ALBERTA WATER COUNCIL

Water for Life Implementation Review 2016 to 2019

About the Alberta Water Council

The Alberta Water Council (AWC) is a collaborative partnership that provides leadership, expertise, and sector knowledge and perspectives to help governments, Indigenous Peoples, industry, and non-governmental organizations to advance the outcomes of *Water for Life*. It advises the Government of Alberta (GoA) on matters pertaining to the successful achievement of the outcomes of the *Water for Life* strategy and on effective water resources management policies, practices, and tools.

The AWC regularly reviews the implementation progress of the *Water for Life* strategy and champions the achievement of the strategy's goals. The AWC may advise on government policy and legislation in some instances. However, the Government of Alberta remains accountable for the implementation of the *Water for Life* strategy and continues to administer and contribute to water and watershed management activities throughout the province.

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Preface — *Water for Life* in the Time of COVID-19

Although the focus of this review of *Water for Life* implementation progress is for the period 2016 to 2019 inclusive, the events occurring in 2020 must be acknowledged. The impact of the COVID-19 pandemic and its associated social, economic, and environmental costs will be felt for years to come.

In uncertain times like these it is reassuring and perhaps taken for granted that Alberta's water management system continues to operate effectively. Every time we wash our hands, we can be thankful that Alberta is blessed with a good supply of raw water and that a small army of provincial and municipal essential workers keep our drinking water and wastewater infrastructure operating efficiently. As Albertans look to rebuild our economy in the wake of the pandemic, we can be assured that our water supply and allocation system will continue to support the needs of our people, as well as our agricultural and industrial sectors. And finally, as we look to our local parks (often associated with a lake, river, or wetland) for relaxation and rejuvenation, we can feel fortunate to have such a wealth of green spaces and healthy watersheds where we can reconnect with nature.

We can take solace in knowing that, although it is not perfect, Alberta has a well-functioning water management system that Albertans have helped to put in place and sustain over time. It took a century of concerted and proactive effort to ensure that we now have a framework of policies, legislation, plans, and best practices in place — and this framework supports our needs in challenging times. Over the past 17 years, the Government of Alberta's *Water for Life* strategy and the multi-sector partnerships that have been forged through it have shone a light on this water management framework. The strategy has been tested, and its strengths and weaknesses have been regularly assessed. This sustained scrutiny and these ongoing efforts to improve our water and watershed management systems, with the input of all relevant sectors, has served Albertans well in the past. But as always, we must ask, will it continue to serve us well in the future?

To reduce risks to our water supply, managers have engaged in a number of initiatives in recent years, such as looking at potential contaminants, mapping

flood plains, making drought mitigation plans, and looking at the impact of forest fires, among others. Generally, these risks have been considered as singular occurrences. Only recently have we been forced to reconsider water management in times of multiple crises (e.g., climatic events, pandemics, economic downturns, infrastructure failures) affecting Alberta communities and watersheds, all at once. Whether our complex water management system is robust enough to support us during such times of multiple and sometimes recurring crises is hard to determine.

While it is still early days regarding what we will learn from the pandemic, now more than ever, we can appreciate the need to proactively improve water management in Alberta. Water issues are not always top of mind for everyone and may not have the traction that other issues have, but it is important that *Water for Life* continues to shine a light on our water resources and that improvements to water management continue to be embedded into the everyday business of provincial and municipal governments and other water-using sectors. Hopefully, this report and its recommendations will help identify what this work needs to look like in the coming years.

Executive Summary and Recommendations

The Alberta Water Council (AWC) was established under the Government of Alberta's (GoA) *Water for Life* strategy. Consistent with its mandate, the AWC regularly reviews the implementation of the strategy. To conduct this work, AWC created the *Water for Life* Implementation Review Committee (the committee) in 2004. Since then, this standing committee has undertaken five reviews. During the last review, which covered 2012 to 2015, committee members suggested that in the next review period, the committee review its methodology. As well, they identified the need to develop performance indicators to improve future reviews and to better inform Alberta's water managers. These two tasks were added to this sixth review of *Water for Life* strategy implementation, which covers the period January 1, 2016 to December 31, 2019.

To inform this review, the committee undertook several data-gathering exercises including reviewing pertinent documents and initiatives, conducting a sector survey, holding roundtable discussions with Government of Alberta staff involved in implementation activities, and working with Watershed Planning and Advisory Council managers to gather input from their boards. The committee then formulated recommendations in a draft report, before engaging peers and AWC sectors in their review. A final report with recommendations and a communications plan were provided to the AWC board of directors for approval in the winter of 2021. The committee also oversaw work on *Water for Life* implementation performance indicators during this period and revised its terms of reference and the *Water for Life* Implementation Review How-To Guide. After reviewing the committees work, the AWC approved their report and recommendations to improve *Water for Life* implementation progress and water and watershed management in Alberta:

Recommendation 1. New *Water for Life* Action Plan

That the AWC collaborate with its partners and stakeholders to identify, by 2024, current work, information, challenges, and opportunities, that could be used to inform any development of a new 10-year action plan to achieve *Water for Life* goals and key directions and how the *Water for Life* partnerships can support plan implementation.

Recommendation 2. Improved *Water for Life* Reviews

That the AWC improve future *Water for Life* assessments by using performance indicators where applicable and feasible, and which may be adjusted from time to time, implementing a schedule of reporting and periodically producing more comprehensive reviews of individual *Water for Life* elements.

Recommendation 3. Small Systems Standards

That the GoA finish and publicly release standards for non-municipal public drinking water systems that fall under the *Public Health Act* as guidance for system operators by the end of 2022.

Recommendation 4. Drinking Water Safety Plan Audits

That the GoA improve the drinking water safety plan program for publicly regulated systems by adding a mandatory review and/or auditing function to the current process by 2024.

Recommendation 5. State of Drinking Water Report

That the GoA, working with its drinking water partners, communicate by 2026 the state of drinking water and drinking water management systems (municipal, provincial, and federal) operating in Alberta, including roles and responsibilities, how risks are identified and mitigated, and where the public can get information about their local drinking water supply.

Recommendation 6. One-water Approach

That the AWC work with municipalities and other major water using sectors to provide the GoA advice (by 2024) on how management of source drinking water, waste water, storm water, and water reuse can be improved by 1) identifying the policy or regulatory barriers and economic constraints to a "one-water" systems approach and 2) exploring the pros and cons of using green infrastructure to manage water quantity and quality in Alberta.

Recommendation 7. Healthy Aquatic Ecosystems Review

That the AWC strike a project team to examine and report on the state of Alberta's aquatic ecosystem health and its management (by 2022) and identify barriers and opportunities to improve capacity, governance, and accountability (by 2024) for achieving the *Water for Life* goal of healthy aquatic ecosystems.

Recommendation 8. Water Use Data

That the GoA improve our knowledge of water use by finding a mechanism to make licensed actual water use data publicly available by 2022.

Recommendation 9. Sustainable Economy

That the AWC explore and provide advice to the GoA (by 2024) on what "sustainable economy" is in terms of Reliable Quality Water Supplies for a Sustainable Economy and 2) what the policy implications of various options, such as increased storage, improved efficiency, reduced administrative barriers, or sector water supply assistance programs, are to ensure this goal is achieved in the future, recognizing that solutions might look different in different regions and/or to different sectors.

Recommendation 10. Improved modelling

That the GoA and its partners work to improve water supply and demand modelling, including scenario-building and forecasting (particularly in light of population growth, economic development, cumulative effects, and climate variability), periodically updating the AWC and its partners on their learnings and how such information can inform policy and other decision makers (ongoing).

Recommendation 11. Preparedness

That the GoA and its agencies (e.g., Alberta Emergency Management Agency) and the AWC continue to work with WPACs and municipalities to promote municipal flood and drought management and to develop planning, best practices, and other informative and user-friendly tools that improve community preparedness[1] (ongoing).

1 Note that Recommendation 10 contributes to Recommendation 13 (knowledge integration) in the Knowledge and Research section.

Recommendation 12. Education and Outreach

That the GoA continue to work with *Water for Life* partners and other educators to improve the water literacy of Albertans by maintaining the *Water for Life* and Water Channel websites and ensuring they are active, accessible, and user-friendly and provide access to *Water for Life* documents, partners, potential funding sources, water-related programs, citizen science initiatives, etc. (ongoing with periodic updates to the AWC).

Recommendation 13. Knowledge Integration

That the GoA's water education, research, and monitoring and evaluation managers examine how they can better leverage and support each other's work and improve user-friendly communications, reporting to the *Water for Life* partners by 2022 on how their combined efforts and processes support an iterative and adaptive performance-based water and watershed management system.

Recommendation 14. Partnerships Review

That the AWC strike a project team to examine how the *Water for Life* partnership framework can be improved to contribute more effectively to water and watershed management in Alberta (with team work completed by 2022).

Recommendation 15. Advancing CEP

That the AWC continue to provide the forum for advancing voluntary water conservation, efficiency, and productivity (CEP) through the work of the Water CEP Project Team, as needed (ongoing).

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Acronyms

AAF	Alberta Agriculture and Forestry
AEP	Alberta Environment and Parks
AER	Alberta Energy Regulator
AH	Alberta Health
AI-WIP	Alberta Innovates — Water Innovation Program
ALCES	A Landscape Cumulative Effects Simulator
ALMS	Alberta Lake Management Society
ALSA	*Alberta Land Stewardship Act*
ALUS	Alternative Land Use Services
AWC	Alberta Water Council
AWRIS	*Alberta Water Research and Innovation Strategy*
BRBC	Bow River Basin Council
CEP	Conservation, efficiency, and productivity
DWSP	Drinking Water Safety Plan
ESA	Environmentally Significant Area
GoA	Government of Alberta
HAE	Healthy aquatic ecosystems
IFN	Instream flow needs
LUF	Land-use Framework
MGA	*Municipal Government Act*
NSWA	North Saskatchewan Watershed Alliance
SSRB WMP	*South Saskatchewan River Basin Water Management Plan*
SWAD	Surface Water Allocation Directive
SWP	Source water protection
SWPP	Source water protection plan
FNTSAG	First Nations Technical Services Advisory Group
WCO	Water Conservation Objective
WFL	*Water for Life*
WPAC	Watershed Planning and Advisory Council
WSG	Watershed Stewardship Group

Introduction

In 2003 the Government of Alberta (GoA) released the *Water for Life*: Alberta's Strategy for Sustainability, thereby setting high level outcomes and direction for water management in the province. In 2005 the strategy was renewed[2], and in 2018 implementers celebrated the strategy's 15th anniversary.

In 2004, as an action of the strategy, the Alberta Water Council (AWC) was established, first as a Minister's Committee and then transitioning to an independent society in 2007. The AWC, a collaboration of 23 sectors representing the vast majority of water users in the province, was given a mandate to 1) provide policy advice to the GoA and other water-using sectors water, and 2) regularly review and make recommendations on how to improve the *Water for Life* strategy implementation.

To undertake its work to review *Water for Life* implementation progress, the AWC created the *Water for Life* Implementation Review Committee (the committee) in 2004[3]. For a list of committee members, see Appendix A and for its terms of reference, see Appendix B.

Since forming, this standing committee has undertaken five reviews[4]. During the last review, which covered 2012 to 2015, the AWC expressed the need to revisit the process. Previous reporting has been challenged because of a lack of specific performance indicators to measure the successful achievement of *Water for Life* outcomes (e.g., safe, secure drinking water supplies), versus strategy outputs (e.g., reports, programs). Therefore, in addition to examining progress on *Water for Life* implementation, for this review the committee also looked at its methodology and developed a suite of performance indicators to improve future reviews of the *Water for Life* strategy. This work will better inform the GoA and its *Water for Life* partners about the status of *Water for Life* implementation and Alberta's water management systems in general.

Did You Know?

Celebrating its 15th anniversary in 2019, the Alberta Water Council has investigated more than 20 different areas of water policy, such as intra-basin transfers, water allocations, riparian and wetland health, invasive species, source water protection, lake management, and drought mitigation. Over its lifespan, the Council has generated more than 40 comprehensive reports and made more than 275 recommendations on various aspects of water management in Alberta. AWC materials are publicly accessible at www.awchome.ca.

2 See *Water for Life: A Renewal*.

3 For more information about the AWC's *Water for Life* Implementation Review, see this project webpage and video.

4 AWC *Water for Life* implementation review reports are available on the AWC website under Publications.

Previous AWC *Water for Life* Implementation Review Reports and Recommendations

With *Water for Life* released in late 2003, the first Alberta Water Council review examined implementation progress for the period 2004–05. Subsequent reviews covered the periods 2005–06, 2006–08, 2009–11, and 2012–15. The AWC also provided additional advice before the Government of Alberta renewed the strategy (2008) and released the *Water for Life* Action Plan (2009).

In general, each review report confirmed that the three goals and three key directions of the strategy were still relevant and continued to resonate with stakeholders. Collectively, these reports made over 35 recommendations on how to improve *Water for Life* implementation progress. The status of these recommendations can be viewed on the AWC website under Recommendations Tracking.

Each review report provided an update on the status of *Water for Life* implementation activities, identifying where progress was on schedule or where additional focus was needed for each element of the strategy. In general, successive reports documented the following:

- steady progress toward the achievement of safe, secure drinking water supplies and reliable quality water supplies for a sustainable economy
- the challenges regarding defining, measuring, and conserving healthy aquatic ecosystems
- a growing network of partnerships, knowledge and research collaborations, and water conservation initiatives

Successive review reports also identified new water management issues or areas of concern as they arose such as the following needs:

- improve governance by clarifying roles, responsibilities, and accountabilities (including sustainable resourcing) of water partnerships
- address new threats to aquatic ecosystem health such as invasive species and diseases
- integrate land and water management through regional land use planning
- consider the cumulative effects of land use and climate change on the water resource
- create, enhance, and better use regulatory tools and voluntary best practices
- enhance data collection, analysis, and reporting to decision makers
- expand awareness, education, and outreach about the strategy with partners, the public, other governments, and Indigenous communities in order to build a conservation ethic and a shared commitment to water management across the province
- be forward-looking, adaptable, and resilient as new challenges arise

Collectively, implementation review reports document how the *Water for Life* strategy has evolved over time. They show where progress has been made and where improvements are still needed to put Alberta in a strong position for managing its water resources sustainably, for current and future generations.

Methodology

To develop this sixth review of *Water for Life* strategy implementation, the AWC undertook the following steps:

- reviewed GoA's *Water for Life* and other relevant policy documents, previous AWC implementation review and project team reports, the AWC Recommendations tracking webpage, the 2017 and 2018–19 Watershed Planning and Advisory Council Compendium, the Watershed Stewardship Grant Program story map, and other resources relevant to water management in the province
- shared and discussed current and potential future water management issues
- conducted an online survey to gather AWC sector feedback on *Water for Life* progress to date
- conducted roundtable discussions about *Water for Life* with GoA staff involved in strategy implementation and water management in general
- met with Watershed Planning and Advisory Council (WPAC) managers and asked them to share their boards' perspectives
- commissioned a report on and continued work to flesh out an initial suite of *Water for Life* performance indicators
- made minor revisions to the committee's terms of reference and How-to Guide to reflect improvements to the *Water for Life* Implementation review process
- drafted the committee's report and recommendations
- sought peer and AWC sector engagement on the draft documents
- took the final documents and an associated communications plan to the AWC board for approval

While the focus of this report is the period 2016 to 2019, the AWC, in recognizing the 15th anniversary of the *Water for Life* strategy in 2018, has also included brief historical overviews of "where we have been" when relevant. It is important to acknowledge the many people who contributed to this implementation review process and to the goals of *Water for Life*. As such the AWC has decided to reflect that in this report by using a first-person voice to represent Albertans.

Additionally, recognizing the near completion of the GoA's *Water for Life* Action Plan (2009–2019), the AWC also identified what *Water for Life* actions have been successfully completed or transitioned into regular everyday business of the GoA. For instance, Alberta's Working Well Program is a good example of an action that arose out of *Water for Life* but today is well embedded as an ongoing funded collaboration among three GoA departments (Alberta Health, Alberta Environment and Parks, and Alberta Agriculture and Forestry), who oversee delivery of the program to rural areas across the province.

History and Context

Water Management Highlights before 2003

By the time Alberta became a province in 1905, it supported a population of 160,000 people, and water management was already a major activity particularly for irrigation works in the south and drainage projects in the north. A major drought in the 1930s led to further policy conversations and both regulatory and institutional adaptations with a greater focus on water supply and management projects by provincial and municipal governments. Organizations such as the Prairie Farm Rehabilitation Administration, Drainage District Councils, and Drought Management Committees emerged to administer this complex and dynamic system.

For most of the 20th century, natural resource management in general focused on the orderly regulation of consumption, putting in place a permitting system to harvest (e.g., cut trees; trap, shoot, or hook wildlife; and draw water) Alberta's then seemingly abundant resources. Decades later, a busy landscape led to the need for new policy tools, and by the 1970s initiatives were underway, such as the Eastern Slopes Policy, which among other things, recognized the importance of protecting the headwaters.

Inside the GoA, where water demand and supply issues required a water management planning focus, Alberta Environment and Parks formerly known as Alberta Environment's Water Management Planning Branch fulfilled the role of developing water management plans, in consultation with stakeholders, when demand and supply issues required one. Growing concerns about a number of water issues (e.g., water quality, drinking water infrastructure and treatment, water supply and allocation, aquatic ecosystem health) also gave rise to multi-stakeholder watershed organizations, with the Bow River Basin Council (BRBC) forming in 1992 and the North Saskatchewan Watershed Alliance (NSWA) forming in 1997.

To add greater flexibility to provincial water management legislation, the Government of Alberta undertook extensive public consultation on the Water Resources Act in the late 1990s before re-writing it as the current *Water Act* (1999). The new act provides an appeal mechanism for new *Water Act*

decisions, however, it is not retroactive regarding older water licences and approvals. It also enables the use of water licence transfers as a means to move water to where it is needed in highly allocated basins. The act also required the development of the *Framework for Water Management Planning* document that includes the *Strategy for the Protection of the Aquatic Environment*.

About the same time, the GoA also initiated development of the Approved South Saskatchewan River Basin Water Management Plan (Alberta) (SSRB WMP). This plan set Water Conservation Objectives (WCOs) for the mainstem tributaries of the South Saskatchewan River and moratoriums on allocations on some streams before plan completion. The plan also required that, when issuing licences and approvals, certain matters and factors be considered by water directors. The SSRB WMP recognized that there are limits to our water supply and risks to over-allocation. The plan was approved by cabinet in 2006[5], effectively closing most of this basin to new water allocations applications. New applications on the Red Deer River are still allowed. Similar work to set WCOs followed on the Cold Lake-Beaver River (2006), Lesser Slave Basin (2010), Battle River (2014), and Wapiti River (in progress 2021).

5 The SSRB WMP, on the occasion of its 10th anniversary, was reviewed (2019) by the Red Deer, Bow, Oldman, and South Saskatchewan WPACs. Find their report here.

Water for Life Key Milestones

From 2000 to 2001, while Alberta was experiencing a severe drought equivalent to that of the 1930s, two significant drinking water contamination events occurred in Canada (e.g., Walkerton, Ontario and North Battleford, Saskatchewan), raising the profile of drinking water and risk management across the country. With a public eager to discuss water issues, and with lessons learned through the SSRB WMP process, the GoA initiated consultation before drafting the *Water for Life* strategy, approved by Cabinet in November of 2003. The *Water for Life* strategy identified the need to balance water management for social, economic, and environmental values. It also recognizes that Albertans want to participate in managing the water resource and provides a platform for them to do so at the provincial, regional, and local level.

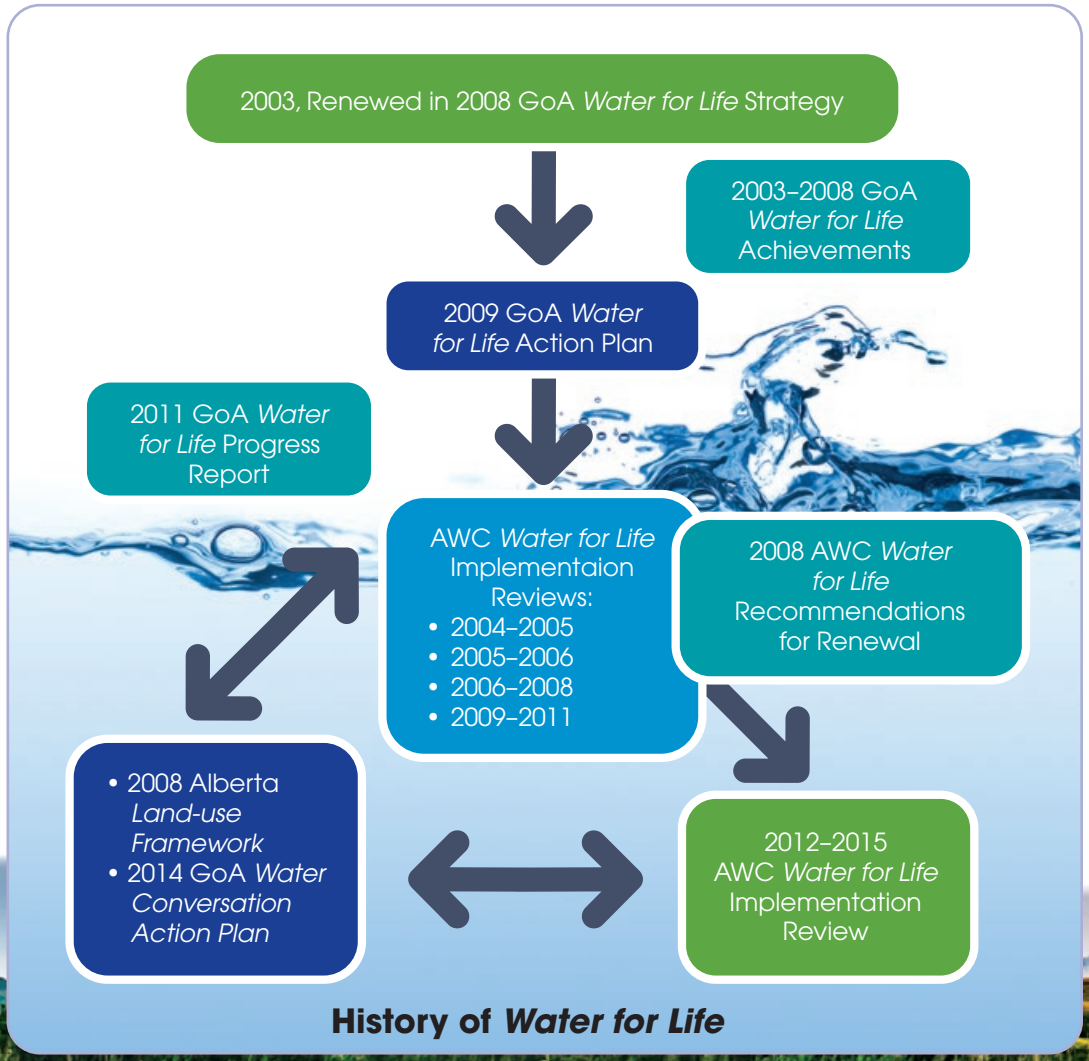
Equally important, the *Water for Life* strategy recognizes several principles and requirements for effective water management including taking a watershed approach; using collaborative, multi-sector consensus-based processes; working toward continuous improvement through iterative and adaptive performance-based management; engaging in knowledge-based decision-making processes; and integrating water with other land and resource management systems.

After five years of successful implementation, the GoA asked the AWC for advice on renewing the *Water for Life* strategy, to address new challenges, specifically population growth and economic development. In 2008, the GoA released *Water for Life: A Renewal* followed by the 2009 *Water for Life: Action Plan*. In 2011, the GoA released a *Water for Life Progress Report* summarizing its efforts to date.

In 2013, the GoA acknowledged that several specific water issues required further widespread public consultation. To address these issues, they carried out a series of conversations around water in Alberta that cumulated in the document *Our water, our future: conversation with Albertans: summary of discussions*, and were followed up with the release of *Our water, our future: a plan for action in 2014*. This plan looked specifically at lake management, water use for hydraulic fracturing, drinking water and wastewater infrastructure, and the water allocation system. Because the GoA needed to address these issues quickly, they chose a public consultation process rather than the AWC's multi-sector consensus process, which could have taken more time. A key learning of this initiative was that many water issues are complex, and the public do not

always have the necessary information to participate effectively in consultation processes. AWC's Water Literacy project and other education initiatives emerged to address this limitation. Additionally, there have been numerous efforts in the past decade to get data and information online so that they are easily accessible to those who need to make decisions that affect their health and livelihoods.

In 2018, the original release of the *Water for Life* strategy saw its 15th anniversary. A number of WPACs have also recently celebrated several important milestones. For example, in 2020, the NSWA Society celebrated its 20th anniversary as a society, and the BRBC celebrated its 28th year in operation. One of the province's younger WPACs, the Athabasca Watershed Council celebrated its 10th year of operations in November 2019. The number and breadth of activities of Watershed Stewardship Groups (WSGs) continues to grow with literally thousands of volunteers and volunteer hours contributed annually to Alberta's unique watershed governance system.



History of *Water for Life*

Today's Water Management Context

Before 2003, when *Water for Life* was first being considered, drought and the risk of surface water over-allocation, were the burning issues. The 2013 flooding event in southern Alberta changed the focus. Now in 2021, an abundance of water (on agricultural fields, in recreational lakes, and on other lands subject to flooding) can be as much of an issue as extended periods of drought. Considering this variability, as well as the frequency and timing of large-scale climatic and other natural and anthropocentric events (e.g., fires, floods, droughts, glacier loss), risk mitigation, adaptability, and resiliency have now become the focus.

Additional water issues that were top of mind for water managers during the period of 2016 through 2019 include the following:

- Continued population growth: Since the strategy was released, Alberta's population has grown by more than a million people (from 3.2 million in 2003 to 4.4 million in 2019)[6]. This population growth influences the rising cost of maintaining drinking water and wastewater infrastructure, regional servicing networks, and other storage and conveyance works. Of note, both the Calgary Metropolitan Area and the Edmonton Metropolitan Areas were mandated to form boards to create growth plans for their regions[7]. All participating municipalities must comply with such plans that may include shared regional water and watershed objectives.
- Addressing cumulative impacts on water: In particular, the challenge of managing non-point source pollution from multiple land uses is coming to the forefront[8], with water managers trying to measure, and where necessary, reduce nutrient and other contaminant loading on waterbodies, through protection of riparian shorelines, improved stormwater and wastewater management, green infrastructure initiatives, low-impact development, etc. Additionally, multiple scales of land-use and watershed planning are occurring, and work is being done to set limits and triggers that can be monitored over time with appropriate management responses when exceedances occur.

6 See the Alberta population statistics archive

7 Learn more about the municipal growth management boards

8 See the AWC's Non-Point Source Pollution project

- Implementing amendments to the *Municipal Government Act* that now include a new municipal purpose to "foster the well-being of the environment." This new purpose has translated into more municipal policies and land-use bylaw amendments to conserve and manage water resources and environmentally significant areas throughout the province.
- Growing concerns about lake health with several incidents of blue-green algae blooms, beach closures, declining biodiversity and/or species at risk, fisheries decline, invasive species (e.g., mussels, flowering rush, exotic species), and whirling disease[9]. On top of these pressures, there is increasing demand from a growing population for recreational opportunities on lakes and other waterbodies. This demand, in turn, translates into issues with maintaining or improving recreational infrastructure, increasing degradation to riparian shorelines and littoral zones, and a growing need to enforce good behaviour.
- Growing importance of groundwater in areas where surface water may be limited seasonally or in the long term with a growing recognition of how development can affect groundwater and surface water interactions, particularly in key recharge and discharge areas[10].
- The challenge of getting knowledgeable stakeholders to the table with the capacity and resources to participate fully in water and watershed conversations.
- The gap between generating information through well-supported research and monitoring, publicly accessible data, and agreed-to performance criteria and then converting this information in a timely manner into knowledge that informs water and land-use decision making by all.

Along with these different issues, the number of water management collaborations around the province has also changed over the past 15 years. While the *Water for Life* strategy envisioned provincial (i.e., the Alberta Water Council), regional (WPACs), and local (WSGs) partnerships, which have all grown since 2003, a number of other collaborations and programs have

9 See the AWC's Lake Watershed Management in Alberta project

10 See the GoA's groundwater management website

become equally important to water management in Alberta. Some of these are listed below:

- A growing network of GoA internal mechanisms to support *Water for Life* implementation and broader provincial water management processes including the AWC's GoA and Provincial Authorities Committee, the *Water for Life* Cross-Ministry Steering Committee, and several water management sections and branches within government departments, such as AEP and AAF.
- A rising number of municipal consortia and regional drinking water and wastewater networks supported by municipal water operator associations and programs.
- An increasing number of Indigenous agencies and communities undertaking water initiatives, such as the First Nations Technical Services Advisory Group Circuit Rider Training Program, the Big Stone Cree Wabasca Source Water protection plan, and the Mikisew Cree First Nation community based monitoring program.
- Granting agencies and programs such as the GoA's Watershed Resiliency and Restoration Program, which has enabled a number of WPACs, WSGs, and others to commission significant research and restoration projects. Similarly, the Watershed Stewardship Grant program has contributed to a number of on-the-ground stewardship projects.
- A network of researchers looking at water issues supported by the Alberta Water Research and Innovation Strategy (2014) and Alberta Innovates' Water Innovation Program; AEP's monitoring, evaluation and reporting activities; and industry and academic research organizations, such as the Canadian Oil Sands Innovation Alliance.
- A network of educators (e.g., Inside Education, Alberta Council for Environmental Education, Inside Tomorrow) and initiatives to improve Albertans' water literacy, such as the AEP Water Channel and the Alberta Water Portal Society. Additionally, Southern Alberta Institute of Technology now boasts a two-year Integrated Water Management Program certificate program. Programs such as the Elbow River Watershed Partnership Field School, which has taken more than 20,000 students into the watershed, is also an excellent example of a collaborative education initiative.

- A growing number of lake and sub-basin groups that go beyond stewardship activities to develop comprehensive watershed assessments and management plans that, in turn, inform municipal and regional land-use policy, planning, and regulations.
- Numerous sector working groups are discussing how water management affects their businesses (e.g., Agri-Environmental Partnership of Alberta Water Working Group and Synergy groups) and developing and distributing water information products (e.g., Alberta Urban Municipalities Association water webpage). The seven major water using sectors in Alberta developed and are implementing water conservation, efficiency, and productivity plans and promoting best practices.
- Some conservation organizations, despite limited capacity, are developing programs that support Albertans participating in volunteer water management activities such as Alberta Lake Management Society (LakeWatch), Land Stewardship Centre (Alberta Stewardship Network), Nature Alberta (Living by Water), Cows and Fish.
- Numerous for-profit consulting agencies and organizations that are providing leading edge tools for modelling geo-spatial and other information to help land-use and watershed managers address emergent issues (e.g., the Bow River project and resulting Bow River simulation).

Review of *Water for Life* Implementation, 2016 to 2019

Having briefly reviewed the events leading up to the task at hand, the following sections now provide a review of *Water for Life* implementation efforts for the period 2016 to 2019. This review includes looking at the 2009 *Water for Life* Action Plan itself, as well as each of the *Water for Life* strategy's three goals and three key directions. Recommendations on where we need to go next are also provided in each section.

The 2009 *Water for Life* Action Plan

Where have we been?

Previous *Water for Life* implementation review reports focused on the status of each action identified in the 2009 *Water for Life* Action Plan. As of December 2019, 16 of 31 actions have been completed or they have become regular ongoing business. Additionally, at least some progress has been made on the remaining 15 actions (see Table 1). However, note that "progress" is a subjective term and sometimes hard to assess, particularly if the original intent of the action or how it was carried out might have changed over the 10-year period. In its review covering 2012–2015, AWC adopted the following progress indicators:

Being re-evaluated: Implementation of this action has been halted while the action is re-evaluated in light of new information, new direction relevancy, or dependence on the completion of other actions.

Limited progress: A minimum amount of work has been taken toward completing this action usually due to extenuating circumstances, or the dependence on the completion of other actions, another action will not be completed within the timeframe given.

Some progress: Some work has been done toward completing the action but it is uncertain whether the action will be completed within the timeframe given.

Progressing-on-track: On track and likely to be completed within the indicated timeframe.

Completed: The action has been completed.

Table 1: Progress on Activities listed in the 2009 Water for Life Action Plan as of December 2019

Goal or key direction	Number of actions being re-evaluated	Number of actions making limited progress	Number of actions making some progress	Number of actions progressing on track	Number of actions completed or now ongoing GoA business	Total number of actions for each goal and key direction
Safe, secure drinking water	0	0	3	0	6	9
Healthy aquatic ecosystems	0	1	2	0	2	5
Reliable, quality water supplies	0	0	2	0	2	4
Knowledge and research	0	0	2	0	2	4
Partnerships	0	0	4	0	2	6
Water conservation	0	0	1	0	2	3
Total number (%) of actions	0 (0%)	1 (3%)	14 (45%)	0 (0%)	16 (52%)	31 (100%)

Have we achieved our desired outcomes?

Time and time again, AWC sectors have indicated that the *Water for Life* strategy has provided a unifying theme as well as an effective platform to bring together diverse viewpoints and build consensus on water management issues across the province. In other words, the *Water for Life* strategy continues to provide a solid foundation for bringing together stakeholders who would otherwise not be connected to address water resource management problems, thereby stimulating water and watershed management conversations, identifying shared values, changing attitudes, and drawing environmental issues into social and economic discussions.

The 2009 *Water for Life* Action Plan provided a list of actions to be implemented over a 10-year period (i.e., by 2019). During this time, some actions were successfully completed, and some became part of the everyday business of the GoA. Some actions proved more difficult to implement, or they no longer reflected management objectives, as priorities and water management issues changed over time. It is important to note that an action plan is a guide only: it should not constrain our ability to adapt as new issues arise or as we learn from past actions.

Where do we need to go next?

The *Water for Life* strategy and its goals and key directions remain as relevant today as when first conceived and adopted as provincial policy. However, the 2009 Action Plan, meant to be a 10-year plan ending in 2019, has become outdated. A number of outstanding actions no longer reflect current management objectives and many things in the world of water management have changed in Alberta since the plan was written. Therefore, the time is right for the GoA to work with the AWC and other *Water for Life* partners to refresh the *Water for Life* strategy by developing a new action plan that identifies and communicates new water management priorities and appropriate actions for the next 10-years. A refreshed action plan could raise the profile of *Water for Life* and reconfirm GoA and sector commitments to ensuring Alberta continues to be a leader in water and watershed management.

"We are only just starting to think about how global warming will impact us, and we cannot afford to act slowly. In the south, we are at high risk of catastrophic drought even without global warming: not enough is being done to facilitate resilience because there are so many other challenges to worry about."

Survey Respondent

A refreshed action plan should look at where we have been and where we are today, as well as emerging issues and priorities. It should have a strong focus on examining our water management systems and ensuring they are robust, truly adaptive, and resilient to climate change. We also need to understand how to manage the cumulative effects of land use and water use on water resources and aquatic ecosystems.

A refreshed action plan might review the body of work done by *Water for Life* partnerships and collaborations to ensure integration points are clear and that there are no gaps or duplications in efforts. In particular, it should highlight watershed management plans as decision-support tools for all provincial and municipal land-use decision makers, as is currently suggested in the South Saskatchewan Regional Plan. And finally, given the current economic climate, a new plan must also embrace efficiencies, including looking at how planning and advisory processes could be streamlined, with timelier and more cost-effective decision making, so that water management is more responsive to changing conditions, particularly during challenging times, such as drought, flood, fire, and pandemics.

Recommendation 1. New Water for Life Action Plan: That the AWC collaborate with its partners and stakeholders to identify, by 2024, current work, information, challenges, and opportunities that could be used to inform any development of a new 10-year action plan to achieve *Water for Life* goals and key directions and how the *Water for Life* partnerships can support plan implementation.

In moving toward an integrated adaptive management approach, it is important that the GoA and its *Water for Life* partners effectively evaluate the achievement of *Water for Life* outcomes. In the past, this evaluation has been hindered by an inability to measure progress due to inconsistent methodology for monitoring and data collection, and a lack of clear performance indicators. This has been an issue since the first review was undertaken. To address this issue, a clear suite of performance indicators that provide feedback on past management actions and inform future actions is needed. This recommendation was made by the AWC in the two previous review reports (Recommendation 12 in 2017 and Recommendation 10 in 2012). Additionally, recommendations to develop indicators of aquatic ecosystem health have been made in several reports,

including the AWC's Recommended Projects to Advance the Goal of Healthy Aquatic Ecosystems.

Another challenge in reviewing *Water for Life* implementation progress is that each element of the strategy has grown in complexity over time, particularly as *Water for Life* actions become embedded in the GoA's or other partners' everyday business. Although its mandate is to focus on the *Water for Life* strategy, the AWC's review reports also try to reflect what water management activity is occurring across the province (whether or not it is specifically identified under the *Water for Life* banner). This approach gives us a greater understanding of how our water management systems are working. However, this can make the review report lengthy and slow to produce while still not providing a level of detail that gives water managers the advice they need in a timely manner. In the future, the AWC might consider reviewing and reporting on *Water for Life* goals and key directions separately (i.e., year one drinking water; year two healthy aquatic ecosystems; and so on) in a set schedule.

Recommendation 2. Improved *Water for Life* Reviews: That the AWC improve future *Water for Life* assessments by using performance indicators where applicable and feasible, and which may be adjusted from time to time, implementing a schedule of reporting, and periodically producing more comprehensive reviews of individual *Water for Life* elements.

Safe, Secure Drinking Water Supply

Where have we been?

With the release of the 2003 *Water for Life* strategy following on the heels of the Walkerton (2000) and North Battleford (2001) drinking water contamination events, an early focus on strategy implementation for drinking water safety was required. To get a better understanding of the state of our drinking water, the GoA undertook in 2004 an assessment of all regulated (public) drinking water facilities in Alberta. This report was followed by significant investment in municipal programs (see *Water for Life* and Alberta Municipal Water/Wastewater Partnerships funding grants) to upgrade infrastructure and expand regional drinking water and wastewater networks. The GoA and its municipal partners also focused on drinking water facility operator training by improving operator certification programs including putting them online, making them easily accessible even for remote communities. Federally, the government provided funding to the First Nations Technical Services Advisory Group (FNTSAG) to deliver the Circuit Rider Training program to facility operators in First Nation communities.

As a condition of their licences, it is mandatory in Alberta that all public drinking water treatment facilities regulated by AEP develop Drinking Water Safety Plans (DWSPs). As well, some operators look beyond their intake pipe and develop broader source water protection plans (SWPPs) and/or undertake studies and monitoring to better understand both point and non-point sources of upstream water pollution[11]. Note that considering the source of the water is one of four requirements of the required DWSP: others are treatment, network, and customer risk areas. The AWC had a Project Team that provided guidance on developing SWPPs. Several communities have now completed plans including large urban centres, such as Calgary and Edmonton, and also a few smaller municipalities, such as Town of Grand Cache, City of Camrose, Indigenous communities (Wabasca Area), and even an aquifer stakeholder group (Grimshaw Gravel Aquifer). Note, however, source water protection planning is a voluntary activity that provides advice to water managers but does not have any statutory standing.

11 For example, see the North Saskatchewan WaterSHED Monitoring project.

Should a water contamination event be identified, Alberta has a warning system in place so that health officials are notified, and health advisory notices are posted. Alberta Health (AH) also works with public operators to monitor recreational waters and beaches and provides a drinking water testing service for small non-municipal public systems and private drinking water systems. Amalgamated data from this program is shared through the Alberta Environmental Public Health Information Network (AEPHIN) website. AH, AEP, and AAF also collaborate on the Working Well program to support private system operators (usually farm and acreage owners) who rely on groundwater wells for their drinking water supply.

Research into drinking water treatment processes is ongoing with the focus shifting when necessary, to contaminants of concern. Provincial and municipal research efforts are enhanced by academic and research agencies, including the Alberta Innovates Water Innovation Program (AI-WIP). While much of the focus has been on drinking water safety, water security, particularly for large metropolitan areas such as the City of Calgary, is also growing in importance in light of an increasing population and climate change. Overall, steady progress has been made over the past four years toward achieving safe, secure drinking water supplies and in carrying out the actions for this goal, as Table 2 illustrates.

Table 2: Status of Water for Life Actions for Safe, Secure Drinking Water Supply as of December 31, 2019

Actions	Timeframe	Last review	2019	Rationale
1.1 Provide and maintain the availability and accessibility of information to Albertans on private water systems	Short-term by 2012	Progressing on track	Ongoing GoA business	The Working Well program is ongoing with dedicated staff and funding embedded in GoA budgets. Several sources online through AH, AEP, and AAF provide a variety of materials to private system operators. New documents are produced as new issues arise.
■ Deliver the "Working Well" extension program for private well owners				
■ Develop and deliver online and print information resources for private water supply owners				
1.2 Review and improve the management of small public drinking water systems	Short-term by 2012	Progressing on track	Some progress	An inventory and audit of "small" public systems was completed in 2012. Voluntary Small Drinking Water System Standards are under development. An online drinking water system owner training program was completed. Other materials are produced as needed.
■ Develop operating standards				
■ Develop and deliver information resources				
■ Conduct an initial audit based on a completed provincial inventory				

Actions	Timeframe	Last review	2019	Rationale
1.3 Work co-operatively with First Nations, Métis, and the Federal Government to ensure safe drinking water in Aboriginal communities	Medium-term by 2015	Some progress	Ongoing GoA business	The Province's certification group has a program for operators; they can register for training and maintain certifications. FNTSAG and INAC deliver the Circuit Rider on-reserve operator training program and are considering an on-reserve Working Well program and/or audits on reserve cisterns and wells. Opportunities to participate in regional networks are being identified through the First Nations Regional Drinking Water Tie-in program. Water needs assessments were completed for a number of First Nations in water- scarce areas of Treaty 7.
■ Provide ongoing operator training and certification				
■ Provide opportunity for participation in regional systems				
■ Facilitate water needs assessments with participating First Nation communities				

Actions	Timeframe	Last review	2019	Rationale
1.4 Develop a waterborne disease surveillance system and undertake waterborne contaminant research	Medium-term by 2015	Progressing on track	Ongoing GoA business	When health inspectors identify an issue related to water, they send it to AH, and advisories are posted. The Public Health Laboratory (ProvLab) has expanded contaminant and trace element testing. Data are shared publicly through the AEPHIN website. Domestic well water surveys were completed for 11 regions (with a focus on nitrates and arsenic). Research to develop laboratory methods for pesticide and pharmaceutical detection and monitoring is ongoing with academic institutions. AEP is updating its protocol for failed biological quality tests. AI-WIP also has a drinking water research focus.
■ Provide ongoing drinking water quality testing and laboratory-based surveillance through the public health laboratories				
■ Conduct domestic well water surveys of specific contaminants in identified areas (e.g., Beaver River and North Saskatchewan river basins)				
■ Undertake applied research in priority water contaminants and develop a public health risk management support system				

Actions	Timeframe	Last review	2019	Rationale
1.5 Design and implement regional drinking water and wastewater solutions ■ Review delivery of the provincial drinking and wastewater program including new funding support programs and governance	Long-term by 2019	Progressing on track	Ongoing GoA business	*Water for Life* and Alberta Municipal Water/ Wastewater Partnership grant programs for drinking and wastewater infrastructure/ networks are well-funded. Additional support is provided through the irrigation sector for conveying raw water to surrounding communities. In southern Alberta, approximately 50,000 people in about 50 different communities receive water from the irrigation sector. Metropolitan growth plans and Intermunicipal collaboration frameworks promote shared infrastructure where it makes sense to do so. A review has not been done since 2004.
1.6 Develop innovative approaches to build and ensure long-term operational capacity in smaller Alberta communities ■ Develop operator consortia ■ Provide ongoing operator training and certification	Long-term by 2019	Progressing on track	Ongoing GoA business	A template and guide were created to assist municipalities to organize consortia. A Drinking Water Safety Plan training course was delivered to municipalities. The Operator certification portal is now online. Certification manuals have been updated. The GoA certification group set up a five-year strategic plan to guide their work. See also the new SAIT Integrated Water Management certificate program.

Actions	Timeframe	Last review	2019	Rationale
1.7 Update water quality programs to support source protection information and planning	Long-term by 2019	Some progress	Some progress	An AWC project team developed a guide to support source water protection planning. Several larger and some smaller communities have developed source protection plans. Some WPACs are involved with planning initiatives (e.g., Camrose) or have source water protections within their documents. The federal government provides SWP resources for Indigenous communities. AAF's beneficial practices report is available online.
■ Work with Watershed Planning and Advisory Councils to incorporate drinking water source protection into watershed planning				
■ Develop information on sector-specific best management practices				
1.8 Facilitate upgrades to drinking water and wastewater facilities to meet standards and, where possible, integrate with regional systems.	Medium-term by 2015	Progressing on track	Some progress	The GoA supports municipalities through a number of programs (e.g., Municipal Sustainability Initiative, Small Communities Fund). The GoA is still investigating water reuse and developing a guidebook to set the stage for industrial and residential water reuse. AEP is looking at the regulations needed.
■ Develop a management framework to facilitate the safe use of reclaimed water for domestic applications in Alberta	Long-term by 2019			
1.9 Facilitate upgrades to drinking water quality in provincial parks and recreation areas	Long-term by 2019	Complete	Ongoing GoA business	Upgrades were finished for a number of provincial parks and recreation areas; some work gets done every year.

Have we achieved our desired outcomes?

Goal: Albertans are assured their drinking water is safe.

Water for Life 2003 goal: Safe, secure drinking water supply

Water for Life (2003) outcomes for this goal include the following:

- a comprehensive strategy to protect Alberta's drinking water
- timely access for all Albertans to information about drinking water quality in their communities
- adherence of Alberta's drinking water infrastructure to emerging standards and management for long-term sustainability

Although "assurance" is challenging to measure, the fact that most Albertans are using their local municipal drinking water supply would indicate that they are confident these supplies are safe. This is particularly true in larger urban centres. Those Albertans without access to large public water systems may feel less assured; hence the focus of provincial and municipal governments to address the capacity issues of smaller public and private water systems, including the feasibility of connecting them to larger networks. Despite substantive progress, some smaller, remote communities are still challenged to find high quality and reliable drinking water supplies nearby and may have to examine more expensive alternatives, such as pipelines or trucking in their drinking water. Some smaller communities still have boil-water advisories or issues with poor source waters, aging infrastructure, retaining trained personnel, etc.

While it is challenging to point to a single provincial drinking water strategy document, there is a comprehensive framework in place to protect Alberta's drinking water, and the Canadian Drinking Water Guidelines inform work at the provincial scale. Additionally, drinking water safety and security have been improved by the work of many municipalities to protect their drinking water supplies through various means including drinking water facility safety plans, source water protection plans, and upstream monitoring. While source water protection planning is relatively new to Alberta, the AWC and WPACs work to provide guidance on this activity is helping to drive progress in this area.

Assurance is also improved by access to information. Although water quality data for regulated community systems and private well owners is available to anyone with concerns, it is challenging to know if this information is well used. Information on new contaminants and concerns is also required as new issues arise (e.g., lead pipes and pharmaceuticals in drinking water). Both public and private operators rely on such information, and on tools and training in order to conform to emerging standards. Whether or not drinking water infrastructure is sustainable over the long term is also difficult to determine because it depends greatly on population growth and development, current economic health, and other strains on the system.

Overall, while there will always be work to do and capacity will always be a limiting factor, Alberta has a fairly robust drinking water management system. Through efforts made to date in this area, there is a strong foundation and strong relationships of trust, collaborative processes, and capacity for resolving issues as they arise. For the most part, Albertans can feel assured that they have access to safe, secure drinking water supplies, but there is a need for regular monitoring, maintenance, and performance reviews.

Figure 1: Major Components of Alberta's Drinking Water Management System

Where do we need to go next?

To continue achieving the goal of safe, secure drinking water supplies, the GoA and its drinking water partners should continue improving Alberta's drinking water management system by incorporating *Water for Life* principles and actions into their everyday business. In particular, the GoA has made, and should continue to make, progress in the following areas:

Building Regional Networks: Improving sustainable drinking water infrastructure and effective operations for all Albertans through the following measures:

- providing capacity (grants and other funding) to upgrade drinking water facilities and to build regional networks, where it is determined to be beneficial for local communities to do so
- encouraging small urban, rural, and Indigenous communities to join regional networks and water consortia where feasible and beneficial
- working to find solutions to address drinking water safety and security in remote communities

Supporting Small Operators: Ensuring that small public and private system operators have the tools and knowledge they need to ensure drinking water safety and security through the following measures:

- continuing to make high quality operator certification and ongoing learning programs easily accessible (online) to all small operators
- working with suppliers to ensure information about small systems is provided to users (i.e., so that they know how to manage their systems and protect them from contamination)
- looking for mentoring opportunities between large and small system operators (lessons learned, case studies, webinars, workshops, etc.)
- improving operator and public awareness of drinking water issues and available resources through *The Water Channel*, GoA Working Well program, online information (e.g., factsheets), and data sharing (e.g., AEPHIN website)

Promoting Source Water Protection: Improving risk mitigation through the following measures:

- encouraging greater use of voluntary source water protection planning (for both surface and groundwater sources) and integrating plan advice into regional and municipal planning initiatives
- facilitating gatherings between operators, planners and other interested parties (e.g., through forums, workshops, webinars) to share learnings about required drinking water safety plans, voluntary watershed management, and source water protection plans including how these regulatory and non-regulatory tools fit together and, in turn, support municipal and regional planning
- encouraging WPACs to include source water protection advice in their watershed management plans and policy advice to government

Responding to Emerging Issues: Responding to emerging and new issues and standards through the following measures:

- improving GoA capacity for the timely development of policies, regulations, etc.
- continuing to formalize relationships and processes among AH, AEP, and AAF and building stronger connections to Health Canada, emergency management agencies, etc.
- ensuring effective and well-funded monitoring programs are in place that can adjust as required to address new issues and contaminants, (e.g., lead and plastics for both surface and groundwaters, mainstems, and smaller tributaries)
- improving data management, access to real-time data, and data dissemination and uptake

Conducting Research: Continuing to fund the AI-WIP program to, in turn, do the following:

- encourage more research on drinking water issues including investigating efficient and cost-effective mechanisms to test for contaminants in surface and groundwater
- support and convene researchers to identify and investigate what they believe are priority future contaminant risks in Alberta (e.g., from forest fires, melting glaciers, population growth, food production)

In addition to continuing this work as part of GoA everyday business, the AWC makes several recommendations for new or renewed areas of focus. First, to continue to improve drinking water facility management, we recommend that work on small system standards be completed, and that more structure be implemented for reviewing and auditing drinking water safety plans:

Recommendation 3. Small Systems Standards: That the GoA finish and publicly release standards for non-municipal public drinking water systems that fall under the *Public Health Act*, as guidance for system operators, by the end of 2022.

Recommendation 4. Drinking Water Safety Plan Audits: That the GoA improve the drinking water safety plan program for publicly regulated systems by adding a mandatory review and or auditing function to the current process, by 2024.

Note that a DWSP review and audit function does not need to be regulatory. It could be an internal process — but with more reporting structure so that this activity is done on a regular basis. In some cases, municipalities may already have an audit process in place and may not require anything more (i.e., they do not need to duplicate efforts). This process could be as simple as adding a "date DWSP last reviewed" for each community on the Regulated DW in Alberta Community Finder website[12]. Note that it would also be beneficial if the GoA, working with drinking water facility operators, periodically reported on a roll-up of risks and issues identified in DWSPs and subsequent audits. To provide greater assurance to Albertans that their drinking water supply is safe and secure, the GoA might also provide more information to Albertans about how drinking water is managed:

Recommendation 5. State of Drinking Water Report: That the GoA, working with its drinking water partners, communicate by 2026 the state of drinking water and drinking water management systems (municipal, provincial, and federal) operating in Alberta, including roles and responsibilities, how risks are identified and mitigated, and where the public can get information about their local drinking water supply.

12 Note that the FCM Municipal Environmental Management Systems, 2005 includes a process for auditing all municipal water systems for intended purposes, efficiencies and cost effectiveness. The document includes forms for conducting audits.

Although not identified as a specific element of *Water for Life*, wastewater and stormwater management are important considerations as they relate to aquatic ecosystem health. However, wastewater and stormwater are also topics that should be discussed in the context of drinking water, particularly if they contribute to downstream source drinking waters. More and more, municipalities (e.g., City of Vancouver), drinking water operators, and regional consortia (e.g., Okanagan Valley) are looking at this concept of "source to tap to source." Some suggest that a "one-water approach" is needed — where water managers look at source, waste, and stormwater management requirements, locally and regionally, to determine if any efficiencies can be gained by co-managing these inter-related systems.

Additionally, tied to this one-water concept is the idea of using "green infrastructure" (e.g., floodplain, riparian areas, wetlands, beaver ponds, rain gardens) as a cost-effective tool to manage source, waste, and storm waters. Green infrastructure may be increasingly important for the ecological goods and services it provides, including reducing erosion and sedimentation, filtering contaminants from run-off (water quality component), and mitigating climate variability by storing and slowing the release of water in periods of extremes (i.e., flood or drought). In Alberta, these concepts are emerging and warrant further investigation. Therefore, we recommend the following:

Recommendation 6. One-Water Approach: That the AWC work with municipalities and other major water-using sectors to provide the GoA advice (by 2024) on how management of source drinking water, wastewater, storm water, and water reuse, can be improved by a) identifying the policy or regulatory barriers and economic constraints to a 'one-water' systems approach and b) exploring the pros and cons of using green infrastructure to manage water quantity and quality in Alberta.

The Growth of Regional Drinking Water Networks in Alberta

While communities have partnered on drinking water treatment and other public infrastructure for decades, regional networks were seen as an important component of the *Water for Life* strategy when it was first released in 2003. For this reason, substantial financial support was made available to municipalities through the GoA's *Water for Life* and Alberta Municipal Water/ Wastewater Partnership grants to build new or extend existing drinking water and waste water networks. Recent changes to the *Municipal Government Act*, including the required development of Intermunicipal Collaboration Frameworks and metropolitan growth plans, also supports the development of regional shared infrastructure.

While we might expect to see large projects in dense urban areas, it is interesting to note that the list of grant recipients spans the width and breadth of Alberta. Networks generally are managed collaboratively through a commission such as the Aspen Regional Water Services Commission servicing several communities in the Athabasca region. The Alberta Urban Municipalities Association (AUMA) has compiled a list of 38 of these commissions.

Like other small rural communities, First Nations' reserves can also benefit from joining regional networks, and there are a growing number of examples of this occurring, such as the following:

- the West Inter Lake District Regional Water Services Commission extending west to Paul and Alexis First Nations
- NEW Water Ltd, a network that includes Northern Sunrise County, the Village of Nampa, and Woodland Cree First Nation
- the town of High Level water supply being extended to tie into the Dene Tha First Nation's Bushe River Reserve east of the town
- a water transmission line being constructed from Cold Lake to the town of Bonnyville, with connections to the hamlets of Ardmore and Fort Kent and Cold Lake First Nation

While regional networks are not a solution for everyone, they have improved drinking water safety and security for many communities across Alberta.

Healthy Aquatic Ecosystems

Where have we been?

After the *Water for Life* strategy was released in 2003, three was a concerted effort to improve understanding of the state of aquatic ecosystems in Alberta. The Alberta *Water Act* defines aquatic environment as the components of the earth related to, living in, or located in or on water or the beds or shores of a water body, including its organic and inorganic matter, living organisms and their habitats, and their interacting natural systems[13]. The definition includes any type of aquatic ecosystem, such as lakes, wetlands, rivers, streams, aquifers, and riparian areas. In 2007, after some preliminary work[14], AEP commissioned a provincial-scale healthy aquatic ecosystem assessment report based on water and sediment quality and non-fish biota information for major rivers and a selection of tributaries and streams in Alberta. The report also provided an overview of published information for major basins and identified information gaps and made recommendations for more comprehensive monitoring in the future.

In 2008, the AWC developed a working definition for healthy aquatic ecosystems (HAE) as an aquatic environment "that sustains its ecological structure, processes, functions, and resilience within its range of natural variability." This work was followed by a 2009 report on potential HAE projects that could be undertaken to achieve this goal. One such project was the AWC's 2010 Provincial Ecological Aquatic Criteria for Health report. The criteria identified in this initiative were used to map critical aquatic habitat across the province consistent with the GoA's Environmentally Significant Areas (ESA) process. ESA maps identify elements that may require special management consideration because of their conservation needs and are publicly available to inform provincial and municipal land-use planners, industry, consultants, environmental organizations, academic institutions, and others. There have also been recent efforts to update flood hazard area maps.

Alberta has a long history of managing the fisheries resource, an important indicator of healthy aquatic ecosystems. When the AWC was formed in 2004, a *Fish Habitat Conservation Collective* including Trout Unlimited, Nature

13 *Water Act*. Section 1 (h). Page 9.

14 See also 2005 Scope of Work for Initial HAE assessment (Jacques Whitford) and Issues and Monitoring Techniques report (Stantec).

Conservancy Canada, Cows and Fish, Alberta Fish and Game Association, and Alberta Conservation Association was created to represent this sector. Numerous fisheries management tools (such as the Fish Conservation and Management Strategy, Fish Sustainability Index, and Fall Index Netting) have been developed in recent years to support the management of this resource.

In addition to fisheries, aquatic ecosystem managers usually focus on water quality, instream flow needs (IFN), and riparian health. Although it has been restructured several times in recent years, the responsibility for water quality and quantity monitoring rests with the GoA and a substantial amount of data does exist for key waterbodies (see GoA WQ Data portal). Additionally, industry, municipalities (e.g., EPCOR's WaterSHED Monitoring Program), and conservation organizations (e.g., Alberta Lake Management Society) also undertake various water quality monitoring initiatives, depending on their mandate, activity, issues of concern, etc. When issues are identified through monitoring and assessment, actions to address concerns are included in watershed management plans, source protection plans, and in some cases, more specific documents such as the Bow River Phosphorus Management Plan.

To improve our management of instream flow needs (IFN), *Water for Life* called for the creation of a Desk-top Method for Establishing Environmental Flows in Alberta Rivers and Streams (April 2011) and for Water Conservation Objectives (WCO) to be set for major basins. In 2009, the AWC's Recommendations for Improving Alberta's Water Allocation Transfer System Upgrade Project (WATSUP) restated the need to be proactive in setting aside a known amount of "protected water" in order to maintain the health and sustainability of aquatic ecosystems. As mentioned previously, WCOs have been developed for the SSRB, Cold Lake-Beaver River (2006), Lesser Slave Basin (2010), Battle River (2014), and Wapiti River (in progress 2021). Additionally, there has been a recent focus on regulatory decision-making tools that inform individual *Water Act* decisions, such as the *Surface Water Allocation Directive* (SWAD), to guide conditions placed on a licence to limit the timing and amount of water withdrawals in periods of low flow or to address other sensitive issues. The SWAD is a supplement to the desk-top method, for use in areas where the desk-top method has not been used and there are no watershed management plans or water management frameworks in place.

Long before *Water for Life* was released in 2003, Cows and Fish was promoting riparian health, particularly in agricultural areas in southern and central Alberta. In 2011, the AWC struck a project team to examine riparian management across the province. This team developed a working ecological definition of riparian lands, described what was currently known about their state in the province, and in 2012 made recommendations to improve management of these critical components of healthy aquatic ecosystems. Additionally, in 2012, *Stepping Back from the Water* was released by the GoA as a guidance document to help municipal planners in the white area delineate appropriate building setbacks and riparian "buffers" from the water's edge when approving new development. During this time, progress was also made in managing riparian lands in regulated systems such as the Oldman watershed, where managing the dam to mimic natural flood cycles has benefitted downstream cottonwood forests, which require periodic flooding in order to regenerate. In more recent years, significant progress has been made in developing riparian assessment tools (e.g., North Saskatchewan Watershed Alliance desktop assessment) and in providing the capacity for on-the-ground riparian protection and restoration through a number of stewardship programs (e.g., ALUS Canada, Cows and Fish, Watershed Restoration and Resiliency program, and the Watershed Stewardship Grant program).

Another significant piece of work since *Water for Life* was released in 2003 was the development and implementation of the *Alberta Wetland Policy* and associated tools. Developing advice on a wetland policy was one of the early projects of the AWC. This advice informed the GoA as it completed work on a policy for the entire province (both Green and White areas). Today, work continues to be done to improve implementation and to develop performance measures to gauge policy success.

WPACs and assessment and management plans for sub-basins and lakes are other resources to protect healthy aquatic ecosystems because they bring together many partners who would otherwise not be connected (e.g., municipalities, industry) with jurisdiction over water and land use. See more on the state of watershed management planning in the Partnerships section of this report.

Regional land-use plans, created under the Land-use Framework (LUF) and the *Alberta Land Stewardship Act* along with their associated surface water quality and quantity management frameworks where they have been completed, also have the potential to protect aquatic ecosystems. Regional land-use plans inform where development will occur, including agriculture, urban development, forestry, or resource extraction. Regional land-use plans also inform the regulatory system, such that protection of the aquatic environment is built into approvals for activities on crown land (e.g., forestry, oil and gas, and gravel extraction). Agriculture and industry also have a number of initiatives that promote sustainability, stewardship, and the uptake of best practices that are key to protecting aquatic ecosystem health (e.g., Sustainable Forestry Initiative, the Forest Stewardship Council, Watercourse Crossing Program).

For additional information on *Water for Life* actions for Healthy Aquatic Ecosystems, see Table 3.

Table 3: Status of Water for Life Actions for Healthy Aquatic Ecosystems as of December 31, 2019

Actions	Timeframe	Last review	2019	Rationale
2.1 Finalize and implement a new wetland policy for Alberta	Short-term by 2012	Some progress	Ongoing GoA business	A new wetland policy is completed and being implemented. Related implementation tools are either under development or completed. The Alberta Merged Wetland Inventory is a work in progress. The Alberta Wetland Rapid Evaluation Tool has been developed. Wetland health indicators are being developed within an Oilsands Wetlands Monitoring Program.
■ Complete an Alberta wetlands inventory	Medium-term by 2015			
■ Apply research and knowledge to develop and model indicators of wetland health	Medium-term by 2015			

Actions	Timeframe	Last review	2019	Rationale
2.2 Protect critical aquatic ecosystems and develop a provincial action plan	Short-term by 2012	Some progress	Some progress	Guidance is provided by the *Strategy for the Protection of the Aquatic Environment*, with more detailed actions in water/watershed plans, where they exist. Additionally, several tools, such as Class A watercourse maps, Codes of Practice for Watercourse Crossings, the *Stepping Back from the Water* guide, and municipal riparian strategies (where they exist) inform regulatory decisions. The AWC PEACH project developed criteria for HAE which were incorporated into GOA Environmentally Significant Areas mapping. Regional, watershed, and sub-basin planning processes, and water management frameworks are expected to contribute to the health of aquatic ecosystems. An amended *Fisheries (Alberta) Act* and a provincial Aquatic Invasive Species (AIS) program manage AIS. Conservation organizations are doing habitat work. Ongoing monitoring of some metrics is occurring
■ Define criteria and identify critical and significantly impacted aquatic ecosystems	Short-term by 2012			
■ Maintain or improve the health of critical and impacted aquatic ecosystems through legislation, watershed and regional planning, and conservation organizations	Medium-term by 2015			
■ Monitor, report, and adjust where necessary, to ensure the health of aquatic ecosystems are maintained or improved	Long-term by 2019			

Actions	Timeframe	Last review	2019	Rationale
				through the GoA, ALMS. GoA data is now available through the WQ Data portal. Also, see AEP's Knowledge for a changing environment: 2019-2024 Science Strategy and five-year monitoring strategy for lentic and lotic systems. Some phosphorus and small tributary monitoring is also being done.
2.3 Establish science-based methods and tools to determine ecological requirements for HAE ■ Complete instream flow needs methods and tools including a desk-top approach ■ Complete the Alberta fish community index for assessing watershed health	Short-term by 2012	Complete	Some progress	Both an IFN desktop method and Surface Water Allocation Directive (2019) have been developed. Fish management is guided by the 2014 Fish Conservation and Management Strategy. Fish management and fish habitat management objectives have been developed for some areas of the province. The Alberta fish community index was piloted in the Beaver River but not found to be effective. GoA is now using fish sustainability assessments and cumulative effects monitoring with a focus on connectivity. Also see the AI-WIP research strategy and program for projects related to aquatic ecosystems.

Actions	Timeframe	Last review	2019	Rationale
2.4 Establish the Bow Habitat Station	Short-term by 2012	Complete	Ongoing GoA business	An interactive public educational facility with exhibits and aquariums located in Calgary; content is updated from time to time.
2.5 Set Water Conservation Objectives on all major basins	Medium-term by 2019	Limited progress	Limited progress	WCOs have only been set for some basins but other tools (e.g., SWAD) have been developed to consider IFN when making regulatory decisions.

Have we achieved our desired outcomes?

Goal: Albertans are assured that Alberta's aquatic ecosystems are maintained and protected.

Water for Life 2003 goal: Healthy Aquatic Ecosystems

Water for Life (2003) outcomes for this goal include the following:

- protection of aquatic ecosystems in critical areas
- establishment of priorities for sustaining aquatic ecosystems to be implemented through watershed plans
- management and allocation of water to sustain aquatic ecosystems and ensure their contribution to Alberta's natural capital and quality of life are maintained

Although progress has been made overall on the development of a number of tools and other initiatives to advance the goal of healthy aquatic ecosystems, it is hard to assess whether Albertans feel assured that the province's aquatic ecosystems are maintained and protected. Without clear definitions, delineations, and performance metrics, it is challenging to determine if Alberta's aquatic ecosystems are indeed sustaining their ecological structure, processes, functions, and resilience within their range of natural variability. Alberta's aquatic ecosystems, particularly lakes, small streams, wetlands, and riparian lands continue to face significant pressures from a variety of issues (e.g., cumulative effects of disease, invasive species, nutrient enrichment, increasing temperature, development associated with stormwater, wastewater). Where

they are completed, state of the watershed reports and other assessments (e.g., riparian assessments, wetland inventories, fisheries work) often show a mix of healthy and unhealthy aquatic ecosystem components and/or areas[15]. While the *Strategy for the Protection of the Aquatic Environment* could provide direction, few people know about the strategy and there is currently no mechanism, which is a policy gap, to ensure its guidance is used in land use approval processes.

Although the AWC's PEACH project and subsequent GoA Environmentally Significant Areas mapping made an attempt to identify critical aquatic ecosystem areas. ESAs are not regulatory they do not confer protection, and their consideration is not mandatory, thereby creating a gap in the system. Additionally, further work is needed to refine maps and to ensure conservation and protection activities are occurring in priority critical areas. It is worth noting that the Oldman Watershed Priority Mapping used different criteria and methodology than what was used to identify Alberta's ESAs.

In particular, the protection of headwaters, source drinking waters, floodplains, riparian lands, high-value wetlands, recreational lakes, and key groundwater recharge and discharge areas is different in different regions, and such areas continue to be pressured by land development, industrial activities, urban expansion, tourism and recreation, and other activities. Fortunately, a growing number of municipalities are using tools, such as natural area and lakeshore districting and overlay maps, that restrict certain activities in certain areas, incorporate sensitive areas into green space and recreational planning, use building and development setbacks from the water's edge, or require the dedication of environmental reserves during subdivision processes to protect water bodies within their jurisdiction. However, the use of such tools varies from one community to the next, and compliance with and enforcement of such tools is often lacking because of limited personnel and financial resources, with encroachment often an issue.

Although wetlands have received a significant amount of attention over the past decade, there has not been a formal assessment of the effectiveness of the new *Wetland Policy*. Some would argue that policy implementation has had mixed success, both geographically (with better appreciation for the value of wetlands in southern Alberta than in the north) and for different types of wetlands (less

15 For example, the Sturgeon River watershed has both healthy and unhealthy aquatic areas according to a riparian assessment (Fiera 2018) and an aquatic ecosystem assessment (CPP 2019).

concern for a loss of boreal bogs and fens than for prairie marshes). Today, wetlands are still lost because of urban development, agricultural practices, and rural industry. However, the implementation of the policy has great potential to support healthy aquatic ecosystems and many municipalities and conservation groups are putting the Wetland Replacement Program into action.

Similarly, while some progress has been made in identifying aquatic ecosystem health priorities in watershed management plans, some WPAC regions still do not have plans in place (see more about this in the Partnerships section), and where they exist, plan implementation is limited by capacity and the voluntary nature of the plans. To be successful, advice in watershed management plans must be embedded in provincial and municipal land-use planning and regulatory decision-making processes. For example, Intermunicipal Development Plans and Intermunicipal Collaboration Frameworks, now required under the new *Municipal Government Act*, provide an excellent opportunity for municipalities to discuss shared watershed objectives for waters that cross their boundaries.

The creation of water quantity and quality management frameworks under regional land-use plans created pursuant to the *Alberta Land Stewardship Act* (ALSA) will bolster management of aquatic ecosystems; however, these frameworks are behind schedule. Biodiversity frameworks have similar potential but are yet to be developed. Fish management objectives have been developed for some, but not all, fish-bearing waters. As key aquatic resources and important indicators of health, an increasing number of fish (as well as other aquatic species) are at risk, and fishing in many popular waterbodies is limited to catch and release.

And finally, while there has been good progress in developing tools to assess instream flow needs and to allocate water accordingly, it is unclear if these tools will be adequate to sustain healthy aquatic ecosystems. As of the end of 2019, WCOs have not been set for all major basins, and desktop IFNs are used selectively. It is probably too early to determine if the Surface Water Allocation Directive has been successful. Note that the directive does not have the statutory consideration under the *Water Act* (and related accountability) that WCOs have. Government-issued WCOs to protect water and its aquatic environment in priority areas are generally not used. Similarly, the effectiveness of water management frameworks, currently developed only for the Lower

Athabasca and South Saskatchewan regions, is also unknown at this time. Overall, it is unclear if existing tools can ensure that the goal of healthy aquatic ecosystems will be achieved, although *Water for Life* partnerships are working to protect these systems throughout the province.

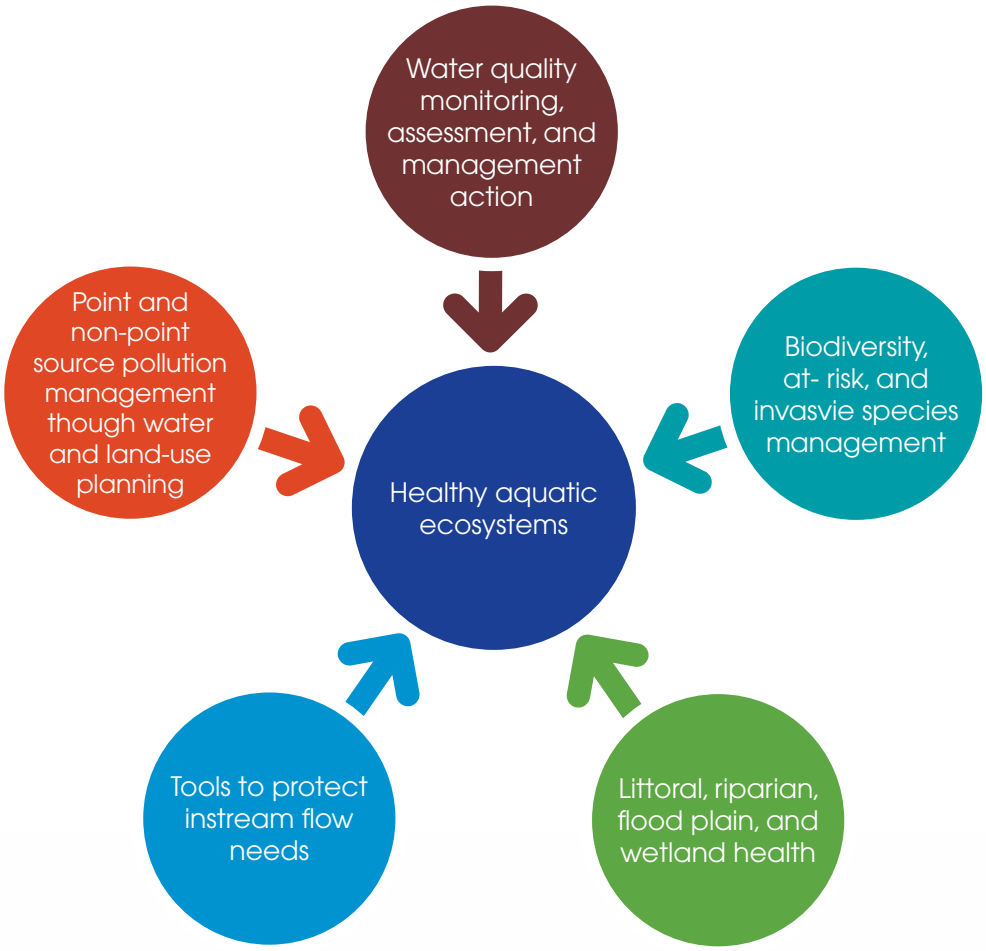


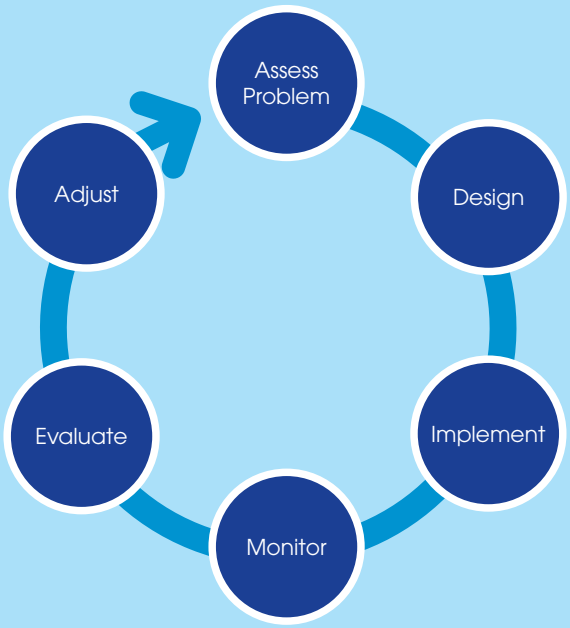
Figure 2: Major Components of Alberta's Healthy Aquatic Ecosystem Management System

The Challenge with Instream Flow Terminology

One of the biggest challenges with managing aquatic ecosystems is to determine how much water can be removed from a waterbody safely and how much water needs to remain at any given time, in order not to degrade the health of the system irrevocably. Some will argue that some degradation is okay, some of the time, particularly if other social and economic values are being met. Others would argue that if aquatic ecosystems are not sustained as the foundation, other social and economic values will also not be sustained.

This discussion has been around for a long time, with different terminology used, and sometimes misused, at different times. Some examples of these definitions are provided below. Note however, that the AWC defines healthy aquatic ecosystems as "sustaining their ecological structure, processes, functions, and resilience within their range of natural variability." Therefore, when talking about how much water to leave in the system (whether it is referred to as instream flow needs, environmental flows, or something else), we are talking about how much water is needed to maintain structure, processes, functions, resiliency, and natural variation.

Until we know more about, and can better quantify, the relationship between water quantity (flow and level) and aquatic ecosystem health, we will continue to have difficult conversation. However, taking an adaptive and iterative approach, we can continue to apply what we know today and adjust our management systems as new issues arise and our understanding evolves. Using a performance-based system to benchmark and



assess our progress against such benchmarks in the future is also important, as it provides a feedback mechanism that helps us to adjust our course when needed. Understanding terminology and the adaptive management process is critical to moving *Water for Life* goals forward.

Environmental Flows: a colloquial term used to refer to the amount of water needed by an aquatic ecosystem to remain healthy and sustained over time. Some would argue that these flows need to be "protected waters" that are not included in the allocation system.

Environmental Flow Needs: in relation to a stream, the volume and timing of water flow required for the proper functioning of the aquatic ecosystem of the stream, as used by British Columbia in their Environmental Flow Needs Policy.

Ecosystem Baseflow: A flow at which any human-induced reductions in flow would result in not meeting the defined objective for the aquatic ecosystem, consistent with the Alberta's Surface Water Allocation Directive.

Instream Flow Needs: The scientifically determined amount of water, flow rate, or water level that is required in a river or other body of water to sustain a healthy aquatic environment or to meet human needs such as recreation, navigation, waste assimilation, or aesthetics. An IFN is not necessarily the same as the natural flow.

Instream Objectives (IO): Regulated flows that should remain in the river through improved dam operations or restrictions on licences. The term was common before 2002 when it was replaced by Instream Flow Needs. Instream Objectives were usually set in response to fish habitat and/or water quality requirements.

Water Conservation Objective (WCO): As outlined in Alberta's *Water Act*, a water conservation objective is the amount and quality of water set by a Director for the protection of a natural water body or its aquatic environment; the protection of tourism, recreational, transportation, or waste assimilation uses of water; or the management of fish or wildlife.

Where do we need to go next?

The goal of healthy aquatic ecosystems is still relevant and valid with stakeholders, and since 2003, attitudes and values about this resource have changed. Ecosystem objectives are a larger part of the discussion than they once were. However, despite some substantive pieces of work (e.g., planning tools, water management frameworks, regulatory decision-support tools, inventories), it is still challenging to provide assurance that aquatic ecosystems are being maintained or protected. Therefore, to build on the progress made to date and to meet these challenges, the AWC recommends that this element be given greater scrutiny and urgency.

> *"Healthy aquatic ecosystems as a goal under Water for Life has provided a good foundation and an umbrella or guiding document. It has raised awareness of the importance of aquatic ecosystem health and has helped make it an accepted and key component in conversations and processes with stakeholders."*
>
> ***Roundtable participant***

Recommendation 7. Healthy Aquatics Ecosystems Review: That the AWC strike a project team to examine and report on the state of Alberta's aquatic ecosystem health and its management (by 2022) and identify barriers and opportunities to improve capacity, governance, and accountability (by 2024) for achieving the *Water for Life* goal of healthy aquatic ecosystems.

The AWC project team could look at the efficacy of existing HAE management tools and identify the gaps in the governance system to determine where new policy, regulatory, and institutional arrangements, tools, or resources are needed. They might also look at how new technology (e.g., DNA testing for benthic invertebrate identification) and citizen science programs can leverage efforts. The team might also examine and make recommendations on several individual components of aquatic ecosystems and their associated issues, a number of which are identified as follows:

Wetlands: The *Wetland Policy* has the potential to protect many aquatic ecosystems. However, it is unclear how successful implementation of the *Wetland Policy* will be assessed, including how it will be determined that wetlands are healthy and still providing the functions they are valued for at local, wetland-complex, and watershed scales. It is also important to know how many high-value wetlands have been protected through implementation of the policy and how this is being reported on to Albertans. While outside the review period for this report, it is worth noting that AWC struck a project team in 2020 to review the implementation of the Alberta *Wetland Policy*.

Riparian Policies: The role of the GoA in managing riparian areas and its expectations for other jurisdictions and entities (e.g., how municipal planning tools support *Public Lands Act* responsibility for bed and shore)

needs to be made clear. In particular, building and development setbacks are critical to sustaining ecosystem services provided by riparian lands. To improve their use, the GoA should finalize an implementation guide and online tool to support the *Stepping Back from the Water* guide for municipal planners. The GoA might also consider stronger policies and strategies for comprehensive and consistent riparian management, including legal definitions and regulations, approved processes for delineating and assessing the health or intactness of riparian lands, and the development of other mapping and management tools.

Lake Management: The role of the GoA in managing lakes and what its expectations are for other jurisdictions and entities also needs to be made clear. Regional recreation planning also needs to be considered because it impacts lakes and other waterbodies. In general, lake management needs to be improved, not only for the intrinsic value of lakes but also for the following reasons:

- issues associated with human health (e.g., blue-green algae, public beaches)
- safety (e.g., boater traffic)
- quality of life (recreation) and the economic importance of lakes for tourism (as demonstrated in the AWC Lake Watershed Management Report)

Flow Needs for Aquatic Ecosystem Health: The GoA has developed regulatory support tools that consider individual allocation decisions; however, the GoA could also improve assurance of aquatic ecosystem health by developing and communicating a more proactive policy[16] protecting flows or lake levels required for aquatic ecosystem health as defined by the AWC.

Fisheries: Alberta has a limited number of fish-bearing waterbodies relative to the demand for high quality fishing experiences. To manage this challenge, data, desired stakeholder outcomes, and biological context of the fishery is used to determine if a fishery can support significant recreational use or not. This approach provides for a diversity of fishing opportunities to reflect the diversity of stakeholder perspectives.

16 For example, see British Columbia's *Environmental Flow Needs Policy.*

To date, formal scientific review processes have supported Alberta's approach. Alberta Fisheries Management incorporates third-party peer review of the scientific and management aspects of the program. This process is realized by Canadian Science Advisory Secretariat (CSAS) reviews, peer-reviewed publications, and reports. For example, a review of the North Central Native Trout Recovery Program was recently completed. Additionally, because fisheries management may benefit from strengthened connections to land-use planning and management tools, the CSAS performed a substantive review of Alberta's approach to fisheries cumulative effects using Joe modelling methodology.

Despite this work, there continues to be differing views regarding the success of fisheries management initiatives in the province, with some Albertans expressing frustration with sport fishing and fish consumption restrictions in some areas, and for some species. To improve public assurance, greater communication, education, and outreach activities may be required. A review of the state of Alberta's fisheries and the current approach to fisheries management could also be conducted as a communications and education initiative and to confirm 1) the appropriate approach to fisheries management in the province; 2) how management can be improved to assure the recreational fishery is sustained, or where needed or possible, improved; and 3) how fisheries management can better connect to watershed and land-use planning and management tools such that fish habitat and connectivity are restored where required to support both sport and non-sport healthy fish populations. This review could include looking at both federal and provincial roles and accountability in fisheries management.

Aquatic Species at Risk: Including provincial and Committee on the Status of Endangered Wildlife in Canada listings, there are about 11 species of fish at risk in Alberta (e.g., bull trout, cutthroat trout, lake sturgeon). Many other at-risk species, such as northern leopard frogs and western grebes, also rely on healthy aquatic ecosystems. Efforts to protect critical aquatic ecosystems should support the management of at-risk species as well. Compliance with federal legislation to protect breeding and nesting species at risk, migratory birds, and fisheries is also required.

Invasive Species and Disease: The GoA should continue working with its partners to avoid the high economic and ecological cost of managing emergent issues, such as invasive species and disease. This includes stepping up invasive species and disease education, monitoring, research, and regulatory tools (e.g., pursuing legislation to prohibit the sale of listed invasive species, such as purple loosestrife and flowering rush).

Monitoring and Assessment: The GoA also needs to continue working with its partners, particularly WPACs, to ensure Alberta has robust performance criteria and indicators to measure aquatic ecosystem health and a comprehensive monitoring, evaluation, and reporting program to communicate and act on changes over time.

Protecting Critical Areas: The GoA and AWC need to work together to 1) define what is meant by HAE "critical areas" and identify the tools available for protecting such areas in Alberta (e.g., *Public Lands Act* enforcement, municipal land-use districting, building and development setbacks, requirement for dedication of environmental reserves, conservation reserves and easements, and new policy and planning tools in the amended *Municipal Government Act* and ALSA); 2) revisit the AWC's Provincial Ecological Aquatic Criteria for Healthy Aquatic Ecosystems to ensure criteria are robust and support the definition of "critical areas"; 3) use definitions and criteria in future iterations of ESA mapping to identify critical areas; and 4) provide guidance on who should be informed by ESA maps and how they will be used.

Flood Hazard Areas: Flood hazard areas are an important component of critical aquatic ecosystems. While there have been good efforts to map these areas in recent years, more work is needed to identify all lands subject to flooding and to ensure that consistent polices regarding development in these areas are in place and enforced across the province. Managers and planners also need to determine what is appropriate land use in flood hazard areas, which should be delineated and mapped well in advance of any development along our major rivers and tributaries.

Land Use: The GoA and its *Water for Life* partners need to continue to work together to lessen the impact of land use on Alberta's waterbodies including the following:

- improving our understanding of how current and future land use affects HAE and how climate change may exacerbate issues such as non-point source pollution, nutrient and contaminant loading, and loss of riparian filters
- improving compliance and enforcement of legislation around water bodies through collaboration of federal, provincial, and municipal regulators
- improving riparian, wetland, and floodplain governance and management by 1) working with producers to understand agricultural impacts on water quality, to protect ecological goods and services, and to comply with the *Agricultural Operations Practices Act*; and 2) working with municipalities to use statutory tools (e.g., land-use plans, development setbacks, environmental and conservation reserves) to protect these areas
- working with metropolitan growth boards to ensure corridors adjacent to rivers and streams are consistently managed across the province
- improving the uptake of agricultural and industry beneficial practices by removing barriers and disincentives to voluntary implementation

Education: The GoA should continue to work with WPACs, WSGs, conservation organizations, and Indigenous communities to 1) better coordinate HAE educational programming and messaging through "Respect Our Lakes," "Know Before You Go," "Wheels out of Water," and other recreation and water literacy type programs; 2) promote the use of citizen science and Traditional Knowledge; 3) encourage a stewardship ethic among municipal councils and land-use planners; and 4) facilitate the formation of stewardship groups and support individual conservation and management action.

A Focus on Headwaters

Many of our major rivers arise out of the Rocky Mountains, which bring us a supply of quality water that currently meets our social, economic, and environmental needs. The importance of these mountain headwaters as the source waters for much of our population was formally acknowledged in the 1970s with the Eastern Slopes Policy. In more recent years, there has been renewed interest in headwaters protection.

In 2016, the Oldman Watershed Alliance created a Headwaters Action Plan "to maintain and protect the integrity of the Oldman headwaters and source waters." In 2017, the NSWA supported the creation of the Headwaters Alliance, a sub-basin planning group with a focus on managing riparian areas in both the Green and White areas of the upper North Saskatchewan watershed. And very recently, the Alberta Chapter of the Wildlife Society commissioned ALCES (A Landscape Cumulative Effects Simulator) to complete *Cumulative Effects of Land Uses and Conservation Priorities in Alberta's Southern East Slopes*, which models different management scenarios and outcomes to inform future management of the Southern East Slopes to achieve long-term conservation objectives.

While the flow of mountain headwater rivers may once have been more reliable than foothill or prairie rivers, they are still variable because snowmelt and rainfall are the dominant water source, with only minor glacial contributions. Additionally, climate change, with a reduction in glaciers and potential changes to precipitation patterns, may affect these source waters in the future.

Note, however, that not all our headwaters arise out of the mountains. Several of our smaller central and eastern watersheds have headwaters that arise within the prairies, parkland, and boreal forest. These headwaters do not receive any glacier melt, but rely on snowpack, rain, and run-off to make up river flows. These headwaters also need special management considerations, particularly as they influence downstream flows and users.

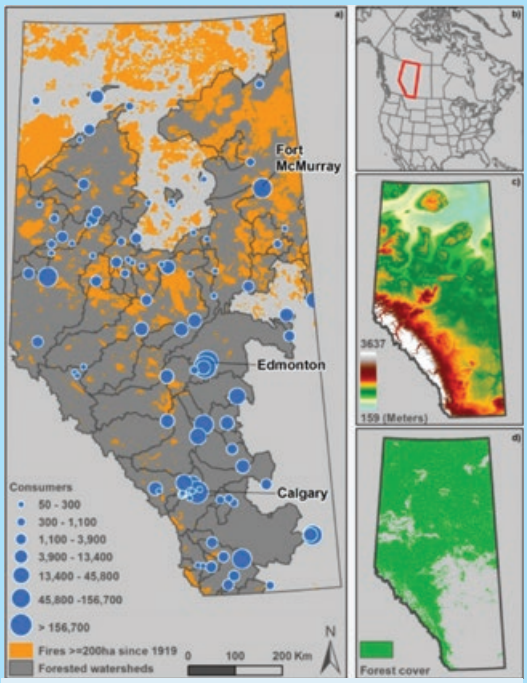
Importance of Forests in Alberta's *Water for Life* Strategy

Healthy resilient forests produce clean, reliable water supplies and watershed ecosystem goods and services. Forests provide natural filtration and attenuation of contaminants in our source waters and, if forest cover and health is maintained, forests can significantly reduce downstream water treatment requirements and costs. For every 10 percent increase in forest cover, water treatment costs have been shown to decrease by up to 20 percent[17].

Alberta's forests, their disturbance ecology, and the way they are managed can play a significant role in the provision and maintenance of water quality, quantity, and healthy aquatic ecosystems across the province. In fact the majority of the population of Alberta is dependent on forested watersheds for providing municipal water supplies[18].

One of the most significant natural threats to Alberta's high quality water supply is contamination due to high severity wildfires. Under future climate change scenarios, the likelihood of larger, more severe wildfire behaviour impacting source watersheds is higher. This is evident now in Alberta with recent large wildfires causing treatment challenges and increased treatments costs for water utilities[19].

A key strategy for sustainable water resource management and implementation of the *Water for Life* strategy is the incorporation of forest management and wildfire risk management planning into SWP.



Details of the study area, including: (a) the location of drinking-water treatment facilities reliant on surface water supplies from forested watersheds in Alberta (symbol size indicates population size class served by the utility) and historic spatial distribution of large fires (>200 ha); (b) the location of Alberta in North America; (c) Alberta terrain (elevation); and (d) Alberta forest cover.

This will help to address both the importance of forests in providing clean, reliable water supplies and also identify the risks of wildfire-related disturbance to surface water in Alberta.

As a reflection of the importance of forests and the management of forest disturbance, both Edmonton and Calgary water utilities have recently integrated source water and wildfire threat analysis into their SWPPs. However, further work needs to be completed under provincial frameworks to identify and mitigate wildfire risk in smaller and often more vulnerable water utilities across the province.

17 AWWA 2004

18 see inset image from Robinne et al., 2019

19 CBC News. February 9, 2017

Reliable, Quality Water Supplies for a Sustainable Economy

Where have we been?

Alberta has been managing its water supplies for more than a century. Understanding what supplies are available, the province, as the authority responsible, makes informed decisions about how much water to allocate to users and how much to leave in the river, lake, or aquifer in order to ensure aquatic ecosystem health and sustainability. As a majority of our withdrawals come from our major rivers, there is a good amount of data for these systems (see Alberta River Basins website). However, more recent efforts have been made to learn more about smaller tributaries and groundwater supplies.

Over time, the province has developed tools to support decisions made about water allocation. Allocations are guided by the first-in-time first-in-right (FITFIR) principle and managed by term and temporary diversion licences, transfers, holdbacks, and other legislative and regulatory tools. Licence holders also have a role to play. As a condition of their licences, term licence holders must report their water use through the Water Use Reporting System. Both term and temporary licence holders must satisfy conditions of their licence, such as when and how much and at what rate, they can divert at a time[20].

As tools and processes have evolved, Alberta for the most part, has had water available when and where it was needed. However, events like the 2001 drought and the 2006 closing of the SSRB to new licence applications prompted calls to review our water supply management system. Several reviews were conducted after the *Water for Life* strategy was released in 2003 (see the AWC WATSUP report). For the most part, these reviews did not call for radical change to the existing system.

20 Note the Alberta Water Tool has added a new water use component to its website.

From time to time, related issues, such as inter- and intra-basin transfers, transboundary commitments[21], industry use, best available technologies, best management practices (particularly in the irrigation, municipal, and energy sectors), aquatic health, and sustainability also drive the conversation around reliable water supplies. Water conservation and reuse are also important considerations (see more about these in the Water Conservation section).

Overall, there has been good progress on this specific goal as the actions described in Table 4 illustrate. However, understanding how the achievement of this goal affects other elements of *Water for Life*, particularly healthy aquatic ecosystems, is perhaps more of a challenge.

Table 4: Status of Water for Life Actions for Reliable, Quality Water Supplies for a Sustainable Economy as of December 31, 2019

Actions	Timeframe	Previous Status	Status	Rationale
3.1 Develop and implement a viable governance system that supports sustainable management of water.	Short-term by 2012	Progressing on track	Ongoing GoA business	Alberta partners with the federal government in a number of initiatives under the *Canada Water Act*. Several reviews of Alberta's allocation system were completed including the AWC WATSUP project. Allocation and transfer systems were not changed markedly but several tools have been developed to support decision making, e.g., ***Water Act*** Temporary Diversion Licence Electronic Review System (WATERS) and Water Restrictions map; Alberta flow estimation tool for ungauged watersheds (in development); Water Use Reporting System (WURS); AER water use

21 Alberta has been a partner with the federal government and the other prairie provinces in the Prairie Province Water Board since its inception to ensure that water from the headwaters in the Rockies is fairly apportioned across the prairies. The Master Agreement on Apportionment is a framework document for provincial decision makers.

Actions	Timeframe	Previous Status	Status	Rationale
■ Review and renew Alberta's current water allocation system to meet future needs including the environment and other protected uses.	Short-term by 2012			performance webpage; Surface Water Allocation Directive; and Canada Alberta Partnership Farm Water Supply program. Also, work on a water storage assessment and a water reuse policy is in progress. WPACs reviewed the Approved SSRB WMP and discovered a number of challenges to the transfer system in place for this closed basin.
■ Develop and implement an enhanced water rights transfer system that supports sustainable economic development.	Medium Term by 2015			
■ Develop a publicly accessible, automated decision-support system for temporary diversion licences.	Short-term by 2012			
■ Investigate further support system applications for water approvals.	Medium-term by 2015			

Actions	Timeframe	Previous Status	Status	Rationale
3.2 Address the water management and policy risks associated with a changing future water supply resulting from the impacts of challenging climate regimes	Medium-term by 2015	Progressing on track	Some progress	Regional work has been done under the Prairie Regional Adaptation Collaborative. Provincially, the GoA has completed hydro-climate scenarios for the Lower Athabasca and South Saskatchewan regional planning areas. Also, some work has been done on the Bow River. More work is needed to comprehend climate change impacts in other areas and investigate adaptation measures. Note that the Climate Change office is no longer stand alone but resides within AEP, and regional planning is behind schedule.
■ Develop future hydro-climate scenarios for major watersheds.	Short-term by 2012			
■ Develop strategies to deal with the management of changing future water supplies through the provincial Climate Change Adaptation Strategy and through implementation of the Land-use Framework and watershed planning.	Medium-term by 2015			

Actions	Timeframe	Previous Status	Status	Rationale
3.3 Institute mandatory water use public reporting for water licences.	Medium-term by 2015	Progressing on track	Ongoing GoA business	A Water Measurement Guidebook was completed in 2009 and is a part of the water-user reporting website (WURS). GoA has amended the reporting conditions of existing licences. Electronic reporting is now part of regular business; there are some compliance issues with small licensees. The WURS tool will eventually enable self-service queries; the capability to view water use data is being tested.
■ Implement a water measurement pilot project using the water measurement guide.	Short-term by 2012			
■ Amend reporting conditions of existing water licences.	Short-term by 2012			
■ Implement electronic public reporting.	Medium-term by 2015			
3.4 Assess future water supply demands and management options within watershed management planning. Options could include conservation, storage (based on provincial inventory), and water allocation transfers.	Long-term by 2019	Some Progress	Some progress	GoA is examining provincial approaches and policies for water reuse, storage, and optimization. Water management frameworks under regional planning will consider recommendations for establishing management objectives in river basins. Water management plans/WCOs in specific areas are developed as needed. Around the province, some work is being done to consider future scenarios for population growth, economic development, future water supply and demand, etc.

Have we achieved our desired outcomes?

Goal: Albertans will be assured that water is managed effectively to support sustainable economic development.

Water for Life 2003 goal: Reliable supplies for a sustainable economy

Water for Life 2003 Outcomes for this goal include the following:

- implementation of a broad range of water management tools
- increased awareness for all Albertans of the holistic value of water — as both a part of the economy and improved quality of life
- establishment of water management objectives and priorities that support sustainable economic development to be implemented through watershed plans
- management and allocation of water to support sustainable economic development and the strategic priorities of the province

For the most part, Albertans have had the water we needed to pursue economic development, even in the SSRB where the southern water supply is tightly managed. To manage water effectively, the GoA has developed a broad range of water supply and allocation tools to optimize water supplies where they are needed most, as reflected by the strategic priorities of the province. And although it is hard to put a dollar figure on it, Albertans value water. It touches our lives daily, whether as part of our economy or as an influence for where we live or how we enjoy recreation.

Studies such as the Bow River Project and Athabasca River Basin Initiative have shown that management overall is quite efficient, although there is always room for improvement. FITFIR, unused licences, unlicensed withdrawals, water use reporting, and other aspects of the system warrant review and discussion from time-to-time. There are also some unknowns, in particular how well this system will stand up in the face of a multi-year drought, glacier loss, warming temperatures, and other aspects of climate change, particularly in areas where growth and development are driving demand.

It is also unclear whether the system is doing enough to balance water supply for the economy with water for aquatic ecosystem health, recreation, and improved quality of life. Some Albertans would like to see stronger protections put in place proactively through the use of limits implemented through

watershed management plans or regional plans and water quantity management frameworks. Others would like to see more water allocated for use, particularly as our population and economy grow, and as water demands increase for food production and rural, suburban, and urban drinking and sanitation purposes. Regulators believe tools such as the Surface Water Allocation Directive will ensure decisions do not have a cumulative impact on aquatic ecosystems. Continued work on both approaches (stronger policy direction and better regulatory decision-support tools) is probably beneficial.

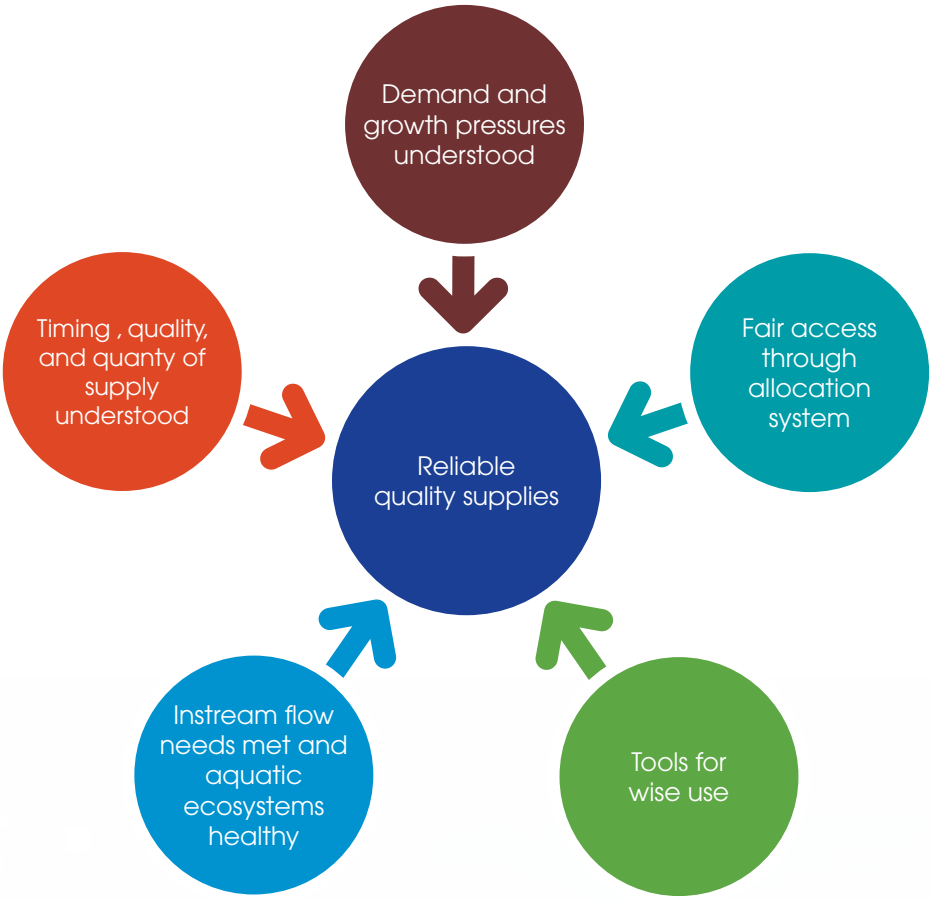


Figure 3: Major Components of Alberta's Water Supply and Allocation Management System

Where do we need to go next?

While work toward this goal has seen significant progress, there is still room to improve. To strengthen our water supply and allocation system, we suggest that greater effort be put into understanding our future water supply and demand, particularly under climate change. Our natural water supply is highly variable, and it may become even more so in the future. We need to understand what the realistic range of water yield and demand is in order to guide future management actions. Some of this work will be done to inform the development of regional and watershed management plans. However, to improve this work, we need to be better at sharing data, making more robust models that help us to explore potential future scenarios, and making predictions about the future.

Recommendation 8. Water Use Data: That the GoA improve our knowledge of water use by finding a mechanism to make licensed actual water use data publicly available by 2022.

Recommendation 9. Sustainable Economy: That the AWC explore and provide advice to the GoA (by 2024) on what "sustainable economy" is in terms of Reliable Quality Water Supplies for a Sustainable Economy and 2) what the policy implications of various options, such as increased storage, improved efficiency, reduced administrative barriers, or sector water supply assistance programs, are to ensure this goal is achieved in the future, recognizing that solutions might look different in different regions and or to different sectors.

Recommendation 10. Improved modelling: That the GoA and its partners work to improve water supply and demand modelling, including scenario-building and forecasting (particularly in light of population growth, economic development, cumulative effects, and climate variability), periodically updating the AWC and its partners on their learnings and how such information can inform policy and other decision makers[22] (ongoing).

22 Note that Recommendation 10 contributes to Recommendation 13 (knowledge integration) in the Knowledge and Research section.

Several considerations for modellers include the following:

- agreeing to shared standards or best practices around modelling and scenario building
- improving our understanding of what both averages and periods of extremes look like
- improving our understanding of potential changes in timing of water events (e.g., spring break-up) under future climate change scenarios
- improving our knowledge about different impacts at different scales (e.g., tributaries versus mainstems) or in different geographic areas of the province (e.g., prairies versus boreal forest) under future climate change
- defining and considering the impacts of cumulative effects and the use of thresholds
- simulating scenarios such as exceeding limits in times of drought and using scenarios to discuss management options with decision makers
- ensuring model results are communicated in a user-friendly, easy to understand, and informative way to decision makers

While models help to proactively inform us of what might happen, we also need to continue to improve our preparedness for periods of extremes, by developing drought, flood, and other emergency plans that identify roles, responsibilities, and management actions when needed.

Recommendation 11. Preparedness: That the GoA and its agencies (e.g., Alberta Emergency Management Agency) and the AWC continue to work with WPACs and municipalities to promote municipal flood and drought management, and to develop planning, best practices, and other informative and user-friendly tools that improve community preparedness (ongoing).

Alberta Water Council Drought Resiliency Work

Multi-year droughts have been recurrent events throughout Alberta's history. The Canadian disaster database describes drought as a prolonged period of abnormally dry weather that depletes water resources including both natural sources (e.g., rivers, streams, lakes, groundwater) as well as man-made storage (e.g., reservoirs, dugouts). The risks and impacts associated with multi-year droughts require advanced and ongoing preparation. Drought management at the municipal and community level considers the impacts of depleted water resources on environmental, economic, and social needs.

In 2018, the AWC approved terms of reference for a project team to assist WPACs as they engage municipalities and communities within their watershed to better plan for, mitigate, respond to, and recover from multi-year droughts. Representatives from governments, non-government organizations, and industry participated on the team. The projects objectives were as follows:

- highlight the importance of multi-year drought management in Alberta by documenting lessons learned from previous droughts and expected changes due to climate change
- compile existing drought management information and resources in Alberta and case studies from selected jurisdictions
- increase awareness of federal, provincial, and municipal water management roles, responsibilities, and regulations relevant to drought
- provide guidance on management objectives, potential risk and impacts, triggers, and suggested actions for small urban and rural municipalities before, during, and after a drought
- produce a guide and workshop materials to support WPACs in engaging small urban and rural municipalities

The project team completed a literature review and conducted interviews before developing the *Building Resiliency to Multi-Year Drought Guide* and then tested the guide and supporting documents in a pilot workshop hosted by the Battle River Watershed Alliance. Participants provided feedback on the workshop delivery, supporting materials, and the guide itself, which was incorporated into project deliverables before review and approval by the AWC Based on the team's work, the AWC recommended the following performance measure, to be evaluated one year after public release of the guide:

- Percentage of WPACs that have held drought resiliency workshops using the *Building Resiliency to Multi-Year Drought Guide* 18 months after the report and supporting materials are publicly released.

The project team also recommends that a WPAC be tasked with periodically reviewing the guide and updating the web addresses as needed. see the project page on the AWC website.

Knowledge and Research

Where have we been?

When *Water for Life* was first considered, Albertans made it clear they wanted to be engaged in water management discussions. To ensure that everyone had a common knowledge and understanding, the GoA developed a number of educational materials (e.g., Facts About Water in Alberta booklet, Glossary of Terms Related to Water And Watershed Management In Alberta) and supported a number of outreach initiatives (e.g., Bow Habitat Station, Water literacy program, the Water Channel). The AWC also contributed to this body of information through its many reports, videos, and newsletters. Similarly, WPACs, WSGs, and several other organizations (e.g., Alberta Water Portal, Alberta Council for Environmental Education, Inside Education) have also developed numerous water-related educational materials and programs.

To inform education initiatives and water management in general, we need good information. Therefore, in 2003 the GoA provided significant funding was to develop the Alberta Water Research Institute. Today, the program has evolved into the Alberta Innovates Water Innovation Program (WIP), guided by Alberta's Water Research and Innovation Strategy (2014). This program has become an important funding body that supports a community of researchers undertaking numerous collaborations that, in turn, contribute data, information, and recommendations for water management. For example, the program provided funding to the University of Alberta's School of Public Health for Dr. Patrick Hannington to research the relationship between swimmer's itch, zebra mussels, bacteria, and other water-related public health issues with the use of DNA test kits used along with citizen science initiatives. WIP funding also supported the Southern Rockies Watershed Project — work that led to an examination of how salvage and other logging practices occur on the Eastern Slopes. The GoA's Watershed Resiliency and Restoration Program has also provided significant funds to researchers and *Water for Life* partners to undertake initiatives that have improved our knowledge and understanding.

To understand whether water management actions are working, we need a comprehensive monitoring, evaluation and reporting system in place. The responsibility for this rests with the GoA; however, this activity has undergone a number of organizational changes in the past 15 years, with some programs absorbed, replaced, or reorganized. Currently, GoA activities in this area are guided by the recently released 2019–2024 Science Strategy, as well as the five-year lotic (rivers and streams) monitoring plan.

Information and knowledge generated by research and monitoring, if not readily available and user-friendly, can be underused by decision makers who may not know how to find it or use it when faced with an application for approval of an activity. So today, there is closer collaboration between academia and government, with research initiatives targeted at answering a specific question. Additionally, AEP has recently taken a more active role with WPACs, working to provide them with a baseline of data and analytics specific to their watersheds which, in turn, can be used in watershed assessments and education programs. AEP is also looking at using citizen science in some areas (e.g., Wabasca Lake). The Oil Sands Information Portal is another example of how the government has been facilitating the transfer of knowledge. Therefore, progress, overall, has been made in this area over the past four years, as Table 5 illustrates.

Table 5: Status of Water for Life Actions for Knowledge and Research as of December 31, 2019

Actions	Timeframe	Previous Status	Status	Rationale
4.1 Develop and implement an education framework to support *Water for Life*	Short-term by 2012	Currently being re-evaluated	Ongoing GoA Business	AEP has developed an Internal Education framework and is working on a public Water Literacy strategy, consistent with the advice of the AWC water literacy project. They have developed several resources, including Facts about Water in Alberta, The Water Channel, Respect our Lakes, and Working Well programs. The GoA also supported development of the Alberta Water Portal. AAF also provides a variety of print and web-based materials and supported development of the Irrigation Districts Water Quality Data Tool.
■ Develop print- and web-based public information resources on the following topics: watershed management, wetlands, groundwater, and water conservation	Short-term by 2012			The GoA (including AEP, AGS, and AI) also supports Inside Education, Alberta Science Network, etc. that develop and distribute teacher resources. GoA staff respond to requests to give presentations on a number of topics.
■ Develop and support teacher resources and programs on watershed management, wetlands, groundwater, and water conservation	Short-term by 2012			

Actions	Timeframe	Previous Status	Status	Rationale
■ Support and facilitate partnerships on education programs related to watershed management, wetlands, groundwater, and water conservation	Short-term by 2012			
4.2 Enhance the Water Information Centre for accessible web-based public information	Short-term by 2012	Progressing on track	Some progress	There is no one public water data management support and reporting system. Several databases exist. See Water Use Reporting; AER water use performance report for the oil and gas sector; Alberta Water Well Information Database; Alberta Health AEPHIN website for drinking water quality data; AEP Alberta River Basins website; oil sands monitoring; for groundwater, see the GOWN website. The GoA continues to provide the river forecasting function. Also see the Flood Hazard Identification Program and Flood Mitigation and Flood Recovery programs. Maps can be viewed at the Flood Hazard Area Application.
■ Establish a data management support and reporting system integrated with Land-use Framework and cumulative effects information systems	Medium-term by 2015			
■ Complete flood risk maps and warning systems for all communities where a flood risk exists	Long-term by 2019			

Actions	Timeframe	Previous Status	Status	Rationale
4.3 Develop qualified water expertise and apply research findings	Medium-term by 2015	Some progress	Ongoing GoA Business	GoA updated the Water Research and Innovation Strategy in 2014 and has led three open competitions seeking proposals to fund 6 to 9 million dollars of research on key water issues. AEP has 16 watershed scientists and a budget to design monitoring programs and evaluate data. They promote research excellence through co-location with universities and better alignment with academia. GoA agencies have ongoing summer students/intern programs focused on developing skill sets and knowledge. They also support undergraduate/ graduate thesis work and short-term Northern Alberta Institute of Technology practicum students. Some GoA staff are also adjunct professors. Note that Southern Alberta Institute of Technology now has a two-year Integrated Water Management certificate program.
■ Work with Alberta Water Research Institute to identify and resource key expertise in Alberta (e.g., instream flow needs specialists, hydrogeologists)	Short-term by 2012			
■ Apply research findings from the Alberta Water Research Institute and other research partners to support water management decision making	Long-term by 2019			

Actions	Timeframe	Previous Status	Status	Rationale
4.4 Enhance the provincial water monitoring and evaluation program to include information on wetlands, groundwater, aquatic health, and water quality and quantity	Long-term by 2019	Some progress	Some progress	The provincial water monitoring and evaluation program is constantly evolving and provides some information on the components listed. IFNs have not been completed for all major basins; however, the GoA is using tools such as water management frameworks, desktop IFN method, or the Surface Water Allocation Directive to consider IFN in its decision making. AEP has developed a five-year plan for river monitoring, is working on one for lakes, and has improved tributary monitoring. The Alberta Geological Society continues to map and model ground water resources. Effluent monitoring requirements are managed through AEP as well as federal legislation. Alberta Innovates has funded initiatives to improve effluent management (Swirltex project, ACWA initiative).
■ Ensure aquatic health instream flow needs are complete for major basins	Medium-term by 2015			
■ Implement the system for monitoring, evaluation, and reporting on aquatic ecosystems	Medium-term by 2015			
■ Complete mapping and modelling of Alberta's groundwater resources	Long-term by 2019			
■ Implement a long-term water quality and effluent monitoring and evaluation system	Long-term by 2019			
■ Implement a long-term water supply monitoring and evaluation system	Long-term by 2019			

Have we achieved our desired outcomes?

Key Direction: Albertans will have access to the knowledge needed to achieve safe drinking water, healthy aquatic ecosystems, and reliable quality supplies for a sustainable economy.

Water for Life (2003) outcomes for this key direction include the following:

- an understanding by *Water for Life* partners of the state of Alberta's drinking water, aquatic ecosystems, and the quality and quantity of surface and groundwater resources
- easy access to knowledge and information regarding Alberta's water resources and applicable research to make informed water and related air, land, and resource management decisions
- incorporation of education tools and strategies into all *Water for Life* actions

Today, more than ever, there are a multitude of educational resources available to all Albertans to give them the information needed to understand their municipal drinking water or to manage their own private drinking water systems, to understand the many aspects of aquatic ecosystems, and to understand Alberta's system of managing its water supply. *Water for Life* partners and the sectors they represent have access to a growing number of databases and reports that provide details on the state of various components of our watersheds. In turn, *Water for Life* partners are doing an admirable job of producing educational tools and initiatives concerning all aspects of *Water for Life* actions.

However, accessing available information is not always easy; it takes concerted effort to pull it together because the information is diffuse. It is also challenging to vet information generated by multiple sources. Collating and synthesizing information to answer day-to-day management questions is also challenging. Once produced, reports may sit on shelves unused, and despite some advances, it can be challenging to get uptake of this information by stakeholders and decision makers, particularly with successive changes in leadership. These challenges make it difficult to move stakeholders from knowledge to informed action.

Communicators must work hard to emphasize the importance of employing current knowledge and science-based research in the decision-making process. They have to find and synthesize the right information, which can then be used to inform a management action or decision, as seen in the development of

water quality and quantity management frameworks. However, even when the science points to a specific course of action, other factors, such as competing outcomes and multiple priorities, may still affect how or if decision makers use the science. Sometimes, trade-offs are made.

In general, we talk about how research and monitoring will lead to an iterative and adaptive water management system, but, unfortunately, we are not quite there yet.

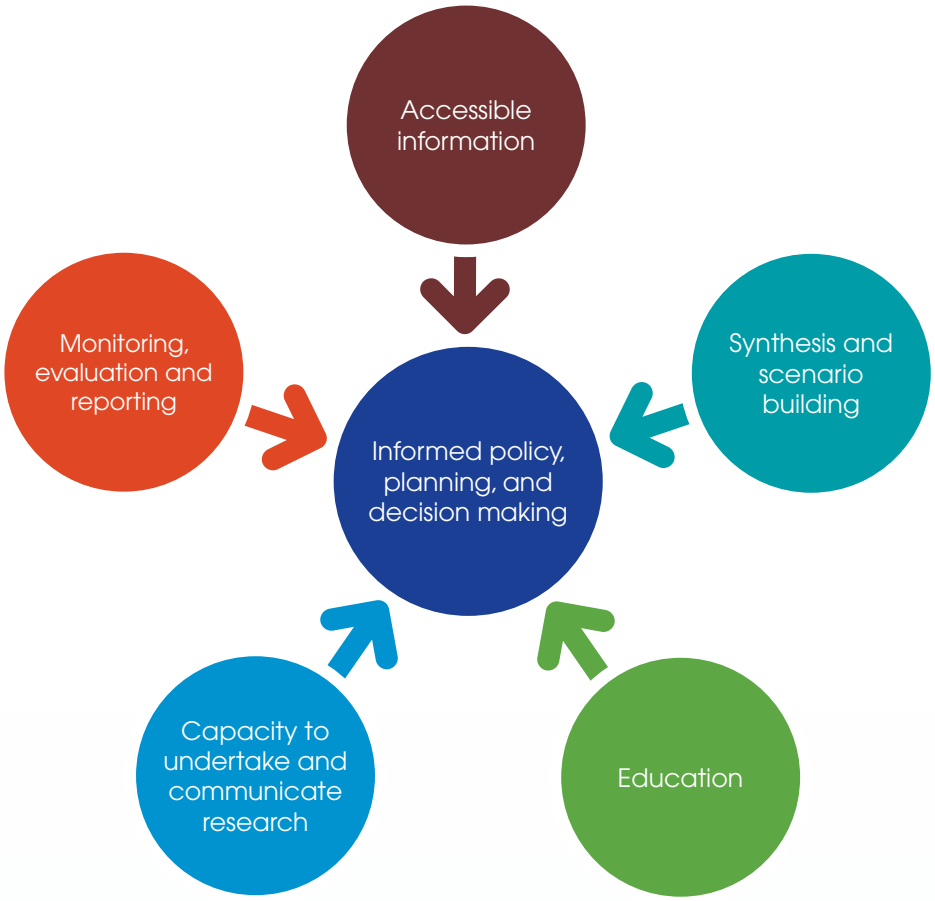


Figure 4: Major Components of Alberta's Water Knowledge and Research System

Where do we need to go next?

To better achieve this outcome, the AWC recommends the following:

Recommendation 12. Education and Outreach: That the GoA continue to work with *Water for Life* partners and other educators to improve the water literacy of Albertans by maintaining the *Water for Life* and Water Channel websites and ensuring they are active, accessible, and user-friendly and provide access to *Water for Life* documents, partners, potential funding sources, water-related programs, citizen science initiatives, etc. (ongoing with periodic updates to the AWC).

Recommendation 13. Knowledge Integration: That the GoA's water education, research, and monitoring and evaluation managers examine how they can better leverage and support each other's work and improve user-friendly communications, reporting to the *Water for Life* partners by 2022 on how their combined efforts and processes support an iterative and adaptive performance-based water and watershed management system.

Wabasca Lake Citizen Science Monitoring Project

The Indigenous Lake Monitoring Program, embedded in the provincial long-term lake monitoring program, began with the North Wabasca Lake Monitoring project — a coordinated effort between AEP and Bigstone Cree Nation (BCN). The goals of the project were to address lack of water quality information for North Wabasca Lake and, where possible, find opportunities to apply traditional ecological knowledge (TEK) to science-based lake monitoring.

Water holds cultural and spiritual importance for Indigenous peoples who regard it as the interconnection among all living beings. Indigenous communities across Alberta have concerns and questions about water quality and quantity in their local rivers, lakes, and wetlands. The North Wabasca Lake Monitoring project filled a gap in scientific data and provided First Nation staff the opportunity to gain technical skills and experience in water monitoring.

The North Wabasca Lake Monitoring Project originated, in part, from community concerns about general water quality degradation and the health of walleye in the lake. Lake water quality, including chemical, physical, and biological measures, was monitored in 2016–17 over the summer (June–September) and winter (February) periods. To better understand the influence of Desmarais (South Wabasca) Lake and Willow River on the water quality of North Wabasca Lake, samples were collected concurrently from the outlet of Desmarais Lake and Willow River upstream of North Wabasca Lake in the July–September (above it is the June–September) period and February. Project highlights include the following:

- North Wabasca Lake receives nitrogen and phosphorus from its nutrient-rich watershed
- The lake is "typical" of other boreal lakes and the degree of eutrophication (nutrient richness) is natural. There does not appear to be any human impacts or disturbances impacting the lake
- Like other eutrophic boreal lakes, the summer phytoplankton community was largely dominated by *Aphanizomenon flos-aquae*, a large, colonial, nitrogen-fixing cyanobacteria. Although toxin-producing cyanobacteria were present, microcystin was detected only at trace levels
- Growths on adult walleye are due to Lymphocystis, a viral disease that affects fish in boreal lakes
- Concentrations of metals (total recoverable) were not significantly or unusually high and did not exceed guidelines for the protection of aquatic life

The lessons learned through this project are to be applied to other lake monitoring efforts in collaboration with Indigenous peoples in Alberta. For more about this project, see the environmental monitoring website.

Partnerships

Where have we been?

Partnerships have been a foundation of *Water for Life* since the strategy was released. The GoA's Enabling Partnerships document (2004) further described three types of collaborations (i.e., the provincial AWC, regional WPACs, and local WSGs). The AWC has also provided partnership guidance through its Shared Governance and Moving from Words to Actions reports. Partnership grants, provided by AEP since the early 2000s, have been a cornerstone of these relationships: municipalities, industry, and non-government organizations have also provided generous funding and in-kind support.

Since 2003, a significant amount of work has been done by the AWC, WPACs, and WSGs to establish their governance and operations as they formed and before undertaking projects. Relationships are key and for the most part, partnerships have good representation from Alberta's water-using sectors, although some gaps remain and some sectors are more engaged than others.

Collectively, the *Water for Life* partnerships have generated a substantial body of work across the province:

- The AWC has used its consensus-based multi-sector platform to examine and make recommendations on more than 20 different areas of provincial water policy (see Table 6a for a list of AWC projects for 2016–2019).
- Most WPACs have completed comprehensive state of the watershed assessments and undertaken water and/or watershed management plans (see Table 6b), with a plethora of technical reports and educational products to support these plans.
- Nearly 150 grassroots WSGs have designed and implemented over 300 education and restoration projects in communities across Alberta[23].

Perhaps unforeseen by *Water for Life*, a WPAC–WSG hybrid partnership has also evolved, with an increasing number of sub-basin and lake groups moving beyond stewardship activities and undertaking comprehensive watershed assessment and planning activities, often working in close tandem with local municipal authorities to embed local watershed management principles into statutory municipal planning activities. Some of these sub-basin and

23 For examples of watershed stewardship projects, see the publication Awareness to Actions (2007) and the Land Stewardship Centre's WSG Grant Program Interactive Map.

lake planning initiatives are strongly supported by the regional WPAC (e.g., the North Saskatchewan Watershed Alliance's support of the municipally led Sturgeon River Watershed Alliance). Others operate independently from WPACs.

Table 6a: Alberta Water Council Projects, 2016 to 2019

Project	Completed	Description
Aquatic Invasive Species Project Team	2016	To enhance the effectiveness of the provincial AIS program, focusing particularly on prevention; increasing public awareness of AIS, targeting high-risk audiences; and supporting AIS-related stakeholder communication networks.
Water Literacy Project Team	2016	Undertaken in parallel with development of the GoA Water Literacy Strategy. The AWC's five recommendations suggest ways in which water literacy can be improved in Alberta.
Water for Life Implementation Review Committee	2016	The AWC completed its 5th review in 2016 and initiated its 6th review in 2019. The multi-stakeholder review focuses on existing and emerging water issues and the effectiveness of the strategy in addressing them.
Lake Watershed Management Project Team	2017	The team engaged experts on a variety of topics including legal aspects, policy issues, and current approaches to lake watershed management.
Evaluation of Water Conservation, Efficiency, and Productivity Plans Project Team	2017	Results in the final report on evaluating water CEP showed that the seven major water-using sectors have substantially improved their water use efficiency and productivity since 2005, meeting the target of a 30 percent improvement set in the original *Water for Life* strategy.
Building Resiliency to Multi-year Drought Improving Resilience to Drought Through Simulation	2019	These two AWC projects aim to facilitate increased the effectiveness drought management in the province of Alberta through public agency education, and a simulation to identify gaps and risks in drought planning.

Project	Completed	Description
Protecting Sources of Drinking Water in Alberta	2019	Review existing source water protection practices in Alberta and other jurisdictions, determine strengths and weaknesses in existing approaches, and highlight best practices.
AWC Annual *Water for Life* partnerships newsletter	Annually	The AWC's annual partnerships newsletter highlights the successes of *Water for Life* partners over the past year and helps to increase awareness of the work being done across Alberta.
Factsheets, videos, etc. Droughts in Alberta video ■ *Water for Life* Implementation Review video ■ Source Water Protection video	As needed	Consistent with its Communication Strategy, the AWC develops materials to provide sectors with the necessary tools to reach a wider audience within each sector. The intent is to showcase key learnings from our recently completed projects. In 2016–2019, three project videos were completed.

Table 6b: Status of Water and Watershed Assessments, Plans, and Frameworks in Alberta as of December 31, 2019

Major basin/ sub-watershed	WPAC	State of report	Water/ watershed management plan	LUF Regional Plan	LUF Water Management Framework	Other water initiatives in the basin
Hay	No WPAC present	State of aquatic knowledge report (Stantec 2016)	None. But see Hay-Zama Wildland Park Management Plan	Lower Peace — not started	None to date	See AB-NWT Bilateral Agreement, 2016 report.
Peace-Slave	Mighty Peace Watershed Alliance	State of the Watershed (2015)	Integrated Watershed Management Plan IWMP 2018	Upper and Lower Peace — not started	None to date	Grimshaw Gravels Aquifer SWP Plan; Wapiti River WMP and SWP plan; Heart River Watershed Restoration Plan; Redwillow Restoration Plan and the AB-NWT Bilateral Agreement
Athabasca	Athabasca Watershed Council	State of report	IWMP initiated in 2019; not yet complete.	Upper Athabasca not started; Lower Athabasca completed 2012	LARP — surface water quality and quantity and groundwater management frameworks	Baptiste and Island Lakes WMP; Lac La Biche WMP renewal started 2019

Major basin/ sub-watershed	WPAC	State of report	Water/ watershed management plan	LUF Regional Plan	LUF Water Management Framework	Other water initiatives in the basin
/Lesser Slave	Lesser Slave Watershed Council	State of (2009)	Lesser Slave River Water Mgmt. Plan 2010; IWMP 2019	Upper Athabasca not started	None to date	
Beaver	Lakeland Industry and Community Association	State of (2013)	Cold Lake-Beaver River Water MP (2006). A Watershed MP was initiated 2018.	Lower Athabasca completed 2012	LARP — surface water quality and quantity and groundwater management frameworks	– a number of lake groups including Moose Lake WMP 2007
North Sask.	North Saskatchewan Watershed Alliance	State of 2005	IWMP 2012	North Sask. Regional Plan — draft in progress	Industrial Heartland WMP	Mayatan, Wabamun, and Wizard lake initiatives; headwaters of Vermilion and Sturgeon sub-basin WMPs; Pigeon, Chain Lakes WMP
/Battle	Battle River Watershed Alliance (includes Sounding Creek basin)	State of 2011	Approved Water MP 2014; 12-part Watershed MP in progress			

Major basin/ sub-watershed	WPAC	State of report	Water/ watershed management plan	LUF Regional Plan	LUF Water Management Framework	Other water initiatives in the basin
South Sask.	The South Sask. river basin is divided into four sub-basins below	Several technical documents for SSRB process	SSRB WMP; see also 10-year review.	Not Applicable	Not Applicable	PPWB transboundary agreement Sylvan Lake MC Ghost River Watershed Alliance Society, Jumpingpound Creek WMP
/Red Deer	Red Deer River Watershed Alliance	State of the watershed 2009	IWMP Phase I complete 2016; phase II started	Red Deer Regional Plan — not started	None to date	
/ Bow	Bow River Basin Council	State of interactive web	WMP 2012	South Sask. Regional Plan — amended 2018	Surface Water Quality Management Framework 2014	
/Oldman	Oldman Watershed Council	State of the watershed 2010	IWMP Goals; Headwaters Action Plan			
/South Sask.	South East Alberta Watershed Alliance	State of the watershed (contact SEAWA)	Next steps IWMP initiated			
Milk	Milk River Watershed Council Canada	State of the watershed 2008; 2013	IWMP 2015			AB-MT Transboundary Agreement

Overall, significant progress has been made in establishing and operationalizing the *Water for Life* partnerships as the actions in Table 6c illustrate.

Table 6c: Status of Water for Life Actions for Partnerships as of December 31, 2019

Actions	Timeframe	Previous Status	Status	Rationale
5.1 Continue to resource and support *Water for Life* partnerships	Long-term by 2019	Progressing on track	Some progress	Multi-year commitments to operating grants have been provided by the GoA to the AWC and WPACs for core operations and some project-specific needs. WSG projects are funded through the Watershed Stewardship Grant program. Dollars are leveraged with other sectors. GoA staff provide expertise for most AWC, WPAC, and WSG projects and boards. GoA has several internal water structures including regional planning teams that should be connecting with air and water partnerships.
■ Work with partners to develop a sustainable funding approach	Short-term by 2012			
■ Establish regional cross-ministry support teams for watershed and regional planning	Short-term by 2012			

Actions	Timeframe	Previous Status	Status	Rationale
5.2 Integrate watershed management with the Government of Alberta's Land-use Framework regional planning and cumulative effects management system	Long-term by 2019	Progressing on track	Ongoing GoA Business	The Framework for Water Management Planning provides general guidance. A watershed management planning guide was released in 2015. Additionally, a state of the watershed guide was produced. *The Guide to Reporting on Common Indicators Used in State of the Watershed Reports* was created in 2012. State of the watershed reports are being looked at by AEP to better understand the data and information needs of *Water for Life* partners. Water and watershed plans inform regional and municipal planning. Several groups are looking at how to better integrate water into municipal and regional land use and how to improve performance-driven management. Legislation, such as the MGA, has been updated to support regional planning and municipal alignment.
■ Develop a watershed management planning framework and a guidebook for implementation	Short-term by 2012			
■ Review and update legislation as required	Long-term by 2019			
■ Develop core indicators and reporting tools for watershed and regional planning	Short-term by 2012			
5.3 Establish Watershed Planning and Advisory Councils for the Athabasca and Peace watersheds	Short-term by 2012	Complete	Complete	The Athabasca Watershed Council was established in 2009, and the Mighty Peace Watershed Alliance was established in 2011.

Actions	Timeframe	Previous Status	Status	Rationale
5.4 Develop watershed management plans for the Milk, Oldman, South Saskatchewan, Bow, Red Deer, North Saskatchewan, Battle, Cold Lake-Beaver, and Lesser Slave Lake	Medium-term by 2015	Progressing on track	Some progress	WPAC watershed plans are in various stages of development and implementation. Where they exist, they may inform other levels of municipal and regional planning.
■ Integrate priority water management frameworks into watershed management plans (e.g., Industrial Heartland and mineable oil sands)	Medium-term by 2015			
5.5 Complete and implement watershed management plans for all major watersheds	Long-term by 2019	Progressing on track	Some progress	Nine of eleven WPACs have a water or watershed management plan in place (although some are still working on various phases of their plans). Athabasca and South East Alberta Watershed Alliance have initiated some work in this area. Also, note that some WPACs have contributed advice to regional planning initiatives and the development of water management frameworks. No overall assessment of watershed planning has been conducted.
■ Assess the effectiveness of watershed management planning system achieving desired outcomes	Long-term by 2019			

Actions	Timeframe	Previous Status	Status	Rationale
5.6 Complete transboundary bilateral agreements with neighbouring jurisdictions	Short-term by 2012	Progressing on track	Some progress	In 2008, Alberta members of a Montana-Alberta Joint Initiative Team were appointed. This team worked from 2009 to 2012 on modelling over 300 scenarios to improve the access to the shares of water of the St. Mary and Milk rivers as set in the 1909 Boundary Waters Treaty. A series of reports documenting this work were completed in 2009, and a joint recommendations report was submitted to the Governor of Montana and Alberta Premier in 2016. Note that Montana experienced a significant infrastructure failure in 2020 that affected Milk River watershed flows throughout the summer. The AB-NWT Bilateral Agreement is complete. British Columbia and Saskatchewan agreements are in discussion through the Mackenzie River Basin Board process.
■ Montana regarding the water of the St. Mary and the Milk River	Short-term by 2012			
■ British Columbia, Saskatchewan, and the Northwest Territories, as part of the Mackenzie River Basin Transboundary Waters Master Agreement	Short-term by 2012			

Have we achieved our desired outcomes?

Key Direction: *Water for Life* partnerships are empowered, informed, and fully engaged in watershed stewardship.

Water for Life (2003) outcomes for this key direction include the following:

- timely and strategic advice given to governments, industry, and non-government organizations by the AWC
- maintaining WPACs as leaders in watershed assessment and planning
- continued work by WSGs to take community-level action to safeguard Alberta's water resources

Although they vary in areas of focus and approach to issues, in general, *Water for Life* partnerships are working well to leverage resources and generate consensus-based multi-sector policy advice, information about our watersheds, stewardship action, and public knowledge through education and outreach. However, some challenges still exist, specifically around capacity, representation, and effective and timely watershed assessment and planning. The AWC is provided core funding support by the GoA (its primary client for policy advice) with additional support from the 23 sectors that sit at the table (who provide in-kind support by participating and financial support for projects relevant to their sectors).

WSGs have successfully leveraged (by four to five times) $2 million provided by the GoA and administered as small grants through the Watershed Stewardship Grant program administered by the Land Stewardship Centre. The stewardship movement has also been greatly enhanced by dollars and support flowing through land stewardship programs, such as ALUS Canada, Living by Water, and the Green Acreages program. Although they are all different, WPACs have also had success at leveraging core GoA funding; however, capacity is still an issue that hampers WPACs being "empowered," particularly for undertaking technical work such as state of the watershed assessments and watershed management plans.

Funding and in-kind support is often tied to the representatives at the table, who must feel that they are receiving some benefit from participating. The AWC has 23 sectors that are well engaged and participating at both the board and project team levels. WSGs engage a variety of stakeholders and, increasingly, local municipalities, provincial government departments, industry,

and academia. Representation on WPACs varies, with some gaps in active sector engagement. All three partnerships are challenged to engage Indigenous communities in their work.

Overall, the AWC has been successful in developing timely and strategic policy advice (although it is not always heeded); WSGs can point to on-the-ground improvements; and WPACs have been successful in numerous educational initiatives and in commissioning significant technical reports that improve our understanding of various aspects of watershed health. Additionally, several guidance documents have been developed to improve water and watershed management planning, watershed state of assessment, and the use of performance indicators[24]. Guidance is also facilitated by GoA planners and other technical experts participating in WPAC and WSG assessment and planning initiatives. However, planning approaches — and the plans themselves — are quite different from basin to basin and in how they address different issues. Although the system is growing, we do not yet have, from an adaptive management perspective, a robust system of iterative and adaptive assessment, planning, plan implementation, monitoring, and re-assessment across the province.

Grant programs, such as the Watershed Resilience and Restoration Program, have played a role in addressing capacity limitations by moving pieces of technical work forward, that, in turn, inform plan development and implementation. However, some WPACs are still challenged to develop watershed management plans that, in turn, inform land-use planning at the regional scale. There are, however, several good examples of municipal plans that are incorporating watershed principles from WPAC and smaller sub-basin and lake planning initiatives that should then benefit aquatic ecosystems in these jurisdictions[25]. Many municipal councils have also provided support for, and endorsement of, WPAC watershed management plans where they have been developed.

There are also several good examples of WPACs providing an important service to the GoA by bringing together stakeholders and developing consensus-based multi-sector regional policy advice, as seen by the work of the southern

24 See Alberta Environment and Parks' Watershed Resources webpage.

25 For a good example of a municipal document that incorporates watershed principles, see Parkland County IDP with the Summer Village of Betula Beach.

WPACs who provided input to the South Saskatchewan Regional Plan and who undertook a review of the SSRB WMP[26]. Some WPACs have also provided input to the GoA on transboundary water issues. WPACs can also form new partnerships with groups and individuals that traditionally have opposing views. This ability to be a regional convenor should not be overlooked.

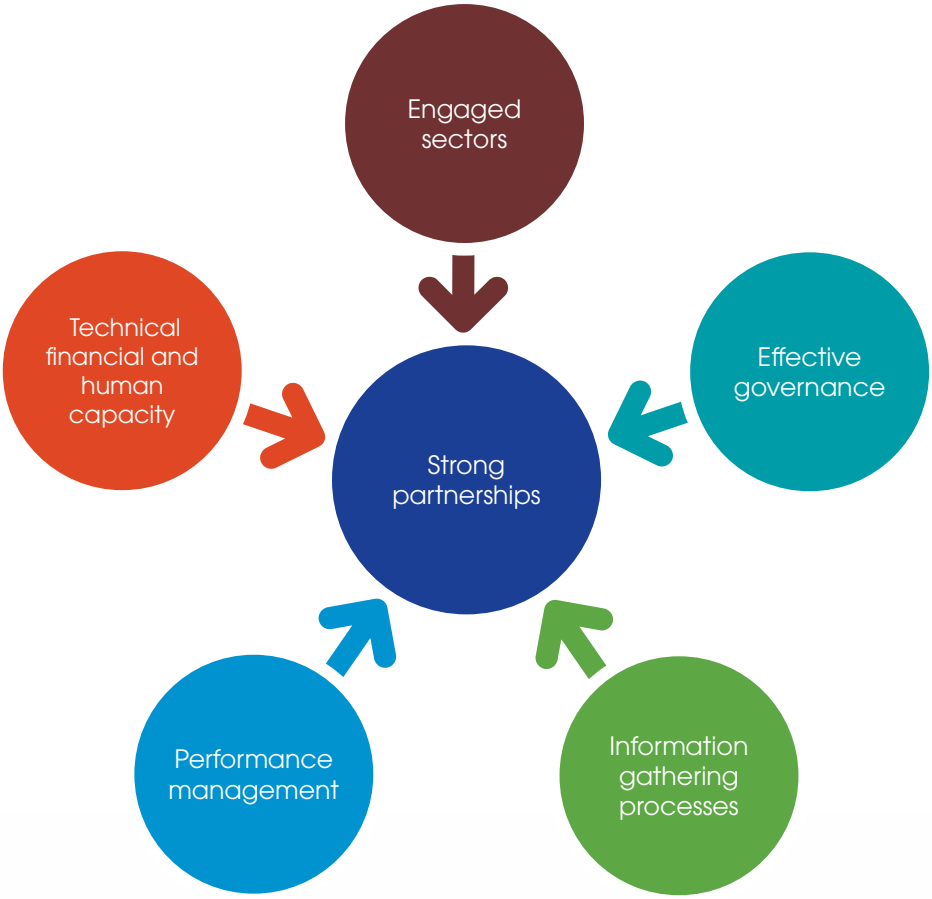


Figure 5: Major Components of Alberta's Water for Life Partnerships System

26 The SSRB WMP, on the occasion of its 10th anniversary, was reviewed (2019) by the Red Deer, Bow, Oldman, and South Saskatchewan WPACs. Find their report here.

Where do we need to go next?

To achieve the outcome that *Water for Life* partnerships are successful, the AWC makes the following recommendation:

> **Recommendation 14. Partnerships Review:** That the AWC strike a project team to examine how the *Water for Life* partnership framework can be improved to contribute more effectively to water and watershed management in Alberta (with team work completed by 2022).

A project team might consider the following additional points:

GoA Participation: There are four seats on the AWC Board of Directors for GoA and Provincial Authorities (Environment and Parks, Agriculture and Forestry, Health, and Alberta Innovates) and at least one GoA representative on each WPAC. Additionally, GoA technical staff often support WSG initiatives. Other sectors look to GoA staff to represent or speak on behalf of all of GoA — no small challenge. Hence, we need to consider how the GoA can strengthen its internal communication processes for supporting their representatives on *Water for Life* partnerships so that the information flow between the entire GoA and the *Water for Life* partnerships is improved. In particular, GoA and *Water for Life* partnerships need to work together to provide more clarity about the current process for how advice and watershed assessment and plans (i.e., at multiple scales including watershed, sub-basin, and lake) is received and used by GoA in policy development, regional, and municipal planning, regulatory activities, and other decision-making processes.

Sector Representation and Engagement: As well-informed, cross-sections of society, the AWC, WPACs, and WSGs can provide best in-class advice and water expertise to the GoA, municipal governments, industry, and others. To provide well-rounded consensus advice, *Water for Life* partnerships must be inclusive and have meaningful sector engagement and participation. To improve sector representation on partnerships, the AWC could work with WPACs and WSGs to share success stories, assess current board make-up and sector participation, identify gaps and barriers to involvement, and develop and implement a plan to address such gaps. The AWC and WPACs might also look to strengthen connections with other partnerships, such as the Agri-Environmental Partnership of Alberta, FNTSAG, and municipalities. Additionally, the AWC and WPACs must work to find ways to engage Indigenous communities to better understand their perspectives and traditional knowledge. They must also

continue to help sectors that are diffuse and challenged to provide a single-sector voice at the consensus table. Note, however, there may not be a one-size-fits-all strategy as each board is different with different needs.

WPAC and WSG Collaboration: WPACs are working together to amplify their voice, stretch limited resources, share learnings, avoid duplication, etc. Similarly, WPACs are providing greater support to WSGs in their region, which in turn, might bring more support for WPACs. For example, the BRBC has supported more than 30 stewardship and environmental groups with approximately $2.3 million in direct funding. They also have a stewardship committee and dedicate at least one quarterly forum every year to stewardship. Developing strategies for building on this success is something all partners can contribute to.

Capacity: Stable, reliable long-term funding for the AWC, WPACs, and WSGs is a foundational requirement for success. Progress can be hampered by uncertainty, timing of funds, and reductions in grants. *Water for Life* partners have had some success despite these challenges, particularly in soliciting in-kind support, municipal per capita annual contributions, and grants through federal and provincial research, and environmental damages funds. Recent efforts to move to multi-year funding have alleviated some issues. Going forward, *Water for Life* partnerships, including their GoA representatives, need to work with partners to solidify both GoA and other sources of funding, including consideration of other government-based revenue sources earmarked for water and watershed management.

Watershed Planning: The GoA and WPACs need to work together to improve the iterative and adaptive process, such that robust watershed assessments (supported by robust monitoring) and management plans are developed at the appropriate scale (i.e., watershed, sub-basin, lake watershed, and aquifer) to address the issues identified by stakeholders. This collaboration might be achieved by improving the GoA Guide to Watershed Management Planning in Alberta by:

- developing a more detailed implementation toolkit to accompany the guide
- providing a workshop to reinforce guide content particularly for new staff and board members and to share lessons learned

- providing more information and training on how to carry out public, Indigenous, municipal, and other sector engagement
- providing state of the watershed and watershed management plan outlines with minimum requirements: individual WPACs can elaborate beyond the outline, but these should be required to meet at least the minimum to improve quality control and make reports comparable year after year

Governance, Land and Watershed Plan Integration: Currently, watershed assessments and management plans provide advice, and their implementation is voluntary. This advice is generally directed to the provincial and municipal governments with the responsibility for legislated regional and municipal planning and regulatory processes that, in turn, support the achievement of the three goals of *Water for Life*. Watershed plans can also inform industry planning and operations. While there is a growing number of examples of watershed objectives informing and being embedded into municipal and regional land-use planning and decision making, we can improve this integration of water and land use, thereby improving adaptive management of cumulative effects, by:

- ensuring watershed plans and objectives complement and feed into regional land-use plans and the development of water quality and quantity management frameworks
- focusing not just on main stem rivers but also on small tributaries and lakes by supporting the development of sub-basin and lake watershed management plans
- understanding how land-use tools (e.g., Land Footprint Management Plans, municipal districting, development setbacks, environmental reserves) can be used to manage water issues (e.g., the impact of non-point source pollution on receiving waterbodies)
- considering a model that would see watershed management plans considered by provincial and municipal land-use decision makers when they are reviewing and approving applications for land-use approvals on both public and private lands

Monitoring and Assessment: To carry out effective watershed management, WPACs need a dedicated data collection process (i.e., a formal relationship with AEP to communicate needs and exchange information). They also need access to academics and other subject matter experts, as well as geo-spatial and mapping experts, who do not provide help as a side-of-desk task but who are identified and assigned to work with WPACs. This support, along with financial help, will help WPACs develop effective products. We can also build on the *Guide to Reporting on Common Indicators Used in the State of the Watershed Report* to include more detailed information so that results can be compared between groups (GoA and other WPACs). This information should include best practices, techniques, and considerations for determining how and where samples and results should be sent and interpreted. There also should be a section on social science qualitative techniques that can be used in community engagement forums.

Wapiti River Water Management Plan

The Wapiti River, with the highest concentration and diversity of water withdrawals and wastewater discharge, is the most impacted sub-watershed within the larger Peace River watershed. Communities in the Wapiti River basin have expressed concerns about water use from the river, particularly about diversions during winter low-flow periods and the potential negative impacts to the aquatic environment. In response, a steering committee of local stakeholders was formed with representatives from affected municipalities, industry, non-government organizations, and Government of Alberta. The steering committee has engaged with the public, stakeholders, Indigenous communities, and organizations, which led to the creation of the draft Wapiti River Water Management Plan and the suggestion of a water conservation objective as follows:

- when natural flow in the Wapiti River below Big Mountain Creek is above 20 m^3/s: net water use up to 2 m^3/s is allowed in Wapiti River Basin
- when natural flow in the Wapiti River below Big Mountain Creek is between 10 m^3/s and 20 m^3/s: net water use of up to 1 m^3/s is allowed in Wapiti River Basin
- when natural flow in the Wapiti River below Big Mountain Creek is less than 10 m^3/s: net water use of up to 8 percent of natural flows is allowed in Wapiti River Basin

The plan provides guidance and recommendations on balancing the needs of municipal water supply, industry uses, agriculture and other uses, while ensuring a healthy aquatic ecosystem in the Alberta portion of the Wapiti River basin. This draft plan is now in the final phase of public and Indigenous engagement. Following this final phase of engagement, a final plan will be provided as a recommendation to Alberta Environment and Parks and, if adopted, will form policy for water licensing in the Wapiti River basin.

The steering committee has recommended that this plan's implementation be reviewed every five years and that the water conservation objective is reviewed every ten years. It is also recommended that a source water protection plan be completed for the Wapiti River basin and that an assessment of flow, water quality, riparian health, aquatic habitat use be performed as well as a risk assessment for the area. For more information, see the Steering Committee's report summary or the AEP Public Engagement webpage.

Water Conservation

Where have we been?

Water conservation has been of primary importance to the region and its people, since the first homesteaders arrived on the Prairies. When *Water for Life* was released in 2003, the province had just emerged from a multi-year drought, and water conservation was top of mind. Therefore, the *Water for Life* strategy called for a 30 percent water conservation target from 2005 levels, by 2015.

To achieve this goal, one of the earliest AWC project teams was struck to define what was meant by "conservation" and to determine how we would go about measuring it. To date, four AWC project teams have contributed to work in this area. Through a multi-stakeholder process, sectors agreed to develop water conservation, efficiency and productivity (CEP) plans that in turn contribute to this *Water for Life* key direction. While sectors voluntarily adhered to the AWC's CEP process to develop, implement, and report on their respective plans, each plan is unique and reflects the circumstances of individual sectors. The AWC's most recent water CEP project was undertaken to 1) evaluate and report on the contributions of Alberta's water-using sectors CEP goals, and 2) assess and recommend improvements to the AWC CEP process that was followed to support this work. Key successes of the CEP process include the following:

- Alberta's seven major water-using sectors[27] improved water use efficiency and productivity by 32 percent over the reporting period, exceeding the *Water for Life* target of 30 percent
- Overall, there was a 25 percent reduction in net water use over the reporting period
- Participating sectors achieved CEP desired outcomes
- Most sectors achieved their individual targets
- Most sectors increased their production output over the reporting period
- Important perspectives were brought forward that were not considered previously

27 Alberta's seven major water-using sectors are Irrigation, Urban Municipalities, Upstream Oil and Gas, Downstream Petroleum, Forestry, Power Generation, and Chemical. To learn more about these sectors, see the AWC's Water Conservation, Efficiency, and Productivity project webpage.

To keep building on the CEP foundation created through the AWC process, four recommendations emerged from the last project team, as follows:

1. Major water-using sectors continue reporting CEP trends and progress through the AWC at five-year intervals.
2. Major water-using sectors continue working with the GoA to resolve existing challenges with the Water Use Reporting System to improve data collection, management and reporting tools to track CEP trends and report progress.
3. Major water-using sectors raise their members' awareness of the responsibility to report their water use and encourage reporting where appropriate.
4. The GoA continue working to make the Alberta Water Use Reporting System publicly accessible.

As an important component of water conservation, water reuse has also been a topic of discussion for some time. The AWC's 2014 Water Reuse Symposium brought together water-using sectors and others to share water reuse knowledge, challenges, and solutions to inform development of a water reuse policy for Alberta. A water reuse and stormwater use guidebook has been drafted and reviewed by external stakeholders and is currently at the approval stage with AEP. The public release of this work is keenly anticipated by *Water for Life* partners. This key direction is still important to Albertans and much has been achieved as the list of actions in Table 7 illustrate.

Table 7: Status of Water for Life Actions for Water Conservation as of December 31, 2019

Actions	Timeframe	2015	2019	Rationale
6.1 Develop tools to integrate environmental, economic, and social values into water management decision making	Medium-term by 2015	Some progress	Some progress	The GoA uses a water allocation operational decision-support tool in southern Alberta (e.g., Water Resource Management Model) to optimize water management, but it does not include social and economic values. Alberta WaterSmart and ALCES have used the "Oasis" model to inform water management in the Athabasca River Basin project that included social, economic, and environmental values. Both models optimize water use but do not necessarily incorporate economic valuations into models. Some theoretical work has been done on ecological goods and services (EGS): for example, see Gillian Kerr's thesis on market based instruments and Kerr et al. Wetland Ecosystem Services pilot, Work of the Natural Capital Lab, and the reverse auction project of the Alberta Land Institute. Note, however, while no comprehensive EGS policy framework or market exists, there are several

Actions	Timeframe	2015	2019	Rationale
■ Develop a policy framework for ecosystem service markets with the Alberta Institute for Agriculture, Forestry, and the Environment	Short-term by 2012			municipal level programs providing EGS payments to landowners, including the ALUS Canada program, Green Acreages program, Clear Water Land Care program, Canadian Agricultural Partnership program, and the Alberta Environmental Farm Plan. Also, see AUMA's work on economic and financial tools for municipal water managers.
■ Implement a market-based ecosystem services incentive program	Medium-term by 2015			
■ Integrate economic instruments and full cost accounting tools into priority water policy and planning initiatives	Medium-term by 2015			

Actions	Timeframe	2015	2019	Rationale
6.2 Develop and implement an enhanced education program to encourage water conservation	Short-term by 2012	Currently being re-evaluated	Ongoing GoA business	AEP developed education and outreach programs to promote water conservation. The AWC hosted the Water Reuse Symposium in 2014. Most municipalities have water conservation information available for their ratepayers. (e.g., City of St. Albert Water Conservation webpage). Some municipalities offer incentive programs for water-efficient fixtures. See the work of AUMA for municipalities. Water recycling requirements have been developed for in situ oil sands operations. Examples exist of reusing effluent for hydraulic fracturing to encourage water conservation. The GoA's Water Conservation and Allocation Policy 2006 is being updated and encourages the use of alternate water sources. See AER's Area Based Play pilot for water use in the County of Greenview.
■ Engage Albertans in water conservation activities through education and outreach programs	Short-term by 2012			
■ Develop information and education resources to help Albertans understand the uses of water in Alberta and opportunities for conservation	Short-term by 2012			

Actions	Timeframe	2015	2019	Rationale
6.3 Work with key water sectors to:		Progressing on track	Ongoing GoA business	See the work of the AWC CEP teams: CEP plans have been produced and implemented by Alberta's seven major water-using sectors. Additionally, ongoing monitoring and reporting are occurring.
■ Develop Conservation, Efficiency, and Productivity Plans	Short-term by 2012			
■ Implement CEP Plans	Medium-term by 2015			
■ Establish an ongoing monitoring program to ensure all sectors are achieving water CEP outcomes	Long-term by 2019			

Have we achieved our desired outcomes?

Key Direction: All sectors understand how their behaviours impact water quality, quantity, and the health of aquatic ecosystems, adopt a "water conservation ethic," and take action.

Water for Life (2003) outcomes for this key direction include the following:

- Demonstration in all sectors of best management practices, ensuring overall efficiency and productivity of water use in Alberta improves by 30 percent from 2005 levels by 2015. This will occur when:
  - demand for water is reduced
  - water use efficiency and productivity are increased

Water conservation, efficiency, and productivity has been a major focus of *Water for Life* and the AWC for the past decade with significant investment and progress made by the seven major water-using sectors in the province. These sectors continue to focus on improvements in a number of areas (e.g., implementation improvement, best available technologies, economic feasibility, a framework for water/effluent reuse and recycling, incentives, sharing success stories and lessons learned, and examining other jurisdictions).

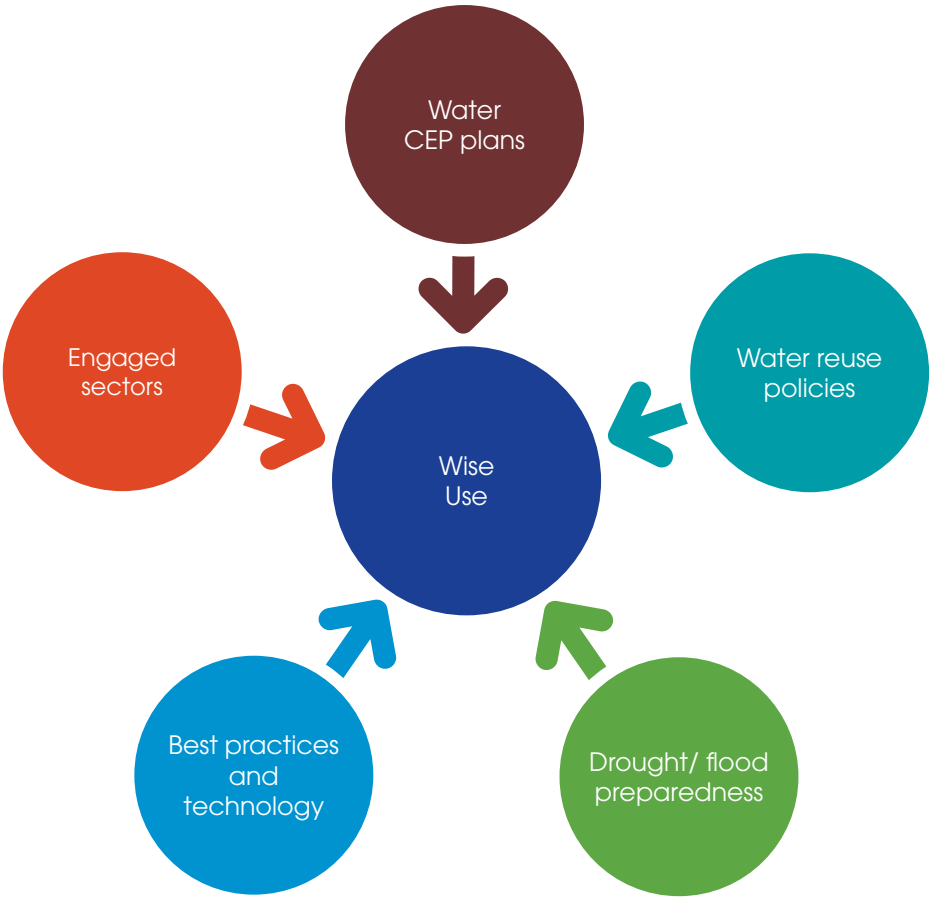


Figure 6: Major Components of Alberta's Water Conservation Management System

Where do we need to go next?

We face several challenges in realizing this goal including the following:

- Water CEP work is aimed at improving the efficient use of allocated water, but savings made are not necessarily tied to the protection of critical aquatic ecosystems (i.e., they can be re-allocated)
- further water CEP will require large investments of financial and human resources (i.e., we have already invested heavily in the easy wins)
- development and population growth may continue to stress supplies in water short periods

Work in this area should continue to build on the good start made to date under this key direction. Hence, the AWC recommends that the AWC continue to support a Water CEP Project Team. Based on the last CEP team's recommendation, the major water-using sectors are scheduled to convene in 2022–2023 to discuss their progress to date (reporting on the parameters they previously set as a baseline) and share learnings, challenges, and opportunities.

Recommendation 15. Advancing CEP: That the AWC continue to provide the forum for advancing voluntary water conservation, efficiency, and productivity (CEP) through the work of the Water CEP Project Team, as needed (ongoing).

Conclusion

In the 18 years since the *Water for Life* strategy was released, the GoA and its partners have continued to implement it, incorporating many of the strategy's actions into the everyday business of managing a comprehensive water management system that addresses social, environmental, and economic needs across Alberta. During this time, the province has also experienced a number of events (e.g., floods, fires, population growth) that have tested this management system and found it to be resilient in challenging times.

Over this period, a wide range of tools, collaborations, processes, and initiatives have been put in place, providing a foundation that hopefully will continue to meet the needs of all Albertans. While toolbox contents may change from time to time, the goals and outcomes of *Water for Life* remain valid and relevant to all water-using sectors.

The AWC's mandate to periodically review *Water for Life* implementation progress will ensure ongoing improvement and adaptation to new issues, as they arise. These improvements and adaptations will, in turn, ensure that Alberta's water management system is well prepared for any event and any challenge, now and in the future.

Glossary

Adaptive management	The *Water for Life* strategy and its supporting documents describe an approach to managing watersheds that uses adaptive management: that is, a systematic process for continually improving management policies and practices by learning from the outcomes of previously employed policies and practices. This approach often relies on using performance measures to assess past and present performance (i.e., it is performance-based). It is also usually "iterative," in that it is never finished, but instead creates an ongoing cycle of repeated assessment, planning, monitoring, and re-assessing.
Cumulative effects	Generally, changes to the environment caused by the combined impact of past, present, and future human activities and natural processes.
Green infrastructure	Generally, refers to the use of natural assets (soils, vegetation, slope, wetlands, etc.) versus built infrastructure to manage storm and wastewaters, often while providing additional social economic benefits such as green space and cost savings.
Regional	Used in this document generically to mean at a large, landscape level as opposed to a smaller local level. If used to refer to GoA regional land-use planning, this will be clearly stated.
Source water protection planning	Source water protection plans are meant to be a tool to help users identify upstream risks to their drinking water source. As such, they are voluntary and advisory in nature.
Sustainable economy	The *Water for Life* strategy identified the need to manage water to support economic needs but it did not identify what it meant by "reliable supplies for a sustainable economy." Hence, this report recommends that work be done to define this term in the specific context of Alberta's future water supply and demand management.
Water managers	Anyone engaged in managing water in Alberta.
Water for Life partners	A casual term usually meant to describe the partnerships described in the Enabling Partnerships document (GoA, AWC, WPACs, and WSGs) but can also include various sectors and other experts and institutions involved in water management in Alberta.

Appendix A. Committee Members and Acknowledgements

The Alberta Water Council acknowledges the contributions of the following committee members who volunteered their time and expertise on this project, and the organizations they are affiliated with:

Committee Members:	Representing:
Brian Deheer	Environmental
Dörte Köster	Lake Environmental Conservation
Jason Unger	Environmental
Joey Hurley	Alberta Environment and Parks
Judy Stewart	Lake Environmental Conservation
Kristen Lorenz	Alberta Agriculture and Forestry
Margo Redelback	Irrigation
Morris Nesdole	Watershed Planning and Advisory Councils
Nancy Stalker	Large Urban
Pat Marriott	Alberta Energy Regulator
Paul McLauchlin	Rural Municipalities
Richard Phillips	Irrigation
Lauren Hall	Alberta Water Council
Petra Rowell	Alberta Water Council
Thorsten Hebben	Alberta Environment and Parks
Karen Young	Alberta Environment and Parks
Cara McInnis	Alberta Water Council

Corresponding Members:	
Keith Murray	Forestry
Holly Johnson-Rattlesnake	Samson Cree Nation

Acknowledgements:

The *Water for Life* Implementation Review Committee would like to thank participants who completed the sector survey, GoA staff who participated in a series of roundtables, and WPAC managers who met with AWC project managers. We also thank those individuals who provided information to the committee and those who reviewed successive drafts of the report. Finally, we thank the AWC for the opportunity to be a part of this important work.

Appendix B. *Water for Life* Implementation Review Committee Terms of Reference

Approved by the Alberta Water Council on June 17, 2008. Revisions approved June 25, 2019.

Context

This standing committee was established to assess and report on behalf of the Alberta Water Council, the progress that is occurring with respect to the implementation of the *Water for Life* strategy. The review reports provide feedback and recommendations to the Government of Alberta and other stakeholders, and thus assist the Council in achieving an important component of its mandate. The committee will operate in a manner that is consistent with the rules, policies and procedures adopted by the Alberta Water Council, including the use of consensus to make decisions in a multi-stakeholder process.

Goal

Objectively review progress being made with respect to implementation of the *Water for Life* strategy and release periodic reports containing the findings of the reviews.

Objectives

1. Review and assess the status, effectiveness, and progress of implementation of the *Water for Life* strategy.
2. Identify opportunities and provide advice and recommendations based on this assessment.

Key Tasks

1. Develop a process, budget, and timeline for producing periodic review reports, to be approved by the AWC Board.
2. Oversee the drafting of the review reports, including the development of advice and recommendations on implementation progress.

Membership

Membership on the committee includes at least two, but not more than three, members from each of the four broad categories on the AWC Board:

- Industry
- Non-Government Organizations
- Government of Alberta and Provincial Authorities
- Government

To ensure continuity, members are encouraged to remain on the committee for at least two reporting periods.

ALBERTA WATER COUNCIL

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