negotiation. In 2002, a negotiated settlement between the Alberta Government and Piikani Nation was reached (Nowlan 2004). A second source of conflict was initiated by the Friends of the Oldman River Society who were concerned about impacts of the dam on downstream aquatic, riparian, and wildlife communities and lack of environmental assessment by the federal government, who at the time were delegating responsibilities for managing inland fisheries to the provinces. The decision to forgo an assessment was later challenged and the Supreme Court of Canada forced the federal government into completing a review. The resulting process found that the environmental and cultural impacts of the project far outweighed the benefits and recommended the dam be decommissioned. Despite this finding, the project proceeded but not without dramatic changes to the legal landscape in Canada. The legal challenge established that the federal government had a significant and legislated role and responsibility for protecting fish habitat in Canada—a precedent that forever changed the scope of fish habitat responsibilities for Fisheries and Oceans Canada.[32]

The Oldman River and southern Alberta are increasingly vulnerable to the effects of climate change due to changes in human demands and water supplies (Alberta Environment 2002; 2005; 2006 as cited in Sauchyn and Kulshreshtha 2008). Population in the South Saskatchewan River Basin is expected to grow from 1.3 million in

[31] Welcome to the home page for the Oldman River. Available from: http://www.uleth.ca/vft/Oldman_River/Intro.html

[32] Oldman River Dam. Available from: http://www.uleth.ca/vft/Oldman_River/OldmanDam.html

Westcoast Environmental Law News 20(7) November 1, 1996. "Update on Delegation of fish habitat powers". Available from: http://www.wcel.org/4976/20/20_07.html#2

1996, to more than 2 million in 2021, and more than 3 million in 2046. Moreover, the southern Irrigation Districts have the potential to expand by up to 10%, and demand for non-irrigation is predicted to increase 35–67% by 2021 and 52–136% by 2046. By the 2050s, hydrological models predict a 4% decrease in mean annual flow at the mouth of the Oldman River (Pietroniro *et al*. 2006 as cited in Sauchyn and Kulshreshtha 2008).

As described above the *Water Act* allows for development of water management plans, though none have been officially approved by Cabinet (Wenig *et al*. 2006). The South Saskatchewan River Basin Water Management Plan represents one of the most advanced planning efforts that the province has adopted (Alberta Environment 2006). From the perspective of protecting instream flows in the Oldman Sub-Basin it includes some of the instruments described above. First, it recommends using a previously regulated Crown Reservation[33] as a mechanism by which to restrain new water allocations and license applications. New allocations would represent transfers from the Crown Reservation if consistent with a few designated uses, of which protection of instream flows was one. Second, it recommended establishing quantitative Water Conservation Objectives for specific reaches of the Oldman River[34], though these would only apply to applications received after May 1, 2005. Third, it recommended the Director consider applications for transfers of water allocations, and where appropriate withhold 10% of the volume of water being transferred if in the public interest to protect the aquatic environment. Fourth, changes to dam operations and restoration of flows for instream needs are encouraged, though voluntary in nature and without incentives. Lastly, it encouraged development of water markets and transfers to improve efficiency and productivity of water uses across the Basin. Despite the Plan's desire to balance human and ecosystem needs for water, it isn't clear whether these actions will be effective in protecting instream flows or resolving conflicts between instream and out-of-stream users. Water managers are still unable to cancel or amend existing licenses in systems that are over-allocated or where instream needs are not being met (Wenig *et al*. 2006). There are also concerns that this Water Management Plan doesn't sufficiently describe how environmental, hydrological, and cumulative effects will be considered when considering water diversions within Sub-Basins such as the Oldman, which could adversely affect instream values (Beveridge and Droitsch 2008).

3.3.3 OUTCOMES IN ALBERTA AND THE OLDMAN RIVER WATERSHED

Given the relatively recent announcement of Alberta's *Water for Life* strategy (Alberta Environment 2003b) and recent completion of the South Saskatchewan River Basin Water Management Plan (Alberta Environment 2006), it is early to determine the full effectiveness of these non-binding strategies at improving water management in Alberta and the Oldman. However, a recent call for renewal of *Water for Life* and reviews by others provide guidance on emerging weaknesses (Alberta Wilderness Association *et al*. 2007; Rosenberg International Forum on Water Policy 2007; AWC 2008; GOA 2008). Below we synthesize key insights emerging from these reviews as related to three relevant recommendations by the Alberta Water Council (2008): (i) address aquatic ecosystem degradation, (ii) integrate water and land management; and (iii) clarify roles, responsibilities, and accountabilities.

In regards to addressing ecosystem degradation, *Water for Life* does not identify and prioritize critical aquatic ecosystem areas / objectives and sufficiently support protection through mandatory tools entrenched in law (Alberta Wilderness Association *et al*. 2007; Rosenberg International Forum on Water Policy 2007; AWC 2008). Conservation holdbacks are considered insufficient in over-allocated watersheds and of limited strength given their discretionary nature. As well, Water Conservation Objectives do not provide new water for ecosystems in fully allocated watersheds, are unable to restore impacted ecosystems, and are of limited effectiveness given they have a junior priority relative to earlier allocations in time. In some cases, these objectives have also been

[33] The South Saskatchewan Basin Water Allocation Regulation (1991) reserved all unallocated water in the Basin for the Crown.

[34] Alberta Environment. "Establishment of Oldman River Sub-Bain Water Conservation Objectives" January 16, 2007. Available from: http://www.assembly.ab.ca/lao/library/egovdocs/2007/alen/158806.pdf

recognized as leading to an degradation of the rive. The government's response (GOA 2008) to these weaknesses is to "develop and implement an enhanced surface water rights transfer system that supports sustainable economic development", "develop a provincial action plan to improve the health of significantly impacted aquatic ecosystems", and "set water conservation objectives on all major basins".

As with other the case studies, *Water for Life*, has been recognized as insufficient in the way it integrates water and land management (Alberta Wilderness Association *et al*. 2007; Rosenberg International Forum on Water Policy 2007; AWC 2008). In particular, the strategy does not adequately recognize links between surface water and groundwater uses and the need to conjunctively manage this resource. Given relatively few restrictions on surface water in the past, pressures on groundwater have not been a high priority. However, as scarcity of surface water increases and restrictions increase, pressures on groundwater will also increase unless strong and effective groundwater regulations are implemented. The government's renewal plan is largely silent on actions to address this gap (GOA 2008), which is somewhat surprising given the prevalence of this problem in other jurisdictions.

As recognized by the Instream Flow Council, public involvement is critical for the protection of instream flows. In Alberta, a need has been identified to clarify roles, responsibilities and accountabilities of those involved in implementing *Water for Life* (Alberta Wilderness Association *et al*. 2007; Rosenberg International Forum on Water Policy 2007; AWC 2008). In particular, recommendations have been made to expand public awareness and build shared commitment. Currently the Alberta Water Council's role in water management is still evolving and there should be better representation of the public. The voluntary nature of stakeholder involvement has been recognized as a barrier to participation which could be overcome with better public funding. The Alberta government has acknowledged this weakness by recommending (GOA 2008) actions to "develop and implement a viable governance system that supports sustainable management of water" and "continue to resource and support Water for Life partnerships".

4.0 FACILITATING THE PATH FORWARD

Section 2.0 provides a general policy framework for resolving conflicts between instream and out-of-stream water uses. Effective policy design requires **defining the problem** that requires a policy solution, **articulating goals** (and objectives) that set the direction for a particular policy, and **designing policy instruments** to achieve the intended goals. Elaborating upon these policy elements, the enabling framework provides relevant objectives and an understanding of the general types of instruments needed for addressing the problems that will help British Columbia transition from the current situation (Section 2.2) to the one envisioned under Living Water Smart (Section 2.4). Section 3.0 reviews relevant laws and supporting instruments from other jurisdictions to provide insights and facilitate this transition.

The sections below use the policy context described earlier as a basis for synthesizing key findings from the case studies and other research to facilitate the path forward. In particular, a discussion about policy objectives helps highlight priorities and potential gaps with Living Water Smart (Section 4.1). A discussion about more specific instruments summarizes important considerations for strengthening existing or developing new tools for water managers (Section 4.2), many of which have been contemplated in B.C. (e.g., Westland Resource Group Inc. 2007; OWSC 2008). It is also recognized that there are benefits to designing and implementing instruments in a coordinated fashion (Section 4.3) and to being aware of the potential for unintended (and adverse) consequences on water resources (Section 4.4). Lastly, we recognize that good governance and effective institutions are crucial for successful implementation of Living Water Smart. In other words, relevant objectives and well designed instruments are insufficient without effective governance and supporting institutions. The solutions below deliberately ignore the role of governance and institutions largely because others are working on these topics in B.C. (e.g., Polis Project on Ecological Governance[35], Program on Water Governance[36], WGPT 2008).

[35] University of Victoria. Polis Project on Ecological Governance. "Water Sustainability". Available from: http://www.polisproject.org/researchareas/watersustainability

[36] University of British Columbia. "Program on Water Governance". Available from: http://www.watergovernance.ca/

TABLE 10. Association among policy objectives and generic regulatory / policy instruments.

Ecosystem component	Objective	Regulatory / policy instrument				
		Command and control regulation	Financial disincentives	Market oriented regulations	Financial incentives	Information and moral suasion
Legal	Ensure clear legal responsibilities for protecting instream values	X				
	Develop effective laws for protecting water rights of instream needs	X		X		
	Recognize appropriate water uses for protecting instream values	X	X	X	X	X
Institutional	Conduct comprehensive planning of instream flow programs	X			X	X
	Ensure effective implementation of instream flow programs				X	X
Public Involvement	Support public education				X	X
	Enable public engagement				X	X
Hydrology, geomorphology, biology, water quality, connectivity	Establish credible science to support decision making				X	X
	Implement effective management practices for protecting instream values	X	X	X	X	X

To develop effective solutions, it is additionally helpful to understand the relationship among the above policy objectives and regulatory / policy instruments available to address issues underlying these objectives (see Table 10). To develop lasting solutions, this alignment is important because *"instruments need to be paired with the objectives 'on which they have the most influence'"* (see Mundell's Assignment Principle as cited in Young and McColl 2005). For effectively resolving water use conflicts it is also worth noting that "*there is a need for at least as many instruments as there are goals or important dimensions to a problem*" (see The Tinbergen Principle as cited in Young and McColl 2005). Table 10 highlights that only some types of instruments can be used to address certain problems or achieve certain objectives.

4.1 POLICY OBJECTIVES

To facilitate the path forward, the broader list of objectives and related issues can be prioritized and compared to Living Water Smart. Objectives can be prioritized on the basis of the order in which regulatory and policy instruments need to be developed. Policy components (Figure 3) should be addressed before riverine components (Figure 4) because they are more strongly associated with early stages of policy implementation—the current status of Living Water Smart (riverine components are more strongly associated with on-the-ground science and management activities which can occur at a later time). Underlying several policy components are issues that represent some of the greatest challenges to protecting instream values. Thus, the broader list can be reduced to a subset of 4 objectives and 10 issues (see Table 11). A comparison of objectives and issues to Living Water Smart can reveal gaps or ambiguities—areas where additional work may be required. An initial comparison showed that Living Water Smart reflects all objectives in some way (Table 6). A closer examination, however, reveals that some policy issues are either **absent** or it is **ambiguous** whether Living Water Smart will adequately address these issues (Table 12).

TABLE 11. Objectives and related policy issues that are a priority for developing regulatory / policy instruments.

Objective	Policy issue	Action that instrument should support
Develop effective laws for protecting water rights of instream needs	State and provincial water rights	Legally recognize instream rights to water
	Water rights certainty	Provide long term certainty of water rights for instream needs
	Priority and legal standing	Prioritize instream rights relative to other water users
	Private instream flows	Enable private owners to hold instream rights for water
Recognize appropriate water uses for protecting instream values	Connectivity of surface and groundwater	Manage surface and groundwater conjunctively
	Water conservation	Encourage water use efficiency Ensure efficiency gains can be transferred to instream values
Conduct comprehensive planning of instream flow programs	Comprehensive planning	Conduct comprehensive (water and land) water resource planning
	Drought planning	
	Land use	
Enable public engagement	Public input	Enable public input in decision making processes

TABLE 12. Objectives and related policy issues that are absent or ambiguously described in Living Water Smart (LWS).

Objective	Policy issue	Link to Living Water Smart
Ensure clear legal responsibilities for protecting instream values	Federal water management	**Absent / ambiguous.** Though there is mention of seeking synergies with other legislation under "*developing regulatory tools*" it isn't clear if there will be links to federal legislation (e.g., *Fisheries Act*).
	Legal authority	**Ambiguous.** Not clear how "*reviewing the Water Act*" will clarify or strengthen the province's role in protecting instream needs.
Develop effective laws for protecting water rights of instream needs	State and provincial water rights	**Ambiguous.** Not clear how "*reviewing the Water Act*" and "*developing regulatory tools*" will clarify or strengthen the province's role in protecting instream needs.
	Water rights certainty	**Ambiguous.** Not clear how "*reviewing the Water Act*" and "*developing regulatory tools*" will provide long-term certainty for protection of instream needs.
	Priority and legal standing	**Ambiguous.** Not clear how "*reviewing the Water Act*" and "*developing regulatory tools*" will determine prioritization and legal standing of ecological needs relative to other water users.
	Private instream flows	**Ambiguous.** Not clear if "*reviewing the Water Act*" and "*developing regulatory tools*" will expand and improve private holders of water rights for instream needs.
Recognize appropriate water uses for protecting instream values	Connectivity of surface and groundwater	**Ambiguous.** LWS is focused on regulating groundwater in high priority areas and for large users which aren't defined.
	Water conservation	**Ambiguous.** LWS emphasizes need for conservation, though it isn't clear if conservation will be a legal requirement and if gains can be dedicated for instream purposes.
Conduct comprehensive planning of instream flow programs	Drought planning	**Ambiguous.** Not clear how "*cutting back in times of scarcity*" will affect instream needs.
	Land use	**Ambiguous.** Integrating land and water decisions is not trivial. It isn't clear if "*watershed planning*" will occur in all locations and to what extent land and water decisions will be integrated.
Ensure effective implementation of instream flow programs	Process development	**Ambiguous.** The need for quantifying instream flows is recognized, but the methods and locations aren't provided.
	Adaptive management	**Absent.**
	Interdisciplinary teams	**Absent / ambiguous.** Role of interdisciplinary teams is not mentioned though there is mention of "*training those working with Water Act*."
	Public funding	**Absent.** LWS does not discuss to what extent public funding will be used to support instream flow programs.
Support public education	Public education	**Absent / ambiguous.** LWS is focused on educating youth about healthy streams. It is unclear how the broader public will be educated about water use decisions and instream flow needs.
Enable public engagement	Public input	**Ambiguous.** It isn't clear how improving governance and general references to improving public input will be implemented.
	Negotiation	**Absent.**

4.2 REGULATORY / POLICY INSTRUMENTS

4.2.1 COMMAND AND CONTROL REGULATION

Water Licensing: Water licenses are the means through which the B.C. government allocates rights to divert and use surface water. Groundwater is currently treated as an open access resource that may be withdrawn without a license, though changes are expected through Living Water Smart. Water rights can be thought of as a bundle of sticks, with each stick representing a particular right—such as the right to use water for a certain purpose, the right to priority over other users, and the right to transfer water rights to others (see Table 4 in Section 2.3). These rights come with limitations and obligations as well, such as the requirement for appurtenance that ties water rights to land, and the obligation to use water for the originally intended purpose of the license. As the case studies show, the bundle of rights that is available varies across jurisdictions, and the nature of the rights available in any given jurisdiction can be changed by legislation and policy.

Wilkinson (1993) calls the western doctrine of prior allocation/appropriation a "lord of yesterday," in that it shapes and governs modern attitudes and actions but is rooted in the beliefs, values and goals of the past. The principles of "first in time first in use," "use it or lose it," and appurtenance to land evolved in social and ecological conditions that were very different from today. Demand for water was far lower, ecological needs were not well understood or given priority, and the primary policy objectives were to encourage water use for economic development and productive settlement of the land base. These principles of water licensing are no longer appropriate given current knowledge, values and goals.

The challenge in reforming the water licensing system in B.C. is to balance a number of competing and sometimes conflicting objectives: providing security and predictability of supply for users; protecting instream and ecosystem values; ensuring water is put to the most socially valuable purpose; providing information to decision makers about water use and water needs; and maintaining flexibility to respond to new knowledge and changing circumstances. Finding an appropriate balance among these objectives is difficult, especially when changes to water licensing affect vested rights and strongly entrenched attitudes. It is essential that rights holders be involved in the development of changes to a water licensing system (Figueres *et al*. 2003). The hostile response that the Township of Langley received to proposals in its Water Management Plan to meter and charge for groundwater show how important it is to involve stakeholders early on in discussions about changes to water rights (the proposals were subsequently withdrawn from the plan).

Living Water Smart commits to changing the conditions, restrictions and procedures for new licenses, and revising some of the conditions associated with existing licenses, including the addition of a requirement to cut back use during critical times or when stream health is threatened. The case studies suggest that some of the changes that should be considered include:

- A new form of license specifically for instream flow protection, combined with provisions to allow existing water rights to be transferred and amended to protect instream flow. A good first step in this direction would be to proclaim the provisions of the *Fish Protection Act* enabling the issuance of instream flow licenses to community organizations. In the 1990s, similar provisions for land conservation covenants were enacted under the B.C. *Land Title Act,* and these covenants have been used successfully to protect ecologically significant land in B.C.
- A cap on water rights allocations under licenses, based on an instream flow standard (see below), which sets a limit on the total amount to be allocated. A minimum flow could be maintained by reserving water from all licenses or by issuing instream flow licenses, or by a combination of both.

- In addition to a cap on total allocation in a watershed, the amounts available under licenses may need to be reduced in any year based on an assessment of the amount of water available in the system for that year. LWS indicates that this is planned for critical times or when stream health is threatened.
- Monitoring and reporting of actual extraction rates should be required for all major licenses, as is proposed under LWS. Over time, it may be advisable to phase in monitoring and reporting of extraction for all licenses.
- Although groundwater licensing is very controversial among groundwater users, some form of regulation of groundwater extraction is needed where aquifers or their associated surface water bodies are susceptible to depletion, and licensing is highly efficient means to regulate and allocate use. LWS proposes to begin by licensing larger commercial and industrial users, but the cumulative effects of smaller extractions may also be a problem in some water systems.
- Allowing more open trading of water rights could help to ensure that rights go to where they are most highly valued. This may require the relaxation or removal of appurtenancy requirements.
- New licenses should have an expiry date to allow flexibility to deal with changes in the future. LWS indicates that new licenses will have a 40 year term, but for some watersheds or circumstances, this may not be short enough. For existing licenses that do not expire, it may be necessary to establish a buy back program for over-allocated watersheds to ensure sufficient water is available for instream flows.
- The rights and obligations associated with water licenses should be clearly spelled out, to avoid the inefficiencies and costs associated with uncertainty.
- License provisions need to be enforced. This requires the dedication of sufficient resources to the task.

Given the complexity of the problem of revising the water licensing scheme, the potential resistance to changes, and the need to involve rights holders, it may be advisable to try out new licensing approaches at a smaller scale in selected watersheds to learn from experience before attempting wholesale changes.

Water planning: Planning involves the "scientific, aesthetic and orderly disposition of land, resources, facilities and services with a view to securing the physical, economic and social efficiency, health and well-being of urban and rural communities" (Canadian Institute of Planners 2009). Water planning has been included under command and control regulation, because in practice planning processes are often instituted by government and implemented through regulations. However, planning can also be voluntary, and the recommendations arising from planning can include the full range of policy instruments, from voluntary to compulsory. In natural resources management, planning can be conceived of as a process for defining problems, formulating and evaluating alternative strategies to address those problems, and making recommendations to decision makers, including recommendations about the instruments through which plans and policy objectives should be pursued (Clark 2002). As such, planning is an essential component of governance. "Planning with water in mind" is one of the main strategies in Living Water Smart, and planning is emphasized throughout the document.

The case studies discussed earlier highlight the importance of well designed water planning processes and offer a variety of lessons for successful planning. First, both surface water planning and groundwater planning are necessary, and they should be undertaken together (conjunctive planning). In the Murray-Darling Basin, capping surface water extraction without regulating groundwater extraction shifted development pressure to groundwater, resulting in new problems with the security of groundwater supplies. Failure to plan conjunctively also allowed double allocation of water in some instances (to surface water rights and ground water rights). In the Walla Walla River watershed, improvements in the efficiency of irrigation methods increased flow in the main

river, but reduced infiltration to the aquifer from irrigation leaks, which in turn led to reduced flows in a tributary. The cumulative effects of unregulated small groundwater extractions may also be problematic for surface and groundwater supplies.

Second, conjunctive water planning should be integrated with other land planning processes, so that the relationships between land use and instream flow can be managed appropriately, and land use can be planned in accordance with forecasts of water availability. The agricultural sector is a prime candidate for such integrated planning, because of its high use of water. Oregon is using collaboratively developed Comprehensive Irrigation District Management Plans to guide water management and Habitat Conservation Planning under the *Endangered Species Act*. B.C. has developed an Environmental Farm Planning process that, although voluntary, can include best management practices to protect fish and fish habitat, and could be applied more widely (Rosenau and Angelo 2005). Living Water Smart also recommends using planning tables to ensure secure access to water supplies for agricultural lands.

One approach to integrated planning that is widely promoted in the water literature is integrated water management, where water and the watershed are used as the focus for broader planning to achieve social, economic and ecological goals. Integrated water management seeks to "manage and develop water resources in a sustainable and balanced way, taking account of social, economic and environmental interests. It recognises the many different and competing interest groups, the sectors that use and abuse water, and the needs of the environment" (Global Water Partnership and International Network of Basin Organizations 2009). The Oldman Watershed Council in Alberta is developing an integrated watershed management plan for the Oldman River watershed.

The third lesson from the case studies and elsewhere is that planning should take place at multiple scales in a hierarchy. Large-scale planning reflects broad social interests and concerns, and can establish standards for the processes and outcomes of regional and local planning. Planning at smaller scales is also crucial to provide the understanding of, and flexibility to address, local ecosystem conditions and social needs. In the Murray-Darling, it was necessary to develop mandatory standards at the national level for water planning, because State level water planning processes were overly influenced by the parochial demands of powerful local interests. Inter-jurisdictional conflicts were addressed by establishing the Murray-Darling Basin Authority and giving it the powers to manage at a basin level. The Walla Walla basin provides additional evidence of how the absence of broad scale planning can create problems for local initiatives, in that the additional instream flow provided by efforts to conserve water in Oregon may be taken up by water users in Washington rather than remaining instream.

Fourth, good planning requires reliable scientific information, recognition of uncertainty, and the flexibility to adaptively respond to changes and errors. Precaution and adaptability are essential given the uncertainty associated with climate change. Experience in the Murray-Darling and the Walla Walla shows the importance of developing good hydrologic models to estimate sustainable levels of extraction, establishing limits on water allocations based on such estimates, and adjusting the amounts to be taken under existing allocations yearly based on annual assessments of water availability. This requires good baseline data, ongoing monitoring, and feedbacks from monitoring to change prescriptions in response to new information. In this way, planning becomes an adaptive cycle rather than a one-time event.

Finally, plans are of limited value unless they are supported by adequate resources and an effective strategy for implementation and monitoring. Planning processes often suffer from goal substitution, where participants become so focused on simply "producing a plan" that this goal replaces more fundamental goals such as protecting instream flow. Providing sufficient resources for implementation and monitoring, and tying monitoring to ongoing planning, can help to ensure that plans do not just sit on the shelf once they are created.

There are numerous planning processes currently in place in B.C. that have the potential to directly or indirectly protect instream flow, including Water Management Planning and Water Use Planning under the *Water Act*, Drinking Water Protection Planning under the *Drinking Water Protection Act,* and recovery planning for fish in streams designated as sensitive under the *Fish Protection Act* (see Section 2.2). Although these planning processes have been infrequently used in the past, Living Water Smart indicates that they will be used more often in the future and that new water planning processes may be developed.

B.C. has become a leader in collaborative land use planning in recent years (Day *et al*. 2003). Collaborative planning is an approach that actively engages stakeholders and focuses on problem solving (Wondolleck and Yaffee 2003). It typically "uses a facilitator, seeks consensus, ensures that all participants are heard and respected, and ensures that discussions are based on interests, not predetermined positions" (Frame *et al*. 2004). Among other potential benefits, collaborative planning can reduce conflict, build social capital and develop plans that are supported by stakeholders. Table 13 lists criteria (best practices) for collaborative planning processes. These criteria were developed by Frame *et al*. (2004) from an extensive review of the literature on collaborative planning. When combined with the water-specific Elements of Good Water Planning identified by the Australian Government National Water Commission (see Box 1 in Section 3.1.1), the result is an excellent framework for future collaborative water planning processes in B.C.

TABLE 13. Best practices criteria for collaborative planning processes (from Frame *et al*. 2004).

Criterion	Description
Purpose and incentives	The process is driven by a shared purpose and provides incentives to participate and to work towards consensus in the process.
Inclusive representation	All parties with a significant interest in the issues and outcome are involved throughout the process.
Voluntary participation and commitment	Parties who are affected or interested participate voluntarily and are committed to the process.
Self-design	The parties involved work together to design the process to suit the individual needs of that process and its participants.
Clear ground rules	As the process is initiated, a comprehensive procedural framework is established including clear terms of reference and operating procedures.
Equal opportunity and resources	The process provides for equal and balanced opportunity for effective participation of all parties.
Principled negotiation and respect	The process operates according to the conditions of principled negotiation including mutual respect, trust, and understanding.
Accountability	The process and its participants are accountable to the broader public, to their constituents, and to the process itself.
Flexible, adaptive, and creative	Flexibility is designed into the process to allow for adaptation and creativity in problem solving.
High-quality information	The process incorporates high-quality information into decision making.
Time limits	Realistic milestones and deadlines are established and managed throughout the process.
Commitment to implementation and monitoring	The process and final agreement include clear commitments to implementation and monitoring.
Effective process management	The process is co-ordinated and managed effectively and in a neutral manner.
Independent facilitation	The process uses an independent trained facilitator throughout.

Flow standards: Instream flow standards (also termed instream flow needs, streamflow criteria, flow thresholds, or flow reservations) describe the timing and magnitude of stream flows needed to protect fish habitat in the absence of detailed biological and physical habitat information for a stream (Hatfield *et al*. 2002). The use of flow standards is based on a recognition that instream flows affect the ecological structure, function, and composition of riverine ecosystems (Richter *et al*. 2003) as evidenced through relations among flow, habitat availability, and abundance / biomass of fish produced in a given stream. Standards are generally tailored on the basis of the fish species and life stages present in a particular stream. More than 50 approaches are available for assessing minimum or optimum instream flow needs for fish (e.g., EA Engineering Science and Technology 1986; Jowett 1997). This diversity speaks to the urgency for credible and effective tools, as well as to the many limitations of approaches being applied (Hatfield *et al*. 2002).

Flow standards are generally not entrenched in regulation. Across the 10 western United States reviewed in Section 2.3, only 3 jurisdictions require establishment of minimum flow levels (Washington, Oregon, and Idaho, Locke *et al*. 2008). Flow standards have, however, been used by water users, managers, and regulators

elsewhere to inform water licensing decisions and planning activities (see above instruments) by assessing potential effects of flow-related activities (e.g., diversions or consumptive uses), thereby helping managers focus on activities where additional biological, hydrological, or geomorphological information may be necessary.

The use of instream flow standards can not directly reduce conflicts between instream and out-of-stream water users. They can, however, help clarify the context for understanding and resolving conflicts by describing basic needs for fish and fish habitat, and providing consistency in approaches for identifying those needs, both of which are important. Moreover, from the perspective of core policy objectives flow standards help define instream water rights and water uses more clearly by quantifying them in terms of volume of flow, and provide scientific information for water planning activities. An additional consideration is that flow standards represent average conditions needed to protect instream needs. By definition **average** standards will in some locations be too lenient (underestimate flow needs) or too stringent (overestimate flow needs). Thus, when used in isolation of more accurate local information, they may fail to identify situations where conflicts between instream and out-of-stream users actually exist (if too lenient), or identify locations of conflict when none actually exists (if too stringent).

British Columbia has recently pursued efforts to clarify the role of flow standards by developing "*Instream Flow Guidelines for Aquatic Habitat*". A first effort provided an initial review of instream flow approaches and consultation among managers in the province (Hatfield *et al*. 2002). Subsequent efforts proceeded to finalize *Instream Flow Thresholds* needed to protect freshwater ecosystems from excessive water withdrawals (Hatfield *et al*. 2003), and *Instream Flow Assessment Methods* needed to identify impacts of water withdrawal on freshwater ecosystems (Lewis *et al*. 2004). Emerging from the initial review and consultation was a set of principles to guide development of instream flow thresholds: (i) work within existing legal framework (i.e., provincial and federal laws), (ii) develop standards from the perspective of protecting the fish resource (as opposed to other needs); (iii) minimize review costs (for water license applicants and regulators); (iv) maximize consistency and transparency (among reviewers across the province); and (v) implement a scientifically defensible approach (by considering risk aversion, monitoring, and measures of mitigation / compensation). One of the most recent and advanced applications of flow standards in the province is unfolding in the Okanagan basin (ESSA Technologies Ltd. and Solander Ecological Research in prep), where the Okanagan Sustainable Water Strategy (OWSC 2008) provides guidance by committing to actions that "*establish conservation flows, preserve environmental baseflows, and designate environmental water reserves*" alongside actions to "*establish an agricultural water reserve.*"

Other jurisdictions in western North America have varying experience developing and using flow standards. In Oregon, an abundance of instream flow studies in the 1960s and 1970s provided managers with large quantities of data across all major basins in over 1500 stream reaches. These data provided the basis for defining habitat and flow relationships, which continue to be used today in many streams (Hatfield *et al*. 2002). Alberta has only more recently identified the need for better information to support water allocation decisions. This identified need has led the province to invest in a research program that classifies streams using hydrologic and geomorphic differences, and assess instream flow needs for different stream types. The intention is to develop instream flow standards for sampled locations that can be extrapolated to unsampled locations (Hatfield *et al*. 2002). In the Northwest Territories, a jurisdiction with abundant water supplies, general protocols have been established for protection of fish and fish habitat. Water licensing decisions are made such that total water withdrawals from all users are not to exceed 5% of the instantaneous flow in a water course at the time of withdrawal (Nathen Richea, Indian and Northern Affairs Canada, pers. comm.).

When considering the use of flow standards to help resolve water use conflicts, four insights emerge from the above discussion, each of which is consistent with policy issues identified by the Instream Flow Council (see

Appendix B). First, as highlighted by the guiding principles of Hatfield *et al*. (2002), flow standards have not yet been set within the existing provincial and federal regulatory context in British Columbia. The suggestion is that existing laws supersede the flow standards, which implies that these standards may be ineffective if superseded by less stringent requirements. Given the opportunity for change under Living Water Smart, it therefore seems important to ensure that provincial laws be adjusted to support the use of flow standards and wherever possible federal laws be aligned with this objective. A second insight emerges upon recognizing that conflicts will emerge when setting flow standards that are optimal for fish, but sub-optimal for other users. Consequently, to help resolve conflicts it is important that flow standards be supported by a legal framework that clarifies the rights of different users for water and the priority of access for those users. Third, as evidenced in B.C., Alberta, and Oregon development of scientifically defensible flow standards requires a strong monitoring program. Lastly, given the many assessment approaches, many jurisdictions using flow standards, many years over which flow standards have been developed, and lack of a clear and easy solution, policy makers should expect a variety of technical and non-technical challenges when using this instrument.

Zoning and designations: An observation by others is that water laws in western provinces tend to ignore environmental factors when making water licensing decisions (Locke *et al*. 2008). This omission seems unusual given that surface water and groundwater supplies are directly related to climate, physiography, and geology among other variables, and that instream flow needs for fish are a direct function of hydrological, geomorphological, and biological variables. The extent and types of human uses of water are also highly variable (e.g., Figure 1).

A failure to recognize such variation has implications on the effectiveness of regulatory / policy instruments in resolving conflicts between instream and out-of-stream users. For instance, when setting flow standards others have recognized that ecological and hydrological variation makes it difficult to develop a single set of criteria that can be broadly applicable (Hatfield *et al*. 2002; Arthington *et al*. 2006). To account for this variation they have advocated for a water classification system that stratifies rivers on the basis of hydrological and biological data, thus allowing for a greater consideration of regional differences. A formal system that classifies human needs and water availability across regions (interior vs. coastal) and years (wet years vs. dry years) can help resolve conflicts because it would help policy makers and managers tailor instruments to the inherent environmental conditions and human demands, thereby improving effectiveness. It would also allow for a greater level of transparency in communicating policy preferences for water uses (as a reflection of society's values) and in understanding regions where and years when the greatest conflicts are likely to occur. As an example, a classification system could help guide water licensing decisions in areas designated as a high priority for ecosystem protection due to limited surface water or vulnerable groundwater supplies. In contrast, licensing in other areas may be guided by a classification where agricultural interests are the highest priority due to the high demand and low ecological concerns. The intent would be to use a classification system to address conflicts around water use at a regional scale and in years with abundant supplies, so as to reduce conflicts when individual water licensing decisions are made and before drought conditions emerge.

In British Columbia, the scientific foundation is currently available to help classify watercourses from a hydrologic point-of-view. For surface waters, 4 hydrologic stream types—hybrid, coastal, interior, and glacier—have been used to classify watersheds on the basis of differences in runoff patterns (Eaton and Moore 2007), and 41 hydrological zones have been used to delineate the province on the basis of climate, runoff patterns, and physiography (Summit Environmental Consultants 1998). Likewise, large differences in groundwater patterns have been described using 7 hydrogeologic landscapes, grouped on the basis of variation in biogeoclimate, physiography, and geology (Smerdon *et al*. 2009), and a 9 category aquifer classification has been used to distinguish aquifers on the basis of vulnerability to withdrawals and development pressure (Kreye *et al*. 1998).

The concept of zoning and designations is inherent within instruments applied in British Columbia and elsewhere across western North America. Opportunities are currently available in B.C. to designate "protected" and "sensitive" rivers under the *Fish Protection Act*, or "Fisheries Sensitive Watersheds" or "Temperature Sensitive Streams" under the *Forest and Range Practices Act*, all of which represent tools to highlight areas of ecological concern (see Section 2.2). Moving forward, Living Water Smart recognizes the importance of critical and priority groundwater areas[37] and of the need for "*cutting back in times of scarcity*" (Government of British Columbia. 2008b). Though not strictly for the purposes of managing water, Alberta is divided into white (settled) and green (unsettled and forested) management zones, each of which delineates differences in uses and management of land and water resources (e.g., current wetlands policy only applies to the white zone, Alberta Wilderness Association *et al*. 2007). In Ontario, watersheds are grouped on the basis of intensity of water use and criteria for water permitting are more restrictive in high use categories (de Loë *et al*. 2007). As illustrated in Section 3.2, Oregon uses groundwater administrative areas to assist in water allocation decisions by identifying regions most vulnerable to additional withdrawals. Though applied in a reactive manner, many other western States use "critical areas" to designate regions (usually aquifers) with over-allocations of water (Johnson 2009).

If used proactively, zoning and designations can be a useful tool to help avoid water use conflicts before they occur. Critical to their success is ensuring the criteria and indicators used to support delineations are transparent and scientifically defensible. Though stressed groundwater areas and periods of scarcity are recognized as priority situations under Living Water Smart, the criteria to define them are not provided at this time. Given the nature of water use conflicts, these criteria should help distinguish spatial and temporal differences in water supply, instream needs, and human demands. It is also important that there is clarity and support for the different management approach being applied in different zones / designations; i.e., a description of what specifically will be done differently in priority groundwater areas and during periods of drought.

Water efficiency: Water efficiency refers to a variety of strategies designed to minimize the amount extracted from water systems by reducing demand or improving the efficiency of extraction, delivery and use. As with water planning, water efficiency programs may be implemented through regulation, but can also make use of the full range of instruments, from voluntary to compulsory.

Three main paradigms are discussed in the literature about water management and conservation: supply side management, demand side management, and the soft path for water management (Hennessy 2009). As the name suggests, supply side management focuses on developing sufficient water infrastructure to provide supplies of water to meet forecasts of demand. This has been the traditional approach to water management in Canada and many other settings. In contrast, demand side management attempts to reduce the amount of water extracted from water sources by improving the efficiency with which water is delivered and used, and reducing societal demand. Examples of demand side management initiatives include improved irrigation practices, high efficiency water fixtures, and information programs designed to encourage less wasteful water use habits. The soft path to water management is a new approach promoted by water conservation advocates, which involves rethinking how water is used, by focusing on the services that water provides, and considering whether those services could be provided by other mechanisms that do not require water (Gleick 2003; Brandes and Brooks 2007).

Both demand side management and the soft water path aim to reduce the amount of water extracted from water sources and, as such, are important strategies to maintain or increase instream flows. A complete discussion of water efficiency is beyond the scope of this report, but readers are referred to the extensive literature on water conservation and efficiency (e.g., Gleick 1998; 2003; Brandes and Ferguson 2004; J. Kinkead Consulting 2006;

[37] Okanagan Basin, Lower Fraser Valley, east coast of Vancouver Island, Gulf Islands, Nicola Basin, and Williams Lake area

Brandes and Brooks 2007). An important caution for any water efficiency strategy is to ensure that the potential gains from water conservation are used to achieve the intended goals, such as instream flow protection, and not lost due to perverse incentives and unintended consequences (Section 4.4).

4.2.2 FINANCIAL DISINCENTIVES

Financial disincentives are deterrents that penalize individuals or organizations involved in undesirable behaviour. They can include fines, charges, or legal action if applied reactively after an environmental incident occurs. Alternatively, they can include fees, bonds, or security deposits that are applied proactively and retained only if an incident occurs. Financial disincentives are not used in isolation of other instruments. Typically they are tied to command and control regulations and implemented through an enforcement regime which includes a description of prohibited (i.e., undesirable) activities, efforts to monitor compliance with the prohibitions (e.g., terms of a water license), and enforcement of penalties if prohibitions are violated (e.g., fines or legal prosecution).

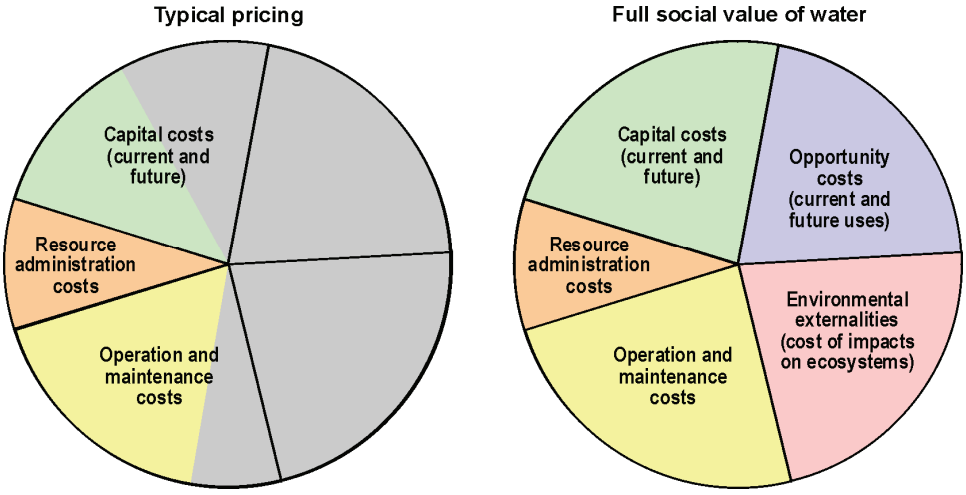
Currently in B.C., fines can be imposed for violating prohibitions under the *Water Act*, *Drinking Water Protection Act*, *Fish Protection Act*, *Species at Risk Act* and *Fisheries Act*. Of relevance to the protection of instream flows, is Section 35(1) of the *Fisheries Act* which requires that "no person shall carry on any work or undertaking that results in the harmful alteration, disruption or destruction (HADD) of fish habitat". HADD's under Section 35 can result in fines, but are often difficult to prove, difficult to enforce, and infrequently applied to protect instream flow needs for fish. Alternatively, Fisheries Officers can use Section 32 of the Act if fish kills occur because mortality can more definitively be linked to an activity.

For the most part, financial disincentives are reactive and confrontational, suggesting they may not be an ideal solution for resolving water use conflicts in the long-term. In some instances, though, the threat of charges can motivate restoration of flows (see Cowichan River and Trout Creek examples in Section 1.0 and ESA concerns in the Walla Walla River watershed, Section 3.2). Non-governmental organizations are supportive of financial disincentives to support the conservation objectives implied by provincial and federal legislation, while government agencies are less supportive preferring greater stewardship, self-regulation, and results based monitoring (e.g., Young and Werring 2006). Given the need for an accompanying compliance monitoring and enforcement regime, governments find financial disincentives costly to implement and some have reduced enforcements efforts in recent years (e.g., Young and Werring 2006).

4.2.3 MARKET-ORIENTED REGULATIONS

In British Columbia, Canada, and elsewhere it is generally recognized that the cost individuals and organizations pay for water does not reflect its true value to society. Sawyer *et al*. (2005) elegantly represent this disparity as a "value gap" between "typical pricing" and the "full social value of water" (see Figure 10). Typical pricing includes a portion of capital costs associated with water infrastructure, a portion of operation and maintenance costs associated with that infrastructure, and resource administration charges associated with water withdrawals and licensing. The shortfall in covering even basic costs suggests that current water pricing provides a subsidy to users. The full social value of water includes the full value of resource administration, capital, operation and maintenance costs, in addition to the opportunity costs associated with water allocations (e.g., value of foregone recreation opportunities), and the full cost of impacts of water use on ecosystems (e.g., loss of services that help sustain human and ecosystem health). Adjustments in water pricing and market-oriented approaches represent ways of closing the value gap.

FIGURE 10. Hypothetical comparison of costs included in "typical pricing" and the "full social value of water". *The difference between these situations is described as a "value gap", which price adjustments can help address (adapted from Sawyer et al. 2005).*



Addressing this gap is important because an undervaluation of water creates a variety of problems. In particular, it can lead to inefficient allocation and water use conflicts, excessive or wasteful use, a lack of innovation in water use, and deterioration of water infrastructure (Renzetti 2007). In agriculture low water prices and direct subsidies to the sector have led to activities that would not normally be economically competitive. Such support has resulted in appreciation of land values, discouraged greater water use efficiency, and contributed to excessive withdrawals of groundwater and surface water supplies to the detriment of freshwater ecosystems (Zilberman and Schoengold 2005). The use of pricing instruments alone is not sufficient to address all these problems. For instance, agricultural policy and subsidies have been noted as having a greater effect on agricultural water demand than pricing (cited by Cantin *et al*. 2005). However, some benefits of pricing are that it can reduce consumption, encourage water conservation and greater use efficiency, and provide revenues to fund water and/or habitat conservation measures. Arguments against pricing are that it may constrain economic growth, be difficult to implement, be seen as a tax grab, result in stakeholder opposition, and create an opportunity to trade water as a resource under the North American Free Trade Agreement (Wilkie 2005).

Recognizing that prices can be increased up to a level that fills the value gap, one of the key challenges behind water pricing is determining what constitutes the right price (Tsur 2005; Renzetti 2007). Natural variation in water supplies across watersheds, seasons, and years complicates pricing and allocations further because this stochasticity affects water scarcity and the corresponding value of water (Zilberman and Schoengold 2005). Uncertainty about the effects of climate change on water supplies adds to this complexity. Price adjustments can affect municipal water supplies or raw water prices (e.g., licensed surface water or groundwater users), the latter of which is most relevant to resolving conflicts between instream and out-of-stream users. This distinction is important because price adjustments and pricing methods can differ markedly between these uses. A variety of methods can be used to structure a water pricing system (Table 14), with some evidence suggesting that changes in water demand are more sensitive to these price structures than the level of price adjustments (Cantin *et al*. 2005). Within these approaches, prices for water can either be set by government institutions (e.g., defined rates) or by individuals buying and selling water based on their willingness to pay (e.g., free-market).

TABLE 14. Summary of alternative water pricing methods.
(Methods drawn from Tsur 2005; Sawyer et al. 2005; Renzetti 2007).

Pricing method	Description
Flat rate	Fixed fee independent of the amount of water consumed.
Volumetric	Pricing based on direct measurement of the volume of water consumed with a constant per unit charge.
Block-rate	Multi-rate volumetric approach in which per unit charge varies based on the amount of water consumed (e.g., per unit charge increases or decreases with increased consumption).
Two-part tariff	A two-part pricing method in which a fixed annual charge plus an additional price per unit of water is levied.
Area	Water priced on the basis of irrigated area, the kind and extent of crop, or irrigation method. Variations in pricing by region / watershed can help deal with the natural variability in water supplies and differences in water scarcity across the landscape.
Seasonal	Changes in pricing across seasons (i.e., in the summer) or years (e.g., wet vs. dry years) helps reflect natural variation in supplies over time and account for related changes in water scarcity and supply costs.
Betterment levy	Fees charged on the basis of increases in land value due to irrigation practices.
Output / input	Pricing based on units of output (e.g., crop production) or by taxing inputs to production.
Water markets	Various forms of markets exist, but generally include trading of water allocations or rights where the value of tradable units is based on a set price or individuals are free to set the price based on their willingness to pay. An example of a water market is represented by the cap and trade system in Australia (described in more detail below).

Economists tend to use four criteria to evaluate the appropriateness of alternative prices and pricing methods (Renzetti 2007): (i) **financial soundness**—prices should help sustain related government services; (ii) **efficiency**—prices should reflect full societal costs and ensure efficient use; (iii) **environmental sustainability**—prices should encourage water conservation and ensure ecosystem protection; and (iv) **equity**—access to water is a basic human right and prices should not pose an unacceptable burden on lower income earners. In consideration of financial soundness, seven of thirteen jurisdictions in Canada request licensing fees for raw water, all of which are relatively low (from $0.01 to $143 per 1,000 m^3 annually). In B.C., fees contribute significantly to government revenues ($400 million in 2004). Challenges around pricing often emerge when viewed through the lens of efficiency because water uses have not historically been allocated on the basis of most efficient uses or those uses that necessarily contribute the greatest social benefits. Pricing and markets are believed to help resolve this concern (Zilberman and Schoengold 2005). This issue is relevant in B.C. and other western jurisdictions in North America which have tended to allocate water using the "first in time, first in right" doctrine (see Section 2.3). Limits in the ability to transfer water rights add to the challenge of adjusting allocations to more efficient or high value uses through pricing signals. In seeking to achieve greater environmental sustainability, pricing signals generally do not reward those who minimize impacts on ecosystems or downstream users. Lastly, given the large economic benefits derived from surface water and groundwater withdrawals, water allocation decisions have been characterized as an exercise in wealth distribution by governments which do not explicitly consider the equity of that distribution. For instance, in Australia, a cap and trade system has lead to competition between agricultural users and urban water users without consideration of the ability of both users to pay for water or a consideration of the broader equitability of such transfers.

Of the pricing methods described in Table 14, some advocate that improvements in the economic efficiency of water allocations can best be gained by transitioning from the current system of queued water rights to a market system where users are allowed to trade amongst themselves (Sawyer *et al*. 2005; Zilberman and Schoengold 2005). The cap and trade system in Australia is an example of such a market system. Basic requirements include the need for multiple water users within a watershed / basin and that water resources are scarce. Within this system a cap defines water scarcity by setting limits on total withdrawals as determined through water balance models that provide an understanding of the impacts of extraction on interconnected surface and groundwater resources. Where necessary, the cap can be lowered over time to achieve conservation goals. To enable trade, water allocations can be set up to recognize all established users, be based on historical use, and be established within the existing permitting and licensing system. Restrictions on trade can also be set within a context of environmental needs for water at particular locations and times. The economic efficiency of trading is based on the presumption that water users are best informed about the costs and benefits of water use and are in the best position to determine efficient water use. As a result, each water user becomes a decision maker who responds to the cap on extraction by: (i) reducing their use to achieve a target; (ii) reducing use in excess of the target and selling the excess; or (iii) doing nothing and buying excess reductions from others. The role of governments is to establish the rules of trade rather than make decisions on specific allocations.

Accompanying a cap and trade system are non-trivial challenges around costs and political feasibility (Sawyer *et al*. 2005; Zilberman and Schoengold 2005). As illustrated in Australia, a water trading system includes **transaction costs** for reviewing and transferring allocations among users, **infrastructure costs** to support water metering and inter-basin transfer, and **institutional costs** to develop sophisticated models for setting caps on water extraction and an accounting system for monitoring water transfers. Thus, the decision to establish a market system depends on whether the benefits of trade outweigh these costs. Another challenge is that some may be politically opposed to a market system due to perceptions about the "privatization" of water, potential for unfair competition between users (e.g., urban and rural users as seen in Australia), and changes to the status quo where some current water rights holders won't be able to pay market prices.

Based on the many considerations associated with implementing pricing and market instruments, Sawyer *et al*. (2005) provide a few key recommendations to facilitate their use. First, they recommend moving water prices in the right direction to close the "value gap", thereby helping cover basic government costs and addressing impacts on ecosystems. Where the gap is large, small changes in price can significantly affect demand and as the gap decreases benefits diminish. Second, given challenges related to political feasibility, it is important to be transparent and include the public when deciding on appropriate price levels and pricing methods. Lastly, this group of instruments is one of the easier to implement through experimentation. Therefore, it seems prudent to design rigorous experiments that test alternative price levels and pricing methods before broad-scale application.

4.2.4 FINANCIAL INCENTIVES

Financial incentives include tax breaks, credits, grants, low-interest loans, rebates, or direct subsidies that are provided by governments to encourage desirable behaviour (Wilkie 2005; Sawyer *et al*. 2005). Incentives are useful because they can stimulate activities that neither market, nonprofit, nor voluntary actions would normally provide. They are also useful in government relationships when one level of government wishes to encourage another or non-governmental organizations to pursue desired actions (Bardach 1996). Among other reasons, they are typically easier to implement than other instruments because they are non-compulsory and as a result more politically feasible (Wilkie 2005).

Incentives are most often discussed in the context of water conservation, though their application in resolving water use conflicts can be much broader (see Table 10). In British Columbia, the Living Rivers Trust Fund[38] was established by the provincial government in 2002 to support preservation and restoration of the province's rivers, which includes improved management and restoration of instream flows for fish. A portion of these funds has also been committed to the Fraser Salmon and Watersheds Program[39] which is funded by a partnership between the federal and provincial governments to "*protect and restore habitat and water*". As described in Section 3.1, the Australian government is investing heavily in buying water entitlements from out-of-stream users to allocate water for instream needs. A related challenge is determining the appropriate price for buying water for instream needs which may vary between "wet" and "dry" years (e.g., Sisto 2009). As well, in Australia and Oregon governments are investing in water conservation to improve efficiency with rules being used to ensure that some of the efficiency gains are allocated for instream needs (50% and 25%, respectively). The Oregon Watershed Enhancement Board provides substantial funding to support public involvement in resolving water use conflicts, in particular supporting the capacity of local Watershed Councils. In both of these case studies, government has also invested significantly in hydrometric monitoring and modeling to provide managers with the information needed to make good water use decisions. These examples show that incentives are encouraging better water management and restoration, water use efficiency, public involvement, and contributions of science to decision making.

A caution when using incentives to encourage water use efficiency stems from research in energy conservation which shows that subsidies can be potentially more expensive and less effective than other instruments (e.g., Simpson *et al*. 2007). The reasons for these concerns are related to two factors which economists call "rebound effect" (Berkhout *et al*. 2000) and "free riders" (Loughran and Kulick 2004). The rebound effect refers to situations where efficiency gains due to investments in improved technology are absorbed by other activities that offset the benefits (e.g., improvements in irrigation efficiency enable a larger portion of land being irrigated with the same amount of water, Young and McColl 2003). Free riders refer to situations where incentives are less effective than expected because a portion are being directed to people who would have taken some action regardless of whether the incentive existed (e.g., rebates for people to install low flow toilets who would have done so without the rebate).

Despite these concerns, incentives have a role in helping reduce water use conflicts given that they support some activities that markets or voluntary actions wouldn't normally provide (e.g., support for scientific studies). In addition, the value of incentives has been demonstrated by an economic study that compared incentive-based and water pricing policies to improve water conservation in agriculture in the Pacific Northwest (Schaible 2000). When tied to increases in crop productivity, the incentive-based policy promoted changes in irrigation technology, encouraged greater water conservation, and farmers had a greater willingness to accept the policy. In contrast, the water pricing policy increased farm costs, generated the least amount of conserved water, and farmers were less willing to accept it.

[38] Ministry of Environment. June 2006. "Province Boosts Living Rivers Trust Fund to $21 Million." Available from: http://www.env.gov.bc.ca/pac/envrep/envrep01/index.html

[39] Fraser Salmon and Watersheds Program. "History of the Program." Available from: http://www.fswp.ca/history.htm

4.2.5 INFORMATION AND MORAL SUASION

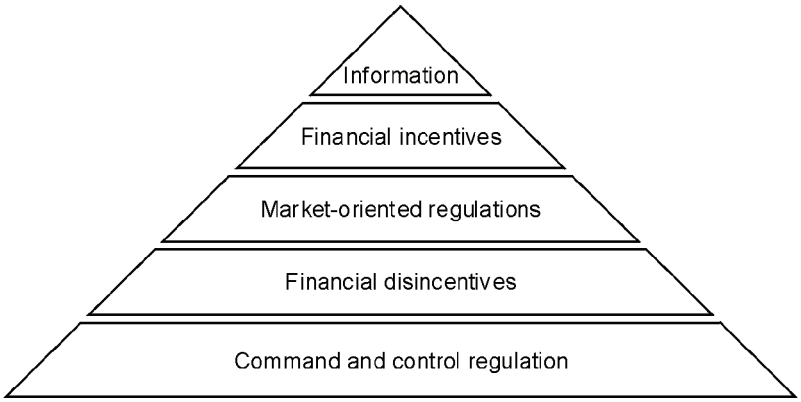
Information campaigns, education, and moral suasion represent useful, though voluntary, approaches to helping resolve water use conflicts. Such instruments can raise awareness about important problems (e.g., the effect of climate change on water supplies, linkage between human demands and surface water-groundwater supplies), provide training to improve people's skills, or enable social change through voluntary actions (Bardach 1996; Wilkies 2005). Voluntary measures can also be an alternative way of implementing the command and control instruments described above (e.g., water planning, flow standards, and water efficiency). This group of instruments can be political acceptable, influence actions among a broad audience, and increase public support for government action. However, they are also limited in that it can be difficult to influence social change and capture people's attention, the benefits are typically only realized in the long-term, and there are challenges in communicating information accurately to ensure public perception is close to reality (Wilkies 2005). When used to reduce domestic water consumption, economists have noted that voluntary actions or information campaigns can sometimes be less effective than other instruments (e.g., water pricing, conservation technologies, subsidies, rationing, or restrictions, Wang *et al*. 1999; Renwick and Green 2000), though they can add value when combined with implementation of such tools (Sawyer *et al*. 2005).

Based on the case studies, two insights emerge about the use of voluntary instruments in helping resolve water use conflicts. First, voluntary measures need to be accompanied by regulatory measures to have their greatest effect. In Oregon, the State culture is one of volunteerism and grassroots engagement in resolving water use conflicts. This perspective has been fundamental in supporting a variety of voluntary planning efforts, particularly ESA recovery plans, Habitat Conservation Plans, Comprehensive Irrigation District Management Plans, and the Oregon Plan for Salmon and Watersheds (see Table 8). These voluntary efforts, however, have been motivated by a desire to avoid legal action under the *Endangered Species Act* and *Clean Water Act*. As a contrast, in Australia a suite of regulations have been pursued and changes are occurring which would not have been possible using voluntary action alone. A second insight is that education campaigns are needed to inform water users and the broader public about key water issues. For instance, in Australia, climate change is having a devastating effect and it has been generally recognized that greater public awareness is necessary to deal with some of the politically challenging decisions that are being contemplated (e.g., abandoning parts of the Murray-Darling Basin). Additionally, in both Oregon and Australia, there is a general lack of awareness about links between groundwater and surface water supplies and the impacts of wells on this interconnected resource.

4.3 COORDINATION OF INSTRUMENTS

Though an independent understanding of instruments is helpful, we believe they are not mutually exclusive. There are benefits to designing and implementing them in a coordinated fashion where several are used to achieve a common objective (illustrated in Figure 11). A recent and related example is B.C.'s efforts to reduce greenhouse gas emissions (Government of British Columbia 2008a). The current approach is to use multiple instruments to reduce emissions (e.g., a carbon tax on carbon-based fuels, a cap and trade system for large emitters, and emissions standards for vehicles and landfill gas). A variety is employed to ensure comprehensive coverage of emissions given differences in approaches needed to address different sources. Greater coordination is also supported by economic studies evaluating the effect of multiple policy instruments in achieving water conservation (Wang *et al*. 1999). For instance, an economic analysis (Renwick and Green 2000) demonstrated that the use of public education, subsidies, water rationing, and water restrictions led to varying and additive reductions in household water consumption (8%, 9%, 18%, and 29%, respectively).

FIGURE 11. Illustration of the regulatory / policy instruments presented in Figure 5 represented as a hierarchy where instruments are developed in a coordinated manner to achieve a common policy objective (adapted from Matt Horne, The Pembina Institute, pers. comm.).



Consequently, an approach that employs multiple instruments in a coordinated fashion would improve management of water uses and protection of instream values in B.C. As a hypothetical example, a range of instruments could be used to achieve "*more efficient water use in agricultural sector*", an outcome specified by Living Water Smart. As a foundation, command and control regulation could be used to define minimum water efficiency standards in agriculture (among other sectors). Financial disincentives (i.e., fines) could then be used to penalize individuals who do not comply with those standards. Market-oriented regulations, such as volumetric water pricing, could be used to provide an additional incentive to encourage reductions in water use. As well, financial incentives (i.e., subsidies) could be offered to help agricultural users adopt higher efficiency irrigation technologies. Lastly, an education campaign could be used to inform the agricultural sector about this suite of instruments and how each may affect them. At the core is recognition that command and control regulation is needed as the foundation for achieving a particular objective and those regulations are complemented by one or more other instruments. A coordinated approach would be more comprehensive in addressing key problems than an approach in which a single instrument was used.

4.4 UNINTENDED CONSEQUENCES

It is generally recognized that situations can arise where well intentioned laws, policies, and regulatory instruments can have unintended consequences that lead to adverse effects on the environment. The general situation is one in which affected stakeholders find ways to avoid being subject to a particular law / regulation or take advantage of a subsidy / incentive which leads to actions that have adverse effects on the environment, sometimes termed perverse incentives (e.g., OECD 2003). A more specific example is one in which endangered species designations have encouraged private landholders to reduce the conservation value of their land so as to remove suitable habitats and thus avoid the effort required in protecting and conserving these species (e.g., Polasky *et al*. 1997). Table 15 provides a list of examples where policies around water management have led to unintended consequences that adversely affect water resources. These examples illustrate how some solutions can actually fail to protect instream flows or resolve conflicts between instream and out-of-stream users. Overcoming these failures isn't easy, but recognizing they exist when substituting, adjusting old, or designing new instruments is an important first step. In some situations, more careful analyses (e.g., economic studies) may be required to understand the implications of changing incentives or instruments that have unintended consequences.

TABLE 15. Summary of unintended consequences when using various instruments to protect instream values.

Unintended consequence	Description	Relevant citations / evidence
Rebound effect	Increases in water use efficiency can lead to expansion of other water uses which reduces gains realized by implementing efficiency measures. This concept is referred to as the "rebound effect" which has emerged from economic analysis related to energy efficiency and applies to management of other natural resources, including water.	Grub 1990; Young and McColl 2003; Berkhout *et al*. 2000
Reduced instream flow with increased water conservation	Increases in water conservation can be used to justify increased use of water within existing limits of water licenses (e.g., increase area of irrigated land for same amount of water withdrawal). In some locations, a concern is that technologies to improve conservation and expand water use may actually reduce the amount of water available for groundwater infiltration, which can lead to a related decrease in the amount of water entering back into streams.	Gyles 2003; Wilkie 2005; Ward and Pulido-Velazquez 2008; Bower and Petrides 2009
Increased total withdrawals with transfer of water rights	The transfer of water rights within an existing water allocation scheme may allow for shifts of water use from one user who doesn't use their entire allocation to a user that does. Ultimately, this change could lead to an increase in the total level of withdrawals, despite any change in the total allocation or number of licenses on a watercourse. This can be problematic in situations where the allocation across all licenses exceeds the available supply, there is uncertainty about sustainable rates of withdrawal, or there is poor monitoring of actual water use in accordance with licensed limits.	Christensen and Lintner 2007
High rates of water use due to undervaluation	Among other problems, a failure to recognize the true value of water can lead to over-consumption. An undervaluation essentially provides a subsidy for consumption and encourages higher rates of use than would be expected if water were valued appropriately.	Renzetti 2007
Market-prices or subsidies to agriculture in support of water inefficient crops	High value crops or government incentives to produce certain types of crops can lead to situations where water inefficient crops are grown in water scarce areas.	OECD 2003
Increased pressure on groundwater when restricting surface water allocations	Restrictions on surface water allocations can lead to greater pressures on groundwater if surface water and groundwater resources are not conjunctively managed / regulated. In other words, water users can avoid restrictions by taping into less stringently regulated groundwater supplies. Given connections between surface water and groundwater sources, this action ultimately affects surface waters despite the intention to avoid such impacts.	Doug Geller, Summit Environmental Consultants, pers. comm.; see Australia case study
Water license conditions that restrict conservation or enable unnecessary consumption	The "*use it or lose it*" principle associated with water licenses under some water rights doctrines may encourage full use of allocations regardless of whether it is required. In addition, such a principle poses a barrier to water conservation because the benefits of efficiency gains can not be transferred to those investing in efficiency technology.	Annear *et al*. 2004
Cumulative effects on water resources	An emphasis on only licensing, monitoring, or metering large water users overlooks potential concerns related to effects from a large number of small users that as a whole may contribute a large cumulative withdrawal or use.	Hatfield *et al*. 2002
Competition among jurisdictions	Federal and provincial / state laws that are developed independently may lead to competition (instead of cooperation) among resource agencies.	Annear *et al*. 2004; see Australia case study
Greater water consumption with price increases	Raising water prices in a flat-rate pricing system can increase consumption if people feel they are entitled to more water because they are paying more.	Dinar *et al*. 1997 as cited in Cantin *et al*. 2005

5.0 REFERENCES

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APPENDIX A. LIVING WATER SMART ACTIONS, STRATEGIES, AND THEMES

TABLE 16. Summary of the Living Water Smart actions, strategies, and themes their details as described at www.livingwatersmart.ca.
Rows with dark shading are indirectly related to protecting instream values.

Themes	Strategies	Actions	Description of actions
Doing business differently	Modernizing our Water Laws	Reviewing the Water Act	The focus of the legislative review will be to: * Recognize the needs of aquatic ecosystems and protect their health; * Encourage water efficiency; * Build in more flexibility so that we are able to adapt to climate change impacts and other emerging issues; and * Consider options that will enable effective and efficient decision making with broader participation. Policy options to provide flexibility in the Act will be explored (for example policy tools that can deal with regional or issue-specific concerns) so the Act can help us manage regional variations in water resources and the uncertain impacts of climate change that might arise in the future. For example: * In areas where there is high demand and pressure on water resources, we will require all new licences be limited to 40 year terms. * In times of drought or where stream health is threatened, all users will be required to cut back their water use. * Incentives to use water more efficiently will be provided in the Act to help maximize benefits from water that is diverted from our streams.
		Recognizing water flow requirements	The B.C. government will explore the best options to make sure all land use and water allocation decisions recognize the water flows required at different times to sustain aquatic ecosystems and maintain proper ecological function.
		Improving water governance	None available.
	Protecting Nature's Needs	Developing regulatory tools	Regulatory tools will be reviewed to include provisions for adequate water flow requirements for ecosystems and species. Water flow requirements aren't just about a minimum flow in a stream. The Instream Flow Council of North America has identified five components to assess water flow needs for ecosystems and species. The Water Act modernization project will consider: * The quantity and timing of water available for allocation in a stream; * Conditions, restrictions and procedures which should be included in new licences; and * Compliance and synergy with other Acts and legislation designed to protect fish habitat and fish populations. Current water flow requirement tools that the Ministry of Environment and others are already working with include: * Guidance for assessing instream flow needs related to water-power projects. * The Vancouver Island region provides water resource information (maps) indicating times when water is available for diversion to storage and when water cannot be taken from a river. * Reports describing the hydrology, water use and conservation flows for various fish species throughout B.C. such as the Okanagan Lake Basin (Rood 2001) and Fraser River Action Plan (Rood & Hamilton 1995).

Themes	Strategies	Actions	Description of actions
		Training those who work with the Water Act	Guidance to support new water flow requirements for ecosystems and species will be provided for water licences applications and approvals. New training will be provided to consider water flow requirements, including the variability of seasonal stream flow and aquatic ecosystem needs. These will include: * Information requirements for the decision-maker; * Methods for assessing instream flow requirements; * Clarification of who provides input on the requirements; * Roles of applicants, decision-makers, and agency specialists.
		Cutting back in times of scarcity	When water is scarce or where stream health is being threatened tough decisions will need to be made about how to use what is available. To protect aquatic values, water laws will be amended to require water users to cut back on water when there is not enough water to meet all demands. * New water licences are being issued with conditions allowing province to require users to cut back in critical times to protect aquatic life. * Water Act modernization will include guidance on how to best regulate water users with existing licenses during critical periods. * Work will take place with licencees to help clarify how they exercise their rights, such as maximum rates of diversion where it is not stated in licences, to help protect stream flows and ecosystem health.
	Protecting our Ground-water	Developing the Groundwater Protection Regulation	The Ground Water Protection Regulation is being developed in three phases by the Ministry of Environment, and sets standards and requirements for: * Qualifications of well drillers and pump installers who drill wells and install well pumps (phase 1). * Location, construction, identification, maintenance and closure of wells (phases 1, 2). * Stopping and controlling flow from artesian wells (phase 2). * Well testing and reporting requirements (phase 2). * Storage of hazardous or toxic materials near wells (phase 2). * Address standards for well operation (phase 3). * Implementation of water management plans in designated areas (phase 3). * Requirements relating to aquifer protection, ground water quantity and use (phase 3). The B.C. government is also working with other agencies and the B.C. Ground Water Association to promote compliance of phase 1 of the Ground Water Protection Regulation by drillers, pump installers and the public.
		Regulating Groundwater Use	Through Living Water Smart the provincial government has committed to regulate groundwater use in priority areas and large groundwater withdrawals by 2012. B.C.'s government will not regulate groundwater use for single, private domestic wells except in priority areas where there is a Water Management Plan in place. Instead the focus will be on larger wells, wells for commercial water bottling operations, open-loop water supply wells for geo-exchange purposes, irrigation wells, wells for fish hatcheries, coal-bed methane extraction wells, or larger wells in priority areas. Priority areas for regulating groundwater removal, because of intensive extraction and water conflicts and shortages, include the Okanagan Basin, Lower Fraser Valley, east coast of Vancouver Island and the Gulf Islands, Nicola Basin, and the Williams Lake area. The B.C. government also passed legislation establishing a statutory process for community-based, legally binding water management plans to address groundwater extraction, impacts on groundwater quality from land-use activities and water conservation. Lessons learned through the development of the first Water Management Plan by the Township of Langley will to ensure local groundwater resources will be protected and sustainable into the future. Additional non-regulatory efforts such as technical studies, are vital to give us a better understanding of the groundwater resource to manage and protect it better.

Themes	Strategies	Actions	Description of actions
	Water for Agriculture	Securing access to water for ALR lands	Government will work with the agricultural industry to identify priority areas of the province where irrigation water supply is critical, and take steps to secure access to water supplies for those lands, through planning tables, or possibly establishing agriculture water reserves or through the water licensing process.
		Requiring more efficient water use	The B.C. government will require more efficient water use in the agriculture sector. Future irrigation water licences will be based on climate, crop and soil water needs using efficient irrigation systems. The provincial government will work with industry and others to adopt the Irrigation Industry Association of British Columbia's Certified Irrigation Designer and Certified Irrigation Technician Programs to ensure efficient systems are in place to help producers ensure best results are achieved from these investments. To be water efficient, we need to know how much water is actually being used. By 2012, the provincial government will require all large water users to measure and report their water use. Find out more about this proposed requirement, and its benefits to operation of irrigation systems and ongoing management and licensing of water use, at Becoming Water Efficient in B.C.
		Helping farmers manage water demand	The B.C. government will continue to develop the Irrigation Scheduling Calculator used by landscape and agricultural irrigators to improve irrigation management with real-time climate data. Irrigators will be able to enter their own specific crop, soils and irrigation system data, and the calculator will determine their irrigation requirements based on current local weather conditions and forecasts. The Environmental Farm Plan program, delivered through the British Columbia Agriculture Council, also includes detailed assistance for irrigators. The Irrigation Assessment Guide assists farmers and ranchers improve their water management and implement beneficial irrigation management practices through examples and worksheets for self-evaluation.
	Becoming Water Efficient in B.C.	Requiring all large water users to measure & report water use	Many of the nearly 44,000 licenced water users in B.C.—single households, water suppliers, cities and agricultural irrigators—are not currently metered. As a result, we have limited data on how much water is being used. The provincial government will define "large" users and their measuring requirements, but will exclude single home use or domestic water licences. Requirements may vary, depending on the location of the user, how much water is available, and the impact that using the water may have on the environment. Requirements will be introduced through the Water Act Modernization project after consultation with water users. Metering water use, particularly for large users such as irrigators and industrial facilities, can help identify leaks and inefficient use, and help users find ways to use less water. Government will invest in our water information systems to better track water usage and will also look at providing information, incentives and other assistance to water licencees to assist them in the transition to metering.
		Requiring more efficient water use in agricultural sector	In some areas of the province, the agriculture sector accounts for up to 70% of the surface and groundwater consumed. The B.C. government will support continued water innovation and efficiency while providing water security for farmers. Encouraging best practices in irrigation and managing crop and soil water requirements will help ensure that water use on farms is as efficient as possible. This is especially important as agricultural water needs are greatest during the hot, dry summer months when water supplies are most vulnerable.
		Encouraging Green Infrastructure	Eighty percent of provincial funding to local governments goes to water-related infrastructure such as water and waste water systems, drinking water treatment and flood protection. Adapting to climate change and reducing our impact on the environment is a condition for receiving provincial infrastructure funding. Provincial policy, design criteria and new incentives for provincial infrastructure funding already requires greener and smarter designs for development. Higher criteria will be established as technology improves over time. This will encourage developers and engineers to continually seek better solutions to reduce our future water needs.
		Choosing to be water smart	Further water efficiency measures that the provincial government will introduce in coming years are outlined in the Being Water Smart in your Home.

Themes	Strategies	Actions	Description of actions
		Celebrating our water smart choices	The B.C. government wants to recognize and celebrate the important work of our water heroes. By celebrating the successes of individuals or groups, others will feel inspired and motivated to do their part. Awards and ceremonies provide an opportunity to support and recognize community-based water stewardship initiatives and to keep water issues in the spotlight. Government will celebrate and recognise examples of successful water stewardship by awarding water awards. As a starting point, the Green City Awards for local governments will include a new category for water conservation leadership. The Minister of Environment's Abor Vitae Awards for individuals and groups will also have a new water stewardship category. Sustainability is at the heart of the Vancouver 2010 Olympic and Paralympic Winter Games. The Games present a great opportunity to showcase our water smart innovation and choices to the rest of the world. The government of British Columbia will work with our Olympic partners to use sports and the Olympic Games spotlight to engage British Columbians and support smarter water choices.
Preparing communities for change	Adapting to Climate Change	Preparing for floods	The frequency of damaging floods is expected to increase as our climate continues to change. Effective ways of helping communities better manage the risk of more frequent floods include: * Avoiding building in flood prone areas; * Allowing room for rivers to meander; * Improving flood protection infrastructure; and * Planning for flood proofing measures. Concentrating on floodplain management and structural flood protection will decrease spending on emergency response and prevent damage. Dike standards are being revised to ensure the protective flood proofing measures we build today will protect our communities in the future. The B.C. government has committed $100 million over 10 years for flood infrastructure improvements to help communities prepare. Restricting or preventing development on flood prone lands will improve public safety and reduce the costs of potential flood damage. Under LWS, where new development on flood plains is unavoidable, it will be flood-proofed to high provincial standards. New design standards for buildings in flood prone areas and flood protection infrastructure will be developed that reflect increasing flood risk.
		Working with other provinces	All provinces are working to ensure water management is sustainable and helps us adapt to climate change. The B.C. government will work with other provinces to share ideas and resources to improve water conservation and collectively help communities adapt to climate change. B.C. will work to establish an inter-provincial "Western Water Stewardship Council" to better coordinate water conservation programs, share information networks and systems, reduce the costs of water stewardship programs and develop a clearer understanding of the impacts of climate change, future water demand and changes to water supply.
		Creating community development strategies	Community development strategies will help to build resilient communities by recognizing the importance of riparian zones in buffering the effects of extreme flows associated with climate change. Healthy riparian zones can effectively store carbon dioxide, reduce erosion during high flows and protect aquatic habitat during low flows. Healthy lakes, rivers, streams, wetlands, and riparian zones play a role in: * Storing carbon in plants and soils; * Releasing water vapour to naturally cool landscapes; * Buffering the effects of extreme weather events; and * Storing and providing water during times of drought.

Themes	Strategies	Actions	Description of actions
		Developing new approaches to water management	Through Living Water Smart the B.C. government is committing to many new actions that will enable B.C. to adapt to climate change, and create liveable communities. * Through modernizing our water laws we will revisit methods to allocate water and protect ecosystems. * Being more efficient we will reduce B.C.'s vulnerability to increasing uncertainty over future water supplies due to climate change. * By planning with water in mind we will promote innovation and creativity related to how we design and build communities, new buildings and infrastructure.
	Conserving and Restoring Our Watersheds	Conserving and restoring stream function	The provincial government works with the private sector and supports communities to conserve and restore stream function, for example: * Recognising water flow requirements in legislation to protect nature's needs. * Helping all land and water managers to understand what makes a stream healthy, so land and water users factor in new approaches to securing stream health and the full range of stream benefits. * Undertaking research into watershed restoration and health assessment, such as ground and surface water interactions and climate change impacts on water supply and hydrology. * Coordinating conservation and watershed restoration efforts through processes such as watershed-based fish sustainability planning. * Implementing watershed and habitat restoration projects through the $21 million Living Rivers Trust Fund, Habitat Conservation Trust Fund, and other partnerships. * Working closely with the federal government on restoration and protection initiatives such as the Wild Salmon Policy.
		Protecting and rehabilitating wetlands	Wetland and waterway function will be protected and rehabilitated by: * Providing incentives to land developments that store more greenhouse gases by restoring sections of streams or wetlands. * Continuing provincial government participation in the North American Waterfowl Management Plan, Joint Ventures in B.C. and the B.C. Trust for Public Lands to secure and restore important migratory bird wetland habitat and adjacent uplands, and * Continuing government participation in Wetland Stewardship Partnership and development and implementation of Wetland Action Plan: —supporting implementation of Green Bylaws Toolkit for Conserving Sensitive Ecosystems, developing wetland BMPs to provide guidance to landowners, land managers, local governments, developers, utility companies, businesses, industries, and agencies. —developing a wetland mitigation and compensation strategy that supports no net loss, and where appropriate, net gain of wetlands where wetland losses from development have resulted in impaired watershed hydrology.
		Supporting specific restoration projects	* The B.C. government provided $4.5 million to support the clean-up of acid rock drainage into the Tsolum River. For more information on this project visit the Tsolum River Restoration Society * The B.C. government will restore ecological health to 30 km of stream between Vaseux Lake and Osoyoos Lake. For more information on this project visit the Okanagan Basin Technical Working Group. * To enhance some watersheds, the provincial government will examine the potential of decommissioning or modifying dams.
	Planning with Water in Mind	Supporting watershed planning	Watershed management plans coordinate development and management of water, land and related resources, resulting in benefits to the community, economy and environment. The provincial government will work with communities in order to achieve greater community involvement in planning. This will lead to fewer conflicts in the future, and greater awareness about water issues and watersheds through watershed plans. The provincial government will continue to be accountable for the protection of water resources in the public interest. We're exploring options to enable more effective and efficient decision-making with broad participation by government and partners.

Themes	Strategies	Actions	Description of actions
		Creating community development strategies	Healthy riparian zones can effectively store carbon dioxide, help to slow global warming and are vitally important for protecting fish and other aquatic species. Community development strategies will be created to recognize the importance of riparian zones in adapting to climate change. These strategies will be developed with input from developers, planners and local government. The provincial government will integrate Living Water Smart with the Climate Action Plan to reflect the essential role healthy streams wetlands, and riparian zones can play in storing carbon in plants and soils; releasing water vapour to naturally cool landscapes; buffering the effects of extreme weather events, and storing and providing water during times of drought.
		Leading the way	Life-cycle assessments of the ways we construct buildings and communities help us see the costs and benefits over the lifetime. Developments and re-developments that consider water efficiency, stream health, and smart growth principles will deliver better environmental health and economic returns over the long term. The B.C. government intends to set an example. The newly established Capital Planning Secretariat is developing new protocols to consider the lifecycle costs and benefits of buildings, goods and services. The protocols will be incorporated into a long-term strategic plan for capital. In future, all new provincial public buildings will be constructed to Leadership in Energy and Environmental Design (LEED™), Gold or equivalent standards. Existing B.C. government buildings will be retrofitted to make them more water and energy efficient, climate-friendly, and healthier places. Research suggests that a LEED™ Gold building can cost 2–15% more than a non certified building, but quantifiable and significant productivity and conservation benefits provide better value to the tax payer. Government will also restore sections of streams or wetlands in the surrounding landscapes where practical.
		Encouraging and fast tracking green development	New thinking about land development practices leads to new benefits. These benefits include more green spaces, improved community vitality, reduced demand for water, and less pressure on infrastructure. Already, building design and technologies are getting better at reducing water and energy use, which helps us respond to our changing climate. Green developments waiting for provincial environmental approvals will be fast-tracked and given priority. Working with industry and local government, the Province will develop criteria for fast tracking green, water efficient developments, to be included in provincial approval policies and practices. In the future, green building criteria could be used to update building and plumbing codes. Restoring sections of streams or wetlands while developing communities helps store greenhouse gases. Government will provide incentives to developers for the restoration of streams or wetlands.
	Protecting Our Drinking Water	Improving drinking water source protection	Starting at the source is the most cost effective way to ensure safe clean drinking water comes out of our taps. Water suppliers are required to conduct source-to-tap assessments in order to plan system improvements and identify any source contamination risks that need to be fixed. The provincial government will continue to improve the quality and protection of drinking water sources in B.C. by ensuring drinking water protection is a high priority consideration in land use and resource activity decisions. Local water suppliers are responsible for the delivery of safe, clean drinking water but have little input into regulating activities for source watersheds. The B.C. government will explore opportunities to provide for additional input regarding activities that take place in source watersheds.
		Ensuring First Nations communities have safe, clean water	In B.C. some water systems serving First Nations communities need improvement. The B.C. government will continue to collaborate with the federal government, First Nations and Health Authorities to ensure that by 2015 the quality of drinking water in all Aboriginal communities will meet the same provincial standards applied across British Columbia.
		Protecting our groundwater	Groundwater is also an important source of drinking water for British Columbians. Protecting our groundwater provides more information about what the government is doing to protect groundwater from pollution and overuse.

Themes	Strategies	Actions	Description of actions
Choosing to be water smart	Being Water Smart at Home	Creating stronger water conservation targets	The provincial government has outlined a strong target that fifty percent of new municipal water needs will be acquired through conservation by 2020 and water use in B.C. will be 33 percent more efficient across the province. Government will support these targets with a range of measures to improve the way we use water in our homes, businesses, farms, and communities. Education and outreach about conserving water will help reduce water demands. The B.C. government will look at new ways to help promising water conservation technology succeed.
		Funding household evaluations of water, energy, and transportation use	LiveSmartBC strategy will reward smart choices to save energy, water, fuel, time and money. The LiveSmart program operates parallel to existing federal ecoENERGY program and provides homeowners with "one-window" access to provincial and federal incentives for energy efficiency improvements. Future household evaluations will provide advice and incentives to residents for reducing water and energy use, and advising on transportation options to reduce environmental impacts. The government will promote installation of inexpensive technology such as low-flow showerheads, tap aerators and dual flush toilets. Evaluations will provide information and tools to help change water use behaviour in laundry, bathroom, kitchen and garden. Similar programs have been offered in the USA and Australia and have proven remarkably effective in helping residents reduce their water use.
		Requiring water-conserving plumbing fixtures such as low flush toilets	Making new, inexpensive and readily available technology such as new "low flush" toilets mandatory means significant reductions in water use and decreases demand on water resources. As one of the first steps in the greening of the B.C. Building Code, the Province has added a new Code objective for water efficiency. Low-flow plumbing fixtures (for example, 6 L toilets) and fittings will become mandatory in new construction on September 5, 2008. Changes to the B.C. Building Code will be supported by a comprehensive education program for the building industry and homeowners. Other ways to allow interested local governments to require even more efficient fixtures, such as dual-flush toilets, within their jurisdictions are also being considered.
		Mandating purple pipes for water collection and reuse	Household purple pipes are a second set of plumbing that captures rainwater and recycles leftover water from the dishes, washing and showers. Government will mandate purple pipes in new construction so we can use this 'extra' water for flushing toilets and watering gardens. Recycling water means we can save the best water for drinking and take less from the environment. The Province is currently exploring grey water recycling as a possible area for future green changes to the Code. There are many ways to recycle water. One way is to capture rainwater and reuse it for watering gardens. Another is to create a non-potable water system in a house that recycles water from sinks and showers and uses it for flushing toilets or landscape irrigation. Sometimes non-potable water system is contained in pipes that are coloured purple to differentiate it from the potable water system. Government will investigate how to make sure we allow and encourage grey water reuse in houses without compromising health and safety of occupants.
		Labeling efficient water consuming products	The B.C. government will work with industry to lead the development of a voluntary, water-efficiency labelling system so that products such as clothes washers, toilets, showerheads and taps reveal how much water is used at the point-of-sale. Government will work with manufacturers, retailers and other jurisdictions to ensure the full support of industry. This will be the first such initiative in Canada and it aims to be as recognisable as the successful energy-star rating system for energy efficient products. When it comes to water efficiency, not all technology is the same. For example, top loading washing machines (clothing) use much more water than comparably priced front loading machines. Water efficiency labelling provides consumer information on water consumption and the relative efficiency of a product. This information can help you to see how one product compares with another product manufactured by a different company, and help you to make the smartest water choices. Water efficiency labelling is already in place across Australia, Europe and parts of the U.S.

Themes	Strategies	Actions	Description of actions
	Getting Smarter with Science	Implementing a water science strategy for B.C.	The provincial government has begun the development of a Water Science Strategy for B.C., which will help guide knowledge and information needs for B.C. and help respond to future water changes. Implementation of the strategy will require participation from many people and organizations in order to help to identify water science opportunities and challenges. This will also allow for better alignment of resources and efforts on projects and activities.
		Expanding hydrometric and climate-related networks	Climate-related information is crucial to protect public safety, secure economic development, manage the environment sustainably, and adapt to climate change. Information from the water quantity monitoring (hydrometric) network is highly valued by a variety of users for flood warning, water supply, resource management, and other purposes. Communities will benefit from having access to improved climate-related information to help guide response to potential climate change-related effects. This includes water supply conditions which are being altered by climate change through increased frequency and magnitude of extreme conditions such as droughts, floods, and earlier spring melts. The B.C. government has committed $10 Million between 2007 and 2010 to improve and expand our hydrometric and climate-related networks. Planning has begun and the start of the network improvements is anticipated to begin later in 2008.
		Reporting on the state of our water	The B.C. government will expand the scope of water-related reporting to help establish initial benchmarks and monitor progress towards the Living Water Smart goals, with the expectation that by 2012 a state of our water report will be published. The reporting framework will include water quantity and quality, watershed health, and other indicators that help us better understand the state of our water resources.
		Improving modelling and analysis	The B.C. government is working on modelling projects to help improve our understanding of stream flows and hydrology. All projects will help to provide the data and knowledge required to make science-informed decisions around water and land management. They include: * B.C. and the Pacific Climate Impacts Consortium are involved in a two-year Natural Resources Canada-funded project to assess the impacts of Mountain Pine Beetle on hydrology. * Ministry of Environment is involved in an assessment of the impacts of climate change on hydrology in the Columbia Basin, led by the Climate Impacts Group at the University of Washington. * Ministry of Environment is studying groundwater and aquifer science, and water quality conditions. * The River Forecast Centre is modernizing the Water and Routing Numeric System, which will improve stream flow predictions and provide timelier forecasts and advisories.
	Youth and Water	Teaching our youth about healthy streams	To become successful water stewards, young people need a basic understanding of stream health and riparian zones. Living Water Smart commits to all B.C students completing a stream health assessment by 2012. Stream health assessments will give young people hands-on skills and knowledge about the processes and attributes of healthy creeks and streams. Our plan is for students to complete these assessments with ecologists and other stream health experts as part of the students' school-based education. Once the program is up and running in 2009/2010, teachers will be trained in stream health assessments and regional trainers will assist them on field trips.
		Rewarding youth excellence in science	The government will award a youth water-science prize or scholarship for excellence in water stewardship to help encourage next generation of water scientists, planners and decision makers. Young people will be educated about water and encouraged to consider water-related sciences through a youth science prize for excellence in water stewardship. Prizes may include university bursaries or other incentives that encourage recipients to take their water science education to the next level.

Themes	Strategies	Actions	Description of actions
		Providing summer jobs to help out our environment	The B.C. government will provide a number of summer jobs for youth between the ages of 16 to 22, to undertake 20 stream restoration projects across the province. Practical, hands-on "gumboot" experience rehabilitating creeks and wetlands empowers youth and helps them understand how they can make a difference. This experience may lead youth to choose a career in the environmental field. Youth teams will be provided with the tools, training and supervision to complete stream restoration projects across the province. These projects will be delivered through partnerships among private sector companies, non-governmental agencies and the B.C. government.
	First Nations Traditions and Knowledge	Ensuring a clean and plentiful water supply on reserves	The Transformative Change Accord is a commitment between the Leadership Council (Representing the First Nations of British Columbia) the Government of Canada, and the Government of B.C. The accord aims to strengthen relationships on a government-to-government basis. Efforts to bridge the differences in socio-economic standards between First Nation citizens and other British Columbians are focused on the areas of education, health, housing and economic opportunities. Two commitments in Living Water Smart reflect ongoing actions within this accord. * The B.C. government will cooperate with Canada to ensure the quality of drinking water in all Aboriginal communities will meet the same provincial standards applied across British Columbia by 2015. * The B.C. government and First Nations' treaty water negotiations and other related agreements support providing a clean and safe domestic, agricultural and industrial water supply for First Nation communities.
		Preserving cultural and social practices	First Nations cultural and social practices around water can be better preserved with a greater understanding of the practices, and the locations that need protecting from activities that impact practices. The B.C. government will continue to work toward building a new relationship and facilitating knowledge sharing with First Nations to help us learn about, respect and uphold what is important to First Nations.
		Consulting with First Nations	The need for meaningful consultation with First Nations on water has been clarified by court decisions in B.C. over the last 20 years. In 2005, the Province and First Nations leaders agreed to work together to develop a New Relationship founded on respect, recognition and reconciliation of Aboriginal rights and title. Since 2005, B.C. and First Nations have worked together on a number of initiatives to build a new relationship and close the socio-economic gaps between Aboriginal and other British Columbians. The Ministry of Aboriginal Relations and Reconciliation has prepared a list of all New Relationship initiatives since 2006.
		Facilitating knowledge sharing	First Nations have been observing and learning about water and ecological change in B.C. for generations. Wisdom about water is woven into cultural rules and practices for resource management as well as First Nations oral histories, stories and ceremonies. Traditional ecological knowledge can make a valuable contribution to water science and policy, while also helping to bridge understanding and relationships between First Nations and other resource managers. There are many benefits from incorporating traditional ecological knowledge into provincial government decision making. Tools like GIS can help map important sites and indicate sensitivity of activities on sites of significance or water resources of significance. This will result in fewer demands on both First Nations and provincial government time. The B.C. government will work with First Nations on priorities for Traditional Ecological Knowledge on water, to help with the development of appropriate tools to incorporate traditional knowledge and information into decision making.

APPENDIX B. INSTREAM FLOW COUNCIL POLICIES

TABLE 17. Relationship among Instream Flow Council's policy statements, policy issues, inferred policy objectives, and core ecosystem components for successful instream flow programs.
All content relates to the three Policy Components for developing instream flow programs (adapted from Annear et al. 2004).

Component	Policy objective	Policy issue	Policy statement
Legal	Ensure clear legal responsibilities for protecting instream values	Public trust doctrine	Laws, regulations, and/or policies affecting fishery and wildlife resources and the habitats upon which they depend should be based on the state or province's legal stewardship responsibilities to manage those resources for the benefit and enjoyment of present and future generations.
		Public trust advocacy	Advocacy for and protection of the principles of the Public Trust Doctrine must be among the fundamental guiding principles of an effective instream flow program.
		Federal water management	Federal agencies should integrate their water and riverine management efforts within the constructs of state and provincial laws, regulations, and policies to protect riverine resources.
		Fishery and wildlife agency role	State and provincial fishery and wildlife agencies should have the primary authority for determining appropriate stream and river flow quantity, quality, and other needs and requirements necessary to restore, manage, and protect fishery and aquatic wildlife resources and processes.
		Legal authority	Effective instream flow programs must be based on a clear recognition of legal authorities to protect, enhance, and restore instream flow for public riverine resources.
		Legal counsel	Instream flow programs should have ready access to specifically trained legal counsel familiar with water law statutes and instream flow programs in order to obtain consistent representation and maximize instream flow benefits under existing laws and regulations.
	Develop effective laws for protecting water rights of instream needs	State and provincial water rights	State and provincial laws, regulation, and policies should provide the authority, opportunity, procedure, and process to enable a state or provincial fishery and wildlife agency the right to obtain and/or hold instream water rights, reservations or licenses in perpetuity for the specific purpose of protecting, rehabilitating, restoring and managing fishery and wildlife resources and habitats and other trust resources.
		Water rights certainty	State and provincial instream water rights, reservations, and licenses should be afforded permanent status to enable them to fulfill their custodial trust obligations for riverine resources.
		Priority and legal standing	Instream flow rights, reservations, and licenses to restore, manage, and/or protect the aquatic resources of streams, rivers, and lakes should have priority and legal standing to protect aquatic resources.
		Private instream flows	State and provincial laws, regulations, and policies should provide the authority, opportunity, procedure, and process to enable an organization, group, or individual the right to obtain, retain, secure, and/or hold instream water rights for individual streams or rivers, or specific sections of individual streams or rivers, for the specific purpose of benefiting fisheries and wildlife and other in-channel purposes.

Component	Policy objective	Policy issue	Policy statement
	Recognize appropriate water uses for protecting instream values	Public interest	States and provinces should designate instream uses of water as in the public interest and/or beneficial uses to ensure that riverine resources and processes are considered on an equal basis with other traditional uses of water.
		Riverine resource stewardship	All streams and rivers should have instream flows that maintain or restore, to the greatest extent possible, ecological functions and processes similar to those exhibited in their natural or unaltered state.
		Connectivity of surface and groundwater	The hydrological interconnectivity between ground-water and surface flows should be recognized, and these waters should be conjunctively managed to protect the short- and long-term fundamental public value of fishery and wildlife resources and habitats.
		Water conservation	State and provincial governments should develop and implement legal opportunities to enable consumptive water users to conserve water and dedicate conserved or unused water to instream purposes.
Institutional	Conduct comprehensive planning of instream flow programs	Comprehensive water resource planning	Comprehensive water resource planning that includes recognition of instream flows as an essential water use is an important part of an effective instream flow program.
		Drought planning	State and provincial instream flow programs should support and participate in development of mechanisms or plans to implement water use reductions during drought periods to protect essential instream flows.
		Land use	Instream flow practitioners should recognize the effects of land use practices on instream flows and work with land managers to promote land use practices that maintain or restore the natural hydrograph and avoid or minimize those that negatively affect the natural hydrograph.
	Ensure effective implementation of instream flow programs	Process development	Instream flow programs should establish a process for quantifying instream flow needs that allows the state, or provincial, fishery and wildlife management agency to identify or approve study needs, study design, data analysis, and flow implementation.
		Adaptive management	Adaptive management can be an effective tool but should be used selectively to answer critical uncertainties for instream flow-setting processes.
		Interdisciplinary teams	Effective instream flow programs require a well coordinated, interdisciplinary team with adequate staff, training, and funding to address all instream flow and related issues that fall under the agency's responsibilities.
		Public funding	Public funding for water management projects should include conditions for the protection of instream flows necessary to meet the needs and requirements of aquatic and riparian fishery and wildlife resources and habitats.
Public involvement	Support public education	Public education	State and provincial instream flow programs should include specific actions to inform the public about instream flow concepts, how instream flows are administered, what benefits the programs provide, and what opportunities exist for public involvement.
	Enable public engagement	Public input	Effective instream flow programs should incorporate public input in the decision-making process.
		Effective communication	Information intended for public consideration in instream flow decision-making processes should be straightforward, free of jargon, and provide a basic understanding of technical and legal concepts, biological processes, and trade-offs.
		Negotiation	Effective instream flow programs should include personnel who are trained in negotiation skills, supported by their agency administration, and engaged in appropriate negotiation from the start of projects.

TABLE 18. Relationship among Instream Flow Council's policy statements, policy issues, inferred policy objectives, and core ecosystem components for successful instream flow programs.
All content relates to the five Riverine Components for developing instream flow programs (adapted from Annear et al. 2004).

Policy objective	Component	Policy issue	Policy statement
Establish credible science to support decision making	All	Riverine components	Instream flow studies must evaluate flow needs and opportunities in terms of hydrology, biology, geomorphology, water quality, and connectivity.
		Monitoring	Monitoring riverine resource responses to instream flow prescriptions is a fundamental component of effective instream flow programs. Monitoring studies should be based on long-term ecosystem processes as opposed to short-term responses of individual species.
	Hydrology	Stream gauging	Instream flow programs must support individual gauging stations and networks of gauging stations necessary to quantify hydrographs, make and defend instream flow prescriptions, and monitor and enforce instream flow compliance.
		Discharge measurements	Discharge meters, stream gaging devices, and flow data collection protocols should meet accepted standards of the U.S. Geological Survey and/or Environment Canada.
		Synthetically derived hydrologic data	Instream flow assessments based on synthetically developed hydrologic information should acknowledge the source and quality of data. Final decisions or agreements should be based on collection and use of appropriate field data to refine the precision of the original estimates.
Implement effective management practices for protecting instream values	Hydrology	Flow variability	Instream flow prescriptions should provide inter-and intra-annual variable flow patterns that mimic the natural hydrograph (magnitude, duration, timing, rate of change) to maintain or restore processes that sustain natural riverine characteristics.
		Ice processes	Water management decisions for streams that are prone to ice formation should document the potential effects that the proposed action might have on the stream channel or associated aquatic organisms and, where appropriate, include measures to minimize or avoid potentially negative effects of project-related ice forming processes.
	Geomorphology	Reservoir management	Instream flow programs should acknowledge the effects of new and existing dams on sediment transport and allow managers the ability to recommend strategies for water releases and sediment management that minimize negative effects to existing channel, riparian, and flood plain properties and processes below the dam.
		Flushing flow	For many stream types, a flushing flow for removing fine sediments is a necessary component of instream flow prescriptions.
		Channel maintenance	Channel maintenance flow is an essential component of instream flow prescriptions for alluvial channels, and the maintenance, rehabilitation, restoration, and preservation of stream channel form and associated biological communities.
		Channel modification	Any proposed stream channel modification should document the hydrologic and geomorphic character and function of the watershed and floodplain and incorporate principles of applied fluvial geomorphology and natural habitat features.

Policy objective	Component	Policy issue	Policy statement
		Dam removal	Instream flow programs should support the removal or modification of dams or in-channel barriers and restoration or rehabilitation of affected riverine resources to more natural conditions and functions when those structures' benefits no longer outweigh their societal costs.
		Instream mining	Instream mining as a source of sand, gravel, or other materials should only be considered as a last option, and the mining operation should only be allowed to remove material in excess of the normal sediment transport carrying capacity of the stream.
Implement effective management practices for protecting instream values	Biology	Native species	Instream flow programs should acknowledge the importance of and need to manage stream communities and indigenous aquatic biota. Management of nonnative species should not threaten the long-term health or survival of native species and their habitats.
		Habitat	Instream flow prescriptions must maintain spatially complex and diverse habitats, which are available through all seasons.
	Water quality	Water quality	Instream flow prescriptions must recognize the relation between the quantity and quality of water in streams, document the effects of water quality changes on riverine resources, and implement prescriptions that maintain or improve water quality characteristics for natural riverine resources.
		Water quality standards	State and provincial fishery and wildlife agencies should include stream and river flow quantity and other needs and requirements necessary to restore, manage, and protect aquatic and riparian fishery and wildlife resources and habitats within water quality standards and permitting processes.
	Connectivity	Groundwater connectivity	Instream flow prescriptions should recognize and describe the extent and nature of connectivity between instream flows and groundwater and manage groundwater withdrawals to avoid potentially negative impacts on instream flows and riverine resources.
		Riparian connectivity	Instream flow prescriptions must recognize the connectivity between instream flows and riparian areas and maintain or establish riparian structure and functions.
		Floodplain connectivity	Instream flow prescriptions should maintain or re-establish connectivity between instream flows and floodplains.
		Longitudinal connectivity	Instream flow prescriptions should recognize and document the importance of connectivity within defined stream segments and the stream system in general. Management actions should avoid creating longitudinal disconnectivity where appropriate and restore connectivity where needed.

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