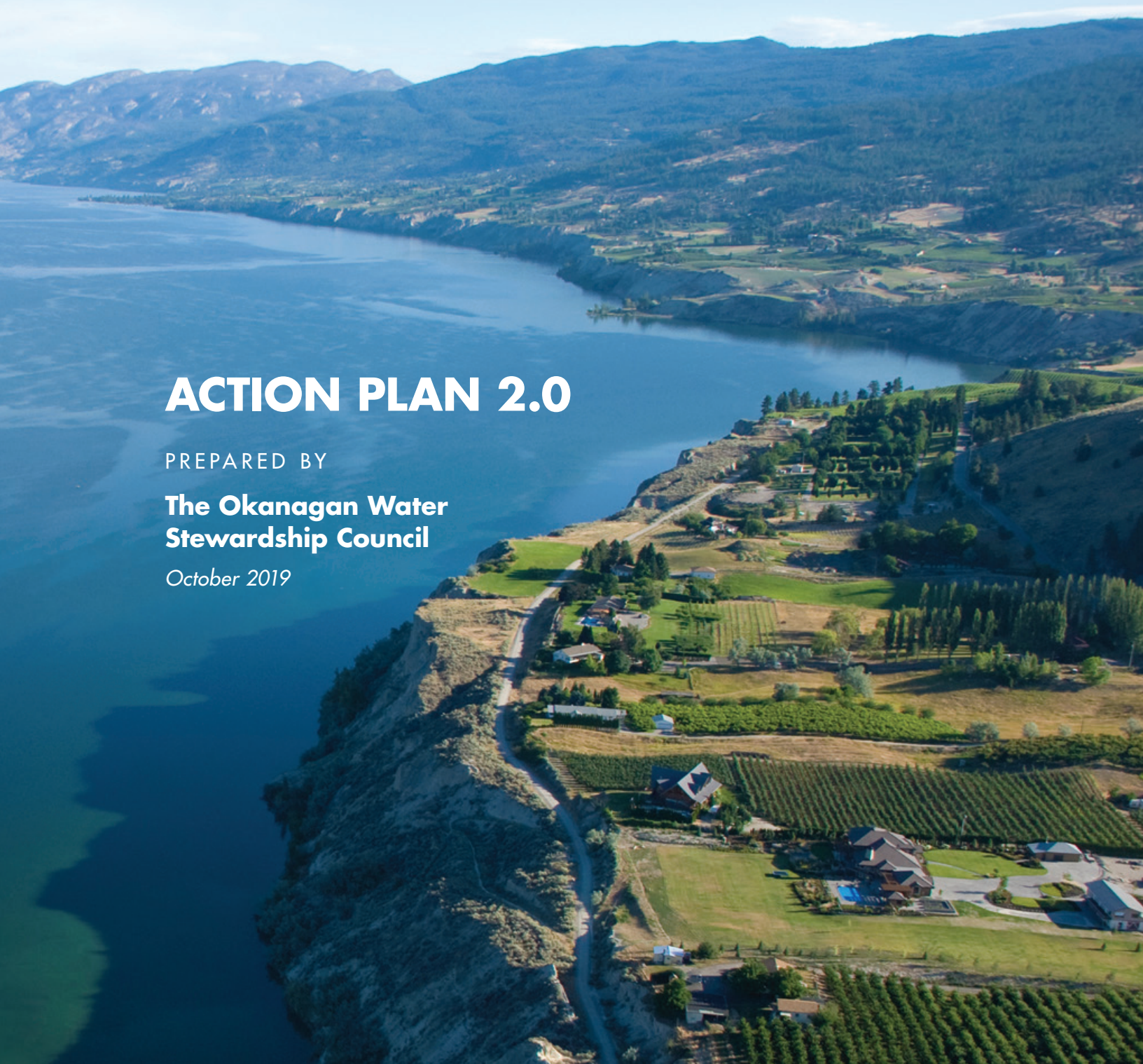
OKANAGAN SUSTAINABLE WATER STRATEGY



ACTION PLAN 2.0

PREPARED BY

The Okanagan Water Stewardship Council

October 2019

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The **Okanagan Sustainable Water Strategy** was developed by the Okanagan Water Stewardship Council, a technical committee to the Okanagan Basin Water Board (www.obwb.ca). The Council acts in an advisory role to the 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 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 almost 50 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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LETTER FROM THE CHAIR AND PAST CHAIR OF THE OKANAGAN WATER STEWARDSHIP COUNCIL

The Okanagan Water Stewardship Council (the Council) is an advisory body for the Okanagan Basin Water Board. In 2008, recognizing a need for enhanced knowledge and improved management of Okanagan water, the Council developed the Okanagan Sustainable Water Strategy: Action Plan 1.0. The Action Plan was guided by 12 principles, and provided 45 actions focussed on water quality, water quantity, and water governance and management. Since its publication, Action Plan 1.0 has been an effective guide for prioritizing data acquisition, research, water management activities, and projects in the Okanagan basin.

By late 2016 many of the actions had been addressed, new data and research was available, and new issues were emerging or gaining prominence; and the Council recognized that it was time to update the Strategy. While many issues that drove Action Plan 1.0 remain highly relevant, issues with increased prominence include:

- The impacts of ongoing climate change, which continue to increase the pressures on natural and managed ecosystems, water supply and water users;
- A rapidly growing population;
- An increased awareness of the need for reconciliation with Indigenous peoples in the Okanagan and across Canada;
- Passage and implementation of the provincial *Water Sustainability Act*, with its focus on regulating groundwater and preserving instream flows for the benefit of aquatic ecosystems; and
- The risk that aquatic invasive species could be introduced to Okanagan waterbodies.

The effort involved in creating Action Plan 2.0 has been substantial, and it has extended over parts of two Council terms. The work was led by Okanagan Basin Water Board staff and an Editorial Board of Council members, with significant input and review by the full Council. The result is a collaboratively developed, modern, comprehensive strategy intended to guide water management priorities in the Okanagan for the next several years. Action Plan 2.0 continues the tradition of water leadership by the Council and the Okanagan Basin Water Board, and we hope that it will contribute to a more sustainable future for the Okanagan.

Denise Neilsen

Denise Neilsen
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EXECUTIVE SUMMARY

The Need for an Updated Sustainable Water Strategy

People in the Okanagan are taking action to protect water, the valley's most important natural asset. Water is central to everything in the region – the survival of plants and animals, the well-being of residents, the health of the economy, and the beauty of the natural landscapes. The key challenges of protecting this shared resource are that supply is limited and demand is high. The Okanagan has several large lakes, so it is easy to assume there is plentiful water. However, it is one of the most water-stressed regions in Canada. The region's growing population and changing climate have placed more pressure on water than ever before. This semi-arid region receives very little precipitation, which falls mainly in winter as snow, and experiences high evaporation rates. Most of the surface runoff in the region occurs during a short period each spring when the snow melts. Reservoirs capture and hold some of the runoff, which enables slow but sustained releases during summer and fall when water is needed the most for irrigation, fish, and other purposes. The timing and volume of runoff determine whether there is enough water for all uses in any given year. Within the last decade, we have experienced early snowmelt (as early as March), record high water flows in spring bringing unprecedented flooding, record low streamflows in summer and fall, and extreme and prolonged summer heat events.

This Sustainable Water Strategy was first written in 2008 to bring a watershed-approach to balancing multiple uses and providing a sustainable supply of clean water for all needs in perpetuity. The 2008 Strategy (Action Plan 1.0) gave technical information about water in the Okanagan and important water management issues of the time and included 45 action items to protect water at its source, share water in times of shortages, manage water demand, and support good governance. The 2008 Strategy has guided the projects and priorities of the Okanagan Basin Water Board and its Water Stewardship Council, and has inspired new studies, guidelines, and projects in the Okanagan region.

Changes in the Last Decade

It is now more than 10 years since the release of the 2008 Strategy and much has changed, including environmental conditions, land and water use patterns, climate change awareness, public policy and legislation, and societal views. To ensure that the Strategy remains relevant and current, it has been modernized with new information and actions. This 2019 Strategy (Action Plan 2.0) expands on topics that were only just emerging in 2008, such as climate change adaptation, highlights new issues, such as the threat of invasive zebra and quagga mussels, and discusses policy and legislation changes that impact water management today. It also reports on progress made and insights gained over the last decade and showcases recent projects and case studies. This updated Strategy includes new actions designed to protect water at its source, share water in times of shortages, plan for flooding, manage water demand, collect and share data, and collaborate and build partnerships.

The population across the Okanagan region has grown over the last decade and will continue to grow. The region becomes more sensitive to water supply problems as demand increases. Aging infrastructure and shrinking budgets place financial pressure on water systems. Water conservation is critical to addressing these challenges. One of the most pressing issues associated with population growth is the development of agricultural and urban land in the valley bottom and surrounding hillsides and the resulting impacts on water quality, water supply, and biodiversity.

The recent effects of extreme weather, flooding, and drought in the Okanagan have been unprecedented. In summer 2015, the Okanagan experienced a Level 4 drought – the highest drought rating – due to unusual climatic conditions, including a mild winter with little snow, early peak inflows, and persistent below-average precipitation and warmer-than-normal temperatures in spring and summer. In spring 2017, heavy rains combined with rapid snowmelt caused severe flooding across the Okanagan region. In 2018, an unusually high snowpack melted rapidly in early May, and

The Okanagan region is unique and beautiful, with golden grasslands, expansive forests, world-class vineyards and orchards, and clean, blue lakes.

brought flooding to some Okanagan regions that were still recovering from 2017. In both years, spring floods were followed by summers with extreme heat and record low precipitation.

Erratic weather conditions will have wide-ranging and significant impacts in the Okanagan. Projected water-related climate effects include increased wildfire frequency; longer agricultural growing seasons (requiring more irrigation); increased summertime water demands; increased severe storm frequency; changes to timing and magnitude of springtime high and summertime low stream flows, warmer lake and river temperatures in the summer and fall; and appearance of new water-borne pests, diseases and invasive species. We need to build climate resiliency by improving our understanding of local trends, identifying vulnerabilities, developing adaptation plans, improving response plans, and moving forward with protection measures. Across the Okanagan region we need land-use plans that limit development in hazard-prone areas and preserve areas such as wetlands, marshes, and riparian corridors, source water protection plans that focus on collaboration in multi-use watersheds, and water conservation plans that promote a year-round water conservation ethic.

Changes to water legislation are also impacting how water is managed in B.C. The new *Water Sustainability Act* came into force in 2016, replacing the century-old *Water Act*. One of the cornerstones of the *Water Sustainability Act* is the regulation and licensing of groundwater. Under the new Act, water dedicated for agriculture can be protected in Agricultural Water Reserves, established as part of Water Sustainability Plans. The Act also enables the establishment of water objectives for a watershed, stream, aquifer or other specified area or environmental feature to sustain water quantity and quality for specific uses or to sustain aquatic ecosystems. There is also now a legal requirement under the Act to set aside enough water for the health of riparian areas and the aquatic environment. Environmental flow needs (EFNs) must now be considered when making water allocation decisions. Other features of the Act include improved tools to manager water during shortages, and increased dam safety and awareness.

Water is a key aspect of reconciliation with Indigenous peoples. An important step is to develop an understanding of different perspectives and approaches to water management. Settler and Indigenous communities can build a collective vision by integrating Western science and traditional knowledge. One of the potential paths towards reconciliation is working collaboratively to develop informed decisions and improve water and watershed management. This path requires new governance relationships. A valley-wide approach is critical for making decisions based on the best available knowledge, meeting the needs of natural ecosystems and all residents, and achieving the actions in this Strategy, now and in the future.

Guiding Principles for the Okanagan Sustainable Water Strategy

Ten Guiding Principles provide a framework for the actions in Action Plan 2.0. Although the principles are presented individually, they are interconnected and must be considered together for the Strategy to be effective.

1. **Respect water.** Water connects and sustains all life. It is our responsibility to protect water and watersheds.
2. **Think and act as one watershed.** Local decisions must consider water and ecosystem interconnections within a broad, Okanagan watershed context. Collaboration and partnerships across political boundaries are essential for informed and coordinated decision-making.
3. **Control pollution at its source.** The Okanagan must be protected from pollution for the benefit of healthy ecosystems and to safeguard a clean, safe, and reliable water supply for human use.
4. **Restore aquatic and riparian ecosystems.** Natural ecosystems, especially those that are rich in biodiversity, are needed to maintain water quality and quantity. Their protection is also critical for maintaining resilience to climate change.
5. **Put water stewardship at the forefront of land-use planning decisions.** Land and water are interconnected. Urban and rural land-use decisions must minimize local and cumulative impacts on water resources and aquatic habitats.
6. **Allocate water in a transparent and responsible manner.** How and when water is allocated must be determined in a way that is rational, evidence-based, and easy to understand. Sufficient water must be available for the environment, basic human needs, agriculture, cultural self-determination, and economic livelihoods - now and in the future.
7. **Ensure community water supply systems are resilient to climate change.** Water systems must be designed to reduce water waste, maximize water use efficiency, and minimize environmental impacts. When practical, alternative sources such as rainwater harvesting and greywater reuse should be developed.
8. **Collect and share knowledge.** Decisions about water should be informed by technology, science, and traditional knowledge (when used with permission). Data must be integrated and easily accessible. Decisions should be based on evidence; however, a lack of data must not limit action to protect water.
9. **Encourage active public engagement and learning.** Transparent and collaborative decision-making and opportunities for information sharing and communication are essential to a collective understanding and acceptance that human activities affect water.
10. **Practice adaptive management and think long-term.** Continuous learning, innovation, planning, and improvement are essential for sustainable water management. Long-term 'water-first' thinking prevents the cumulative effects of short-sighted land-use actions.

Water Quality

Surface water and groundwater are vulnerable to contamination from human land use and natural processes. Climate change impacts on water quality include landslides and bank erosion, high flows and turbidity during extreme rainfall events. The key elements required to protect water quality are (1) protecting water at its source, (2) conservation and restoration of aquatic ecosystems, (3) invasive species control, and (4) water quality monitoring.

There are numerous ways that water can be polluted and numerous ways to address pollution in different geographic areas (upper, rural, urban watersheds). Each geographic area has unique challenges, and approaches to mitigation vary. Some areas are subject to water contamination from human or animal sources, including agriculture activities, residential septic fields, chemical spills, bank erosion, drainage and stormwater runoff. Many suppliers have completed, or are in the process of completing, source water assessments that evaluate the source and identify hazards, and subsequent response plans that identify the measures to reduce the risk of those threats. It can be challenging to take action on source protection plans due to a lack of stable funding, a lack of staff and resources dedicated to the process, the need for multi-jurisdictional collaboration and integrated resource management, and a lack of overall coordination.

In upper watersheds, the best way for water suppliers to protect water sources is through long-term, partnerships with the watershed users, including private industry, public interest and recreation groups, and provincial regulators and enforcement staff. Some forestry, range and other Crown land leaseholders attend meetings with water suppliers and stakeholders to gain a better understanding of the watershed, but more partnerships are needed.

In rural watersheds, riparian buffers, wetland protection, drainage and nutrient management plans are often the best way to limit water pollution from agricultural areas. Some rural communities have tertiary systems. In other areas, seepage from septic fields is still a source of phosphorus and nitrate pollution; therefore, further investment is needed to move from septic systems to community sewer systems, and to extend existing sewer systems.

In urban watersheds, green infrastructure is an emerging approach to water management, which incorporates natural mechanisms of filtration and percolation to improve urban stormwater management. Building green infrastructure into community development can maintain or restore natural flow patterns, preserve or restore stream buffers and wetlands, reduce the area of paved surfaces, create wildlife corridors and habitat, and recharge aquifers. Integrated asset management strategies, which include green infrastructure, are now being embraced by many communities. Other strategies to improve stormwater management include property-specific stormwater fees and site design strategies to manage runoff. Stormwater user fees charged through the utility can be used by municipalities to create a dedicated funding stream to ensure that infrastructure requirements don't compete with other municipal services for resources. Site design strategies can manage runoff and decrease reliance on stormwater drains. Absorbent landscaping, sufficient topsoil, infiltration facilities, green roofs, and rainwater reuse are practical strategies that provide significant benefit to the environment by reducing stormwater flows.

In natural areas, conservation and restoration of aquatic ecosystems help to prevent further loss and degradation due to extreme weather events. Wetlands, shorelines, and riparian areas have many biological functions and significant social, cultural and economic values. Most wetlands in the Okanagan have been lost or impacted by being filled or drained for land development, commercial, industrial, residential or agriculture. Further cumulative impacts to wetlands have occurred from forestry roads, range, off road vehicles, nitrification and invasive species.

Zebra and quagga mussels are a major threat to the quality of Okanagan waters, although they have not yet been detected west of Manitoba. Potential future impacts include disruption of aquatic food webs, collapse of fish populations, displacement of native aquatic species, degradation of the natural environment, pollution of drinking water, and damage to water supply systems. Prevention is essential. The OBWB's *Don't Move A Mussel* campaign, launched in 2013, has been raising awareness of the risks and engaging the public to help prevent an invasion. Recent water quality sampling indicates that the region is still mussel-free, but more work is required. The OBWB has lobbied provincial and federal governments to increase funding for inspection efforts, and called for additional regulations to further protect B.C. waters.

The OBWB also continues to control Eurasian watermilfoil. While there is no way to eradicate the invasive aquatic plant, control measures have improved over the last four decades. In 2018, control operations were further enhanced with fully-integrated electronic mapping and tracking systems to target specific areas, monitor long-term milfoil growth, and track milfoil control activities.

Water quality data collection and analysis is an ongoing effort by various agencies, consultants and water suppliers using various methods. Although the efforts have been extensive, there is no consistent, standard approach, and no central repository for water quality data. Collaborative efforts to develop standard methods based on standard best practices would make the data more consistent, and increase confidence in the results. Currently, the Province of B.C. website and interactive map portal provides water quality data collected under the B.C. Lake Monitoring Program. In addition, the OBWB is developing a water quality data portal. Various users will have access to long-term data records collected by set standards. Understanding trends in water quality and having confidence in results will help water managers allocate scarce resources and protect the public during times of poor water quality.

Water Quality Actions

2-1 Account for the impact of weather and climate on water in all planning and decision-making.

2-2 Prepare and fully resource collaborative source protection plans for all watersheds in the Okanagan.

2-3 Develop and conduct outreach and education programs to raise awareness about the importance of source protection.

2-4 Review and update forestry, mining, range, recreation and wildfire management practices to increase water infiltration and reduce potential for surface runoff and contamination of source waters.

2-5 Improve understanding of nutrient sources in rural areas and undertake collaborative and coordinated efforts to monitor nutrient inputs to surface water and groundwater.

2-6 Bring areas with septic systems onto community sewer.

2-7 Prepare natural asset strategies for Okanagan communities.

2-8 Improve stormwater management practices and policies in Okanagan urban communities.

2-9 Develop Okanagan-wide policies and plans for wetland protection focusing on no net loss, and restoration and enhancement.

2-10 Strengthen provincial legislation to protect, restore and enhance wetlands.

2-11 Prepare shoreline protection plans for Okanagan, Kalamalka, Wood, Skaha, Vaseux and Osoyoos lakes.

2-12 Strengthen local government oversight of riparian area and other development-related assessments completed by Qualified Environmental Professionals.

2-13 Collect up-to-date ecosystem inventory and mapping information across the valley and integrate into land use and source protection policies and plans.

2-14 Focus new development in areas currently served by community water and sewer, and minimize development in hazard areas and on or near sensitive aquatic ecosystems.

2-15 Educate elected officials about the importance of considering water in all development decisions and understanding that water management decisions should be based on watershed boundaries, not jurisdictional boundaries.

2-16 Provide funding and support initiatives for the prevention, early detection, rapid response and containment of aquatic invasive species.

2-17 Educate the public about aquatic invasive species.

2-18 Complete vulnerability assessments of water intakes and other in-lake infrastructure to identify the potential impacts of invasive mussels and other aquatic invasive species.

2-19 Control Eurasian watermilfoil in Okanagan lakes.

2-20 Develop standard methods for water quality data collection. Consistently track and enhance access to the data.

2-21 Review and update existing provincial Water Quality Objectives in the Okanagan, and expand to other Okanagan lakes and streams if needed.

2-22 Develop tools that support benchmarking, measuring, tracking, management, and accountability for water in the Okanagan.

Water Quantity

The availability of water in the Okanagan varies from year to year, depending on the amount of annual precipitation, the storage capacity of upland reservoirs and aquifers, and the amount of evaporation and evapotranspiration. The increasing pressures from population growth and land development and the accelerating effects of climate change also influence availability. Variability in the timing and amount of water inflows creates challenges in water supply management. The timing of water availability has a great influence on whether there is water abundance or scarcity for different needs.

Setting environmental flow needs (EFNs) for Okanagan streams is integral for sustainable water management. Understanding stream-specific flows that are sensitive to time of year and different life stages of fish and other aquatic organisms improves water allocation decision-making. Under the *Water Sustainability Act*, it is now mandatory to accommodate EFNs when issuing licences. Historically, reserving water for the environment has been a source of conflict, particularly where there is significant demand or competition. The *Siwłkʷ (Water) For All – Our Responsibility* environmental flow needs conference in 2018 brought together researchers, fisheries and water managers, policy-makers, planners, regulators, Indigenous peoples, among others, to develop recommendations for EFN-setting, policy-making, and regulation. This conference was a catalyst for further action, further collaboration, better information, and improved EFN decision-making.

Meeting EFN requirements combined with agricultural irrigation requirements is an ongoing challenge. If irrigation systems were designed for only part-time use (for example, running only at night to reduce evaporation while irrigating), the pipes would be much larger and water withdrawals from streams would have huge temporal variations, making it more difficult to maintain environmental flows. Given the new legal requirements to consider EFNs, combined with the expected changes due to climate change and the increasing water demands from a growing population, there may be more frequent agricultural water shortages. This has implications for future agricultural productivity, and the local agricultural economy. A flexible licensing structure, with late-season and part-season licensing would allow farmers to make the most of available water and minimize withdrawals during low flow periods when it is needed to maintain EFNs.

Water conservation is the most cost-effective way to tackle increasing water demands. Strategies such as crop selection, landscape design, updated irrigation methods, water metering, and new technologies can improve water-use efficiency. New climate projection models can better predict temperature and rainfall, which allows growers to develop longer-term plans for efficient water use. Water Conservation Plans manage water demand by reducing consumption. Education and outreach programs are an important part of a broad-based water conservation strategy. *Make Water Work* is an outdoor water conservation initiative of the OBWB's *Okanagan WaterWise* program, delivered in partnership with local governments and water suppliers throughout the valley. The initiative was launched in 2011 to provide common materials and messages to promote water conservation, prevent conflicting information, and help the public transition to waterwise landscaping.

Developing additional water storage is another way to provide sustained water supply during long, dry periods – although more complicated and expensive than water conservation. The current trend in the Okanagan is toward smaller winter snowpacks, earlier snowmelt, and less water during mid to late summer peak demand. However, retaining water in reservoirs to supply users during shortages is only one objective. Dam operations also sustain downstream flows for critical fish periods. New methods of optimizing dam operations must accommodate changing conditions and changing future needs.

Aquifer storage and recovery is another form of storage that could be considered for the Okanagan. Aquifer storage and recovery is essentially a water bank that can receive water deposits during rainy events and allow withdrawals during times of need. This is an emerging strategy that has potential to contribute to local and regional climate change adaptation.

Given the changing climate, Okanagan communities need to better prepare for more frequent and more extreme conditions, such as droughts and floods. Comprehensive emergency management should be based on a four-pillar approach: (1) prevention and mitigation, (2) preparedness, (3), response, and (4) recovery. These four pillars are interconnected and designed to better prepare for droughts and floods in advance of, during, and after an emergency event. Good progress around drought planning has been made in the Okanagan. However, work must continue until every community has a Drought Management Plan with defensible triggers and responses and protocols for communication and enforcement. Comprehensive flood management plans are less common; and after the floods of 2017 and 2018 many communities are working to get them in place.

Natural flooding is an integral component of a healthy ecosystem. Flooding alters channels, deposits materials, creates new habitats, and sustains wetlands. Manmade flood control strategies can alter biodiversity, habitat, and ecosystem productivity, yet in many areas they are important to protect existing buildings and infrastructure. Flood mapping is a valuable tool for local governments to identify vulnerable infrastructure and property, and associated costs of emergency response and mitigation. An innovative flood mapping project is underway in the Okanagan. The project is a collaborative effort to map floodplains along the lakeshores and river channel in the valley. It is hoped that these maps will help communities better assess flood risks and allow for more strategic planning.

Land use policies will be changing based on this new information. New flood construction levels and floodplain setbacks will be needed to protect areas from flooding and reduce the risk of damage. Physical and biophysical improvements, such as flood protection structures, diversions, setback dikes, and reconstructed channels, can improve flood control and make communities more resilient to climate change.

Accurate, long-term, real-time hydrometric data are fundamental to understanding the spatial distribution and variability of natural runoff in the Okanagan and how the changing climate may be modifying the valley's hydrology. Hydrometric data are used in many ways, including water licence management, reservoir operations, water supply planning and management, regional flood and drought frequency analysis and forecasting models, climate change assessments, hydrologic model calibration and verification, and aquatic ecosystem assessments. Long-term hydrometric data for Okanagan streams is ever more valuable, given our increasing population, changing climate, and changing human-built landscape.

Similarly, expanding the network of climate stations and improving weather prediction systems is needed to provide realistic and reliable projections for agriculture producers and more accurate and efficient use of irrigation water.

Groundwater studies conducted over the last decade clearly expressed a need to develop better local information and gain a better understanding of ongoing changes to groundwater supplies across the valley. A major review of the Observation Well Network in 2009 identified gaps in the monitoring network and recommended expansion. The 2013 Okanagan Groundwater Monitoring Project was a collaborative effort that resulted in the installation of new groundwater wells to increase the monitoring of priority aquifers in the Okanagan. The observation well data are used to support water management decision making and local water services planning.

Water Quantity Actions

3-1 Determine EFNs for all Okanagan streams, and share with decision-makers to support sound and defensible water allocation decisions that maintain proper functioning of aquatic ecosystems.

3-2 Develop a pilot Agricultural Water Reserve for a watershed in the Okanagan basin and then work towards a basin-wide Agricultural Water Reserve if it is deemed feasible based on the learnings and outcomes of the pilot.

3-3 Build more flexibility into irrigation licences to allow for early-season, late-season and part-season irrigation in the Okanagan, without increasing allocation of water or jeopardizing environmental flows.

3-4 Prepare or update Water Conservation Plans for all Okanagan water suppliers.

3-5 Improve irrigation management and water efficiency in the residential, commercial, parks and recreation, and agricultural sectors.

3-6 Implement universal water metering in the Okanagan and promote best practices for how and when meter data are collected and how data are stored for analysis and communication to customers.

3-7 Carry out education and outreach campaigns focused on water conservation and efficiency.

3-8 Prepare drought management plans for all Okanagan communities. Periodically review the plans and update as needed to reflect changing conditions.

3-9 Optimize and modernize the operation of existing storage reservoirs. Investigate opportunities to increase storage capacity in the Okanagan.

3-10 Explore ways to offer tangible incentives to dam owners who provide services for the public good, such as timed releases for environmental flows and ecosystem services, and holding back water to relieve flooding.

3-11 Investigate the feasibility of using aquifer storage and recovery.

3-12 Improve the knowledge base to better inform flood management decisions and mitigation activities.

3-13 Develop and maintain up-to-date flood inundation, hazard and risk mapping for the Okanagan valley bottom.

3-14 Improve flood management by strengthening collaboration, increasing public engagement, and including (with permission) local and Indigenous knowledge in decision-making and mitigation activities.

3-15 Review flood construction levels and floodplain setbacks and strengthen land use regulation in floodplains.

3-16 Add to snow data networks and improve inflow forecast models. Complete watershed assessments to identify risks to water flow and timing and other risks related to a changing climate.

3-17 Maintain and expand the network of hydrometric stations in the Okanagan and enhance the sharing and open sourcing of collected hydrometric data.

3-18 Increase climate stations in the Okanagan to allow for better resolution in weather projections.

3-19 Undertake groundwater mapping, aquifer characterization, and groundwater-surface water interaction studies in the Okanagan. Link these efforts with ongoing EFN studies to identify water-stressed areas.

Delivering the Strategy

Residents, visitors, businesses, governments, and water suppliers all need to be good stewards in helping to preserve and protect water. We are all responsible for a similar set of values related to Okanagan water. Building partnerships and working collaboratively to deliver the Strategy actions is essential. Many of the critical actions require collaboration and strong partnerships, especially with Indigenous peoples, and call for good water governance, informed decision making, and adequate funding and resources. The actions also require monitoring and follow-up to ensure success and achieve the intent of the Strategy – clean and healthy water in the Okanagan.

This Strategy is a modernized, valley-wide approach that expands on the issues and actions outlined in the initial Strategy (Action Plan 1.0) developed more than a decade ago. As emphasized at that time, balancing multiple water needs has become increasingly difficult as more and more people live, work, and play in the Okanagan. This is still a challenge today. Action Plan 1.0 warned that climate change was expected to bring more intense storms, increased drought, higher lake evaporation rates, greater evapotranspiration, and longer growing seasons, resulting in increased demand. Action Plan 2.0 reports on the predicted extreme weather and climate trends seen within the last decade, and the continued demands on water in a changing climate and expanding population.

Okanagan communities face complex challenges in water governance, including conflicting watershed management priorities with those of senior governments. Governance is more effective if water institutions at all levels are more integrated and coordinated. Working together at the local, regional, First Nation and provincial levels can reduce conflict to address complex challenges, ensuring the best outcome for the collective future. Collaborative and coordinated water governance must include a common vision, mutual trust and understanding, clear and open communication, equitable representation, partner involvement, and consistent resources. Better decisions are made by bringing people to the table to discuss mutual interests and develop workable solutions.

Collaboration is critical because water governance is multi-jurisdictional. Collaboration must extend beyond political boundaries to connect upstream and downstream communities and recognize that Okanagan water supports the whole system. A collective approach to decision-making ensures that efforts are better coordinated, reducing overlap and duplication. They better reflect the concerns of citizens and reduce conflict between interests. Meaningful involvement is essential to effectively solve water problems.

Working towards reconciliation with Indigenous peoples in the Okanagan is crucial. Progress has been made since the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) in 2007, including Canada's call for all levels of government to adopt and fully implement UNDRIP as the framework for reconciliation, but there is much to do. Local governments and First Nation communities have shared interests and responsibilities to meet community needs and protect Okanagan water. Shared learning and shared expertise leads to better relationships and better decisions.

Decisions related to water should be based on the best available science, traditional knowledge, and local knowledge collected across communities, cultures, and disciplines. This approach leads to healthier, more sustainable communities. Knowledge integration requires a systematic approach so that quality data are complete and easy to find. The OBWB has undertaken or participated in several efforts to collect, store, integrate, and share information, and more work is needed. Starting conversations, cultivating relationships, convening workshops, expanding networks, and engaging the public provides meaningful opportunities to learn and share information and involve people in decision-making. Many efforts of community engagement have been made in the Okanagan, including education and outreach programs focused on promoting stewardship, conserving and protecting water, preventing invasive aquatic species, and waterwise landscaping, among others.

Many opportunities are already developed to protect water and use it more efficiently: employing new technology and infrastructure, refining management

practices, and drawing on better information. These opportunities require ongoing stable funding, and access to new funds. For valley-wide projects, rather than each jurisdiction hiring staff or contractors to manage projects and planning initiatives, the OBWB can centralize activities. This creates capacity for inter-regional projects that are outside any individual jurisdiction's mandate, and where a collaborative approach increases efficiency. Pooling funds, sharing resources, and leveraging dollars from outside of the valley enables communities to take advantage of economies of scale.

In the past, provincial and federal governments took a far more active role in funding water science, water monitoring through agencies like the Water Survey of Canada, flood mapping, extension services, and enforcement within watersheds. Over the past two to three decades, senior governments have cut staff and reduced their roles. These activities have often been downloaded to local jurisdictions or are simply not being done because they are within the jurisdiction of provincial/federal agencies that do not have capacity to carry them out. There are many opportunities for senior governments to re-embrace their historical roles, or better support local governments in watershed protection and management.

The Sustainable Water Strategy is intended to be a living document. The actions provided are based on the best information available at this time. Environmental conditions will continue to change; information will evolve; regulations, policy and planning will progress; and relationships will develop. It is imperative that the actions in this Strategy are flexible and adaptive, and monitored. A review process will ensure the Strategy remains current and relevant. The action items in the Strategy are not intended to be simply checked off once completed. Rather, they are core components of a process of engagement, one that gives us all a sense of common purpose and has us working towards the same goal – a sustainable water future for the Okanagan.

Delivering the Strategy Actions

4-1 Integrate management objectives throughout government agencies and with external partners.

4-2 Share Okanagan-specific information and knowledge with partners within the valley and beyond to facilitate common pools of knowledge and to bring in new partners.

4-3 Strengthen relationships between Okanagan local governments, non-governmental organizations, professional organizations, First Nations, and the faculty, staff and students at academic institutions to promote community-engaged research and learning.

4-4 Increase opportunities for shared learning with Okanagan Indigenous communities, especially of cultural practices, environmental stewardship, and governance processes.

4-5 Deliberately expand the network of Okanagan water professionals and interested parties to create a greater diversity of knowledge from which to develop solutions. Facilitate knowledge transfer across generations, cultures, communities and sectors. Support new professionals by linking them with research networks and employment opportunities.

4-6 Build-out outreach programs and communications strategies, working with all Okanagan communities and partner organizations to facilitate consistent messaging, mutual understanding, and a shared way of framing problems and solutions.

4-7 Complete coordinated or joint funding applications for water planning, management or infrastructure projects, where possible.

4-8 Identify and match-make funding organizations and agencies that can support water projects in the Okanagan, and help Okanagan communities identify opportunities for grants.

4-9 Monitor progress on completing the actions recommended in the Strategy and report out on progress made.

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INTRODUCTION

1.0 INTRODUCTION

The Okanagan region is unique and beautiful, with abundant lakes and beaches, world-class orchards and vineyards, sprawling grasslands, and expansive forests. Water is central to everything in the region. It is essential to the survival of plants and animals, the well-being of residents, the health of the economy, and the beauty of the natural landscapes.

1.1 Water in the Okanagan

The Okanagan basin is nearly 200 kilometres long and covers approximately 8,000 km^2. It is part of the B.C. Interior Plateau, characterized by moderately steep valley sides and a broad valley bottom (Figure 1-1). The valley includes six main lakes – Wood, Kalamalka, Okanagan, Skaha, Vaseux and Osoyoos. Many tributary streams flow from headwater lakes to the valley lakes. The Okanagan River drains the valley lakes and flows south across the international boundary as a small tributary to the Columbia River, past the City of Portland, to the Pacific Ocean.

The large lakes in the region suggest water abundance; however, the Okanagan is one of the most water-stressed areas in Canada. With a semi-arid climate, the lowest average annual precipitation in southern Canada, high evaporation rates, hot summers, and relatively mild winters, the region's growing population and changing climate place more and more pressure on water quality and supply.

The importance of water has been recognized since the first people arrived in the Okanagan. The *Syilx/Okanagan* People have lived in the Okanagan for thousands of years, and the valley is part of their unceded and traditional territory. Water is woven into the *Syilx/Okanagan* culture. It is necessary for basic survival activities like fishing and agriculture, and it is the foundation of spiritual practices, customs, and traditions. The *Syilx/Okanagan* Nation *Siwɬkʷ* (Water) Declaration (Story 4-3) states: "Water is life. Water is our relation. Water bonds us to our ancestry, our descendants and our land."[1]

Since the arrival of European settlers in the late 1800s, the valley has seen major water management changes as the landscape was transformed from dry pine forests and range lands, to orchards, tobacco farms, and hay lands, and then to bustling urban areas. In the early 1900s, snowmelt catchment reservoirs were constructed throughout upland plateaus to provide irrigation for agriculture.[2] Irrigation and flood control dams were installed along the valley bottom between Vernon and Osoyoos in the 1950s, and the Okanagan River was channelized between Okanagan Lake and Osoyoos Lake. This water regulation system was intended to manage flooding; however, water levels in Okanagan Lake are now managed to mitigate both flood and drought. Operational decisions also consider environmental water level requirements around the lakeshore and downstream environmental flow needs (EFNs) and recreational values.

This Sustainable Water Strategy provides actions needed to maintain clean and healthy water in the Okanagan, meeting the needs of natural ecosystems, residents and agriculture – now and in the future. It contains principles and actions for regulators, elected officials, local governments, water utilities, stewardship groups, and the general public to better protect and manage the Okanagan's limited water resources. The decisions we make now will affect water quality and quantity throughout this century and leave a legacy for future generations.

One of the most powerful assets of the Okanagan region is the desire of local communities to collaborate – working together to protect and enhance water sources. Establishment of the Okanagan Basin Water Board (OBWB, Section 1.3.1) in 1970 was based on a shared understanding that individual communities could not protect water on their own. The ongoing commitments to collaboration by the OBWB and its Water Stewardship Council, local governments, First Nation communities, and all aspects of the water sector are further evidence that this is a unique and powerful base to grow and improve our relationship to water and the way it is shared and managed. The desire to work together and thrive together remains an integral part of the Okanagan culture.

1 Okanagan Nation Alliance. 2014. Siwɬkʷ (Water) Declaration. URL: https://www.syilx.org/about-us/syilx-nation/water-declaration/.

2 Wilson. K. 1989. Irrigating the Okanagan: 1860 - 1920. https://royalbcmuseum.bc.ca/exhibits/living-landscapes/thomp-ok/irrigating-of-okanagan/index.html.

LEFT: *Okanagan Lake looking towards West Kelowna. Photo courtesy Alison Thorpe.* ***TOP RIGHT:*** *Kalamalka Lake and Kalamalka Lake Provincial Park. Photo courtesy Debbie Gibson.* ***BOTTOM RIGHT:*** *Okanagan River near Oliver. Photo courtesy Town of Oliver.*

LEFT: *Skaha Lake outlet dam at Okanagan Falls.* ***RIGHT:*** *Zosel Dam at the outlet of Osoyoos Lake. Photo courtesy Dan Millar.*

Figure 1-1 *Okanagan basin and watersheds.*

1.2 The need for a sustainable water strategy

Sustainability means that human needs are met now and in the future within the Earth's ongoing capacity to function in a healthy manner. In water management, a sustainability framework should balance the needs of the population while maintaining an ecosystem that is resilient to change.

Society has a collective duty to protect and preserve the Okanagan's precious water, to have a sustainable supply for all needs in perpetuity. The challenge of water sustainability in the Okanagan is that supply is limited and under increasing pressure. Balancing the requirements of the environment, with basic human needs, irrigation, tourism, recreation, industry and cultural values has become more challenging as more and more people live, work, and play in the Okanagan. These interests all rely on a renewable supply of clean water.

Recognizing the need for a clear plan, the Okanagan Water Stewardship Council (the "Council") (Section 1.3.2) developed its first water strategy in 2008 – entitled Okanagan Sustainable Water Strategy Action Plan 1.0 (Story 1-1). Some things have changed since Action Plan 1.0 was released, especially environmental conditions, land and water use, climate change effects and awareness, public policy and legislation, and societal views. To maintain relevance in the upcoming years, Action Plan 1.0 needed to be rehoned and new actions needed to be established. While this modernized (2019) strategy includes similar topics, principles and actions as contained in Action Plan 1.0, it also incorporates new water information and research as well as new actions, and highlights the progress made and insights gained over the last decade. It expands on topics that were only just emerging in 2008, such as climate change adaptation, invasive zebra and quagga mussels, and changes in water legislation (for example, the provincial *Water Sustainability Act*[3]).

STORY 1-1 SUSTAINABLE WATER STRATEGY ACTION PLAN 1.0 (2008)

In 2008, the Council released its first sustainable water strategy – Action Plan 1.0[4]. The purpose of the strategy was to bring together technical information about the Okanagan basin and highlight the important water management issues of the time. The 2008 strategy has been an important reference document over the last decade; it has informed the work plans of the Council and guided projects and priorities of the Okanagan Basin Water Board. It has inspired and guided studies to identify emerging issues and develop scientific insights into potential solutions. The strategy was widely distributed and became the 'go-to' document for Okanagan water issues and priorities.

Editorial Board celebrating the release of the Okanagan Sustainable Water Strategy: Action Plan 1.0 in 2008.

3 Water Sustainability Act, S.B.C. 2014, c. 15. http://www.bclaws.ca/civix/document/id/complete/statreg/14015

4 Okanagan Water Stewardship Council. 2008. Okanagan Sustainable Water Strategy Action Plan 1.0. https://www.obwb.ca/fileadmin/docs/osws_action_plan.pdf

LEFT: *Okanagan Lake Beach at Penticton. Photo courtesy Alison Thorpe.* ***RIGHT:*** *Okanagan Lake looking north from Knox Mountain Park, Kelowna.*

1.2.1 Population growth and land development

As agriculture and settlement in the Okanagan region grew and prospered, water issues became more prevalent. It became evident that to improve water management, a watershed-wide approach was needed. A joint Federal/Provincial Okanagan Basin Study (the "Study") commenced in 1969, shortly after the establishment of the OBWB, and was completed in 1974.[5] The Study developed a comprehensive framework plan for water resources management for the social betterment and economic growth of the Okanagan region to the year 2020. It brought together the combined skills of many experts in the fields of water quantity, water quality, waste treatment, socioeconomics, limnology and fisheries. Information on health, wildlife, forestry and land use was also included in the development of the plan. The OBWB was given responsibility in its Supplementary Letters Patent to coordinate the implementation of the recommendations of the Study.[6]

Since the Study was released in 1974, population has tripled in the three regional districts that make up the Okanagan basin. Census data indicate that the total population in the Regional District of North Okanagan (RDNO), Regional District of Central Okanagan (RDCO), and Regional District of Okanagan-Similkameen (RDOS) was approximately 360,000 in 2016 and is anticipated to reach approximately 450,000 by 2041 (Figure 1-2).[7]

With population growth, the region is more sensitive to water supply problems. One of the most pressing issues is the development of agricultural and urban land in the valley bottom and resulting impacts on water quality, water supply, and biodiversity. Most communities are committed to reducing sprawl and promoting dense urban centres, as outlined in their regional growth strategies and official community plans. Nonetheless, growth has occurred in satellite areas, creating challenges for delivering water and wastewater services, managing runoff from roads and other impervious surfaces, and in addressing ecosystem impacts.

5 Canada-British Columbia Consultative Board. 1974. Okanagan Basin Study. https://www.obwb.ca/library/1974-okanagan-basin-study/.

6 Canada, Province of British Columbia. 1970. Okanagan Basin Water Board Supplementary Letters Patent (Consolidated). https://www.obwb.ca/fileadmin/docs/supplementary_letters_patent.pdf.

7 The RDCO is located entirely within the boundaries of the Okanagan basin, but some areas of the RDNO and RDOS are not. In 2016, about 20,000 people lived in the RDNO and RDOS outside of the Okanagan basin (in Princeton, Keremeos, Enderby, Lumby, RDOS Electoral Areas B, G and H, and RDNO Electoral Areas E and F).

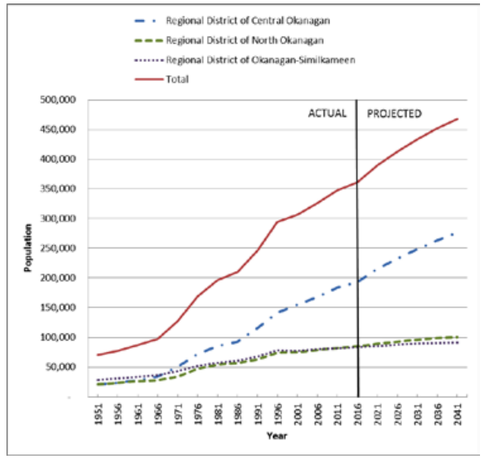


Figure 1-2 *Actual and projected population in the Regional District of Central Okanagan, Regional District of North Okanagan, and Regional District of Okanagan-Similkameen, 1951 to 2041.*[8]

1.2.2 Climate change

Climate change presents a fundamental long-term challenge to water sustainability in the Okanagan. Key projections of future Okanagan climate include substantial increases in temperature and changes in the amount and timing of precipitation, both as rain and snow (Story 1-2). These upcoming changes largely reflect a continuation – and acceleration – of ongoing weather and climate trends. Indeed, within the last decade, the Okanagan has already experienced high elevation snowmelt occurring earlier than normal (as early as March), record high water flows in spring, record low flows in summer and fall, and extreme and prolonged summer heat events.

A continuation of these climate trends into the future will have wide-ranging and significant impacts in the Okanagan region. Developing resilience to these impacts involves:

- Improving understanding of local climate change trends and impacts, particularly related to extreme weather and climate events;

Lake Okanagan on a beautiful summer day.

- Identifying key Okanagan climate vulnerabilities and risks to public safety and well-being, the environment, and the economy;
- Prioritizing, designing and implementing climate adaptation plans that increase overall Okanagan climate resiliency; and
- Continuously monitoring ongoing change and review regional response plans.

8 BC Stats. 2017. B.C. Regional District and Municipal Population Estimates and Projections. https://www2.gov.bc.ca/gov/content/data/statistics/people-population-community/population/population-estimates.

STORY 1-2 REGIONAL CLIMATE PROJECTIONS AND IMPACTS FOR THE OKANAGAN[9]

Global climate models can be used as the basis for understanding future Okanagan climate change trends. Summarizing downscaled climate projections across models highlights the breadth of remarkable environmental change that is in store for our region. For example, relative to the 1971-2000 period, the Okanagan can expect:

- warmer overall temperatures *(annual average temperature increases of 1.6°C by 2020s and 3.1°C by the 2050s)*;
- fewer frosty days *(an average of 14% fewer frost days by 2020s and 28% fewer by the 2050s)*;
- more growing degree days *(an average of 25% more growing degree days by 2020s and 54% more by 2050s)*;
- less summer precipitation *(an average of 9% less seasonal summer precipitation by 2020s and 14% less by 2050s)*;
- more winter precipitation *(an average of 5% more seasonal winter precipitation by 2020s and 6% more by 2050s)*;
- stronger individual precipitation events *(an average of 6% higher annual maximum daily rainfall by 2020s and 11% higher by 2050s)*;
- longer summertime rain-free periods *(an average of a 4% increase in maximum number of consecutive dry days by 2020s, and 10% increase by 2050s)*; and
- more wintertime precipitation as rain.

These changes will drive a range of direct water-specific Okanagan climate impacts, such as:

- increased wildfire frequency;
- longer agricultural growing seasons;
- increased summertime water demands;
- increased severe storm frequency;
- changes to timing and magnitude of springtime high and summertime low stream flows;
- warmer lake and river summer and fall temperatures; and
- appearance of new aquatic and water-borne pests, diseases, and invasive species.

1.3 About the Okanagan Basin Water Board and its Council

1.3.1 The Okanagan Basin Water Board

Established in 1970 to promote the shared water interests of Okanagan communities, the Okanagan Basin Water Board (OBWB) has a 50-year history as a reliable, forward-looking watershed agency with stable finances and a consistent record of successfully executing water projects to support water sustainability in the Okanagan. It is a regional watershed agency that derives authority through Supplementary Letters Patent to the three Okanagan regional districts. The OBWB provides leadership, timely information, communication, and funding for water initiatives that benefit the region, and its jurisdiction is set by the geography of the Okanagan basin rather than by political boundaries.

The OBWB's purpose is to provide leadership to protect and enhance quality of life in the Okanagan basin through sustainable water management. The Vision of the OBWB is *"for the valley to have clean and healthy water in perpetuity, meeting the needs of natural ecosystems, residents and agriculture – now and in the future."*[10] The OBWB works toward this Vision by:

- Advocating and representing local needs to other levels of government to protect Okanagan waters;
- Undertaking collaborative public outreach programs on initiatives related to water conservation and water quality protection;
- Providing science-based information on Okanagan water to local government decision makers and water managers for sustainable long-term planning;
- Building funding opportunities by providing leverage grants, pooling funds, securing external dollars, and identifying cost-sharing partners to expand local capacity;
- Communicating and coordinating between governments, non-governmental entities, universities and schools, businesses, and the public to increase the effectiveness of water initiatives; and
- Maintaining Okanagan-wide programs for watermilfoil control and wastewater infrastructure funding to benefit all Okanagan residents.

The OBWB does not have regulatory authority but does have taxation powers to support its activities. Base funding for the OBWB comes from property taxes across the Okanagan basin, and its initiatives are focused on region-wide benefits. Nine of the 12 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 Council each appoint an additional Director.

In the early 1970s, nutrient conditions, algal blooms, and invasive Eurasian watermilfoil were the most serious water issues facing Okanagan waters. For many years, OBWB activities focused almost exclusively on these issues, bringing significant improvements to wastewater infrastructure, water quality, and Okanagan lakeshores. Several factors, including rapid population growth, increased awareness of climate change, and impacts of the 2003 drought and forest fires, led local community leaders and provincial authorities to refresh the OBWB's purpose. In 2006, the OBWB adopted a more proactive leadership role in the region, introducing a new Water Management Program (Story 1-3) and creating the Council.

STORY 1-3 OBWB WATER MANAGEMENT PROGRAM

A core service of the OBWB is the **Water Management Program**. Communications and outreach, the Okanagan Water Stewardship Council, water conservation and quality improvement grants, and science and information projects are all delivered under the Program. The OBWB helps local governments prepare for impacts on water resources from population growth, urban development, and extreme weather events like droughts and floods. The Program works to leverage funding, institutional resources, and the great store of local expertise in the region to provide significant economies of scale. The OBWB has received more than $6 million in external funding since the Program began in 2006.

9 Pacific Climate Impacts Consortium. 2019. Climate projections prepared for the Regional District of North Okanagan, Regional District of Central Okanagan, and Regional District of Okanagan-Similkameen Climate Projections Report (In Press).

10 Resolution to adopt the OBWB Strategic Plan in "Minutes of a Regular Meeting of the Okanagan Basin Water Board," held October 1, 2013, at Regional District of North Okanagan.

1.3.2 The Okanagan Water Stewardship Council

The OBWB initially created an advisory council in 1968. At that time, the council was a formal committee of the OBWB, known as the Liaison Committee; however, this committee was not maintained after the 1970s. Revived in 2006 as the Okanagan Water Stewardship Council, it now plays an important role in enabling collaboration and dialogue among water users and partners in the Okanagan and beyond. The Council provides a framework for building partnerships on water issues in the Okanagan and for generating innovative ideas to support local governments and communities.

The value and strength of the Council is derived from its community roots, providing balanced and considered advice to the OBWB – and through the OBWB to the community at large. Council members are appointed for 2-year terms as representatives of various levels of government (First Nations, federal, provincial, and local), academic and professional organizations, non-governmental environmental groups, and industry sectors. The Council provides technical and expert support on water regulations and policies, drought and flood planning, hydrology and water use studies, and data collection, and identifies contemporary research needs.

Representatives contribute expertise and local knowledge at monthly meetings, sharing Okanagan water concerns and project proposals, engaging in discussions, and participating in Council committees. Council committees are established each term to address issues of immediate concern arising during Council or Board meetings and to bring recommendations for action items to the Council and OBWB for consideration.

TOP LEFT: *The Council working on the Okanagan Sustainable Water Strategy: Action Plan 2.0.* ***BOTTOM LEFT:*** *The Council working on their Term 8 workplan.* ***RIGHT:*** *Council members celebrate the 10th anniversary of the Council in 2015.*

1.4 Guiding principles

Ten guiding principles provide a framework for the actions in the Sustainable Water Strategy[11]. Although the principles are presented individually, they are interconnected and must be considered together for the strategy to be effective.

1. **Respect water**. Water connects and sustains all life. It is our responsibility to protect water and watersheds.
2. **Think and act as one watershed.** Local decisions must consider water and ecosystem interconnections within a broad, Okanagan watershed context. Collaboration and partnerships across political boundaries are essential for informed and coordinated decision-making.
3. **Control pollution at its source.** The Okanagan must be protected from pollution for the benefit of healthy ecosystems and to safeguard a clean, safe, and reliable water supply for human use.
4. **Restore aquatic and riparian ecosystems.** Natural ecosystems, especially those that are rich in biodiversity, are needed to maintain water quality and quantity. Their protection is also critical for maintaining resilience to climate change.
5. **Put water stewardship at the forefront of land-use planning decisions.** Land and water are interconnected. Urban and rural land-use decisions must minimize local and cumulative impacts on water resources and aquatic habitats.
6. **Allocate water in a transparent and responsible manner.** How and when water is allocated must be determined in a way that is rational, evidence-based, and easy to understand. Sufficient water must be available for the environment, basic human needs, agriculture, cultural self-determination, and economic livelihoods - now and in the future.
7. **Ensure community water supply systems are resilient to climate change.** Water systems must be designed to reduce water waste, maximize water use efficiency, and minimize environmental impacts. When practical, alternative sources such as rainwater harvesting and greywater reuse should be developed.
8. **Collect and share knowledge.** Decisions about water should be informed by technology, science, and traditional knowledge (when used with permission). Data must be integrated and easily accessible. Decisions should be based on evidence; however, a lack of data must not limit action to protect water.
9. **Encourage active public engagement and learning.** Transparent and collaborative decision-making and opportunities for information sharing and communication are essential to a collective understanding and acceptance that human activities affect water.
10. **Practice adaptive management and think long-term.** Continuous learning, innovation, planning, and improvement are essential for sustainable water management. Long-term 'water-first' thinking prevents the cumulative effects of short-sighted land-use actions.

11 Action Plan 1.0 contained 12 guiding principles, which were reviewed by the Okanagan Water Stewardship Council and revised for Action Plan 2.0.

1.5 Overview of actions in the Sustainable Water Strategy

The remaining chapters of the Sustainable Water Strategy are organized into themes. Chapter 2 Water Quality discusses actions needed to ensure clean water is available for humans and ecosystems by protecting water sources, conserving and restoring aquatic ecosystems, reducing the impact of land use on water, and managing invasive aquatic species. Chapter 3 Water Quantity focuses on actions required to make sure there is enough water for ecosystems, agriculture, and domestic uses now and in the future. Chapter 4 Delivering the Strategy describes the actions required to carry out the water quantity and quality actions in the Strategy, including a solid governance framework, strong partnerships, an engaged community, and adequate funding and resources. An overview of the actions presented in Chapters 2, 3 and 4 is provided below.

ID	ACTION	OBWB PARTNERS	RECOMMENDATION FOR THE OBWB	PAGE #
Water Quality				
2-1	Account for the impact of weather and climate on water in all planning and decision-making.	All organizations involved in protecting water.	Apply a climate lens to all initiatives led by the OBWB.	23
2-2	Prepare and fully resource collaborative source protection plans for all watersheds in the Okanagan.	Water suppliers, Interior Health, B.C. Ministry of Forests, Lands and Natural Resource Operations and Rural Development (FLNR), tenure holders, conservation groups, First Nations.	Convene a group with Okanagan-wide representation to coordinate and lead source protection initiatives, provide technical advice, and encourage consistency in the format and content of source protection plans.	25
2-3	Develop and conduct outreach and education programs to raise awareness about the importance of source protection.	Water suppliers, watershed users (licensees, provincial staff and public) and conservation groups.	Expand Okanagan WaterWise water quality strategies.	25
2-4	Review and update forestry, mining, range, recreation and wildfire management practices to increase water infiltration and reduce potential for surface runoff and contamination of source waters.	FLNR, B.C. Ministry of Energy, Mines and Petroleum Resources (EMPR), water suppliers, tenure holders (range and forestry), Interior Health, First Nations.	Advocate for source protection considerations to be included in natural resource management by provincial agencies. Facilitate communication and coordination among levels of government.	27
2-5	Improve understanding of nutrient sources in rural areas and undertake collaborative and coordinated efforts to monitor nutrient inputs to surface water and groundwater.	B.C. Ministry of Agriculture (AGRI), BC Agriculture Council, B.C. Ministry of Transportation and Infrastructure (MOTI), B.C. Ministry of Environment (ENV), water suppliers.	Support farmers, local governments and water suppliers in protecting water in rural areas.	28
2-6	Bring areas with septic systems onto community sewer.	Local governments, B.C. Ministry of Health, B.C. Ministry of Municipal Affairs and Housing, ENV.	Provide grant funding through the Sewerage Facilities Assistance program.	29
2-7	Prepare natural asset strategies for Okanagan communities.	Local governments.	Facilitate knowledge-sharing among local governments and provide funding to support natural asset strategy projects.	30
2-8	Improve stormwater management practices and policies in Okanagan urban communities.	Local governments, MOTI.	Research best practices for stormwater management and share that information with local governments. Provide funding for innovative stormwater management projects. Encourage stormwater utilities to create funding through their rates for projects to protect source water.	31
2-9	Develop Okanagan-wide policies and plans for wetland protection focusing on no net loss, and restoration and enhancement.	Local governments, conservation groups.	Facilitate collaboration, identify funding opportunities, and participate in investigations, reporting and projects.	34
2-10	Strengthen provincial legislation to protect, restore and enhance wetlands.	Provincial government.	Advocate for improved legislation.	35
2-11	Prepare shoreline protection plans for Okanagan, Kalamalka, Wood, Skaha, Vaseux and Osoyoos Lakes.	Local governments, provincial government, federal government, First Nations, nongovernmental organizations.	Participate in the planning processes.	36
2-12	Strengthen local government oversight of riparian area and other development-related assessments completed by Qualified Environmental Professionals (QEPs).	Local governments, provincial government, QEPs.	Bring planners and QEPs together to share knowledge and experiences, develop a template terms of reference for environmental impact assessments and restoration plans, and share the template with interested local governments.	38
2-13	Collect up-to-date ecosystem inventory and mapping information across the valley and integrate into land use and source protection policies and plans.	Local governments.	Provide funding to support data collection projects.	39

ID	ACTION	OBWB PARTNERS	RECOMMENDATION FOR THE OBWB	PAGE #
Water Quality (continued)				
2-14	Focus new development in areas currently served by community water and sewer, and minimize development in hazard areas and on or near sensitive aquatic ecosystems.	Local governments.	Bring planners together to share knowledge and resources, and promote consistency in policies across local jurisdictions.	40
2-15	Educate elected officials about the importance of considering water in all development decisions and understanding that water management decisions should be based on watershed boundaries, not jurisdictional boundaries.	Local governments.	Develop a "Water 101" education package for elected officials and support planning staff in educating elected officials and voters.	40
2-16	Provide funding and support initiatives for the prevention, early detection, rapid response and containment of aquatic invasive species.	Provincial government, federal government, local governments, conservation groups.	Advocate for resources to carry out robust aquatic invasive species programs.	42
2-17	Educate the public about aquatic invasive species.	Provincial government, federal government, local governments, conservation groups.	Build-out OBWB public outreach and education campaigns related to invasive species and coordinate the campaigns with neighbouring watersheds where appropriate.	42
2-18	Complete vulnerability assessments of water intakes and other in-lake infrastructure to identify the potential impacts of invasive mussels and other aquatic invasive species.	Water suppliers.	Provide funding and compile and share best practices and technical standards to support vulnerability assessments.	42
2-19	Control Eurasian watermilfoil in Okanagan lakes.	Provincial government, federal government.	Continuously improve the OBWB Eurasian watermilfoil control program using relevant new technologies and the best available science.	42
2-20	Develop standard methods for water quality data collection. Consistently track and enhance access to the data.	ENV, Interior Health, water suppliers, First Nations.	Encourage partnerships and enhance sharing of water quality data to ensure timely application of valuable water quality data to water management decisions. Develop a public web-based water quality data portal that supports benchmarking long-term water quality changes.	44
2-21	Review and update existing provincial Water Quality Objectives (WQO) in the Okanagan, and expand to other Okanagan lakes and streams if needed.	ENV, water suppliers.	Support the Provincial government and Okanagan water suppliers in the review and provide recommendations on other lakes and streams that would benefit from WQOs.	45
2-22	Develop tools that support benchmarking, measuring, tracking, management, and accountability for water in the Okanagan.	Water suppliers, provincial government.	Participate in or lead projects that contribute to progress reporting on watershed indicators.	45
Water Quantity				
3-1	Determine EFNs for all Okanagan streams, and share with decision-makers to support sound and defensible water allocation decisions that maintain proper functioning of aquatic ecosystems.	Okanagan Nation Alliance, Canada's Department of Fisheries and Oceans (DFO), FLNR.	Obtain funding, provide project management services, and share results.	51
3-2	Develop a pilot Agricultural Water Reserve for a watershed in the Okanagan basin and then work towards a basin-wide Agricultural Water Reserve if it is deemed feasible based on the learnings and outcomes of the pilot.	FLNR, AGRI, Agriculture and Agri-Food Canada (AAFC), water suppliers, agricultural associations.	Identify funding sources, help facilitate the pilot project, and assist with the basin-wide planning process.	53
3-3	Build more flexibility into irrigation licences to allow for early-season, late-season and part-season irrigation in the Okanagan, without increasing allocation of water or jeopardizing environmental flows.	FLNR, agricultural associations.	Lobby the provincial government to consider flexible licensing for agriculture.	53
3-4	Prepare or update Water Conservation Plans for all Okanagan water suppliers.	Water suppliers.	Promote best practices and provide funding to support water conservation initiatives identified in the plans.	55

ID	ACTION	OBWB PARTNERS	RECOMMENDATION FOR THE OBWB	PAGE #
Water Quantity (continued)				
3-5	Improve irrigation management and water efficiency in the residential, commercial, parks and recreation, and agricultural sectors.	Water suppliers, irrigation and landscape contractors, agricultural associations, Irrigation Industry Association of BC (IIABC), AGRI.	Prepare a model topsoil bylaw (using information from the Topsoil Bylaws Toolkit) and standard landscape guidelines and promote adoption throughout the Okanagan. Support water suppliers and agricultural and irrigation organizations in promoting water efficiency and delivering irrigation and landscaping certification programs. Advocate for senior government resources and funds to support farmers in improving water efficiency.	57
3-6	Implement universal water metering in the Okanagan and promote best practices for how and when meter data are collected and how data are stored for analysis and communication to customers.	Water suppliers, appropriate business sectors (water utility software companies, for example).	Organize a workshop to enable the sharing of knowledge and experiences among water suppliers and prepare a 'water meter data collection and analysis best practices and standards' document.	59
3-7	Carry out education and outreach campaigns focused on water conservation and efficiency.	Water suppliers, appropriate business sectors (for example, nurseries and garden centres, landscape and irrigation).	Build on and deliver the water conservation and efficiency outreach program under Okanagan WaterWise.	60
3-8	Prepare drought management plans for all Okanagan communities. Periodically review the plans and update as needed to reflect changing conditions.	Water suppliers, local governments, provincial government, agricultural associations.	Encourage consistency in these plans and coordination and collaboration among the different partners. Support the dissemination of best practices via OBWB/CivicInfo Planning Guides database.	62
3-9	Optimize and modernize the operation of existing storage reservoirs. Investigate opportunities to increase storage capacity in the Okanagan.	Water suppliers, provincial government.	Support research and infrastructure investment.	64

ID	ACTION	OBWB PARTNERS	RECOMMENDATION FOR THE OBWB	PAGE #
Water Quantity (continued)				
3-10	Explore ways to offer tangible incentives to dam owners who provide services for the public good, such as timed releases for environmental flows and ecosystem services, and holding back water to relieve flooding.	Provincial government, First Nations.	Communicate with water suppliers to identify and rank possible incentives.	64
3-11	Investigate the feasibility of using aquifer storage and recovery (ASR).	Local governments, water suppliers, researchers.	Obtain funding to assist water suppliers. Leverage valley-wide information and data to add value to studies by individual water suppliers. Contribute to monitoring and assessment of ASR opportunities.	66
3-12	Improve the knowledge base to better inform flood management decisions and mitigation activities.	Local governments, provincial government, First Nations.	Obtain funding and lead initiatives with valley-wide significance. Help local governments understand how to use the latest data. Work with Indigenous communities to establish long-term goals and progressive actions to mitigate flood impacts and risk.	70
3-13	Develop and maintain up-to-date flood inundation, hazard and risk mapping for the Okanagan valley bottom.	Local governments, provincial government, First Nations.	Identify and obtain funding, provide project management and coordination services, and support and facilitate collaboration.	70
3-14	Improve flood management by strengthening collaboration, increasing public engagement, and including (with permission) local and Indigenous knowledge in decision-making and mitigation activities.	Local governments, provincial government, First Nations.	Include (with permission) local and Indigenous knowledge in OBWB-led projects, act as a bridge between Okanagan communities, and include public engagement on OBWB initiatives.	70
3-15	Review flood construction levels and floodplain setbacks and strengthen land use regulation in floodplains.	Local governments, provincial government, First Nations.	Identify and obtain funding, provide project management and coordination services, and support and facilitate collaboration.	70

ID	ACTION	OBWB PARTNERS	RECOMMENDATION FOR THE OBWB	PAGE #
Water Quantity (continued)				
3-16	Add to snow data networks and improve inflow forecast models. Complete watershed assessments to identify risks to water flow and timing and other risks related to a changing climate.	Provincial government, water suppliers.	Encourage water suppliers to apply common approaches and standards to these assessments. Make climate change projections widely available. Support vulnerability (quantity) mapping research.	71
3-17	Maintain and expand the network of hydrometric stations in the Okanagan and enhance the sharing and open sourcing of collected hydrometric data.	Provincial government, federal government, local governments, First Nations.	Influence the provincial and federal governments to expand their networks. Provide funding for local organizations to collect and report data. Encourage use of the Integrated Hydrometric Data System to support the provincial hydrometric data warehouse.	72
3-18	Increase climate stations in the Okanagan to allow for better resolution in weather projections.	AGRI, AAFC, local governments, water suppliers, agricultural associations.	Identify funding sources and coordinate partners to submit funding applications.	72
3-19	Undertake groundwater mapping, aquifer characterization, and groundwater-surface water interaction studies in the Okanagan. Link these efforts with ongoing EFN studies to identify water-stressed areas.	Researchers, provincial government, local governments, First Nations.	Identify priority areas for aquifer mapping and groundwater/surface water interaction assessments and obtain funding for research.	74
Delivering the Strategy				
4-1	Integrate management objectives throughout government agencies and with external partners.	Federal government, provincial government, local governments.	Advocate for local government participation in dialogue at the provincial and federal levels	80
4-2	Share Okanagan-specific information and knowledge with partners within the valley and beyond to facilitate common pools of knowledge and to bring in new partners.	Okanagan Water Stewardship Council member organizations, local governments.	Present at conferences and workshops. Participate in the work of professional organizations.	81

ID	ACTION	OBWB PARTNERS	RECOMMENDATION FOR THE OBWB	PAGE #
Delivering the Strategy (continued)				
4-3	Strengthen relationships between Okanagan local governments, non-governmental organizations, professional organizations, First Nations, and the faculty, staff and students at academic institutions to promote community-engaged research and learning.	Local governments, UBC Okanagan, Okanagan College, First Nations.	Work with faculty and researchers to identify opportunities for community-engaged research.	82
4-4	Increase opportunities for shared learning with Okanagan Indigenous communities, especially of cultural practices, environmental stewardship, and governance processes.	First Nations, provincial government, local governments.	Maintain dialogue and strengthen relationships with Indigenous communities in the Okanagan basin.	86
4-5	Deliberately expand the network of Okanagan water professionals and interested parties to create a greater diversity of knowledge from which to develop solutions. Facilitate knowledge transfer across generations, cultures, communities and sectors. Support new professionals by linking them with research networks and employment opportunities.	UBC Okanagan, Okanagan College.	Work with the Okanagan Water Stewardship Council and ensure that membership remains diverse and active. Provide and facilitate mentoring opportunities. Convene workshops and other learning opportunities and provide funding for events offered by partner organizations.	88
4-6	Build-out outreach programs and communications strategies, working with all Okanagan communities and partner organizations to facilitate consistent messaging, mutual understanding, and a shared way of framing problems and solutions.	Local governments, provincial government, federal government, Okanagan Water Stewardship Council member organizations.	Facilitate working groups of OBWB partners to gather input on programs.	90

ID	ACTION	OBWB PARTNERS	RECOMMENDATION FOR THE OBWB	PAGE #
Delivering the Strategy (continued)				
4-7	Complete coordinated or joint funding applications for water planning, management or infrastructure projects, where possible.	Local governments, First Nations.	Support clear communication between organizations with similar goals in different parts of the Okanagan so that grants are more aligned and collaborative. Assist communities and organizations with grant application writing by providing technical assistance, review, or letters of support and/or linking groups with grant writing professionals.	90
4-8	Identify and match-make funding organizations and agencies that can support water projects in the Okanagan, and help Okanagan communities identify opportunities for grants.	Local and external funding organizations.	Convene gatherings of grantees and funders in the Okanagan to share successes and build relationships. Engage with funder organizations to raise awareness among funders about Okanagan water issues and innovative approaches.	91
4-9	Monitor progress on completing the actions recommended in the Strategy and report out on progress made.	Local governments, provincial government, and other agencies responsible for implementing the Strategy.	Compile information from implementing organizations, and track and report progress in addressing and completing each of the actions in the Strategy. Periodically revise and update the Strategy.	92

CHAPTER 2
WATER QUALITY

2.0 WATER QUALITY

Many Okanagan residents drink water from surface sources like mountain streams with headwater reservoirs, and lakes in the valley bottom. In general, valley-bottom lakes have good water quality and low turbidity. Typically, spring runoff increases sediment levels and leads to turbidity in these lakes. Pollutants such as dissolved metals, nutrients, and pathogens can attach to suspended particles and enter the water. Several of these pollutants, especially heavy metals, can be detrimental and often toxic to aquatic life. The addition of nutrients can encourage the development of harmful algal blooms. Pathogens contribute to waterborne diseases like *cryptosporidiosis*, *cholera* and *giardiasis*. Many tributary streams and upper elevation reservoir sources have sediment (which makes them turbid), colour, and pathogen and organic loading. As with the valley-bottom lakes, turbidity can be greatest during spring freshet and is of most concern when pathogens are present because the sediment can interfere with treatment to remove the pathogens.

Sediment plume from Mission Creek during freshet in 2012. Photo courtesy Bob Hrasko.

Surface water entering the valley bottom is influenced by many land-use practices and discharges from agriculture, industry, commercial businesses, and urbanization. These land uses have transformed the landscape, which has resulted in increased impervious surfaces, like rooftops, driveways, roads, parking lots, sidewalks, patios, compacted soil, and runoff. With more riparian and wetland areas disappearing under impermeable cover, with runoff directed to drainage pipes and stormwater outfalls, it has become more difficult to protect water quality.

Groundwater is also an important water source in the Okanagan. Groundwater is found almost everywhere underground in saturated soils, sands, gravels and glacial till, or in crevices and cracks in rock geological deposits (Figure 2-1). Significant areas of underground water are known as aquifers. Naturally occurring sources of groundwater contamination include arsenic, uranium, or other metals that occur in the geological formation around the aquifer. However, most groundwater contamination is from human or animal sources, including pathogens and nitrates from agriculture, chemicals from industrial or commercial land uses, and nitrates from residential septic fields. The type of aquifer determines how vulnerable it is to contamination. If a sand aquifer is capped by a low permeability clay layer (confined), rain and snowmelt move very slowly (years to decades) through the protective clay cap. However, if a sand aquifer has no such cap (unconfined), there is little protection from contamination originating at the surface. These types of aquifers are deemed vulnerable, and land uses in the vicinity of these aquifers must follow best practices to minimize impacts on the aquifers.

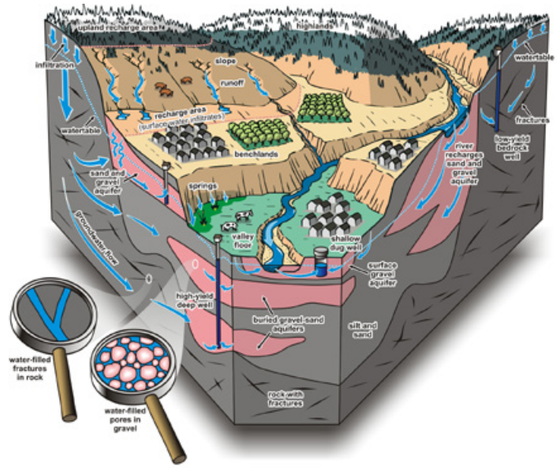


Figure 2-1 *Groundwater can be a source of reliable, clean water but the supply that is available for use depends on the rate of natural recharge, not the total volume stored.*[12]

Climate change affects water quality in the Okanagan. The Okanagan is experiencing more frequent landslides and bank erosion, and higher stream flows during extreme rain events, which increase sediment and lead to turbidity in watercourses. Additionally, our stormwater and sewer systems are often not designed to deal with the high intensity, short duration rainfall events brought on by climate change, which can result in localized flooding and increased runoff. Wildfires can also impact water quality in streams, rivers, and lakes. After a fire, hydrophobic soils can increase water repellency, which in turn leads to surface runoff and erosion, transporting nutrients to surface waterbodies.

This chapter focuses on four key elements needed to protect water quality in the Okanagan: source water protection, aquatic ecosystem conservation and restoration, aquatic invasive species management, and water quality monitoring.

ACTION 2-1

Account for the impact of weather and climate on water in all planning and decision-making.

Partners: All organizations involved in protecting water.

Recommend that the OBWB: Apply a climate lens to all initiatives led by the OBWB.

2.1 Source water protection

The requirements for drinking water systems are set out by the B.C. *Drinking Water Protection Act* and the *Drinking Water Protection Regulation*.[13] Under the Act, water suppliers are responsible for providing safe water and notifying users if there is an actual or potential risk to their drinking water.[14] The Canadian Council of Ministers of the Environment (CCME) multi-barrier approach is recognized as best practice in the provision of safe drinking water. It recognizes that no single barrier alone adequately reduces the public health risk related to drinking water. To keep drinking water clean, safe and reliable, the components of the water supply system need to be understood and managed holistically (Figure 2-2). The multi-barrier

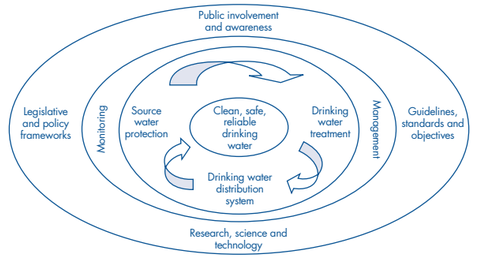


Figure 2-2 *Components of a multi-barrier approach to drinking water protection.*[15]

12 Turner, R, R. Franklin, B. Taylor, M. Ceh, S. Grasby, B. Symonds, M. Adams, P. Armour, C. Harlow, M. Journeay, D. Machin, T. Molyneux, D. Neilsen, R. Simpson, K. Stephens, and T. van der Gulilk. 2006. Okanagan Basin Waterscape. Geological Survey of Canada, Miscellaneous.

13 Drinking Water Protection Act, S.B.C. 2001, c. 9 and Drinking Water Protection Regulation, B.C. Reg. 200/2003.

14 Office of Medical Health Officer. 2017. Drinking Water in Interior Health: An Assessment of Drinking Water Systems, Risks to Public Health, and Recommendations for Improvement.

15 Canadian Council of Ministers of the Environment. 2004. From Source to Tap: Guidance on the Multi-Barrier Approach to Safe Drinking Water. Winnipeg, Manitoba: Federal-Provincial-Territorial Committee on Drinking Water and CCME Water Quality Task Group.

Impacts of human activities in source watersheds in the Okanagan.

approach includes (1) selecting the best available water source and protecting it from contamination, (2) using effective water treatment, and (3) preventing water quality deterioration in the distribution system. This Strategy focuses on the first – source water protection.

Source water protection, broadly defined as watershed management to minimize or prevent contamination of waterbodies and aquifers, is critical to the provision of safe drinking water. The central challenge of source protection is that there are numerous ways that water can be polluted, such as natural erosion and fecal deposition from wild or domestic animals, resource development such as mining and forestry, leaching of contaminants from road drainage, petro-chemical spills, septic leaks, and application of nutrients and pesticides. The middle and upper elevations of Okanagan watersheds and headwaters are mainly designated as Crown land and are open to forestry, recreation, mining, livestock grazing and other activities that pose a risk to source water protection.

The B.C. legislative framework for drinking water source protection includes numerous acts and regulations enacted and enforced by many government agencies, which can result in both overlapping authority and gaps in authority.

There is no easy solution to these challenges. Source protection calls for long-term planning, collaboration, public education, regulation and consistent effort to prevent, minimize, or control potential sources of water pollution. Water suppliers can complete source protection plans to identify and mitigate risks and bring stakeholders together. Tools such as spill reporting, RAPP (Report All Poachers and Polluters) lines, and community-driven watershed and lake watches allow citizens to become watershed stewards.

2.1.1 Source Protection Plans

Under the *Drinking Water Protection Act*, Drinking Water Officers can direct water suppliers to complete source protection plans. These plans have two parts: a source water assessment and a response plan. The assessment identifies natural and human hazards that may impact the drinking water quality and quantity of the source. The response plan provides measures to reduce the threats to the drinking water source. The response plan may include public education and engagement; best management and conservation practices; infrastructure improvements; cooperative planning and voluntary programs; and local authority zoning and other land-use regulation requirements.

Under the *Water Sustainability Act*, formal water objectives establish thresholds for water quality or quantity for specific uses, such as drinking water, and measures needed to sustain aquatic ecosystems. They can be used by water suppliers and others to evaluate the impacts of land use on the water source. This provides a crucial link between land use and water decision making, within the context of a source protection plan.

Implementation of source protection plans can be challenging due to a lack of stable funding, staff that are assigned to monitor the plan and resource management in the watershed, the need for multi-jurisdictional collaboration, and a lack of an overall coordinating entity. Some jurisdictions outside of the Okanagan have moved forward on addressing these issues by assigning a regional district as the coordinating entity, collecting a tax for watershed protection and planning (Story 2-1). Regional districts in the Okanagan could investigate the feasibility of a similar program.

STORY 2-1

REGIONAL DISTRICT OF NANAIMO DRINKING WATER AND WATERSHED PROTECTION PROGRAM

The Regional District of Nanaimo **Drinking Water and Watershed Protection Program** (DWWP) is designed to help the region learn more about source water, use the information to make better land-use decisions, and help communities protect the environment. The four municipalities and seven electoral areas in the regional district all contribute funding to the DWWP, which they collect through a property tax. The funding is used to hire the expertise needed to support the data gathering and planning programs for source protection. It is also used to develop education programs and incentive programs to promote more efficient water use, and to support non-government organizations that assist with collecting field data. The initiatives of the DWWP recognize the need to take a regional perspective to address protection of watersheds and drinking water in cooperation with the many other stakeholders in the region.

ACTION 2-2

Prepare and fully resource collaborative source protection plans for all watersheds in the Okanagan.

Partners: Water suppliers, Interior Health, FLNR, tenure holders, conservation groups, First Nations.

Recommend that the OBWB: Convene a group with Okanagan-wide representation to coordinate and lead source protection initiatives, provide technical advice, and encourage consistency in the format and content of source protection plans.

ACTION 2-3

Develop and conduct outreach and education programs to raise awareness about the importance of source protection.

Partners: Water suppliers, watershed users (licensees, provincial staff and public) and conservation groups.

Recommend that the OBWB: Expand Okanagan WaterWise water quality strategies.

Source protection in the Okanagan should be considered for three broad geographic areas:

1. Upper watersheds around reservoir lakes and streams on Crown land;
2. Rural watersheds (areas not incorporated by municipalities) that include agricultural areas and large lots; and
3. Stormwater management in urban watersheds with densely developed areas.

While different actions are needed in these areas to address different sources of pollution, residents and water suppliers should adopt a holistic view and come to appreciate that source protection encompasses activities on all lands and waters in the Okanagan.

2.1.2 Upper watersheds

Source water protection in the Okanagan is particularly challenging because the upland watersheds are mainly Crown land and are managed for multiple uses, such as recreation, mining, forestry, and range. The OBWB policy statement for Crown lands supports the responsible and informed management of human activities and multiple land uses in Okanagan watersheds, but states that the protection of water supply and quality should take priority in the watersheds.

Many government agencies at a local, provincial or federal level have a role in minimizing potential impacts on watersheds through legislation, policy and best practices that govern the activities and industries they regulate. Indigenous communities also have specific land use and management goals for Okanagan watersheds, their unceded, traditional territory. Although local water suppliers do not have jurisdiction over land use in the source watersheds, they are responsible and legally accountable for providing potable water to their customers. The best way for water suppliers to protect water sources is through long-term, coordinated and collaborative partnerships with the watershed users, including private industry, public interest and recreation groups (like Fish and Game Clubs), provincial regulators and enforcement staff (Story 2-2), and Indigenous communities. However, it can be challenging to bring these groups together in a meaningful, long-term process.

Forestry and other Crown land leaseholders are not obligated to attend meetings with water suppliers and other stakeholders but often do so to gain a better understanding of the watershed and to strengthen their social licence (Story 2-3).

STORY 2-2 **REGIONAL DISTRICT OF NORTH OKANAGAN (RDNO) SOURCE PROTECTION PLANNING**

The RDNO completed a source assessment for the Duteau Creek watershed in 2008 and then created a technical advisory committee comprising provincial and federal agencies, licence and tenure holders, and First Nations to set priorities to reduce risks to drinking water. In 2014, the Duteau Creek Watershed Assessment Response Plan was completed. The technical advisory committee meets twice annually to develop work plans and joint projects and recommend improvements to management of the watershed. Successes have included the creation of designated recreation sites at Grizzly Reservoir with a campsite host and self-contained toilets; implementation of improved off-stream watering and on-site fencing; management of cattle grazing rotations and cattle exclusion areas; collaborative work with the forest industry through sharing data, mapping and reporting; improving knowledge of aquatic ecosystem flow needs; educational signage; and development of source vulnerability mapping.

TOP: *The Duteau Creek advisory committee. Photo courtesy Regional District of North Okanagan.* ***BOTTOM:*** *Information Kiosk at Grizzly Lake. Photo courtesy Jennifer Dundson.*

STORY 2-3 **SILVOPASTURE PROJECT IN VERNON CREEK COMMUNITY WATERSHED**

The main goal of the Vernon Creek community watershed silvopasture project is to draw cattle away from sensitive riparian areas to improve water quality. Silvopasture blends agriculture, silviculture and conservation practices in the same land-use system. The project is led by the Ministry of Agriculture and supported by FLNR, Agriculture and Agri-Food Canada, Tolko Industries, Coldstream Ranch and other ranches, and the District of Lake Country. Various best management practices have been studied over six seasons, including off-stream watering, riparian fencing, controlled access to rangelands, livestock behaviour, forage analysis, and tree growth. The research has shown that the placement of forage can mitigate water quality impacts in community watersheds. In addition, grass-seeded cutblocks can reduce livestock use and impacts on wetland meadows in community watersheds.

LEFT: *A research group visits a Silvopasture cutblock in the Vernon Creek watershed. Photo courtesy Rob Dinwoodie.* ***RIGHT:*** *A Coldstream Ranch cowboy points to abundant forage in a Silvopasture cutblock, intended to draw cattle away from sensitive streams and riparian areas. Photo courtesy Rob Dinwoodie.*

ACTION 2-4

Review and update forestry, mining, range, recreation and wildfire management practices to increase water infiltration and reduce potential for surface runoff and contamination of source waters.

Partners: FLNR, EMPR, water suppliers, tenure holders (range and forestry), Interior Health, First Nations.

Recommend that the OBWB: Advocate for source protection considerations to be included in natural resource management by provincial agencies. Facilitate communication and coordination among levels of government.

2.1.3 Rural watersheds

The valley-bottom rural areas are managed for many uses, including vineyards and orchards, pasture, aggregate quarries, golf courses and parklands, forestry, and livestock operations. As these land-uses and associated rural road and drainage networks have developed, the natural streams have been constrained, diverted or covered, and wetland areas have been filled.

Phosphorus and nitrate pollution from rural and urban watersheds was a driving force for the founding of the OBWB (Story 2-4), because of widespread concern about algae blooms in the lakes. Nitrates are highly mobile in groundwater, and phosphorus in surface water can lead to algae growth. High concentrations of these nutrients can reduce water quality.

STORY 2-4 SEWERAGE FACILITIES ASSISTANCE GRANTS

Since 1970, the OBWB has been providing Sewerage Facilities Assistance (SFA) grants to local governments to move from septic systems to tertiary community sewage treatment plants. Between 1970 and 2018, these grants provided more than $65 million for improved wastewater treatment in the Okanagan. Phosphorus loading into lakes from Okanagan municipalities decreased from almost 60,000 kg/year in 1970 to less than 4,000 kg/year by 2007[16] despite significant population growth during this period. This change was mainly attributable to improved sewage treatment. As new technologies become available, the SFA program will continue to support improvements and reduce nutrient loading.

Example of a rural area in the Okanagan. Photo courtesy Mike Biden, IFLyPhoto.com.

ACTION 2-5

Improve understanding of nutrient sources in rural areas and undertake collaborative and coordinated efforts to monitor nutrient inputs to surface water and groundwater.

Partners: AGRI, BC Agriculture Council, MOTI, ENV, water suppliers.

Recommend that the OBWB: Support farmers, local governments and water suppliers in protecting water in rural areas.

In 2017, the B.C. Minister of Environment issued a review of the Hullcar (*Clcahl*) aquifer in the North Okanagan because of nitrate contamination in nearby drinking water wells. As a result, new regulations have been developed for spreading manure and other liquid waste from livestock operations[17]. Riparian buffers, wetlands, drainage and nutrient management plans are often the best way to limit water pollution from agricultural areas.

16 Sokal, M. 2018. B.C. Ministry of Environment and Climate Change, personal communication.

17 Code of Practice for Agricultural Environmental Management.

Most Okanagan communities now have tertiary wastewater treatment systems, with biological nutrient removal and/or terrestrial spray irrigation to limit pollution of surface water and groundwater. However, there is continual need for public investment in wastewater treatment infrastructure to maintain the highest water quality standards.

In addition, because seepage from septic fields is still a source of phosphorus and nitrate pollution in the Okanagan, further investment is needed to move from septic systems to community sewer systems. In spring 2017, flooded septic systems from lakeshore cottages triggered a blue green algae bloom in parts of Okanagan Lake. Even though there has been substantial advancement in provincial regulation of on-site wastewater treatment systems, there are insufficient resources to provide effective oversight. Many of the existing on-site systems are located along the waterfront in rural electoral areas and First Nation lands. Extending community sewer systems to these areas is an effective strategy to reduce septic-related pollution; however, this approach is very costly, and implementation has been limited.

ACTION 2-6

Bring areas with septic systems onto community sewage systems.

Partners: Local governments, B.C. Ministry of Health, B.C. Ministry of Municipal Affairs and Housing, ENV.

Recommend that the OBWB: Provide grant funding through the Sewerage Facilities Assistance program.

2.1.4 Urban watersheds

Stormwater is a broad term that describes runoff from urban areas. Under natural conditions, rain and snowmelt typically infiltrate the soil. In urban areas, runoff is captured on roadways, roofs, parking areas and other impervious surfaces and transferred directly to creeks and lakes via a network of buried pipes, introducing sediments and contaminants without any natural remediation. Urban stormwater drainage systems may also act to route point-source pollutant spills quickly and directly into surface waters.

Example of an urban watershed in the Okanagan. Photo courtesy Dan Millar.

The 'pave-and-pipe' approach also contributes to increased runoff and higher peak flows that can cause flooding, road damage, shallow and deep channels (rills and gullies) in soil, as well as stream bank erosion, mudslides, and landslides. The capacity of urban stormwater drainage systems is often exceeded, which results in localized flooding and property damage. Stormwater drainage systems are often undersized for higher flows.

Infiltration and percolation are two key mechanisms for the downward movement of water and filtering of water through soil particles. Enhancement and preservation of these natural processes can improve water quality by decreasing contaminants and allowing groundwater recharge.

Green infrastructure and stormwater user fees are two tools that help local governments improve urban stormwater management. Green infrastructure practices maintain or restore natural flow patterns by allowing water to slowly permeate the ground. Green infrastructure can include preserving or restoring natural areas such as stream buffers and wetlands, and reducing the area of paved surfaces. In addition to managing stormwater, green infrastructure can

provide wildlife habitat, create wildlife corridors, cool urbanized areas, improve air quality, and recharge aquifers. An integrated asset management strategy – one that includes green infrastructure in addition to traditional grey infrastructure (pipes and culverts) – provides many benefits (Story 2-5).

STORY 2-5 TOWN OF GIBSONS NATURAL ASSET MANAGEMENT

In 2014, Gibsons became the first community in North America to pass a municipal asset management policy that explicitly defines and recognizes natural assets as an asset class and creates specific obligations to operate, maintain and replace natural assets alongside traditional capital assets. **Towards An Eco-Asset Strategy in the Town of Gibsons**[18] was developed in 2015, which identifies and inventories its natural assets and documents the Town's approach to place the assets, and the municipal services they provide, at the core of their municipal infrastructure system.

Gibsons is a founding member of the **Municipal Natural Asset Initiative (MNAI)**, which was developed to replicate the Town's approach in other municipalities. The Town and the MNAI are working to create a recognized accounting standard that communities can use for valuation of their assets. **Advancing Municipal Natural Asset Management: The Town of Gibsons' experience in financial planning and reporting**[19] was published in 2018 to help educate other municipalities about this concept.

MNAI pilot projects have been completed in Grand Forks, Nanaimo, and West Vancouver in B.C. and Peel and Oakville in Ontario. All pilots found that:

- natural assets provided stormwater management services equivalent to engineered alternatives,
- the value of natural assets increased considerably due to their resiliency and adaptability under climate change and intensified development scenarios,
- the full value of natural assets is likely much higher since economic valuations did not include lifetime operations and maintenance costs or the value of services beyond stormwater management.

ACTION 2-7

Prepare natural asset strategies for Okanagan communities.

Partners: Local governments.

Recommend that the OBWB: Facilitate knowledge-sharing among local governments and provide funding to support natural asset strategy projects.

Stormwater user fees have the potential to create a dedicated funding stream on a basis that is transparent and fair to residents.[20] Dedicated revenue created through user fees helps to ensure that infrastructure requirements do not compete with other municipal services for resources. Property-specific stormwater charges are being used in several communities in Canada to improve urban stormwater management (Story 2-6).

18 Town of Gibsons. 2015. Towards An Eco-Asset Strategy in the Town of Gibsons. URL: https://gibsons.ca/wp-content/uploads/2017/12/Eco-Asset-Strategy.pdf.

19 Town of Gibsons. 2017. Advancing Municipal Natural Asset Management: The Town of Gibson's experience in financial planning & reporting. URL: https://gibsons.ca/wp-content/uploads/2018/01/GibsonsFinancialPlanningReportJan2018-PRINT.pdf.

20 Sustainable Prosperity. 2016. New Solutions for Sustainable Stormwater Management in Canada. URL: https://institute.smartprosperity.ca/sites/default/files/stormwaterreport.pdf.

STORY 2-6 PROPERTY-SPECIFIC STORMWATER CHARGES IN VICTORIA, B.C.[21]

Before 2016, all stormwater fees in the City of Victoria were included in property taxes and based on the assessed property value. In 2016, after extensive public engagement, a new stormwater utility was introduced and most stormwater fees were removed from property taxes.

Stormwater fees are now charged through the utility and based on property-specific characteristics:

1. Impervious area – square metres of hard surfaces such as roofs, parking areas and driveways measured through building plans, aerial photography, and GIS mapping;
2. Street cleaning area – the length of the property street frontage and the street type;
3. Intensity code – the impact the property has on the stormwater system, based on property type (low density residential, multi-family residential, civic/institutional, or commercial/industrial); and
4. Codes of practice program – for properties that have 10 or more parking spaces and are automotive businesses, recreation facilities, recycling operations, storage yards, or have construction activities on site.

The utility offers financial incentives for sustainable rainwater management, including rain gardens, cisterns and permeable (absorbent) paved areas.

The development community and individual homeowners play a key role in improving stormwater management and building climate resilience. Site design strategies specific to local climate and soil conditions can be used to manage runoff and decrease reliance on stormwater sewers (Story 2-7). Absorbent landscaping, sufficient topsoil, infiltration facilities, green roofs, and rainwater reuse are practical strategies that provide significant benefit to the environment by reducing stormwater flows. Local governments can educate residents and the development community about the importance of on-site stormwater reduction and retention as best practice. Appropriate bylaws, cross-connection programs, and source control strategies can support detailed land-use planning and site design.

ACTION 2-8

Improve stormwater management practices and policies in Okanagan urban communities.

Partners:
Local governments, MOTI.

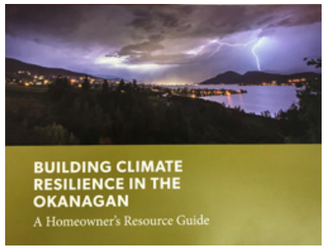
Recommend that the OBWB:
Research best practices for stormwater management and share that information with local governments. Provide funding for innovative stormwater management projects. Encourage stormwater utilities to create funding through their rates for projects to protect source water.

21 City of Victoria. 2019. Stormwater Utility website. URL: www.victoria.ca/EN/main/residents/water-sewer-stormwater/stormwater/stormwater-utility.html.

STORY 2-7 RESOURCES TO HELP HOMEOWNERS PROTECT THEIR PROPERTIES FROM RUNOFF

Several resources are available to help homeowners protect their properties from runoff.

Slow It, Spread It, Sink It: An Okanagan Homeowner's Guide to Using Rain as a Resource[22] is an easy-to-use guidebook that explains how local residents can easily capture and re-use the water that falls on their properties. The guidebook demonstrates how to divide a typical property into runoff zones, explains how to evaluate runoff potential, provides techniques for capturing rainfall and controlling runoff, and gives examples of local rainwater management projects.



The **Water Balance Express**[23] is a modelling tool that helps homeowners learn how to reduce runoff and increase infiltration to the soil. Homeowners can identify their property on a map, recreate their current house and yard, and then add building blocks of different features to the property to see how they impact stormwater.

Building Climate Resilience in the Okanagan: A Homeowner's Resource Guide[24] summarizes climate challenges and identifies key actions that Okanagan homeowners can take to protect properties from flood, drought, fire, and invasive species.

2.2 Aquatic, wetland and riparian ecosystem conservation and restoration

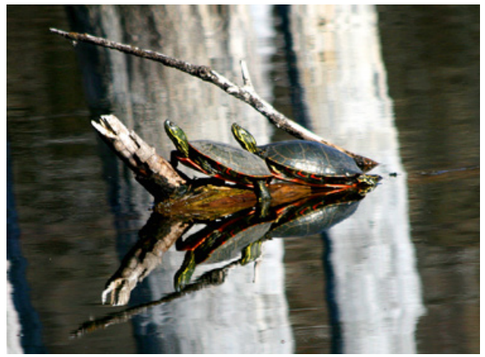
In addition to their intrinsic value, diverse and productive aquatic, riparian and wetland ecosystems provide significant social, economic, and environmental benefits. Aquatic ecosystems include fish, plants and invertebrates and the lakes, ponds and streams where they reside. Riparian ecosystems are the rich lands bordering streams and lakes, with their own characteristic trees, plants and animals. Wetlands are highly productive ponded or boggy areas that may be dry or wet to different degrees, depending on the time of year.

Preserving and restoring these water-associated ecosystems helps to reduce the impacts of extreme weather events, especially with increases in extreme events with a changing climate. Healthy aquatic ecosystems provide culture and recreational values, and drinking water sources. Robust and intact wetland and riparian ecosystems purify water, decrease runoff, attenuate flooding, and contribute to nutrient cycling. All provide habitat for fish and wildlife. Collectively, the benefits from aquatic and other ecosystems are "ecosystem services."

22 www.okwaterwise.ca/pdf/HomeDrainageGuide_Okanagan.pdf
23 https://waterbalance.ca/tool/water-balance-express/
24 www.rdosmaps.bc.ca/min_bylaws/PublicWorks/Building_resilience_Guidebook/SOREBRDOS.pdf

LEFT: *Thomson Marsh wetland, Kelowna.* ***RIGHT:*** *Fascieux Creek wetland, Kelowna.*

Biodiversity – the variety of species and ecosystems and the ecological processes of which they are a part – underpins ecosystem resilience, integrity and functioning. For example, willow trees are excellent for stabilizing stream banks, but cottonwoods are better for shading and cooling the water in the stream. Both tree species host different insects, which feed the fish in the stream. The more species of plants and animals there are in an area (the more biologically diverse the area is) the more that region can adapt to different weather fluctuations (hot or cold years, wet or dry years) and still keep the landscape and water supplies clean and intact.



Western painted turtles sun themselves on a log in a North Okanagan wetland. Photo courtesy Debbie Gibson.

It is imperative that we protect and maintain the integrity and diversity of aquatic, riparian and wetland ecosystems and work to restore degraded areas so we can continue to benefit from the ecosystem services they offer.

2.2.1 Wetlands

Wetlands play an especially important role in natural ecosystem function for the Okanagan. Prior to the extensive agricultural and urban development that now characterizes the Okanagan, wetlands were found throughout the valley, despite it being one of the warmest and driest regions of B.C. A study completed in 2008 found that from 1800 to 2005, low elevation wetlands had declined by 84% in the Okanagan and Similkameen valley study area.[25] A 2013 study focused on the South Okanagan used remote sensing and existing land-cover classifications to assess whether current (2010) wetland occurrence had changed in comparison to a historic baseline (1988). The study detected a significant degree of wetland conversion (for example, drained and used for agriculture) and loss (for example, filled and used as a building site) among freshwater wetlands – 38% conversion – over the 22-year period.[26] Many of the remaining wetlands in the Okanagan region have been degraded by cattle grazing, nutrification and invasive species, and by habitat fragmentation caused by roads and other development.

25 Lea, T. 2008. Historical (pre-settlement) Ecosystems of the Okanagan Valley and Lower Similkameen Valley of British Columbia – pre-European contact to the present. URL: http://a100.gov.bc.ca/appsdata/acat/documents/r52470/Lea,T.Historical(pre-settlement) EcosystemsoftheOk_1497897392061_7896636654.pdf.
26 Harrison, B. and Moore, K. 2013. BC Wetland Trends Project: Okanagan Valley Assessment. URL: https://greatnorthernlcc.org/sites/default/files/documents/bc_wetland_trends_final_report_for_gnlcc_20131031_0.pdf.

The OBWB is working cooperatively with the Okanagan Nation Alliance, local, provincial and federal governments, environmental groups and businesses on a strategy to prevent further wetland loss, and support protection, as well as science, restoration and enhancement.[27] The main objective of the Okanagan Wetlands Strategy is to establish valley-wide wetland policies and best practices to protect wetlands in all jurisdictions. Other objectives include improving communication between partners and facilitating and funding wetland outreach and education.

Official Community Plans in many Okanagan communities recognize that wetlands are valuable and sensitive ecosystems. However, communities vary widely in the protection afforded to wetlands through their bylaws. Most local governments have established development permit areas (DPAs) for riparian or aquatic ecosystem protection, consistent with the importance of these ecosystems. However, a variety of maps and other criteria have been used to define the DPAs across local governments, and they do not always include all known wetlands, especially ephemeral wetlands that are dry for portions of the year.[28] The guidelines for DPAs vary among communities, and are not always clear when an environmental assessment is required, or how to evaluate impacts on environmentally sensitive areas.

Okanagan communities have many opportunities to protect wetlands and other natural assets by improving DPA maps; enhancing guidelines for development permit applications, including terms of reference for environmental assessments; and by enacting or enhancing bylaws to expand enforcement options. Local governments should strive for consistency in their policies and approaches to increase clarity for citizens and for businesses that operate between jurisdictions. Local governments can look to examples from across the region and the province for conserving wetlands, riparian areas, and other natural areas on private land within their boundaries.[29]

Education and outreach are fundamental to changing how we value and protect Okanagan wetlands. Because decision-makers have discretion for most approvals regarding impact on wetlands and mitigation of those impacts, it is critically important that elected officials understand the exceptional value that wetlands provide. Information must be delivered with the appropriate level of detail to a variety of audiences, including the general public, elected officials, local government staff, and the scientific community. Collaboration between diverse partners is also essential.

ACTION 2-9

Develop Okanagan-wide policies and plans for wetland protection focusing on no net loss, and restoration and enhancement.

Partners: Local governments, conservation groups.

Recommend that the OBWB: Facilitate collaboration, identify funding opportunities, and participate in investigations, reporting and projects.

The Province of B.C. has developed a variety of policy statements and initiatives favourable to wetland conservation, including the British Columbia Water Plan (LivingWater Smart), Conservation Framework, Riparian Areas Regulation, and Climate Change Strategy. Most recently, under the 2016 *Water Sustainability Act*, many wetland types such as marshes, swamps, and fens were clearly defined. Thus, the Act enables protection from many activities that would occur in or near these wetlands. The previous *Water Act* that the *Water Sustainability Act* replaced only specified swamps as requiring protection.

27 Okanagan Basin Water Board. 2018. Okanagan Wetlands Strategy web page. URL: www.obwb.ca/wetlands/.

28 Okanagan Collaborative Conservation Program. 2017. Conserving Okanagan Wetlands: Local Government and Provincial Tools Workshop Report. URL: http://a100.gov.bc.ca/appsdata/acat/documents/r53168/OkanaganWetlandsWorkshopReport2017_Final_1516292463609_6290678573.pdf

29 Curran, D. 2016. Green Bylaws Toolkit. URL: https://stewardshipcentrebc.ca/PDF_docs/GreenBylaws/GreenBylawsToolkit_2016.pdf.

Riparian areas and shorelines provide habitat, reduce erosion, attenuate flooding, filter sediment, and regulate water temperatures by providing shade and wind protection, among other important functions. ***LEFT:*** *Mission Creek. Photo courtesy Bob Hrasko.* ***RIGHT:*** *Vaseux Lake.*

A provincial wetland policy, such as those prepared for Alberta, Nova Scotia and Ontario, could better provide the coordination, strategic direction, and tools required to make informed decisions. A B.C. policy could provide:

- better clarity for businesses, developers, and other proponents, on expected outcomes of their projects, enabling them to understand potential costs early in the business proposal;
- more guidance and enabling mechanisms to local government decision makers who make and implement land use decisions; and
- improved provincial accounting for wetland impacts and measures to prevent or mitigate these impacts.

ACTION 2-10

Strengthen provincial legislation to protect, restore and enhance wetlands.

Partners: Provincial government.

Recommend that the OBWB: Advocate for improved legislation.

2.2.2 Shorelines and other riparian areas

Shorelines and riparian areas have wide-ranging biological values and social, cultural and economic significance to Okanagan residents and visitors. These areas provide critical habitat for fish and wildlife and their ecosystem services include filtering sediment and pollutants, reducing erosion, storing water, attenuating flooding, and regulating water temperatures by providing shade and wind protection. Riparian areas provide essential corridors for wildlife to move from place to place, to congregate, and to find food and shelter, which are required for the long-term survival of species.

Local and senior governments share the jurisdiction for shoreline and riparian protection and restoration – and there is often confusion about roles and responsibilities. These rich areas hold particular value and significance for Indigenous communities, who have many restoration and protection goals. There is limited funding available for protection and restoration, and limited capacity within governments to ensure compliance with rules prohibiting damage and disturbance. Lakeshore planning is one way to engage all applicable agencies and partners and prepare a framework for informed land use decision-making in the short and long terms. Education and outreach are critical to change attitudes and behaviours of lakeshore residents toward shoreline management and to encourage land stewardship. Residents need access to information about best practices for shoreline living and benefits of keeping the lakeshore natural (Story 2-8).

STORY 2-8 SHORELINE PROTECTION AND MANAGEMENT PLANNING

The **Kootenay Lake Shoreline Guidance Document**[30] is a result of a comprehensive inventory and assessment of ecological, archaeological and Ktunaxa cultural values along the shoreline of Kootenay Lake. A similar project was completed for Slocan Lake, which reflects ecological values only. The resulting guidance documents deal with shoreline development such as docks, retaining walls, or dredging activities to protect high value shoreline habitats.

The **Okanagan Collaborative Conservation Program** (OCCP) and the **South Okanagan Similkameen Conservation Program** (SOSCP) are leading a multi-jurisdictional project to identify the most pertinent issues impacting lakes in the Okanagan including water quality, aquatic and terrestrial ecosystem health, and cultural and recreational values. This collaborative, regional approach will identify common policies, regulations and processes that can be used to enhance shoreline management and source water protection throughout the Okanagan basin.

In 2018, the OCCP and several partners created a best management practices guide, **A Resource for Okanagan Lakeshore Living**, for property owners on the Okanagan Lake shoreline.[31] The guide promotes actions that can be taken to protect and restore natural areas, safeguard drinking water, obtain proper permitting, and support flood preparedness.

ACTION 2-11

Prepare shoreline protection plans for Okanagan, Kalamalka, Wood, Skaha, Vaseux and Osoyoos Lakes.

Partners: Local governments, provincial government, federal government, First Nations, nongovernmental organizations.

Recommend that the OBWB: Participate in the planning processes.

In addition to protecting what habitat remains in the Okanagan, there is an impending need to address restoration of riparian and shoreline habitat. Restoration targets should be set using ecosystem inventory and mapping (Section 2.2.3) and the information in the biodiversity conservation strategy for the Okanagan region (Story 2-9). The most successful restoration projects involve multiple partners working towards a common goal. The Okanagan River Restoration Initiative is an excellent example of this collaborative approach (Story 2-10).

*Riparian restoration work on Coldstream Creek (**LEFT**) and Joe Rich Creek (**RIGHT**).*

30 http://kootenaylakepartnership.com/wp-content/uploads/2018/08/Kootenay-Lake-Guidance-Document-FINAL-June-6-2018.pdf

31 http://lakeshore-living.okcp.ca/

STORY 2-9 KEEPING NATURE IN OUR FUTURE: A BIODIVERSITY CONSERVATION STRATEGY FOR THE OKANAGAN REGION

Keeping Nature in Our Future is an environmental policy framework that sets priorities for identifying, preserving, and restoring important natural areas in the Okanagan. The strategy creates a landscape view and provides a framework of conservation options for entire ecosystems and watersheds that go beyond municipal or rural boundaries and includes all forms of land tenure.[32] The strategy identifies which natural areas should be protected and restored, who can contribute, and how and when conservation and enhancement of these natural areas can be achieved. Keeping Nature in Our Future includes large digital maps that local governments can use to integrate biodiversity protection into policies, plans, and regulations.

STORY 2-10 OKANAGAN RIVER RESTORATION INITIATIVE

The health of the Okanagan River was severely impacted by channelization works that occurred in the mid-1950s. The goal of the **Okanagan River Restoration Initiative** (ORRI) is to return portions of the channelized river back to a more natural condition and regain some of the lost habitat quality and quantity. The restoration site is in Oliver, approximately 17 km upstream of Osoyoos Lake. It was specifically chosen based on channel gradient and connection to upstream productive habitats. The project involves relocating dikes to restore the natural floodplain with wetland habitat, lengthening the straightened channel with natural meanders and pool/riffle sequences, creating side channels (natural oxbows) and replanting riparian vegetation. Extensive work has been done since 2014, including building ponds for amphibians in a reconnected floodplain and constructing four spawning beds for salmonids. The new spawning beds provide excellent public viewing opportunities of salmon in October and improve the health of the channel by reducing the abundance of invasive species. Another project completed as part of the ORRI was the creation of four spawning areas in the Penticton with optimized gravel size, bed slope and hydraulics for Sockeye, Kokanee, Steelhead, Rainbow Trout and Chinook. The ORRI is led by the Okanagan Nation Alliance and involves collaboration among Indigenous communities, provincial and federal governments, local stakeholders and stewardship groups, and funding agencies.

Redevelopment provides an important opportunity for restoration that is too often missed.[33] The Riparian Areas Regulation (RAR), under the *Riparian Areas Protection Act*[34], calls on local governments to protect riparian areas during residential, commercial and industrial development by having a Qualified Environmental Professional (QEP) conduct a science-based assessment of proposed activities. The QEP assesses habitat and potential impacts on habitat and develops mitigation measures. The QEP determines the Streamside Protection and Enhancement Area, or the area bordering the stream within which development is prohibited.

32 Okanagan Collaborative Conservation Program and South Okanagan Similkameen Conservation Program. 2014. Keeping Nature in our Future: A Biodiversity Conservation Strategy for the Okanagan Region. URL: https://soconservationfund.ca/wp-content/uploads/2017/08/KNOIF-2013-web-1.pdf.

33 Ecoscape Environmental Consultants Ltd. 2017. Okanagan Lake Foreshore Inventory and Mapping 2016 Update Report.

34 Riparian Areas Protection Act, S.B.C. 1997, c. 21. URL: www.bclaws.ca/civix/document/id/complete/statreg/97021_01

Under this professional reliance model, local governments depend on private, accredited professionals to do the work, while the cost of hiring these professionals is borne by a project's proponent. The RAR does not explicitly require restoration, and QEPs are often challenged by what is most sustainable (a good plan with biological merit) versus what is considered the 'minimum requirement' (what is the least the proponent needs to do obtain approval). This creates a risk for conflicts of interest. By clearly identifying restoration expectations in local government policy, there will be less variability in what is considered a good restoration plan and differences in professional opinion will be reduced. In this way, the focus of assessments can transition from evaluating minimum setback widths to identifying natural areas and restoration planning that is consistently applied across the region.

ACTION 2-12

Strengthen local government oversight of riparian area and other development-related assessments completed by QEPs.

Partners: Local governments, provincial government, QEPs.

Recommend that the OBWB: Bring planners and QEPs together to share knowledge and experiences, develop a template terms of reference for environmental impact assessments and restoration plans, and share the template with interested local governments.

2.2.3 Ecosystem inventory and mapping

Inventory, mapping and monitoring are essential to the conservation and restoration of ecosystems and for making good land use planning decisions. They provide planners, environmental organizations, and government agencies with an understanding of the location and quality of environmentally sensitive areas and natural assets in their land base. Mapping gives crucial up-front information to land users and developers, and helps local governments and Indigenous communities understand the ecosystem value of particular properties in a broader regional context.[35] Ecosystem inventory and mapping can be used to help determine setbacks and fish/wildlife-sensitive zones, highlight areas that may have problems with channel stability, and identify point and non-point sources of pollution. When integrated with strategic planning and policies, inventory maps are powerful communications tools that help to synthesize information on watersheds and prioritize sites for restoration and protection.

Sensitive Habitat Inventory and Mapping is used to map aquatic habitats and their associated riparian areas and terrestrial habitats. Geographical Positioning System (GPS) and photo surveys are collected for fish spawning areas and wetlands, as well as other features and attributes, such as retaining walls, bridges and culverts, side channels and tributaries, points of erosion, sources of agricultural runoff, wildlife trees, and the presence of fish. The data are intended to enhance local land use planning maps and/or specific site or detailed planning surveys.

Wetland Inventory and Mapping is used to determine the location, size, characteristics and condition of a wetland, and contribute to wetland protection strategies. The maps show wetland functionality, livestock use intensity, wetland community type, biodiversity, vegetation, proximity to other wetlands, and soils – among other aspects of the ecosystem.

Foreshore Inventory and Mapping (FIM) is used to map lake shorelines and quantify the level of disturbance to the foreshore. Baseline data collected include land use type, shoreline type, riparian condition, and the presence of human-caused alterations along the foreshore. An **Aquatic Habitat Index**, which is generated using FIM data, is used to estimate the relative habitat value of a shoreline segment. FIM allows planners and resource managers to assess the rate of loss of natural areas to development and the quality of remaining habitat along shorelines (Story 2-11).

35 Curran, D. 2016. Green Bylaws Toolkit. URL: https://stewardshipcentrebc.ca/PDF_docs/GreenBylaws/GreenBylawsToolkit_2016.pdf.

STORY 2-11 FORESHORE INVENTORY MAPPING FOR OKANAGAN LAKE

In 2016, a FIM survey for Okanagan Lake found that 171 km of the 290 km of shoreline, or 59%, had been developed or disturbed.[36] Over the 7-year study period (2009 – 2016), 4.1 km of the natural area around the shoreline was lost or permanently altered. An estimated 0.2% (588 lineal metres) of natural shoreline was lost per year. From a biological perspective, this progressive loss is significant and has the potential to affect nearly all natural shoreline processes over time, which would subsequently affect many of the critical habitats surrounding the lake. Key changes to the shoreline over the study period included the removal of native vegetation, the construction of 1.45 km of retaining wall, 164 new docks, and nine new marinas, and the increase in road construction for access and in landscaping.

At present, local government budget constraints limit the extent and quality of ecosystem monitoring. Up-to-date ecosystem maps, and standardized metrics for measuring environmental protection, should be embedded into Official Community Plans and Regional Growth Strategies. Local governments should budget for monitoring and evaluation and conduct annual reports to determine if adequate protections are in place.

ACTION 2-13

Collect up-to-date ecosystem inventory and mapping information across the valley and integrate into land use and source protection policies and plans.

Partners: Local governments.

Recommend that the OBWB: Provide funding to support data collection projects.

2.2.4 Land-use planning and growth management

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 recreation centres, and develop vibrant neighbourhoods. However, where and how communities grow has a profound impact on the quality of their streams, lakes, rivers, beaches and groundwater and also determines how much residents, businesses and infrastructure are exposed to the physical risks associated with climate change, such as flooding and wildfires.

Land-use planning refers to the processes and instruments employed to manage the use of land and the physical development of a community for the common interest. Land-use planning is one of the most effective ways to facilitate local adaptation to climate change and protect water and land. Communities with land-use planning that limits development in hazard-prone areas and preserves areas such as wetlands, marshes, and riparian corridors can grow in population and still safeguard water.

Historically, Okanagan population growth included highly dispersed development. Urban sprawl, the spreading of a city and its suburbs over rural land at the fringe of an urban area, is common. This form of development is typically low density and car-oriented. As a result, it is associated with issues such as diminished water quality and quantity, degraded aquatic ecosystems, and an increase in water demand and infrastructure costs.

Okanagan communities can identify designated areas for urban/suburban growth and other areas that must be preserved. Regional Growth Strategies and Official

36 Ecoscape Environmental Consultants Ltd. 2017. Okanagan Lake Foreshore Inventory and Mapping 2016 Update Report.

Community Plans are used to define growth management in a community. This can be done by defining urban containment boundaries, by setting out future land use designations (for example, rural character versus urban development), and/or by identifying growth areas. To protect water quality and aquatic ecosystems, development can be encouraged on lands with less ecological value, such as previously disturbed or developed areas, and directed to areas that are already serviced by community sewer and water infrastructure.

ACTION 2-14

Focus new development in areas currently served by with community water and sewer, and minimize development in hazard areas and on or near sensitive aquatic ecosystems.

Partners: Local governments.

Recommend that the OBWB: Bring planners together to share knowledge and resources, and promote consistency in policies across local jurisdictions.

Ultimately, decisions about development applications fall to elected officials. Therefore, it is critical that planning staff have the tools to effectively communicate to elected officials why a development is or is not consistent with the policies, and elected officials respect the growth management policies and the expertise of staff.

ACTION 2-15

Educate elected officials about the importance of considering water in all development decisions and understanding that water management decisions should be based on watershed boundaries, not jurisdictional boundaries.

Partners: Local governments.

Recommend that the OBWB: Develop a "Water 101" education package for elected officials and support planning staff in educating elected officials and voters.

2.3 Aquatic invasive species management

Zebra and quagga mussels, if introduced, would be a threat to Okanagan waters and ecosystems. Monitoring for the species is ongoing. The OBWB has many decades of experience managing invasive Eurasian watermilfoil at significant public cost, and is concerned that the negative impacts of invasive mussels would be even greater.

2.3.1 Zebra and quagga mussels

Zebra mussels (*Dreissena polymorpha*) and quagga mussels (*Dreissena bugensis*), closely related mollusks that originate from freshwater lakes in Russia and Ukraine, have been spreading across North America for the past 30 years. They were first introduced in Canada's Great Lakes region and the United States in the late 1980s after ballast water was discharged by vessels traveling from Europe. The mussels have now reached in 33 U.S. states, including California, Nevada, and Arizona. In October 2013, the mussels were discovered in Lake Winnipeg, Manitoba, and then Cedar Lake, Manitoba in October 2015.

Zebra mussel shells cover a Lake Michigan beach in Door County Wisconsin. Photo courtesy PJ Bruno.

Okanagan valley bottom lakes are at high risk of infestation. These mussels can substantially alter aquatic food webs, which could result in the collapse of valuable native fish populations such as kokanee and sockeye salmon. Zebra and quagga mussel infestations can displace native aquatic plants and wildlife, degrade the environment, and affect drinking water quality. The mussels would also have a dramatic and expensive impact on our infrastructure: clogging water supply systems, and fouling and eroding bridges, retaining walls and docks. The social costs of an infestation would be staggering. Not only would these species change the way we use our beaches, covering them with sharp, smelly shells, their impact would cost local taxpayers many millions of dollars per year.

Water intakes and other related infrastructure are particularly vulnerable to damage and increased maintenance costs from encrusted zebra/quagga mussels. Proactive measures that can be taken include using anti-fouling paints and having back-up systems in place for water infrastructure. While prevention is the most important action, it is also important to plan in advance and anticipate the impacts of an invasion into Okanagan lakes.

LEFT: *Quagga mussels on rotor.* ***RIGHT:*** *Example of invasive mussel-infested pipe.*

The OBWB has lobbied provincial and federal governments to prevent mussel introduction. Calls for governments to increase funding for zebra and quagga mussel inspections, additional full-status conservation officers, mussel-sniffing dogs, and decontamination stations have been met with encouraging responses, but more is needed.

Since 2012, the OBWB's Okanagan WaterWise program has been educating and engaging the public to prevent the spread of invasive mussels to B.C. through its Don't Move A Mussel outreach and advocacy campaign (Story 2-12).

STORY 2-12 DON'T MOVE A MUSSEL OUTREACH PROGRAM

The OBWB-OkWaterWise launched the **Don't Move A Mussel** (DMM) campaign (www.DontMoveAMussel.ca) to raise awareness and help prevent the introduction of invasive mussels into Okanagan waters. The campaign includes billboards, radio and print ads, social media, and direct outreach to engage the public. The campaign has been very effective, with several local governments, media outlets, businesses, and non-profits helping disseminate the message. As a result, it has caught the attention of government and conservation groups in B.C., Saskatchewan and Manitoba, which are seeking to adopt similarly successful campaigns.

*The Don't Move a Mussel message has been shared on buses (**LEFT**), shirts (**RIGHT**), and many other communication channels.*

ACTION 2-16

Provide funding and support initiatives for the prevention, early detection, rapid response and containment of aquatic invasive species.

Partners:
Provincial government, federal government, local governments, conservation groups.

Recommend that the OBWB:
Advocate for resources to carry out robust aquatic invasive species programs.

ACTION 2-17

Educate the public about aquatic invasive species.

Partners:
Provincial government, federal government, local governments, conservation groups.

Recommend that the OBWB:
Build-out OBWB public outreach and education campaigns related to invasive species and coordinate the campaigns with neighbouring watersheds where appropriate.

ACTION 2-18

Complete vulnerability assessments of water intakes and other in-lake infrastructure to identify the potential impacts of invasive mussels and other aquatic invasive species.

Partners: Water suppliers.

Recommend that the OBWB:
Provide funding and compile and share best practices and technical standards to support vulnerability assessments.

2.3.2 Eurasian watermilfoil

Eurasian watermilfoil (*Myriophyllum spicatum*) is an invasive aquatic plant, native to Europe, Asia and northern Africa, that is now growing in the shallow waters of lakes in B.C. and other parts of North America. The plants form thick underwater stands and dense mats on water surfaces. Uncontrolled Eurasian watermilfoil growth can interfere with opportunities for water-based recreation, including boating, waterskiing, sailing, swimming, and angling. Oxygen levels can be depleted when the plants decay and dense growth can limit light penetration and decrease water circulation, causing problems for aquatic life and toxic algae blooms.

Eurasian watermilfoil was first identified in the Vernon Arm of Okanagan Lake in 1970. By 1974, the plant was well established in the valley bottom lakes. In 1981, the OBWB took over full responsibility for milfoil control in the Okanagan from the Province. Treatment methods include harvesting the weeds in the summer (similar to underwater lawn mowing) and rototilling the milfoil beds when the plants die back in the winter.

While there is no way to eradicate the invasive plant, control measures have improved over the last four decades, leading to cleaner beaches and healthier ecosystems. In 2018, milfoil control operations moved from paper-based maps to fully-integrated electronic mapping and tracking systems that incorporate all known environmental concerns and restrictions throughout the work areas. OBWB milfoil control operations are permitted under provincial and federal regulations and follow best practices to minimize any potential negative effects.

ACTION 2-19

Control Eurasian watermilfoil in Okanagan lakes.

Partners: Provincial government, federal government.

Recommend that the OBWB:
Continuously improve the OBWB Eurasian watermilfoil control program using relevant new technologies and the best available science.

LEFT: *The OBWB rototiller docked at a beach in Kelowna.* ***MIDDLE:*** *Dense growth of Eurasian watermilfoil along an Okanagan Lake shoreline.* ***RIGHT:*** *Collecting water quality data on Okanagan Lake. Photo courtesy John Janmaat.*

2.4 Water quality monitoring

Reliable and up-to-date water quality data help us understand the overall health of aquatic ecosystems and informs decision-making about water infrastructure, water-based recreation, and ecosystem stewardship. The ability to track trends depends on having long-term data sets, collected using consistent, standard methods.

Many agencies and groups are participating in significant water quality monitoring efforts:[37]

- Water suppliers collect a large amount of water quality data to meet regulatory requirements for drinking water treatment. Untreated water is collected at water intakes on a regular basis to check for turbidity, microorganisms, bacteria, and protozoa. These data sets are available to the public through local water suppliers.
- Interior Health tests water samples from small water supply systems and provides water quality results and pass/fail ratings on their website.[38]
- Federal and provincial environment ministries have limited water quality monitoring programs for surface and groundwater, and limited publicly available data, as does the Society for Protection of Kalamalka Lake and the Osoyoos Lake Water Quality Society.
- The Okanagan Nation Alliance and several university researchers have studied and reported on various aspects of water quality, including short-term data collection programs.
- Environmental consultants collect water quality data for local communities and businesses, and compile these data in databases.

2.4.1 Water quality data

Water quality, for drinking, swimming and recreating is an important indicator of ecosystem health and an important component of the Okanagan's quality of life. In the Okanagan, there is no central data repository for water quality data. The diversity of groups collecting data means there is sometimes inconsistency in the methods, leading to a lack of confidence in the data. Collaborative development of standard methods that are easy to follow and based on best practices is needed so that practitioners from various groups can produce data sets consistently and share data in formats that make the data easily useable to others. A consistent approach would increase confidence in the data and create widely accepted results. An organized and concerted effort to support access to existing data and reduce the gaps in water quality monitoring for the Okanagan is also needed (Story 2-13).

37 Okanagan Basin Water Board. 2019. Water Quality Monitoring Webpage. Overview of Okanagan Water Quality Studies and Monitoring. URL: www.obwb.ca/water-quality-monitoring.

38 Interior Health. Sampling Results. URL: www.interiorhealth.ca/YourEnvironment/DrinkingWater/Pages/WaterSamples.aspx.

STORY 2-13 **OKANAGAN WATER QUALITY PORTAL**

The OBWB is currently developing a water quality portal, in partnership with Larratt Aquatic Consulting, Okanagan municipalities, and water suppliers. The Okanagan Water Quality portal (WQ portal) will be an information source for available water quality data. Users include: local governments, community members, resource managers, educators and students. Understanding trends in water quality and having confidence in results requires long-term data records that are collected to a high-standard and are transparent about the degree of uncertainty associated with each data point. Trending water quality data over time helps water managers efficiently allocate scarce resources and protect the public during times of poor water quality. This new tool allows you to view Okanagan water data, including water chemistry and algae taxonomic data. The water quality data portal does not include all Okanagan-collected data. The data are collected by a local environmental consulting company for a number of public entities who have agreed to have them published for public education and use.

ACTION 2-20

Develop standard methods for water quality data collection. Consistently track and enhance access to the data.

Partners: ENV, Interior Health, water suppliers, First Nations.

Recommend that the OBWB: Encourage partnerships and enhance sharing of water quality data to ensure timely application of valuable water quality data to water management decisions. Develop a public web-based water quality data portal that supports benchmarking long-term water quality changes.

2.4.2 Water quality objectives

Water Quality Objectives (WQOs) are site-specific management targets, established based on historical data and reasonable expectations for a particular water body. WQOs also consider the generic provincial and national water quality guidelines, which are safe limits of the physical, chemical, or biological characteristics of water for various uses. WQOs are only set for waterbodies that have or are expected to experience stress from human activities, so the relatively large number of Okanagan sites with WQOs reflects the sensitivity of local streams and lakes to changes in water quality.

The B.C. Ministry of Environment and Climate Change Strategy (ENV) has set water quality objectives (WQO) for the following water bodies in the Okanagan[39]:

- Coldstream Creek
- Kalamalka Lake
- Wood Lake
- Ellison Lake
- Skaha Lakes
- Okanagan Lake
- Deep Creek
- Lower Vernon Creek
- Hydraulic Creek
- Mill Creek
- Brandt's Creek
- Mission Creek
- Trepanier Creek
- Westbank Creek
- Peachland Creek
- Osoyoos Lake

39 Province of British Columbia. Water Quality Objectives web page. URL: www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/water-quality-objectives.

ENV carries out the B.C. Lake Monitoring Program with province-wide delivery of lake monitoring and stewardship functions. Physical, chemical and biological data are collected biannually from a wide variety of B.C. lakes to compare current water quality status to WQOs and to understand long-term trends. For the Okanagan, the sampling program includes Ellison, Wood, Kalamalka, Okanagan, Skaha, and Osoyoos Lakes, and data collection dates back to the 1960s. In February 2019, the Province launched its own website and interactive map portal to provide access to the water quality data collected under the B.C. Lake Monitoring Program (gov.bc.ca/lake-monitoring).

The Okanagan Lake Collaborative Monitoring Agreement,[40] which has been in place since 2011, includes ENV, the City of Kelowna, the Regional District of Central Okanagan, and the District of Summerland. The impetus for the agreement is to enhance the biannual sampling of lake water conducted by ENV staff with monthly sampling (April to August) by the local governments to better understand seasonal trends and assess conditions against WQOs for the lake each year.

ACTION 2-21

Review and update existing provincial WQOs in the Okanagan, and expand to other Okanagan lakes and streams if needed.

Partners: ENV, local governments, water suppliers.

Recommend that the OBWB: Support the Province of B.C. and Okanagan water suppliers in the review and provide recommendations on other lakes and streams that would benefit from WQOs.

2.4.3 Watershed health

Typical watershed indicators, such as water meter data or water quality information, have been collected, reported, and stored in a haphazard fashion in the Okanagan. To create a watershed 'report card' will require ongoing efforts to improve the quality and amount of data available in the Okanagan. For example, there are some data sets for water quality, but they have mostly not been collected in consistent locations for a consistent period of time. An "interregional indicators" project by the three Okanagan regional districts led to the development of several comparable water indicators, although these were limited in scope.[41] To properly develop indicators of watershed health will require a plan to identify what indicators provide the most information, and a plan to collect data to support those indicators over time, working with partners.

ACTION 2-22

Develop tools that support benchmarking, measuring, tracking, management, and accountability for water in the Okanagan.

Partners: Water suppliers, provincial government.

Recommend that the OBWB: Participate in or lead projects that contribute to progress reporting on watershed indicators.

40 Province of British Columbia. Okanagan Lake Collaborative Monitoring web page. URL: www2.gov.bc.ca/gov/content/environment/research-monitoring-reporting/monitoring/lake-monitoring/long-term-lake-trends/area-specific-water-quality-monitoring/okanagan-lake-collaborative-monitoring

41 State of the Basin Report 2016 Okanagan Valley Interregional Monitoring and Evaluation Framework. 2017. Regional Districts of North Okanagan, Central Okanagan, and Okanagan-Similkameen.

2.5 Summary

Surface water and groundwater are vulnerable to contamination due to land use practices and discharges. Climate change impacts on water quality include landslides and bank erosion, high flows and turbidity during extreme rainfall events. The key elements required to protect water quality are (1) source protection, (2) conservation and restoration of aquatic ecosystems, (3) invasive species control, and (4) water quality monitoring.

Protecting the best water sources from contamination is challenging because there are numerous ways that water can be polluted and numerous ways to address pollution in different geographic areas (upper, rural, urban watersheds). Each geographic area has unique challenges, and approaches to mitigation vary.

In upper watersheds, the best way for water suppliers to protect water sources is through long-term, coordinated and collaborative partnerships with watershed users, including Indigenous communities, private industry, public interest and recreation groups, and provincial regulators and enforcement staff. Some forestry and other Crown land leaseholders attend meetings with water suppliers and stakeholders to gain a better understanding of the watershed, but more partnerships are needed.

In rural watersheds, riparian buffers, wetlands, drainage and nutrient management plans are often the best way to limit water pollution from agricultural areas. There is continual need for public investment in wastewater treatment infrastructure in rural areas and to move from septic systems to community sewer systems.

In urban watersheds, emerging approaches to stormwater management include natural mechanisms (infiltration and percolation) and green infrastructure. Building green infrastructure into community development can maintain or restore natural flow patterns, preserve or restore stream buffers and wetlands, reduce the area of paved surfaces, create wildlife corridors and habitat, and recharge aquifers. Green infrastructure and stormwater user fees are two tools that help local governments achieve better urban stormwater management. Integrated asset management strategies, which include green infrastructure, are now being embraced by many communities.

Conservation and restoration of water-associated ecosystems help prevent further loss and degradation due to extreme weather events. Wetlands, shorelines, and riparian areas have multiple biological functions and significant social, cultural and economic values. Most wetlands in the Okanagan have been lost or impacted.

Zebra and quagga mussels are a major threat to Okanagan waters. Potential future impacts include disruption of aquatic food webs, collapse of fish populations, displacement of native aquatic species, degradation of the natural environment, pollution of drinking water, and damage to water supply systems. Prevention is important in protecting our waters and water-related infrastructure from these invasive mussels. The OBWB also continues to control Eurasian watermilfoil. While there is no way to eradicate the invasive plant, control measures have improved over the last four decades.

Water quality data monitoring is an ongoing effort by various agencies, consultants and water suppliers using various methods. Although the efforts have been extensive, standard methods have not been developed and a central repository for water quality data is not available in the Okanagan. Collaborative efforts to develop standard methods based on standard best practices would create greater consistency and confidence in the data. In future, various users will have access to an Okanagan water quality portal of long-term data records collected by set standards. Understanding trends in water quality and having confidence in results will help water managers allocate scarce resources and protect the public during times of poor water quality.

CHAPTER 3
WATER QUANTITY

3.0 WATER QUANTITY

Each year, the available water supply in the Okanagan is determined by rainfall, snowfall, and the storage capacity of upland reservoirs and aquifers, and the amount of evaporation and evapotranspiration (Figure 3-1). Okanagan communities share water with one another and with the natural environment. All water sources, including groundwater, feed the valley-bottom lakes, connecting creeks and the Okanagan River. Ecosystems and downstream communities depend on careful water management throughout the Okanagan watershed.

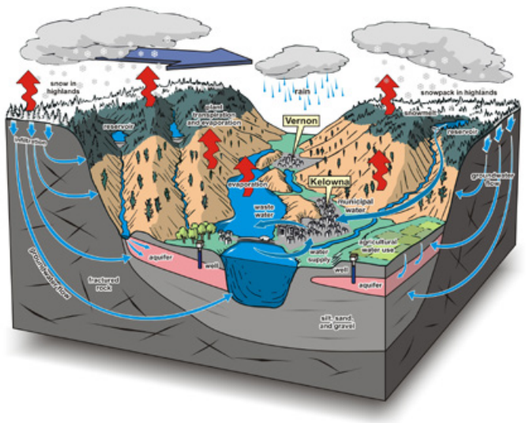


Figure 3-1 *The hydrological cycle in the Okanagan basin.*[42]

In B.C., water is allocated by the provincial government according to a 'first in time, first in right' (FITFIR) licensing system[43]. During times of scarcity, licensees with the earlier priority dates are entitled to take their full allocation of over junior licences, regardless of the purpose for which the water is used.

From the perspective of First Nations, Aboriginal Rights include the title to use and govern fresh water that flows through their territory.[44] Water rights that were accorded to reserve lands were often not registered as holding the earliest priority date, despite the fact that First Nations were the earliest users of water in the province. Many First Nations in B.C. are now asserting their rights, authorities, and laws to protect fresh water through activities such as developing water declarations based on Indigenous laws, to establishing water monitoring networks that span multiple territories, to negotiating shared decision-making arrangements, to co-leading watershed boards.

There is a legal requirement under the new B.C. *Water Sustainability Act* to set aside enough water for the health of riparian areas and the aquatic environment. In earlier eras of human settlement, there were fewer demands on surface water and groundwater. With the higher demands on water today, more formal measures are needed to protect natural systems. Setting environmental flow needs for Okanagan streams is essential.

Another change brought forward by the new *Water Sustainability Act* is the ability to protect water for agriculture in a reserve, established as part of a Water Sustainability Plan. Without irrigation, most agricultural production would not be possible in the Okanagan. The character of the valley, the capacity to produce local food, and the economic engine of food and wine production along with agri-tourism would be dramatically altered.

Some water sources in the Okanagan have generous surpluses while many smaller creeks are over-allocated. In the future, some water supply systems in the region may not be able to meet demands based on their supply capacity. There may be a need to adjust existing water licence allocations and to investigate storage opportunities. Community efforts will be needed to address shortfalls by increasing the efficiency of water use, reducing water waste, and using alternative sources wherever possible to maintain the health of the environment and the quality of life of all communities through dry years, wet years, and other weather extremes.

It is increasingly important that government, First Nations, post-secondary institutions, and industry jointly undertake water supply and demand studies – to share data and costs and, more importantly, to develop a shared understanding of water supply and demand conditions.

3.1 Water supply and demand

From one year to the next, there can be a significant variation in the amount of precipitation received in the Okanagan. Figure 3-2 shows the annual net inflows to Okanagan Lake measured between 1921 and 2018. 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 the variability in volume over time and the challenge in water supply management in the Okanagan.

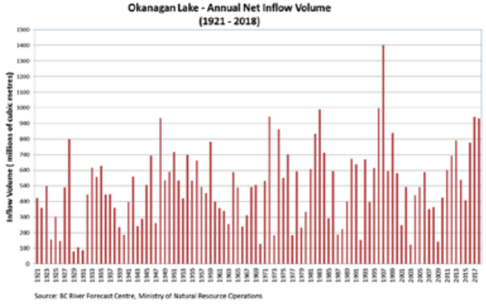


Figure 3-2 *Annual net inflow to Okanagan Lake from 1921 to 2018.*

In addition to the annual net inflow, the within-year (seasonal, monthly, weekly) pattern of water flow is very important for water management planning. The timing of spring freshet has a great influence on whether there is water abundance or scarcity for different needs of uses. For example, the highest year of water flow in Figure 3-2, was not a severe flood year compared to 2017, because of the timing we received the inflows. Figure 3-3 represents a typical annual hydrograph for the southern interior of B.C., using data for Mission Creek. Most precipitation occurs and accumulates during winter as snowfall, resulting in a dominant spring freshet. Approximately 80% of the total annual flow in the creek occurs during the months of April, May, and June. Reservoirs capture and hold the runoff, which provides a mechanism for slow but sustained releases during summer and fall when it is needed the most for irrigation and other purposes. Figure 3-4 illustrates the timing differences between the annual freshet in spring and the demand peak in mid-summer. Streamflows and lake levels decline through summer and fall and remain relatively steady over winter as the next spring's snowmelt accumulates again.

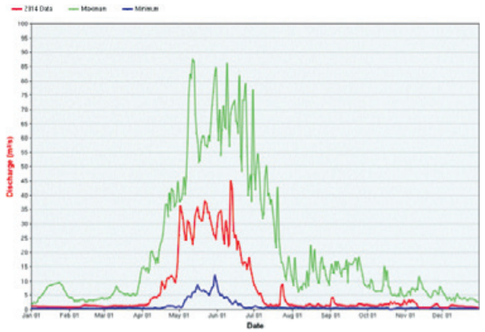


Figure 3-3 *Typical annual hydrograph for the southern interior of British Columbia, showing the dominance of the spring freshet (data for Mission Creek from Government of Canada).*

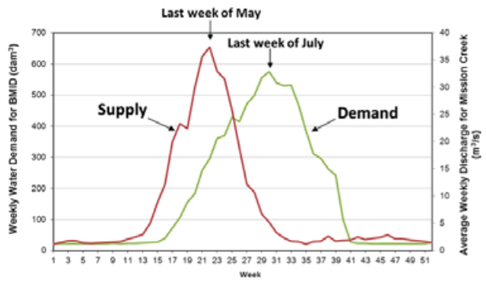


Figure 3-4 *Timing differences between the annual freshet in spring and the demand peak in mid-summer in the Okanagan basin.*

Modeled results from the Okanagan Water Supply and Demand Project (OWSDP, Story 3-1) suggested that the Okanagan's outdoor water use is much higher

42 Turner, R, R. Franklin, B. Taylor, M. Ceh, S. Grasby, B. Symonds, M. Adams, P. Armour, C. Harlow, M. Journeay, D. Machin, T. Molyneux, D. Neilsen, R. Simpson, K. Stephens, and T. van der Gulik. 2006. Okanagan Basin Waterscape. Geological Survey of Canada, Miscellaneous.

43 As described in Section 22 of the Water Sustainability Act.

44 First Nations Fisheries Council. 2018. Protecting Water Our Way, First Nations Freshwater Governance in British Columbia.

STORY 3-1 OKANAGAN WATER SUPPLY AND DEMAND PROJECT

The **Okanagan Water Supply and Demand Project** (OWSDP) is an ongoing effort to quantify where water is used in the valley, how much is needed for nature, for agriculture, and for residential and industrial use, how much is reliably available in streams, lakes and aquifers, and how supply and demand will be affected by climate change, population growth and land use change.[46] The Project includes studies on groundwater, stream flows, environmental water needs, and water use. A 2010 report examined valley-wide water budgets by developing and combining a series of models on water demand, naturalized stream flows, environmental flow needs, evaporation and groundwater. The study estimated future water supply and demand conditions that could result from population growth, land-use change, and climate change. Subsequent studies have refined our knowledge in each of these areas, and have more thoroughly examined potential future changes. It has been a multi-agency collaborative effort with significant contributions from provincial and federal agencies that have jurisdiction over water.

than elsewhere in Canada.[45] This is because of our dry climate and long growing season. According to the OWSDP, 86% of annual water use in the Okanagan is for outdoor irrigation, with the actual volumes varying year to year. In hot, dry growing seasons, irrigation increases to make up for lack of rainfall. Indoor water use is relatively independent of weather, but can be influenced by levels of tourism, and water conservation campaigns. The adoption of efficient irrigation practices in some agricultural sectors and a shift to crops that require less water (for example, wine grapes) also changes the amount of water needed for agricultural irrigation. The OWSDP estimated that only 14% of annual water use in the Okanagan is used indoors: in homes, and for commercial, industrial and institutional purposes. The gradual installation of water meters and low-flow appliances reduces indoor water demand on a per capital basis over time.

3.1.1 Environmental flows

Environmental flows are critical for the health of aquatic ecosystems and to ensure a continuous delivery of essential ecosystem goods and services. Environmental flow needs (EFNs), a formally-established estimation of the amount of water needed to support stream health, are an integral part of sustainable water management. Under the B.C. *Water Sustainability Act*, it is mandatory to consider EFNs when making water allocation decisions and providing day-to-day management. Meeting EFN requirements is particularly important for sustaining native fish stocks, which are a living part of Okanagan history, culture and heritage.

Kokanee salmon at Hardy Falls. Photo courtesy Regional District of Central Okanagan.

45 Summit Environmental Consultants Inc. 2010. Okanagan Water Supply and Demand Project: Phase 2 Summary Report. Prepared for the Okanagan Basin Water Board. URL: www.obwb.ca/wsd/wp-content/uploads/2011/02/339_2011_summary_report.pdf

46 Okanagan Basin Water Board. Water Supply and Demand in the Okanagan Basin web page. URL: www.obwb.ca/wsd/.

The OBWB in collaboration with the Okanagan Nation Alliance, the Province of B.C., and the federal government have established a set of scientifically defensible methods for determining EFN values for Okanagan streams, and have determined actual EFN values for selected high-value fish-bearing streams. This improved understanding of stream-specific flows that are sensitive to time of year and different life stages of fish and other aquatic organisms enhances and supports water allocation and decision-making throughout the Okanagan Valley.

The *Siwłkʷ (Water) For All – Our Responsibility* environmental flow needs conference in 2018 brought together researchers, fisheries and water managers, policy-makers, planners, regulators, Indigenous peoples, among others, to develop recommendations for EFN-setting, policy-making, and regulation. This conference was a catalyst for further action, further collaboration, better information, and improved EFN decision-making.[47]

ACTION 3-1

Determine EFNs for all Okanagan streams, and share with decision-makers to support sound and defensible water allocation decisions that maintain proper functioning of aquatic ecosystems.

Partners: Okanagan Nation Alliance, DFO, FLNR.

Recommend that the OBWB: Obtain funding, provide project management services, and share results.

TOP LEFT: *A technical team takes measurements to help determine environmental flow needs in an Okanagan stream. Delegates at the 2018 Siwłkʷ (Water) For All - Our Responsibility environmental flow needs conference add their thoughts to the poster board (**TOP RIGHT**) and listen to a presentation (**BOTTOM**).*

47 Okanagan Basin Water Board. Siwłkʷ (Water) For All – Our Responsibility Environmental Flow Needs Conference 2018. URL: www.obwb.ca/efnconference/.

Irrigation has shaped the Okanagan valley, allowing for fruit production and defining our landscapes. ***LEFT*** *photo courtesy Mike Biden, IFlyPhoto.com.* ***MIDDLE and RIGHT*** *photos courtesy Alison Thorpe.*

3.1.2 Agriculture

In the 1920s, many individual irrigation licences were amalgamated under the authority of Irrigation Districts. Infrastructure was built to supply water to farms and administered by the Irrigation Districts, which were run largely by local agricultural producers. In recent years, many Irrigation Districts have been incorporated into and are now managed by local governments and their councils. Rapid population growth and urban development in the Okanagan combined with increased drought frequency, severity, and duration raise the potential for urban/agricultural conflicts over access to water. The relatively new legal requirement to accommodate EFNs (Section 3.1.1) may also impact water supply in some areas. All of these factors indicate that water licensed for agriculture may be less available in coming years, and this consideration, combined with development pressure on agricultural land has implications for future agricultural productivity.[48]

Agricultural water demand is influenced by crop type and management, soil characteristics, irrigation method, prevailing climate, and weather. At peak season, the agricultural industry requires access to irrigation water 24 hours a day, 7 days a week. This is because most water supply infrastructure and on-farm irrigation systems are sized to operate continuously, rather than only at night or part time. If irrigation systems were designed for only part-time use (to allow all farm land to be irrigated at the same time), the pipe sizes would have to be significantly larger to accommodate higher flow rates. Water withdrawals from streams would have huge temporal variations, making it difficult to maintain environmental flows. Historically, irrigation licences have been sized to match the needs of higher water-demanding crops (such as forage), even though a crop with lower water needs (such as grapes) may have been planted. This allows farmers to change crops as required without re-evaluating their water allocation. Crops and irrigation systems may change over time, but licence holders are required to stay within their water allotment. Currently, Ministry staff adjudicating water licence applications review the crop to be irrigated and use an agriculture demand tool developed by the Ministry of Agriculture to determine the required volume for that specific crop (such as grapes or forage), and the licence is issued for that volume.

Under extreme conditions, loss of irrigation or farm water can kill perennial plantings like fruit trees and grapes leading to crop failure; or force ranchers to reduce herd size. One way to preserve access to water for ALR and other agricultural lands, even under extreme drought stress, would be to establish an Agricultural Water Reserve. Under the B.C. *Water Sustainability Act*, water dedicated for agriculture can be protected in such a reserve, established as part of a Water Sustainability Plan. It has been proposed that the Agricultural Water Reserve would include existing licensed allocations for agricultural properties. It may also include allocations for land in the ALR or other qualifying agricultural land (for example, land zoned for agriculture by local government) that currently do not have water allocations. Thus, the choice to protect water for agriculture is a natural extension of the choice to protect land through the ALR. Under the *Water Sustainability Act*, the actual structure of an Agricultural Water Reserve will depend on the outcome of the process to develop a Water Sustainability Plan, and would have to be approved by an Order in Council of the B.C. legislature.

ACTION 3-2

Develop a pilot Agricultural Water Reserve for a watershed in the Okanagan basin and then work towards a basin-wide Agricultural Water Reserve if it is deemed feasible based on the learnings and outcomes of the pilot.

Partners: FLNR, AGRI, AAFC, water suppliers, agricultural associations.

Recommend that the OBWB: Identify funding sources, help facilitate the pilot project, and assist with the basin-wide planning process.

A flexible licensing structure, with late-season and part-season licensing, would allow farmers to make the most of available water and minimize withdrawals during low flow periods when it is needed to maintain EFNs. For example, most licences state that irrigation must end by September 30, so many farmers irrigate in September (when stream flows are low). This is intended to ensure enough soil moisture on their fields prior to winter to protect root systems from frost damage in perennial crops. In addition, longer growing seasons have resulted in much later harvest dates for some tree fruits and grapes. If the irrigation season was extended into October, farmers could irrigate when flows were higher or reduce their use if enough rain falls.[49] Part-season licensing would allow farmers to irrigate short-season crops during the spring freshet (May to July) when surplus water is available and then shut down during a subsequent lower flow period.

ACTION 3-3

Build more flexibility into irrigation licences to allow for early-season, late-season and part-season irrigation in the Okanagan, without increasing allocation of water or jeopardizing environmental flows.

Partners: FLNR, agricultural associations.

Recommend that the OBWB: Lobby the provincial government to consider flexible licensing for agriculture.

3.2 Water conservation and efficiency

Aging infrastructure and shrinking budgets are placing financial pressure on water systems. Climate change is making weather more variable and stressing infrastructure in new ways. Meanwhile, land development is forcing the expansion of water systems to meet the needs of new subdivisions. Water conservation and efficiency help to address these challenges.

Though the terms *conservation* and *efficiency* are often used interchangeably, they are different. A water conservation measure is an action, behaviour change, device, technology, improved design or process to reduce water loss, waste, or overall water use. Water efficiency focuses on reducing waste, but not necessarily restricting use. Examples of water efficient actions include fixing leaks, replacing inefficient water equipment, and using efficient irrigation systems. The Strategy focuses mainly on water efficiency.

Historically, agricultural water use was highly inefficient, with only a fraction taken up by plants and most lost through runoff, infiltration to groundwater, or evaporation. With human population growth, the need for crops and thus irrigation water is increasing, and the need to improve water efficiency in agriculture is

48 Neilsen, D. Bakker, M., Van der Gulik, T., Smith, S., Cannon, A., Losso, I. and Warwick Sears, A. 2018. Landscape Based Agricultural Water Demand Modeling—A Tool for Water Management Decision Making in British Columbia, Canada Front. Environ. Sci. 6:24 https://doi.org/10.3389/fenvs.2018.00074

49 Most irrigation infrastructure cannot withstand severe, early frost events, so there is a limit on how far the irrigation season can be extended.

important. Strategies such as crop selection, irrigation methods, and new technologies can improve water efficiency. Producers need to calibrate the water demand for each crop to maximize production and quality. Increasing efficiency of irrigation systems allows for more exact water delivery to grow a better crop.

Water conservation and efficiency are critical in summer, but year-round water conservation has significant benefits that go beyond reduced water use. Direct benefits include cost reductions for infrastructure and increased water security. Large swings in water demand between summer peaks—usually the time when water suppliers experience their Maximum Daily Demand (Story 3-2)—and winter use are a major cost to water utilities. Sizing infrastructure to meet high summer demands for lawn watering means the system is oversized for most of the year, requiring extra flushing of water mains to maintain water quality and larger pipes to replace at higher cost, for example. Denser development and climate-appropriate landscaping methods reduce those infrastructure costs. The indirect benefits are also considerable and include energy savings, reduced greenhouse gas emissions from treatment and distribution, resource and energy recovery, and fewer materials used in infrastructure.

STORY 3-2 | MAXIMUM DAY DEMAND AND ANNUAL WATER DEMAND

Two important measurement concepts relate to water conservation: Maximum Day Demand (MDD) and Annual Water Demand (AWD). A reduction of MDD 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 AWD helps ensure that the utility has enough water for beneficial use throughout the year and provides resiliency for drought.

3.2.1 Water conservation plans

Water conservation plans (WCP) focus on managing water demand by reducing consumption. These plans look at all the ways water is used and how those uses impact the source of that supply. The Province of B.C. has outlined a process for developing WCPs and encouraging communities to conserve (Story 3-3). A completed WCP is often a requirement for drinking water and wastewater infrastructure grants.

A key focus for any WCP is to assess the drivers of water demand and how people use water. The WCP should also look at the operations of the water supplier, including:

- **Source water metering** to track how much water is taken into the system.
- **Service connection** metering to help water users understand how much water they use.
- **Water system audits** (annually) to compare water source inflows to water used at each service connection (water user). Audits help identify water losses from leaks in the distribution system as well as potential losses from unauthorized water users (theft). Formal audit methodology and calculation software has been developed by the American Water Works Association.[50]
- **Distribution management**, informed by audits, helps water suppliers reduce water waste by directing leak detection efforts, system pressure management, and water main repairs.

In addition to providing important data on current water demands of the community, a water audit can be useful in providing the baseline information to forecast future water demands. A forecast will then direct what kind of water efficiency initiatives should be undertaken to ensure the demand does not exceed water supply. The WCP process considers water supply in both abundant and scarce years. As such, a WCP is important to drought preparedness and should be included as an appendix to a drought management plan (see Section 3.3.1).

50 American Water Works Association. 2016. M36 Water Audits and Loss Control Programs, Fourth Edition.

STORY 3-3 | WATER CONSERVATION GUIDE FOR BRITISH COLUMBIA

The go-to guide for small- to medium-sized communities is the Water Conservation Guide for British Columbia. The guide provides a seven-step process for developing a WCP that includes:[51]

- water system profile – describe the water system in a series of snapshots (community, watershed and infrastructure);
- demand forecasts – determine where the community is likely to end up if it stays on the same water consumption course;
- conservation goals and objectives – investigate the community's water issues and collaboratively develop tangible goals and objectives that set the direction for the WCP and provide benchmarks to evaluate progress on water savings;
- conservation measures – identify the tools, instruments, or programs that the community will use to achieve water savings; and
- implementation strategy – design the conservation projects and define how the plan will be successfully rolled out.

The guide includes clear instructions for each of the seven steps, supported by case studies, checklists, and worksheets.

ACTION 3-4

Prepare or update Water Conservation Plans for all Okanagan water suppliers.

Partners: Water suppliers.

Recommend that the OBWB: Promote best practices and provide funding to support water conservation initiatives identified in the plans.

Waterwise demonstration garden at Summerland Ornamental Gardens.

3.2.2 Landscaping and irrigation

The irrigation season is the period of greatest potential for improving domestic and agricultural water efficiency, when water consumption in some communities is more than 10 times greater than in the winter. Landscape design has a direct effect on water use in developed areas. Water conserving landscapes must have sufficient topsoil, include well-mulched, water-efficient plants and be divided into hydrozones (plants grouped based on their water needs). Irrigation systems should be properly designed and installed, and electronic timers should be programed with appropriate watering schedules. Local government policies regulating private landscaping can also improve the management of water on a property.

51 Belzile, J.,M. Martin, L. Edwards, G. Brown, L. Brandes, and A. Warwick Sears. 2013. Water Conservation Guide for British Columbia. Victoria: BC Ministry of Community, Sport & Cultural Development, POLIS Project on Ecological Governance, Okanagan Basin Water Board. URL: www.obwb.ca/newsite/wp-content/uploads/WCG_Design3.0_Web.pdf

Topsoil is the layer of soil closest to the surface (the layer exposed to air and rain). It is composed of organic matter and minerals, and is home to beneficial microorganisms that recycle nutrients, making them available to plants. Pore spaces between the soil particles hold air and water, letting topsoil soak up water and release it slowly, like a sponge. Good topsoil supports faster plant establishment and higher plant survival rates, and can reduce the need for weed and pest control. The nature of the topsoil on a site is crucial to effective stormwater management and water conservation (Story 3-4).

STORY 3-4 | TOPSOIL BYLAWS TOOLKIT

The **Topsoil Bylaws Toolkit** was developed in 2012 to give local governments practical tools that support smart topsoil policies.[52] The toolkit presents the basic principles of topsoil science and management and outlines the roles and responsibilities of government for managing topsoil. It also provides local governments with sample policy and bylaw language that can be tailored to the specific needs of the community.

Local government policies, standards, and initiatives can play an important role in creating more water-efficient landscapes and better irrigation systems (Story 3-5). Drainage bylaws encourage landowners to redirect stormwater towards plants, reducing demands for irrigation with potable water, and to limit impermeable surfaces to increase stormwater infiltration. Neighbourhood and watershed land use plans can contain more detailed policies about area-specific requirements for managing water movement, including standards that can be incorporated into subdivision servicing bylaws. Finally, development permit guidelines, landscape standards bylaws, and soil removal and deposit bylaws can set specific standards for topsoil quality, quantity, and retention.

Proper irrigation system design, installation, maintenance and scheduling are critical to reducing water use while maintaining healthy landscapes and crops. The Irrigation Industry Association of BC (IIABC) has certification programs in both landscape and agriculture to help irrigation and landscape contractors become more knowledgeable and capable of developing efficient irrigation system designs. In addition, in 2018, the City of Kelowna introduced the Qualified Water Efficient Landscaper (QWEL) certification program to enhance public knowledge about water conservation, promote efficient water use, and encourage the installation of water smart

STORY 3-5 | CITY OF KELOWNA LANDSCAPE WATER CONSERVATION INITIATIVES

The City of Kelowna has several initiatives to curb outdoor water use. All residential dwellings installing new irrigated landscape of 100 square metres or more must obtain approval from the City before installation. These requirements are specified in the Water Regulation Bylaw[53] for portions of Kelowna serviced by the City's water utility. The City released its Landscape and Irrigation Guide to Water Efficiency[54] in 2010. The guide provides detailed information on site design, soil and plantings, irrigation, and maintenance for water conservation. The City also offers free irrigation system assessments.

52 Okanagan Basin Water Board, Green Infrastructure Partnership and Partnership for Water Sustainability in British Columbia. 2012. Topsoil Bylaws Toolkit: An Appendix to the Green Bylaws Toolkit. URL: www.obwb.ca/fileadmin/docs/TopsoilBylawsToolkit_2012.pdf.

53 City of Kelowna Water Regulation Bylaw No. 10480. URL: www.kelowna.ca/city-hall/city-government/bylaws-policies/water-regulation-bylaw.

54 City of Kelowna. 2010. Landscape & Irrigation Guide to Water Efficiency. URL: www.kelowna.ca/sites/files/1/docs/city-services/2010-05-03_landscape-irrigation-guide-web_brochure.pdf.

Irrigation systems should be as efficient as possible while matching the needs of the crop. Photos courtesy Alison Thorpe.

ACTION 3-5

Improve irrigation management and water efficiency in the residential, commercial, parks and recreation, and agricultural sectors.

Partners: Water suppliers, irrigation and landscape contractors, agricultural associations, IIABC, AGRI.

Recommend that the OBWB: Prepare a model topsoil bylaw (using information from the Topsoil Bylaws Toolkit) and standard landscape guidelines and promote adoption throughout the Okanagan. Support water suppliers and agricultural and irrigation organizations in promoting water efficiency and delivering irrigation and landscaping certification programs. Advocate for senior government resources and funds to support farmers in improving water efficiency.

landscaping. The training and designation complement the existing IIABC Certified Irrigation Technician certification and are customized to the Okanagan environment. The QWEL program has been successful across the western USA, but this is the first application in Canada.

Irrigation scheduling considers the location, landscape, soil, and irrigation system operation parameters. An online irrigation scheduling calculator (www.irrigationbc.com) and real time climate station network (www.farmwest.com) are available to assist agricultural irrigators (such as farmers, land managers, and property owners). Using the online calculator, the irrigator enters information on the soil type and soil depth on site, crop rooting depth, and information about the irrigation system, to determine the number of days to water, the irrigation run-time for each day, and the maximum run times per cycle. The scheduling calculator is integrated with the climate station network so that real-time evapotranspiration estimates are used in the scheduling calculation. A scheduling calculator is available for both landscape and agricultural irrigation systems. The scheduling calculator is effective in reducing water use during the non-peak times of the irrigation season.

3.2.3 Metering and pricing

Water metering can play an important role in water conservation. Water metering is used for various objectives, depending on whether the customer is residential, agricultural, or industrial-commercial-institutional (ICI). For residential and ICI customers, metering is often used for volume-based billing, to encourage water conservation and to identify leaks

An example of a water meter at an Okanagan vineyard. Photo courtesy Alison Thorpe.

(Story 3-6). For agricultural customers, it is often used to track water allocations to identify over-use. Metering also enables water suppliers to establish water pricing levels that promote water conservation, and provides a mechanism for fairly distributing the costs of providing water to individual users.

Water meters that give customers personalized feedback on their water use and behaviours in a timely manner, like information provided by mobile phone companies, internet providers and energy utilities, drive change in water use patterns. Water suppliers who meter customers can provide more detailed information to consumers than those who do not meter.

A 2016 survey of 17 major water suppliers in the Okanagan found that an estimated 84% of all residential connections and 79% of all agricultural connections were metered.[55] Water suppliers with unmetered residential connections indicated they would approach universal metering within the next five years, with only difficult installations or unique circumstances remaining. The survey also found that water suppliers are metering agricultural customers to some degree – with pilot projects (23% of suppliers), partial metering (23% of suppliers), or universal metering (54% of suppliers). Despite the progress, many water suppliers only read the meters every month or two, and are not set up to gather real-time water use information. This limits the ability of water suppliers to detect system leaks, and limits the ability of customers to understand their daily or weekly water use patterns and adjust behaviours.

STORY 3-6

WEST BENCH HOMEOWNER LEAK DETECTION PROGRAM

In 2016, the Regional District of Okanagan-Similkameen (RDOS) embarked on a program to identify and encourage homeowners on the West Bench to fix leaks before volume-based pricing was implemented. The program successfully identified 167 individual accounts with an intermittent or continuous leak, which accounted for over 500 litres per hour of wasted water. Using new water meter technology, RDOS staff were able to provide detailed reports of leak volumes over time, which assisted homeowners in pinpointing and fixing leaks. This resulted in greater overall water conservation, reduced costs to the distribution system, and over 85% reduction in high bill complaints. Homeowner buy-in to the metering process was boosted, and the RDOS won a Canada-wide Water Award for the program. The RDOS is implementing a similar program for the communities of Naramata and Olalla.

Zoe Kirk, Public Works Projects Coordinator with the Regional District of Okanagan-Similkameen, received a Water Canada award for her work on the West Bench Homeowner Leak Detection Program. Photo courtesy Zoe Kirk.

ACTION 3-6

Implement universal water metering in the Okanagan and promote best practices for how and when meter data are collected and how data are stored for analysis and communication to customers.

Partners: Water suppliers, appropriate business sectors (water utility software companies, for example).

Recommend that the OBWB: Organize a workshop to enable the sharing of knowledge and experiences among water suppliers and prepare a 'water meter data collection and analysis best practices and standards' document.

Full-cost accounting for the service of water delivery includes the complete end-to-end cost to operate the water system. Water suppliers can then determine what to charge for water provision services. Full-cost accounting factors in the lifecycle costs for all utility assets, from reservoir dams and watershed protection programs to the individual homeowner's water meter. These costs should include the delivery of educational programs that promote water quality protection and water conservation. It may be challenging for some utilities to fund such programs, but full-cost accounting shows benefits to the community. For example, the benefits of protecting water quality include the reduced cost of treatment and the increased health of aquatic ecosystems.

Full-cost accounting must consider lifecycle costs for maintenance as well as eventual replacement, to ensure the water utility is sustainable financially. Without clear accounting and planning, future customers are burdened with the costs to address infrastructure deficiencies at the least cost-effective time (such as an emergency or urgent replacement).

Water pricing must achieve a balance among competing objectives such as water conservation, revenue stability, and operational needs. It is inherently more expensive to deliver water from some sources than from others due to higher operational costs, such as pumping or filtration. As such, Okanagan water utilities will likely never have the same prices for water.

3.2.4 Public education and outreach

Education and outreach programs are an integral element of a broad-based water conservation strategy. Outdoor water use is heavily influenced by weather conditions (lack of rain) or vegetation condition (stressed plants). Brown grass can be misinterpreted as being dead, but it is more likely naturally dormant because of growing conditions. Poor plant growth is often blamed on a lack of water, but other factors affect growth, such as a lack of nutrients or poor soil.

Education efforts should continue to focus on improving awareness of gardening practices and materials suited to the Okanagan climate (Story 3-7). This can be a challenging task because some homeowners have long-established gardening habits and some have experience only gardening in wetter climates. Programs that promote a shift to water-efficient landscaping should be based on xeriscape gardening principles to reduce water use and demonstrate that waterwise gardening can be cost effective and easy to maintain.

Appropriate plant selection is key to water-efficient landscapes. Several plant lists have been created for the Okanagan, including the Make Water Work Plant Collection,[56] which is promoted through various garden centre partners in the Okanagan, and the Okanagan Xeriscape Association plant database.[57] Public education should focus on how to choose

55 Okanagan Basin Water Board. 2017. Water Supplier Survey.

56 Okanagan Basin Water Board. Make Water Work Plant Collection. URL: www.makewaterwork.ca/wp-content/uploads/2018/05/Plant-Collection.pdf.
57 Okanagan Xeriscape Association. Plant Database. URL: http://okanaganxeriscape.org/plant-database.

STORY 3-7 MAKE WATER WORK OUTREACH PROGRAM

Make Water Work (www.MakeWaterWork.ca) is a valley-wide outdoor water conservation initiative of the OBWB's Okanagan WaterWise program (Story 4-5), delivered in partnership with local governments and utilities throughout the valley. Its purpose is to tackle the second largest use of Okanagan water - outdoor residential use.

The program began in 2011, after Okanagan water suppliers expressed a need to use common materials and messages for public outreach. The program uses Community-Based Social Marketing to change people's behaviours, including pledges, prompts (such as yard signs) and other resources to guide homeowners to transition to more waterwise landscaping. The program includes a direct outreach component delivered by OBWB staff and local government partners.

Okanagan nurseries and garden centres are important partners in the Make Water Work program.

ACTION 3-7

Carry out education and outreach campaigns focused on water conservation and efficiency.

Partners: Water suppliers, appropriate business sectors (for example, nurseries and garden centres, landscape and irrigation).

Recommend that the OBWB: Build on and deliver the water conservation and efficiency outreach program under Okanagan WaterWise.

appropriate plants (drought-tolerant or fire-resistant) and how to irrigate to meet the water needs of those plants, rather than simply following a schedule based on local water restrictions. Outreach programs should increase communication with the British Columbia Landscape and Nursery Association and local nurseries and landscapers to ensure that waterwise plants are available and promoted to the public.

3.3 Droughts and floods

Communities need to be better prepared to deal with more frequent extreme weather events, as the climate continues to change. These events are resulting in prolonged droughts and intense floods. As in 2017 and 2018, spring floods can be followed by periods of drought (and subsequent wildfire). As such, drought and flood management must be integrated into a wider risk and emergency management framework.

A comprehensive emergency management program can be based on a four-pillar approach:[58]

1. **Prevention and mitigation** – actions taken to eliminate or reduce hazards and their impacts (land-use management, public education, and infrastructure enhancements).
2. **Preparedness** – measures taken in advance to ensure that individuals and agencies are ready to react (emergency plans, training, resource inventories, mapping and data collection, and emergency communication systems).
3. **Response** – activities that address the direct effects of an incident and are designed to limit the loss of life, personal injury, and property damage (coordinating and provisioning resources, restoring critical infrastructure, and communicating to affected individuals and groups).
4. **Recovery** – actions to restore a community to as close to pre-disaster state as possible (providing financial assistance, restoring economic activity, and supporting evacuees).

These four pillars are interconnected, and their associated activities take place concurrently in advance of, during, and after an emergency event. For example, recovery needs to begin shortly after response activities are initiated, and mitigation activities often start prior to recovery being complete and carry on while preparedness activities are underway.

3.3.1 Drought management planning

Drought impacts may include reduced water availability for drinking and household use, irrigation, and streamflows, and may result in warmer stream temperatures potentially harming fish and other aquatic life. In the Okanagan, droughts are typically caused by low snow accumulation, early snowmelt, insufficient rainfall, and/or hot and dry weather. Drought conditions depend on geography, infrastructure and management regimes, and water demands. Drought response planning requires an understanding of events that trigger special management practices or emergency responses by municipalities. If municipalities declare a drought too late, opportunities for conservation measures may be lost; if they declare a drought too early and it is less severe than forecast, the public may become skeptical of drought warnings and the economy may suffer.

Many water suppliers have access to both groundwater and surface water sources and can switch between sources as necessary in times of water shortages. Other water suppliers have interconnections with adjacent water suppliers for emergency use. In general, having interconnections and more than one water source makes suppliers more resilient to drought and other emergencies such as short-term source contamination.

A local drought management plan outlines specific conditions that will trigger a drought declaration, and responses for drought stages. It clearly assigns roles and responsibilities for staff and elected officials, and provides protocols for communication and enforcement. A plan should include a water system profile that looks at the factors influencing the potential for drought, a description of the drought forecast approach, and a summary of the conditions under which the plan is to be

LEFT and MIDDLE: *Signs used by Okanagan municipalities to ask residents to conserve water.* ***BOTTOM:*** *Extreme low flows occurred in several South Okanagan streams in 2015, including Shuttleworth Creek.*

58 Province of British Columbia. 2011. Emergency Management in BC: Reference Manual. URL: www2.gov.bc.ca/assets/gov/public-safety-and-emergency-services/emergency-preparedness-response-recovery/embc/training/reference_manual.pdf.

carried out (drought triggers). A drought management team should be formed to lead drought preparedness and response. The community's water conservation plan (Section 3.2.1) should be used in conjunction with the drought management plan.

While good progress around drought planning has been made in the Okanagan, there is still more to do. We need to continue until all water suppliers in the Okanagan Valley have current and robust drought management plans. Monitoring, inspection and periodic review of the plans is imperative to consider a growing population, legislative and regulatory changes, new professional standards, provincial guidance, best practices, and environmental change.

The OBWB has created drought planning templates based on the provincial *Dealing with Drought* handbook[59] and input from Okanagan water suppliers. Okanagan communities can use the templates as a guide and customize their responses and actions to accommodate major water demands in their area. The OBWB has also worked with water suppliers who draw from the mainstem lakes to prepare robust triggers (based on water levels) to include in their drought management plans (Story 3-8).

ACTION 3-8

Prepare drought management plans for all Okanagan communities. Periodically review the plans and update as needed to reflect changing conditions.

Partners: Water suppliers, local governments, provincial government, agricultural associations.

Recommend that the OBWB: Encourage consistency in these plans and coordination and collaboration among the different partners. Support the dissemination of best practices via the OBWB/CivicInfo BC Planning Guides database.

3.3.2 Water storage

While water conservation is the most cost-effective and sustainable way to deal with increased water demands, developing adequate water storage capacity allows for

STORY 3-8 MAINSTEM LAKES DROUGHT STAGE TRIGGERS

Many Okanagan water utilities that withdraw water from valley lakes and the Okanagan River are working on drought response plans, and have requested assistance with identifying triggers for moving between water restriction stages. These utilities do not control the level of their reservoirs—the Province of B.C. does—making it difficult for the utilities to develop rational and easy-to-quantify drought stage triggers. Ideally, they need triggers that link with the Province's management practices, including established lake elevation and river flow targets.

In 2016, the OBWB convened a technical team of lake management, hydrology, water supply, and fisheries experts to begin work to develop appropriate mainstem drought stage triggers. Okanagan water utilities also provided considerable input. The recommended triggers use the elevations of Okanagan Lake and Kalamalka Lake between July and November to indicate potential water shortages. Two trigger graphs were developed: one for Okanagan Lake and downstream mainstem lakes (Skaha, Vaseux, and Osoyoos) and the Okanagan River; and one for the Kalamalka/Wood Lake system.

59 Province of British Columbia. Drought Information web page. URL: www2.gov.bc.ca/gov/content/environment/air-land-water/water/drought-flooding-dikes-dams/drought-information.

Examples of upland reservoirs in the Okanagan. ***LEFT:*** *Graystoke Reservoir in the Central Okanagan. Photo courtesy Bob Hrasko.* ***RIGHT:*** *Aberdeen Reservoir in the North Okanagan. Photo courtesy Jennifer Dundson.*

more flexible resource management especially in the face of future climate change challenges. Most of the surface runoff in the Okanagan region occurs during a short period each spring when the snow melts (the annual freshet). Reservoirs capture and hold some of the runoff, which allows slow but sustained releases during summer and fall when water is needed for irrigation, environmental flows, and other purposes. Figure 3-4 in Section 3.1 illustrates the timing differences between the annual freshet in spring and the demand peak in mid-summer. This timing difference is the primary reason that storing water for subsequent human uses is needed in the Okanagan.

Most of the water that recharges the mainstem lakes originates on the high elevation plateau surrounding the Okanagan valley, and the snowmelt freshet is quite short (approximately 4-6 weeks in late spring), coinciding with the start of the growing season. The total annual flow from all the streams feeding the mainstem lakes is relatively small compared to the total volume of water that is stored in mainstem lakes. Okanagan Lake, for example, has a volume of about 24.6 km^3, whereas the average inflow and outflow from the lake is only 0.6 km^3 per year. Also, much of the streamflow to Okanagan Lake is contributed by Mission Creek (about 35%). There are no major hydroelectric power generating facilities in the Okanagan, because neither local creeks nor Okanagan River has sufficient flow and elevation drop to warrant the investment.

About 150 dams are licensed to provide water storage in the Okanagan. These reservoirs are licensed to store 163,000 ML (megalitres) of water, in support of 443,000 ML of licensed water extractions from streams for water supply purposes. Many of these reservoirs were constructed over the past 100 years for purposes of storing irrigation water to supply lower elevation farms and orchards as agriculture expanded in the Okanagan. Most of the large reservoirs are located in the upper elevations of the Okanagan watershed and are under the management of cities, regional districts, or improvement districts. There are also many smaller dams, some of them owned and operated by individual ranchers or farmers. Okanagan dams vary in design and construction - from large concrete structures with automated monitoring and gate controls to small earthen check dams, and are regulated under the provincial *Water Sustainability Act*.

Climate change is causing a trend towards less total snow accumulation in the winter throughout the Okanagan watershed. With climate change, the winter snowpack is prone to melt earlier in the spring, and sometimes with a faster rate of melt. Finally, summers are becoming longer, hotter, and drier. Each of these factors is increasing the demand for reservoir storage to supply water for irrigation and other human uses. Separately, the growing population is also increasing the demand for water. Thus, the trends are towards having less water available when it is most needed and potentially higher flows during spring freshet leading to flooding challenges. Finally, there is a growing awareness among the non-Indigenous population of traditional and cultural values that promote better stewardship of the environment by maintaining (or enhancing) healthy ecological systems and respecting water as a sacred entity. Nowhere is this more clearly

elucidated than in the *Syilx/Okanagan* Nation *siwɬkʷ* Declaration (Story 4-3), which treats water as a relative that connects all life.

These ongoing changes to water supply and demand, and the expanded recognition of traditional values have implications for reservoir management in the future. In addition, instead of only one management objective—retaining water in the reservoirs for as long as possible to supply users during the mid to late summer peak demand period—water suppliers must now meet multiple objectives, which sometimes conflict. Dam managers still need to attend to the supply issue, but they are also asked to operate reservoirs in a manner that sustains downstream flows during fish migration, spawning, incubation, and rearing periods. It is important to develop new methods of optimizing dam operations that accommodate changing conditions and multiple objectives, which may require more sophisticated monitoring and automation systems than are currently in use.

The feasibility of expanding existing reservoirs and developing new reservoirs in the Okanagan should be examined. If additional capacity exists, the benefits and impacts of reservoir expansion should be carefully considered. Additional reservoir storage would capture more of the spring runoff and thereby improve the capacity to provide water supply during long, hot summers. If carefully managed, this additional supply may also provide a means to meet environmental flow requirements, especially in systems that may be prone to running dry. However, altering the stream flow hydrograph by installing or expanding a dam could also have negative effects to the natural aquatic ecosystem downstream. In the Okanagan River, the sockeye salmon run has been severely impacted since the placement of dams and other flow control structures between Penticton and Osoyoos Lake in the past century. In addition, there may be economic barriers, land constraints, and other challenges, including public opposition, to development of new reservoirs or expansion of existing reservoirs. Lastly, expanding reservoir storage could be considered a short-term fix to a long-term problem. It may satisfy a short-term need for water, perhaps for a few decades, but the challenge in the future will be to live within our means. The Okanagan watershed has only so much water to provide, so serious consideration must be given to what a sustainable future implies for water demand.

ACTION 3-9

Optimize and modernize the operation of existing storage reservoirs. Investigate opportunities to increase storage capacity in the Okanagan.

Partners: Water suppliers, provincial government.

Recommend that the OBWB: Support research and infrastructure investment.

Finally, there are regulatory pressures regarding dam safety, especially for dams that may pose significant risks or consequences to downstream infrastructure and communities – should they fail. Many Okanagan dams were constructed before there was extensive development downstream, so the risk categorization of many dams has changed through time. A public dialogue is needed about whether there should be shared responsibilities (and liabilities) for dam and reservoir operations and maintenance. Should a dam owner (individual or city) be burdened with sole responsibility for the costs of maintaining a dam if there are benefits to society by way of flood protection and ecosystem integrity, which were not considered when the decision to approve and build the dam was made?

ACTION 3-10

Explore ways to offer tangible incentives to dam owners who provide services for the public good, such as timed releases for environmental flows and ecosystem services, and holding back water to relieve flooding.

Partners: Provincial government, First Nations.

Recommend that the OBWB: Communicate with water suppliers to identify and rank possible incentives.

Aquifer storage and recovery (ASR) refers to storing water in aquifers and in the lower permeability layers between them, and later releasing the stored water for human use. The method is an alternative to storing water in upland surface reservoirs, and has been used in many places to achieve multiple benefits.

ASR involves injecting water into an aquifer through wells or by surface spreading and infiltration, and then pumping it out when needed (Figure 3-5). The aquifer functions as a water bank. Deposits are made in times of surplus, typically during the rainy season, and withdrawals occur when available water falls short of demand. Compared with conventional surface storage, ASR has proven to be cost-effective in locations having a combination of suitable quantity and quality of source water, and suitable (usually confined) aquifers located close to where the stored water will be needed. In addition, the required surface infrastructure occupies much less land than required by a surface water reservoir.

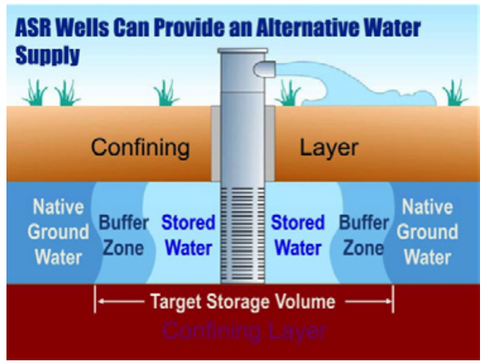


Figure 3-5 *Schematic of an aquifer storage and recovery system.*

ASR can be used for:

- Creating an emergency source of water;
- Creating off-stream storage for peak season use;
- Reducing groundwater diversions and their effects on streamflow;
- Offsetting historic declines in groundwater levels; and
- Storing better-quality (treated) surface water underground to displace lower quality groundwater.

Numerous ASR projects have been completed in Washington and Oregon, USA (Story 3-9). Many of these were developed by municipalities or other large-scale water providers, and some have involved agricultural operators. To date, exploration of ASR in

STORY 3-9 EXAMPLE AQUIFER STORAGE AND RECOVERY PROJECT – CITY OF BEAVERTON, OREGON

The City of Beaverton is located near Portland. The City (population 105,000) experienced rapid growth in the 1990s and 2000s. At the time, Beaverton relied on imported surface water from pipelines to meet its water demands. The cost of this water increased substantially as the cost of treatment and transmission from regional providers was passed on to municipalities. Beaverton is situated above deep basalt aquifers that have been used widely for groundwater supply and for ASR. Between the late 1990s and late 2000s the City explored, tested, and implemented ASR on a large scale, and the system has continued to expand to one of the largest in the U.S.[60] The Beaverton ASR system provides up to 35% of the City's peak season summer water supply. The ASR wells receive recharge water during the wet winter season when there is surplus surface water and lower municipal demand. This water is then withdrawn during the summer. Use of these wells has saved the City and its water ratepayers millions of dollars in capital and operating costs by deferring or reducing the need to build new storage or surface supply pipelines, and helped the City defer the cost of surface water filtration expansion.

60 Eaton, L., J. Melady, and T. Tolan. 2009. Successful implementation of ASR in basalt aquifers of the U.S. Pacific Northwest. Boletín Geológico y Minero, 120 (2): 131-156.

B.C. has been limited to a handful of feasibility studies, with no actual operating projects. Nevertheless, the potential exists for applying ASR in the Okanagan, particularly in watersheds that are 'fully allocated' (where no new surface water withdrawals are allowed unless additional off-stream storage is created). ASR could serve as a form of off-stream storage in such cases. This type of managed recharge could also provide a means of flood control, as shown in several locations around the world where infiltration basins provide a place to divert floodwaters before they cause damage to habitats or human infrastructure further downstream.

Improved knowledge of the underlying aquifers and geology in the Okanagan along with detailed analysis and modelling to understand the effects of groundwater pumping on storage and on surface water will be required before ASR can be adopted in the Okanagan. Nevertheless, such systems have considerable potential to contribute to local and regional scale climate change adaptation, while increasing the overall reliability of water supplies.

The Province of B.C. is beginning a feasibility study of ASR systems in B.C., including in the Okanagan. The study objectives are to 1) Investigate and identify key issues and constraints for siting, design and operation of ASR systems; 2) Develop guidance and policy strategies that support the implementation of ASR in B.C. and 3) Identify potential areas/sites for pilot testing of ASR systems. Work involves a literature review, workshops with regional Ministry staff and others involved in water management, regional hydrogeologic assessment of opportunities for ASR and a detailed review of regulatory frameworks to identify where new policies and regulations may be appropriate in order to facilitate ASR under the *Water Sustainability Act*.

ACTION 3-11

Investigate the feasibility of using ASR.

Partners: Local governments, water suppliers, researchers.

Recommend that the OBWB: Obtain funding to assist water suppliers. Leverage valley-wide information and data to add value to studies by individual water suppliers. Contribute to monitoring and assessment of ASR opportunities.

3.3.3 Flood management planning

Flooding is a natural ecological process that plays an integral role in maintaining healthy ecosystems. Under natural conditions, rivers and creeks continuously migrate across their floodplain. Flooding changes the shape and direction of the channel, creates new habitats, deposits silt and fertile organic materials, sustains wetlands, and renews floodplain ponds. Flood control strategies that largely rely on structural solutions, such as dams, dikes, and bypass channels, alter the natural environment of the waterbody, resulting in loss of habitats, biological diversity, and ecosystem productivity – yet in many areas they are important to protect existing buildings and infrastructure.

Humans have a long history of settling in floodplains. Early Okanagan settlers preferred to site farms and villages on flat, valley-bottom lands where the soil was rich, instead of on hillsides. Level ground near waterways was prized for roads and rail lines. Today, waterfront homes and beach access are highly sought after. Valley-bottom lands are also the ideal location for wastewater treatment plants to take advantage of gravity flows. Consequently, this strategy has put some of our most expensive infrastructure in the path of flood waters.

Local communities are working to better understand the risks of flooding in their areas and adjusting land use policies to manage future development in a manner that reduces flood damage and promotes public safety. Senior governments also play a role in flood management, although it is more limited. After years of only assisting with emergency response and disaster recovery, several programs are funding flood mitigation, including planning and capital works.

The three main sources of flood hazard in the Okanagan are overbank flooding of local creeks, high water levels in the valley-bottom lakes, and high groundwater tables that push to the surface. Flood risk assessments identify flood hazards, potential impacts, and where the community and infrastructure are vulnerable. Floodplain mapping is a key tool for visualizing and communicating risk.

Examples of flood damage and flood protection measures in the Central Okanagan in 2017.

Flood mapping requires a solid base of topographic data. Flood risk maps are particularly valuable for local governments because they reflect potential damage from a range of flood scenarios, by identifying populations, buildings, infrastructure, residences, and environmental, cultural and other assets that could be damaged or destroyed.

In the water sector, flood risk maps identify potential impacts on water storage, delivery, treatment and drainage systems. For local governments, the maps are used for land use and development planning and emergency responses. The maps also empower residents and business owners to address their own flood risk on their properties. Senior governments use the maps to identify emergency management costs, mitigation opportunities, and infrastructure damage. Climate change, alteration in forest cover, watershed hydrology and riverbed geomorphology, alter the probability of flooding over time, and best engineering practices recommend that floodplain maps be updated every 10 years.

Light Detection and Ranging (LiDAR) imagery is the latest available tool to capture topographic information for flood maps. LiDAR is a remote sensing technology that uses the pulse from a laser to collect measurements, which can then be used to create 3D models and maps of objects and environments. The LiDAR imagery is combined with geo-referenced aerial photos to accurately show the contours of the land and thereby help construct flood maps (Story 3-10).

In addition, flood hazard and risk mapping requires models for how the water flows across the landscape. For streams, the modelling estimates flood flows and corresponding water levels, depths, velocities and durations for a set of possible events. For lakes, the modelling estimates maximum water levels expected under different lake regulation operations and various stream inflow scenarios. The effects of wind-generated waves on lakeshore infrastructure can also be estimated. These wave heights help to determine the freeboard (or factor of safety above flood level) requirements along the lakes.

Communities can reduce the extent and severity of flood damage to key infrastructure through flood protection practices. Stream-specific bylaws, watershed-specific development permit areas (DPAs), and re-zoning are tools local governments can use to modify standards, eliminate certain types of construction, and protect floodplain setbacks. Long term policies (50-100 year) are required to re-establish reasonable urban channels that are flood tolerant.

STORY 3-10 OKANAGAN COLLABORATIVE FLOOD MAPPING PROJECT

Following the historic flooding of Okanagan lakeshores in 2017, OBWB staff began working with Okanagan communities and provincial ministries to secure funding to update local flood maps. In April 2018, the OBWB received $1.45 million from Emergency Management BC (EMBC) to acquire LiDAR and ortho-imagery for the entire Okanagan watershed.

The project is moving forward under a unique partnership between the OBWB, Okanagan local governments, the Okanagan Nation Alliance and its member communities, EMBC, and GeoBC (a branch of B.C. Ministry of Forests, Lands, Natural Resource Operations and Rural Development). GeoBC is managing the LiDAR acquisition and will own, hold, and manage the data. Under an agreement, all Okanagan local governments and First Nations have free, unrestricted, perpetual rights to the use of the LiDAR-derived products, aerial photos, and any other products or data produced as part of the project.

The OBWB is helping coordinate efforts to use the LiDAR data to prepare flood maps and risk assessments for communities. It is a collaborative process with communities working together to develop common standards for legends, colours, scales, and critical infrastructure included so the flood maps are complementary across the valley. All communities around Okanagan Lake and Kalamalka Lake will use the same models for design lake levels (for example, the 1:200-year flood level and other design levels associated with higher or lower probabilities) and appropriate freeboard.

Provincial and local government and First Nations representatives attend the kick off meeting for the Okanagan Collaborative Flood Mapping Project.

Appropriate flood construction levels (FCLs) and floodplain setbacks are also critical components of land use policies and regulation. FCLs are set to keep living spaces and storage areas above flood levels. An FCL is determined using an observed or calculated water level for an extreme flood, along with a freeboard factor that is intended to capture both the uncertainty in the estimate, and added wave heights.

The FCL for Okanagan Lake is currently 343.66 m GSC (geodetic survey of Canada). This elevation was developed in the 1970s, based on a "200-year" (0.05% annual probability) flood level of 343.06 m plus a freeboard allowance of 0.60 m. A freeboard of 0.60 m is not adequate for Okanagan lakes, because observed wave heights on Okanagan Lake are frequently 1.0 m or more, especially in exposed areas. Also, in Okanagan Lake, high water levels can be sustained for long periods, putting waterfront properties and infrastructure at greater risk from wave action during storms. In addition, flooding from high groundwater tables adjacent to the large lakes can be considered in setting a FCL, and more work should be done to evaluate this source of flood risk in areas of the Okanagan prone to groundwater-induced flooding.

In 2017, the level of Okanagan Lake peaked on June 8 at 343.25 m and extensive flooding occurred. The lake elevation would have been higher if there had been normal June rainfall, but instead, there was unusually dry weather after June 8. The 2018 flood level (342.68 m) was caused by a rapid melt of an unusually high snowpack in early May. With climate change, and an earlier freshet, it will become more difficult to regulate future lake levels. This means we have to plan for more variation in lake heights, and become better prepared to manage risks.

Floodplain setbacks keep development away from areas of potential overbank flooding or erosion and avoid restricting the flow capacity of the floodway. Keeping the floodway clear of development reduces the risk of damage to properties and maintains more natural river processes. Setbacks are measured from the natural boundary unless otherwise specified.

Land acquisition is another important, albeit expensive and often complicated method of keeping people and property away from floods. In cases where development exists in high-risk areas, the lowest-cost, long-term solution may be for the local jurisdiction to buy out the property and relocate the home and/or other vulnerable structures.

Flood risk can also be mitigated to some extent through physical and biophysical improvements including flood protection structures, diversions or flood by-passes, riparian buffer zones and green shorelines, setback dikes (Story 3-11), wetland restoration, and channel reconstruction and reconnection. Building additional capacity into infrastructure systems that serve multiple purposes, such as natural or recreational spaces that can also act as flood control measures, is important for creating climate-resilient communities.

The upper watershed reservoirs in the Okanagan are not able to attenuate spring snowmelt floods. Individually and collectively, these reservoirs do not hold very much water compared with snowpacks, so it is not realistic to expect these reservoirs to serve a flood control function.

STORY 3-11 MISSION CREEK RESTORATION INITIATIVE

The Mission Creek Restoration Initiative (MCRI) formed in 2002 as a multi-disciplinary, multi-stakeholder undertaking with the over-arching goal of restoring the lower section of Mission Creek to a more natural condition. In 2016, MCRI removed the existing dikes on one hectare of land acquired through land assembly and constructed 570 m of new dikes further back, creating a 150-m wide floodplain in that section of the creek. The new dike was tested in 2017, during a 1-in-100-year flood, and again in 2018 with a 1-in-200-year flood. The project performed as designed, allowing the water to meander through oxbows and side channels rather than funnel straight downstream as before.

*The Mission Creek dyke setback area before (**LEFT**) and after (**RIGHT**) spring freshet.*

ACTION 3-12

Improve the knowledge base to better inform flood management decisions and mitigation activities.

Partners:
Local governments, provincial government, First Nations.

Recommend that the OBWB:
Obtain funding and lead initiatives with valley-wide significance. Help local governments understand how to use the latest data. Work with Indigenous communities to establish long-term goals and progressive actions to mitigate flood impacts and risk.

ACTION 3-13

Develop and maintain up-to-date flood inundation, hazard and risk mapping for the entire Okanagan valley bottom.

Partners:
Local governments, provincial government, First Nations.

Recommend that the OBWB:
Identify and obtain funding, provide project management and coordination services, and support and facilitate collaboration.

ACTION 3-14

Improve flood management by strengthening collaboration, increasing public engagement, and including (with permission) local and Indigenous knowledge in decision-making and mitigation activities.

Partners:
Local governments, provincial government, First Nations.

Recommend that the OBWB:
Include (with permission) local and Indigenous knowledge in OBWB-led projects, act as a bridge between Okanagan communities, and include public engagement on OBWB initiatives.

ACTION 3-15

Review flood construction levels and floodplain setbacks and strengthen land use regulation in floodplains.

Partners:
Local governments, provincial government, First Nations.

Recommend that the OBWB:
Identify and obtain funding, provide project management and coordination services, and support and facilitate collaboration.

3.4 Water quantity monitoring

Climate and hydrology have changed in B.C. in recent decades, and will continue to change. This will increase the challenges faced by organizations responsible for water-related data collection, forecasting, and water management.

3.4.1 Inflow forecasting

Each winter and spring, the B.C. River Forecast Centre (RFC) develops and delivers monthly forecasts of inflow to the Okanagan and Kalamalka Lakes to the regional water manager, who considers the forecasts, the management objectives for each lake and other information, and makes decisions that establish the rate of outflow from each lake. These decisions influence the flows in the channels downstream of the dams, and the level of the lakes behind the dams. The inflow forecast relies on snow cover information provided by automated snow weather stations and snow courses, which are manually measured once per month.

Without good snowpack estimations, it is difficult to have accurate inflow estimates. A substantial long-term commitment is needed to achieve enough high quality and consistent data to support inflow forecasts. In the flood year of 2017, for example, every inflow forecast produced by the RFC underestimated actual inflows to Okanagan Lake.[61] The network of snow courses and automated stations in the region should be reviewed, and additions made to the network where needed to provide an accurate representation of snow conditions. A similarly significant commitment is needed to improve and regularly update the models used to generate the forecasts. Inflow forecasting models that run weekly or bi-weekly instead of monthly would provide much better information on which to make decisions about the rate water is released from the valley lakes.

ACTION 3-16

Add to snow data networks and improve inflow forecast models. Complete watershed assessments to identify risks to water flow and timing and other risks related to a changing climate.

Partners: Provincial government, water suppliers.

Recommend that the OBWB:
Encourage water suppliers to apply common approaches and standards to these assessments. Make climate change projections widely available. Support vulnerability (quantity) mapping research.

3.4.2 Hydrometric stations

The first hydrometric stations were established in the valley by Water Survey of Canada (WSC) around 1910. Over the years, 181 hydrometric stations were installed by WSC. Many stations were discontinued in the 1980s and 1990s due to funding limitations, leaving just 25 active stations by 2007. Currently, there are 23 WSC hydrometric stations, inadequate to support adequate environmental flow regulation for Okanagan fish species, and natural hydrologic functioning of wetlands. Better hydrometric data is also needed for planning engineered structures and/or replacement of aging infrastructure including the design of dams, reservoirs and water supply systems, roads, bridges and other stream crossings, flood mitigation structures, sewage treatment and waste disposal facilities, flood and erosion protection works, drainage and irrigation schemes, and in-stream fisheries works.

The B.C./Canada hydrometric network has been under stress for the past three decades due to funding cutbacks, policy changes, and several staff retirements, with little to no succession planning. Hydrometric data are valuable: a study conducted by the Ministry of Sustainable Resource Management (2003) estimated a $19 return for every dollar invested (physical hydrometric stations and data management).[62] Hydrometric data has become even more important in the face of social and ecological water challenges in our semi-arid watershed. Today, all levels of government need to diagnose, manage, and plan for replacing aging infrastructure, adapting to changing intensity and frequency of extreme drought and flood events, and integrating groundwater and surface water management, among other challenges.

To that end, the provincial government is leading a new "provincial hydrometric data warehouse" pilot project to collect, store and share important hydrometric data. The OBWB and the City of Kelowna are working with the Province of B.C. on this new pilot to improve third-party hydrometric data collection, storage, QA/QC, and meta-data management, sharing the data through an open source web portal. To support the collection and recording of meta-data (background information about how and where the hydrometric data was collected), the OBWB created the Integrated Hydrometric Data System to enhance information added to the hydrometric data warehouse. The system automates the attachment of meta-data, enhancing the confidence water professionals have in any given hydrometric dataset, and the appropriateness for using the dataset in any given application or project use.

61 Associated Environmental. 2017. Review of 2017 Flood Response: Okanagan Lake Regulation System and Nicola Dam. Prepared for the Ministry of Forests, Lands, Natural Resource Operations & Rural Development.

62 Ministry of Sustainable Resource Management. 2003. Water Quantity Monitoring in British Columbia: A Business Review of the BC Hydrometric Programs. URL: www.obwb.ca/newsite/wp-content/uploads/2013/09/water_quantity_monitoring_in_bc_business_review.pdf.

Moving forward, senior government must provide stable funding for adequate long-term hydrometric stations in the Okanagan. Enhancing the sharing of hydrometric data will support government staff, environmental and engineering professionals and decision makers, today and in the future. Developing a collaborative framework and sharing and applying hydrometric data will enable multidisciplinary applications throughout the Okanagan, thereby benefiting society, our economy, and the ecosystems we depend on.

ACTION 3-17

Maintain and expand the network of hydrometric stations in the Okanagan and enhance the sharing and open sourcing of collected hydrometric data.

Partners: Provincial government, federal government, local governments, First Nations.

Recommend that the OBWB: Influence the provincial and federal governments to expand their networks. Provide funding for local organizations to collect and report data. Encourage use of the Integrated Hydrometric Data System to support the provincial hydrometric data warehouse.

3.4.3 Weather (climate) stations

An important part of water use in horticulture is monitoring evapotranspiration and adjusting water use accordingly. With new climate projection models, it is possible to accurately predict weather (temperature and rainfall) extending out two weeks. This information allows growers to make longer-term plans for efficient water use, instead of reacting on a day-by-day basis.

The information for such projections is available, but more weather stations (also known as climate stations) are needed to provide realistic projections that producers can rely on. Currently, Farmwest.com collects data from a network of climate stations. Similarly, the Washington State University's Decision Aid System, licensed by the Okanagan Kootenay Sterile Insect Release Program, collects weather data from the same (or similar) network of Okanagan weather stations and makes projections using climate models and important input data error-correction algorithms. The 2-week weather projections are accurate for areas within 0.5 km to 1.0 km of the weather station, but beyond that distance, local effects occur. These weather predictive systems would benefit from an increased 'resolution' in projections provided by increased density of weather stations. The benefit of an increased resolution on weather projections is an increased use of predictive weather models and more accurate and efficient use of irrigation water.

ACTION 3-18

Increase climate stations in the Okanagan to allow for better resolution in weather projections.

Partners: AGRI, AAFC, local governments, water suppliers, agricultural associations.

Recommend that the OBWB: Identify funding sources and coordinate partners to submit funding applications.

3.4.4 Groundwater

Compared to surface water resources, there is more uncertainty about groundwater supply in most areas of the Okanagan. Demand for groundwater resources, both now and in the future, is not clearly understood but appears to be increasing. Scientific groundwater studies completed over the past decade clearly show a need to develop better local information in priority areas and to gain a better understanding of ongoing changes to groundwater supplies in the valley as a whole.

On a broad scale, improvements have been made to the Province's Observation Well Network that tracks groundwater levels. Monitoring wells help water managers understand the basic health of aquifers and how they are affected by human use and changes in rain and snowfall. A major review of the network was completed in 2009 to develop a method to recommend where observation wells need to be in the province to help protect, manage and sustain groundwater resources. Following completion of the review, provincial staff looked at Okanagan-specific groundwater information and used criteria to prioritize aquifers and provide detailed recommendations for new observation wells in the Okanagan valley.

The Okanagan Groundwater Monitoring Project, a collaborative effort involving local, federal and provincial governments and led by the OBWB, was initiated shortly after the review to implement the recommendations and expand coverage of the observation well network in the Okanagan valley.[63] The project resulted in the installation of 12 new observation wells.

Installing a groundwater monitoring well in Joe Rich.

There are currently 28 active groundwater observation wells in the Okanagan valley. The Groundwater Level Data Interactive Map[64] provides access to groundwater level data collected at these observation wells.

In addition, investments have been made by local and senior governments in updating aquifer mapping and characterization in selected areas of the valley, such as Kelowna area and North Okanagan (Story 3-12). Attempts have been made to model groundwater occurrence and flow on a broad scale, which have given some insights into the role of groundwater in the overall basin water balance.

Surface water and groundwater are often closely connected (Story 3-12). For example, most groundwater eventually flows into streams and lakes, and groundwater keeps streams flowing between snowmelt and rainfall events. The groundwater contribution to surface streams and lakes is called baseflow. The

STORY 3-12

MISSION CREEK SURFACE WATER AND GROUNDWATER INTERACTION PROJECT

The goal of the Mission Creek Surface Water and Groundwater Interaction Study is to help quantify the nature of surface water/groundwater interaction between Mission Creek and the alluvial aquifer underlying the lower reaches of the creek. In particular, the study aims to identify stream reaches that are losing water through the streambed to underlying groundwater, and stream reaches that are gaining water from groundwater inflow through the streambed. Fifteen hydrometric stations were installed to measure surface water levels and discharge within lower Mission Creek. In addition, eight piezometers were installed to measure groundwater levels adjacent to Mission Creek. A geodetic elevation survey of all hydrometric stations and piezometers determined groundwater flow directions and hydraulic gradients under varying streamflow levels, seasons, and water use periods (in particular for the irrigation season). The results are being used to determine environmental flow needs and potentially to manage extractions from wells along Mission Creek.

63 Okanagan Basin Water Board. Okanagan Groundwater Monitoring Project web page. URL: www.obwb.ca/projects/okanagan-groundwater-monitoring-project/.

64 Province of British Columbia. Groundwater Level Data: Provincial Groundwater Observation Well Network Mapping. URL: https://governmentofbc.maps.arcgis.com/apps/webappviewer/index.html?id=b53cb0bf3f6848e79d66ffd09b74f00d

View of Okanagan Lake from the Naramata Bench.

baseflow keeps streams cooler in the summer and warmer in the winter, supporting aquatic life. At the same time, many aquifers in the valley are naturally recharged by seepage from streams (exfiltration) that flow across unconsolidated sediments on valley slopes and alluvial fans.

Hydrogeological (groundwater) knowledge should gradually improve as all non-domestic groundwater sources are licensed under the *Water Sustainability Act* and expected requirements for reporting and monitoring groundwater use are brought into practice. The Province of B.C. must now consider EFNs before issuing any new groundwater licences in aquifers determined to be hydraulically connected to a stream (contributing baseflows). Most water suppliers measure water withdrawal rates for large production wells, and have developed specific estimates of future groundwater demand as part of their capital planning efforts, but extraction from private wells has typically not been measured or reported in the past. Pumping data collected by large water utilities only provide information for that specific site. Comparisons with other areas are difficult because the form of data collection varies among water suppliers.

ACTION 3-19

Undertake groundwater mapping, aquifer characterization, and groundwater-surface water interaction studies in the Okanagan. Link these efforts with ongoing EFN studies to identify water-stressed areas.

Partners: Researchers, provincial government, local governments, First Nations.

Recommend that the OBWB: Identify priority areas for aquifer mapping and groundwater/surface water interaction assessments and obtain funding for research.

3.5 Summary

Variability in the timing and amount of the water annual net inflow creates challenges in water supply management. The timing of when water is available has a great influence on whether there is water abundance, flooding or scarcity for different needs.

Setting EFNs for Okanagan streams is an integral part of sustainable water management. Under the *Water Sustainability Act*, it is now mandatory to accommodate EFNs in water licencing decisions. The OBWB in collaboration with the Okanagan Nation Alliance, the Province of B.C., and the federal government have established a set of scientifically defensible methods for determining EFN values for Okanagan streams and determined actual EFN values for selected high-value fish-bearing streams. This improved understanding of stream-specific flows that are sensitive to time of year and different life stages of fish and other aquatic organisms enhances and supports water allocation and decision-making throughout the Okanagan Valley.

Meeting requirements for EFNs as well as agricultural irrigation needs is an ongoing challenge. The new legal requirements for EFNs, combined with the expected climate changes and the increasing water demands from a growing population, water licensed for agriculture may be less available than previously thought. A flexible licensing structure would help to provide water to farmers when they need it and enable them to use water efficiently.

With population growth and a changing climate, the need to improve water efficiency is more important than ever. Strategies such as crop selection, landscape design, irrigation methods, water metering, and new technologies can improve water-use efficiency. New climate projection models can better predict temperature and rainfall, which allows growers to develop longer-term plans for efficient water use. More and more communities are developing Water Conservation Plans, and local residents are increasingly taking part in waterwise strategies and programs, as part of a broad-based water conservation strategy.

Okanagan communities are becoming better prepared for more frequent and more extreme conditions, such as droughts and floods. Good progress around drought planning has been made in the Okanagan. However, work must continue until every community has a Drought Management Plan with defensible triggers and responses and protocols for communication and enforcement. Communities are developing better land use policies to manage future development and reduce flood damage to infrastructure properties. Flood risk mapping is a valuable tool for local governments in identifying anticipated impacts on infrastructure and property and associated costs of emergency response and mitigation. An innovative flood mapping project is underway in the Okanagan. The project is a collaborative effort to enhance flood mapping for the entire valley, which will facilitate effective and dynamic flood mapping and risk assessments and allow for more strategic planning.

Developing adequate water storage for subsequent use provides a mechanism for a sustained water supply during long, dry periods. However, retaining water in reservoirs or aquifers to supply users during shortages is only one objective of many, including sustaining adequate downstream flows for critical fish periods. However, expanding storage is only a short-term solution to a long-term problem. The real solution is to live within our means.

Future changes in climate and hydrology are expected to create new challenges in inflow forecasting for Okanagan mainstem lakes. A substantial long-term commitment is needed to achieve adequate, high quality and consistent data needed to drive forecasting models. A similarly significant commitment is needed to improve and regularly update the forecasting models. Accurate, long-term, real-time hydrometric data are fundamental to understanding the spatial distribution and variability of natural runoff in the Okanagan and how the changing climate may be modifying the valley's hydrology.

Compared to surface water supply, there is more uncertainty about groundwater supply. Groundwater studies conducted over the last decade clearly expressed a need to develop better local information and to gain a better understanding of ongoing changes to groundwater supplies across the valley.

Kids play in the newly re-opened splash park in Kelowna's City Park. The old splash park was destroyed in 2017 when severe flooding damaged the infrastructure used for the water delivery and drainage system. After a year of renovations, the splash park re-opened this summer, and the kids went back to playing.

CHAPTER 4

DELIVERING THE STRATEGY

4.0 DELIVERING THE STRATEGY

This Strategy describes actions that are needed to safeguard clean and healthy water in the Okanagan, meeting the needs of natural ecosystems, residents and agriculture, now and in the future. Delivering the actions requires good water governance supported by adequate and secure funding and resources. Water knowledge must be integrated into management decisions and planning frameworks and readily transferred between partners in a transparent way to be of greatest benefit. Coordination and collaboration are central, and decisions must consider community needs through ongoing engagement. Finally, we must measure our progress through ongoing monitoring and reporting.

It is ineffective to work in siloes when working on water – from water conservation to source protection and flood planning, each affects the others. As a valley, across all communities and sectors, there is a groundswell of collaboration, sharing ideas and resources. Local groups and governments are organizing themselves to take on leading roles in water decision making, and this Strategy will be a guide for action.

Through this Strategy, the Council recognizes that addressing the challenges and complex issues around water in the Okanagan will require decades of diligent action. This chapter outlines the broad actions that will support the implementation of the overall Strategy, ensuing that a robust and well-supported plan is in place to achieve the intent of clean and healthy water in the Okanagan.

4.1 Water governance

In Canada, responsibility for water management is shared by the federal, provincial, and municipal governments and in some instances by the territories and by Aboriginal governments under self-government agreements. The shared responsibility necessitates close cooperation and collaboration.

Before the OBWB's Water Management Program was formally started in 2006, and the Okanagan Water Stewardship Council was formed, there was widespread concern about fragmented water initiatives. This was a central argument for launching the Water Management Program (Story 1-3) – to bring together the water community, to share information, and to accelerate knowledge transfer. It has become a key role of the OBWB and a key strategic approach to advancing water science and policy.

4.1.1 Water governance in the Okanagan

Water governance can be defined as the range of political, social, economic, and administrative systems spanning different levels of society for developing, managing and delivering water resources.[65] Water governance takes place at every level of government (Story 4-1), and often through non-governmental structures. This differs from water management, which includes operational activities to regulate water and impose conditions on its use.[66] Put simply, governance refers to how we make decisions and who gets to decide, whereas management refers to the models, principles and information used to make those decisions.[67]

Okanagan communities face complex challenges in water governance, including conflicting water management priorities with senior government objectives. Governance is more effective if water institutions at all levels are more integrated and coordinated. Working together at the local, regional, provincial, and Indigenous government levels can reduce conflict to address complex challenges, ensuring the best outcome for the collective future.

The foundation for healthy water governance for the Okanagan includes the following components:

- **Vision:** There must be a common vision that recognizes the interdependence of Okanagan communities and their shared water.
- **Trust:** Communities, local organizations and citizens work most effectively when there is mutual trust and understanding.
- **Communication:** Clear and open communication reinforces trust, supporting collaboration and avoiding duplication of efforts.
- **Scale:** Matters influencing only a portion of the Okanagan may best be addressed by authorities in that area and, at the same time, solutions from one jurisdiction can often be replicated in others.
- **Representation:** Equitable representation and balanced interests are critical for institutions to function well. For example, weighted voting based on community population size may not be desirable for policy making on valley-wide issues because it perpetuates competition between communities.
- **Partner Involvement:** It is crucial to have key partners and stakeholders involved in the development of water policy. For example, the Okanagan Water Stewardship Council, with its many representative organizations, has provided essential contributions to the governance process.
- **Resources:** Coordinated watershed governance needs consistent resourcing to provide the most value, and can reduce costs over the long-term through better planning and increased efficiencies.

STORY 4-1 JURISDICTION OF FRESH WATER IN B.C.

The **federal government** is generally responsible for navigable waters, waterways where anadromous fish migrate, water and wastewater on reserves, and waterbodies on federal lands such as national parks and that cross the border with the United States. While Canadian provinces have the primary jurisdiction over most areas of water management and protection, federal health, environmental and fisheries legislation do impact fresh water management. Federal statutes most pertinent to fresh water governance and planning include the *Fisheries Act*, the *Canadian Environmental Assessment Act*, the *Species at Risk Act*, the *Canada Water Act*, and the *Navigation Protection Act*.

Provincial and territorial governments have regulatory power over water use, approvals, and licensing. B.C. does not have overarching legislation designed to protect fresh water. Instead, it attempts to address water issues through a number of separate laws. Numerous provincial ministries have jurisdiction and authority over the Crown land areas in watersheds. Drinking water falls under the Ministry of Health and Health Authorities, water licensing and raw water management falls under the Ministry of Forests, Lands, Natural Resource Operations and Rural Development, and water policy and regulation falls under the Ministry of Environment and Climate Change Strategy. Key freshwater-related statutes in B.C. include the *Water Sustainability Act*, the *Environmental Management Act*, the *Drinking Water Protection Act*, the *Riparian Areas Protection Act*, the *Forest and Range Practices Act*, the *Oil and Gas Activities Act*, and the *Drainage, Ditch and Dike Act*.

Provinces delegate certain authorities to **local governments** through the *Local Government Act*, especially in the drinking water treatment and distribution and wastewater treatment operations of urban areas. The *Community Charter* provides municipalities with the authority to establish bylaws pertaining to the protection of the natural environment and public health. The Province may also delegate some water resource management functions to local authorities that may be responsible for a particular area or river basin.

Most **Indigenous peoples** in British Columbia have never ceded title and rights within their territories. As B.C. and Canada implement the United Nations Declaration on the Rights of Indigenous Peoples (see Section 4.2.1), many changes will take place in the management of water and other resources.

65 Global Water Partnership. 2003. Effective water governance. Learning from dialogues. Stockholm, Sweden: GWP Secretariat.

66 Nowlan, L and K. Bakker. 2007. Delegating Water Governance: Issues and Challenges in the BC Context. Program on Water Governance. University of British Columbia. P. 5.

67 Bakker, K. (2006). 'Introduction'. From Eau Canada- The Future of Canada's Water. Vancouver: UBC Press.

Truly regional activities are those that are difficult or impossible for an independent jurisdiction to lead—because they are outside its mandate—or those where a valley-wide approach greatly increases efficiency. For example, source protection and other issues related to water pollution are regional by nature because the receiving bodies—lakes, rivers, and groundwater—link all communities in the watershed. In contrast, drinking water treatment and delivery systems are best managed by individual utilities, because they benefit only the customers of that utility.

It is challenging for any agency to function both as a regulator and a catalyst for collaboration. The OBWB (including the Okanagan Water Stewardship Council) exercises a form of water governance without rule-making authority, striving to support parties that do have such authority to use scientific evidence and community involvement to make water decisions. This 'soft-power' approach allows the Board and Council to act as conveners and find mutual solutions to difficult problems, without carrying a 'big stick.' Trust and communication are essential for collaboration, and trust is built by bringing people to the table to discuss mutual interests.

The structure of the OBWB, as a watershed institution, is designed for conflict resolution and enhanced communication, and for harmonizing policies among jurisdictions. Many of the critical tasks in this Strategy require strong partnerships. Given the uncertainties associated with climate change, population growth, economic cycles, and demographic shifts, collaborative water governance must build flexibility and resiliency into water management systems.

From its beginning in 1970, the OBWB has had a mandate to advocate for water, identifying issues and priorities and communicating back to senior government. Over the years, this role has expanded to include an active voice that advocates on behalf of local governments. The OBWB recognizes the risk of promoting actions that shift responsibilities from the provincial government to local governments. If there is an actual or perceived gap in regulatory enforcement (for example, to stop mud bogging around reservoirs) or conflicting priorities (for example, mining permits in community watersheds), it is tempting for local governments to seek more authority and tackle problems directly. Activities should only be undertaken by local governments if there is a compelling local benefit, cost savings, or risk abatement, and significant, permanent funding support. As well, Indigenous governments have a strong and evolving role in watershed governance and management, and are keenly interested in leadership and protection of resources within their territories, and must be fully engaged in discussions.

In most cases, it is most efficient for senior levels of government to maintain regulatory authority and meet their statutory obligations while working in partnership with local governments and Indigenous governments who can best identify problems and act on the ground. Good communication among all levels of government is essential.

ACTION 4-1

Integrate management objectives throughout government agencies and with external partners.

Partners: Federal government, provincial government, local governments.

Recommend that the OBWB: Advocate for local government participation in dialogue at the provincial and federal levels.

4.1.2 Coordination and collaboration

For the OBWB and Okanagan Water Stewardship Council, collaboration is not just a strategy, but a central tenet. We are all responsible for a similar set of values related to water supply, quality and connection. The OBWB is structured to leverage collaboration as an essential aspect of watershed management; one that is the common thread running through the actions in this Strategy. Collaboration leads to better decisions and better outcomes because stakeholders are involved in identifying challenges and opportunities and achieving workable solutions. When we pool resources—whether ideas, information, knowledge, individual efforts or funding—our goals are more easily reached. There are never enough resources if everyone works in individual siloes, so by working together, new solutions can emerge.

LEFT: *A working group gathers in the Duteau Creek watershed to discuss source protection.* ***RIGHT:*** *The Okanagan Basin Water Board and its Water Stewardship Council hold a joint session every year to discuss current initiatives.*

ACTION 4-2

Share Okanagan-specific information and knowledge with partners within the valley and beyond to facilitate common pools of knowledge and to bring in new partners.

Partners: Okanagan Water Stewardship Council member organizations, local governments.

Recommend that the OBWB: Present at conferences and workshops. Participate in the work of professional organizations.

Collaboration is critical in the Okanagan because Okanagan water governance is multi-jurisdictional. 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. The actions in this Strategy cannot be achieved without partnerships with all sectors of the community. This collaboration must extend beyond the borders of political jurisdictions to connect upstream and downstream communities, protect natural corridors for fish and other animals, and recognize that Okanagan water supports a whole system of living things.

To integrate watershed management means considering how land is used and managed. It requires wider partnerships between all Okanagan communities and levels of government, as well as with landowners, developers, farmers, scientists, residents, recreational groups, and others. 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.

One essential part of collaboration is to build relationships and strengthen partnerships by knowing one another as individuals. These opportunities for personal connection can come in the form of extended coffee breaks, meet-and-greet sessions, volunteer appreciation parties, and other formal or informal social gatherings.

Local and provincial government staff, water suppliers, conservation groups and others learn about the Joe Rich Restoration Project.

Coordination and collaboration are necessary to:[68]

- Bring consistency to local regulations and plans;
- Support integrated land and water management;
- Enable inter-jurisdictional approaches to water issues in a watershed context;
- Coordinate flood planning and hazard mitigation;
- Coordinate source protection and ecosystem restoration activities;
- Control the introduction and spread of invasive species;
- Design and implement controls for nonpoint source runoff;
- Support effective habitat conservation and protection projects; and
- Support coordinated research, study, and monitoring of surface water and groundwater to further our understanding of ecological processes.

In an era of climate change and uncertain weather patterns, when rapid population growth makes our communities more sensitive to risks, it's even more important to find new ways to work together to protect and care for Okanagan water.

All life depends on a clean, healthy water supply. Meaningful involvement of people and various sectors, including water suppliers, Indigenous peoples, industry, government institutions, and nongovernment organizations, is essential to effectively solve our water challenges.

4.2 Reconciliation with Indigenous peoples

Across Canada, communities are working towards reconciliation with Indigenous peoples. This is especially true in B.C., where most First Nations have never ceded rights and title. Water is a key aspect of reconciliation in the Okanagan—there is a need first to understand the differences in culture between settler and First Nation communities about water and water management, and then to enter into discussions about how we can better manage water together.

ACTION 4-3

Strengthen relationships between Okanagan local governments, non-governmental organizations, professional organizations, First Nations, and the faculty, staff and students at academic institutions to promote community-engaged research and learning.

Partners: Local governments, UBC Okanagan, Okanagan College, First Nations.

Recommend that the OBWB: Work with faculty and researchers to identify opportunities for community-engaged research.

4.2.1 International and national calls to action

The United Nations Declaration on the Rights of Indigenous Peoples[69] (UNDRIP) was adopted by the UN General Assembly in 2007. UNDRIP is currently the most comprehensive international instrument on the rights of Indigenous peoples. It establishes a universal framework of minimum standards for the survival, dignity and well-being of Indigenous peoples and elaborates on existing human rights standards and fundamental freedoms. Water is only specifically mentioned in UNDRIP twice, but references to Indigenous "lands, territories and resources" throughout UNDRIP are interpreted to include water.[70] Story 4-2 lists the 13 articles in UNDRIP that are relevant to water.

68 Delaware River Basin Commission. 2004. Water Resources Plan for the Delaware River Basin. p. 49.

69 United Nations. 2007. United Nations Declaration on the Rights of Indigenous Peoples. URL: www.un.org/development/desa/indigenouspeoples/wp-content/uploads/sites/19/2018/11/UNDRIP_E_web.pdf.

70 Askew, H., C. Snelgrove, K. Wrightson, D. Couturier, A. Koebel, L. Nowlan and K. Bakker. 2017. Between Law and Action: Assessing the State of Knowledge on Indigenous Law, UNDRIP and Free, Prior and Informed Consent with reference to Fresh Water Resources. URL: www.wcel.org/sites/default/files/publications/betweenlawandaction-undrip-fpic-freshwater-report-wcel-ubc.pdf.

STORY 4-2

UNITED NATIONS DECLARATION ON THE RIGHTS OF INDIGENOUS PEOPLES: ARTICLES RELEVANT TO WATER

According to West Coast Environmental Law, 13 of the 46 articles in UNDRIP are relevant to water:[71]

ARTICLE 3: Indigenous peoples have the right to self-determination. By virtue of that right they freely determine their political status and freely pursue their economic, social and cultural development.

ARTICLE 4: Indigenous peoples, in exercising their right to self-determination, have the right to autonomy or self-government in matters relating to their internal and local affairs, as well as ways and means for financing their autonomous functions.

ARTICLE 8.2b: States shall provide effective mechanisms for prevention of, and redress for: (b) Any action which has the aim or effect of dispossessing them of their lands, territories or resources.

ARTICLE 10: Indigenous peoples shall not be forcibly removed from their lands or territories. No relocation shall take place without the free, prior and informed consent of the indigenous peoples concerned and after agreement on just and fair compensation and, where possible, with the option of return.

ARTICLE 18: Indigenous peoples have the right to participate in decision-making in matters which would affect their rights, through representatives chosen by themselves in accordance with their own procedures, as well as to maintain and develop their own indigenous decision-making institutions.

ARTICLE 19: States shall consult and cooperate in good faith with the indigenous peoples concerned through their own representative institutions in order to obtain their free, prior and informed consent before adopting and implementing legislative or administrative measure that may affect them.

ARTICLE 20.2: Indigenous peoples deprived of their means of subsistence and development are entitled to just and fair redress; and

ARTICLE 25: Indigenous peoples have the right to maintain and strengthen their distinctive spiritual relationship with their traditionally owned or otherwise occupied and used lands, territories, waters and coastal seas and other resources and to uphold their responsibilities to future generations in this regard.

ARTICLE 26:

1. Indigenous peoples have the right to the lands, territories and resources which they have traditionally owned, occupied or otherwise used or acquired.
2. Indigenous peoples have the right to own, use, develop and control the lands, territories and resources that they possess by reason of traditional ownership or other traditional occupation or use, as well as those which they have otherwise acquired.
3. States shall give legal recognition and protection to these lands, territories and resources. Such recognition shall be conducted with due respect to the customs, traditions and land tenure systems of the Indigenous peoples concerned.

71 West Coast Environmental Law. 2017. Between Law and Action: Assessing the State of Knowledge on Indigenous Law, UNDRIP and Free, Prior and Informed Consent with reference to Fresh Water Resources. Table 1, p. 10.

STORY 4-2 UNITED NATIONS DECLARATION ON THE RIGHTS OF INDIGENOUS PEOPLES: ARTICLES RELEVANT TO WATER (continued)

ARTICLE 27: States shall establish and implement, in conjunction with indigenous peoples concerned, a fair, independent, impartial, open and transparent process, giving due recognition to indigenous peoples' laws, traditions, customs and land tenure systems, to recognize and adjudicate the rights of indigenous peoples pertaining to their lands, territories and resources, including those which were traditionally owned or otherwise occupied or used. Indigenous peoples shall have the right to participate in this process.

ARTICLE 28:

1. Indigenous peoples have the right to redress, by means that can include restitution or, when this is not possible, just, fair and equitable compensation, for the lands, territories and resources which they have traditionally owned or otherwise occupied or used, and which have been confiscated, taken, occupied, used or damaged without their free, prior and informed consent.
2. Unless otherwise freely agreed upon by the peoples concerned, compensation shall take the form of lands, territories and resources equal in quality, size and legal status or of monetary compensation or other appropriate redress.

ARTICLE 29:

1. Indigenous peoples have the right to the conservation and protection of the environment and the productive capacity of their lands or territories and resources. States shall establish and implement assistance programmes for indigenous peoples for such conservation and protection, without discrimination.
2. States shall take effective measures to ensure the no storage or disposal of hazardous materials shall take place in the lands or territories of indigenous peoples without their free prior and informed consent.
3. States shall also take effective measures to ensure, as needed, that programmes for monitoring, maintaining and restoring the health of indigenous peoples, as developed and implemented by the peoples affected by such materials, are duly implemented.

ARTICLE 32:

1. Indigenous peoples have the right to determine and develop priorities and strategies for the development or use of their lands or territories and other resources.
2. States shall consult and cooperate in good faith with the indigenous peoples concerned through their own representative institutions in order to obtain their free and informed consent prior to the approval of any project affecting their lands or territories and other resources, particularly in connection with the development, utilization or exploitation of mineral, water or other resources.
3. States shall provide effective mechanisms for just and fair redress for any such activities, and appropriate measures shall be taken to mitigate adverse environmental, economic, social, cultural or spiritual impact.

After six years of hearings and testimony, the Canadian Truth and Reconciliation Commission (TRC) released its summary report, *Honouring the Truth, Reconciling the Future*, in 2015. The report contains 94 Calls to Action. Several of these Calls to Action speak to the recognition of Indigenous rights over land, calling on all levels of government, including local government, to "repudiate concepts used to justify European sovereignty over Indigenous people and lands … and to reform those laws, government policies and litigation strategies that continue to rely on such concepts."[72]

In May 2016, the Government of Canada announced its commitment to adopt and implement UNDRIP. It also accepted all of the TRC's Calls to Action, including the call for all levels of government to adopt and fully implement UNDRIP as the framework for reconciliation. The Province of B.C. declared its commitment to UNDRIP in 2017 and drafted 10 principles, intended as "bold statements to guide this new relationship and end the denial of Indigenous rights that have led to disempowerment and assimilationist policies and practices."[73]

4.2.2 Community-level reconciliation

Many local governments in B.C. have taken up the TRC's Calls to Action, providing examples of how to move forward on the reconciliation journey at the local level. This will require new practices on the ground (and in the water), and changes to governance and how decisions are made. Some of these changes are within local government jurisdiction, and others must be supported by changes to legislation at the provincial and federal levels. In the Nicola Watershed, for example, a Memorandum of Understanding was established in 2018 between the Province and First Nations to "develop and recommend a governance approach to sustainably manage water resources within the Nicola Watershed, informed by *Nlaka'pamux* and *Syilx/Okanagan* law, and the relevant legislative framework, including the *Water Sustainability Act*." As changes flow from this new governance relationship, it will change the direction of local government interactions with both the Province and First Nations.

The *Syilx/Okanagan* Nation *Siwɬkʷ* (Water) Declaration (Story 4-3) helps the OBWB, the Council, local governments, and other water stakeholders improve their cultural understanding and engagement with the *Syilx/Okanagan* People, and raises the bar for caring for and protecting Okanagan water.

Local governments and First Nation communities are natural partners. Although each has a different order of government (local vs. Nation level), both are responsible for meeting community needs and protecting water sources. Some Okanagan local governments have established formal relationships with *Syilx/Okanagan* and *Splatsin* governments and hold regular community-to-community meetings to discuss shared interests. These relationships will be broadened and deepened by the acceptance of the reconciliation process across all levels of government. Many public meetings, including those of the OBWB and Okanagan Water Stewardship Council, now begin with an explicit recognition of traditional and unceded territory, which was not occurring when the first edition of the Sustainable Water Strategy was written in 2008.

The Okanagan Nation Alliance and member bands have significant expertise in fisheries science and watershed planning, and have a long history of traditional ecological knowledge. One of the most direct forms of meaningful engagement at the local level is to work with the Okanagan Nation Alliance on initiatives related to water management. There have been many successful examples from recent years, including the Okanagan Wetland Strategy, the Environmental Flow Needs project, flood risk assessments, stream hydrology, and studies on the impact of milfoil treatments to natural and cultural resources in Vaseux Lake.

4.3 Informed decision-making

Watershed management should be based on the best available science, traditional knowledge, and local knowledge. Instead, decision-making is often driven by development pressures and other economic forces. While community values will continue to determine how water and watersheds are managed, there is a

72 Truth and Reconciliation Commission of Canada. 2015. Calls to Action. URL: http://nctr.ca/assets/reports/Calls_to_Action_English2.pdf.

73 Province of British Columbia. 2017. Draft Principles that Guide the Province of British Columbia's Relationship with Indigenous Peoples. URL: https://news.gov.bc.ca/files/6118_Reconciliation_Ten_Principles_Final_Draft.pdf?platform=hootsuite.

STORY 4-3

EXCERPT FROM THE SYILX/OKANAGAN NATION SIW̓K̓ʷ (WATER) DECLARATION

SIW̓K̓ʷ - WATER

siw̓k̓ʷ is a part of us and a part of all life.

siw̓k̓ʷ must be treated with reverence and respect. Our relationship with *siw̓k̓ʷ* is not taken lightly; we are responsible to ensure that our relation can continue to maintain the health and resiliency of our tmxw ulaxw and timixw.

siw̓k̓ʷ is the lifeblood of our tmxw ulaxw and our timixw and we as *Syilx* People recognize *siw̓k̓ʷ* as a sacred entity and relative that connects all life.

siw̓k̓ʷ comes in many forms and all are needed for the health of tmxw ulaxw and for the timixw.

siw̓k̓ʷ is our most sacred medicine: *siw̓k̓ʷ* nourishes, replenishes, cleanses, and heals. Any use of *siw̓k̓ʷ* should be an act of reverence and a commitment to our responsibilities to all life: now and to come, as *Syilx* People.

siw̓k̓ʷ comes from the sky and the highest places yet it never willfully rises above anything. It will always take the lowest path in its humility, yet of all the elements, it is the most powerful.

Our sacred *siw̓k̓ʷ* water teaches us that we have great strength to transform even the tallest mountain while being gentle, soft, and flexible.

siw̓k̓ʷ will always find a way around obstructions: under, over and through. It teaches us that anything is possible.

siw̓k̓ʷ movements, pathways, resiliency and power teach us who we are and who we can be as people.

ACTION 4-4

Increase opportunities for shared learning with Okanagan Indigenous communities, especially of cultural practices, environmental stewardship, and governance processes.

Partners: First Nations, provincial government, local governments.

Recommend that the OBWB: Maintain dialogue and strengthen relationships with Indigenous communities in the Okanagan basin.

significant risk of unintended consequences if decisions are made in an information vacuum. Science and traditional knowledge have informed us, for example, that tree-covered shorelines are prone to floods, slopes are prone to crumble, streams go dry in summer, and fish spawn in some types of gravel but not others. This strategy is based on the idea that communities will be healthier and more sustainable if decisions are based on the best knowledge we have.

Sections 2.4 and 3.5 of the Strategy describe the specific types of data that need to be collected to support sound water management in the Okanagan. This section highlights the critical need to integrate data, so they can be incorporated into the decisions, practices and policies of organizations and systems.

4.3.1 Knowledge integration and transfer

Because the OBWB bridges so many jurisdictions and so many aspects of water issues over so many years, it has become an important hub for water information. Maintaining an archive of reports is one aspect of this role, and so is maintaining a network and base of institutional knowledge about what has been accomplished in the region. Indigenous Elders also have this role, bringing knowledge of the past to younger generations, informing the future. Elders hold not just the knowledge they've gained through their lifetimes observing water and natural processes, but also traditional knowledge that has been passed down through previous generations. One of the potential paths toward reconciliation is to work on integrating these forms of knowledge, and using this integrated knowledge to improve water and watershed management.

Knowledge integration and transfer, in its many forms, requires a systematic approach. From a science perspective, we work to archive research and data and make it accessible to use for public benefit. For knowledge to be accessible people must know what is available and how to find it. Many websites, data hubs, and databases relate to B.C. water. A 2017 review found 42 water monitoring data hubs alone; yet the most common complaint was that the data were difficult to access and many of the data sets were incomplete or of unknown quality.[74] The OBWB has undertaken or participated in several efforts to collect, store, integrate and distribute information, with some successes and some failures. The OBWB is trying to share many information sources on common platforms and in common formats, for example, the Aquarius water data management software, CivicInfo BC (Story 4-4), EcoCat,[75] or the Community Mapping Network.[76] In an era of internet search engines, the goal is to put the data where it will be easy to find.

Knowledge integration brings different sources together. For example, flood mapping brings together climate science, hydrometric station data, hydrology models, LiDAR data, and information about dam operations as well as critical infrastructure. The Okanagan Nation Alliance took their flood risk assessment even farther, combining traditional knowledge about the watershed with science information about flood probabilities and areas at risk of debris flows.

Knowledge integration often happens first through conversation, for example, when people with different

STORY 4-4

OBWB/CIVICINFO BC PLANNING GUIDES DATABASE

Many planning toolkits and guides are available that provide innovative policies, case studies, bylaw language, and legal approaches to help communities adapt to climate change, support water conservation, and practice sustainable development. In 2017, with funding from the B.C. Ministry of Municipal Affairs and Housing, the OBWB brought together more than 100 of these valuable resources into a searchable hub at www.civicinfobc.ca/planning-guides.

An OBWB staff person gives a demonstration of the planning guides hub at the 2019 Union of BC Municipalities convention.

74 Luttmer, C. 2018. Water Monitoring in British Columbia: Scanning the Data Landscape Public Report. Prepared for the Water Monitoring Working Group of the BC Water Funders Collaborative. URL: www.obwb.ca/newsite/wp-content/uploads/water_monitoring_in_british_columbia_2018.pdf.

75 BC Ministry of Environment. EcoCat: The Ecological Reports Catalogue. URL: https://a100.gov.bc.ca/pub/acat/public/welcome.do.

76 Community Mapping Network. URL: www.cmnbc.ca/.

ACTION 4-5

Deliberately expand the network of Okanagan water professionals and interested parties to create a greater diversity of knowledge from which to develop water management solutions. Facilitate knowledge transfer across generations, cultures, communities and sectors. Support new professionals by linking them with research networks and employment opportunities.

Partners: UBC Okanagan, Okanagan College.

Recommend that the OBWB: Work with the Okanagan Water Stewardship Council and ensure that membership remains diverse and active. Provide and facilitate mentoring opportunities. Convene workshops and other learning opportunities and provide funding for events offered by partner organizations.

expertise come together to talk about complex issues. The most influential way that the OBWB and the Council have supported and promoted knowledge integration and transfer has been through the professional and social networks created through the Water Management Program. Usually, the best source of information on a particular water issue is another person. First Nations have a tradition of formal knowledge keepers, and we should learn to recognize and engage knowledge keepers among all cultures and communities.

By cultivating relationships, and convening groups of technical experts for specific projects, knowledge is integrated, and the best, most relevant resources are sourced to address any problems. Collaboration draws on the experience of many individuals. The OBWB is important as a communications hub and as a convener of meetings and workshops, through knowledgeable staff, and by having institutional memory to provide continuity.

The OBWB is an important convener of knowledge-sharing events, such as the 2015 Drought Information Workshop pictured here.

4.3.2 Community engagement

Community engagement is the process of involving people in decisions that affect them. The protection and prudent use of water in the Okanagan is the responsibility of every resident, every business, and every organization involved in activities related to or relying on water. A sense of individual and collective stewardship is critical for achieving the actions in this Strategy. The OBWB slogan is "One Valley, One Water," which underpins our outreach and education program Okanagan WaterWise (Story 4-5). We are all connected in the Okanagan Valley and share the water; therefore, decisions and actions made in one part of the watershed can have impacts throughout the watershed.

Having a deliberate strategy of community engagement has changed the public's knowledge about water in the Okanagan, and strengthened the OBWB and the Council. There is now a much broader understanding about OBWB programs among the public, elected officials, local and senior government staff, and stakeholders.

There are many levels of engagement with water topics in the Okanagan.

The guests and committee members of the Okanagan Water Stewardship Council share and report water information back to their respective networks. The OBWB and Council maintain a close consultative relationship with these groups, exchanging ideas and keeping them updated with initiatives.

The OBWB disseminates a monthly Board Report with highlights from the board's meeting. This is distributed to Okanagan local governments and First Nation councils, federal and provincial government elected and staff, council members, media, and others who have asked to be included. An annual meeting is also held which includes the dissemination of an annual report.

STORY 4-5 **OKANAGAN WATERWISE**

In 2010, following extensive consultation with partners, the OBWB launched Okanagan WaterWise, an outreach and education program, with the tagline "One valley. One water." The program began with a website[77] that provided information to the public on valley-wide water issues: where our water comes from, where it goes, how to be WaterWise (conserving and protecting water) in our homes, yards, in nature, in our businesses and schools. At that time, the Okanagan WaterWise program launched Facebook[78] and Twitter[79] pages as a way to engage regularly with the public on water issues.

Since then, the program has expanded. The website now includes several resources including the *Slow it. Spread it. Sink it! Okanagan Homeowners Guide*, educator and student resources, and more. WaterWise videos have been created, and additional related videos have been collected and placed on the Okanagan WaterWise YouTube channel.[80] The program now has an Instagram[81] feed, further extending public outreach. Through Okanagan WaterWise, the OBWB has hosted numerous public events, and each year provides a summertime outreach program, attending events and providing classroom and community presentations. The OBWB is also developing an Okanagan WaterWise school curriculum as a further step for public education.

Okanagan WaterWise has been the launching off point for two outreach campaigns: *Don't Move A Mussel* (Story 2-12) and *Make Water Work* (Story 3-7).

Okanagan WaterWise display that is used at numerous community events throughout the year.

The media also engages with water topics, receiving OBWB news releases and board reports, attending news conferences, following OkWaterWise on social media, attending Board and Council meetings, often following up with questions.

Another level of engagement with water topics comes from members of the public who attend Okanagan WaterWise events, or follow OkWaterWise on social media. These are enthusiastic, motivated people who are interested in water-related issues, including OBWB and Council activities, and the work of our water-related partners.

For the Make Water Work campaign (Story 3-7), the steering committee includes local governments and utilities. Partners also include local garden centres, landscape and irrigation businesses, the Okanagan Xeriscape Association, Friends of Summerland Ornamental Gardens and others. For Don't Move a Mussel (Story 2-12), a core partner is the Okanagan and Similkameen Invasive Species Society. Again, there are several business, community and industry partners, and staff also consult with the province, provincial invasive species groups and others.

The Okanagan WaterWise campaigns for *Don't Move a Mussel* and *Make Water Work* seek to educate the broadest audiences possible. These campaigns have many public touch points, such as tabling at farmers' markets and festivals, targeted social media, billboards, and radio spots.

77 www.OkWaterWise.ca
78 www.facebook.com/OkWaterWise
79 https://twitter.com/okwaterwise?lang=en
80 https://www.youtube.com/OkanaganWaterWise
81 https://www.instagram.com/okanagan_waterwise/

Outreach to school-aged children is an important part of the Okanagan WaterWise program.

ACTION 4-6

Build-out outreach programs and communications strategies, working with all Okanagan communities and partner organizations to facilitate consistent messaging, mutual understanding, and a shared way of framing problems and solutions.

Partners: Local governments, provincial government, federal government, Okanagan Water Stewardship Council member organizations.

Recommend that the OBWB: Facilitate working groups of OBWB partners to gather input on programs.

4.4 Funding and resources

Managing uncertainties and risks to water is one of the great challenges facing local communities into the future. Many opportunities to make better use of water supplies are already developed, to employ new technology and infrastructure, to improve and refine management practices, and to draw on better information. These opportunities require ongoing stable funding, and access to new funds for specific projects. This was one of the reasons the OBWB was established under legislation in 1970.

The OBWB has long-term base funding to hire expert staff, lead priority projects, provide grants to help communities do their own projects, and leverage external funding. The base funding comes from property taxes within the Okanagan. To add to this base, the OBWB has the ability to form funding agreements and receive grants from senior governments for shared water initiatives. For valley-wide projects, the OBWB can centralize activities rather than each jurisdiction hiring staff or contractors to manage projects and planning initiatives. This creates capacity for inter-regional projects that are outside any individual jurisdiction's mandate, and where a collaborative approach increases efficiency. Pooling funds, sharing resources, and leveraging dollars from outside of the valley enable communities to take advantage of economies of scale.

ACTION 4-7

Complete coordinated or joint funding applications for water planning, management or infrastructure projects, where possible.

Partners: Local governments, First Nations.

Recommend that the OBWB: Support clear communication between organizations with similar goals in different parts of the Okanagan so that grants are more aligned and collaborative. Assist communities and organizations with grant application writing by providing technical assistance, review, or letters of support and/or linking groups with grant writing professionals.

Okanagan Lake from above Peachland.

Other approaches that are valuable for increasing local resources include:

- **Connecting Okanagan communities to funding opportunities** – The OBWB participates in the BC Water Funders Collaborative, Canadian Environmental Grantmakers' Network, and other funder organizations and raises awareness about Okanagan water issues, playing matchmaker between funders and communities. The OBWB also provides small grants for water quality and conservation improvement projects (Story 4-6).
- **Partnerships** – Okanagan communities are all partners in protecting and sustaining water. Often, there is substantial leveraging available if communities work together, pool funds and share resources. Funding partnerships can be more efficient than parallel projects, and the outcomes are often better – for example, leading to harmonized policies or joint planning.
- **Supporting local grant applications** – Watershed partners (local governments, First Nations, non-profits, university researchers) can greatly increase the success of each other's grant applications by writing strong letters of support.
- **Technical grant writing assistance** – The OBWB, Council members, and larger communities often have staff that can provide technical assistance to smaller communities on their funding applications.
- **Funding advocacy to senior governments** – There is a greater chance of success when many groups come together to speak with one voice about priorities for funding.
- **In-kind contributions/volunteering** – Sometimes it's not a shortage of funding that's a problem; it's a shortage of ideas – demonstrating the high value of the volunteer contributions of Okanagan Water Stewardship Council members and other local experts who sit on technical advisory committees.
- **University research partnerships** – Many faculty and graduate students who have external grant funding seek meaningful local projects. With participation by the OBWB, local communities or community groups, this research can make a significant contribution.

ACTION 4-8

Identify and match-make funding organizations and agencies that can support water projects in the Okanagan, and help Okanagan communities identify opportunities for grants.

Partners: Local and external funding organizations.

Recommend that the OBWB: Convene gatherings of grantees and funders in the Okanagan to share successes and build relationships. Engage with funder organizations to raise awareness among funders about Okanagan water issues and innovative approaches.

STORY 4-6

WATER CONSERVATION AND QUALITY IMPROVEMENT GRANTS PROGRAM

Since 2006, the OBWB has provided Water Conservation and Quality Improvement (WCQI) grants to Okanagan local governments, non-profits and irrigation districts for projects. The program has paid over $4.4 million in the 13 years since its inception, funding projects such as river restoration, wetland protection, technological advancements, studies, education and outreach, demonstration sites, metering, mapping, leak detection, and many more. The grants focus on projects that provide a valley-wide benefit, either through geographical outreach, physical scope, or the replicability of a pilot project from one area of the valley to another.

The program has brought more water-investment into the valley through matching grant funds, and helped establish the Okanagan as a strong water-leader community, capable of delivering on its objectives. Going forward, this valley-wide funding will continue to focus on projects that are interregional in scope, expanding the benefits to water in the Okanagan.

Past WCQI grant recipients celebrate 10 years of collective impact conserving and protecting Okanagan water.

4.5 Monitoring and reporting on the Strategy

The Sustainable Water Strategy is based on the best available information at the time of preparation. Developments in water science, population growth patterns and climate change, combined with changes in regulations, relationships, policy and planning, mean that the actions in the Strategy must be flexible and adaptive. To fill knowledge gaps and ensure that actions are taken to improve water management and protection over time, the Council and the OBWB should regularly revisit the Strategy, and develop ways to monitor progress towards completing its actions. The Strategy should be reviewed every five to seven years to ensure it remains current and relevant and incorporates new knowledge as it emerges. A robust review process will be as important as the existence and implementation of the Strategy.

ACTION 4-9

Monitor progress on completing the actions recommended in the Strategy and report out on progress made.

Partners: Local governments, provincial government, and other agencies responsible for implementing the Strategy.

Recommend that the OBWB: Compile information from implementing organizations, and track and report progress in addressing and completing each of the actions in the Strategy. Periodically revise and update the Strategy.

4.6 Summary

Progress towards a more sustainable water future depends on the engagement of all stakeholders. Building partnerships and working collaboratively to deliver the Strategy actions is essential. Many of the critical actions noted here require collaboration and strong partnerships, especially with Indigenous peoples, and call for good water governance, informed decision making, and adequate funding and resources. The actions also require monitoring and follow-up to ensure success and to achieve the intent of the Strategy – clean and healthy water in the Okanagan.

This Strategy is a modernized, valley-wide approach that expands on the issues and actions outlined in Action Plan 1.0 developed more than a decade ago, including balancing multiple water needs in a growing region. Many of the issues and actions are still relevant today. Action Plan 1.0 warned that climate change was expected to bring more intense storms, increased drought, higher lake evaporation rates, greater evapotranspiration, and longer growing seasons, resulting in increased demand. Action Plan 2.0 reports on the predicted extreme weather and climate trends seen within the last decade, and the continued demands on water in a changing climate and with an expanding population.

Okanagan communities face complex challenges in water governance, including conflicting management priorities with senior governments in our common watershed. Governance is more effective if water institutions at all levels are more integrated and coordinated. Working together at the local, regional, provincial and federal levels can reduce conflict to address complex challenges, ensuring the best outcome for our collective future. Collaborative and coordinated water governance must include a common vision, mutual trust and understanding, clear and open communication, equitable representation, partner involvement, and consistent resources.

Collaboration is critical because water governance is multi-jurisdictional. Collaboration must extend beyond political boundaries to connect upstream and downstream communities and recognize that Okanagan water supports a whole system. A collective approach to decision-making ensures that efforts are better coordinated, reducing overlap and duplication. They better reflect the concerns of citizens and reduce conflict between interests.

Given the importance of improved communication and collaboration, working towards reconciliation with Indigenous peoples in the Okanagan is crucial. Developing partnerships between local governments and First Nation communities makes sense, as they both have a shared interest and responsibility in meeting community needs and protecting Okanagan water.

Shared learning and shared expertise will help guide us toward better relationships, better decisions, and better outcomes.

5.0 GLOSSARY

Agricultural Land Reserve (ALR) — The ALR is a provincial zone in which agriculture is recognized as the priority use for arable lands. Farming is encouraged, and non-agricultural uses are restricted.

Aquifer — A layer of rock, sand, or earth that contains water or allows water to pass through it.

Basin — A region drained by a single river system.

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.

Drinking water — Water that has been treated to provincial standards and is fit for human consumption.

Drinking water officers — Mandated to apply and enforce the *Drinking Water Protection Act* and Drinking Water Protection Regulation. Monitor the operations of drinking water systems and act on any notices of threats to drinking water quality. Responsible for issuing operating permits, and will work with water suppliers to help them achieve compliance with the legislation and the conditions on their permits.

Drought trigger — A drought trigger is a specific indicator that activates a management response. The indicator is a single observation or combination of observations that identifies the onset and/or continuation of a drought. Examples of drought indicators are basin snow indices, moisture conditions, weather forecasts, groundwater levels, and reservoir levels. An example of a drought trigger could be a reservoir decreasing below 50% of its storage capacity.

Drought management plan — A community-specific plan that designates trigger conditions for different drought stages and 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 goods — Products of ecosystems such as food, fibre, clean air and water.

Ecosystem services — Processes such as climate regulation, stormwater reduction, and nutrient cycling as well as recreational, aesthetic and cultural benefits.

Environmental flow needs — The volume and timing of streamflow required for proper functioning of an aquatic ecosystem.

Ephemeral wetland — A depressional wetland that temporarily hold water in the spring and early summer or after heavy rains. Periodically, these wetlands dry up, often in mid to late summer. They are isolated without a permanent inlet or outlet, but may overflow in times of high water.

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 vapour.

Evapotranspiration — The combined process of evaporation and transpiration. It can be defined as the sum of water used by vegetation and water lost by evaporation.

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 that are subject to overflow during floods.

Foreshore — The shoreline between the high and low water marks.

Freshet — A spring thaw resulting from snow and ice melt in streams and rivers.

Green infrastructure — Strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services. Urban green infrastructure is not just open spaces such as parks, playing fields, cemeteries, and private gardens, but also green roofs, trees and sustainable urban drainage systems, as well as ponds and rivers.

Groundwater — All subsurface water found in the pores and between particles of glacial till or other unconsolidated material, or in crevices and cracks in rock geological deposits.

Habitat — The term used to describe the natural home of living organisms. The three components of wildlife habitat are food, shelter, and water.

Key performance indicators — One of the most important indicators (something that shows what a situation is like or how it is changing) that show how well an economy, company, project, etc. is doing, or how well an employee is working.

Knowledge integration — The combination of specialized, differentiated but complementary knowledge to produce common knowledge that can be incorporated into the decisions, practices and policies of organizations and systems.

Impermeable surface — A material added to the surface of the ground, or on the exterior of a structure, that is impermeable to water.

Mainstem lakes — Refers to the chain of lakes located along the Okanagan Valley, namely Wood, Kalamalka, Okanagan, Skaha, Vaseux, and Osoyoos lakes.

Municipal natural assets — The stock of natural resources or ecosystems that is relied upon, managed, or could be managed by a municipality, regional district, or other form of local government for the sustainable provision of one or more municipal services.

Natural assets, or eco-assets or natural capital — The stock of natural ecosystems from which these benefits flow. For example, healthy soil is a natural asset, while food or energy production might be the ecosystem service it provides.

Nutrification — the process by which a body of water becomes enriched in dissolved nutrients (such as phosphates) that stimulate the growth of aquatic plant life usually resulting in the depletion of dissolved oxygen.

Okanagan basin — Refers to the land stretching from the City of Armstrong to the US border that drains into the six large lakes and Okanagan River on the valley bottom. Also referred to as the "Okanagan" or the "Okanagan Valley" in this strategy.

Potable water — Water that is fit for human consumption, but has not been treated.

Qualified environmental professional — A qualified environmental professional (QEP) is an applied scientist or technologist who is registered and in good standing with an appropriate B.C. professional organization constituted under an Act. A QEP could be a professional Biologist, Agrologist, Forester, Geoscientist, Engineer, or Technologist.

Recharge — The process by which water moves from surface water to groundwater.

Reservoir — Any natural or artificial holding area used to store, regulate, or control water.

Riparian area — The transitional area between an upland dry area and a waterbody such as a stream or lake.

Septic system — An onsite system designed to treat 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.

Sewerage — A physical arrangement of pipes and plant for the collection, removal, treatment and disposal of sewage.

Stormwater — Runoff from urban areas.

Turbidity — The quality or state of liquid being cloudy because a lot of small pieces of matter are held in it

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.

Watershed — A high area of land where rain collects, some of it flowing down to supply rivers, lakes, etc., at lower levels.

Water suppliers — When used in this strategy, means organizations in the Okanagan basin that provide water under "Waterworks – Local Provider" licensing and includes municipalities, regional districts, irrigation districts, improvement districts, and water utilities.

Water Sustainability Plan — Enabled under Part 3 of the *Water Sustainability Act* and initiated by the Minister of Forests, Lands, Natural Resource Operations and Rural Development (or by request) (s 64). Meant to assist in preventing or addressing: conflicts between water users, risks to water quality, risks to aquatic ecosystem health, and restoration measures in relation to a damaged aquatic ecosystem (s 65).

Watershed — The are of land that catches precipitation and drains into a larger body of water such as a marsh, stream, river, or lake.

Wetland — An area that is saturated with sufficient water, either permanently or intermittently, to promote poorly drained soils, the growth of hydrophytic (water-loving) vegetation, and other biological activities associated with a wet environment.

Valley-bottom — The low elevation area running north to south between Armstrong and Osoyoos and containing large lakes such as Kalamalka Lake, Okanagan Lake and Osoyoos Lake, and the Okanagan River.

6.0 LIST OF ABBREVIATIONS AND ACRONYMS

AAFC Agriculture and Agri-Food Canada

AGRI B.C. Ministry of Agriculture

ALR Agricultural Land Reserve

ASR Aquifer storage and recovery

AWD Annual Water Demand

CCME Canadian Council of Ministers of the Environment

DFO Fisheries and Oceans Canada

DPA Development permit area

EFN Environmental flow need

EMPR B.C. Ministry of Energy, Mines and Petroleum Resources

ENV B.C. Ministry of Environment and Climate Change Strategy

FCL Flood construction level

FLNR B.C. Ministry of Forests, Lands, Natural Resource Operations and Rural Development

GSC Geodetic survey of Canada

ICI Industrial-commercial-institutional

IIABC Irrigation Industry Association of BC

KPI Key performance indicator

LiDAR Light Detection and Ranging

MDD Maximum day demand

MOTI B.C. Ministry of Transportation and Infrastructure

ORRI Okanagan River Restoration Initiative

OBWB Okanagan Basin Water Board

QEP Qualified Environmental Professional

RDCO Regional District of Central Okanagan

RDNO Regional District of North Okanagan

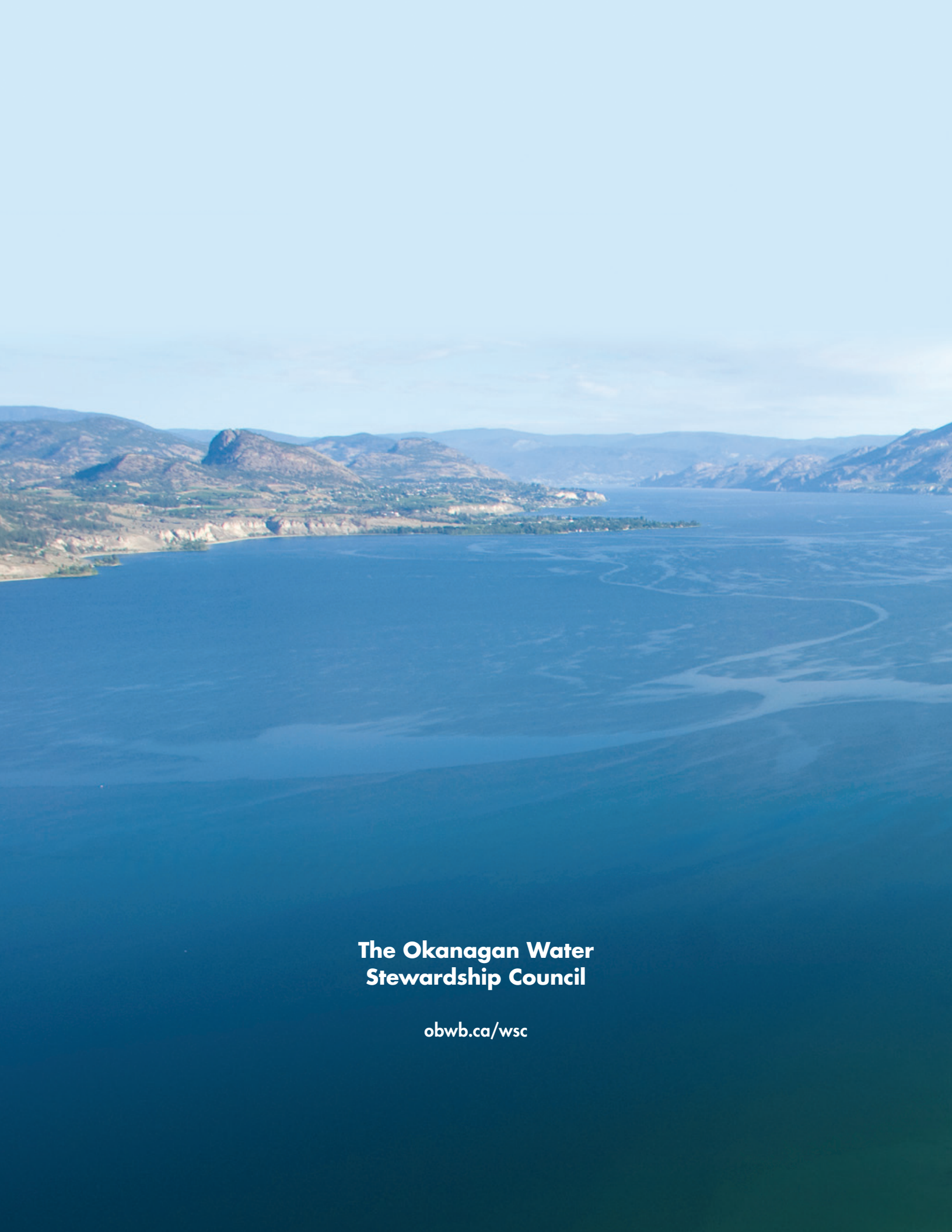
RDOS Regional District of Okanagan-Similkameen

SFA Sewerage Facilities Assistance

WCP Water Conservation Plan

WSC Water Survey of Canada

WQO Water quality objective



The Okanagan Water Stewardship Council

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