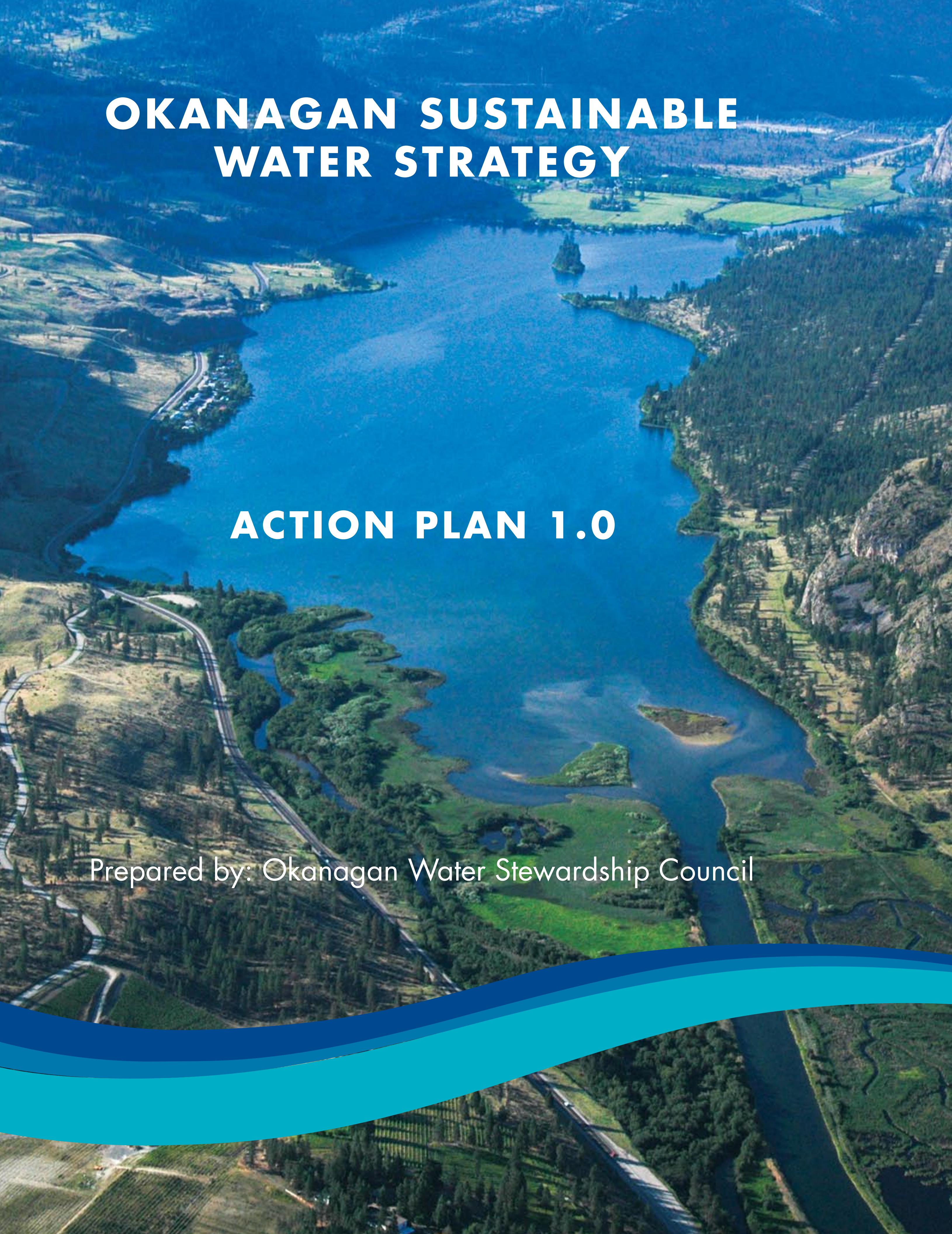

OKANAGAN SUSTAINABLE WATER STRATEGY

ACTION PLAN 1.0

Prepared by: Okanagan Water Stewardship Council

The **Okanagan Sustainable Water Strategy** is developed by the Okanagan Water Stewardship Council, an ad hoc technical committee to the Okanagan Basin Water Board (www.obwb.ca). The Council acts in an advisory role to the Okangan Basin Water Board and the Council Chair is a voting member on the Board. The goal of forming this Council is to capitalize on local water management expertise to improve long term decision making – in light of current trends toward rapid growth, climate change and the uncertain water supplies. The Water Stewardship Council meets monthly.

The Okanagan Basin spans the communities of Osoyoos in the south to Armstrong in the north – incorporating most of the three Okanagan regional districts. The Okanagan Basin Water Board was established more than 35 years ago – charged with taking a basin-wide perspective and building collaborative solutions. The Board's jurisdiction is defined by the borders of the Okanagan watershed rather than by political boundaries.

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OKANAGAN SUSTAINABLE WATER STRATEGY

ACTION PLAN 1.0

Prepared by: Okanagan Water Stewardship Council

Hon. Tom Siddon, L.L.D.
Chair, Okanagan Water Stewardship Council

We live in a very unique and beautiful part of the world with lovely lakes and beaches, lush green orchards and vineyards, and an apparent abundance of that all-precious commodity: water. But in fact, due to the pressures of rapid population growth, climate change, and creeping encroachment on Mother Nature's ecological support system, the Okanagan Basin has become one of the most heavily-stressed water systems in all of Canada.

Many lakes and rivers on our planet have already been devastated or destroyed by a lack of vision, poor water planning, and little sense of shared responsibility for the destiny of our watersheds. Some examples coming to mind include Lake Balaton in Central Europe, the Salton Sea in Southern California, and Lake Powell on the Upper Colorado River (which is presently drying up at an astonishing rate).

Recognizing the seriousness of our collective duty to protect and preserve our precious Okanagan water resources, the Okanagan Water Stewardship Council has prepared this Sustainable Water Strategy. This document sets out a long range vision and twelve Guiding Principles to manage water, in both quantity and quality, for decades to come. The Council, comprised of more than two dozen water management experts, representatives of user groups, and concerned community leaders, has devoted several thousands of hours over the past thirty months in preparation of this important work. Our findings, conclusions, and recommended Actions are based on a remarkable degree of consensus among all participants.

Members of the Council are extremely indebted to Nelson Jatel and Dr. Anna Warwick Sears at the Okanagan Basin Water Board, to our Editorial Committee and its Chair, Bob Hrasko, to our researcher and writer, Kellie Bunting, and to all of our staff who have contributed so ably to preparation of this landmark work.

Finally, we trust you will enjoy your read of this document; that you will take it to heart, and put it to practice in devoting your own personal stewardship toward our common heritage – "the Waters of the Okanagan."

Tom Siddon

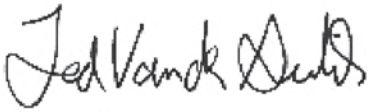
Dr. Tom Siddon
Co-Chair of Water Flagship Group
The Okanagan Partnership Society

Ted van der Gulik, P. Eng.
Vice Chair, Okanagan Water Stewardship Council

I was raised in the Okanagan on an orchard and as a youngster I remember the summers being very hot and dry. As a young boy my job was to change the sprinklers every evening and I remember marvelling how irrigation could convert the dry landscape into lush green orchards. The valley was very rural and except for a few small cities it seemed that orchards, vineyards and the lakes defined the valley, much like what citizens want to define the valley as today. The world seemed a much simpler place then, where climate change was a storm passing through and competition for water was getting your favourite spot on the beach.

But times change and the burgeoning development taking place in the valley, both for urban growth and agricultural production requires that we assess how we are going to manage water. A water strategy needs to take into account ecological, domestic and agricultural needs and consider the impacts of a changing climate on the region's hydrology. This strategy starts the process and has been developed with input from many water professionals. To achieve fruition, the plan will need a coordinated effort from law makers and practitioners and buy in from residents to ensure that changes are made on the ground.

It is important to remember that the Okanagan Valley is a headwater region and all we have to work with is the moisture that falls from the sky, which makes this strategy imperative. We cannot get water from anywhere else.



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EXECUTIVE SUMMARY

The Need for a Sustainable Water Strategy

Water is one of the most precious and important natural assets in the Okanagan Basin. Even though the Basin is endowed with several large lakes, the supply of clean, reliable water is inherently limited by the semi-arid climate, which produces minimal precipitation and high evaporation and evapotranspiration rates. According to Statistics Canada, the Okanagan Basin has the smallest, per-capita availability of freshwater in Canada. Water shortages have already occurred in some areas of the Basin, and are expected to occur more widely and frequently in the future.

Balancing the often competing water requirements of the environment, basic human needs, irrigation, tourism, recreation, industry, and cultural values has become increasingly difficult as more and more people live, work, and play in the Basin. Large seasonal fluctuations in water availability occur naturally. Climate change is expected to bring more intense storms, increased drought cycles, higher lake evaporation rates, greater evapotranspiration in vegetation and crops, and a longer growing season resulting in increasing irrigation demand. Changes in forest cover (due to mountain pine beetle infestation and associated salvage harvesting operations) will also alter the timing and quantity of runoff of water in the Okanagan Basin.

Given climate change, rapid population growth, and the fact that most water in the Basin has already been allocated to some use, conflicts over water are likely to intensify. How do we plan for a future with enough water for all priorities, including ecosystems? What happens in drought years — where is water allocated and in what proportions? What can we do to reduce our demand and use water more efficiently? How do we develop the required storage needed to capture water in the spring for use later in the year? How can we ensure high water quality is maintained and sensitive riparian and wetland ecosystems protected? What is the best structure for water governance in the Basin? These are critical questions that the Sustainable Water Strategy explores.

Sustainable use means accommodating the needs of the present without compromising the needs of the future. The Sustainable Water Strategy seeks to ensure water resources are managed in a broader sustainability framework – working towards a future for the Okanagan where water quality or quantity does not compromise human health and well-being, the environment, or the economy.

The Sustainable Water Strategy is designed to build on the 1974 Okanagan Basin Study, a joint Federal/Provincial initiative to develop a comprehensive plan for the development and management of water resources in the Basin. The 1974 study is the only Basin-wide study completed to date for the Okanagan. A subsequent Basin-wide study of surface water and groundwater resources – the Water Supply and Demand Project – was initiated in 2004 and is expected to be completed in late 2009. The goal of the Water Supply and Demand Project is to provide the best estimate of present and future water need and availability, taking into account present water use, population growth, climate change, land use change, preservation of the environment, and other factors. Once complete, the Water Supply and Demand Project will be complementary to the Sustainable Water Strategy. The Strategy articulates the vision and provides direction whereas the S&D Project provides the data needed to develop and implement strong water management practices.

The Sustainable Water Strategy is grounded in action. Twelve high-level Guiding Principles for water management and policy provide a framework for the Strategy. The key action items in the Strategy were developed respecting these Guiding Principles. It is important to note that although the Principles are presented as a list and may appear distinct from one another, they are in fact interwoven and must be considered concurrently in order for the Strategy to be successful.

Guiding Principles for the Okanagan Sustainable Water Strategy

1. Recognize the value of water. Water is a common good that is essential to the survival of people and ecosystems. The consumptive and non consumptive values of water will be recognized and respected in all water management decisions.
2. Control pollution at its source. Water quality in lakes, streams, and aquifers will be protected for the benefit of healthy ecosystems and to help ensure clean, safe, and reliable drinking water is available to all residents of the Okanagan Basin.
3. Protect and enhance ecological stability and biodiversity. Natural processes in healthy watershed ecosystems are the most effective and cost-efficient means to maintain instream water quality and quantity. Water management will commit to protecting and restoring ecosystems and will ensure that local and cumulative impacts on sensitive habitats are considered in land and water management decisions. A watershed based approach will be taken to identify the natural features that are essential to protecting water quality and quantity (e.g., wetlands, waterways, adjacent uplands, and riparian areas).
4. Integrate land use planning and water resource management. Integrated water resource management means recognizing the interrelationship between land use and water quantity and quality. Land use decisions will work to minimize the impact of urbanization and reduce the human footprint on the environment, which will in turn reduce impacts on water resources.
5. Allocate water within the Okanagan water budget in a clear, transparent, and equitable way. Identifying how and when water will be allocated is critically important to prepare for the possibility of increasing drought conditions in the Okanagan. Sufficient water must be available for the environment, agriculture, basic human needs, and economic development now and in the future. Existing historical inequities of water supply in the Basin need to be addressed and policies should be developed to prevent the emergence of new inequities as a result of increasing competition over water.
6. Promote a Basin-wide culture of water conservation and efficiency. Reducing water waste and promoting water use efficiency is central to sustainable water management. Water saved through improved water use efficiencies by a water use sector should be held for that sector
7. Ensure water supplies are flexible and resilient. Even with improved Basin-wide water conservation and efficiency, water storage capacity will need to be increased in some sub-basins to meet the joint challenges of population growth and climate change.
8. Think and act like a region. Local decisions must consider watershed and aquifer interconnections with the larger Basin. Work towards a governance system that integrates existing institutions from the sub-basin level to the Basin as a whole, and provincial and federal governments. Specific types of decisions are appropriate at each level of this nested system of governance institutions and a reasonable balance of authority must be achieved.
9. Collect and disseminate scientific information on Okanagan water. The best available technology and science will be used to inform water management decision-making. Information will be managed in an integrated manner that is readily available to stakeholders Basin-wide.
10. Provide sufficient resources for local water management initiatives. Sufficient financial resources will be allocated to support better use of supplies of water that we have already developed, to employ new technology and infrastructure, to improve and refine management practices, and to draw on better information.
11. Encourage active public consultation, education, and participation in water management decisions. Transparent decision-making processes and opportunities for information sharing and open communication are essential to a collective understanding and acceptance that we are part of the environment and our activities have implications on clean available water. A culture of accountability needs to inform everything from high level planning to individual perceptions and patterns of consumption.
12. Practice adaptive water and land management. Continuous learning, innovation, and improvement are essential to effective and efficient implementation of the Sustainable Water Strategy. An on-going monitoring and reporting program will be developed for the Strategy. In addition, a comprehensive review of the Strategy needs to be conducted every five to seven years.

Protecting our Lakes, Rivers, Wetlands, and Aquifers

Water shapes lands, transports materials, and transforms the environment. It has incredible power—through intense storm events and slow but steady erosion. Because of this power, water also has an enormous ability to transfer contamination from a source to a much larger area. Source water protection, which encompasses land use, ecosystem protection, and the entire hydrological cycle, is fundamental to reducing or preventing contaminants from entering lakes, rivers, and aquifers.

Ecosystem processes in healthy watersheds are the most natural, effective, and cost-efficient means to keeping contaminants out of source water. Channelization of the Okanagan River in the 1950s, rapid urban development, road building, forestry, agricultural activities, livestock grazing, off-road recreation, wildlife, and natural events like storms and fires have resulted in the loss and fragmentation of over 85 percent of wetlands and riparian areas in the Basin. The loss of these natural purification systems has increased the risk of contamination for drinking water supplies and has harmed aquatic ecosystems. Protection and restoration of ecosystems is critical to maintaining clean water.

The health of our waters is directly affected by how we live on the land. The vast majority of land in the upper watersheds of the Okanagan Basin is Crown land designated for "multiple uses", meaning that forestry, development, recreation, mining, and livestock grazing are permitted and often encouraged in community watersheds that are the source areas for public drinking water. Local water suppliers do not have regulatory control over Crown land use in their source watersheds, and must rely on decisions made by other multiple levels of government. To ensure water quality is maintained now and in the future, local water purveyors must have more influence over what activities occur in source watersheds.

The amount of land in the Okanagan consumed by development has grown rapidly in recent decades. Historically, growth in the Okanagan has been accommodated through patterns of highly dispersed development; know as urban, suburban, and exurban sprawl. This type of development can lead to a number of negative environmental, economic, and public health outcomes. In contrast, development that uses land efficiently and protects undisturbed natural lands allows a community to grow and still protect its water resources.

This Strategy recognizes that source protection does not replace the need for adequate drinking water treatment. The benefits associated with drinking water treatment are of a local scale (i.e., customers of the utility), whereas source water protection provides benefits on a regional (i.e., Basin-wide) scale. All downstream uses, including non-consumptive uses such as ecosystem function, water-based recreation, and aesthetic values, benefit from clean source water. For this reason, the Strategy focuses on source water protection as a key principle of sustainable water management.

Adequate wastewater treatment is also essential to clean water in the Okanagan Basin since treated effluent is discharged regionally into mainstem lakes and the Okanagan River. Wastewater treatment plants in the Okanagan are currently designed to treat nutrients and pathogens effectively and efficiently. However, there is continual need for public reinvestment in this infrastructure to maintain the highest standards of treatment and to bring areas with old, failing septic systems onto community sewer systems where it is beneficial to do so. New information on emerging contaminants, such as endocrine disrupting chemicals and pharmaceuticals and personal care products require further study and may necessitate further wastewater treatment plant upgrades.

Key Actions

- Work cooperatively to protect, restore, and enhance riparian and wetland areas.
- Undertake individual source water assessments and prepare joint source water assessments where feasible in order to develop a regional (Basin-wide) source protection strategy.
- Manage livestock through the installation of fencing and off-stream cattle watering stations.
- Develop and implement well protection plans.
- Create bylaws and best management practices for geothermal energy.
- Consider water in community design by promoting development that is high-density and uses existing infrastructure.
- Improve stormwater management.
- Enact or amend land use policies and tools to protect water and the surrounding land.
- Develop and harmonize groundwater protection bylaws.
- Support appropriate sewerage system regulation and application.
- Support research on emerging water contaminants.
- Complete Basin-wide wetland, foreshore, and sensitive habitat inventory mapping to support water and land management.
- Streamline data reporting for water quality and supplies.

Securing our Water Supplies

Identifying how and when water will be allocated is critically important to prepare for the possibility of increasing drought conditions in the Okanagan. Accurate and rigorous water accounting is important for developing an Okanagan water budget. Water must be reserved within this budget for appropriate uses. Groundwater and surface water are connected resources. It is essential to consider them as such when determining allocation and use.

Water allocations for the environment are not optional or discretionary. Conservation flows need to be established, groundwater environmental baseflows preserved, and Environmental Water Reserves designated to protect natural systems during drought periods. "Conservation" licensing must be considered on all creeks requiring conservation flows.

Water is also needed to maximize food production in the Basin. The development of an Agricultural Water Reserve would provide for the appropriate water allocation to land that is viable to grow food for residents of the Okanagan and beyond. Reserving water for these lands will also encourage farmers to invest in water-efficient farming practices by providing assurance that water saved will be available during water shortages, and not allocated irretrievably to downstream developments. "Irrigation" designated licences must be adjusted to match the land they irrigate and the availability of water from the sources.

An adequate portion of water must be designated for drinking, food preparation, hygiene, and sanitation. Water is also necessary to support economic development in the Basin – virtually all economic sectors are water dependent. Just as water is set aside for the environment and for agriculture, water must be set aside within the Okanagan water budget for domestic, industrial, commercial, and institutional uses. Most of the larger utilities in the Basin are licensed for annual water volumes much greater than what they currently use or require. An accounting of water licensing and water uses for each larger water supplier in the Basin needs to be conducted. "Waterworks Local Authority" (domestic) designated licences must be validated to realistic levels for each of the water utilities in the Basin.

Reducing water waste and promoting the efficient use of water is central to ensuring water supplies are adequate now and in the future. Many communities in the Basin have implemented water conservation programs, but are working independently of one another. Sharing knowledge and experience between communities would be invaluable to improving water conservation in the Basin. Implementing measures that reduce irrigation will result in the greatest water savings in the Basin since approximately 70 percent of water used is for agriculture and an additional 15 percent is used for irrigation of parks, boulevards, golf courses, and residential landscapes.

Even with improved Basin-wide water conservation and efficiency, water storage capacity will need to be increased in some sub-basins to meet the joint challenges of population growth and climate change. Water storage must be strategically developed in the Okanagan Plateau and mainstem lakes to build flexibility and resiliency in the water supply. Most of the accessible and lower cost upstream storage sites have already been developed, resulting in higher development costs for municipalities and irrigation districts. Funding strategies must be identified to support the construction of new upstream storage reservoirs.

Key Actions

- Establish conservation flows, preserve environmental baseflows, and designate environmental water reserves.
- Establish an agricultural water reserve.
- Extend the date on irrigation licences to allow for irrigation later in the season (October) without increasing the allocation of water. Allow part-season licensing to maximise beneficial use of water.
- Ensure sufficient potable water is available in each community for domestic, industrial, commercial, and institutional use.
- Review Basin water licensing and water uses.
- Prepare and implement drought management plans for individual utilities and the Basin as a whole.
- Develop Water Use Plans for all major fish-bearing watercourses in coordination with a Basin-scale water use agreement.
- Develop an Okanagan Water Management Plan (or plans) that includes groundwater licensing and monitoring, source water protection, and Basin-wide drought management planning.
- Develop a collaborative Okanagan water conservation strategy.
- Reduce outdoor water use by using certified irrigation designers, implementing bylaws, and improving scheduling.
- Implement universal metering.
- Conduct a basin-wide domestic water pricing assessment.
- Maintain affordable agricultural water rates by splitting systems, increasing use of treated wastewater, implementing education and incentive programs, and other mechanisms where appropriate.
- Develop a watershed storage reserve fund.
- Implement policies that support coordinated water storage.
- Measure and monitor water use, storage, and availability.

Delivering the Strategy

Water should be managed as a collective resource in Canada, shared by people and the environment, supporting food production, and underpinning the economy. Current water governance and management structures will be tested in the future as climate change and a growing population put pressure on water quality and supply. More than thirty-five Acts, Regulations, and policies directly or indirectly govern water and aquatic and riparian ecosystems in the Basin. Many of the critical tasks laid out in this Strategy require a focused governance structure that can form strong partnerships with local and senior governments as well as with landowners, developers, farmers, scientists, homeowners, recreational groups, and other constituents in the Basin. A regional water governance institution is ideal for conflict resolution, enhanced communication, and harmonizing and making more equitable and uniform policies among jurisdictions. Basin-scale governance should focus on issues that have distinct regional benefits and do not duplicate efforts of local or national governments.

Long-term, stable organizational and funding support is essential for maintaining a functional water management institution in the Basin. There are a range of options available to support the water governance, including volume-based water use fees, water licence rentals, recreational user fees, and sales taxes. Each funding option has strengths and weaknesses and operational costs.

Partnerships and active dialogue between non-aboriginal water managers and aboriginal peoples are essential for sustainable water management in the Basin. Aboriginal peoples have a rich heritage regarding the land and water in the Okanagan Basin. Aboriginal title, aboriginal rights, and treaty rights to water are recognized, but not well defined, under the Constitution Act of 1982. Where an Indian Reserve allotment does not explicitly include water, it is understood to include a sufficient supply of water for full and beneficial use of the land, including economic purposes. In the absence of treaties, there are great uncertainties regarding future claims to land and water by aboriginal peoples in the Basin.
The success of this Strategy depends on the extent to which services are planned and implemented in an open, transparent, and accountable manner based on broad consultation, citizen engagement, and consensus on the need to practice sustainability. Ongoing stakeholder involvement like that provided by the Okanagan Water Stewardship Council is essential for creating workable water policy and reducing conflict in the Okanagan. This Strategy supports the premise that every individual in the Basin shares the water resource; therefore, decisions and actions made in one part of the Basin have impacts throughout the watershed.

The Okanagan is a centre for water science in Western Canada. Partnerships with universities, government, and independent research institutions provide leadership on important questions regarding adaptation to climate change, understanding the next generation of pollutants, restoring wetlands and waterways for healthy water and ecosystems, and defining groundwater and surface hydrology.

Although large quantities of technical and planning information are available for water resources in the Okanagan Basin, the challenge is that much of the data are collected for site-specific (not Basin-wide) purposes, and some are historical, discontinuous, or collected in a form that is not useful for current studies or modeling. In addition to data gaps and inconsistencies, access to information is hindered because isolated databases are housed at many locations, and different databases contain fundamentally distinct and somewhat incongruous elements. Many of the action items in this Strategy require the support of specific data collected on a Basin-wide, long-term basis and increased accessibility to data now and in the future.

The Sustainable Water Strategy is meant to be a living document that will change with time under the principle of adaptive management. Monitoring and reporting tools that incorporate benchmarking and results-oriented focus need to be developed to support the measuring, tracking, management and accountability of water resources in the Okanagan. Continuous reassessment and improvement of the Strategy will be conducted in order to manage uncertainties and allow new knowledge to be incorporated as it emerges.

Key Actions

- Support and foster collaboration through partnerships.
- Partner with aboriginal people in the development of Basin water management strategies.
- Develop a community engagement strategy that highlights water conservation and pollution prevention.
- Obtain local government representation on the Southern Interior Regional Drinking Water Team.
- Identify knowledge gaps and encourage focused research to fill those gaps.
- Develop web-based water management monitoring and reporting tools.
- Create an Okanagan Basin Information Network.
- Undertake an economic analysis of funding mechanisms for Okanagan water governance.
- Create an Okanagan Water Fund.
- Revisit and reassess the Sustainable Water Strategy every five to seven years.

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CHAPTER 1

THE NEED FOR A SUSTAINABLE WATER STRATEGY

1.0 THE NEED FOR A SUSTAINABLE WATER STRATEGY

1.1 Introduction

The setting of the Okanagan Basin is unique in Canada. The climate of the Basin is semi-arid, which produces minimal annual precipitation and high evaporation and evapotranspiration rates. Water is one of the most precious and important natural assets in the Basin. It is essential to the survival of plants and animals, the well-being of citizens, a healthy economy, and the beauty of the natural landscapes.

Almost 200 km in length and approximately 8,000 km^2 in area, the Okanagan Basin is approximately two-thirds the size of Vancouver Island (see Figure 1-1). Six large lakes form a chain along the valley floor of the Basin. Wood Lake is the first in the chain, and joins Kalamalka Lake through a short dredged channel. Kalamalka Lake drains into Okanagan Lake via Lower Vernon Creek. The outlet of Okanagan Lake is the Okanagan River at Penticton, which flows south through Skaha, Vaseaux, and Osoyoos lakes, in that order. Several other smaller lakes also lie along the floor of Okanagan Basin, and include Otter, Swan, Ellison, and Tugulnuit lakes. Many tributary streams flow from headwater lakes to the valley lakes.

This document provides a guide for sustainable water management practices that will help us adapt to changing climate and water demand in the Okanagan Basin. Water must be managed collaboratively; mindful of the Basin's water budget and using good science, appropriate regulatory legislation, water management tools, and communication strategies to inform the public and elected leaders. The Okanagan Sustainable Water Strategy contains principles and action items for regulators, politicians, local governments, water utilities, and stewardship groups to better manage the Okanagan's limited water resources.

Figure 1-1 Okanagan Basin topography and watersheds.

The importance of water has long been recognized in the Okanagan Basin. The Syilx aboriginal people have lived in the Okanagan for thousands of years, and before the European settlers arrived in the early 1900s the traditional governance of the water resources fell into the hands of the 'Salmon Chief'. Water was integrated into the culture and spiritual practices of the Syilx people. Water systems were recognized as being central to all life and protection of the water was viewed as an ethical responsibility.

Since the arrival of European settlers, the valley has had to adapt to major water management changes as the landscape was transformed from dry pine and range land, to orchards, tobacco farms, and hay lands, and then to bustling urban areas. Irrigation and flood control dams were installed throughout the valley system in the 1950s (see Figure 1-2) and the Okanagan River was channelized between Okanagan and Osoyoos lakes to control flooding (see Figure 1-3).

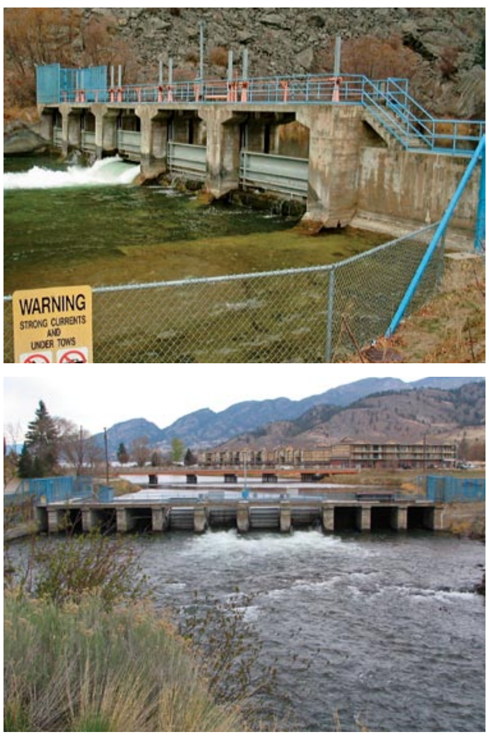


Figure 1-2
Examples of control structures on the Okanagan River - the McIntyre Dam (top), located just south of Vaseux Lake, and the Skaha Lake Outlet Dam (bottom) at Okanagan Falls.

As agriculture and settlement in the Basin prospered, water issues became more and more prevalent. Many of the issues called out for a watershed approach. In 1969, the Okanagan Basin Water Board (OBWB) was established to better define water resource problems in the valley and determine priorities and opportunities for solving them. More information about the OBWB is provided in Section 1.4.1.

Figure 1-3
A section of Okanagan River where it drains into Skaha Lake in 1949 (top) and 2004 (bottom).

The joint Federal/Provincial Okanagan Basin Study commenced in 1969, shortly after the OBWB's formation, and was completed in 1974. The Study intended to develop a Basin-scale comprehensive framework plan for the development and management of water resources for the social betterment and economic growth of the Okanagan community. The Study produced a 50-year development plan with three economic growth projections and a conclusion that the existing available water supply was sufficient to meet all three scenarios. However, population growth in the Basin has proceeded at a much higher rate than even the highest of the three projections.

Today, 22,000 hectares of agricultural land is in production, of which 19,000 hectares are being irrigated, and up to 8,094 hectares more of viable agricultural land is not in use (BC Ministry of Agriculture and Lands, 2008). Approximately 90 percent of all streams in the Okanagan are at, or beyond, their licensed capacity for water withdrawal. In thirty years the population has tripled to almost 350,000, and is projected to reach 445,600 by 2035 (BC Stats, 2008). Thousands of tourists visit the valley every year to enjoy the region's climate, natural beauty, and cultural activities. With more and more people, balancing the water needs of the environment, drinking water, crop irrigation and other outdoor watering, tourism and recreation, industry, and cultural values is increasingly difficult. Climate change is expected to increase the frequency of drought and flood events in the Okanagan due to warmer, wetter winters and longer, hotter, drier summers. Of critical concern is, *"How do we best manage the water that is available to us, now and in the future?"*

1.2 Why is a sustainability framework necessary?

"While most Canadians believe that water is a human right, it is important to realize that [water] is a finite resource and part of a fragile ecosystem. We need our actions and policies to reflect the importance of maintaining that balance."

- John Austin, Globe and Mail, 27 April 2008

This Sustainable Water Strategy 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. The 1987 Brundtland Report published by the United Nations World Commission on Environment and Development (1987) defines sustainable development as *"development that meets the needs of the present without compromising the ability of future generations to meet their own needs."*

The challenge of sustainable development is inextricably bound to the challenge of water management. The Okanagan boasts a high quality of life, and over the past decade the human impact on the landscape has intensified as a result of increased growth, largely driven by retirees – a trend that is anticipated to continue for the foreseeable future. The supply of clean, reliable water is inherently limited because of the Basin climate and geography. A robust water strategy, one that accommodates the needs of the present without compromising the needs of the future, must integrate water issues within a broader sustainability framework considering interconnected environmental, social, and economic factors.

This Strategy seeks to build consensus about short-term and long-term priority uses of water, including:

- water for drinking,
- water for food production,
- water for maintenance of ecosystem functioning,
- water for sanitation, and
- water for quality of life (includes economic development, power generation, transportation, and tourism and recreation).

Given climate change, rapid population growth, and the fact that most water has already been allocated to some use, conflicts over water are likely to intensify. How do we plan for a future with enough water for all priorities? What happens in drought years—how is water allocated and in what proportions? How do we develop the required storage needed to capture water in the spring for use later in the year? How can we ensure high water quality is maintained and sensitive riparian and wetland ecosystems protected? These are critical questions that the Sustainable Water Strategy explores.

1.3 The challenges facing sustainable water management

1.3.1 The myth of water abundance

"The Okanagan Basin has the lowest, per capita availability of freshwater in Canada."

- Statistics Canada, 2003

The Okanagan Basin is endowed with several large lakes, so it is easy to believe that there is more than enough water for everyone. However, this may not be the case.

There is only one way that water enters the Basin, through precipitation in the form of rainfall or snow. The Okanagan Basin receives on average of about 53 cm of precipitation annually. The valley bottom receives less precipitation on an annual basis than upper elevations, ranging from 25 cm in the south valley to 45 cm in the north (see Figure 1-4). The Basin lies in the rain shadow of the Coast Mountains, which means that most of the moisture in the air flowing from the Pacific Ocean has already dropped out as precipitation prior to reaching the Okanagan. As moist air masses from the Pacific are forced to rise to the top of the mountains, the air cools causing condensation and precipitation (see Figure 1-5). The land on the eastern side of the mountain range – including the Okanagan Basin – receives dry, warm air and little precipitation.

Most of the water arrives in the Basin as snow in the winter, which melts in the spring and infiltrates into the ground or flows in streams to highland reservoirs and valley lakes.

There are two ways that water leaves the Basin; through evapotranspiration and evaporation, and through Okanagan River flow to the south. More than 80 percent of precipitation falling in the valley is lost through evapotranspiration from forests and

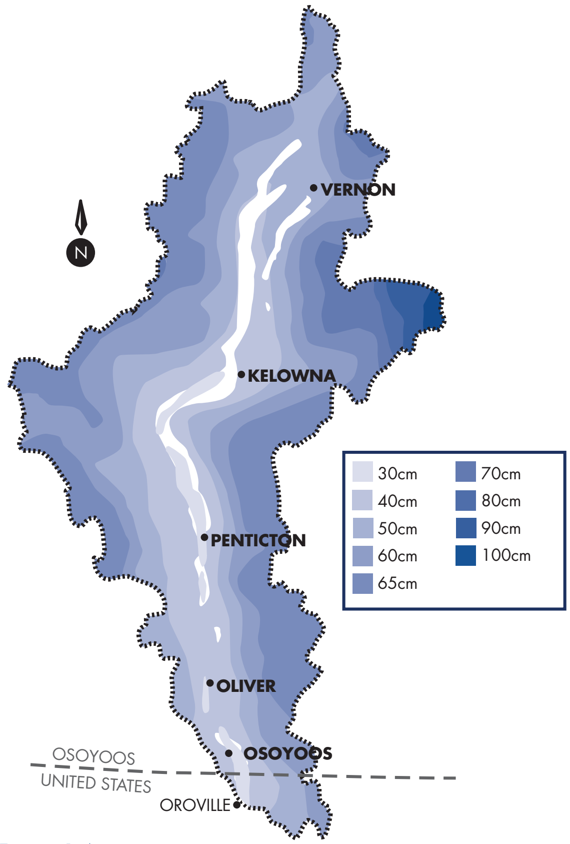


Figure 1-4
Okanagan Basin mean annual precipitation.
(Canada-British Columbia Consultative Board, 1974)

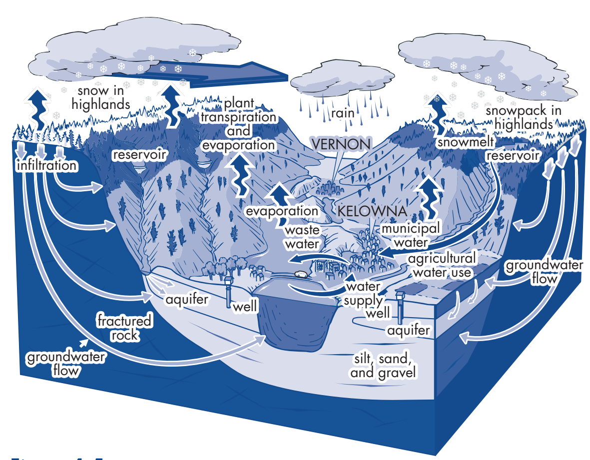


Figure 1-5
The hydrological cycle in the Okanagan Basin.
(Turner et. al., 2006)

evaporation from local lakes (Cohen & Kulkarni, 2001).

Okanagan Basin valley lakes act as natural storage reservoirs through which water slowly flows. Even though they have fairly large capacity and are usually "full", water levels can be drawn down quickly if water is not replenished at the same rate it is removed. This is prevalent during drought years when lake levels fall, exposing the nearshore shallows and stranding boat launches, docks, and water supply intake pipes. In the Okanagan the amount of inflow to the valley lakes is small compared to the total volume of water (see Figure 1-6). On an annual basis, a volume equal to only the upper one and a half metres of the largest lakes is replenished each year (Turner et. al., 2006). Just like a bank account, if you take more money (water) out than you put in on a monthly or annual basis, the balance (lake level) will fall. If we are to take care of the needs of future generations, we must maintain the natural wealth of the "bank account".

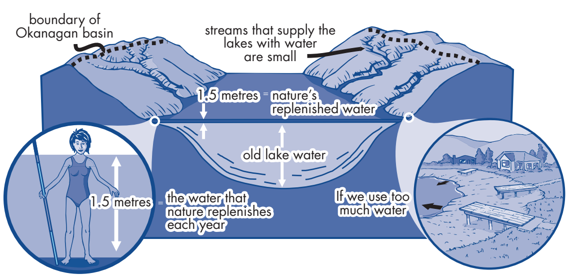


Figure 1-6
Only the upper one and a half metres of the valley lakes is replenished each year and is available for human withdrawal. If more water is withdrawn, lake levels will fall. (Turner et. al., 2006)

The myth of abundance also extends to groundwater reservoirs. Groundwater is closely connected to surface water through co-dependent ecosystems and the flow of water. Although groundwater can be found in most places if one drills deep enough, there is not an endless supply of water in the ground. Aquifers are very much like lakes in the sense that they act as storage reservoirs through which water flows, although at a much slower rate than surface water. Their water levels fluctuate annually and seasonally depending on the balance of inputs and outflows (see Figure 1-7). Water seeps into the ground in upland recharge areas and returns to the surface as springs, low-lying wetlands, or direct seepage into rivers and lakes. Groundwater mining occurs when water is extracted from aquifers at a rate faster than the natural flows can replenish the supply. This can be a serious problem because the amount of natural groundwater recharge is low (i.e., a fraction of precipitation) and typically most occurs within a very short time span of a few weeks in the spring. Once in the subsurface, groundwater tends to move slowly through the system – much more slowly than surface water flow. All of this means that only a part of the groundwater that is in storage can be accessed and used. One example of severe groundwater mining is the Ogallala aquifer in the Great Plains of south-central United States where the drawdown exceeds more than 50 metres in places, reducing groundwater quality and quantity and threatening the capital-intensive irrigated agricultural economy of the area. Just as with lakes, the supply of groundwater that is available for use is dependent on the rate of natural recharge, not the total volume stored.

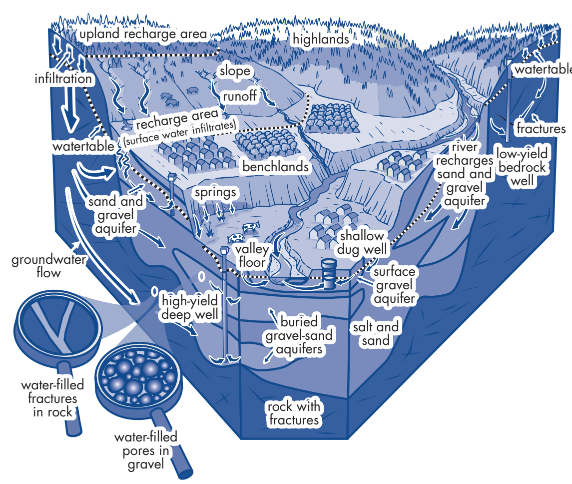


Figure 1-7
Groundwater can provide a source of reliable, clean water in remote locations but the supply that is available for use is dependent on the rate of natural recharge, not the total volume stored. (Turner et. al., 2006)

1.3.2 Variability and timing of water supply

The Okanagan Basin experiences significant variations in the quantity of precipitation it receives. Figure 1-8 shows peaks and valleys of the annual net inflow to Okanagan Lake between 1921 and 2003. The difference between the highest net inflow of 1,400 million cubic metres in 1997 and the lowest net inflow of 75 million cubic metres in 1931 demonstrates just how much of a challenge water supply variability represents to water managers.

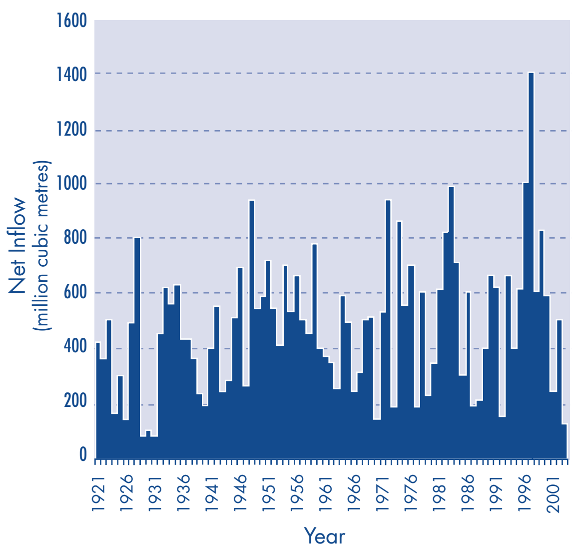


Figure 1-8
Annual net flow in Okanagan Lake from 1921 to 2003. (Chapman, n.d.)

Water shortages are common in the Okanagan Basin. Between 2001 and 2003, severe droughts occurred throughout British Columbia. In 2003, Kelowna recorded the driest June to August period since records began in 1899 and set a record for consecutive days without precipitation (Land and Water BC, 2004). The District of Summerland declared a state of emergency over its water supply, while trying to balance the water needs of the residents and fish. The low water levels were caused by a culmination of low snowpack, hot and dry conditions in the summer, and a delay in the onset of fall rains. Water levels in Okanagan Lake were extremely low and stream flows were at the lowest seasonal levels in the historical record. The drought resulted in extreme fire hazard and the Okanagan Mountain Park Fire, the most destructive interface wildfire in Canadian history, occurred in the Basin (see Section 1.3.7 for more information about the wildfire).

Flooding has also been a concern in the Basin, even after the construction of flood control structures in the 1950s. In the flood of 1972, Okanagan Lake exceeded its normal high water elevation by almost a foot and Osoyoos Lake rose almost 5 feet (Canada-British Columbia Consultative Board, 1974). Flood damage amounted to approximately $56,500 around Okanagan Lake, exclusive of flood damage at the mouths of tributaries, and $212,000 within the Canadian portion of Osoyoos Lake. The hydrological impacts of the current mountain pine beetle infestation (see Section 1.3.6), the degradation and fragmentation of riparian ecosystems due to land development, and the possible increase in rainfall due to climate change (see Section 1.3.5) may all contribute to increased risk of seasonal flooding in the Basin. However, increased risk of flooding does not necessarily result in reduced risk of water shortage, as annual water supplies are also limited by total reservoir storage capacity and other factors. Flooding and high streamflows can however, adversely affect raw water quality.

In addition to the variability of water annual net inflow, the annual pattern of water flow in the Basin is very important to consider in water management planning. Figure 1-9 is a typical annual hydrograph for the southern interior of BC, using data for Mission Creek. The majority of precipitation occurs and accumulates during the winter months as snowfall, resulting in a dominant spring freshet. Approximately 80 percent of the total annual flow in the creek occurs during the months of April, May, and June. Rates of discharge are much lower from late July to mid-April.

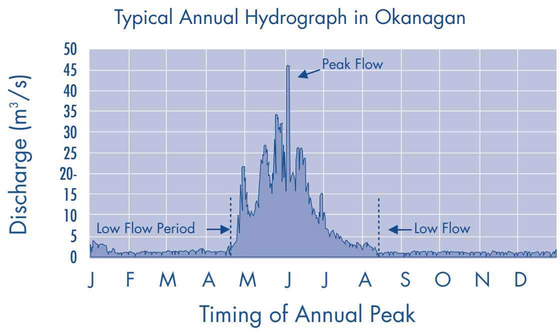


Figure 1-9
Typical annual hydrograph for the southern interior of British Columbia, showing the dominance of the spring freshet (data for Mission Creek from Environment Canada).

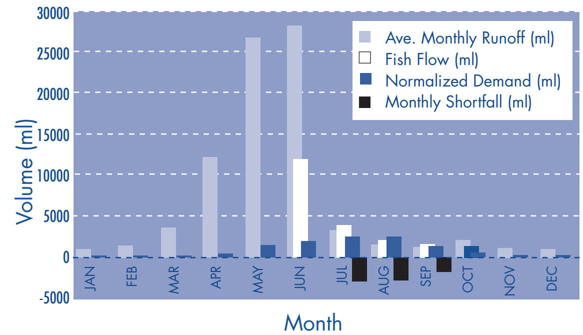


Figure 1-10
Typical runoff versus demand in an Okanagan Basin watershed.

The pattern of annual water flow in the Basin is out of sequence with water demand. Figure 1-10 shows typical runoff versus demand in an Okanagan Basin watershed. The light blue columns provide the average monthly flow in Trout Creek. The white columns represent fish habitat requirements as set out in the Summerland Water Use Plan agreement with Fisheries and Oceans Canada and the Ministry of Environment (see Section 3.1.3 for more information about the Water Use Plan). The fish flow is required between June and October annually. The monthly Normalized Water Demand shown in the dark blue columns is the water demand by Summerland that occurs on a year of average temperature and moisture conditions. This normalized demand number is obtained by trending the water use in previous years to the present year to account for population growth and land use changes and previous water demand trends. The variance from normalized water demand can be as much as 10 percent higher or lower for a dry or wet year. The black columns show the average monthly shortfall when accounting for water demand and in-stream flow requirements. In dry years, the monthly average shortfall increases unless there are allowances and agreements made by the stakeholders through the means of a Water Use Plan. Reservoir storage must be in place to account for this shortfall.

1.3.3 Population growth

One of the most pressing issues in the region is rapid development of land and the ensuing impacts on natural factors such as water quality and quantity and biodiversity. The Okanagan is continuing to experience rapid population growth (see Figure 1-11). Since the original Okanagan Basin Water Study was completed in 1974 the valley population has tripled to almost 350,000 people. This population already exceeds the highest level projected in the Study of 290,000 by the year 2020. The population is anticipated to reach 445,600 by 2035 (BC Stats, 2008).

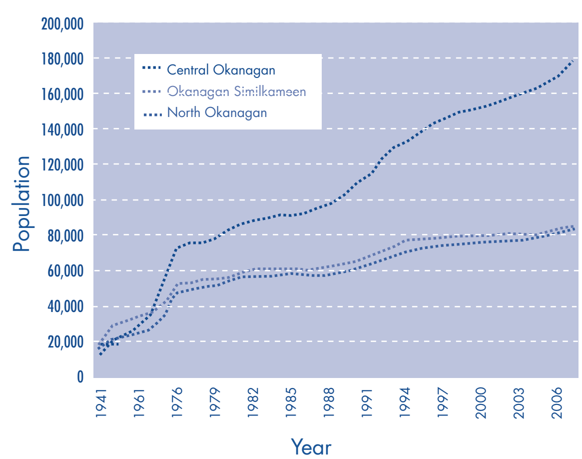


Figure 1-11
Okanagan population 1941 to 2006. (BC Stats, 2008)

This increase in population and associated development will result in increased urban water demands, especially if our current water consumption rates do not change.

1.3.4 Economic development

"[Okanagan Lake] serves as the economic and cultural backbone of the Okanagan Valley. Without the presence of the lake, the communities and the economy would be so different it would be difficult to imagine. The lake is the focus of life in the valley, a source of recreation and drinking water for an ever-growing population as well as habitat for a wide range of organisms. Changes in the lake have the potential of affecting a wide range of economic and aesthetic values and the general social fabric and structure of the communities that border the lake."

- Nordin, 2005, p. 1

The Okanagan has a strong and diverse economic base and a high quality of life. Water and the riparian corridors that surround it play an important role in the economic and social lifestyle of tourists and residents of the valley.

Water is essential to the economic viability of the farms, pastures and forage areas, orchards, vineyards, and ranches that occupy about 70 percent of the developed land in the Basin. The Okanagan Basin is one of the driest agricultural regions in Canada and is highly dependent on irrigation. Crop irrigation accounts for about 70 percent of water use in the Basin. Agriculture creates the rural character of the Okanagan Valley that is valued by residents and tourists alike. But, more importantly, the valley produces 25 percent of the total value of British Columbia's agriculture, and is the province's major producer of apples, peaches, pears, and other tree fruits (Turner et. al., 2006). Vegetables and forage crops that support milk and meat production are also important in the Basin. Figure 1-12 shows the contrast between the desert landscape and irrigated vineyards in Osoyoos.

Figure 1-12
Vineyards in Osoyoos.

The tourism sector is a significant economic generator in the Okanagan, employing over 25,000 people (ICF Consulting, 2004). Visitors come by the thousands to enjoy the region's climate and natural beauty – a pastoral oasis of lakes and orchards in a dry landscape. Popular water-based activities include swimming, boating (see Figure 1-13), and fishing. Residents and tourists also enjoy golfing (see Figure 1-14), walking, biking, hiking, and wildlife viewing. More recently, the region has been developing new tourism products, including high-end lakeside resorts and agritourism activities such as vineyard, winery, and orchard tours (see Figure 1-15).

Figure 1-13
Boats on Okanagan Lake at Westbank.

Figure 1-14
The Kelowna Golf and Country Club, the City of Kelowna, and Okanagan Lake.

Figure 1-15
Burrowing Owl Estate Winery and vineyards in the South Okanagan.

For the Okanagan Basin to continue to prosper, we must ensure that we have reliable, fit-for-purpose water supplies to retain and attract industry. Preservation of publicly accessible lakeshore areas and maintenance of excellent water quality is critical to the Okanagan Basin's appeal as an economically important recreational destination. On the other hand, we must also make sure that economic development does not negatively impact the very resources it relies upon: water quality, water quantity, and healthy ecosystems.

1.3.5 Climate change

Watersheds and water systems are known to be sensitive to climatic variations. Changes in temperature, precipitation amount and form as rain or snow, and evapotranspiration from lawns, farms and forests have implications for managed and unmanaged water systems.

In 2004, a study was completed on the effect of climate change on water supply and demand in the Okanagan Basin (Cohen, Neilsen, & Welbourn, 2004). Model output from this work (Neilsen et al., 2006; Cohen et al., 2006, & Merritt et al., 2006) was used in 2006 in a *Participatory Integrated Assessment of Water Management and Climate Change in the Okanagan Basin, British Columbia* report (Cohen & Neale, 2006). The reports suggest that climate changes will alter the quantity and quality of water that is available at any given time and place.

Highlights of the reports include:

- Annual Okanagan Lake inflows from all surface sources are projected to decline by up to 30 percent by the 2080s due to longer, hotter, and drier summers,
- Seasonal peak streamflow is projected to occur earlier, possibly by a month or more by the 2080s, due to earlier snowmelt, resulting in an extended low flow period, (see Figure 1-16),
- Crop water demand is projected to increase by up to 60 percent by the 2080s due to a longer, warmer growing season, and
- Residential water demand is projected to increase due to population growth, with climate change accelerating this rate of increase.

The most important message from the report might be that however the Basin evolves, we must adapt and manage the water that we will receive.

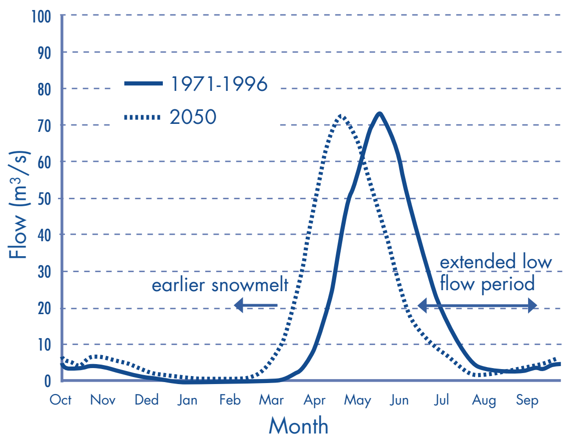


Figure 1-16
Past and projected water flows in Whiteman Creek, which enters Okanagan Lake near Vernon. (adapted from Cohen & Kulkarni, 2001)

This combination of reduced supply and increased demand will lead to more frequent water shortages in the Basin. It is not known if the Okanagan Valley will experience more or less annual precipitation as a result of climate change. However, we can expect changes in the timing and reliability of runoff, more intense storms, and increased drought cycles. This, combined with higher lake evaporation rates, greater evapotranspiration in natural vegetation and crops, and a longer growing season, poses the greatest long-term risk to the region. Therefore, climate change scenarios must be incorporated in watershed planning and modelling.

1.3.6 Mountain pine beetle

The mountain pine beetle infestation and associated salvage harvesting operations will affect the Okanagan Basin landscape and alter the way water moves through forested watersheds. Forest canopies intercept rain and snow (Figure 1-17), temporarily storing and then redirecting it back to the atmosphere or down to the ground where it infiltrates into the soil or pools on the soil surface and evaporates. Water stored in the soil may be taken up by the trees and returned to the atmosphere through transpiration or it may flow to surface waterbodies or aquifers. All of these processes are affected by tree species, composition, age, density, health, and understory vegetation (Redding, Pike, & Teti, 2007). Changes in forest cover and ground disturbance associated with mountain pine beetle and salvage logging will alter the water balance at affected sites and may also contribute to hydrologic change at the sub-basin level (Winkler et. al., 2008).

When substantial forest cover is lost at the stand and sub-basin scales, expected changes include:

- increased rain and snow reaching the ground,
- increased soil moisture,
- increased hillslope flow,
- earlier onset of spring snowmelt,
- more rapid streamflow response to storms,
- increased magnitude and frequency of peak flows, and
- increased total streamflow.

Given these potential changes, it is very important to include mountain pine beetle and salvage harvesting in watershed planning.

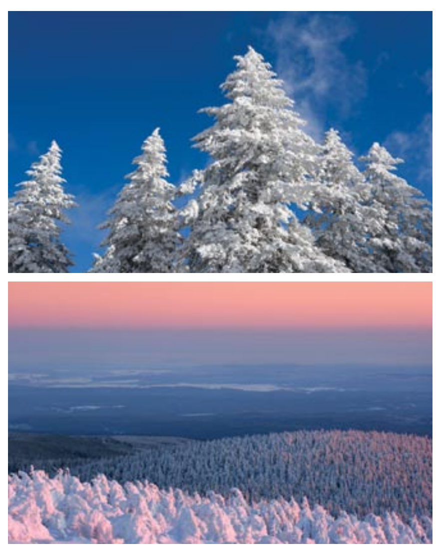


Figure 1-17
Photos of snow-laden trees that demonstrate the capacity of the trees to intercept and hold snow. Changes in forest cover will result in more snow accumulation on the ground, potentially increasing peak flow magnitudes and decreasing infiltration.

1.3.7 Wildfires

The 2003 Okanagan Mountain Park Fire caused enormous damage in the Central and South Okanagan. It devastated nearly 26,000 hectares of forest, including forest in nine drainage basins that flow through the city, and burned through the southern neighbourhoods of the City of Kelowna consuming 239 homes with estimated losses exceeding $100 million (Dobson, 2006). Wildfires are a result of numerous conditions including dry conditions, high fuel conditions in the forest, and some form of combustion.

Fire protection planning is based on changing forest harvesting practices to manage the fuel load in the watershed, and harvest so that cut blocks form reasonably defendable barriers in the event of a wildfire. The BC Ministry of Forests and Range, the forest industry, and the water suppliers all see the benefits of implementing these practices to protect the water resource. The first Fire Protection Plan has been initiated in the Mission Creek watershed.

Fire protection planning is complex to implement, due to the tradeoffs that must be made between creating fuel free corridors and the management of riparian areas, wildlife habitats, sensitive soils, visual aesthetics, and timber quality. The development of these plans will take years to complete as they must be structured to be economically viable in order to be accomplished.

1.4 Developing the Strategy

The Sustainable Water Strategy is the product of the Okanagan Water Stewardship Council (the "Council"). The Council is an advisory committee that provides technical expertise and policy recommendations to the OBWB on water related issues. The strength of the Council lies in its diversity of Council members that represent a broad cross section of water use activities in the Okanagan Basin. The Council includes representatives from Okanagan College and UBC Okanagan, water and climate change scientists from local, provincial, and federal government, water user groups, non-profit organizations, professional associations, economic interests, and First Nations.

A description of the OBWB and the Council, and an explanation of the relationship between these two groups, is provided below.

1.4.1 The Okanagan Basin Water Board

The Okanagan Basin Water Board (OBWB) is a unique form of inter-regional government established in 1969 under the *BC Municipalities Enabling and Validating Act* through Supplementary Letters Patent of the three Okanagan regional districts. The OBWB was designated to implement the recommendations of the 1974 Okanagan Basin Study, and to take on a range of responsibilities for water management. These included receiving proposals in the public interest, defining problems and priorities, communicating and coordinating between agencies and organizations, and participating financially in studies and projects. The OBWB's jurisdiction is defined by the geographic borders of the Okanagan Basin rather than political boundaries.

The OBWB does not have regulatory authority, but has taxation powers to support its activities, the only example of its kind in the province. The OBWB operates primarily as regional service delivery body focusing on incentive-based programs, which provide support for projects promoting good water management. As the OBWB obtains funds from all Basin residents, initiatives are focused on activities that have Basin-wide benefits. Nine of the twelve Directors are elected officials appointed by the three Okanagan regional districts, and (since 2006) the Okanagan Nation Alliance, the Water Supply Association of BC, and the Okanagan Water Stewardship Council each appoint an additional Director.

At the time of the OBWB's inception, algal blooms and other signs of deteriorating lake water quality and the explosive invasion of Eurasian watermilfoil *(Myriophyllum spicatum)* were the most serious water issues in the Basin. For many years the OBWB's activities focused almost exclusively on these areas, bringing significant improvements to water quality and the aesthetics of Okanagan beaches. Several factors over the past thirty years, including rapid population growth, increased awareness of climate change, and the 2003 forest fires and drought, reinforced calls to refresh the OBWB's mandate. In 2006, the OBWB took on a new Water Management Initiative and a more active leadership role in the valley.

The new Water Management Initiative brought the OBWB closer to its original mandate from 1969-1970. The OBWB's purpose is now stated as: *"Providing leadership to protect and enhance quality of life in the Okanagan Basin through sustainable water resource management".*

The OBWB's functions include:

- Implementing Basin-wide programs for watermilfoil control, wastewater infrastructure funding, and water research and management to benefit all Basin residents;
- Advocating and representing local needs to senior government planners and policy makers to protect Okanagan interests;
- Providing science-based information on Okanagan water to local government decision makers and water managers for sustainable long-term planning;
- Communicating and coordinating between government, non-government, universities and businesses to increase the effectiveness of water initiatives; and
- Building funding opportunities by providing leverage grants, securing external dollars and identifying cost-sharing partners to expand local capacity.

Over the period of this initiative, OBWB has been increasingly effective at promoting best practices and improving communication between jurisdictions. The OBWB has also had great success partnering with provincial agencies – especially in support of regional water science and monitoring.

1.4.2 The Okanagan Water Stewardship Council

"The Okanagan Water Stewardship Council has been a very successful venue for allowing representatives of all water stakeholders/groups to express their opinion and for exchange of information. Our successes are speaking as one voice for the Okanagan Basin for important issues such as governance, groundwater protection and development around reservoir lakes."

- Lorne Davies, Oceola Fish and Game Club, Council member

" – the benefit of the Council is that it brings together a group of people working within water management in some capacity from a wide spectrum of backgrounds and organizations – multiple levels of government, private sector, water utilities, and major water users. There is tremendous value in having such a group convene and be able to look at issues, potential projects, and overall water management from all perspectives – integration of these perspectives is vital for sound resource management."

- Anna Page, Sustainability Coordination, Regional District of North Okanagan, Council member

The Okanagan Water Stewardship Council (the "Council") was established in 2006 as part of the Water Management Initiative, but authority to convene an advisory Liaison Committee dates back to the 1970s under the supplementary letters patent. The goal of forming the Council was to capitalize on local water expertise and improve long-term decision making. The Council is a broad-based body of water stakeholder groups and technical experts that provides independent advice and policy recommendations to support sustainable water management.

The Council's Vision is that the Basin will have clean and healthy water in sufficient abundance to support the Okanagan's natural ecosystems, agricultural lands and high quality of life for perpetuity. Accurate, up-to-date water information and scientific knowledge will support community and regional planning. Water will be managed in a spirit of cooperation, and a valley-wide ethic of conservation will create a lasting legacy of sustainable water resources for future generations. Five principles provide a framework within which the Okanagan Water Stewardship Council evaluates specific water management policies or proposals (see Fact Box 1-1).

FACT BOX 1-1

Okanagan Water Stewardship Council Guiding Values

1. Think Regionally and Think Long- Term
2. Protect Nature for the Benefit of All
3. Anticipate Change – Plan Accordingly
4. Balance Multiple Priorities
5. Practice Clear and Open Communication

The Council's mission is to be a trusted source of expertise and knowledge for sustainable water management in the Okanagan, providing balanced and considered advice to the OBWB – and through them to the community at large. The Council draws on its member's diverse knowledge and experience to develop the recommendations and implement the actions needed to achieve the Council's Vision.

Council members and affiliations are listed at the beginning of this Strategy. The Council Chair is a voting member on the OBWB. Members are nominated for 18 month terms by their respective organizations, and these nominations are ratified by the OBWB.

1.5 Guiding Principles of the Strategy

Twelve high level Guiding Principles for water management provide a framework for the Sustainable Water Strategy. These interwoven principles must be considered concurrently.

1. *Recognize the value of water.* Water is a common good that is essential to the survival of people and ecosystems. The consumptive and nonconsumptive values of water will be recognized and respected in all water management decisions.

2. *Control pollution at its source.* Water quality in lakes, streams, and aquifers will be protected for the benefit of healthy ecosystems and to help ensure clean, safe, and reliable tap water is available to all residents of the Okanagan Basin.

3. *Protect and enhance ecological stability and biodiversity.* In addition to the inherent value of biodiversity and environmental protection, natural ecosystem processes in healthy watershed ecosystems are the most natural, effective, and cost-efficient means to maintain instream water quality and quantity. Water management will commit to protecting and restoring ecosystems and will ensure that local and cumulative

impacts on sensitive habitats are considered in land and water management decisions. A watershed based approach will be taken to identify the natural features that are essential to protecting water quality and quantity (e.g., wetlands, waterways, adjacent uplands, and riparian areas).

4. *Integrate land use planning and water resource management.* Integrated water resource management means recognizing the interrelationship between land use and water quantity and quality. Land use decisions will work to minimize the impact of urbanization and reduce the human footprint on the environment, which will in turn reduce impacts on water resources.

5. *Allocate water within the Okanagan water budget in a clear, transparent, and equitable way.* Identifying how and when water will be allocated is critically important to prepare for the possibility of increasing drought conditions in the Okanagan. Sufficient water must be available for the environment, agriculture, basic human needs, and economic development now and in the future. Existing historical inequities of water supply in the Basin need to be addressed and policies should be developed to prevent the emergence of new inequities as a result of increasing competition over water.

6. *Promote a Basin-wide culture of water conservation and efficiency.* Reducing water waste and promoting water use efficiency is central to sustainable water management. Water saved through improved water use efficiencies by a water use sector should be held for that sector.

7. *Ensure water supplies are flexible and resilient.* Even with improved Basin-wide water conservation and efficiency, water storage capacity will need to be increased in some sub-basins to meet the joint challenges of population growth and climate change.

8. *Think and act like a region.* Local decisions must consider watershed and aquifer interconnections with the larger Basin. Work towards a governance system that integrates existing institutions from the sub-basin level to the Basin as a whole, and provincial and federal governments. Specific types of decisions are appropriate at each level of this nested system of governance institutions and a reasonable balance of authority must be achieved.

9. Collect and disseminate scientific information on Okanagan water. The best available technology and science will be used to inform water management decision-making. Information will be managed in an integrated manner that is readily available to stakeholders Basin-wide.

10. *Provide sufficient resources for local water management initiatives.* Sufficient financial resources will be allocated to support better use of supplies of water that we have already developed, to employ new technology and infrastructure, to improve and refine management practices, and to draw on better information.

11. *Encourage active public consultation, education, and participation in water management decisions.* Transparent decision-making processes and opportunities for information sharing and

open communication are essential to a collective understanding and acceptance that we are part of the environment and our activities have implications on clean available water. A culture of accountability needs to inform everything from high level planning to individual perceptions and patterns of consumption.

12. *Practice adaptive water and land management.* Continuous learning, innovation, and improvement are essential to effective and efficient implementation of the Sustainable Water Strategy. An on-going monitoring and reporting program will be developed for the Strategy. In addition, a comprehensive review of the Strategy needs to be conducted every five to seven years.

1.6 Navigating the Strategy

The remaining sections of the Sustainable Water Strategy are organized into three Chapters. Chapter 2 outlines a plan to enhance water quality for humans and ecosystems by protecting water sources, reducing the impact of land development on water, and managing wastewater. Chapter 3 focuses on water quantity; ensuring enough water is available for ecosystems, agriculture, and domestic uses (including residential, commercial, industrial, and institutional) now and in the future. This will be done by creating water reserves, developing and implementing Drought Management Plans and Water Use Plans, promoting water conservation and efficiency in all sectors, and building resiliency in our water supplies through increased storage. Chapter 4 provides recommendations for improving water governance in the Basin, including implementing an inter-regional governance structure, and discusses actions that will be key to the successful implementation of the Sustainable Water Strategy.

The twelve Guiding Principles discussed in Section 1.5 are identified in boxes throughout the Strategy. The Strategy contains Action Boxes that provide specific actions developed to address the Guiding Principles. Each Action Box provides an action statement and identifies who should complete the action and in what timeframe. Where applicable, the Action Boxes also include important recommendations developed by the Okanagan Water Stewardship Council for consideration by the OBWB.

Story Boxes and Fact Boxes are also used throughout the Strategy. The Story Boxes provide examples of local water issues and successful projects and initiatives that have been conducted to address those water issues. Fact Boxes contain short paragraphs or lists meant to provide specific details about a topic.

There is a substantial volume of work on water resources in the Okanagan Basin. These projects range from climate change research to on-the-ground riparian restoration, testing the vulnerability of aquifers to pollution, and hydrological studies on water availability. Many of the studies were invaluable to the preparation of this Strategy. The Sustainable Water Strategy is a strategic document that works to increase collaboration and connectivity between these projects, reduce duplication of work, compile data in central locations, and provide better insight to the complex issues being faced. Implementation of many of the actions included in the Strategy will require information provided by the detailed assessments and studies underway in the Basin.

CHAPTER 2

PROTECTING OUR LAKES, RIVERS, WETLANDS, AND AQUIFERS

2.0 PROTECTING OUR LAKES, RIVERS, WETLANDS, AND AQUIFERS

Principle 1
Recognize the value of water.
Water is a common good that is essential to the survival of people and ecosystems. The consumptive and nonconsumptive values of water will be recognized and respected in all water management decisions.

Water should be managed as a collective resource in Canada, shared by people and the environment, supporting food production, and underpinning the economy. Under current legislation water is often owned collectively as either public or common property but it can also be owned privately. Management policy needs to accommodate these various property regimes while giving primacy to the idea of collective ownership. Clean water is valued for many consumptive purposes, including drinking, hygiene, and irrigation of crops and orchards. Clean water is also necessary for nonconsumptive uses such as ecosystem function, spiritual values of Aboriginal people, and aesthetic values.

Water shapes lands, transports materials, and cleanses the environment. It has incredible power through both intense storm events and the slow but steady erosion that continually defines lakes, river, and aquifers. Because of this power, water also has an enormous ability to transfer contamination from a source to a much larger area.

In the past, the emphasis has been on treating "dirty" or contaminated raw water in order to make it safe to drink. As a result, considerable expertise has been developed for drinking water treatment. There is emerging recognition that reducing or preventing contaminants from entering source water is integral to helping ensure potable water, while at the same time protecting non-consumptive water values.

2.1 Source water protection

Principle 2
Control pollution at its source.
Water quality in lakes, streams, and aquifers will be protected for the benefit of ecosystem function and to ensure clean and safe drinking water is available to all residents of the Okanagan Basin.

2.1.1 What is source water protection?

Source water protection is broadly defined as watershed management to control or prevent the contamination of water bodies and aquifers. More specifically, it is a coordinated approach among stakeholders to develop short- and long-term plans to prevent, minimize, or control potential sources of water pollution (Canadian Council of Ministers of the Environment, 2004). It extends beyond drinking water to encompass land use, ecosystem protection, and the entire hydrological cycle.

Most residents in the Okanagan Basin drink water from surface sources. Our main potable water sources are mountain tributary streams and upper reservoirs, but streams and lakes in the valley bottom also provide drinking water. In general, the lake sources have good raw water quality, with low turbidity levels and excellent taste and odour. Most of the tributary streams and upper reservoir water sources are unprotected and have problems with sediment (turbidity), colour, and organics. Turbidity is highest during spring freshet and is of most concern when combined with a high pathogen load in the watershed.

Biological and chemical contamination risks to drinking water exist in the Okanagan Basin. Several water suppliers in the Okanagan have experienced waterborne disease outbreaks (see Story Box 2-1). Sources of microbiological and chemical contamination include road building, forest harvesting, urban development, agricultural activities, cattle, recreational activities, wildlife, and natural events (e.g., large storms). Figure 2-1 shows the impacts of human activities in source watersheds in the Okanagan Basin.

Figure 2-1
Impacts of human activities in source watersheds in the Okanagan Basin.

STORY BOX 2-1
LESSONS LEARNED FROM WATERBORNE DISEASE OUTBREAKS IN THE OKANAGAN BASIN

Several water suppliers in the Okanagan have experienced waterborne disease outbreaks: specifically the Black Mountain Irrigation District *Giardia* outbreak in 1988; the City of Penticton *Cryptosporidium* outbreak in 1996; and the City of Kelowna Cryptosporidium outbreak in 1996. The Kelowna outbreak sparked huge media attention at a local and regional level, and eventually became a national and international story. The outbreak resulted in 157 confirmed cases and between 10,000 and 21,000 suspected cases of *Cryptosporidiosis* between June and August (Alliance Professional Services, CV Marketing Research, & Metz Murray Group, 1998). The outbreak had a significant economic impact on communities throughout the Okanagan.

Following these outbreaks, suppliers relocated intakes, improved disinfection practices and monitoring, established cross connection control programs, and set up automated controls and warning systems (Water Supply Association of BC & Interior Health Authority, 2007). Important lessons were learned from these outbreaks – minimizing contaminant potential in the source watershed and having enhanced treatment is absolutely essential.

This Strategy recognizes that source protection does not replace the need for adequate drinking water treatment. The multi-barrier approach, which includes a treatment component, should be employed to ensure safe drinking water (see Figure 2-2). The Canadian Council of Ministers of the Environment (2004) define multi-barrier approach as "an integrated system of procedures, processes and tools that collectively prevent or reduce the contamination of drinking water from source to tap in order to reduce risks to public health" (p. 15). Source water protection is the first step in the multi-barrier approach to ensuring safe drinking water.

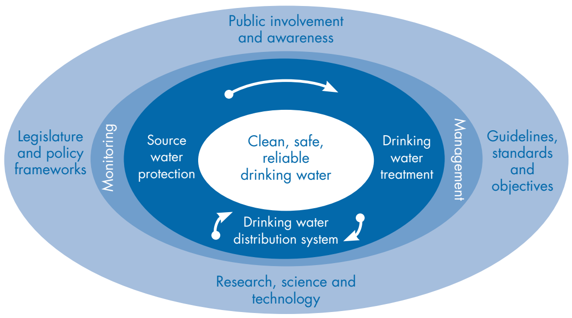


Figure 2-2
Components of a multi-barrier approach to drinking water protection. (Canadian Council of Ministers of the Environment, 2004)

The *Drinking Water Protection Act* mandates that all water suppliers provide potable water to their customers. In the absence of Provincial water quality standards, the Interior Health Authority looks to the Guidelines for Canadian Drinking Water Quality for direction on water quality from a national perspective. The *43210 Drinking Water Objective* is a simplified way of expressing treatment provisions of the guidelines. The Objective requires water suppliers to provide long-term plans to reach the goals of **4** log inactivation of viruses, **3** log removal or inactivation of *Giardia* and *Cryptosporidium*, **2** treatment processes for all surface drinking water systems, less than **1** NTU of turbidity with a target of 0.1 NTU, and **0** total fecal coliforms and *E. Coli.* (Interior Health Authority, 2006).

As identified by Interior Health (letter to Tom Siddon, Chair Water Stewardship Council, September

STORY BOX 2-2
NEW YORK CITY WATERSHED PROTECTION PROGRAM

New York City has one of the largest safe unfiltered surface water supply in the world. Every day, approximately 1.3 billion gallons of water is delivered to eight million New York City residents, one million more consumers in four upstate counties, and hundreds of thousands of commuters and tourists (New York City, 2008). Ninety percent of the water is drawn from the Catskill/Delaware watershed, which extends 125 miles north and west of the city. Land use in the watershed is diverse, and includes forested land (61 percent of which is privately owned), 500 farms, and 60 towns.

In 1990, the City was faced with an order from the US Environmental Protection Agency to either protect the City's water sources or be forced to provide filtration. With the estimated cost of filtration being $6-$8 billion, the City looked to find a more affordable way to comply with the order. By contrast, watershed protection efforts, which would include not only the acquisition of critical watershed lands but also a variety of other programs designed to reduce contamination sources in the watershed, would cost only approximately $1.5 billion.

In January, 1997, the City embarked on a comprehensive, long-range water protection program under a 5-year Filtration Avoidance Determination. The program includes a variety of management options to protect and improve water quality. These source protection components of the program include:

- Stormwater controls
- Waterfowl management
- Forestry program
- Wetlands protection
- Education and outreach
- Land acquisition
- Agricultural program
- Monitoring/modeling/GIS
- Watershed rules and regulations
- Stream management

The EPA has determined that New York City's long-term watershed protection program, coupled with two forms of treatment and an extensive water quality monitoring program, meets the requirements of the Surface Water Treatment Rule and the Interim Enhanced Surface Water Treatment Rule for unfiltered water supply systems. Filtration Avoidance Determinations were re-issued November 2002 and July 2007.

10, 2008), there is a need to develop a strategy that focuses on drinking water for the Okanagan Basin. Such a strategy would be complementary to the Okanagan Sustainable Water Strategy and would need to involve collaboration and leadership from a number of organizations including, Interior Health, water purveyors, and the OBWB. A drinking water strategy would include, but not be limited to, source water protection, adequate treatment, shared infrastructure, and the governance of drinking water. The drinking water strategy should be developed in the next three to five years.

Source protection provides benefits on a watershed scale. All downstream uses, including non-consumptive uses such as ecosystem function, water-based recreation, and aesthetic values, benefit from clean water. For that reason, this Strategy focuses on source water protection as a key principle of sustainable water management. New York City is an excellent example of the multiple benefits of source water protection – the City's effective watershed protection program, coupled with two forms of treatment and an extensive water quality monitoring program, was so successful that it earned a filtration waiver from the EPA (see Story Box 2-2).

2.1.2 The link between ecosystems and water quality

Principle 3
Protect and enhance ecological stability and biodiversity.
Natural processes in healthy watershed ecosystems are the most effective and cost-efficient means to maintain instream water quality and quantity. Water management will commit to protecting and restoring ecosystems and will ensure that local and cumulative impacts on sensitive habitats are considered in land and water management decisions. A watershed-based approach will be taken to identify the natural features that are essential to protecting water quality and quantity (e.g., wetlands, waterways, adjacent uplands, and riparian areas).

Degradation of water quality or quantity has serious adverse impacts on ecosystems. Similarly, degradation of ecosystems has negative impacts on water quality and quantity.

Healthy ecosystems provide a range of services that are valued by humans, including water purification. Terrestrial ecosystems, such as riparian areas (see Figure 2-3), act as buffers that filter and process heavy metals, oils, excess nutrients, microorganisms, sediment, and waste products from plants and animals. Aquatic ecosystems also improve water quality. A wetland or the gentle meanders of a river, for example, slow water down and allow for deposition of sediment, organic material, nutrients, and other suspended material. Ecosystems also decrease stormwater runoff, attenuate flooding, contribute to nutrient cycling, provide fish and wildlife habitat, enhance aesthetic appeal, provide recreational opportunities, and increase property values.

Figure 2-3
Riparian vegetation along Mission Creek acts as a buffer that filters and processes heavy metals, oils, excess nutrients, microorganisms, sediment, and waste products from plants and animals.

Riparian and wetland ecosystems once covered a significant portion of the valley bottom in the Okanagan. Channelization of the Okanagan River in the 1950s, rapid urban development, road building, forestry, agricultural activities, livestock grazing, off-road recreation, wildlife, and natural events like storms and fires have resulted in substantial loss and fragmentation of wetlands and riparian areas. Over 85 percent of valley bottom wetlands and other riparian habitats have been lost and many remaining habitats are highly fragmented (BC Ministry of Water, Land and Air Protection, 1998). The loss of these natural purification systems has increased the risk of contamination for drinking water supplies and harmed aquatic ecosystems (see Story Box 2-3 for an example).

STORY BOX 2-3
THE TEMPERATURE-OXYGEN SQUEEZE IN OSOYOOS LAKE

Osoyoos Lake is an example of how river channelization and degradation of riparian and wetland habitat has reduced water quality in the Basin. Located at the southernmost end of the Basin, Osoyoos Lake receives agricultural runoff and pollution from the Okanagan River and communities to the north. Land development, dams for flood control, channel straightening and dyking, and removal of streamside vegetation has substantially reduced natural water purification processes of the Okanagan River. Degradation and loss of the Osoyoos oxbows, a wetland system that lies at the north end of Osoyoos Lake (see Figure 2-4), has also reduced the natural purification. The oxbows were formed from original meanders, but cut off from the river when it was channelized. July 2007.

Figure 2-4

The nutrient and sediment-rich water entering the lake has contributed to high productivity, resulting in a condition in late summer known as a temperature-oxygen squeeze (see Figure 2-5). As organic matter decomposes, bacteria use up oxygen in the water so that it drops to very low levels at the lake bottom. At the same time, water temperature rises in the surface layers of the lake, resulting in only a small middle layer being tolerable for many fish species.

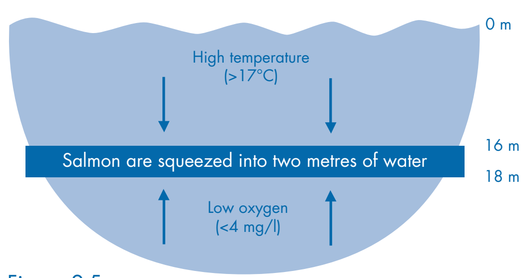


Figure 2-5
The temperature-oxygen squeeze in Osoyoos Lake. (Rae, 2005)

2.1.3 Protecting and restoring riparian and wetland ecosystems

Protecting and restoring ecosystems is a key component of source water protection. Considering the staggering trend of riparian and wetland loss that has already occurred in the Okanagan Basin, ecosystem restoration needs to be a top priority. Successful restoration and enhancement requires strong partnerships between stakeholders: property owners, local government, water purveyors, Provincial ministries, local associations, and stewardship groups. The Joe Rich Stream Restoration Project (see Story Box 2-4) is a local example of how successful riparian restoration can be accomplished through partnerships of local stakeholders. Of course, protection of any remaining riparian and wetland ecosystems is also extremely important. Tools, policies, and regulations for ecosystem protection are discussed in Sections 2.2 and 4.1.1 of this Strategy. Methods to collect data on sensitive ecosystems are described in Section 2.4.1.

ACTION 2-1

Manage livestock in watersheds through the installation of fencing at key locations and the provision of off-stream cattle watering stations.

Who: water purveyors with noted high coliform and E. coli counts, Ministry of Environment (water licences)

Timeframe: 5 yrs

Recommend that the OBWB continues to support livestock management initiatives.

ACTION 2-2

Work cooperatively to protect, restore, and enhance riparian and wetland areas that have been impacted by human activities.

Who: local governments, water purveyors, property owners, local associations, Ministry of Forests and Range, and stewardship groups

Timeframe: ongoing

Recommend that the OBWB continues to support riparian and wetland restoration projects.

Cattle grazing in Basin watersheds pose a significant risk to water quality. In the case of Joe Rich Creek, strategic fencing of the riparian area significantly reduced this risk. Another mechanism to reduce the impact of cattle is the provision of off-stream watering stations as alternatives to watering directly from streams. Off-stream water stations have been shown to reduce the time spent by livestock in riparian areas by more than 90 percent (Meays, n.d.). However, with most streams in the Okanagan already fully recorded, water licences are generally not issued for any purpose. Partnerships between the ranchers, water suppliers, and Provincial ministries to cooperatively build and licence these works is one way of achieving off-stream watering. For example, the Ministry of Environment is currently working with Greater Vernon Water to apply a "Transfer of Appurtenancy" that will allow Greater Vernon Water to give a small part of their water licence to the Ministry of Forest and Range for stock watering.

STORY BOX 2-4
JOE RICH STREAM RESTORATION PROJECT

Joe Rich Creek is a major tributary to Mission Creek, which is the largest single contributor to the Okanagan Lake system. The Joe Rich watershed has been affected by activities on Crown and private land, including resource extraction, transportation, agriculture, and residential development. Extensive bank erosion, over-widening, riparian clearing, poor water quality, and channel dewatering have damaged the health of the system. Cattle have had a particularly large impact by eating and trampling riparian vegetation, eroding the streambank with their hooves, stirring up the streambed, and defecating in the water.

In 2007, the OBWB provided a grant to the Central Okanagan Regional District to restore and enhance a section of Joe Rich Creek. This grant money triggered funding and involvement from a number of other agencies, including several Provincial ministries, the Black Mountain Irrigation District, BC Cattleman's Association, the City of Kelowna, and Ducks Unlimited.

Today, nearly two kilometres of streamside have been fenced along both sides, protecting 1,500 newly planted native cottonwood, willow, and fir trees and grasses that will restore a riparian forest along the creek (see Figure 2-6). The fencing prevents livestock from accessing the creek, except at designated watering areas. The plantings will ultimately provide shade and stabilize banks to improve the creek's fish habitat as well as the quality of the water. Fifty truckloads of rock were also installed to reduce future erosion by protecting stream banks (see Figure 2-7) and creating riffles to slow the water flow.

Restoration efforts are expected to substantially improve water quality in the creek, which is a spawning ground for rainbow trout as well as the source of water for BMID users. The cooperation displayed in this project serves as a model for other areas of the Basin.

Figure 2-7
Before and after restoration of an eroding bank on Joe Rich Creek.

Figure 2-6
Before and after the construction of a controlled cattle crossing at Joe Rich Creek.

2.1.4 Preventing the introduction and spread of aquatic invasive species

"The introduction and spread of Invasive Alien Species is affecting Canada's environment, economy, and society, including human health. The current threats posed by existing and potential invasive alien species are significant and are growing at an alarming rate."

- Environment Canada,
An Invasive Alien Species Strategy for Canada, p. 1

The introduction of aquatic invasive species such as Eurasian watermilfoil (introduced around 1970), zebra mussels and New Zealand mud snails (not yet in the Okanagan) are of particular relevance and concern to Okanagan water systems. It is not the intent of this section to provide a comprehensive list of invasive species—its intention is to raise this issue such that it will be considered in future water management planning.

Increasing public awareness of aquatic invasive species and creating communication tools to support public participation in reducing the spread of these harmful organisms is an important role to be played by all levels of government. Story Box 2-5 provides an example of how local government has successfully managed the spread of Eurasion milfoil is still spreading, but at a much reduced rate.

STORY BOX 2-5
EURASIAN WATERMILFOIL MANAGEMENT IN BASIN LAKES

In the early 1970s, the destructive effect of Eurasian watermilfoil on public beaches garnered almost daily media attention. Eurasian watermilfoil is an introduced aquatic plant that forms thick underwater stands and covers water surfaces. Dense growth of Eurasian watermilfoil throughout the Okanagan lake system in the 1970s restricted water flow, negatively affected fish and wildlife, impeded navigation, made swimming hazardous, and limited angling opportunities (Dunbar, 2008). Figure 2-8 provides an aerial view of an Okanagan beach and shallow-water stands of Eurasian watermilfoil.

Since the 1970s, (originally in partnership with the Ministry of Environment) the OBWB has taken responsibility for Eurasian watermilfoil control in the Okanagan Basin. After many years of experimenting with different methods, the OBWB now focuses on summer harvesting for cosmetic control and winter rototilling (i.e., de-rooting) of the root system on shallow portions of the lake floor (see Figure 2-9). The goal of the program is to control Eurasian watermilfoil in a cost effective manner so that it does not interfere with the public enjoyment of the lakes and minimizes negative impacts on the aquatic ecosystem and benefits the regional economy.

Figure 2-8
Aerial view of Eurasian watermilfoil along a beach in Kelowna in the 1970s.

Figure 2-9
The machine used for rototilling Eurasian watermilfoil root systems on shallow portions of the lake floor.

2.1.5 Source water assessments and protection plans

In British Columbia, drinking water systems are regulated under the *Drinking Water Protection Act.* Under Part 3 of the *Act*, a Drinking Water Officer may order a water supplier to complete a water source and system assessment. The purpose of the assessment is to identify, inventory, and assess:

- the drinking water source for the water supply system, including land use and other activities and conditions that may affect that source,
- the water supply system, including treatment and operation,
- monitoring requirements for the drinking water source and water supply system, and
- threats to drinking water that is provided by the system.

Water suppliers in the Okanagan Basin have been asked as part of the Drinking Water Quality Improvement Program to submit a source protection plan to the Interior Health Authority. The purpose of the plan is to identify areas and activities that could affect the quality, quantity, and timing of flow of the drinking water sources. Large water suppliers have been asked to delineate and characterize water sources, inventory contaminant sources, characterize drinking water risks from source to tap, and recommend actions to improve drinking water protection. Separately, as another Condition on Permit, water suppliers have also been asked to provide long-term plans for source, treatment, and distribution system improvements taking into account the goal of the *43210 Drinking Water Objective.*

Consideration is being given to undertaking "joint assessments" by water purveyors that use the same source (e.g., suppliers with deep water intakes on Okanagan Lake). This coordinated effort would be fundamental to developing and implementing a regional (Basin-wide) source protection strategy.

The *Comprehensive Drinking Water Source to Tap Assessment Guideline*, developed by the BC Ministry of Health Services and the BC Ministry of Water, Land and Air Protection (currently BC Ministry of Environment), is one tool that can be used to develop source protection plans. The Guideline provides a structured and consistent approach to evaluating and managing risks to drinking water. It contains guidance for identifying hazards and vulnerabilities in the source to tap system, and assessing the risks they pose to human health and sustainability of the water supply. Its modular format enables portions of the assessment procedure to be used if risk is perceived only in certain portions of a water supply system.

ACTION 2-3
Undertake individual source water assessments and prepare joint source water assessments where feasible in order to develop a regional (Basin-wide) source protection strategy.
Who: all large water purveyors
Timeframe: 3 yrs
Recommend that the OBWB supports source water assessments by facilitating collaboration and helping to identify funding sources.

2.1.6 Assessment response plans

A source and system assessment can lead to the requirement for an assessment response plan (Section 22 of the *Drinking Water Protection Act*). The purpose of an assessment response plan is to identify the reasonable measures that may be taken to address identified threats to drinking water. Provisions that may be required by the Drinking Water Officer to be contained in the assessment response plan include, but are not limited to, the following:

- public education and other means of encouraging drinking water source protection;

- guides to best management and conservation practices;
- infrastructure improvements;
- cooperative planning and voluntary programs;
- input respecting local authority zoning and other land use regulation.

With rapid population growth and development in the Okanagan Basin, there is an increase in proposed activities in the watersheds. If new activities are allowed in the watershed, they should come with the responsibility to incorporate precautions in decision-making. The onus should be placed on the advocate for the new activity to demonstrate that there will be no negative impacts on the water resource. This would require a commitment by the new user group to hire an independent water quality monitoring professional to collect baseline water quality data upstream and downstream of new activities. Placing the onus on the new user group would ensure that they become a stakeholder in the watershed. When risks to drinking water quality are managed effectively, the multiple use of a watershed for resource development, extraction, and recreational purposes can occur without harm to the water resource.

2.1.7 Drinking Water Protection Plans

In circumstances where monitoring or assessment indicates a potential threat to drinking water that may result in a health hazard, and no other practicable measures are available under the *Drinking Water Protection Act* to address or prevent the drinking water health hazard, a Drinking Water Protection Plan (DWPP) may be initiated under Part 5 of the *Act*.

A DWPP can only be initiated by the Minister of Healthy Living and Sport upon recommendation of the Provincial Health Officer (Section 31 of the *Act*). Although the local Drinking Water Officer does not have the authority to initiate a DWPP, he or she can request that the Provincial health officer make a recommendation to the minister to initiate a DWPP. Section 31(4) of the *Act* provides that a local authority or water supplier can request a Drinking Water Officer to make a recommendation to the Provincial health officer. If the Drinking Water Officer is asked by a local authority or water supplier to do so, the Drinking Water Officer must consider the request and should provide reasons as to whether or not a request will be made to the Provincial Health Officer.

The Minister may, by order, establish the process by which a proposed drinking water protection plan for a designated area is to be developed, including, but not limited to:

- establishing who is to be responsible for preparing the proposed plan,
- establishing the terms of reference for the plan, or authorizing the preparation of some or all of the terms of reference subject to approval by the minister, and
- requiring the establishment of a technical advisory committee in relation to development of the plan.

The structure and scope of a DWPP are not predetermined in the Act, but instead are customized to address the specific drinking water health hazard identified by the Provincial health officer.

The *Water Act* contains provisions allowing for the establishment of Water Management Plans (see Section 3.2 for more information). These plans are in some ways similar to DWPPs that can be developed under part of 5 of the *Drinking Water Protection Act*. Given the potential for overlap, the acts provide that, if plans are to be developed under both acts in respect of a particular area, the plans can be developed jointly.

To date, no DWPPs have been prepared in British Columbia.

2.1.8 Well Protection Plans

As surface water reaches allocation limits in the Okanagan Basin, it becomes increasingly important to understand groundwater resources. There are 73 mapped aquifers in the Basin and over 6200 wells listed in the provincial database. Figure 2-10 shows the "quilt" of bedrock and alluvial aquifers in the Basin[1].

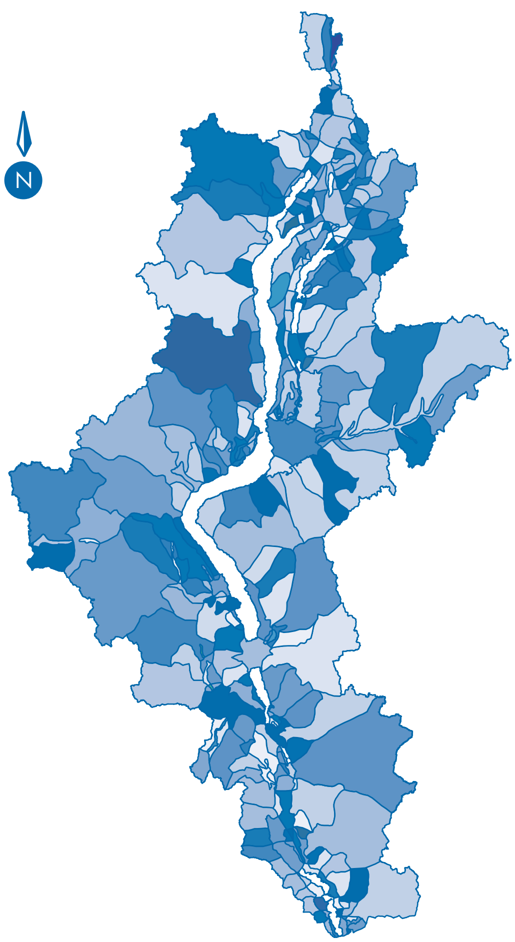


Figure 2-10
Bedrock and alluvial aquifers in the Okanagan Basin. (adapted from map provided by Summit Environmental Consultants Ltd.)

[1] Polygons in Figure 2-10 are for water balance calculations and do not necessarily designate useable aquifers.

Groundwater in the Basin is vulnerable to contamination. The degree to which an aquifer can become contaminated depends on two main factors: is there a source of contamination and how susceptible is the aquifer to that contamination? Generally, the sand and gravel aquifers in the valley bottom are more susceptible to contamination than the bedrock aquifers in the valley uplands (Carmichael, 2006).

Naturally occurring contaminants are found in groundwater in areas of the Okanagan Basin. For example, groundwater near Summerland contains uranium and some rural wells near Vernon contain arsenic. Both arsenic and uranium enter groundwater as it passes through bedrock and picks up the elements as dissolved ions.

Although some groundwater contaminants are naturally occurring, many groundwater quality problems emanate from inappropriate land use directly over susceptible aquifers. For example, elevated levels of nitrate nitrogen found in a significant number of domestic wells in Osoyoos and Oliver most likely reflects the impact of human activities on well water quality. Sources of nitrate can include leaching of chemical fertilizers and animal manure and septic and sewage discharges.

Groundwater is a supply for drinking water, agriculture, fisheries and numerous aquatic habitats such as wetlands, lakes and streams, and must be protected. Experience from elsewhere in Canada, the United States, and Europe shows that preventing water quality degradation by implementing a Well Protection Plan is the best way to protect a community's well water supply. Well protection planning provides a mechanism for protecting drinking water sources, human health, and the economic investment the water purveyor and community have made in the groundwater supply.

In 2000, the Province of British Columbia, Environment Canada, and the British Columbia Ground Water Association jointly published the *Well Protection Toolkit*. The Toolkit is a six step approach on how a community can develop and put into place a protection plan to prevent well water contamination.

The steps included in the Toolkit are:

1. Form a community planning team;
2. Define the capture zone (recharge area) of the community well;
3. Map potential sources of pollution in the capture zone;
4. Develop and implement protection measures to prevent pollution;
5. Develop a contingency plan against any accidents; and
6. Monitor, evaluate, and report on the plan annually.

A number of large Okanagan water suppliers that rely on groundwater have completed steps 1 to 3 of the Toolkit. As of the summer of 2008 steps 4 to 6 are yet to be implemented anywhere in the Basin.

ACTION 2-4a
Implement steps 1 to 3 of the provincial *Well Protection Toolkit.*
Who: all water purveyors that rely on groundwater
Timeframe: 5 yrs
ACTION 2-4a
Implement steps 4 to 6 of the provincial *Well Protection Toolkit.*
Who: all water purveyors that rely on groundwater
Timeframe: 7 yrs
Recommend that the OBWB ensures utilities know about the *Well Protection Toolkit* and understand the need to develop a Well Protection Plan.

2.1.9 Understanding the potential impacts of geothermal energy

The increasing use of geothermal energy may also impact the water quality of aquifers in the Basin. Geothermal systems (or "geo-exchange" systems as they are called by industry) are recognized as highly energy efficient means of heating and cooling a building and providing domestic hot water (GeoExchange BC, 2008). The systems use a closed or open loop configuration, installed below the surface of the ground or submersed in a pond or lake, to tap the Earth's natural thermal energy. In a closed loop system, fluid (water or refrigerant) circulating in the loop carries this natural heat to the building during the winter. In summer, the process is reversed to cool the building. In an open loop system, groundwater from an aquifer is piped directly from the well to the building, where it transfers its heat to a heat pump. After the water leaves the building, it is pumped back into the same aquifer via a discharge well.

Geothermal heating and cooling has enormous environmental benefits and reasonable precautions must be made to ensure its success and viability in the future. Currently, there are many unknowns with regard to the risks and impacts of geothermal heating and cooling on drinking water aquifers.

There are several issues related to the technology that need to be well understood by the regulators and the business community, including:

1. the potential for contamination with the leaking of closed loop systems;
2. increased biological and chemical activity in the aquifer due to higher temperatures;
3. the pincushion effect of having many holes and potential points of contamination being introduced into an aquifer; and
4. the lack of centralized tracking, monitoring, and ongoing reporting of the condition of the aquifer.

As more and more geothermal holes are drilled for new development in the Basin the need for regulation of the industry and study of its impacts is increasingly important. Best management practices relating to the development of geothermal energy must be created for local building departments, with guidelines for tracking and mapping the geothermal holes and determining the draws from each system.

The Kelowna Joint Water Committee, comprised of the five major water utilities within Kelowna bounds, has recently delineated well capture zones, completed an inventory of contaminant chemicals and locations of concern for the wells in consideration, and provided preliminary recommendations for more in depth groundwater protection planning and risk management. The Kelowna Joint Water Committee service area would be an excellent location for a pilot project to develop and implement bylaws and best management practices for geothermal energy use.

Bylaws and best management practices could include the following components.

- Tracking and reporting procedures for all geothermal wells requiring information such as location, depth of well, pump rate, thermal exchange information and type of installation.
- Municipal inspection procedures related to the design and installation of systems. These details could include checklists related to risks such as set backs from municipal wells, and limitations on the aquifer.
- Requirements for training and accreditation of individuals, qualification of firms, and system certification.
- Provision of information regarding sustainable geothermal energy development to developers and homeowners. A danger exists of too much load being placed on an aquifer and tracking and centralized reporting of this information would be useful to both municipalities and designers and builders.
- Requirement for proper closure of geothermal boreholes.
- Mandatory tracking, monitoring, and reporting of water quality and quantity in wells that could potentially be affected by the system. The groundwater resource requires as much protection as surface water sources.

ACTION 2-5
Create bylaws and best management practices for geothermal energy and implement a pilot project in the Kelowna Joint Water Committee service area, followed by an Okanagan program to appropriate local governments.
Who: Kelowna Joint Water Committee, OBWB
Timeframe: 2-5 yrs
Recommend that the OBWB communicates the results of the pilot project to the rest of the Basin and encourages the best management practices to be implemented Basin-wide.

The intent of Action 2-5 is to protect Okanagan groundwater resources so that they remain viable for future generations.

2.2 Land use and water resources

"Water is the most critical resource issue of our lifetime and our children's lifetime. The health of our waters is the principal measure of how we live on the land."

- Luna Leopold, former Chief Hydrologist, US Geological Survey

Principle 4
Integrate land use planning and water resource management.
Integrated water resource management means recognizing the interrelationship between land use and water quantity and quality. Land use decisions must work to minimize the impact of urbanization and reduce the human footprint on the environment, which will in turn reduce the impact on water resources.

Growth and development can provide many benefits to a community. New residents, businesses, and investments can give a community the resources to revitalize a downtown, build new schools and recreation centres, and develop vibrant neighbourhoods. However, where and how communities accommodate growth and development has a profound impact on the quality of their streams, rivers, lakes, beaches, and groundwater.

The amount of land in the Okanagan consumed by development has grown rapidly in recent decades. The growth of developed areas has led to an increase in impervious surfaces— including rooftops, roads, parking lots, sidewalks, patios, and compacted soil. Research has shown a strong inverse relationship between impervious cover and water quality. The more riparian and wetland areas that disappear under impermeable cover, and the more kilometres driven and vehicles parked on impermeable road surfaces, the more difficult protecting the quality water supplies becomes.

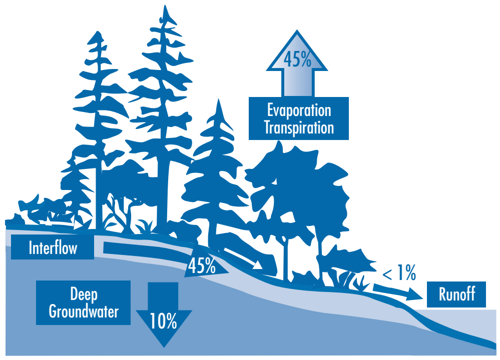
Historically, growth in the Okanagan has been accommodated through patterns of highly dispersed development. Urban sprawl, broadly defined as the spreading of a city and its suburbs over rural land at the fringe of an urban area, is quite common in the Basin. A relatively new development pattern referred to as "exurbia" is also emerging. Exurbia is a region or settlement outside a city, and usually beyond its suburbs, which is often characterized by large properties inhabited chiefly by well-to-do families. Exurban development is neither fully suburban nor fully rural. Urban sprawl and exurban development are associated with a number of negative environmental, economic, and public health outcomes, including a decrease in land and water quality and quantity and an increase in water demand and infrastructure costs.

Figure 2-11 illustrates how the water balance changes when natural vegetated cover is replaced by suburban development. In a natural environment, less than 1 percent of the water from a typical rainstorm flows overland (Stephens, Graham, & Reid, 2002). In a forested area, about 55 percent soaks into the ground and recharges underground aquifers or slowly moves through the soil into streams, rivers, and lakes. Another 45 percent evaporates or is absorbed by plants. As more impervious surfaces are constructed, stormwater runs more quickly into drainage waterways without filtering into the ground.

This change to the water balance is of concern for three main reasons:

1. the volume and timing of runoff water can affect water supplies and also increase the risk of flooding, erosion, and scouring of streambanks,
2. the reduction in infiltration may lower the water table and prevent water from being naturally cleansed and filtered by the soil, and

3. the runoff water carries natural and man-made contaminants to receiving waters.



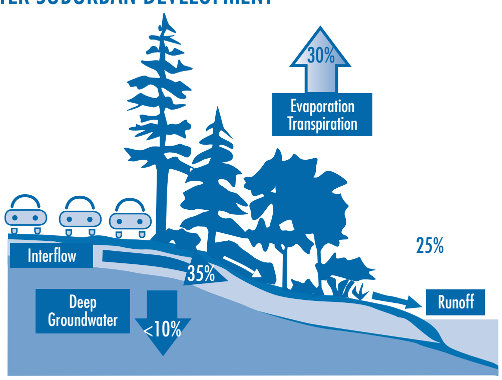


Figure 2-11
Annual water balance under natural conditions and after development. The actual percentages will vary from region to region, but the relationships are universal. (adapted from Stephens et. al., 2002)

The type of water pollution associated with stormwater is called non-point source pollution because it comes from many different locations and types of activities. For developed and developing areas, non-point source pollution can largely be traced to activities that occur on the land. Non-point source pollutants associated with land activities include:

- fertilizers, herbicides, and insecticides from agricultural lands and residential areas,
- oil, grease, and toxic chemicals from urban runoff,
- sediments from improperly managed construction sites, crop and forest lands, and eroding stream banks, and
- bacteria and nutrients from agricultural lands, livestock, pet wastes, wildlife, and faulty septic tanks and septic fields (United States Environmental Protection Agency, 2005).

Linking development, infrastructure, and water policies is critical to sustainable water management. Development that uses land efficiently and protects undisturbed natural lands allows a community to grow and still protect its water resources. The policies and tools in this section focus on regional planning practices that can lead to substantial water quality benefits. These policies support two main concepts: designing communities to live in harmony with water and using integrated stormwater management to minimize overall land disturbance and impervious surface associated with development.

2.2.1 Considering water in community design

Putting water stewardship and sustainability front and center on the agenda of comprehensive land use and development brings many benefits, including more green spaces, more water and fish in the streams, improved community vitality, reduced demand for water, and reduced expenditure on infrastructure (BC Ministry of Environment, 2008a). This type of planning is often referred to as "water-centric" planning.

One of the most important things a community can do to protect water is to determine areas where it wants growth to occur and areas it wants to preserve. When such areas are clearly defined, development is encouraged on land with less ecological value, such as previously developed areas, and vacant properties (infill development), and areas such as wetlands, marshes, and riparian corridors are preserved or otherwise removed from the pool of "developable land." Defining these areas also enables a community to direct development to existing infrastructure, discouraging the construction of small "satellite" water systems and septic infrastructure.

Infill development reuses underutilized or vacant land in urban areas to increase density. Developing infill sites reduces water quality deterioration by accommodating growth on sites that are most likely already impervious, reducing the creation of new impervious cover. This development also reduces the pressure to develop lands on the urban fringe that provide critical water functions (such as riparian areas, forested zones, and wetlands). Infill sites are also generally closer to existing infrastructure, transportation and amenities.

Compact development reduces water quality deterioration and minimizes effects on watershed hydrology. It consumes less land, enabling the preservation of open space, farmland, and natural areas that are critical to clean water. Higher-density development protects water quality by creating less impervious surfaces and generating less stormwater runoff per house (United States Environmental Protection Agency, 2006). Compact neighbourhood design generally has less landscaping and thus less demand for water. By developing more compactly, fewer feet of pipe is needed to service residential and commercial users, resulting in lower infrastructure costs. Furthermore, the transmission systems will be more efficient to operate and less susceptible to water loss through leakage.

ACTION 2-6

Consider water in community design by promoting development that is high-density and uses existing infrastructure.

Who: local governments, developers

Timeframe: ongoing

Recommend that the OBWB supports local governments that are practicing water-centric planning.

2.2.2 Integrated stormwater management

Historically, the predominant philosophy of stormwater control has focused on directing water off a site as quickly as possible using infrastructure such as curbs, gutters, trenches, and pipes. This was a successful strategy for individual properties, but the additive effects of runoff from these properties on a watershed scale were found to contribute to flooding and water quality problems. As a result, water and engineer professionals began looking for opportunities to lessen the volume and increase the quality of stormwater generated from a site.

In 2002, the *Stormwater Planning: A Guidebook for British Columbia* was prepared by several provincial agencies and local governments to provide a comprehensive understanding of the issues and framework for implementing an integrated approach to stormwater management. The Guidebook draws heavily on case study experience from various local governments and developers in British Columbia. It includes five guiding principles for integrated stormwater management and four key types of actions that must all work together to implement integrated stormwater management solutions (see Appendix III).

Site design strategies such as absorbent landscaping, infiltration facilities, green roofs, and rainwater reuse are areas of action that can be implemented today and provide significant benefit to the aesthetics, environment and quality of life in the Okanagan. Low impact development practices should be incorporated as a collective goal of local government, residents and the development community striving to reduce road widths, building footprints, and parking standards, limiting the amount of surface parking, building compact communities, and preserving natural features.

Within planning tools such as Official Community Plans, Regional Growth Strategies, and Water Management Plans, the unique natural features of the Okanagan should be identified at a watershed scale, and then protected through growth management, land use planning, and development policies and regulations. Significant natural features should also be identified at the site design level, and preserved through creative site design practices such as integrating these features with community open spaces.

2.2.2.1 The Water Balance Model

In 2003, the Inter-Governmental Partnership, a consortium of over 20 local, regional, provincial, and federal agencies co-chaired by the Ministry of Agriculture and Lands and Environment Canada, launched the Water Balance Model as an extension of *Stormwater Planning: A Guidebook for British Columbia*. The Water Balance Model is a practical, web-based modeling tool (available at www.waterbalance.ca) that evaluates the feasibility, affordability, and effectiveness of site level stormwater management solutions under different land use, soil, and climate conditions. The Water Balance Model can be used by local governments for public consultation, planners and engineers for setting performance targets, developers and their consultants to test scenarios, and environmental agencies to monitor indicators (BC Water and Waste Association Water Sustainability Committee, 2004). The user can quantify the effectiveness of site designs that incorporate absorbent landscaping, infiltration facilities, green roofs and rainwater harvesting. The Water Balance Model is fast emerging as the decision support and scenario modeling tool preferred by local government throughout British Columbia for use in making 'design with nature' land development decisions.

ACTION 2-7
Prepare new or modify existing stormwater management plans such that they are consistent with the *Provincial Stormwater Planning: A Guidebook for British Columbia*. Use the Water Balance Model to support integrated stormwater management options.
Who: local governments, Ministry of Transportation
Timeframe: ongoing
Recommend that the OBWB supports local governments that are working to implement integrated stormwater management practices based on Provincial guidelines.

2.2.3 Land use policies and tools to protect water resources

Policies and tools that can be used by local governments to encourage water-centric community design and development practices that minimize impervious surfaces include, but are not limited to, the following:

- Regional conservation strategies that identify land and water to be protected;
- Official Community Plans that include development permit areas around all types of watercourses and associated habitats;
- Liquid Waste Management Plans that have an increased emphasis on non-point source pollution and stormwater;
- Zoning bylaws that promote high-density developments;
- Regional Growth Strategies;
- Regulatory bylaws such a watercourse protection bylaws and subdivision bylaws;
- Watershed and Well/Aquifer Protection Plans;
- Tax incentives for land conservation, brownfields redevelopment, and infill and low impact development.
- Infrastructure funding directed to designated growth areas; and
- Leadership in Energy and Environmental

Design (LEED) Green Building Rating System.

The range of policy tools available to local governments is both empowering and overwhelming. In most cases, there are several different ways to achieve the same objective. For example, to maintain the integrity of a watercourse, a municipality may enact a watercourse protection bylaw, or establish regulations about vegetation protection and erosion control in the subdivision bylaw, or develop detailed guidelines as part of establishing a development permit area in the Official Community Plan (Environmental Law Clinic, University of Victoria Faculty of Law, & Deborah Curran and Company, 2007). Deciding which approach to take can be difficult and using reference material such as the *Green Bylaws Toolkit* and the *Develop with Care: Environmental Guidelines for Urban and Rural Land Development in British Columbia* to guide the decision making process is very important.

The primary purpose of the *Develop with Care* document is to provide province-wide guidelines for the maintenance of environmental values during the development of urban and rural lands (BC Ministry of Environment, 2006). It also provides information on ways that environmental protection and stewardship can benefit the community, the property owner and the developer, as well as the natural environment.

The *Green Bylaws Toolkit* is a practical document that brings together examples of local government best practices and identifies specific bylaws that can help communities protect aquatic and terrestrial ecosystems. It provides recommendations for choosing the most appropriate policies, includes bylaw language that local governments in BC are using to protect sensitive ecosystems, and explains the various legal approaches to protection, their benefits and drawbacks. Local governments in the Okanagan Basin would benefit greatly from using the *Green Bylaws Toolkit* to develop policies and bylaws that protect water resources and riparian areas.

ACTION 2-8

Using best practice model bylaws (such as the *Green Bylaws Toolkit* and the *Develop with Care* document) enact or amend land use policies and tools to protect water and the surrounding land (i.e., riparian areas, wetlands, floodplains, etc.).

Who: local governments, political leaders

Timeframe: 2-5 yrs

Recommend that the OBWB supports planners in the development of land use planning documents that have practices to protect water quality and supply.

Two companion documents to the *Green Bylaws Toolkit* are *Wetlands Protection: A Primer for Local Governments and Grasslands Protection: A Primer for Local Governments* are also available. A third companion document, the *Groundwater Bylaws Toolkit*, needs to be developed that provides specific information on what local governments can do to protect groundwater.

The *Groundwater Bylaws Toolkit* will provide local government planners, policy makers, and staff with a clear and concise document that supports the implementation of best practice groundwater policy and bylaws. The Toolkit will provide a compilation of existing local government groundwater bylaws, develop new template groundwater bylaws synthesized from best practices, and identify science in support of local government management of groundwater resources.

ACTION 2-9

Develop and harmonize groundwater protection bylaws. Develop a *Groundwater Bylaws Toolkit* as a companion document to the *Green Bylaws Toolkit.*

Who: OBWB

Timeframe: 1 yrs

2.3 Wastewater management

2.3.1 Nutrient removal at wastewater treatment plants

In the early 1970s, serious degradation of water quality characterized by surface water algae blooms in mainstem Okanagan lakes prompted the implementation of nitrogen and phosphorus removal strategies assisted by the OBWB Sewage Facilities Grant program (see Story Box 2-6). Roughly half the phosphorus load to Okanagan Lake was estimated to be from municipal point sources on an average flow year (Jensen & Epp, 2002). Since that time, Okanagan communities have invested in wastewater treatment plants using biological nutrient removal and other advanced technologies. The portion of phosphorus loadings in Okanagan Lake derived from sewage treatment plants has decreased to less than 3 percent of the total loading

Local governments face emerging challenges that in 1975 were not considered to have a significant impact on water quality. There have been increasing concerns about the impact of non-point source pollution, such as sediment, hydrocarbons, heavy metals, and other pollutants in runoff. There is also an increased awareness about potentially harmful non-nutrient pollutants in wastewater, such as residual pharmaceuticals and other organic compounds from personal care products. At present, non-point sources are the major inputs of nutrients to waters in the Basin. As shown in Figure 2-12, background loadings (watershed runoff, precipitation, and dustfall) represent about 60 percent of the non-point source loading to the lakes, while non-point anthropogenic inputs (septic tanks, agriculture, and forestry) represent about 40 percent of the phosphorus inputs.

STORY BOX 2-6
THE SUCCESS OF THE OKANAGAN BASIN WATER BOARD SEWAGE FACILITIES GRANT PROGRAM

"Visitors to the Okanagan are always impressed by the clear blue water of our valley lakes, but 35 years ago, lakeshore residents were selling their property because of the smelly, polluted and algae-filled water conditions [see Figure 2-13]. *It took a major public outcry and investment to turn the situation around"* (Okanagan Basin Water Board, 2007). Central Okanagan Regional District to restore

Figure 2-13
Early 1970s photo of Okanagan Lake illustrating significant algae blooms and poor water quality.

Phosphorus has been the object of most of the pollution control efforts since 1974, when the *Okanagan Basin Study* identified phosphorus as the main cause of algal blooms and other signs of deteriorating water quality in valley lakes. The major point sources of phosphorus were identified as municipal effluent discharges.

The ensuing Sewage Facilities Grant program developed by the OBWB is a success story illustrating how collaborative problem solving and action can produce significant positive outcomes in the Okanagan. The program provides subsidies for upgrades of sewage treatment plants and collection systems by valley communities. These expenditures resulted in a decrease in phosphorus input into the lakes from municipal effluent of about 92.5 percent, from 59,000 kg in 1970 to less than 5000 kg in 1997.

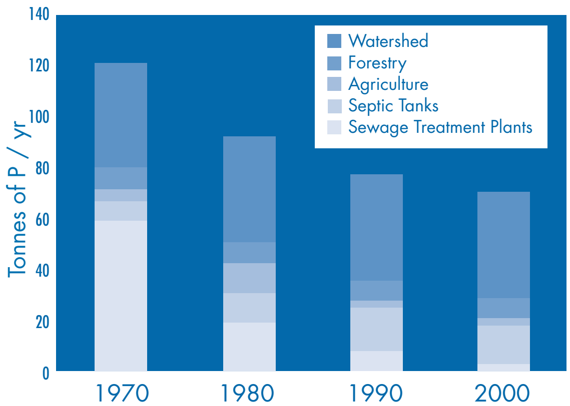


Figure 2-12
Phosphorus loading estimates from various source sectors to Okanagan surface waters.
(Jensen & Epp, 2002, p12)

2.3.2 Sewerage System Regulation

Lakes in the Okanagan Valley have been identified as phosphorous sensitive bodies of water whereby human activity nutrient loading should be kept to a minimum. Figure 2-14 highlights sub-basins in the Okanagan Valley where a high number of septic tanks with poor phosphorus removal efficiency are located.

Accordingly, the previous Sewage Disposal Regulation, BC Reg. 411/85 contained phosphorus protective provisions linked to mapping of soil absorption types in relation to lakefront distance setback for onsite sewage disposal. These provisions no longer exist under the new SSR, BC Reg. 326/2004 effective May 31, 2005. This is a major setback in protecting valley lakes.

The new Sewerage System Regulation (SSR) approaches onsite sewage disposal in an entirely different process than that of previous decades. Septic systems are sewage treatment facilities that require proper design, construction, and operational techniques to be effective. The installation of a septic tank and field (sewerage system) no longer requires

Figure 2-14
Location of septic tanks in the Okanagan Basin with poor phosphorus removal efficiency. (adapted from Nordin et. al., 2001)

a permit or approval from a Health Official. Rather an *Authorized Person* (Professional or Registered Practitioner) conducts preliminary site assessments and designs, and performs installation and associated certification approvals for systems accordingly. Designs and installations are required to meet "standard practice" as determined by the *Authorized Person*; "standard practice" being a method that will not cause or contribute to a health hazard.

The process involves the filing of a design plan prior to construction and a final as-built diagram and letter of certification to the Health Authority within 30 days of construction. The Health Authority does not have the authority to review or critique the design on the basis of technical merit, nor can they intervene and stop the *Authorized Person* from constructing a system even if it is believed that the system will cause or contribute to a health hazard or environmental pollution. This authority to ensure an adequate design remains solely the responsibility of the *Authorized Person*. Under the SSR only an *Authorized Person* or someone supervised by a Professional is allowed to design and construct a sewerage system; and enforcement abilities exist in the SSR to address the contrary. Designs and installations are required to meet "standard practice" as determined by the *Authorized Person*; "standard practice" being a method that will not cause or contribute to a health hazard.

The SSR makes reference to a Standard Practice Manual that contains "recommended" prescriptive criteria such as distance setbacks to water. But, to promote flexibility and creativity, the SSR does not require the *Authorized Person* to adhere to the manual. This, from a SSR context, renders the requirements in the Standard Practice Manual all subjective to the discretion of the *Authorized Person*.

Once installed, a health hazard includes the discharge of domestic sewage or effluent onto the land, or into surface or drinking water. Responsibility is placed upon the owner to maintain according to their maintenance plan, and when a system causes or contributes to a health hazard the Health Authority can enforce corrective action upon the owner.

Problems with the current regulation are[2]:

- There is not setback requirement related to septic tank design adjacent to nutrient sensitive valley lakes.
- The *Authorized Person* is in control of the process; however any problems that show up due to faulty design are assessed to the system owner who must then take action with the *Authorized Person*. There is no long-term liability or accountability requirements set for the *Authorized Person* unless they are a designated Professional that carries Errors and Omissions insurance;
- There is a lack of certified practitioners. This has led to increased demand for their services and rising costs. There are concerns raised by the Union of BC Municipalities that prices for the design and construction of these systems have substantially increased;
- There is no preliminary external check of the thoroughness of design by the *Authorized Person*, particularly with respect to the issues of public safety, proximity to drinking water wells, or proximity to watercourses above where drinking water may be obtained.

ACTION 2-10

Provide technical direction and policy for how to handle sewerage system applications in the sensitive lakeshore and stream areas throughout the Okanagan Basin. Forward the policy statement to municipalities and regional districts to encourage the application of environmental checks for new installations.

Who: OBWB and Okanagan Water Stewardship Council

Timeframe: 2 yrs

[2] These are the opinions of the Okanagan Water Stewardship Council and do not necessarily reflect those of other organizations.

ACTION 2-11
Lobby the Province to add some form of accountability and liability requirement to the Authorized Person in the Sewage Disposal Regulation.
Who: OBWB
Timeframe: 2 yrs

2.3.3 Emerging contaminants

Although there have been significant improvements in terms of nutrient removal from wastewater, there are increasing concerns regarding endocrine disrupting chemicals (EDCs) and pharmaceuticals and personal care products (PPCPs) in wastewater streams. These compounds, which include birth control pills, bisphenol A, DDT, anti-depressants, painkillers, and a host of other compounds, are identified by the EPA as "emerging contaminants." Little is known about the fate of these compounds during drinking water and wastewater treatment.

Further research is needed to answer the important questions of:

- which chemicals we need to be concerned about in the Okanagan,
- the extent and degree of environmental exposure to these chemicals, and
- whether exposure causes adverse effects on species and ecosystems, and if so, the degree and consequence of these effects.

It is important to note that a Medications Return Program has been in place in British Columbia since 1996. The program enables the safe disposal of expired and used medicines including all drugs, all non-prescription medicines, prescription drugs, all non-prescription medicines, herbal products, mineral supplements, vitamin supplements, and throat lozenges. More information about the program can be found at http://www.medicationsreturn.ca/.

ACTION 2-12
Support research on the presence, absence, identification, and effects of EDCs and PPCPs in wastewater discharges.
Who: Ministry of Environment, Environment Canada, university researchers
Timeframe: ongoing
Recommend that the OBWB highlights important problems, support activities or researchers, connect researchers to each other, and seek out and facilitate funds for research and monitoring.

Wastewater treatment plants in the Okanagan are currently designed to effectively treat nutrients and pathogens. However, there is continual need for public reinvestment in this infrastructure to maintain the highest standards of treatment and to bring areas with old, failing septic systems onto community sewer. New information on emerging contaminants may call for further wastewater treatment plant upgrades.

Several options to treat EDCs are available to wastewater managers, including: UV, ozonation, and slow sand filters; membrane technology; advanced photo oxidation processes; ozone and advance oxidation; and granular activated carbon. If EDC treatment is determined to be necessary in the future, the OBWB may need to financially support additional treatment initiatives which to date only focused on implementing nutrient load reduction technologies for local government throughout the Okanagan.

2.4 Data collection, interpretation, and distribution

Information and data regarding riparian, wetland, and aquatic ecosystems and water quality in the Basin is often limited in scope, availability, and comprehensiveness, making it difficult for resource managers to make informed decisions at a local level.

2.4.1 Ecosystem mapping

There are several mapping and inventory tools available to aid in the development of land use policies, regulations, and standards and improve long-term environmental planning capabilities for the protection of riparian, wetland, and aquatic habitat. These include Foreshore Inventory Mapping, Sensitive Habitat Inventory and Mapping, and Wetland Inventory Mapping.

Foreshore Inventory Mapping (FIM) is a standard methodology that is used to collect baseline data of land use, shoreline type, riparian condition, and anthropogenic alteration along the foreshore (Magnan & Cashin, 2005). FIM has been completed for Osoyoos Lake and for Okanagan Lake in the municipal limits of Peachland, Regional District of Central Okanagan, District of Lake Country, and City of Kelowna. FIM will be conducted for the sections of Skaha Lake in the Regional District of Okanagan Similkameen and for the north portion of Okanagan Lake in summer 2008.

Sensitive Habitat Inventory and Mapping (SHIM) is a standard for the collection and mapping of reliable, high quality, current, and spatially accurate information about local freshwater habitats, watercourses, and associated riparian communities in urban and rural watersheds (Mason & Knight, 2002). SHIM has been conducted for many water courses in the Basin including, but not limited to, Mill, Bellevue, BX, Bald Range, Lambly, Vaseux, Fascieux, Brandts, Priest, Lebanon, Thompson, Rumohr, and Middle Vernon creeks; numerous streams entering the east side of Skaha Lake; and select oxbow areas north and south of Oliver.

The City of Kelowna has mapped wetland areas in the City boundaries utilizing an expanded SHIM data dictionary. Wetland Inventory Mapping (WIM) collects information on wetland functionality rating, livestock use intensity rating, Wetland Community Type, biodiversity index, vegetation, proximity to other wetlands, and ecotone abundance.

ACTION 2-13
Complete SHIM, FIM, and WIM Basin-wide.
Who: local governments
Timeframe: 5 yrs
Recommend that the OBWB continues to support ecosystem mapping projects.

Sensitive Ecosystem Inventory (SEI) mapping has been conducted for the Okanagan Valley from Vernon to Osoyoos. A SEI systematically identifies and maps rare and fragile ecosystems in a given area (BC Ministry of Environment, 2008b). The purpose of the SEI is to provide scientific information on sensitive ecosystems to support sustainable land management decisions and encourage conservation and land stewardship (Iverson & Cadrin, 2003). The SEI mapping should be used by all local governments in the Basin.

2.4.2 Long-term water quality monitoring program

The BC Ministry of Environment has the legislated responsibility of monitoring and maintaining water quality in valley lakes. The Province’s involvement in water quality monitoring has been decreasing as a result of budget cuts and the implementation of results-based policies. In light of this, a cooperative approach involving the Ministry of Environment, OBWB, and local water utilities may be required to ensure water quality data are collected throughout the lakes system and interpreted on a regular basis. Water utilities currently sample at intakes throughout the lake system. These data, coupled with data collected at the Ministry of Environment sampling locations, could provide a good baseline to start with. The long-term water quality monitoring program must have a stable source of financial and human resources. The implementation of a collaborative, long-term water quality monitoring program for the six mainstem Okanagan lakes is an important initiative that requires sustained provincial funding resources. Section 4.4.1 further describes the development of an Okanagan Basin Information Network that will support this effort.

2.4.3 Standardized water purveyor data collection and reporting

Currently, data collected by water purveyors are sent to different ministries depending upon what the data are (e.g., quality versus quantity data). This is inefficient for purveyors and also makes it difficult to see the big picture that the data could provide. A streamlined online reporting system for water purveyors to submit water quantity and quality data would be very beneficial to establishing baselines and determining trends. The format, location, and type of data to include in the system would need to be determined through consultation with the various user-groups.

ACTION 2-14
Create a streamlined online data reporting system for water quality and supplies.
Who: Ministry of Environment, Interior Health Authority, Ministry of Community Development, OBWB
Timeframe: 1-2 yrs
Recommend that the OBWB assists with project planning, coordination, and implementation.

2.5 Summary

Clean water is essential for drinking and sanitation, ecosystem function, food production, spiritual values of Aboriginal people and others, recreation and tourism, and aesthetic values. Each of these values and uses requires varying levels of water quality.

Water has an ability to transfer contamination from a source to a much larger area. Reducing or preventing contaminants from entering surface or ground source water is an important and cost-effective way to maintaining cleaner and safer water for all uses and values. Source water protection is a strategic priority of the Sustainable Water Strategy. The protection and restoration of ecosystems that provide natural water purification processes, such as riparian areas and wetlands, is a fundamental component of source water protection. Water source and system assessments, assessment response plans, and source water protections plans are important tools that can be used to reduce the risk to water quality.

Where and how communities accommodate growth and development has a profound impact on the quality of their streams, rivers, lakes, beaches, and groundwater. Putting water stewardship and sustainability front and center on the agenda of comprehensive land use and development brings many benefits, providing local government the tools to make sound decisions that support more green spaces, more water and fish in the streams, improved community vitality, reduced demand for water, and reduced expenditure on infrastructure. Determining areas for growth to occur and critical areas to preserve, developing infill sites, and building compact communities are all components of water-centric planning. Site design strategies such as absorbent landscaping, infiltration facilities, green roofs, and rainwater reuse also work to reduce the impact of land development on water quality. Many land use policies and tools are available to local governments to implement water-centric planning and integrated stormwater management.

Adequate wastewater treatment is also essential to clean water in the Okanagan Basin since treated effluent is discharged into mainstem lakes and the Okanagan River. Wastewater treatment plants in the Okanagan are currently designed to effectively treat nutrients and pathogens. However, there is continual need for public reinvestment in this infrastructure to maintain the highest standards of treatment and to bring areas with old, failing septic systems onto community sewer. New information on emerging contaminants, such as endocrine disrupting chemicals and pharmaceuticals and personal care products may call for further treatment plant upgrades.

The new Sewerage System Regulation approaches onsite sewage disposal using a different process than that of previous decades. The installation of a septic tank and field no longer requires a permit or approval from a Health Official. Rather an *Authorized Person* (Professional or Registered Practitioner) conducts preliminary site assessments and designs, and performs installation and associated certification approvals for systems accordingly. There is no independent second party regulatory review prior to installation and any problems that occur due to faulty design are assessed to the system owner who must then take action with the *Authorized Person*. Technical direction and policy for how to handle sewerage system applications in sensitive lakeshore and stream areas needs to be developed for local government in the Basin and more accountability and liability requirements to the *Authorized Person* added to the regulation.

Good science must be used to support policy and regulation development for the protection of lakes, rivers, and aquifers. Ecosystem mapping and baseline data collection is a fundamental first step in identifying and protecting sensitive ecosystems. The implementation of a collaborative, long-term water quality monitoring program for the six mainstem Okanagan lakes is also an important initiative and requires sustained Provincial funding resources.

With the allowance of new activities in any watershed should also be the responsibility to incorporate the precautionary principle as a basis for decision-making. The onus to demonstrate that there will be no negative impacts on the water resource from that use should be placed on the party proposing to use water or the land near water. Placing the onus on the new user group would ensure that they become a stakeholder in the protecting watershed. Multiple uses in a watershed can co-exist when risks to source water are managed effectively.

CHAPTER 3

SECURING OUR WATER SUPPLIES

3.0 SECURING OUR WATER SUPPLIES

The increased variability of water supply coupled with population growth and development are expected to put increasing pressure on our water supplies. With so many competing uses in the valley, identifying how and when water is to be allocated during water shortages is a critical part of managing uncertainty. Some water supply systems in the region may not be able to meet future demands based on their current capacity. All sectors of the community will need to increase efficient water use, reduce water waste, and use alternative sources wherever possible to ensure we are living within our water means now and in the future. Augmenting upper reservoir storage is also an important priority in the Basin to ensure resilience to variation in precipitation and increased demand.

3.1 Water allocation

Principle 5:
Allocate water within the Okanagan water budget in a clear, transparent, and equitable way.
Identifying how and when water will be allocated is critically important to prepare for the possibility of increasing drought conditions in the Okanagan. Sufficient water must be available for the environment, agriculture, basic human needs, and economic development now and in the future. Existing historical inequities of water supply in the Basin need to be addressed and policies should be developed to prevent the emergence of new inequities as a result of increasing competition over water.

Okanagan communities share water with one another and with the natural environment. Each year, the available supply is determined by rain and snowfall, and the storage capacity of reservoirs and aquifers. With so many competing uses, water must be budgeted to meet all needs. In theory, the Province has established budgets or allocations to match each water source. Water is allocated to water purveyors or individual licence holders, and then apportioned and delivered to users throughout the year. Individual water utilities budget releases from reservoirs depending on water levels. In practice, some water sources have generous surpluses and other sources have been over-allocated, with heavy demands on scant supplies. As one Okanagan water professional said, "When I'm running low on water, I don't run to the filing cabinet and look at my licence. I go into the mountains and see how much water storage we have." As all water sources in the Okanagan feed the mainstem lake system and the Okanagan River, downstream communities depend on appropriate budgeting for the watershed as a whole.

Water managers throughout the Okanagan acknowledge the importance of developing a water budget to account for water and improve management in years when water is limited (i.e., drought conditions). Similar to a business needing to develop an accounting "ledger," water managers must account for revenue (how much water is coming in), savings (how much water can be stored), and expenses (how much water is available for use) in their water budgets.

Historically, water use has been identified as a single line item within a water budget. The concept of creating an enhanced and more sophisticated water budget that delineates the volumes of water available for use to three discrete "accounts": the environment (conservation flows), agriculture (food self-reliance, vineyards), and urban (drinking water, hygiene, sanitation, and business water needs), is an important water management principle (see Figure 3-1).

The Okanagan is at a cross roads. It is in the best interest of all parties to identify how and when water is to be allocated to prepare for the possibility of more frequent drought conditions in the Okanagan. It is similarly important to have the scientific tools and monitoring information to properly inform drought management policies and water restrictions.

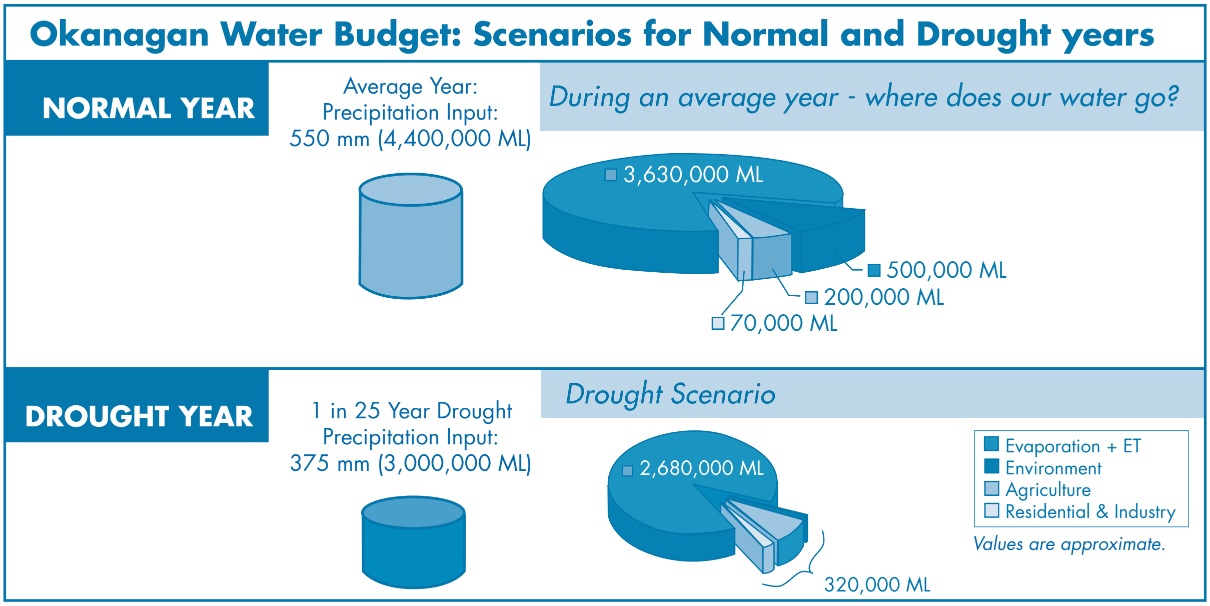


Figure 3-1
Volume of water available after evaporation and evapotranspiration and volumes used by environment, agriculture, and urban (residential and industry).

Okanagan water managers have clearly called for better accounting tools to manage water shortages. The time for developing and implementing those tools is now.

3.1.1 Reserving water for appropriate uses

Within the Okanagan's annual water budget some expenditures are necessities and some are choices available to communities. Water for the environment is not discretionary. There is both a responsibility and a requirement to ensure that sufficient water is set aside for the health of riparian areas and the aquatic environment. Healthy ecosystems in turn support good water quality and strong communities. In earlier eras of human settlement with lightly-populated communities, there were lighter demands on surface water and groundwater and no compelling need to allocate the environment its own share. With the higher demands that are being placed on water today, more formal measures are needed to protect natural systems.

Water for drinking and sanitation is also not discretionary, but fortunately makes up a very small proportion of water delivered to communities. The remainder of human water consumption – where it goes and how it is used – is determined by licence precedence and by the loose requirement for beneficial use.

Presently, the Province issues all water licences in British Columbia. The majority of consumptive use licences in the Okanagan consist of agriculture irrigation licences (Irrigation), domestic water utility use (Waterworks Local Authority), or instream flow needs (Conservation). Storage licences also exist to support the consumptive uses. This process exists for present water allocation and use.

The intent of this section of the Strategy is to raise awareness of the necessity to adjust existing allocations and rethink where and how much water is required for each of the three major water demands—environment, agriculture, and basic human needs and economic development.

Through the Okanagan Water Supply and Demand Project (described in Section 3.5), the Okanagan is developing a knowledge base of how much water is available from the streams and lakes. The optimal allocation for the maximum benefit of the environment and humans can be determined from this information. Once this is known, the allocation of licences can be adjusted over time to reach the end objective of maximized beneficial use.

3.1.1.1 Environment

Water withdrawals in late summer and early fall can significantly impact aquatic habitat in the Okanagan Basin, negatively affecting fish migration, spawning, and rearing. Water flow is naturally low in Okanagan streams during this time and water withdrawals, which peak at this time of year, further limit fish reproduction and survival. Drought years with very low natural flows pose special challenges for balancing human and ecosystem water needs.

About 90 percent of all streams in the Okanagan are already at, or beyond, their licensed capacity for water withdrawal. In times of water shortages, conflicts arise with the need for conservation flows. Under the current Provincial licensing system, water is designated for the environment in the *Water Act* as "conservation purpose", which means the use and storage of water or the construction of works in and about streams for the purpose of conserving fish or wildlife. But, for many tributaries, it has not been established what minimum flow is required for ecological function. It is a high priority for scientists, regulators, and water managers to allocate and licence the flows required to maintain and improve environmental values in Basin tributaries.

Historically, minimum conservation flows have mainly been determined based on what is best for kokanee salmon and rainbow trout. As these species are sensitive to environmental degradation and need cold, clean water, they are seen as appropriate indicators for the health of other aquatic life forms. However, the Okanagan is home to a number of aquatic and riparian species identified as *Species at Risk*, and minimum stream flows must take these species into consideration.

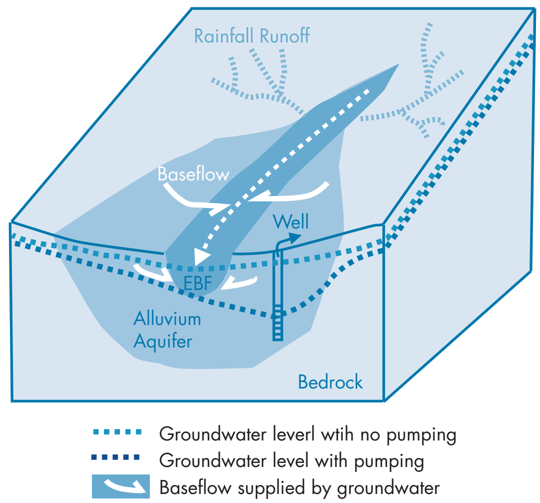


Figure 3-2
Diagram showing the potential effects of groundwater pumping on environmental baseflow. (provided by Golder Associates)

Establishing and maintaining conservation flows also requires an understanding of environmental baseflow. Environmental baseflow in streams and creeks is maintained by groundwater during low flow periods. Pumping from alluvial aquifers can reduce the groundwater contribution to baseflow. Figure 3-2 shows the potential effects of groundwater pumping on environmental baseflow.

The Okanagan Water Supply and Demand Project (described in Section 3.5) is using modeling to determine minimum conservation flows in major tributaries in the Basin. The model results will be very useful, but will need to be ground truthed with actual data collection. Fact Box 3-1 provides an example review process used to determine minimum conservation flows.

FACT BOX 3-1
DETERMINING CONSERVATION FLOWS IN NEW ZEALAND

Environment Canterbury in New Zealand provides an excellent example of a review process used to determine minimum conservation flows. The flow review process includes seven steps and can take 18 months to two years. The steps in the review process include:

1. public meeting;
2. technical panel visit to the waterway and investigations into its hydrology, ecology, landscape values, and traditional uses;
3. Community Advisory Group that provides local input, including the impact of any change to flow regimes on existing users;
4. internal Environment Cantebury staff report detailing options and recommendations;
5. Council decision on the flow regime based on the staff report;
6. public input on variation to flow regime; and
7. implementation of new flow regime.

A national environmental standard on ecological flows and water levels is also currently being established by the New Zealand Ministry for the Environment. The standard proposes that regional councils put in place processes to asses the effects of taking an amount of water from rivers, lakes, or groundwater systems. It also proposes that interim limits be imposed for regional plans which do not already place limits on the alteration to flows and water levels.

Once conservation flows are determined, the next step will be to formally establish an Environmental Water Reserve (EWR) for each major tributary – as has been done in the State of Victoria's Central Region in Australia. EWRs are a marriage of minimum conservation flows and the storage needed to maintain them. In Victoria, the reserves were declared for each river in the region under the Water (Resource Management) Act 2005. A strategy is developed for each river, specifying the total water resource, baseline EWR, how much additional water is needed to meet scientific recommendations, and proposed actions for each river. The EWR can be held in storage (regulated rivers that have reservoirs), as run-of-the-river flows (unregulated rivers that do not have reservoirs), or in groundwater (capping the amount of water for extraction at or below a sustainable limit). A description of how an EWR is allocated is included in Figure 3-3.

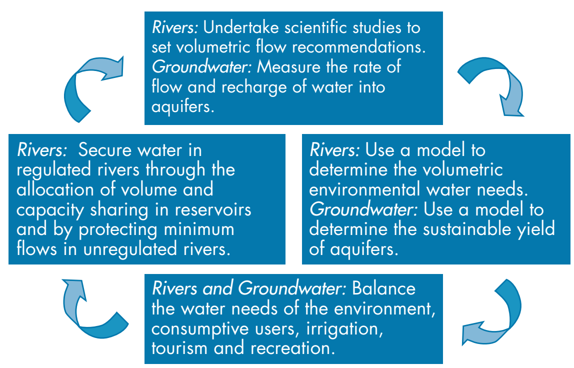


Figure 3-3
A suggested process for developing Environmental Water Reserves. (adapted from Melbourne Water, 2008)

ACTION 3-1
Ensure sufficient water is available to support healthy ecosystems by establishing conservation flows, preserving environmental baseflows, and designating Environmental Water Reserves.
Who: Ministry of Environment, water purveyors, planners
Timeframe: 3-5 yrs
Recommend that the OBWB works with water purveyors to identify potential funding, encourage collaboration, and coordinate activities to reduce redundancies.

3.1.1.2 Agriculture

Approximately 70 percent of the Okanagan Basin's available "consumptive use" water is used for agricultural irrigation, which is in large part responsible for the productivity of the region. If water was not used for irrigation there would be abundant water available for urban uses, but most agricultural industries would be impossible to sustain at current levels. The character of the valley and the ability to address food self-reliance and the capacity to produce our own food would be dramatically altered.

Today, approximately 29,000 hectares of agricultural land is in production, 21,300 hectares are being irrigated, and up to 8,100 hectares more of viable agriculture land is not in use (BC Ministry of Agriculture and Lands, 2008). With an increasing population in the Okanagan and variable precipitation resulting from climate change, it is ever more important to support agriculture and food self-reliance in the Okanagan. Under the current Provincial licensing system, water is designated for agriculture in the *Water Act* as "irrigation purpose", which means the beneficial use of water on cultivated land and hay meadows to nourish crops. The choice to protect water for agriculture is a natural and necessary extension of the choice to protect lands through the Agricultural Land Reserve.

The development of an Agricultural Water Reserve would build on the current licensing system to ensure the provision of appropriate water allocation to land that is viable to grow food for residents of the Okanagan and beyond.

In the 1920s, many individual agricultural water licences were amalgamated under the authority of irrigation districts and infrastructure was built with agriculture funding to supply water to agriculture. Irrigation districts are now being incorporated into local governments, removing management by the agricultural community. Where decisions are made by urban elected representatives, municipal water use may be given priority over agricultural water use, potentially jeopardizing agricultural water security. Rapid growth and development in the Basin and the predicted increases in drought frequency will exacerbate this conflict.

Agricultural water demand is influenced by crop and soil, irrigation type, prevailing climate, and seasonal weather. At peak season, agriculture needs access to irrigation water 24 hours per day, 7 days a week. This is because it is economical to size water supply infrastructure and on-farm irrigation systems to operate continuously rather than only at night or part time. If irrigation systems were designed for only part-time use, the infrastructure must be much larger to accommodate higher flow rates. Water withdrawals from streams where storage is not available would then have huge variations, which impacts stream flows for fish. Irrigation systems are designed to match peak climatic conditions for higher use crops. This allows farmers to change crops as required without re-evaluating their water allocation. Crop and irrigation system may change over time but farmers will be required to stay within the water allotment. Under extreme conditions, cessation of irrigation can cause more than one season of crop loss by killing perennial plantings like fruit trees and grapes, or forcing ranchers to reduce their herd size.

ACTION 3-2
Establish an Agricultural Water Reserve that links agriculture water budget allocations to ALR and agricultural-zoned lands
Who: agricultural community, Ministry of Agriculture and Lands, Ministry of Environment, water purveyors
Timeframe: 5-7 yrs
Recommend that the OBWB supports collaboration, provides communication strategy support, and develops education and information workshops.

An Agricultural Water Reserve established for all lands in the ALR and all lands zoned for agriculture will result in significant strategic advantages. The Agricultural Water Reserve would include existing allocations to agricultural properties as well as reserves for lands in the ALR that do not now have water rights. Development of an Agricultural Water Reserve would be the technical basis for adjusting "Irrigation" designated water licences. Agricultural water reserves could be established through a water management planning process or under Section 44 of the *Water Act.*

In conjunction with the development of an Agricultural Water Reserve, local governments and water authorities must proactively plan to provide water services and distribution systems to service lands that are zoned for agriculture.

Amending the current licensing structure to allow for later-season and part-season irrigation could also provide for better use of water by farmers. Currently, farmers have to irrigate in September when stream flows are low because their water licences state that the irrigation season ends on September 30th. Since they want to ensure sufficient soil moisture on their fields prior to winter farmers have no option but to irrigate before that date. Allowing later season irrigation water use would contribute to the maintenance of conservation flows during low flow periods. If the irrigation season was extended into October farmers could irrigate when flows were higher or reduce usage if there is sufficient rainfall.

ACTION 3-3
Extend the date on irrigation licences to allow for irrigation later in the season (October) without increasing the allocation of water. Allow part-season licensing to maximise beneficial use of water
Who: Ministry of Environment, water purveyors
Timeframe: 1-2 yrs
Recommend that the OBWB support changes to the *Water Act* and water purveyor bylaws that will extend the irrigation season where it is appropriate; and support changes to the *Water Act* to allow for part season irrigation licensing where water is available for beneficial use.

Part-season licensing would allow farmers to irrigate during the spring freshet (May to July) when surplus water is available and then shut down during low flows. This would maximize the beneficial use of available water and minimise the withdrawal of water during low flow periods when it is needed to maintain conservation flows.

3.1.1.3 Human needs and economic development

Every Canadian should have access to clean, safe, and secure water to satisfy basic individual needs for drinking, food preparation, hygiene, and sanitation. Water is also necessary to support economic development in the Basin – virtually all economic sectors are water-dependent.

Just as water is set aside for the environment and for agriculture, water must be set aside for domestic, and industrial, commercial, and institutional (ICI) uses. This is essentially the structure preserved by the existing licensing system (i.e., "waterworks purpose", "domestic purpose", "industrial purpose"). Creating stronger distinctions between the end-uses

ACTION 3-4
Ensure that sufficient potable water is available in each community for domestic, industrial, commercial, and institutional use
Who: water purveyors, Ministry of Environment
Timeframe: 5-7 yrs
Recommend that the OBWB supports collaboration, provides communication strategy support, and develops education and information workshops.

of water creates a better understanding for future apportionments within water budgets for given utilities and for the Basin as a whole. Improved decision making for the nature and location of development can strongly enhance quality of life of communities and reduce economic impacts of climate change.

The average daily residential water use in the Okanagan Basin is highly variable; however, domestic and ICI in most utilities is generally well within supply capacity. With water conservation measures (see Section 3.3) and appropriately designed developments (see Section 2.2), there is no need for water to be a limiting factor to the Okanagan economy.

Most of the larger utilities in the Okanagan Basin are licensed for annual water volumes under the "waterworks purpose" much greater than what they currently use or require. There are several reasons for this over-allocation to public water utilities.

- To ensure the utilities have sufficient economies of scale to operate efficiently.
- To ensure that the water, the rights to water, and the control of water stays in the public realm.
- To ensure that water is issued to those users that will provide for beneficial use.
- To ensure sufficient water is available to supply the utilities, even during drought events where there may only be a fraction of water available for use.
- To reduce conflicts by limiting licensing to additional users.

It may be necessary to rationalize the existing licences issued to water utilities throughout the Okanagan Basin. The valley lakes hold the largest water storage volumes in the Okanagan. Lake levels are managed by the Province and some of the water drawn by utilities from these lakes is supported by upstream storage licences (e.g., City of Penticton licence for Greyback Reservoir on Penticton Creek). If the valley lakes is drawn down to critical levels, those utilities can replace the storage volumes they remove from the lake. Other utilities do not hold storage licences or reservoirs. These utilities are more exposed to the impacts of low valley lake levels.

For water suppliers that draw water from streams, the over-allocated volume of water that is not used supports environmental (conservation) flows. An accounting of the water licensing and water uses for each large water supplier in the valley should be conducted. The review should consider present water demands, long-term demands, irrigated area, source capacity, source reliability, and instream flow needs. A standard template for these assessments should be developed and then run on a trial non-binding basis for one or two larger utilities to understand the potential benefits.

ACTION 3-5

Conduct a review of water licensing and water uses for each large water supplier in the valley. Ensure the review considers present water demands, long-term water demands, irrigated area, source capacity, source reliability, and instream flow needs.

Who: water purveyors, Ministry of Environment

Timeframe: 5-7 yrs

Recommend that the OBWB supports water purveyors in their review process.

3.1.2 Drought Management Plans

Whether a dry period in the Okanagan is considered a drought depends on geography, infrastructure and management regimes, and water demand for environmental and human uses. It is essential to characterize different drought intensities to develop appropriate response plans. If an official drought declaration is called too late, opportunities for conservation measures may be lost; if a drought is called too early and is less severe than forecast, the public may become skeptical of drought warnings.

The Provincial government defines drought as a period of sustained low precipitation and high evaporation, resulting in low streamflow and groundwater levels that can impact the socio-economic or physical health of communities. The Province uses four different indices to measure drought intensity: the Standardized Precipitation Index and indices related to snowpack, stream, and groundwater levels. These are monitored throughout the year, along with weather conditions.

During a run of wet years, it is easy for communities to become complacent. Municipal councils approve subdivisions, farmers plant thirsty crops, and we assume that wet weather is the new norm. Because of increased demand, when dry conditions return we may be even more vulnerable to drought – similar to the way a succession of dry years might lead to floodplain development that is swamped when the water rises again.

Drought Management Plans (DMPs) are one means to minimize drought impacts. DMPs spell out trigger conditions for different drought stages and regulatory responses that might be imposed at each stage (e.g., limiting lawn watering when a reservoir drops to a given level). Every drought is different, and every community responds differently to a drought. For this reason, it is best to have locally-determined drought trigger points, and community-specific DMPs. The DMPs have to have enough detail that anyone can follow them, and must be practiced so that flaws and gaps can be found.

A DMP needs to include establishing a local drought management team, identifying trigger conditions, drought stages and corresponding responses, and clearly assigning responsibilities. Several communities in the Basin have prepared DMPs, but the format, content, and outcomes of DMPs are not consistent. In 2004, the Ministry of Environment published a Dealing with Drought handbook that provides a common template. If all communities implemented plans based on this template, it would simplify efforts to develop common drought stages on all mainstem lakes and Basin-wide prioritization for water use during droughts.

ACTION 3-6
Ensure all significant water purveyors prepare and implement Drought Management Plans based on the Provincial template, with triggers corresponding to mainstem lake conditions as well as upper reservoirs.
Who: water purveyors
Timeframe: 2-3 yrs
Recommend that the OBWB supports fund identification and application writing, encourages collaboration, and coordinates activities to reduce redundancies.

3.1.3 Water Use Plans

While Drought Management Plans (DMPs) specify how a water utility will respond to different conditions, they are based on top-down regulations that do not fit well with all circumstances. In many areas it will be useful to augment DMPs with Water Use Plans (WUPs). WUPs are formal agreements for how water will be shared between licensees while still providing adequate flows for fish and wildlife. WUPs were originally created as a way of resolving conflicts between BC Hydro water use and fish habitat needs, and are particularly effective for improving water management of reservoirs. The goal of a WUP is to avoid litigation by achieving consensus on a plan that satisfies the range of water use interests at stake. Detailed guidelines for preparing Water Use Plans have been prepared by an inter-agency committee including BC Hydro, the Province, and Fisheries and Oceans Canada.

The *Water Act* gives priority to senior licence holders so during shortages the newest licence holders are legally obliged to stop diverting water first. As development in the Okanagan began on the valley floor, newer licences are often upstream of older licences and are typically for small volumes for domestic use. Shutting them off affects many individuals, but has very minimal impact on the remaining water supply. As a result, water managers with the BC Ministry of Environment encourage neighbours to resolve disputes among themselves or through an appointed bailiff, and water use agreements on small water sources are frequently ad hoc and informal. In WUPs, priority rights are set off the table – that is, people with senior rights do not demand that others concede to their needs. The process is intended to be collaborative and cooperative, including a variety of stakeholders in decision making.

The process of preparing a WUP is similar to the DMP process, but DMPs are more general and can be applied in many circumstances with limited hydrologic and reservoir operations studies and without detailed modelling. A WUP can be the defined process for implementing a DMP in a specific basin. A WUP also addresses water allocation during non-drought periods, which benefits fisheries. One of the difficulties of drought is knowing when you are in one, as critical drought periods differ depending on the presence of reservoirs and the volume of available storage. With WUPs there is no need to externally define drought stages as they have built-in triggers that automatically respond to drought conditions. It is important to note that WUPs attempt to mimic natural flows, which means accepting that in drought years most streams may have significantly reduced flows while agriculture, for example, has adequate flows supplied by reservoir storage.

WUPs make no change to legal rights and responsibilities, and must be consistent with both the *Water Act* and the *Fisheries Act*. Nonetheless, the WUP may recommend voluntary changes to water use that diminish water rights. The stakeholders define objectives for each issue and interest, and identify compromises – for example, timing water releases to help juvenile salmon, while protecting residents from flooding. The process may require technical studies to evaluate potential impacts, and models to assess how different management alternatives affect water use objectives. The WUP incorporates strategies that provide the best balance. Before it is made official, the WUP is reviewed and approved by provincial and federal regulators.

The District of Summerland developed a WUP for Trout Creek in 2004-2005 to determine the amount of water that could be diverted while providing adequate flows for fish. Domestic users, irrigators, and fisheries managers all agreed to reductions in use, calibrated to water availability. The WUP was designed to reflect natural variability in stream flows – without a requirement to retain constant flow rates under drought conditions. The planning process led to development of a "Trigger Graph", shown in Figure 3-4. The graph has five use-reduction stages corresponding to different reservoir and stream conditions. An Operating Agreement specifies the target water use reductions for the community and the required fish flow releases.

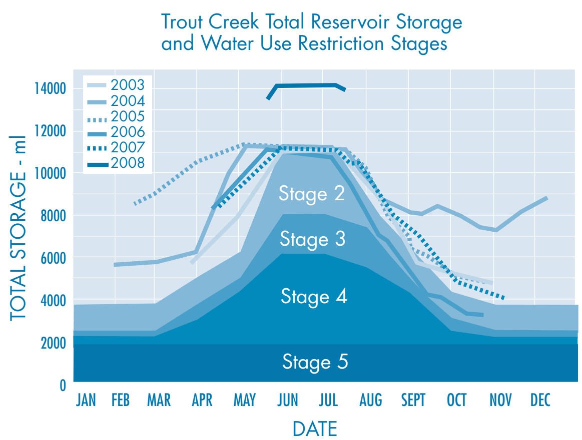


Figure 3-4
Trigger Graph that tracks total storage in the Trout Creek Reservoirs and indicates Stage Levels at which water usage reductions will be required. (Adapted from District of Summerland, 2008)

The water use planning process may be a practical framework for Basin-scale water management planning. This would require two levels of WUPs: one for the Okanagan River to specify how much water must be delivered from each sub-basin to the mainstem system; and individual WUPs for the Okanagan's major sub-basins.

The sub-basins are the areas with the tightest constraints on water supply, but the biggest pressure for new licences will be on Okanagan Lake itself. However, in sub-basins that do not have the threat of lawsuits or other intense conflicts, there may be little motivation to initiate and fund the water use planning process. If instead of a Basin-wide WUP, a legislated Water Management Plan was used to specify minimum return flows, it would provide regulatory power for WUP development in sub-basins to help protect water supplies in the main lakes.

ACTION 3-7

Prepare Water Use Plans for all major fish-bearing watercourses in the Basin in coordination with a Basin-scale Water Use Agreement that specifies responses of all communities to reservoir-level trigger points.

Who: water purveyors, Ministry of Environment, Fisheries and Oceans Canada

Timeframe: 3-5 yrs

Recommend that the OBWB works with water purveyors to identify potential funding, encourages collaboration, and coordinates activities to reduce redundancies.

FACT BOX 3-2
THE FISH/WATER MANAGEMENT TOOL

A computer based water release decision making tool, called the Fish/Water Management Tool (OKFWM Tool) has been developed by the Ministry of Environment and other partners. The OKFWM Tool uses real-time information about kokanee spawning patterns, water temperature, lake levels, and weather conditions to help water and fisheries managers choose optimum weekly water releases at Okanagan Lake dam. The tool increases kokanee survival by minimizing the occurrence and severity of drawdown-related mortality from freezing and desiccation.

There is potential to adapt the OKFWM Tool for use in managing releases from upstream reservoirs on key fish-bearing streams. For example, the Tool could be used to plan increased discharges on warm September days to reduce stream temperatures for kokanee salmon. During sensitive times in the life cycle of some fish species, discharge adjustment could be made on a daily basis to facilitate fish needs. The Tool could also determine if and when maximum flows need to be in effect to prevent high water dislodging of eggs and young from the gravel.

The process for Basin-wide water use planning could proceed as follows:

1. Define the overall water balance for the Basin
2. Establish the required flow regime for the Basin outlet with an Okanagan River WUP, incorporating a 3-year drought scenario in the analysis
3. Determine required target contributions from each sub-basin for a range of different drought conditions
4. Complete WUPs for each sub-basin
5. Revisit and refine the Okanagan River WUP

This process is very effective at developing plans for drought management under different scenarios, clarifying responsibilities and objectives, and identifying feasible alternatives through a rigorous consultative process. WUPs can also incorporate existing drought response plans, hydrology models and water budgets. Although they make no legal commitments, they can be used by local governments as a basis for water use regulation.

The Okanagan River Fish/Water Management Tool is another approach to water use agreements, focusing on the timing and volume of water releases from Okanagan Lake (see Fact Box 3-2). It does not replace the need for a Water Use Plan for the River.

3.2 Water Management Plans

A Water Management Plan is a comprehensive and integrated watershed plan intended to be a basis for provincial regulation on water quality, instream flow requirements, and water supply, among other issues. The planning tool was introduced in 2004 under Part 4 of the *Water Act*.

The structure and scope of a WMP are not predetermined in the *Act*, but instead are meant to be customized to the needs of each community. For the planning process to become official, the Minister of the Environment must give an order to designate the planning area and outline the WMP content and process (see Figure 3-5). Preparation of the WMP must include an extensive public consultation process. Once developed by the community, the WMP must be approved by the Lieutenant Governor in Council before it attains official status.

A Water Management Plan is one of the only mechanisms available to protect groundwater resources in the Okanagan Basin British Columbia remains the sole jurisdiction in Canada with no general licensing requirements for groundwater extraction above a defined threshold level. (Nowlan, 2005). However, in the 2008 *Living Water Smart: British Columbia's Water Plan*, the Provincial government commits to regulating groundwater use in priority areas and large groundwater withdrawals by 2012. It will not be possible to manage groundwater and surface water as a single linked resource until monitoring or controls on groundwater are in place.

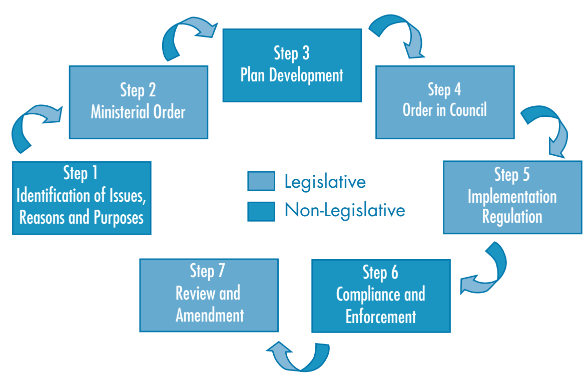


Figure 3-5
Steps in developing a Water Management Plan under Part 4 of the Water Act. (Township of Langley, 2008)

A WMP could also be used as a mechanism to establish authority for source water protection in the Basin. Although water suppliers are held accountable for providing potable drinking water to customers, they do not have regulatory control over Crown land use in their source watersheds, and must rely on decisions made by other levels of government. The vast majority of land in Okanagan upper watersheds is Crown land designated for "multiple uses", meaning that forestry, development, recreation, mining, and cattle grazing are permitted and often encouraged in community watersheds that are the source areas for public drinking water.

There is considerable tension between Crown land areas as places of production (clean water) and places of consumption (recreation, resource extraction, development). The Integrated Land Management Bureau's proposed sale of leased lots on Okanagan drinking water reservoicrs is one expression of the conflict between provincial decisions regarding land use and the local requirement to provide potable drinking water. In 2001, the Province approved the Okanagan Shuswap Land and Resource Management Plan (LRMP) that provides direction for Crown land mangement in the plan area. The 5-year planning process included over thirty participants representing interests such as water, timber, wildlife, fisheries, mining, recreation, tourism, conservation and agriculture. The LRMP has many goals and objectives that pertain to water resources, but does not discuss the connection between development patterns and water quality and quantity and only briefly discusses the impacts of impervious surfaces. A WMP could provide additional tools for water managers to reduce activities, development, and privatization in watersheds.

Finally, WMPs are an excellent structure under which to develop valley-wide response plans for severe water shortages. Water Use Plans, in contrast, are negotiated agreements for different user groups to cut back during drought conditions, but a WMP could provide more authority to bring licence holders to the table and hold to the agreements that have been developed.

ACTION 3-8

Prepare a comprehensive Water Management Plan (or single Water Management Plans) for the Okanagan Basin that specifically address groundwater licensing and monitoring, source water protection, and Basin-wide drought management planning.

Who: OBWB, Ministry of Environment, local governments, stakeholders, and public

Timeframe: 1-3 yrs

Recommend that the OBWB acts as lead agency and local sponsor for the planning process.

Groundwater regulation, source protection and coordinated drought plans could each be developed separately under individual WMPs, or jointly in a single comprehensive WMP. Each option will take substantial commitments and investment by local and senior governments, so it is critical to prioritize the planning process using the best available science. The outcome of the Okanagan Water Supply & Demand Project (to be completed in December 2009) and subsequent consultation process will determine the best course of action – in which areas and on what topics, a Water Management should be pursued.

3.3 Water conservation and efficiency

Principle 6
Promote a Basin-wide culture of water conservation and efficiency.
Reducing water waste and promoting the efficient use of water is central to sustainable water management. Water saved through improved water use efficiencies by a water use sector should be held for that sector.

Water conservation and efficiency are key components of sustainable water management. Though the two are often used interchangeably, there is a difference between them. A water conservation measure is an action, behavioural change, device, technology, or improved design or process implemented to reduce water loss, waste, or use. Water efficiency is a tool of water conservation. It focuses on reducing waste, but not necessarily restricting use, and emphasises the influence consumers can have in water efficiency by making small behavioural changes. Examples of water efficient steps includes fixing leaking taps, using efficient irrigation systems, installing low-flow showerheads and toilets, showering instead of bathing, and using dishwashers and washing machines with full loads.

Two important measurement concepts relate to water conservation: maximum daily water demand and annual water demand. A reduction of maximum daily water demand will reduce water treatment and distribution costs, increase the stability of water systems, and reduce the load on water and wastewater treatment plants. A reduction in annual water demand will help ensure we have enough water for beneficial use throughout the year and provide resiliency for drought.

Benefits realized through a strong commitment to water conservation will include cost reductions for water and wastewater treatment and increased water security.

3.3.1 Coordinated Basin-wide water conservation

There is a need for a coordinated water conservation effort in the Okanagan Basin. Many communities have implemented water conservation programs, but are working independently of one another. Sharing knowledge and experience between communities would be invaluable to improving water conservation in the Basin. Water conservation professionals in the Okanagan have clearly identified a strong desire to collaborate, reduce redundancy among and between Okanagan jurisdictions, and establish a mechanism to identify and apply, where appropriate, best practices and good water management informed by science.

A "Regional Water Conservation Strategy" would provide high-level principles and policies on water conservation and efficiency for adoption by the local governments in the Basin. The Conservation Strategy would also provide guidance on what socio-political (e.g., education, restrictions, bylaws, regulations), economic (e.g., rebates, tax credits, fines), and structural or operational (e.g., water efficient fixtures, metering, water audits) components should be considered by local governments when developing a conservation program. Local government staff would be encouraged to adopt the Regional Water Conservation Strategy and use it to design a program that is best suited to their community and also consistent with the overall strategy for the Basin.

Some have asked: "Why should we conserve water if it only leads to greater development?" This question is based on the assumption that development is constrained by water availability, and that using more water than we need is an appropriate and/or effective response to differing ideas on land use policy. Having sufficient supplies of clean water is essential for protecting our high quality of life, economy, and food self-reliance. Along with these human-centered arguments, taking less water from streams will benefit fish, wildlife, the health of riparian corridors, and the natural water quality.

Everyone needs to share in the responsibility of conservation, as we are all connected in the Basin. Water-wealthy communities taking surface water from the upper watershed are still responsible for resource protection, because water that they save becomes available to people downstream. To build a Regional Water Conservation Strategy, there must be a strong message and logical rationale to encourage local governments and ordinary citizens to recognize the importance of conservation, and take individual responsibility. Development of the Conservation Strategy must include consultation with the public, local politicians, and local government staff.

ACTION 3-9
Develop a Regional Water Conservation Strategy that contains principles, policies, and practices for adoption and implementation by local governments.
Who: Okanagan Water Stewardship Council
Timeframe: 2-3 yrs
Recommend that the OBWB continues to support Water Conservation Professionals by way of the Okanagan Water Stewardship Council and the hosting of workshops to address the problem of resource limited local government in the Okanagan and to encourage partnership development and collaboration.

The basic economic argument for the Regional Water Conservation Strategy is that water providers want effective delivery of a public service when they use public funds. Saving water saves on the per-capita costs of infrastructure. It will be important to work closely with groups like the Okanagan Partnership to further develop the economic and business arguments for sustainable water use.

3.3.2 Reducing irrigation

The greatest potential for domestic and agricultural water savings in the Basin is during the irrigation season of May through September, when water consumption in some communities is more than 10 times greater than the off-season rate. It is estimated that 70 percent of the water used in the Okanagan Valley is for agricultural irrigation. Over half of the remaining 30 percent of water used in the Basin is for outdoor irrigation of parks, boulevards, golf courses, and residential landscapes. Ensuring that irrigation systems are correctly designed and installed, selecting the most efficient systems possible, implementing soil bylaws and landscape standards, and improving irrigation scheduling are techniques that can be used to reduce outdoor water use.

Certification of irrigation designers and installers through the Irrigation Industry Association of British Columbia is the first step to ensuring that irrigation systems are designed and installed correctly. Certified Irrigation Designers are held to a code of ethics that require the selection of efficient irrigation systems, ensuring systems are designed to standards and specifications as outlined in industry adopted irrigation design manuals and providing scheduling information to ensure that the systems are operated correctly. For agricultural irrigation, design manuals are available for both sprinkler and drip irrigation. The National Farm Stewardship Program provides funding incentives for farmers to convert to more efficient systems providing they have completed an Environmental Farm Plan and have a certified plan prepared.

Figure 3-6
Examples of water efficient irrigation systems being used on grapes.

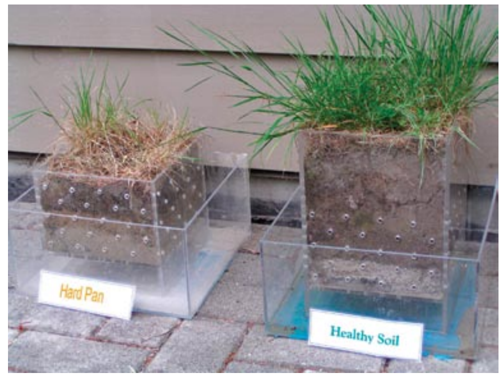


Figure 3-7
Turf grown on healthy soil versus poor soil (hardpan) after no irrigation during a dry summer in North Vancouver.

To improve irrigation efficiency for the landscape and turf industry there are three main steps that should be followed; select landscape material that is drought resistant, ensure that there is sufficient top soil present to encourage deeper roots for plants and turf grass (250 to 300 mm), and use certified designers and technicians to ensure that the irrigation system is designed, installed, and scheduled to operate properly. Figure 3-7 demonstrates how sufficient top soil can increase the productivity of turf with less irrigation.

Soils bylaws and landscaping and irrigation standards are two tools that local governments can use to ensure water efficient landscaping and turf is built into all new developments. The Landscape and Irrigation Standards being developed by the City of Kelowna provide an excellent example of how local government can be proactive in reducing outdoor water use (see Story Box 3-1).

Proper irrigation scheduling is another method to reduce irrigation use in the Basin. Irrigation scheduling takes into account the location, landscape, soil, and irrigation system operation parameters. An on-line irrigation scheduling calculator (www.irrigationbc.com) and real time climate network (www.farmwest.com) is used by farmers to improve irrigation management in the Okanagan. The scheduling calculator can be used for landscape and agricultural systems. The irrigator enters information on the soil type and depth of soil on site, crop rooting depth, the flow rate of a full circle sprinkler, and sprinkler spacing and the on-line calculator provides the irrigator with the number of days to water, the irrigation run time for each day, and the maximum run time per cycle. The scheduling calculator is integrated with the climate network so that current evapotranspiration data is used in the scheduling calculation.

The Okanagan Irrigation Management Program (OKIM) being developed for Vernon and Summerland is an example of improving irrigation scheduling in the Basin. OKIM uses information from the Irrigation Water Demand Model, which calculates agricultural water demand for every parcel in the Okanagan Basin based on climate, soil, crop and irrigation system information stored for each parcel in a database, and agricultural water meters

STORY BOX 3-1
CITY OF KELOWNA LANDSCAPE AND IRRIGATION STANDARDS FOR WATER EFFICIENCY

The City of Kelowna has reduced water consumption in Kelowna by 20 percent through its Get Water Smart and other programs. A 2001 study suggested if residential water users could reduce their consumption by 16 percent in the month of July, the City could defer or eliminate $16 million worth of infrastructure expansions. To meet this target, the City has established a policy to reduce water consumption a further 15 percent by 2012 - with an emphasis on outdoor water use like landscape irrigation. The reduction will be measured on an average household basis. Currently, the average single family home uses 80 cubic metres (80,000 litres) in July. By 2012, it is expected that the average single family home will use 61 cubic metres (61,000 litres) in July.

Over the past couple of years, the City of Kelowna water utility has been working with developers, irrigation companies, landscapers, nurseries, and other stakeholders to develop landscaping and irrigation standards for water efficiency. The intention is to develop a set of standards that ensure water-efficient landscaping is built into all new development. The landscape and irrigation standards are designed specifically address peak demand, although they will also reduce overall consumption throughout the entire spring/summer/fall season. A brochure has been developed that explains how new developments can ensure water efficient systems that reduce outdoor water consumption using:

1. adequate soil to improve moisture retention, requiring less fertilizer and pesticides,
2. reduced turf and more drought tolerant plants,
3. co-ordinated landscape and irrigation design to match irrigation type to landscape type (hydrozones),
4. proper irrigation design and installation to avoid water waste, and
5. more sophisticated timeclock settings or weather-based controllers.

Beyond the educational points in the brochure, the City will require permits for new irrigation installations – with irrigation designers required to meet a minimum standard of expertise, and to certify compliance with City standards. To make standards accessible and widely used, the City is planning to embed landscape and irrigation requirements into its Design Standards (Bylaw 7900).

It is expected that the standards will be complete by the end of 2008 and phased in beginning in 2009. A phased in approach is necessary to give industry the opportunity to train staff and make adjustments to their business practices to comply with the standards.

The City is working on a process to make irrigation permitting very time-efficient and easy. At the same time, the City understands the importance of having compliance across the entire industry. Spot checks will be conducted to ensure the standards are followed.

installed in Vernon and Summerland. OKIM is an online tool that collects the meter data and calculates a theoretical water demand using the Irrigation Water Demand Model and real time climate data. The actual use information is compared to the estimated use from the model. Farmers can access this information through the web. Where large discrepancies exist, the purveyor or producer can investigate how irrigation management may be improved.

For economic reasons, it is in farmers' best interest to increase their water use efficiency – especially in a

For economic reasons, it is in farmers' best interest to increase their water use efficiency – especially in a variable climate with predicted increases in drought frequency. If a farmer can maintain productivity using less water than his legal allocation, then he is assured of a cushion during cutbacks and water shortages. Water conserved by farmers can remain in reservoirs, streams and aquifers to support a healthier environment. However, the "use it or lose it" requirement for beneficial use acts as a disincentive to efficient water use, especially as agricultural water use becomes more carefully monitored and

ACTION 3-10

Reduce outdoor water use by using Certified Irrigation Designers to install systems, implementing soils bylaws and landscape and irrigation standards, and improving irrigation scheduling.

Who: Irrigation Industry Association of BC, water purveyors, local governments

Timeframe: 1-2 yrs

Recommend that the OBWB develops a universal policy for irrigation standards in the Okanagan for adoption by local purveyors, provides a communication strategy, and develops educational and information workshops.

STORY BOX 3-2

WATER METERING IN THE BASIN

Many communities in the Basin have initiated metering programs. The South East Kelowna Irrigation District installed over 400 agricultural water meters in the mid 1990s and accompanied the installation with an education program. Water consumption dropped by 10 percent. Volumetric pricing was added to the program in 2004, when farmers were required to pay a fee if their water use exceeded a pre-determined allotment. The fee structure resulted in an additional 17 percent reduction in average annual water use. The BMID agricultural metering program is underway with the installation of 482 water meters in 2006, 2007, and early 2008. The technology for this program includes underground vault installation and radio frequency reads allowing for up-to-date information to be relayed to the water users. The City of Kelowna implemented a domestic metering program in 1996-1997 with a public education component. This program resulted in a 20 percent reduction in domestic water use, in spite of a 25 percent increase in population over the same period. Other communities in the Basin with water metering programs are Vernon, Penticton, Osoyoos, Summerland, Naramata, Glenmore, Westbank, Lakeview, and Peachland.

metered by utilities and when farmers are nervous that any water they save will be used by downstream developments. Reversing this disincentive would require legislated changes linking water allocations more directly to agricultural lands (i.e., Agricultural Water Reserve), retaining the capacity for agricultural production even if short-term economic changes force land to be fallowed. See Section 3.1.1.2 for more information regarding the Agricultural Water Reserve.

3.3.3 Universal metering

All licensed water extractions by purveyors, as well as unlicensed groundwater extractions, should be metered at the source. Water utilities need to also install end-use meters for all customers. Meters make it possible to monitor how much water is being used and by whom and provide a method of collecting time-series data that can identify trends in water consumption and factors contributing to these trends. Metering also lets utilities establish water pricing levels that promote water conservation, and provides a mechanism for fairly distributing the costs of providing water to individual users. Story Box 3-2 describes metering programs that are currently implemented or underway in the Basin.

ACTION 3-11

Install water meters on all points of diversion and connections in the Basin, and monitor water use.

Who: water purveyors

Timeframe: 5-10 yrs

Recommend that the OBWB supports collaboration, provides communication strategy support, and develops education and information workshops.

3.3.4 Water pricing

Water prices across Canada are generally low. As shown in Figure 3-8, Canadians pay less than many other consumers for their water. The average householder in Canada pays about $33 per month for water delivered to the residence. Monthly bills range between $19 and $52, the lowest being in areas of the west and east coasts, and the highest in the prairie provinces (Environment Canada, 2008).

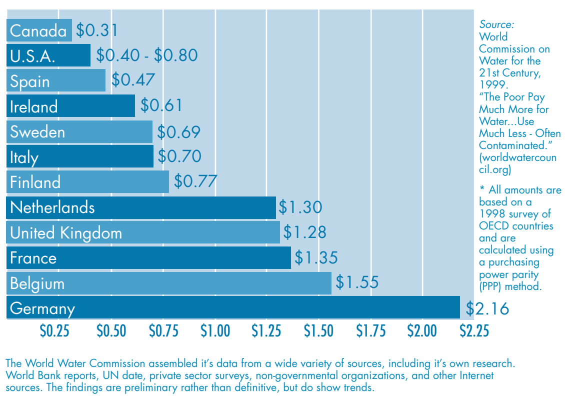


Figure 3-8
Typical municipal water prices in Canada (1999) and other countries (per cubic metre).

As in the rest of Canada, there is a gap between the cost of providing water and the price paid for water use in the Okanagan. In the future, this gap will need to be closed and a more realistic price paid for water use.

3.3.4.1 Increasing block rates for water conservation

Increasing block rates are one mechanism for encouraging water conservation for metered domestic water customers. This is a tier pricing system in which water rates increase as the volume of use increases (see Figure 3-9).

Current domestic pricing for water indicates that there is potential to use pricing as a means for further conservation if supplies become limited by climate

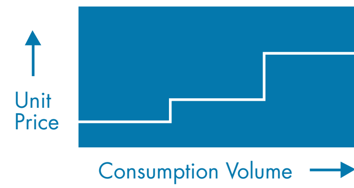


Figure 3-9
The increasing block rate structure consists of a series of price blocks, where the unit prices for each block increase as the block volumes increase.

change (Hrasko & McNeill, 2006). Rate structures can be designed to reduce demands during peak periods. An increasing block rate structure, with a lower charge on the first block (for indoor use) and a higher per unit charge for larger amounts (outdoor use) is one such structure. Since outdoor use is greater than 80 percent of water demand in the Basin, reducing peak period demands has the greatest effect on costs in the long run and conserves water when it is most valuable in the system.

The increasing block rate is also an effective tool for agriculture, but must be used differently. Farmers require a certain amount of water to grow a marketable crop. Reducing water use below this point is not possible. The water allocated to the farm should be based on a higher water use crop with a sprinkler irrigation system. This will allow for changes in crop type and irrigation system type to be accommodated. Farmers require a set price for the water required to grow the crop. However, where water use is in excess of the amount allocated, an increasing block rate can be used in an effort to reduce excessive use.

3.3.4.2 Lifeline rates for equitable domestic water pricing

Every resident in the Okanagan should have access to a basic "lifeline" volume of clean water for drinking and sanitation at a reasonable price. Based on principles of equity, this lifeline volume should ideally be provided at a single common rate to every household in the valley. Nonetheless, geographic and infrastructure differences mean that some water utilities must charge more for water than others.

Uniform lifeline water rates would be easiest to implement if all domestic customers were metered and billed under an increasing block rate pricing system. Utilities with higher delivery costs could then recoup costs for low basic lifeline rates by having higher incremental rates for discretionary water use over the lifeline volume. Customers with greater draws on the delivery system subsidize low rates for low volume use. For example, every person in the Basin could pay the same rate for water use up to 100 litres per day. Residents from districts with high water costs would pay higher rates for water use above 100 litres per day than residents from districts with low water costs.

Even without metering and block rate pricing, water utilities in the Basin should work toward similar standard water rates for low-volume domestic users.

ACTION 3-12
Conduct a Basin-wide water domestic pricing assessment to determine an appropriate water rate for basic "lifeline" volumes and appropriate block rates for increasing metered use
Who: water purveyors, OBWB, local governments
Timeframe: 1-2 yrs
Recommend that the OBWB supports collaboration, provides communication strategy support, and develops education and information workshops.

3.3.4.3 Maintaining affordable agricultural water use

It is generally accepted in economics that full (marginal) cost pricing that includes all explicit, implicit, and external costs of providing a good or service is best. It costs less to supply water to agriculture (i.e., no treatment, no fire storage in water distribution system) and there are external benefits directly attributable to agricultural water use (i.e., food production, pleasant green landscapes, quality of life); therefore agricultural water rates should be lower than rates for water supplied to other uses.

Maintaining affordable agricultural water rates can be accomplished in part by installing dual distribution systems, where appropriate. Many water systems in the Basin were designed to supply large volumes of water for irrigation purposes. Subsequently, residential connections have been added to these systems and treatment requirements have become more stringent. The level of demand in areas where irrigation is the dominant water use (i.e., the South East Kelowna Irrigation District) fluctuates significantly throughout the year. For example, flows in the South East Kelowna Irrigation District during winter months are as low as 30 litres per second, while summer maximum daily demands can reach about 1770 litres per second; this represents a variation in flow of over 50 times (Mould Engineering, 2006). Designing a treatment system to deal with these large flows and fluctuations is expensive and often the costs must be borne by relatively few users. Splitting agricultural water from domestic water would enable purveyors to treat smaller volumes of water to residential standards, thus reducing the overall cost of treatment, but the cost to split the systems is also very high.

Increasing the use of treated wastewater for irrigation can also contribute to affordable water for agriculture. The City of Vernon has been using water reclamation and spray irrigation since 1977.

Following treatment at the Water Reclamation Plant, all reclaimed water is pumped to a reservoir. From late April to early October, reclaimed water is drawn out of the reservoir, chlorinated and used as irrigation water on approximately 970 hectares of land south of Vernon. Areas irrigated with reclaimed water include Predator Ridge Golf Resort, Vernon Golf and Country Club, Vernon Seed Orchard, Kalamalka Forestry Centre, and Pacific Regeneration's Vernon Nursery as well as large areas of agricultural land used for grazing and hay production (City of Vernon, 2008).

ACTION 3-13

Where appropriate, maintain affordable agricultural water rates by splitting systems, increasing use of treated wastewater, implementing education and incentive programs, and other mechanisms.

Who: water purveyors

Timeframe: 5-7 yrs

Recommend that the OBWB supports collaboration, provides communication strategy support, and develops education and information workshops.

3.4 Water storage

Principle 7
Ensure water supplies are flexible and resilient.
Even with improved Basin-wide water conservation and efficiency, water storage capacity will need to be increased in some sub-basins to meet the joint challenges of population growth and climate change.

3.4.1 Storage capacity

One of the central water management problems in the Okanagan is lack of storage. Although there is a series of large, deep lakes, shoreline development limits the ability to increase storage by raising reservoir levels. 'Mining' or drawing down lake levels is another way to manage storage space, but can negatively impact fish passage and spawning areas, marinas, boat docks, and water intakes. Erratic precipitation patterns make it difficult to predict when and whether lakes and reservoirs will refill. Like many other parts of the world, the Okanagan has relied on the 'slow-release' capabilities of the water stored in the snow pack. If climate change reduces the amount of water stored in the snow pack, it will be essential to make best use of our reservoir space.

Water storage must be strategically developed in the Okanagan Plateau to build flexibility and resiliency in water supply. Increased storage is an important priority for the Okanagan to increase our resilience to variation in precipitation (in space and time), impacts of climate change and mountain pine beetle, and the increased demand from agriculture and people choosing to live in the Okanagan.

Okanagan Lake is our largest water storage reservoir holding some 424,000 ML of storage. Approximately three-quarters of this volumes leaves annually through evaporation. Storing more water in Okanagan Lake during the spring is a management option that has a variety of trade-offs. Future decisions to increase storage capacity for Okanagan Lake would require discussion with many stakeholders including lakeshore residents, fish resource managers, the International Joint Commission, and the tourism industry, to name a few.

In most years, surplus water from the spring freshet is released through the Okanagan River Channel and Osoyoos Lake to avoid flood risks. Increased upstream storage would save some of this surplus water for use in the high demand months that follow the freshet. Even during periods of drought and poor snow pack, when spillage is not necessary, increased upstream storage would help mitigate low lake levels by supplying more water during peak demand.

Storing water as far upstream as possible results in a greater potential for repeat use of the same water (Hrasko & McNeill, 2006). For example, an upstream storage reservoir can provide instream flows necessary for domestic and irrigation withdrawals and fish habitat. Further downstream, the same flows can supply municipal needs. The return flows from the municipality will then help to maintain lake levels required for recreation and lake spawning kokanee. Upstream storage is also valuable in that there is less evaporation at higher elevations.

ACTION 3-14
Ensure water storage is identified as a strategic and critical component to water management in an Okanagan Water Management Plan and sub-basin Water Use Plans.
Who: OBWB, water purveyors
Timeframe: 2-5 yrs
Recommend that the OBWB provides for leadership, coordination and good science to support the planning of water storage in the Okanagan Basin.

3.4.2 Watershed storage reserve fund

The costs of developing upstream storage reservoirs vary considerably from project to project as shown in Table 3-1. Most of the accessible and lower cost upstream storage sites have already been developed, resulting in higher costs for further development by municipalities and irrigation districts.

UPPER WATERSHED STORAGE PROJECTS	STORAGE (ml)	TOTAL COST	COST/ml
Black Mountain Irrigation District - Mission Lake Reservoir (proposed)	2280	$1,464,599	$642
Black Mountain Irrigation District - Loch Long Reservoir (proposed)	1850	$1,797,601	$972
Westbank Irrigation District - Raising Lambly Lake (proposed)	6165	$5,630,682	$913
Lakeview Irrigation District - 1993 Big Horn Dam (to full pool in 1993)	3400	$3,333,142	$980
South East Kelowna Irrigation District - Turtle Lake Expansion (prop.)	2096	$2,062,339	$984
Black Mountain Irrigation District - Raising of Fishhawk Reservoir (prop.)	4680	$4,621,973	$988
Lakeview Irrigation District - 1992 Big Horn Dam (existing)	2295	$2,499,856	$1,089
District of Summerland - Site 13 (proposed)	3700	$4,170,515	$1,127
Lakeview Irrigation District - 2005 Big Horn Dam Expansion	1105	$1,743,581	$1,578
District of Summerland - Site 2 Reservoir + Pitin Creek Diversion (prop.)	76600	$12,016,238	$1,581
District of Summerland - Site 9 - Kathleen Reservoir (proposed)	1600	$2,809,521	$1,756
District of Summerland - Site 1 - (proposed)	2240	$4,763,737	$2,127

Table 3-1
Summary of storage reservoir costs. (Agua Consulting Inc., 2008) .

A "watershed storage reserve fund" should be implemented to support the construction of new upstream storage reservoirs The fund would stay in the Basin and could be administered by the OBWB. Setting up the fund would require changes to the current water licensing system. The fund would go to construction of upper watershed storage reservoirs to help build resiliency and capacity to buffer floods and supply during drought cycles. Only licensees that have the opportunity for storage would pay into the fund (i.e., there must be an end-use benefit).

There are three potential ways in which to collect monies for the watershed storage reserve fund:

- Have a licensing surcharge that stays in the Basin (i.e., pay an additional fee for licensing that goes to a pot of money in the Basin to be used for storage). The current fee is very low for water licences; in the range of $1.00 per 1000 cubic metres.

- Require licensees without developed storage to pay a higher fee for the benefits of natural flows provided by the licensees that have storage. The licensees without developed storage would continue to pay until they fund their share of the storage they are using (based on a current average storage cost in the range of $1500 per ML of storage volume).
- Require a storage licence for lake supplies.

The advantage of having a higher fee is that it will discourage water purveyors or private licensees from holding onto additional unutilized licences. The Basin licensing is nearly fully allocated but in most sub-basins nowhere near fully utilized. The Watershed Storage Reserve Fund is a tool that may help to correct the hoarding of water licences.

ACTION 3-15
Change water licence structure so in-stream licences without storage pay a surcharge, which goes in a watershed storage reserve fund.
Who: Ministry of Environment
Timeframe: 2-4 yrs
Recommend that the OBWB coordinate and work out details with Ministry of Environment and industry on a fair and equitable process for the reservoir storage fund.

3.4.3 Coordinated water storage

As more demand is placed on water sources there will be increased pressure to construct additional storage facilities. To reduce potential problems in the future that may result from competing interests, it is recommended that a policy of "coordinating water storage" be implemented.

Advantages of the coordinated water storage policy include:

- Having one designated operator per watershed be responsible for operation of storage facilities,
- having professionally trained staff to operate, maintain, inspect, and replace storage facilities,
- local attention to details and activities in the sub-basin,
- regulated streamflow by the operator to ensure beneficial use as per licensing and safe operating levels, and
- the elimination of irresponsible activities in regulating waterflow in the sub-basin.

ACTION 3-16
Implement policies that support coordinated water storage by utilities.
Who: Ministry of Environment
Timeframe: 3-5 yrs
Recommend that the OBWB represents the Okanagan's interest to Provincial policy makers.

3.5 Data collection, interpretation, and distribution

"We can't manage what we don't measure"
BC Ministry of Environment, Living Water Smart

Effective collection, interpretation, and dissemination of Basin-wide surface water and groundwater quantity data and information is essential to understanding current water supply and use patterns as well as to our ability to predict future trends. A large volume of technical and planning information is available for water resources in the Okanagan Basin, but the challenge is that much of the data are site-specific (not Basin-wide), out-of-date, discontinuous, or collected in a form that is not useful for current studies or modeling. Significant data gaps also exist, including accurate information on evaporation and evapotranspiration, groundwater and groundwater/surface water interactions, and actual water use by licensees (Summit Environmental Consultants, 2005).

A significant number of projects have been completed or are underway in the Okanagan Basin. Two of the largest projects now underway are the Okanagan Basin Water Supply and Demand Project and the Groundwater Assessment of the Okanagan Basin (GAOB).

The Water Supply and Demand Project was initiated in 2004 as a Basin-wide study of surface water and groundwater resources. This is the first comprehensive Basin-wide water study since the 1974 Okanagan Basin Study. The goal of the Project is to provide a best estimate of present and future water need and availability, taking into account, present water use, population growth, climate change, land use change, preservation of the environment, and other factors (Okanagan Basin Water Board, 2008). The first phase, completed in 2005, analyzed what information was available and developed a strategy to create a water budget for the Basin. The second phase, which will be completed in 2009, will provide an updated analysis of current surface water and groundwater supply and use and the potential impacts of population growth and climate change. This project will not in itself make policy recommendations, but will form a scientific basis for Drought Management Plans, Water Use Plans, and Water Management Plans for the Basin.

Phase II of the project includes State-of-the-Basin reports on water supply, water management and use, and groundwater – establishing the current state of information. It also includes hydrologic models for surface and groundwater that support models of minimum instream flow needs. A GIS-based irrigation demand model has been created to test scenarios of how changes in irrigation, crops or climate patterns alter the demand for outdoor water use. Information from all studies is collected into a comprehensive water science database, and supports a water budget model for the Basin.

The GAOB is a large-scale, coordinated research effort, initiated in 2004 to bring together and guide groundwater studies in the Okanagan. The GAOB working group leading the program includes representatives from four federal and provincial agencies, three universities, the OBWB, and the BC Groundwater Association. Key outcomes include aquifer characterization and mapping, water budgets, assessment of groundwater – surface water interactions in key locations, characterization and assessment of water quality, and identification of potential climate change impacts on groundwater.

3.5.1 Surface water flow monitoring

Accurate, long-term, real-time hydrometric data is essential for water management and determining the quantity of water available at dams and reservoirs. With these data, water purveyors can determine the relationship between historical spring freshet volumes and snow pillow depth, and predict water levels for the upcoming storage season.

Although there have long been concerns about water availability and competition between water users in the Okanagan Basin, the basic network of hydrometric stations has been declining for several years. Only 15 of the 79 drainages in the Okanagan Basin are now being monitored, and mathematical models give only rough estimates of flows in un-gauged creeks

Measuring release flows at spillways on upper watershed reservoirs will also assist in determining water availability. This can be done for a reasonable cost using flow measurement recorders installed on the release structure (see Figure 3-10).

ACTION 3-17

Maintain and expand the network of hydrometric and climate stations operating in the Okanagan Basin, and establish a Board comprised of governments and data users to promote and manage the network and the data.

Who: Ministry of Environment, hydrometric working group, water purveyors, OBWB

Timeframe: 2-5 yrs

Recommend that the OBWB supports collaboration and provides communication strategy support.

Hydrometric Metering Station

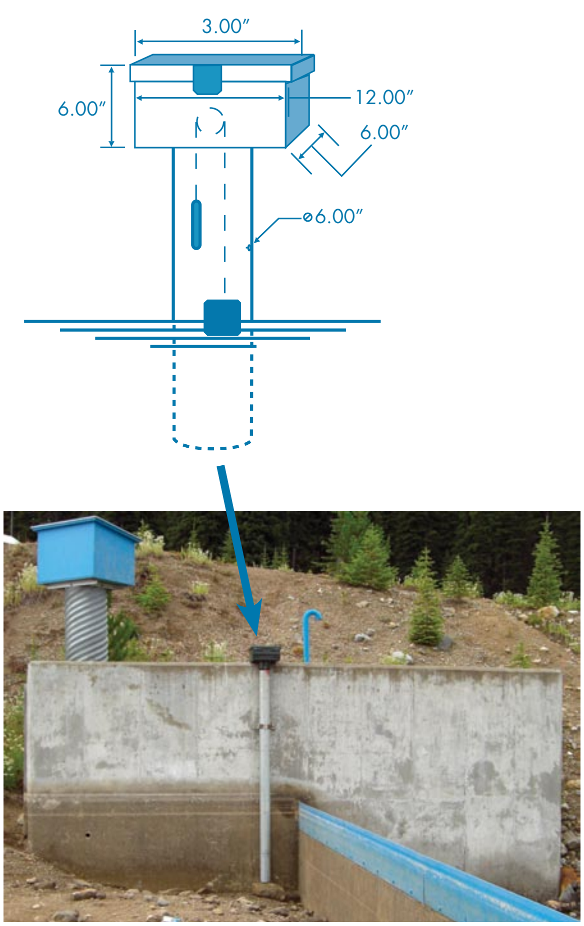


Figure 3-10
Thalmides device being used to monitor water flow at reservoir spillways.

ACTION 3-18

Install flow measurement recorders at all reservoir spillways.

Who: water purveyors

Timeframe: 2-5 yrs

Recommend that the OBWB supports the installation of flow measurement recorders on all reservoir spillways. Standardized drawings of successful installations, including costs, should be collected from completed installations and circulated to water utilities for their consideration and use.

3.5.2 Evapotranspiration and evaporation

Evapotranspiration and evaporation are the largest loss factors from the Okanagan Basin water budget, yet they are the least understood. More than 80 percent of losses in the Basin can be attributed to evapotranspiration and evaporation (Turner et. al., 2006). For example, evaporation from the surface of Okanagan Lake removes almost a metre of water in an average year (Nordin, 2005). Current knowledge regarding evapotranspiration and evaporation has been gained through the use of models based on limited data. More data are required to verify and validate model outcomes.

ACTION 3-19

Collect physical meteorological data on evapotranspiration and lake evaporation to validate model outcomes and derive accurate estimates of evaporative water loss.

Who: Environment Canada, Ministry of Environment

Timeframe: 1-1 yrs

Recommend that the OBWB supports collaboration and provides communication strategy support.

3.5.3 Groundwater supply and demand

There is a high degree of uncertainty regarding groundwater conditions in most sub-basins in the Okanagan. Demand for groundwater resources, both now and in the future, is also not clearly understood. Most water utilities and irrigation districts measure extraction rates and have developed district-specific estimates of future groundwater demand as part of their capital planning efforts, but extraction from private wells is generally not measured. Data collected by large water purveyors is often site-specific and comparison with other areas is difficult because the data varies between districts – from basic annual production and consumption rates to comprehensive analyses of water production by month and year. Also, there are a substantial number of agricultural water users that are not currently irrigating parcels of land, but that could potentially irrigate in the future. This has direct implications when assessing long-term water use trends.

In 2004, a section relating to wells and groundwater protection was added to the *Water Act* (Part 5) and the associated *Groundwater Protection Regulation* (GWPR) was established. This is the only legislation covering groundwater supply in the absence of a Water Management Plan. The Province does not require licensing of groundwater extraction, has not historically kept records of well construction and abandonment, and does not require reporting of groundwater use. The GWPR establishes standards to protect groundwater supplies by requiring all water wells in British Columbia to be properly constructed, maintained, and, at the end of their service, deactivated and closed. The GWPR also establishes the qualifications for well drillers and well pump installers and provided for a provincial registry of those possessing the qualifications. Geothermal wells are not regulated by the GWPR. The main focus of the GWPR is water quality; it does not set standards and requirements for licensing or monitoring water quantity. This is currently being developed at a pilot scale level by the City of Kelowna and the Kelowna Joint Water Committee within the City of Kelowna limits.

ACTION 3-20
Develop a Pilot Project in partnership with the Province and local governments to improve groundwater regulations and requirements for groundwater monitoring.
Who: OBWB, Ministry of Environment, water purveyors, local governments
Timeframe: 1-3 yrs
Recommend that the OBWB works with local governments and water purveyors to identify potential funding, encourages collaboration, and coordinates activities to reduce redundancies.

Under the *GWPR* only a subset of boreholes, wells, and basic well logs are required to be publicly reported and made available on the web based search tool managed by the Ministry of Environment. There are no means of accessing more comprehensive subsurface well and borehole information, thus only rough estimates of groundwater production from individual wells can be made. One proposal is to create a Regional Well/Borehole Database to compile basic subsurface information (including types and densities) for all wells and boreholes in the Okanagan Basin into a centralized and broadly accessible archive.

ACTION 3-21
Develop a Regional Well/Borehole Database that includes basic subsurface information for wells and boreholes, and extraction flows and actual use records for all past, present, and future wells drilled in the Okanagan Basin.
Who: Ministry of Environment, OBWB
Timeframe: 1-2 yrs

New well information (captured through the Development Permit process) and past well information (retrieved from existing records, accessible reports, other databases, and other published information) would be included in the database. A Regional Well/Borehole Database would foster sustainable management, provide support for decisions on development, planning and zoning, provide engineering information, and help reduce liability for local government groups.

3.6 Summary

Identifying how and when water will be allocated is critically important to prepare for the possibility of increasing drought conditions in the Okanagan. Water for the environment is not discretionary. Determining conservation flow levels and establishing Environmental Water Reserves are two tools that protect natural systems during drought periods. Water is also needed to maximize food production in the Basin. The development of an Agricultural Water Reserve will provide for the appropriate water allocation to land that is viable to grow food for residents of the Okanagan and beyond. An adequate proportion water must also be designated for drinking, food preparation, hygiene, and sanitation. Lastly, water is also necessary to support economic development in the Basin – virtually all economic sectors are water-dependent. Just as water is set aside for the environment and for agriculture, water must be set aside within the Okanagan water budget for domestic, and industrial, commercial, and institutional uses.

Drought Management Plans are another means to minimize drought impacts. Drought Management Plans include establishing a local drought management team, identifying trigger conditions, drought stages, and corresponding responses, and clearly assigning responsibilities. If each community in the Basin implemented a Drought Management Plan based on the provincial template in the *Dealing with Drought* handbook, it would simplify efforts to develop common drought stages on all mainstem lakes and Basin-wide prioritization for water use during drought.

Water Use Plans also need to be conducted in some watersheds to augment community Drought Management Plans. Water Use Plans are formal, though voluntary and non-binding, agreements for how water will be shared between licensees while still providing adequate flows for fish and wildlife.

The water use planning process may be a practical framework for Basin-scale water management planning. This would require two levels of Water Use Plans: individual Water Use Plans for the Okanagan's major sub-basins, and one for the Okanagan River to specify how much water must be delivered from each sub-basin to the mainstem system.

A third type of planning process, a Water Management Plan, will also be important to protecting and securing water in the Basin. A Water Management Plan is a comprehensive and integrated watershed planning tool under Part 4 of the *Water Act*. The structure and scope of individual plans is not predetermined in the *Act*, but are meant to be customized to the needs of each community. A Water Management Plan (or Plans) will be key to implementing groundwater licensing and monitoring, source water protection, and Basin-wide drought management planning in the Okanagan Basin.

Reducing waste and promoting the efficient use of water is central to ensuring water supplies are adequate now and in the future. There is a need for a Regional Water Conservation Strategy that provides high-level principles and policies on water conservation and efficiency and guidance on practical tools available for conservation programs. Outdoor water use is where the largest efficiencies can be achieved. Outdoor water use can be reduced by using Certified Irrigation Designers to install systems, implementing soils bylaws and landscape and irrigation standards, and improving irrigation scheduling. All licensed water extractions by purveyors, as well as unlicensed groundwater extractions, need to be metered at the source. Water utilities must also install end-use meters for all customers. Meters provide a method of collecting time-series data that can be used to identify trends in water consumption and factors contributing to these trends. Metering also enables utilities to establish water pricing levels that promote water conservation, and provides a mechanism for fairly distributing the costs of providing water to individual users.

Even with improved Basin-wide water conservation and efficiency, water storage capacity will need to be increased in some sub-basins to meet the joint challenges of population growth and climate change. Water storage must be strategically developed in the Okanagan Plateau to build flexibility and resiliency in water supply. Most of the accessible and lower cost upstream storage sites have already been developed, resulting in higher costs for further development of storage. A watershed storage reserve fund needs to be implemented to ensure funding is developed to support the construction of new upstream storage reservoirs. Future increases in water storage capacity need to be coordinated to reduce potential problems that may result from new and competing interests.

We cannot manage what we do not measure. Hydrometric and climate monitoring, evaporation and evapotranspiration data, and information on groundwater supply and demand are critical to securing water supplies in the Okanagan Basin.

CHAPTER 4

DELIVERING THE STRATEGY

4.0 DELIVERING THE STRATEGY

The Okanagan Sustainable Water Strategy is about changing how we think about, plan for, and use water.

Bridging the gap between talk and action requires that four critical factors be in alignment:

- Partner commitment to take action,
- A champion to provide energy and organizational drive,
- Trust and collaboration between individuals, between government and non-governmental organizations, and between levels of government, and
- Secure funding.

It is important to understand the challenges of implementing the Strategy. Resolving serious and complex issues in the Basin will require a diligently applied program over decades. Implementing the Strategy will take coordinated action on a variety of fronts simultaneously.

4.1 Water governance

Water governance is the process through which public interests are articulated and absorbed, decisions are made and implemented, and decision makers are held accountable for management of water resources and delivery of water services (Nowlan & Bakker, 2007). Governance is the means to create, implement, and account for policy. The discussions and narrative in Chapters 1 to 3 of this Strategy give the context for why good policy is critical. Current water governance and management structures will be tested in the future as climate change and a growing population put pressure on water quality and water supply.

In the Okanagan there are a number of government jurisdictions that play a role in developing, implementing and enforcing water laws, bylaws and policies. In the next sections, the Strategy provides a road map identifying the matrix of interests, regulatory frameworks, and government departments or agencies actively engaged in the Basin.

4.1.1 Existing regulatory frameworks

The purpose of this section is to provide information on the Federal, Provincial, and Local government statutes and policies that currently govern water in the Okanagan Basin. It is important to have a good understanding of the current governance system in order to develop and implement a new Okanagan strategy for effective water governance.

To more fully understand the legal issues of water that have faced people in this region, one must look back to the original laws by which water was managed. A historical account of water law is provided in Appendix IV.

Currently, more than thirty-five Acts, Regulations, and policies indirectly or directly govern water and aquatic and riparian ecosystems in the Basin (see Fact Box 4-1).

FACT BOX 4-1
KEY LEGISLATION AND POLICIES GOVERNING WATER AND RIPARIAN ECOSYSTEMS IN BRITISH COLUMBIA

Federal

- Environmental Assessment Act
- Environmental Protection Act
- Department of Environment Act
- Federal Water Policy (1987)
- Fisheries Act
- Indian Act
- International River Improvements Act
- Navigable Waters Protection Act
- Species at Risk Act
- Water Act
- Wildlife Act

Fact Box continued on next page

Provincial

- Action Plan for Safe Drinking Water (2004)
- Agricultural Land Commission Act
- Dike Maintenance Act
- Drinking Water Protection Act
- Environmental Assessment Act
- Environmental Management Act
- Farm Practices Protection (Right to Farm) Act
- Fish Protection Act (Riparian Areas Regulation)
- Forest and Range Practices Act
- Health Act
- Land Act
- Living Water Smart: British Columbia's Water Plan (2008)
- Local Government Act
- Mines Act
- Okanagan-Shuswap Land and Resource Management Plan
- Private Managed Forest Land Act
- Range Act
- Utilities Commission Act
- Water Act (Groundwater Protection Regulation)
- Water Protection Act
- Weed Control Act
- Wildlife Act
- Water Utility Act

Local

- Official Community Plans
- Zoning bylaws

International

- International Boundary Waters Treaty Act
- Zosel Dam Order of Operation (Osoyoos Lake)
- Columbia River Treaty

The federal *Fisheries Act* is Canada's oldest, most powerful piece of legislation to enforce ecological standards pertaining to watersheds and fish habitat. Fish habitat includes any areas on which fish depend, directly or indirectly, in order to carry out their life processes (Fisheries and Oceans Canada, 2008). Fish habitat extends to streamside areas upon which fish depend directly or indirectly in order to carry out their life processes – such as vegetation that provides shade and insect prey. The *Act* gives Fisheries and Oceans Canada clear power to prevent and control pollution releases into any water frequented by fish, by issuing stop work orders prohibiting any damage from occurring. Million dollar penalties and jail sentences can be imposed through the *Act* for corporate or individual offenders. The Minister's power to issue a stop work order is rarely used and enforcement of the *Act* is carried out in a reactive manner.

The *International Boundary Waters Treaty* between the United States and Canada provides a mechanism for resolving any dispute over waters bordering the two countries. The International Joint Commission (IJC) is an independent bi-national organization established by the *Treaty* to help prevent and resolve disputes over the use and quality of boundary waters. Zosel Dam, located in the USA on the Okanogan River, controls water releases from Osoyoos Lake, which straddles the international boundary. The Osoyoos Lake Board of Control was established by the IJC in September 1946 to oversee the operation of Zosel Dam with respect to water levels. The Board of Control is an IJC-appointed six-member board, with three members each from the United States and Canada. The operating orders for Osoyoos Lake are up for renewal and renegotiation in 2013, and the Osoyoos Lake Board of Control has initiated a series of studies to inform this process.

The Province has been delegated principal jurisdiction in water management, with a number of provincial ministries and agencies sharing responsibility for different aspects. Agencies with authority over water management also have mandates that cover environment, natural resources, agriculture, health, engineering, and public works and infrastructure. Sometimes these mandates overlap, other times they have conflicting objectives. The long-standing division of duties and interests has been criticized as a weakness in British Columbia's water governance system (Provincial Health Officer, 2001).

In June 2008, the Province released *Living Water Smart*, the government's vision and plan to keep British Columbia's water healthy and secure for the future. Through this plan, government commits to new actions and targets and builds on existing water management efforts. The plan draws on a variety of policy tools including planning, regulatory change, education, and incentives like economic instruments and rewards (BC Ministry of Environment, 2008a).

Authority to divert and use surface water in British Columbia is obtained by licence or approval from the Ministry of Environment in accordance with the *Water Act*. Groundwater use is not licensed in British Columbia. A priority system, frequently described as "first in time, first in right", is used to allocate surface water. In times of water scarcity, the licence with the earliest priority date is entitled to its full allocation, over a more junior licence. The *Fisheries Act* has precedence over provincial water licences, and during times of scarcity a licence holder can be ordered to discontinue withdrawals from a watercourse to maintain minimum flows for fish habitat.

Under the *Water Act*, rights to surface water can be forfeited if the licensee fails for three successive years to make beneficial use of the water for the purpose and in the manner authorized under the licence. This "use it or lose it" principle may operate as a disincentive to conservation by encouraging water use when it is not needed in order to maintain the legal right.

The Riparian Areas Regulation (RAR), enacted under the BC *Fish Protection Act* in 2004, requires local governments to protect riparian areas during residential, commercial, and industrial development by requiring a scientific assessment of the proposed activities by a Qualified Environmental Professional (QEP). Land developers hire the QEP to assess potential impacts of the proposed development and mitigation measures, who submits a report to the Ministry of Environment. If the report certifies the work will not harm the environment, the Ministry notifies local government that it can proceed with processing the development application. If the QEP is unable to certify that the proposed works will not impact fish habitat, Fisheries and Oceans Canada must approve the proposal. Agricultural development is exempt from the RAR but the industry is developing agricultural building development standards that are RAR compatible, along with guidelines for vegetation removal in riparian areas on agricultural lands.

The Medical Health Officers employed by Interior Health are responsible for the application of the *Drinking Water Protection Act*. They have the authority to "investigate complaints, require testing and assessment, perform inspections, coordinate source protection, issue orders and take other steps to ensure water safety." These duties are delegated to Health Protection Program public health inspectors. The Ministry of Environment also has the responsibility and authority to protect water quantity and prohibit polluting activities under the *Water Act* and the *Water Protection Act.*

The regional districts and municipalities are delegated zoning, planning, and bylaw authority and certain water-related responsibilities through the *Local Government Act* and have substantial powers to protect water quality on public and private lands in the lower watershed. These responsibilities include providing fire protection, water and sewer, waste disposal and recycling services, and constructing and maintaining sewers, storm drains and drainage.

Twelve municipalities and three regional districts operate in the Okanagan Basin. Most of these local governments also operate their own water utility. The *Local Government Act* also delegates authority to improvement districts to provide utility services, and some private utilities manage domestic water supplies, irrigation, dyking, and drainage in the Basin.

4.1.2 An Okanagan strategy for water governance

An Okanagan strategy for effective water governance will take approaches that are proactive instead of reactive, focused on collaboration, and use good science and best practices to support policy development and prioritization.

An Okanagan water governance body requires the resources to support the following activities:

- Identify water quality and quantity risks.
- Prioritize limited resources.
- Develop comprehensive and inclusive strategies and projects.
- Focus on action – deliver on solutions that benefit Okanagan residents.
- Assess process and outcomes and be held to the highest level of accountability.

There are no external "saviours" who will solve our water resource management problems for us. The assessment, development, and implementation of Okanagan water solutions is critical as we take responsibility for our own collective future.

Water governance in the Okanagan must include a number of core components to plan and undertake strategic actions that best serve the environment, Okanagan citizens, and our economy. Existing water governance institutions, especially those at local, regional, and provincial levels, need to be more fully integrated. The OBWB is uniquely positioned to play a leading role within an integrated multi-level governance system. Basin-wide water governance was a central recommendation of the 1974 Okanagan Basin Study and the need to address climate change and growth management issues on a Basin-wide basis is the subject of ongoing consultation and study.

In this context, we use the term *regional* to refer to the entire Okanagan Basin (bridging individual regional districts).

The following recommendations outline the foundation of an optimal governance model:

1. Vision: There must be a common vision with recognition of the interdependence of Okanagan communities and their shared water resource.
2. Scale: OBWB or any other regional governance institution should focus on areas that do not duplicate the efforts of local government and have distinct regional benefits. Matters influencing only a portion of the Basin should be addressed by authorities at that level.
3. Geographic Scope: Watersheds at the scale of the Okanagan Basin are the optimal unit for managing water resources.
4. Authority: The regional institution needs unambiguous delegated authority to deliver regional services and make decisions for the greater public good. This will take a measure of independence from sub-basin institutions, local governments and the Province, but require their extensive involvement and partnerships. Without autonomy and authority, the institution is limited to planning and advisory body functions.
5. Representation: Equitable representation and balanced interests are critical for well-functioning institutions; however, these mean different things to urban and rural residents. Weighted voting is not desirable for policy

making with true Basin-wide significance because urban and non-aboriginal interests dominate and because it perpetuates competition between communities.

6. Stakeholder Involvement: Ensuring key partners and stakeholders are involved in the development of water policy is crucial. The expanded OBWB, including appointed representatives of strategic partners, and the convening of the Okanagan Water Stewardship Council has provided essential contributions to the governance process.
7. Resources: The governance institution is meant to reduce costs over the long-term through better planning and increased efficiencies. It must be able to generate sufficient funds to function effectively, but not produce an undue financial burden on local taxpayers – this means the institution must have access to revenue sources in addition to property taxes.
8. Board Structure: The regional institution must be small and agile enough to make decisions in an environment of rapid short term changes and decisions that have long-term implications. Directors must come to the table to represent the best interests of the Okanagan commons rather than jurisdictional interests. Effective water governance must include involvement by Okanagan Indian Bands and First Nations.

Given the priorities listed in this Sustainable Water Strategy, and the need to develop formal plans to specify inter-regional infrastructure and policy development, two additional factors are paramount for sustainable, Basin-wide water management:

- Commitment by local governments for long-term ongoing participation – financial, political and through policy setting – in the inter-regional governance process; and
- Commitment by aboriginal peoples and senior governments to participate as full partners – recognizing and respecting local priorities, meeting regulatory obligations, and providing sufficient funding and other resources to support the process.

Water is too important to not be proactive in our understanding of best practices and good science. Our semi-arid climate demands that we act as leaders for water management and policy in British Columbia and Canada.

4.1.2.1 Water governance mandate

Principle 8
Think and act like a region.
Local decisions must consider watershed and aquifer interconnections with the larger Basin. Work towards a governance system that integrates existing institutions from the sub-basin level to the Basin as a whole, and provincial and federal governments. Specific types of decisions are appropriate at each level of this nested system of governance institutions and a reasonable balance of authority must be achieved.

Some water sustainability challenges are best addressed at the local scale. For example, drinking water treatment and delivery systems are best managed by individual utilities. Truly regional activities are those that are difficult or impossible for an independent local government to lead because they are outside its mandate; or those actions where a Basin-wide approach greatly increases efficiency. Source protection and other issues related to water pollution are regional (i.e., Basin-wide) by nature because the receiving bodies – our lakes, rivers, and groundwater – link all communities in the watershed.

A regional water governance institution is ideal for conflict resolution, enhanced communication, and harmonizing and making more equitable and uniform policies among jurisdictions – whether local government or improvement districts. Many of the critical tasks laid out in this Strategy require a focused governance structure that can form strong partnerships with local stakeholders and senior governments. Given the uncertainties associated with climate change, population growth, economic cycles and demographic shifts, water governance must build flexibility and resiliency into water management systems.

The most direct and easy to implement focus areas for Basin-wide governance include:

- Increasing local influence in decisions made by the Province by having one voice for Basin-wide water issues;
- Increasing local capacity with financial leveraging for water management, water planning, and infrastructure grant programs;
- Improving local decision-making by coordinating or sponsoring Basin-scale water science and monitoring, and managing water information systems;
- Coordinating and informing harmonized water policies and bylaws to support greater equity and compliance;
- Developing Water Use Plans, on both sub-basin and Basin scales, to reduce user conflicts during shortages; and
- Developing a Basin-wide Water Management Plan (or Plans) for groundwater protection, increasing source protection powers, or to institute linked drought response plans.

The OBWB's current mandate allows for most of these functions. Other water governance activities require changes in legislation and delegated authority. Some proposals that have recently been put forward for expanded water governance mandates include:

- Approval authority for crown-land dispositions,
- Monitoring and enforcement of activities in sub-basins,
- Decision-making for allocation of new water licences,
- Management of surface and/or groundwater licences,
- Establishing a water dispute resolution panel, and
- Ability to assess or administer alternative funding mechanisms such as volume-based fees on water usage, water licence rentals, fees on specific recreational activities such as power boat rentals, or local sales taxes.

There are pros and cons for each of these activities with delegated authority. When the province transfers power to local government, they transfer at least a portion of operational costs for the program also known as "downloading"). Downloaded costs can be defrayed if the water governance institution is granted access to alternative funding mechanisms, but these also have an administrative cost. With the exception of groundwater legislation, the Province and Government of Canada already have statutory capacity to effectively manage water resources in the Okanagan Basin. The question is whether the resource can be better managed at a regional scale. New activities should only be undertaken if there is a compelling local benefit, cost savings, risk abatement, or funding support.

Many of the activities proposed under an expanded mandate have regulatory aspects. It is challenging for a local government agency to function both as a regulator (holding the stick) and a catalyst for collaboration and partnerships (offering carrots). Political goodwill may be better maintained at a local level when senior governments enforce provincial or federal standards and policies at arm's length. If there is an actual or perceived gap in regulatory enforcement (e.g., for watershed protection) or conflicting priorities (e.g., gravel mining near water sources) it is tempting for local governments to seek more authority and tackle problems directly. It is most efficient for provincial agencies to maintain regulatory authority and meet their statutory obligations while working in partnership with local government who can best identify problems and implement solutions on the ground.

Local management of water licences gives more genuine local control over the resource; however, a locally run water-licensing agency may be more susceptible to political influence than the provincial bureaucracy. At this time, the Province only allows groundwater licensing through the water management planning process – which may leave licence administration to local control. Given the interconnection of groundwater and surface water sources, it is poor and ineffective policy to manage this single resource under separate licensing systems. The most efficient and effective governance is for the Province to maintain authority over surface licences and extend its powers to administer groundwater regulation. However, groundwater regulation is such a high priority for the Okanagan Basin; it is possible that a pilot of shared licence administration could be created in partnership between an Okanagan water governance institution and the Province.

Some mechanisms are already in place for dispute resolution and water use conflicts, including the formal development of Water Use Plans (see Section 3.1.3). In addition to supporting development of these plans by local users in individual sub-basins, one role for the water governance institution could be to form a water dispute resolution panel with a clear process for resolving conflicts. Such a process should include support for negotiation between stakeholders, mediation, review and recommendations by outside experts, and finally adjudication or binding arbitration. An example of a model that may provide for a template mechanism is the one used by the BC Farm Industry Board – Appeals and Complaint desk.

The most promising area for expanded water governance authority is for the Province to delegate the power to assess and administer alternative funding mechanisms. Having financial autonomy and a stable local funding source benefits both local and senior governments by allowing local institutions to implement solutions independently, promoting partnerships, building capacity and providing the fiscal means for adaptation to climate change and other forces impacting water quality and supply. The OBWB's success has been based in part on their ability to raise local funds through property tax assessments and distribute them to priority projects in the watershed.

4.2 Summary of management plans discussed in the Strategy

Several water resource management plans have discussed in Chapters 2 and 3 of the Strategy. Table 4-1 provides a summary of the purpose and scope of each plan; the legislation that guides the planning process; who is involved in initiating, approving, and preparing each plan; and how the plans are connected (where applicable). The plans are ordered according to their ease of implementation.

4.3 Collaboration and communication

Collaboration is critical in the Okanagan Basin because of the multi-jurisdictional nature of Okanagan water governance. In a collaborative environment partners work together to identify and solve problems, are open to change, and are willing to negotiate trade-offs and constructive agreements with one another (Figure 4-1). Implementing this Strategy's actions cannot be achieved without collective and cooperative decision-making and partnerships with all sectors of the community. This collaboration must extend beyond the borders of political jurisdictions to ensure physical watershed boundaries are taken into account when making decisions related to water resources.

The move toward integrated watershed management has meant that more attention must be paid to factors beyond the waterbody—how land is used and managed, and what type of vegetation land cover it has. Such an approach requires wider partnerships between governments as well as with landowners, developers, farmers, scientists, homeowners, recreational groups, and other constituents in the watershed. Collective approaches to decision-making ensure that efforts are better coordinated, reducing overlap and duplication. They better reflect the concerns of citizens and reduce conflict between interests.

ACTION 4-1
Support and foster collaboration through partnerships between local and senior governments, scientists, educational institutions, business community leaders, students, aboriginal peoples, and local citizens.
Who: OBWB
Timeframe: ongoing

Figure 4-1
Partnerships have been fundamental to the success of many initiatives in the Basin.

4.3.1 Aboriginal water interests

"Humankind has not woven the web of life. We are but one thread within it. Whatever we do to the web, we do to ourselves. All things are bound together. All things connect. "
- Chief Seattle

Water is woven into the culture of indigenous people. It is necessary for basic survival activities like fishing and agriculture, and is also the foundation of spiritual practices, customs, and traditions (see Story Box 4-1). Aboriginal title, aboriginal rights, and treaty rights to water are recognized, but not well defined, under the Constitution Act of 1982. Indigenous peoples' understanding of their rights and responsibilities (including their jurisdiction to protect waters) is that they are inherent, far broader then Canadian law currently allows, and do not require Canadian legal or political recognition in order to exist (Walkem, 2007).

Table 4-1
Summary of management plans discussed in the Sustainable Water Strategy

	Purpose and Scope	Relevant legislation and/or guidelines	Who initiates?	Who approves?	Main Parties involved
Water Source and System Assessment	• Identify, inventory, and assess the drinking water source for the water supply system, the water supply system, and threats to drinking water that is provided by the system.	• Part 3 of the *Drinking Water Protection Act* • Comprehensive Drinking Water Source to Tap Assessment Guideline	• Drinking Water Officer	• Drinking Water Officer	• Interior Health Authority • Water purveyors
Assessment Response Plan	• Identify measures that may reasonably be taken in order to address identified threats to the drinking water that is provided by the system.	• Part 3 of the *Drinking Water Protection Act* • Comprehensive Drinking Water Source to Tap Assessment Guideline	• Drinking Water Officer	• Drinking Water Officer	• Interior Health Authority • Water purveyors
Source Protection Plan	• Identify areas and activities that could affect the quality, quantity, and timing of flow of the drinking water sources	• Condition on Permit	• Water purveyor, Drinking Water Officer	• Drinking Water Officer	• Interior Health Authority • Water purveyors
Drought Management Plan (DMP)	• Designates trigger conditions for different drought stages and regulatory responses that might be imposed at each stage. • Community specific (i.e., single water utility). • More general than a Water Use Plan (see below) and can be applied in more circumstances with limited hydrologic and reservoir operations studies and without detailed modelling.	• Dealing with Drought Handbook	• Water purveyor or local government	• n/a	• Ministry of Environment • Water Purveyors • Okangan Basin Water Board

	Purpose and Scope	Relevant legislation and/or guidelines	Who initiates?	Who approves?	Main Parties involved
Water Use Plan (WUP)	• Formal, though voluntary and non-binding, agreement for how water will be shared between licensees while still providing adequate flows for fish and wildlife. • Requires system modeling. • Can be developed on a sub-basin or basin level and can be used to augment Drought Management Plans (see above). • Addresses water use during drought and non-drought periods.	• *Water Act* • *Fisheries Act* • Water Use Plan Guidelines	• Comptroller of Water Rights may require a WUP • The licensee may request a WUP process • Other interested parties may make a request for a plan, for consideration by the Comptroller	• Provincial Comptroller of Water Rights	• All water interests who may be affected by the WUP, including, but not limited to, Fisheries and Oceans Canada, provincial agencies, First Nations, and water licensees
Well Protection Plan	• Identify areas and activities that could affect the quality, quantity, and timing of flow of the drinking water sources	• Part 3 of the *Drinking Water Protection Act* • Well Protection Toolkit	• Drinking Water Officer can require as part of a water source or system assessment plan (see above)	• n/a	• Water purveyors • Local government
Drinking Water Protection Plan (DWPP)	• Provides a long-range land use plan for the watershed(s) that takes into account water quality and quantity issues. • Can be prepared in conjunction with a Water Management Plan (see below).	• Part 5 of the *Drinking Water Protection Act*	• Designated by the Minister of Healthy Living and Sport, by order made on the recommendation of the Provincial Health Officer	• Lieutenant Governor in Council	• Interior Health Authority • Water purveyors
Water Management Plan (WMP)	• Comprehensive and integrated watershed plan intended to be a basis for provincial regulation on water quality, instream flow requirements, and water supply, among other issues.	• Part 4 of the *Water Act*	• Designated by the Minister of the Environment	• Lieutenant Governor in Council	• Ministry of Environment • Local government • Fisheries and Oceans Canada • Other water interests

STORY BOX 4-1
EXCERPTS FROM "THE LAND IS DRY" BY ARDETH WALKEM (IN EAU CANADA: THE FUTURE OF CANADA'S WATER)

Planning for many generations into the future (Seventh Generation Principle)

While newcomer society assesses decisions within a relatively short time frame (i.e., their impact on the present generation and, possibly, on one's grandchildren), indigenous decision making incorporates a broader span of living generations. It acknowledges the equal role and responsibilities of youth and elders and looks far into the future (hundreds of years). Decisions are measured according to their impact that they will have seven generations into the future. And we accept the fact that we have a collective responsibility to pass to those that will come after us the same abundance that was passed on to us. We also accept that we have a responsibility to guard the future ability of the lands and waters to live and to sustain life.

Environmental justice: Learning to say "no"

Indigenous peoples recognize that they have a responsibility to consider how their actions will affect other life forms. We must not simply make decisions on the basis of our own immediate self-interest; rather, we have an obligation to preserve the integrity and intrinsic value of the water that gave us and our ancestors' life. We cannot cast them aside for our immediate benefit. It is fairly uncommon (at least from an indigenous point of view) for newcomers societies to say "no" to developments, even when their environmental impacts will be great. If we are to protect water into the future – for all life – then we need to recognize that we have a responsibility to say "no," that we need to speak for the waters, the land, and for all those life forms with which we share ecosystems. Environmental justice requires a commitment to honouring all of our living relations and measuring the impacts of our decisions not only on humans or immediate generations but also on the present and future generations of all life forms.

Three groups share responsibility for providing water services to aboriginal communities: Band councils, Indian and Northern Affairs Canada (INAC), and Health Canada. INAC provides financial assistance for water facilities. Health Canada works in partnership with communities to ensure water quality monitoring programs are in place, trains water quality monitors, and provides community-based education on water issues. Band councils are responsible for ensuring that drinking water systems are run in accordance with the *Protocol for Safe Drinking Water in First Nations Communities* (developed by INAC). Band councils are also responsible for implementing drinking water monitoring programs on reserves.

Treaties and agreements with First Nations have three parties represented at each negotiation table: First Nations, the BC Ministry of Aboriginal Relations and Reconciliation, and INAC. The negotiation process is facilitated by the British Columbia Treaty Commission – an impartial body consisting of a chair, or chief commissioner, and four commissioners, of whom two are appointed by the First Nations Summit, and one each by the federal and provincial governments. Treaty rights vary in scope from one treaty to the next (BC Ministry of Aboriginal Relations and Reconciliation, 2008). Treaties already ratified in British Columbia have extensive sections on water, covering reservation for domestic, agricultural, and industrial uses of water, law-making regarding water, water licences, the sale of water, flood protection, water management, power reservation, and groundwater. In all Final Agreements, the Province retains full ownership and regulatory authority over water and existing water licences remain in place.

Four bands hold lands in the Okanagan watershed: the Okanagan Indian Band, Westbank First Nation, the Penticton Indian Band, and the Osoyoos Indian Band. Together with the Upper Nicola, Lower and Upper Similkameen Indian Bands, they form the Okanagan Nation Alliance. To date, the Westbank

First Nation is the only Okanagan band that has entered the treaty process. In the absence of treaties, there are great uncertainties regarding future claims to land and water in the Basin. Where an Indian Reserve allotment does not explicitly include water, it is understood to include a sufficient supply of water for full and beneficial use of the land, including economic purposes (Walkem, 2007). Aboriginal peoples in the Okanagan will increasingly quantify and demand their water rights as drought frequency and competition for water increases. Establishing these claims in a timely manner is essential to accurately plan for the future of water governance in the Basin.

It is beyond the scope of this Strategy to provide recommendations for resolving land and water ownership issues between aboriginal peoples and the provincial and federal governments. As information-sharing with local government is not likely to interfere with the Okanagan Nation's negotiations with senior government, there is potential for progress on a grass-roots community basis. Partnerships and active dialogue between non-aboriginal water managers and aboriginal peoples are essential for sustainable water management in the Basin. It is in the best interest of local governments to help meet staff and capacity needs of the Okanagan Nation Alliance natural resource departments. Such support will accelerate resolution of outstanding questions about anticipated water demand on Okanagan reserves.

ACTION 4-2

Partner with aboriginal people in the development of Basin water management strategies.

Who: OBWB, local and senior governments, water purveyors

Timeframe: ongoing

4.3.2 Communication to improve source protection

Poor or non-existent communication between levels of government constrains source water protection in the Okanagan Basin (Patrick, Kreutzwiser, & de Loe, 2008). For example, the impact of land use proposals on drinking water quality is typically a secondary consideration for those making land use decisions. There is no formal process to refer land use proposals to local authorities for comment. When referrals are forwarded, a water supplier's comments are often given equal weight with comments from local interest groups, clubs, and other non-provincial agencies. With no direct authority over Crown land use, water suppliers rely on the Interior Health Authority and the Ministry of Environment to fulfill their mandates to protect water quality. Yet, the same water supplier is given responsibility and held accountable for providing potable water to its customers.

In October 2006, a process for agencies to communicate at a strategic level regarding jurisdiction about drinking water protection was formalized through a Memorandum of Understanding (MOU) between several provincial ministries and health authorities. The MOU commits to the establishment of regional drinking water teams with agency representatives and local governments that wish to participate (Section 3.1 of the MOU). The MOU suggests a template for regional protocols and gives examples of key statutory decisions for which interagency coordination may be appropriate. Although their participation is established by the MOU, local governments have not been invited to participate and are currently represented by the BC Ministry of Community Development. Adding the OBWB or the new Okanagan governance institution as a member of the drinking water team would improve the communication between the provincial ministries, local purveyors and water managers.

ACTION 4-3
Obtain local government representation on the Southern Interior Regional Drinking Water Team established under the Inter-agency Accountability and Coordination on Drinking Water Protection Memorandum of Understanding.
Who: OBWB and local governments
Timeframe: 1-2 years

4.4 Good science to inform policy

Principle 9
Collect and disseminate scientific information on Okanagan water.
The best technology and science must be used to inform water management decision-making. Information must be managed in an integrated manner such that it is readily available to stakeholders Basin-wide.

The Okanagan has greatly benefited over the years from the attention of Federal, Provincial, and academic researchers. The extensive work conducted through the 1974 Okanagan Basin Study set national standards for science-based water policy development and created a solid baseline for all subsequent research. The Okanagan continues to be a centre for water science in Western Canada, and presents great opportunities for establishing best water management practices.

Since the Okanagan is seen as the "canary in the coal mine" for climate change impacts in Canada, research interest has accelerated. Canadian departments of Agriculture and Agrifood, Environment, Natural Resources, and Fisheries and Oceans, as well as the BC Ministries of Environment, and Agriculture and Lands all have substantial ongoing programs related to water science in the valley. The Pacific Agri-Food Research Centre in Summerland has been in operation since the 1930s. Academic research from UBC – Vancouver, Simon Fraser, University of Victoria, Okanagan College, and Okanagan University College (now UBC-Okanagan) contributes substantial funding and in-kind contributions to our knowledge of Okanagan water resources.

Together, this work generates large quantities of technical and planning information for water resources in the Okanagan Basin. The challenge is that much of the data are collected for different site-specific (not Basin-wide) purposes, and some is historical, discontinuous, or collected in a form that is not useful for current studies or modeling. Many of the action items in this Strategy require the support of specific data collected on a Basin-wide, long-term basis. Of particular importance are ecosystem mapping (Section 2.4.1), long-term water quality monitoring (Section 2.4.2), surface water flow monitoring (Section 3.5.1), evaporation and evapotranspiration (Section 3.5.2), and groundwater supply and demand data (Section 3.5.3).

Figure 4-2
Collecting climate data.

Figure 4-3
Collecting Foreshore Inventory Mapping data.

4.4.1 Okanagan Basin Information Network

The 1974 Okanagan Basin Study recommended establishing a central clearinghouse for water-related information and data. Several later reports also made this recommendation. Even though the concept of a central database is well acknowledged, a single repository for data and studies related to water has not yet been developed.

An Okanagan Basin Information Network (OBIN) would be valuable for providing central access to existing and future data, technical reports, management plans, research, and geographic information related to water and land use planning, surface and ground water quality and quantity, and aquatic and terrestrial ecology in the Basin. The Okanagan community's ability to understand current issues as well as the ability to predict future trends will be greatly enhanced by the OBIN. In particular, integrated watershed information helps establish how processes and activities in one part of the watershed may impact other areas. The OBIN should include a listing and description of ongoing management activities, technical studies, and other water initiatives in the Basin in order to foster partnerships and reduce duplication of efforts.

The OBIN would also work to integrate and collaborate with existing data management programs including the Community Mapping Network (www.shim.bc.ca), spOKe (sustainable planning for the Okanagan environment), and potentially GIS from local government sources. The Community Mapping Network integrates resource information, base maps, and imagery from many sources and makes it accessible over the Internet. SpOKe is an information portal, managed by Environment Canada, that facilitates sharing and access to watershed-scale land and water information from distributed sources in the Okanagan Basin

The OBIN will also integrate the large water science data sets and modeling systems being created through the Okanagan Water Supply and Demand Project, including the Okanagan Water Balance Model and the massive Irrigation Water Demand Model – a GIS system that maps and models the water demand for all irrigated land parcels in the Okanagan watershed. Related projects, like the Okanagan Irrigation Management system (see Section 3.3.2) that relates irrigation demand to metered water use would also be incorporated.

Benefits of an OBIN include the ability to:

- Reduce costs to local governments,
- Generate and apply information,
- Support improved decision making,
- Encourage exploration of water resources options,
- Enhance effective water management,
- Allow for the better understanding of economic and environmental trade-offs, and
- Allow for the generation of future scenarios.

The OBIN actively managed by the OBWB or a future water governance institution would constitute a new service, providing valuable information to water managers in a timely manner. The OBWB would work in conjunction with public and private organizations to conduct an initial user needs assessment, establish data quality standards, identify priority gaps, and establish a long-term funding plan. The success of the OBIN will depend upon a collaborative approach, sustained funding, and a data management champion.

ACTION 4-4
Create a new service provided by the OBWB called the Okanagan Basin Information Network (OBIN) to support good water management and governance. Ensure the OBIN is sufficiently resourced with trained staff and secure funding.
Who: OBWB
Timeframe: 1 years

4.4.2 Post-secondary programs and research

Post-secondary education programs support water sustainability in many ways. Along with providing independent expertise on water issues, they attract and train the next generation of water resource professionals to the valley. The Okanagan has two strong post secondary institution programs focused on water in the Okanagan: the UBC Okanagan Freshwater Science program and the Okanagan College Water Quality Technologist program.

The UBC Okanagan Freshwater Science (B.Sc.) program prepares students for careers related to inland aquatic ecosystems. The program integrates and synthesizes aquatic biology, chemistry, geography and earth and environmental sciences. Students study water quality and quantity, aquatic organisms, and the health of aquatic ecosystems.

Okanagan College offers one of the leading water quality technology programs in Western Canada. This program provides Operator training in the design, use, and maintenance of water systems and wastewater and waste disposal facilities, and environmental monitoring. The analysis, distribution, and treatment of water and wastewater as required by municipalities, water-use industries, and environmental monitoring agencies are an integral part of the program.

The Okanagan Sustainability Institute (OSI) at UBC Okanagan is an interdisciplinary, inter-Faculty institute dedicated to basic and applied research, scholarship, and creative works relevant to issues of long-term sustainability in the Okanagan region and beyond (UBC Okanagan, 2008). OSI membership extends across the University, including interested and actively engaged faculty and staff extending from Engineering through the Arts and Sciences to Creative and Critical Studies. The OSI is also complemented by an array of partnerships that activate and leverage capacity and expertise beyond the University. The objectives of the OSI include the generation of information, knowledge, methods, and processes that assist regions in planning sustainable development while also advancing formal academic knowledge and practice in a broad array of disciplines and professions that inform sustainability.

ACTION 4-5
Identify knowledge gaps and actively encourage collaborative projects and post-secondary programs focused on water research that fills those gaps.
Who: OBWB
Timeframe: ongoing

4.5 Funding for water sustainability

Principle 10
Provide sufficient resources for local water management initiatives.
Sufficient financial resources will be allocated to support better use of supplies of water that we have already developed, to employ new technology and infrastructure, to improve and refine management practices, and to draw on better information.

Managing Okanagan water is one of the great challenges facing us as we move into the future. There are many opportunities to make better use of supplies of water that we have already developed, to employ new technology and infrastructure, to improve and refine management practices, and to draw on better information. These opportunities require a secure funding source.

Long-term stable organizational support is essential for maintaining a functional water management institution such as the OBWB. Increased opportunities to leverage federal, provincial, and other funds for project-based water resource planning, protection, and restoration is also critical. These funding streams do not operate in isolation. Stable operational funds for water governance support staff capacity to bring in external grants, and the OBWB's own grant-making programs often provide seed funds for recipients to further leverage funding.

4.5.1 Alternative funding mechanisms for water governance

The OBWB's success has been based in part on its ability to raise local funds through property tax assessments and distribute them to priority projects in the watershed. However, property taxes only target a portion of the population – leaving out tourists and renters, and placing undue burden on long-time residents with large properties. With provincially delegated authority, there are a range of funding options which are commonly used in other regions and could be applied to the Basin (Janmaat, 2007), including the following.

- Volume-based water use fees, either applied to individuals or water suppliers – the latter would be simpler – target heavy consumers and promote conservation while tying revenues to that which is being governed, water. However, fees must be carefully structured to avoid economic hardship to low-income residents and the agricultural community.

- Water licence rentals are collected by the Ministry of Environment and go to Provincial general revenue. If local government becomes actively involved with licence administration at any level, a portion of these funds should be earmarked for local use. Increasing licence rates based on the size of the licence would serve as an incentive for those with large licences that are not being used to reduce the size of their licence. This, together with a mechanism to adjust the size of a licence downward, would serve to recapture water for other uses and/or for the environment.

- Recreational user fees on power boat or off-road vehicle rentals (for example) target polluting activities by tourists and seasonal residents that do not otherwise contribute to water funding. "Effluent Charges" to other polluting activities or industries are an appropriate source of funding for water quality protection.

- Sales taxes are another option for tying water funding to a broader tax base. The

Province could either directly transfer a percentage of the provincial sales tax, or authorize a separate point-of-sale tax for the Okanagan.

Each funding option has strengths and weaknesses and operational costs. It is best if funding mechanisms can also be structured to support behavioural outcomes like increased water conservation. More work is needed to identify the optimal mix of funding mechanisms for the Okanagan Basin.

ACTION 4-6
Undertake an economic analysis of appropriate funding mechanisms to support Okanagan water governance base funding.
Who: OBWB and UBC-Okanagan
Timeframe: ongoing

4.5.2 Okanagan Water Fund for grant leveraging

Grant leveraging is the process of using one source of dollars to attract and match funds from other sources. The OBWB currently has two successful programs that use local tax dollars to support water conservation and water quality in the valley. The Sewage Facilities grant program has distributed millions of dollars to local governments for upgrading sewage treatment plants and community sewer systems. These funds have allowed Okanagan communities to leverage more provincial infrastructure dollars than any other area in British Columbia. The OBWB Water Conservation and Quality Improvement grants program provides seed funds of $3,000 - $30,000 to projects by local governments, improvement districts and non-profit organizations, and leveraged substantial external funds from other agencies and organizations. The OBWB maintains an updated list of funding organizations that have the capacity to support water management projects in the Okanagan.

A new Okanagan Water Fund would expand local capacity to undertake focused initiatives that support sustainable water management beyond these grant programs. Rather than relying solely on property taxes, the fund would also be a landing pad for private donations and would match dollars from senior government project funds. Without local matching grants, many excellent initiatives may miss external funding opportunities. The proposed Okanagan Water Fund aims to accelerate the development and uptake of water management tools, smart technologies, and best water use practices in the Okanagan.

ACTION 4-7
Create an Okanagan Water Fund. Develop external and internal partners to leverage funding opportunities. Link the distribution of funds to strategic Okanagan water management goals and objectives.
Who: OBWB and Provincial Government
Timeframe: ongoing

4.6 Community engagement

Principle 11: Encourage active public consultation, education, and participation in water management decisions.
Transparent decision-making processes and opportunities for information sharing and open communication are essential to a collective understanding and acceptance that we are part of the environment and our activities have implications on clean available water. A culture of accountability needs to inform everything from high level planning to individual perceptions and patterns of consumption.

Community engagement is the process of involving people in decisions that affect them. It encompasses a variety of activities from consultations with the public to education and outreach, community development and capacity building. Community engagement goes beyond making information available or gathering opinions and attitudes. It entails an active exchange of information and viewpoints between the sponsoring organization and the public.

Effective community engagement programs provide a method for identifying public concerns and values, developing consensus among affected parties, and producing solutions through an open, inclusive process. They generally enhance the likelihood of success of water management initiatives by changing people's understanding, behaviours, and actions towards environmental sustainability, water conservation, and healthy watersheds. Informed citizens then support decision makers to create sustainable water policies.

This Strategy supports the premise that we are all connected in the Basin and share the water resource; therefore, decisions and actions made in one part of the Basin have impacts throughout the watershed. Most existing, education and outreach initiatives in the Basin are designed and implemented within jurisdictional boundaries and focus on area-specific issues. Basin-wide community engagement is also needed to inform citizens about integrated processes and interdependencies at the scale of the Okanagan valley.

One engagement strategy could be modeled after campaigns that carry a simple, but effective message, such as the "seatbelts save lives" campaign. A simple message like "Value your water" can have different meanings based on the context – whether it be drinking water, recreation, irrigation, planning, water conservation, or protecting the environment – and could be effective in all of these cases.

The success of this strategy depends on the extent to which we plan and implement services in an open, transparent, and accountable manner based on broad consultation, citizen engagement, and consensus on the need to practice sustainability.

ACTION 4-8
Develop a Basin-wide community engagement strategy highlighting water conservation and pollution prevention.
Who: local and senior governments, OBWB
Timeframe: 2-5 years

4.7 Monitoring, reviewing, and reporting on the Strategy

Principle 12
Practice adaptive water and land management.
Continuous learning, innovation, and improvement are essential to effective and efficient implementation of the Sustainable Water Strategy. An ongoing monitoring and reporting program will be developed for the Strategy. In addition, a comprehensive review of the Strategy will be conducted every five to seven years.

Water resources management is a complex process undertaken in a changing environment with continuously developing knowledge. The Strategy is based on the best available information at the time of preparation. The Strategy must be adaptive and flexible in order to respond to external factors such as actual population growth patterns and climate change. Developments in the science of water resource management will also make refinements necessary. The Strategy is meant to be a living document that will change with time under the principle of adaptive management.

To fill knowledge gaps identified in the Strategy and to ensure that actions taken to manage water in the Basin are effective and efficient, a monitoring program or "report card" should be developed and administered to track physical parameters (e.g., evaporation and evapotranspiration) and human decisions and actions (e.g., changes in water use patterns, effects of land use planning decisions on water use).

ACTION 4-9
Develop reporting tools that incorporate benchmarking and result-oriented focus to support the measuring, tracking, management, and accountability of water resources in the Okanagan.
Who: OBWB
Timeframe: ongoing

The Okanagan Sustainable Water Strategy should be reviewed every five to seven years to ensure it is adaptable over the long-term. This regular review will be used to manage uncertainties and allow new knowledge to be incorporated as it emerges. A robust review process will be as important as the existence and implementation of the Strategy.

ACTION 4-10
Recognize the importance of continuous reassessment and improvement of the Sustainable Water Strategy and use adaptive management to ensure the Strategy remains current.
Who: OBWB
Timeframe: ongoing

4.8 Summary

More than thirty-five Acts, Regulations, and policies indirectly or directly govern water and aquatic and riparian ecosystems in the Basin. Collaboration must extend beyond the borders of political jurisdictions to ensure physical watershed boundaries are taken into account when making decisions related to water resources.

Current water governance and management structures will be tested in the future as climate change and a growing population puts pressure on water quality and supply. Thinking and acting like a region and taking a proactive instead of a reactive approach are crucial components of effective water governance. Many of the critical tasks laid out in this Strategy require a focused governance structure that can form strong partnerships with local stakeholders and provincial and senior governments. A regional water governance institution is well suited for conflict resolution, enhanced communication, and harmonizing and making more equitable and uniform policies among jurisdictions.

Implementation of the Okanagan Sustainable Water Strategy cannot be achieved without collective and cooperative decision-making and partnerships with all sectors of the community. Sustainable water management requires wider partnerships between governments as well as with landowners, developers, farmers, scientists, homeowners, recreational groups, and other constituents in the watershed.

Partnerships and active dialogue between non-aboriginal water managers and aboriginal peoples are essential for sustainable water management in the Basin. Aboriginal peoples have a wealth of knowledge regarding the land and water in the Okanagan Basin. Aboriginal title, aboriginal rights, and treaty rights to water are recognized, but not well defined, under the Constitution Act of 1982. In the absence of treaties, there are great uncertainties regarding future claims to land and water by Aboriginal peoples in the Basin.

Large quantities of technical and planning information are available for water resources in the Okanagan Basin. The challenge is that much of the data are collected for site-specific (not Basin-wide) purposes, and some are historical, discontinuous, or collected in a form that is not useful for current studies or modeling. Many of the action items in this Strategy require the support of specific data collected on a Basin-wide, long-term basis. Of particular importance are ecosystem mapping, long-term water quality monitoring, surface water flow monitoring, evaporation and evapotranspiration, and groundwater supply and demand data.

In addition, access to information is hindered because isolated databases are housed at many locations, and different databases contain fundamentally distinct and somewhat incongruous elements. There is a pressing need to develop an Okanagan Basin Information Network (OBIN) that provides central access to existing and future data, technical reports, management plans, research, and geographic information related to water and land use planning in the Basin. The OBIN would be actively managed by the OBWB or a future water governance institution.

Long-term stable organizational support is essential for maintaining a functional water management institution such as the OBWB. There are a range of options available to support the water governance, including volume-based water use fees, water licence rentals, recreational user fees, and sales taxes. Each funding option has strengths and weaknesses and operational costs. An economic analysis is required to identify the optimal mix of funding mechanisms for the Okanagan Basin.

A new Okanagan Water Fund would expand local capacity to undertake focused initiatives that support sustainable water management beyond the current grant programs provided by the OBWB. Rather than relying solely on property taxes, the Water Fund would also be a landing pad for private donations and would match dollars from senior government project funds. The proposed Water Fund aims to accelerate the development and uptake of water management tools, smart technologies, and best water use practices in the Okanagan.

The success of this Strategy depends on the extent to which services are planned and implemented in an open, transparent, and accountable manner based on broad consultation, citizen engagement, and consensus on the need to practice sustainability. This Strategy supports the premise that everything is connected in the Basin and shares the water resource; therefore, decisions and actions made in one part of the Basin have impacts throughout the watershed. A Basin-wide community engagement strategy is needed to inform citizens about integrated processes and interdependencies at the scale of the Okanagan valley.

The Sustainable Water Strategy is meant to be a living document that will change with time under the principle of adaptive management. Monitoring and reporting tools that incorporate benchmarking and a results-oriented focus need to be developed to support the measuring, tracking, management, and accountability of water resources in the Okanagan. Continuous reassessment (every five to seven years) and improvement of the Strategy will be conducted in order to manage uncertainties and allow new knowledge to be incorporated as it emerges.

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6.0 GLOSSARY

Aquifer	A natural underground layer of porous, water-bearing materials (sand, gravel) usually capable of yielding a large amount or supply of water.
Basin	A region drained by a single river system.
Conservation flow	The streamflow required to maintain appropriate environmental conditions in a waterway.
Comprehensive Source to Tap drinking water assessment	A structured and consistent approach to identifying, evaluating, and managing risks to drinking water. Initiated by the Drinking Water Officer under Part 3 of the *Drinking Water Protection Act*.
Consumptive use	Water removed from available supplies without direct return to a water resource system for uses such as manufacturing, agriculture, and food preparation.
Contaminant	Any physical, chemical, biological, or radiological substance or matter that has an adverse effect on air, water, or soil.
Contamination	The introduction into water of microorganisms, chemicals, toxic substances, wastes, or wastewater in a concentration that makes the water unfit for its next intended use.
Domestic purpose	As per the *Water Act*, the use of water for household requirements, sanitation and fire prevention, the watering of domestic animals and poultry and the irrigation of a garden not exceeding 1,012 m2 adjoining and occupied with a dwelling house.
Drainage basin	The area of land that drains water, sediment, and dissolved materials to a common outlet at some point along a stream channel.
Drinking water	Water that has been treated to provincial standards and is fit for human consumption.
Drinking Water Protection Plan	A long-range land use plan for watershed(s) that takes into account water quality and quantity issues. Designated by the Minister of Health under Part 5 of the *Drinking Water Protection Act* and approved by the Lieutenant Governor in Council.
Drought Management Plan (DMP)	A community specific plan that designates trigger conditions for different drought stages and regulatory responses that may be imposed at each stage.
Ecosystem	A dynamic complex of plant, animal, fungal, and micro-organism communities and the associated non-living environment functioning as an ecological unit.
Ecosystem services	The processes and conditions by which natural ecosystems sustain and fulfill human life. Services such as clean air, water cycling and purification, nutrient cycling, soil formation, biomass production, waste disposal, crop pollination, provision of food and minerals, and the maintenance of genetic diversity result from functioning ecosystems.
Effluent	Treated liquid waste that is discharged out of a sewage treatment plant.
Environmental baseflow	The component of stream flow supplied by groundwater discharge.
Endocrine disrupting chemicals (EDCs)	Naturally occurring compounds or man-made chemicals that may interfere with the production or activity of hormones of the endocrine system leading to adverse health effects. Often discussed in combination with pharmaceuticals and personal care products (PPCPs).

Environmental water reserve (EWR)	The share of water resources allocated to maintain the environmental values of a water system and other water services which are dependent on the environmental condition of the system. EWRs are a marriage of minimum conservation flows and the storage needed to maintain them.
Evaporation	The process by which water or other liquid becomes a gas (water vapour or ammonia vapour). Water from land areas, bodies of water, and all other moist surfaces is absorbed into the atmosphere as a vapor.
Evapotranspiration	The combined processes of evaporation and transpiration. It can be defined as the sum of water used by vegetation and water lost by evaporation.
Fish habitat	The areas in and around a stream, such as spawning grounds and nursery, rearing, food supply and migration areas, on which fish depend directly or indirectly in order to carry out their life processes.
First-in-time, first-in-right	The principle used to prioritize water rights in British Columbia. This principle means that water rights are prioritized according to how senior the licence is, regardless of its use. The older the licence, the higher the user is on the priority list.
Floodplain	Lands which are subject to overflow during floods. Often valuable for their ecological assets.
Groundwater	All subsurface water, generally occupying the pores and crevices of rock and soil. Groundwater originates from rainfall or snowmelt that penetrates the layer of soil just below the surface.
Habitat	The term used to describe the natural home of living organisms. The three components of wildlife habitat are food, shelter, and water.
Hydrologic cycle	Movement or exchange of water between the atmosphere and the earth.
Improvement district	Either the public corporate body or the tract of land incorporated under the *Local Government Act* and includes an improvement district constituted under a former Act.
Irrigation purpose	As per the *Water Act*, the beneficial use of water on cultivated land and hay meadows to nourish crops.
Non-consumptive use	A use of water in which all of the water used is directly returned to the source from which it came.
Non-point source pollution	Pollution that cannot be identified as originating from one site. This type of pollution comes from a larger area of land and is carried by runoff and groundwater.
Pharmaceuticals and personal care products (PPCPs)	Any product used by individuals for personal health or cosmetic reasons or used by agribusiness to enhance growth or health of livestock. PPCPs comprise a diverse collection of thousands of chemical substances, including prescription and over-the-counter therapeutic drugs, veterinary drugs, fragrances, and cosmetics. Often discussed in combination with endocrine disrupting chemicals (EDCs).
Point source pollution	Pollution that originates from identifiable cause or location, such as a sewage treatment plant.
Potable water	Water that is fit for human consumption, but has not been treated.

Recharge	Process by which rain water (precipitation) seeps into the ground-water system.
Recharge area	Generally, an area that is connected with the underground aquifer(s) by a highly porous soil or rock layer. Water entering a recharge area may travel for miles underground.
Recharge rate	The quantity of water per unit time that replenishes or refills an aquifer.
Reservoir	Any natural or artificial holding area used to store; regulate, or control water.
Riparian area	The area along streams, lakes, and wetlands where water and land interact. These areas support plants and animals, and protect aquatic ecosystems by filtering out sediments and nutrients originating from upland reservoirs.
Runoff	Water that moves over the surface of the ground. Runoff collects sediment and contaminants as it moves from higher elevations to lower elevations.
Septic system	An onsite system designed to treat and dispose of domestic sewage; a typical septic system consists of a tank that receives wastes from a residence or business and a system of tile lines or a pit for disposal of the liquid effluent that remains after decomposition of the solids by bacteria in the tank.
Sewage	The waterborne wastes from a community.
Sewerage	A physical arrangement of pipes and plant for the collection, removal, treatment, and disposal of sewage.
Stormwater	Runoff from urban areas.
Sub-basin	Smaller scale basins within a larger basin.
Surface water	All bodies of water on the surface of the earth. Streams, rivers, lakes, wetlands, or oceans are examples of surface water.
Wastewater	The used water and solids from a community (including used water from industrial processes) that flow to a treatment plant. Stormwater, surface water, and groundwater infiltration also may be included in the wastewater that enters a wastewater treatment plant. The term sewage usually refers to household wastes, but this word is being replaced by the term wastewater.
Wastewater treatment plant	A facility that receives wastewaters (and sometimes runoff) from domestic and/or industrial sources, and by a combination of physical, chemical, and biological processes reduces (treats) the wastewaters to less harmful byproducts.
Water allocation	The diversion of water from surface or groundwater sources to distribute or allot to a specific purpose.
Water budget	A summation of inputs, outputs, and net changes to a particular water resource system over a fixed period. (Also, water balance model).
Water conservation	Improved water management practices that reduce or enhance the beneficial use of water.
Water efficiency	A tool of water conservation that focuses on reducing waste, but not necessarily restricting use, and emphasises the influence consumers can have in water efficiency by making small behavioural changes.

Water licence	The authority to divert and use surface water in accordance with the statutory requirements of the *Water Act* and the *Water Protection Act.*
Water Management Plan (WMP)	A comprehensive and integrated watershed regulatory planning tool under Part 4 of the *Water Act.* Intended to be a basis for provincial regulation on surface and groundwater quality, instream flow requirements, and water supply, among other issues.
Water supply system	The collection, treatment, storage, and distribution of potable water from source to consumer.
Water Use Plan (WUP)	Formal, though voluntary and non-binding, agreement for how water will be shared between licensees while providing for adequate flows for fish and wildlife.
Waterworks purpose	As per the *Water Act*, the carriage or supply of water by a municipality, improvement district, development district or person for the use of the residents of an area in British Columbia.
Water well	An opening in the ground, whether drilled or altered from its natural state, that is used for the production of groundwater, obtaining data on groundwater, or recharging an underground formation from which groundwater can be recovered.
Watershed	The area of land that catches precipitation and drains into a larger body of water such as a marsh, stream, river, or lake.
Well Protection Plan	Developed by water purveyors to determine protective measures to manage activities in the capture zone (or recharge area) to reduce the risk of contaminating the well supply.
Wetlands	Permanently or intermittently wet areas, shallow water, and land water margins that support plants and animals that are adapted to wet conditions.

Appendix I: Action focused strategy – management support tool to implement strategic, priority water initiatives.

No.	Recommended Action	Milestone Timelines	Desired Outcome
2-1	Off-stream cattle watering stations	5 Years	Improve water quality – reduce fecal contamination.
2-2	Protect, restore, and enhance riparian and wetland	Ongoing	Improve water quality – invest in our environment and our environment will take care of us.
2-3	Develop a basin wide source protection strategy	3 Years	Coordinated and strategic basin approach to water quality protection.
2-4	Implement well protection toolkit.	7 Years	Protect groundwater quality.
2-5	Implement bylaws and best practices for all geothermal groundwater wells.	2-5 Years	Protect groundwater quality.
2-6	Consider water in community design.	Ongoing	Ensure cost effective and safe supply of water.
2-7	Implement stormwater management plans.	Ongoing	Protect water quality.
2-8	Use best practice local government land-use bylaws to protect local water sources.	2-5 Years	Support local government staff to develop proactive policies to protect water supplies.
2-9	Develop a groundwater bylaws toolkit and harmonize groundwater bylaws.	1 Year	Create increased coordination and efficiencies between local government jurisdictions to protect groundwater.
2-10	Support and coordinate sustainable septic field development along sensitive waterways.	2 Years	Protect water quality.
2-11	Accountability of "Authorized Person".	2 Years	Protect water quality.
2-12	Research emerging health risks identified in other jurisdictions.	Ongoing	Practice good science to support the protection of today's and future water quality.
2-13	Complete appropriate mapping.	5 Years	Ensure that needed information to manage water and ecosystem health is available.
2-14	Create a streamlined on-line data reporting system for water quality and suppliers	1-2 Years	Coordinate water quality information. Ensure needed information is available to support good water management decisions.
3-1	Manage water quantity.	3-5 Years	Coordinate water supply in the Okanagan. Increase efficiencies.
3-2	Establish an Agriculture Water Reserve.	5-7 Years	Ensure that water is available for agriculture.
3-3	Extend the date on irrigation licenses.	1-2 Years	Practice adaptive management to respond to climate change influences affecting agriculture.
3-4	Ensure availability of potable water.	5-7 Years	Equity. Ensure safe supply of water is available for basic human and economic needs.

No.	Recommended Action	Milestone Timelines	Desired Outcome
3-5	Review water licensing.	5-7 Years	Practice pro-active water management. Coordinate and collaborate to resolve drought condition conflicts prior to a drought year.
3-6	Implement drought management plans.	2-3 Years	Support coordination throughout the Okanagan. Develop strategic management tools to support resolving drought condition problems.
3-7	Prepare Water Use Plans for all fish bearing streams	3-5 Years	Plan for drought conditions. Proactively manage water resources.
3-8	Prepare a comprehensive Water Management Plan for the Okanagan Basin	1-3 Years	Proactively manage water resources. Identify priority actions and develop strategic plans to ensure water supply is maximized to support user needs.
3-9	Develop a Regional Water Conservation Strategy	2-3 Years	Reduce redundancy Ensure equity between local governments. Coordinate on drought year management issues.
3-10	Reduce outdoor water use by using Certified Irrigation Designers.	1-2 Years	Minimize water loss to the atmosphere.
3-11	Universal installation of water meters.	5-10 Years	If one doesn't measure it, once can't manage it. Meters provide important information to support best practice water management.
3-12	Conduct a water pricing assessment.	1-2 Years	Equity - ensure everyone, regardless of income level, has access to water.
3-13	Affordable water for agriculture.	5-7 Years	Manage water to support sustainable agriculture.
3-14	Ensure water storage is identified as a strategic and critical component to water management.	2-5 Years	Apply best practices to the planning and management of Okanagan water supplies.
3-15	Change water license structure associated with storage.	2-4 Years.	Equity and fairness.
3-16	Implement policies that support coordinated water storage by utilities.	3-5 Years	Coordinated management of Okanagan water.
3-17	Maintain and expand the network of hydrometric and climate stations.	2-5 Years	Ensure information is available to support the management of Okanagan water supplies.
3-18	Install flow measurement recorders at all reservoir spillways.	2-5 Years	Ensure information is available to support the management of Okanagan water supplies.
3-19	Collect better information on evaporation and evapotranspiration.	1-2 Years	Ensure information is available to support the management of Okanagan water supplies.

No.	Recommended Action	Milestone Timelines	Desired Outcome
3-20	Develop a groundwater regulation pilot program.	1-3 Years	Manage groundwater supply.
3-21	Develop a regional well/borehole. database	1-2 Years	Ensure information is available to manage groundwater supply.
4-1	Support and foster collaboration.	Ongoing	Support coordination of projects. Develop collaborative funding opportunities. Ensure communication channels are open and functioning between multi-jurisdictions.
4-2	Partner with aboriginal people in the development of Basin water strategies.	Ongoing	Develop open and clear communications with senior partners.
4-3	Obtain local government representation on the Southern Interior Regional Drinking Water Team.	1-2 Years	Coordinated local government voice for water management issues.
4-4	Develop an Okanagan Basin Information Network	1 Year	Coordinate water information. Support access to information by water managers, researchers and local governments.
4-5	ID knowledge gaps and support research to strategically fill gaps.	Ongoing	Good management.
4-6	Analyze funding mechanisms to support water governance.	Ongoing	Good management.
4-7	Create an Okanagan water fund.	Ongoing	Ensure identified critical water management projects are funded.
4-8	Develop a Basin-wide community engagement strategy.	2-5 Years	Ensure public is informed and engaged in water management issues, policies and strategic choices.
4-9	Develop water management reporting tools.	Ongoing	Increase accountability, accessibility and transparency.
4-10	Reassess and improve the Sustainable Water Strategy.	Ongoing	Apply adaptive management to strategy development. Ensure strategy is current and informed by current status of water management issues.

Appendix II: Principles and actions for integrated stormwater management

The five guiding principles for integrated stormwater management are:

- **A**gree that stormwater is a resource (for fish and wildlife, water supply, and recreational use)
- **D**esign for the complete spectrum of rainfall events (from small to large storms)
- **A**ct on a priority basis in at-risk drainage catchments
- **P**lan at four scales – regional, watershed, neighbourhood, and site
- **T**est solutions and reduce costs by using adaptive management

The four key types of actions that must all work together to implement integrated stormwater management solutions are:

- **C**apital investment – short-term capital investment will be needed to implement early action in at-risk drainage basins.
- **U**nderstanding science – improved understanding of a watershed, the nature of its problems, and the effectiveness of technical solutions is key to an adaptive approach.
- **R**egulatory change – changes in land use and development regulations are needed to achieve stormwater performance targets and changes to land use planning and site design practices are needed to eliminate the root cause of stormwater related problems.
- **E**ducation and consultation – changes to land use planning and site design practices can only be implemented by building support among city staff, the general public, and the development community through education and consultation.

Appendix III: Principles and actions for integrated stormwater management

Prior to 1859, water in B.C. was governed under the principle of riparian water rights from English Common Law. Landowners living adjacent to a stream or other water body had rights to undiminished and unpolluted flows of water past their property. Water could not be transferred to other land even with the consent of the riparian owner (Percy, 1977). Riparian water law inhibited the development of land distant from good sources of water, and did not provide a way to prioritize water use in dry years—all riparian owners had equal claim to the resource.

The *Gold Fields Act* was passed in 1859 to better address procedures for the appropriation of water and set the tone and direction of water policy in British Columbia to this day. Regulations included who could apply for water privileges, the principle of beneficial use, government regulation of water rates, penalty for waste of water, rights-of-way for construction of works, ensuring of water quality, and priority of access based on priority of appropriation (first in time – first in right). Implementing regulations was difficult as there was no administrative structure to manage the resource.

Between 1892 and 1909 establishment and revisions to the *Water Privileges Act* and *Water Clauses Consolidation Act* strengthened legal and administrative jurisdiction over provincial water. Irrigation law lagged during this time, but as interior orchards grew in the early 1900s, orchardists began to call for new irrigation legislation and better administration of the region's water resources.

In 1909, the provincial government passed a new *Water Act*. Among other important new provisions, the *Act* established water districts with their own water commissioners, and a Board of Investigation to examine and adjudicate water records and issue licences based on priority of appropriation (Wilson, 1989). In 1913, an amendment was added that permitted the incorporation of "Irrigation Communities" to maintain and construct the main works, to appoint a manager, and to levy assessments for expenses.

The first irrigation districts in the Okanagan received letters patent in 1920, shifting the control of irrigation water from private to public hands. These districts included Vernon, Glenmore, Naramata, South East Kelowna, and Black Mountain. Orchardists served by an irrigation district elected a management committee from within their ranks to hire staff and establish the overall policies of the new irrigation district. As more people settled in the Okanagan, residential and recreational land use began to compete with the cooperative family farm culture supported by the 1920 water management system. Balancing water governance and management with new water and land use demands became increasingly complicated.

In 1974, the Okanagan Basin Study conducted a comprehensive review and evaluation of the legal, administrative, and institutional arrangements in the Basin. The Okanagan Basin Study identified the multiplicity of laws and statutes and numerous government agencies involved in their administration as a key limitation to comprehensive Basin-wide planning. Progress has been made since 1974, but the complex patchwork of responsibilities, mandates, and jurisdictions continues to be a major issue.

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"Water is an essential component to the quality of life we share in the Okanagan. It is our lifeblood and soon will become our most treasured resource. A regional water strategy is not just desirable, it is essential to ensuring our most valuable future commodity is managed for the benefit of our children, grandchildren and all those who follow."
Brad Bennett
President, McIntosh Properties

"Agriculture as an industry depends on affordable and adequate water resources. As an agricultural producer I am encouraged by the work of the Council in developing a region wide water management plan. Sustainability is very important if we are to leave a heritage for future generations but is impossible without effective water management planning. We must continue to work on improving our awareness of water management issues and the work of OBWB will be essential in coordinating these efforts."
John Byland
President, Bylands Nurseries

"This regional water strategy is an essential step in rational water management for the present and future of our communities and the ecosystems they depend on. The Water Stewardship Council and Okanagan Basin Water Board have shown commendable leadership in taking-up this important initiative – one that has fallen through jurisdictional cracks for decades."
Dr. Jeff Curtis
Associate Professor, UBC Okanagan

"The Water Stewardship Council has done some impressive work, bringing together a diverse group of community and senior government partners to reach consensus on a vision for water management in the Okanagan. This Okanagan Sustainable Water Strategy is an important decision support tool focused on action – building on the work done previously through the Green Planning for a Sustainable Future and OurOkanagan.ca – this Water Strategy is an important roadmap for future action in the Okanagan."
Honourable D. Ross Fitzpatrick

"Sustainable water supply and quality is important to all living things. This is especially true in the Okanagan where our high quality of life, rapid growth and semi-arid climate converge to make water management a top priority. The Water Stewardship Council is tackling this important issue in an intelligent and thoughtful manner."
Dr. Doug Owram
Deputy Vice Chancellor, UBC Okanagan

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