

Review  
of the Implementation of the  
Approved Water Management Plan  
for the  
South Saskatchewan River Basin

A Report to the Government of Alberta

Prepared by:  
Basin Advisory Committees for the  
Bow River, Oldman River, Red Deer River and  
South Saskatchewan (sub-basin) River

---

October 2018

## Acknowledgements

This project's success and credibility is directly attributable to the commitment and contributions of the volunteer Basin Advisory Committee (BAC) members and support team, all of whom brought their extensive knowledge and expertise to each step of the process. Their considered review of information, and the lively discussions that ensued, was throughout grounded in collaboration and openness. The dedication of BAC members and the support team was exemplary.

Alberta Environment and Parks staff provided exceptional support in delivering available data, as well as assistance in data analysis, answering questions and providing additional information to support BAC discussions. Brian Hills, in particular, committed significant time and effort to the project, helping ensure the discussions were as informed as possible.

The Data Analysis Package prepared by WaterSMART Solutions provided a solid information base from which to work, helping to guide and maintain focus on the project's intent and deliverables. Andrea Czarnecki, through no small effort, collected, collated, and synthesized the information generated through the project, distilling it into a concise, thoughtful and organized report.

## Executive Summary

Water management in southern Alberta saw some significant changes in 2006 with the approval of the Water Management Plan for the South Saskatchewan River Basin (the Plan). The Plan recognized and accepted that limits for water allocations had been reached or exceeded in the Bow, Oldman and South Saskatchewan River sub-basins and that the limit of the water resource in the Red Deer River sub-basin will be reached. This recognition, along with the intent to set a path forward towards a sustainable environment and economy, provided the backdrop to the Plan's key recommendations, including: authorizing water allocation transfers; establishing water conservation objectives; closing the Bow, Oldman and South Saskatchewan River sub-basins to any new applications; and an initial total allocation target for the Red Deer sub-basin.

Implementation of the Plan has been steadily underway. With new pressures, science and interests (e.g., growth planning, stormwater use and re-use, and watershed health), Watershed Planning and Advisory Councils (WPACs) identified the need to reconvene Basin Advisory Committees (BACs) to review the implementation of the Plan, identify emerging themes (along with related challenges and opportunities) and offer suggestions for next steps.

The BAC's focused their discussions on specific recommendations in the Plan:

- The limit on water allocation from the Bow, Oldman and South Saskatchewan River sub-basins
- Future water allocation limit in the Red Deer River sub-basin
- Recommended Water Conservation Objectives (WCOs)
- Establishment of an Interbasin Water Coordinating Committee (IWCC)
- Use of water allocation transfers, water conservation holdbacks, and matters and factors that must be considered when making decisions in the newly-created water market
- Water management strategies

The review confirmed that many of the Plan's recommendations have been implemented. However, BAC discussions also revealed that some of the Plan's more complex and open-ended aspects require a more in-depth review. Emerging themes became apparent, including:

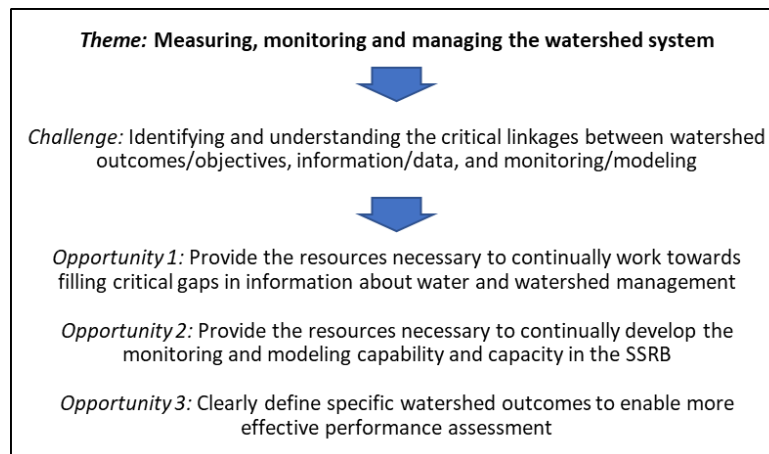
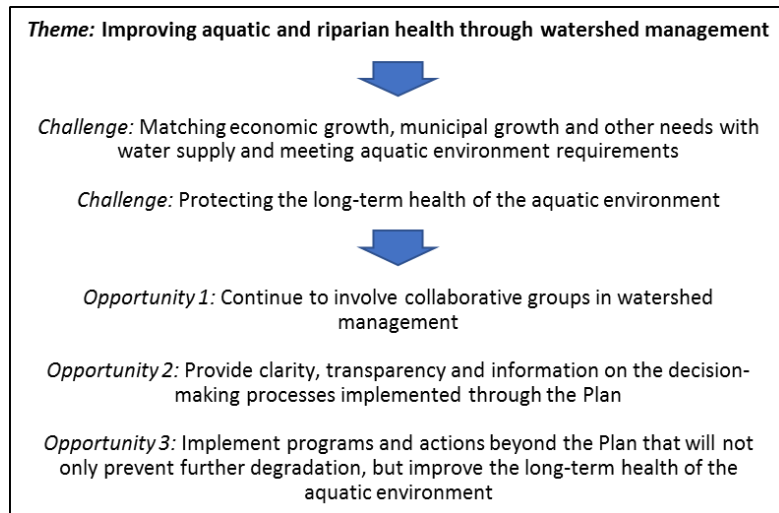
- The Plan recommendations (WCOs, holdbacks and allocation limit) were intended to reduce the risk of further degradation of the aquatic environment, and some gains in conservation have been made. More needs to be done, however, to restore and protect the long-term health of the aquatic and riparian environment, with particular attention to the implications of changing water pattern use through allocation transfers on the tributaries. As part of this, water supply for economic growth, municipal growth and other needs will need to be matched with aquatic environment requirements.
- The ability to properly assess plans and policies requires long-term resource commitments to data collection and exchange, monitoring, modeling, evaluation, and definition of specific watershed outcomes. Moreover, data collection and exchange, monitoring, modeling and evaluation must link to a cumulative effects management approach.

With the intent to inform and improve water management in the South Saskatchewan River Basin (SSRB), the BACs identified many opportunities for all stakeholders, including:

- Continue to involve collaborative groups in watershed management.
- Provide clarity, transparency and information on the decision-making processes implemented through the Plan.

- Implement programs and actions beyond the Plan that will not only prevent further degradation of the aquatic environment, but improve its long-term health. This includes continuing to implement the strategies and actions identified in the South Saskatchewan Regional Plan for advancing watershed management.
- Provide the resources necessary to continually work towards identifying and filling critical gaps in information (e.g., watershed carrying capacity).
- Provide the resources necessary to continually develop and update the monitoring and modeling capability and capacity in the SSRB.
- Define specific watershed outcomes to enable more effective performance assessment.

The themes, challenges and opportunities are summarized as follows:



This review has resulted not only in key findings, but strengthened basin-wide relationships and a shared understanding of the challenges and opportunities at both the sub-basin and SSRB levels. To maintain this momentum - and leverage the groundwork that the four sub-basin BACs have established - next steps were identified. Key next steps include:

- Continue to involve collaborative groups in watershed planning.
- Revitalize the IWCC by augmenting its purpose and role through the development of an updated Terms of Reference.
- Conduct a case study for applying the Matters and Factors in the Plan as an opportunity for basin stakeholders to gain insights on how Matters and Factors are applied in an “indicator” sub-basin.
- Provide clarity on how Alberta Environment and Parks (AEP) and Alberta Energy Regulator (AER) approval agency processes are reconciled to achieve similar desired outcomes. This will help towards process transparency and assuring consistency in protecting water supply and aquatic ecosystems.
- AEP to utilize WPACs as an informed and effective resource to prioritize, identify and trial communication pieces that provide clarity, transparency and information.
- Hold a workshop with AEP and WPACs to prioritize opportunities to improve aquatic health. This workshop could revisit the benchmark Aquatic and Riparian Condition Assessment of the SSRB report (Alberta Environment, 2007), and the Provincial Ecological Criteria for Healthy Aquatic Ecosystems report (Alberta Water Council, 2009).
- AEP complete the water reuse and stormwater policy. This is a key gap in the current policy portfolio and is currently being worked on.
- Collate and provide data/information in a meaningful way to understand the state of the health of the SSRB and the opportunities to restore it where it is degraded. Continue to support monitoring.

BAC members look forward to discussing the findings of this review with AEP, and exploring next steps towards a sustainable environment and economy for the SSRB

## Contents

1. Introduction .....	1
1.1 Background .....	1
1.2 Approach and Project Scope.....	2
1.3 Data Summary.....	3
2. Summary of Key Findings.....	4
2.1 Plan Implementation Since 2006 .....	5
2.1.1: Establish a Limit on Water Allocations from the Bow, Oldman, and South Saskatchewan River Sub-basins .....	5
2.1.2 Future Water Allocation Limit in the Red Deer River Sub-basin.....	6
2.1.3 Recommended Water Conservation Objectives (WCOs).....	6
2.1.4 Establishment of an Interbasin Water Coordinating Committee (IWCC) .....	6
2.1.5 Use of Water Allocation Transfers, Water Conservation Holdbacks and Factors that Must be Considered When Making Decisions .....	7
2.1.6 Water Management Strategies.....	8
2.2 Emerging Themes.....	9
2.2.1 Theme: Improving aquatic and riparian health through watershed management.....	10
<i>Challenges</i> .....	11
<i>Opportunities</i> .....	13
2.2.2 Theme: Measuring, monitoring and managing the watershed system.....	17
<i>Challenge</i> .....	17
<i>Opportunities</i> .....	18
3. Next Steps .....	21
References .....	24
Glossary.....	26
Endnotes .....	31

### Appendices (in separate document):

- Appendix A – Project Scoping Document
- Appendix B – Parking Lot
- Appendix C – Ten-year Review Data Analysis Package
- Appendix D – Notable Initiatives
- Appendix E – BAC Summaries
- Appendix F – BAC Members

# 1. Introduction

## 1.1 Background

The Approved Water Management Plan for the South Saskatchewan River Basin (the Plan) was intended to provide a foundation for changes to how water is managed in the South Saskatchewan River Basin (SSRB). At the time of its preparation in 2006, the Government of Alberta (GoA) acknowledged that a significant amount of water in the basin was already allocated, with expectations that those allocations would be more fully utilized in the future, and that detrimental effects on the aquatic environment were evident. Along with the threat of climate change impacts and the requirement to pass 50 per cent of the annual total natural discharge to Saskatchewan, the need to move towards a more sustainable environment and economy was pressing. The Plan was intended to initiate movement into this new era:

*The plan ... sets the stage for future changes to how water management is conducted. Strong linkages between water quality, land use and water quantity may now be further pursued. It is anticipated that economic tools will continue to influence how water is distributed for use generally and particularly during times of shortage. Greater emphasis will also be placed on ensuring environmental considerations are taken into account. Improved cooperation between all stakeholders is expected and encouraged to occur (AENV, 2006).<sup>1</sup>*

Accordingly, the Plan authorized or recommended key provisions of Alberta's *Water Act*, including water allocation transfers and water conservation holdbacks. It also established a limit on water allocation from the Bow, Oldman and South Saskatchewan River sub-basins, and an initial total allocation target was recommended for the Red Deer River sub-basin. Further, direction was provided on water management strategies to balance protection of the aquatic environment with economic development.

In preparing the Plan, the GoA used the best available data and a consensus-based public consultation process. As such, the Plan directs that as new information comes to light or situations change, Watershed Planning and Advisory Councils (WPACs) can determine when a review of any aspect of the Plan is warranted.<sup>2</sup>

While it is generally good practice to review plans within five to 10-year timeframes (it has been over 10 years since the Plan's approval), the impetus for this review is grounded in more situational considerations. There was, for example, a desire to undertake the review while a large number of original BAC members were available and interested in participating. There was also a general recognition that many issues impacted by the allocation limit (e.g., stormwater use and re-use, growth planning, pressure on tributaries, and watershed health concerns) are of increasing importance. A review of the Plan offered opportunities to gain a better picture of watershed management in the SSRB, including trends that can inform discussions of current issues.

The purpose of this report is to provide an assessment of the Plan's implementation in the four SSRB sub-basins since its approval in 2006. This is a WPAC-led review intended to inform and improve water management in the SSRB; it is not intended to suggest or initiate revisions to the Plan or the *Water Act*. Using the most current available data, the report:

- reviews the implementation of Plan recommendations and provisions;

- identifies emerging themes from the BAC discussions, along with related challenges and opportunities; and
- offers suggestions for next steps.

## 1.2 Approach and Project Scope

The government-led public consultation approach in Phase One (2002) and Phase Two (2006) of the Plan’s development focused on four Basin Advisory Committees (BACs): one for each of the four sub-basins within the SSRB. These BACs were multi-sectoral stakeholder groups that met both individually and in plenary. BAC discussions were informed by common background information packages, with topics ranging from legislation and policy to the status of water supply and demand in the SSRB.<sup>3</sup> In both phases, BAC advice was collected, consolidated and, ultimately, considered by the GoA in finalizing the Plan.

The past success of the public consultation approach in Phase One and Phase Two, built on inclusion and collaboration, has guided the process undertaken to prepare this report. Specifically, this present review brought together BACs representing the four sub-basins within the SSRB and many BAC members from the original planning process participated once again. From summer 2017 to spring 2018, the BACs again met both individually and in plenary, using a common data package to inform their discussions. Each BAC prepared a summary document that identified key findings and recommendations, which in turn informed the preparation of this report.

The process undertaken for the present review differs from the government-led process in that no new research was undertaken. It also differs in that no consultations with the general public were held. Instead, efforts were made to secure the participation of people who could represent sectors and groups with an interest in watershed management planning. These efforts resulted in representation from:

- |  |  |
|--|--|
| ▪ Watershed Planning and Advisory Councils | ▪ Agriculture/Irrigation                   |
| ▪ Provincial government                    | ▪ Environment/Non-government Organizations |
| ▪ Urban municipalities                     | ▪ Academia                                 |
| ▪ Rural municipalities                     | ▪ Industry                                 |
| ▪ Recreation                               |  |

Given this multi-sectoral representation, BAC discussions were robust and informative. These discussions were guided by a Project Scoping Document (see Appendix A), which identified specific questions and Plan recommendations for the review. While many of the questions identified in the Project Scoping Document were answerable by available data, many were not. BAC members’ expertise, along with AEP input, helped move BAC discussions forward on questions where available data was lacking or where the questions were not data-related. Inevitably, certain topics that were tangential or peripheral to the review were raised throughout the discussions. For purposes of this review these topics were deemed to be out of scope, but were documented and are included in Appendix B.



The Project Scoping Document directed that the review would not open the Plan or *Water Act* to revision. Rather, the intent was to inform and improve water management in the SSRB, focusing on the following specific recommendations in the Plan:

- The limit on water allocation from the Bow, Oldman and South Saskatchewan River sub-basins
- Future water allocation limit in the Red Deer River sub-basin
- Recommended Water Conservation Objectives (WCOs)
- Establishment of an Interbasin Water Coordinating Committee (IWCC)
- Use of water allocation transfers, water conservation holdbacks, and Matters and Factors that must be considered when making decisions
- Water management strategies

Out-of-scope topics included:

- Water quality. While Phase Two included a review of the river flows required for protection of the aquatic environment (to assist in establishing WCOs), water quality was not a specific component of the Plan itself.
- Groundwater (except for subsurface water that is identified as hydraulically connected to a water body [river, stream, lake, etc.]).
- *Master Agreement on Apportionment* (1969)
- Repeal of the South Saskatchewan Basin Water Allocation Regulation (1991)
- Suggested changes to the *Water Act*
- Climate change

Due to capacity and resource constraints, this report reflects what was discussed during the BAC meetings only and, therefore, does not cover all potential discussion points related to the in-scope topics.

### 1.3 Data Summary

The questions identified in the Project Scoping Document provided critical direction on the initial data requirements for the review. Based on these requirements, a large amount of data was requested and received from AEP, including but not limited to:

- surface water allocations (interim/full and temporary): number, volume and purpose;
- groundwater allocations (interim/full and temporary): number, volume and purpose;
- water conservation objectives: locations and values; and
- transfers: number, volume, and volume held back.

A summary of average annual flow, licences, and amount/percentage of surface water allocated in the sub-basins and SSRB (total) is provided in Table 1.

Data concerning aspects of water management strategies was also collected. This data related to water demand and consumption, flow restoration and improvements to the aquatic environment. Several existing reports on these topics provided an overview of water management strategies in the SSRB.<sup>4</sup>

With it being only 10 years since implementation of the Plan in the SSRB, there was a limited set of data available (up to 10 years) to compare trends before and since that implementation. As noted in

other sections of this report, other data that would have been valuable for this review were not available at all as they are not monitored and maintained in the SSRB.

Available data was collected and analyzed on behalf of the WPACs by WaterSMART Solutions Ltd. In an effort to provide BACs with summary figures and tables about trends in water use, flows and other key metrics in the SSRB, a 10-year Review Data Analysis Package was prepared (see Appendix C). Each page of the package contains a separate graph or table, along with an explanation of the raw data sources used, the methods employed and other key points for interpretation. The analysis was conducted for all four sub-basins in the SSRB and represents the periods before and after the implementation of the Plan in 2007.

**Table 1:** Summary of average annual flow, licences, and amount/percentage of surface water allocated in the sub-basins and SSRB (total).

Facts about water management in the SSRB	Red Deer River Sub-Basin	Bow River Sub-Basin	Oldman River Sub-Basin	South Saskatchewan River Sub-Basin *	South Saskatchewan River Basin
Mean natural annual flow at the mouth of the river (m <sup>3</sup> ) **	1,666	3,829	3,343	7176 *	8,842
Estimated number of currently active or revised licences (term and temporary) in the basin (#)***	15,038	5,025	7,332	3,701	31,096
Cumulative volume of currently active surface water allocated in the basin as of 2017 (m <sup>3</sup> )	295	2,664	2,266	259*	5,484
Estimated percent of surface water allocated in the basin (%)	~18%	~70%	~68%	~4% *	~62%

\* Average annual flow for the SSR is measured at the border (not the mouth) and includes flow from the Bow and Oldman Rivers; surface licences include only those in the SSR sub-basin; % allocated is derived from the volume of allocations in the SSR sub-basin over the annual flow at the border. The mean natural annual flow for every sub-basin was calculated for 1912-2001.

\*\* Natural flow is flow that is not noticeably affected by direct human activities such as reservoir operation, water withdrawals, diversions or releases.

\*\*\* "Currently active" means not cancelled or expired.

Source: Average annual flow from report: South Saskatchewan River Basin in Alberta Water Supply Summary (Alberta Agriculture and Forestry, 2010); all other data provided by AEP and the analysis conducted for this review.

## 2. Summary of Key Findings

Many of the Plan's recommendations and provisions relate to specific actions to be taken by the GoA. Assessing these recommendations and provisions was, therefore, simply a matter of identifying whether or not, and to what extent, those actions were taken. This assessment is provided in section 2.1.

Other recommendations and provisions reflect the more open-ended and complex aspects of the Plan. These aspects (specifically, watershed management, water administration and system

performance) were significant discussion points for the BACs and, in order to capture their complexity, are presented in section 2.2 as integrated theme statements, and expanded upon in terms of context, challenges and opportunities.

## 2.1 Plan Implementation Since 2006

The Plan states that “Implementation of the plan encompasses both actions that are the legislated responsibility of Alberta Environment and actions that are best implemented through cooperation of partners.” To this end, AEP is commended for implementing many of the Plan’s recommendations as detailed below. (Additional comments on where more work is required, related to these recommendations, are provided in section 2.2.)

### 2.1.1: Establish a Limit on Water Allocations from the Bow, Oldman, and South Saskatchewan River Sub-basins

#### BAC Findings:

- ✓ AEP has stopped accepting applications for new water allocations in these sub-basins, except for purposes as specified under the Crown Reservation. The Bow, Oldman and South Saskatchewan River Basin Water Allocation Order (BOSS Order, 2007) was the mechanism used to stop accepting applications.
- ✓ In the Bow, Oldman, and South Saskatchewan sub-basins, the queue for licences that had already been applied for but are yet to be decided has almost been emptied. Table 2 identifies the number and volume of pre-2007 applications still in the queue.

**Table 2:** The number and volume of pre-2007 applications in the queue.

Facts about water management in the SSRB	Red Deer River Sub-Basin	Bow River Sub-Basin	Oldman River Sub-Basin	South Saskatchewan River Sub-Basin *	South Saskatchewan River Basin
Number of pre-2007 surface water licence applications remaining ("in the queue") as of June 2017 (#)	~8	~16	~38	~18	~80
Total volume of pre-2007 surface water licence applications remaining as of June 2017 (M m <sup>3</sup> )	~62	~11	~25	~2	~100
Total volume of pre-2007 surface water licence applications remaining as of June 2017 as a percentage of average flow in the basin (%)	~3%	<1%	<1%	<1% *	~1%

\* Average annual flow for the SSR is measured at the border (not the mouth) and includes flow from the Bow and Oldman Rivers; surface licences include only those in the SSR sub-basin; % allocated is derived from the volume of allocations in the SSR sub-basin over the annual flow at the border.

Source: Data provided by AEP and the analysis conducted for this review.

- ✓ A Crown Reservation was established for the entire Bow, Oldman and South Saskatchewan River sub-basins to make unallocated water available for:
  - Water Conservation Objectives
  - Storage of peak flows to mitigate impacts on the aquatic environment and to support existing licences
  - Licences and registrations that may be issued for applications and registrations pending at the date of the Crown Reservation
  - First Nations Reserves
    - The BACs noted that, to date, no licences have been issued under the Crown Reservation for this purpose. However, water needs assessments for First Nations are being conducted.
- ✓ Temporary Diversion Licences (TDLs) and groundwater allocations have shown little increase since the closure of the Bow, Oldman, and South Saskatchewan sub-basins.

### 2.1.2 Future Water Allocation Limit in the Red Deer River Sub-basin

BAC Finding:

- ✓ A future allocation limit in the Red Deer sub-basin was set at 600,000 dam<sup>3</sup>, with a temporary closure triggered at 550,000 dam<sup>3</sup>. To date, approximately 300,000 dam<sup>3</sup> of surface water has been allocated through licences in the Red Deer sub-basin.

### 2.1.3 Recommended Water Conservation Objectives (WCOs)

BAC Findings:

- ✓ The Bow, Oldman and South Saskatchewan River sub-basin WCOs were set on select river reaches as specified in the Plan.<sup>5</sup>
- ✓ The Red Deer River sub-basin WCOs were set as specified in Plan.<sup>6</sup>
- ✓ WCOs are applied in two ways:
  - When a 10% conservation holdback is taken on a water licence transfer, a WCO licence is issued to the Crown at the discretion of the AEP Director
  - WCO limitations are applied to new diversion licences
- ✓ In accordance with recommendations in the Plan, WCOs were not typically applied to backlog licence applications (i.e., applications received by AEP before 2006).

### 2.1.4 Establishment of an Interbasin Water Coordinating Committee (IWCC)

BAC Finding:

- ✓ The IWCC was established in 2009; it continues to be in place and meets periodically.

### 2.1.5 Use of Water Allocation Transfers, Water Conservation Holdbacks and Factors that Must be Considered When Making Decisions

#### BAC Findings:

- ✓ A water market, through licence transfers, has been created. Since the Plan’s approval (up to June 2017 when this review project commenced) there have been:
  - 57 transfers in the Bow River sub-basin,
  - 151 transfers in the Oldman River sub-basin,
  - Two transfers in the Red Deer River sub-basin, and
  - 12 transfers in the South Saskatchewan River sub-basin.

A summary table of water transfers is provided in Appendix C (SSRB 10-Year Review Data Analysis Package, pages 72 - 75). Table 3 provides a snapshot of the number and volume of transfers completed in each sub-basin since 2007.

**Table 3:** The number and volume of transfers completed in each sub-basin since 2007.

Facts about water management in the SSRB	Red Deer River Sub-Basin	Bow River Sub-Basin	Oldman River Sub-Basin	South Saskatchewan River Sub-Basin	South Saskatchewan River Basin
Number of transfers completed in the basin from Plan implementation to June 2017 (#)	2	57	131	20	210
Volume transferred in the basin from Plan implementation to June 2017 (M m <sup>3</sup> )	0.4	12.5	22.8	3.5	39.2

Source: Data provided by AEP and the analysis conducted for this review.

- ✓ Holdbacks of up to 10% of allocations of water under licences being transferred are typically applied, at the discretion of the Director. The maximum holdback of 10% is not applied across all transfers. Table 4 shows the volume of water from holdbacks up to 2017, and as a percentage of the annual average flow.
- ✓ Matters and Factors have been considered by the AEP-designated Director in making decisions on applications for water transfers in the SSRB (Table 1 in the Plan) and for applications for water licences, preliminary certificates or approvals affecting surface water in the SSRB (Table 2 in the Plan).

**Table 4:** The volume of water from holdbacks up to 2017, and as a percentage of the annual average flow.

Facts about water management in the SSRB	Red Deer River Sub-Basin	Bow River Sub-Basin	Oldman River Sub-Basin	South Saskatchewan River Sub-Basin	South Saskatchewan River Basin
Volume of water held back on transfers from Plan implementation to June 2017 (M m <sup>3</sup> )	~0.04	~1.2	~1.15	~0.25	~2.64
Volume of water held back as a percentage of natural annual average flow (%)	<1%	<1%	<1%	<1%	<1%

Source: Data provided by AEP and the analysis conducted for this review.

### 2.1.6 Water Management Strategies

#### BAC Findings:

- ✓ WPACs have been involved in providing feedback and insight into provincial planning processes (e.g., South Saskatchewan Regional Plan).
- ✓ Many notable initiatives have been undertaken related to Water Management Strategies put forward in the Plan (see Appendix D).
- ✓ Water Demand and Consumption:
  - Improvements in conservation have happened in all sectors in the province, in part through Conservation, Efficiency and Productivity (CEP) Plan development and implementation. It was noted that the water saved through irrigation district and landowner efficiencies has, to date, benefited the aquatic environment as only a very small portion of the saved water has been used for irrigation expansion. It was also noted, however, that there should be a more intentional effort to ensure that some of the conserved water should remain in rivers to help maintain and/or improve aquatic and riparian health.
  - AEP is upgrading the Water Resources Management Model (WRMM) when possible.
  - AEP has implemented the Water Use Reporting System (WURS) to enable water licence holders, as required, to report their water use in addition to annual water statement filings and other means. However, not all licences are required to report usage data and the system is recognized to have some technical and administrative challenges for some users.
  - There is not yet a complete and reliable source of water use data for sub-basins in the SSRB.
  - Adaptive learning within AEP has occurred (e.g., some progress has been made in understanding when the threshold for significant adverse effects might be crossed in making decisions concerning transfers or other applications).
- ✓ Improved Dam Management to Protect the Aquatic Environment
  - Operational decisions on the Oldman Dam have contributed to two successful cottonwood recruitment periods since 1995 in the Oldman sub-basin (one recruitment period every 15-20 years would be considered “natural”).

- The Dickson Dam in the Red Deer sub-basin is operated to ensure the WCO downstream on the mainstem is always met.
- ✓ Protection and Management of Riparian Vegetation
  - The Aquatic and Riparian Condition Assessment of the SSRB (ARCA) report was completed in 2007 by AEP.
- ✓ Flow Restoration in the Bow, Oldman, and South Saskatchewan Sub-basins
  - Flow restoration has, in part, been achieved through the improved dam operations as noted above. In addition, licence holders (including municipalities, irrigation districts and hydropower companies) work individually and collaboratively to try to maintain sufficient flow in the rivers, in particular during times of low flow.
- ✓ Water Quality
  - Many studies and initiatives have been completed, including (but not limited to):
    - SSRP Surface Water Quality Management Framework (2014)
    - Bow River Phosphorus Management Plan (2014)
    - Tributary Monitoring Program (AEP)
    - Water Quality in Alberta's Irrigation Districts (Alberta Agriculture and Forestry)
    - Assessment of Environmental Sustainability in Alberta's Agricultural Watersheds (2008)
    - Nutrient Beneficial Management Practices Evaluation Project (Alberta Agriculture and Forestry)
- ✓ Maintenance of the Red Deer River Sub-basin's Aquatic Environment
  - A series of four technical reports were developed by independent consultants to support the Red Deer River Watershed Alliance's Integrated Watershed Management Plan, Phase One (2016). These reports included:
    - Surface Water Quality (2012);
    - Wetland, Riparian Areas and Land Use (2013);
    - Surface Water Quantity and Groundwater Resources (2013); and
    - Terrestrial and Aquatic Biodiversity (2014).<sup>7</sup>

## 2.2 Emerging Themes

As the intent of the Plan was to set the stage for future changes in how water management is conducted, and accelerate the steps citizens in the SSRB have already taken on the path towards a sustainable environment and economy, BAC discussion of the Plan's more complex and open-ended aspects led to a more in-depth review. In order to provide some of the groundwork on possible next steps for how water management is conducted – and how we can continue on the path towards a sustainable environment and economy – the BAC discussions generated two key themes:

- Improving aquatic and riparian health through watershed management
- Measuring, monitoring and managing the watershed system

## 2.2.1 Theme: Improving aquatic and riparian health through watershed management

### Integrated Theme Statement

A key pressure point in the Bow, Oldman and South Saskatchewan sub-basins is meeting aquatic environment requirements while matching economic growth, municipal growth and other needs with water supply. This will also likely be a future pressure point in the Red Deer River sub-basin.

The Plan recommendations (WCOs, holdbacks and allocation limit) were intended to reduce the risk of further degradation of the aquatic environment. Some gains in conservation have been made. More needs to be done, however, to restore and protect the long-term health of the aquatic and riparian environment, with particular attention to the implications of changing water pattern use through allocation transfers on the tributaries.

Collaboration and partnerships are vital to improving watershed management. The success of these efforts requires a clear understanding of decision-making processes and strong linkages between basin pressure points, planning and policy.

### *Context*

Review of the plan's implementation was, necessarily, a review of watershed management (defined as "a comprehensive, multi-resource process involving all stakeholders within a watershed"<sup>8</sup>) and water administration (e.g., the administration of provisions under Alberta's *Water Act* and *Environmental Protection and Enhancement Act*). As such, discussions reflected the larger operational and policy context of the SSRB, and surfaced some of the specific challenges and opportunities in meeting the Plan's stated intentions.

In the SSRB, all of the sub-basins are managed systems. In other words, with the exception of some unmanaged tributaries, all stream flows in the SSRB are controlled through varying degrees of human intervention. While this may be stating the obvious, it does serve as a useful reminder that, while certain phenomena (e.g., climate change) lie outside our full understanding, we nevertheless have considerable control – and therefore, opportunity – over how we manage the SSRB.

Legislative and policy direction on managing these systems is provided at all jurisdictional levels, including through federal and provincial acts, strategies and guidelines; municipal plans and policies; WPAC-led Integrated Watershed Management Plans (IWMPs); and Watershed Stewardship Group Watershed Management Plans. The Approved Water Management Plan for the SSRB is but one piece in a complex yet aligned and layered system of mandatory and voluntary courses of action.

Adding to this complexity are the particular characteristics of each sub-basin. For example:

- The 25,000 km<sup>2</sup> Bow River sub-basin is the most managed system, with more control structures than any of the other sub-basins.
- The agriculture-driven Oldman River sub-basin comprises 23,000 km<sup>2</sup>, of which 2,100 km<sup>2</sup> lies in Montana (outside the SSRB Plan authority).



- At 49,650 km<sup>2</sup>, the Red Deer River sub-basin is the largest sub-basin (accounting for approximately 18 per cent of the total flow volume in the SSRB) and is the only sub-basin still accepting applications for new water allocations. The Red Deer River sub-basin is the least managed sub-basin (in terms of control structures).
- There are few areas suitable for holding large volumes of water in the 13,000 km<sup>2</sup> (Alberta portion only) South Saskatchewan River sub-basin, and because of its unique topography only about 50 per cent of that land area actually contributes water to downstream flow (a large part of the sub-basin is made up of smaller, internally draining, sub-watersheds).

While such differences as topography, land use, economics and population growth meant there were different issues and concerns for each BAC, commonalities across the sub-basins were nevertheless evident. (The BAC meetings were thoroughly documented and are included in Appendix E.) These commonalities – specifically, shared challenges and opportunities – are presented below.

### *Challenges*

#### ***Challenge 1: Matching economic growth, municipal growth and other needs with water supply and meeting aquatic environment requirements***

The Plan intends to reflect a balance between protecting the aquatic environment and water allocation in the SSRB. While certain watershed issues at the sub-basin level were not addressed because of the need to focus first on water quantity in the main rivers, the Plan provides a foundation for future watershed management planning for the four sub-basins.

The Plan's focus on managing water supply through setting an allocation limit and establishing a water transfer system certainly sets this foundation – as does other legislation and policy, including *Water for Life's* commitments to Albertans:

- Albertans will be assured their drinking water is safe.
- Albertans will be assured that the province's aquatic ecosystems are maintained and protected.
- Albertans will be assured that water is managed effectively to support sustainable economic development.<sup>9</sup>

In reviewing the Plan's intent and its implementation, and considering other strategic directions such as *Water for Life*, the BACs made the following observations:

- The Plan focused primarily on licence transfers to manage future water needs within the already allocated amount of water. In doing so, broader public policy questions of how to match economic growth, municipal growth and other needs with water supply throughout a region were unaddressed and effectively left to other jurisdictions, departments and processes.
- In the South Saskatchewan River sub-basin, matching growth needs with water supply is not currently a challenge, though the sub-basin has limitations to new storage.
- The Red Deer River sub-basin is the only sub-basin still “open” to new water licence applications. With considerable growth projected within the QEII corridor over the next 30 years, the opportunities and associated risks around growth will need to be carefully and proactively managed to ensure the long-term health and viability of the sub-basin.

- Water supply, waste water treatment and stormwater management are increasingly recognized as limiting factors to growth. The Province's work on its Water Reuse and Stormwater Use Policy was recognized as a positive step forward.

*The take-away ...*

*Provincial legislation, policy and plans provide high-level vision, principles and outcomes for watershed management. Translating that high-level direction to operational and management actions on the ground continues to be a challenge that inhibits effective watershed management. This challenge will be exacerbated as the region endeavours to balance economic growth, municipal growth and other needs with water supply and watershed health.*

### **Challenge 2: Protecting the long-term health of the aquatic environment**

The Plan's recommendations for WCOs, holdbacks and allocation limits were intended to reduce the risk of further degradation of aquatic environments in the SSRB. However, in considering the long-term health of the basin, the BACs made the following observations:

- Holdbacks of up to 10 per cent of the volume of water licence transfers have little impact on flow restoration for mainstem rivers from a volume perspective.
- Holdbacks of up to 10 per cent have the potential for greater effect in smaller systems, for example in the Sheep and Highwood sub-basins, where transfer applications are highlighting local concerns and the limited capacity of those systems.
- Conservation Efficiency and Productivity (CEP) plans have been prepared by many sectors, including urban municipalities, irrigation and upstream oil and gas. CEPs outline a sector's overall strategy for achieving water conservation efficiency and productivity goals. It was noted, however, that a CEP's priority is not necessarily to protect and/or maintain the long-term health of the aquatic environment.
- Water use efficiencies have been achieved in most sectors, including irrigators, municipalities and industry. The Red Deer River BAC made the additional note, however, that this is not reflected in a noticeable reduction in consumption in the Red Deer River sub-basin. This may be the case in the other sub-basins too, as water efficiencies often enable further development rather than a reduction in water diversions.
- Over the past 15 years, irrigation districts, through voluntary conservation efforts, have returned on average a much larger quantity of water to river systems than the 10 per cent holdback from transfers. It is understood that such efficiency gains will not be as large going forward since the majority of the feasible changes to improve efficiency have already been implemented. It was also noted that some districts are looking at expanding their irrigated area because of demand for additional irrigated land.
- Information requirements to support a determination of whether a water source is groundwater or groundwater directly connected to surface water (and the influence of groundwater – surface water interaction on water supply) are unclear.
- Water quality and riparian habitat were only loosely included in the Plan.
- It is not clear to what extent findings in Aquatic and Riparian Condition Assessment of the SSRB Report (2007) have been recognized or acted upon.
- Watershed management planning and state of watershed reporting is happening at the sub-basin and basin level by WSGs and WPACs. However, it is unclear to what extent, if any, the

information from this work is considered by decision makers at the various levels of government.

- For WPACs to more effectively prepare, implement and monitor watershed plans and related tasks vital to the health of the basin (including water quality and aquatic health), they need to be effectively resourced.

*The take-away ...*

*In protecting the long-term health of the aquatic environment, volumes from holdbacks have had little impact, while water use efficiencies and unused water allocations from irrigation districts, municipalities and industry have had far greater impacts. While WCOs should remain in place, and holdbacks should continue to be applied, more needs to be done to restore and protect the long-term health of the aquatic environment.*

### *Opportunities*

Moving forward on the challenges identified above, suggested opportunities are described below.

#### ***Opportunity 1: Continue to involve collaborative groups in watershed management***

Achieving the intended outcomes of watershed plans and strategies is the shared responsibility of all stakeholders and, thus, requires a collaborative effort. As a case in point, collaboration was a core principle guiding both the original SSRB Plan development and this review process. The diverse BAC members, through dedicated and consistent efforts, strengthened their relationships with one another, building trust through respectful, problem-solving dialogue. Representation included government, industry, environmental groups, academia and others. And while collaboration is not unique to this project, it serves as an excellent reminder of its importance in watershed management.

BAC observations and suggestions on collaboration, as an opportunity to improve watershed management and achieve the Plan's intentions and recommendations, include the following:

- WPACs and many municipalities have a keen interest in questions related to water demand, water supply, waste water treatment and stormwater management.
- WPACs are able to pull together a vast array of expertise, experience and knowledge from stakeholders who live and work in their basins, to address common concerns around watershed management. WPACs are effective forums to initiate dialogue and carry out many of the tasks that are central to effective watershed management. WPAC partners can rely on high quality products and information to aid and inform their management decisions.
- There is a need for affirmation of WSG and WPAC roles in collaborative watershed planning and reporting, especially under the umbrella of AEP's Environmental Monitoring and Science Division and in light of Section 60(1) of the *Municipal Government Act*, which purports to give municipalities "the direction, control, and management of the bodies of water within the municipality."
- The newly-formed Calgary Metropolitan Region Board may be one of many possible forums for discussing the broader public policy questions identified in this review in the Bow River sub-basin.

- Watershed management requires an inclusive process; participation from all stakeholders – from landowners to industries to researchers – should be sought whenever appropriate.
- Collaboration links plans with unintended consequences through stakeholders’ unique knowledge and information. Sharing of this information is crucial in identifying all potential consequences of plan implementation (e.g., impacts of transfers on tributaries).
- The Interbasin Water Coordinating Committee (IWCC) should continue to seek input from WPACs on its Terms of Reference and activities.
- The IWCC has been somewhat active, but may not be nimble enough to address short-term issues. It may be better suited to a strategic planning role, where it could function as a proactive, forward-looking regional water management committee.
- Improved communication between the IWCC and sub-basin stakeholders could be facilitated through WPAC forums and other information streams (e.g., WPAC newsletters).

*The take-away ...*

*There are significant resources and opportunities that can be leveraged within the SSRB to achieve watershed management outcomes. WPACs and WSGs, in particular, offer a vast array of expertise, experience and knowledge from which to draw. There are also potential opportunities within existing groups (e.g., IWCC and the Calgary Metropolitan Region Board) to undertake watershed management in a more proactive and cohesive manner.*

***Opportunity 2: Provide clarity, transparency and information on the decision-making processes implemented through the Plan***

The challenges identified by the BACs related to watershed management and administration highlighted opportunities to improve decision-making processes, including:

- Decisions on applications for transfers, licences, preliminary certificates or approvals:
  - Develop clearly defined criteria for acceptance and rejection (draw on precedents set by previous decisions) to help applicants determine, in advance, whether and how to proceed (e.g., to assist in preparing a thorough and effective submission).
  - Decision processes around “in good standing” are evolving and limited government resources prevent a review of the standing of every individual licence (there are 13,000 licences and registrations in the SSRB). There may be value in developing an easy-to-use system for evaluating licence status in order to determine good standing. It was noted that AEP has cancelled licences not in good standing and placed those allocations in the Crown reservation. An easy-to-use system for evaluating licence status could potentially facilitate this process.
- Communications:
  - Better utilize current technologies to enhance access to information (e.g., upgrade the online licence viewer, use email for notifications).
  - Provide more effective opportunities for public input during decision-making processes, especially regarding larger applications.
- Transparency in decision-making processes for those who have an interest in the decisions or are impacted by the decisions:

- Provide clarity on the criteria used around the concept of “no significant adverse effect” (as it pertains to environmental considerations as well as any other relevant considerations outlined in the Matters and Factors).
- Improve clarity on the information requirements to support a determination of whether a water source is groundwater or groundwater directly connected to surface water.
- Utilize WPACs as an informed and effective resource to prioritize, identify and trial communication pieces that provide clarity, transparency and information.
- Clarification of how the Matters and Factors in the Plan that must be considered in making decisions on applications for approvals, licences, preliminary certificates and transfers of allocations are applied in decision making:
  - Generate insights through a case study on a transfer application in the Sheep River sub-basin. Preliminary scoping of this possibility was undertaken as part of this review project.
- Clearer language around certain items in the Plan:
  - Clarify the Plan’s language and intent with respect to which allocations and considerations are referred to in Recommendation 2.1 (establishing a limit on water allocation). This clarity would include surface and groundwater resources, licence types (term or temporary) and quantity and quality considerations. Some of this is presented in the 2007 BOSS Order, but BOSS does not speak to temporary diversion licences and speaks only indirectly to groundwater.

*The take-away ...*

*Effective and inclusive stakeholder engagement in watershed management requires a shared understanding of water administration. Specifically, a shared understanding of key decision-making processes, and the criteria and terminology used within those processes.*

***Opportunity 3: Implement programs and actions beyond the Plan that will not only prevent further degradation, but improve the long-term health of the aquatic environment***

In setting a limit for water allocation in the Bow, Oldman and South Saskatchewan River sub-basins (and a future water allocation limit in the Red Deer sub-basin), along with recommending WCOs and holdbacks, the Plan intended to reduce the risk of further degradation of the aquatic environment. In considering what more needs to be done to restore and protect the long-term health of the aquatic environment, the BACs made the following observations and suggestions:

- Review WCOs for headwater tributaries as there is an opportunity to protect these streams now. An assessment of whether new WCOs could more effectively be used within the transfer approval system would be required. (There is a designated WCO for tributaries of the Red Deer River.)
- Review WCOs in terms of water quantity, water quality, groundwater, groundwater-surface water interaction, and aquatic and riparian ecosystems. While it is understood that including these criteria would likely mean that it would be harder to meet the WCOs, the criteria should still be considered. This is particularly important regarding future WCOs that may be established, as these represent an additional opportunity to do more for the aquatic environment.

- While a rationale for focusing on water quantity is provided in the Plan, moving forward, water quality and quantity should not be separated when discussing the aquatic environment. It was noted that the South Saskatchewan Regional Plan 2014 – 2024 affirms the province’s commitment to integrated management considering water supply, water quality and aquatic ecosystems and the need for ongoing work to ensure innovation and development of tools and approaches.<sup>10</sup>
- Continue supporting important initiatives that protect the long-term health of the aquatic environment (e.g., AEP’s Watershed Resiliency and Restoration Program).
- The work of the Alberta Water Council (AWC) provides an excellent foundation for protecting the long-term health of the aquatic environment and should be used to inform future discussions:
  - The *Water Allocation Transfer Update Project (WATSUP)* report (2009) had six key areas of focus, including establishing “protected water” and incenting water conservation.
  - The *Looking Back: Evaluating Sector Improvements in Water Conservation, Efficiency and Productivity* report (2017) included four key recommendations on reporting and resolving existing challenges.
  - *Provincial Ecological Criteria for Healthy Aquatic Ecosystems* (2009)
  - Protecting Sources of Drinking Water in Alberta (current project)
  - Building Resiliency to Multi-year Drought (current project)
- WCOs are a regulatory mechanism to ensure new diversions have minimal harmful impacts and it is prudent to periodically review and improve them. There is an opportunity for an appropriate group (e.g., WCO experts, scientists, WPACs, IWCC, etc.) to review whether WCOs could be more effective by being added to, improved upon or, possibly, replaced.
- Alternative mechanisms to WCOS should be explored, including (but not limited to): protected water, allowing private entities to hold WCO licences (e.g., water trusts), and a fee system whereby a fee is collected on transfer applications and is directed to initiatives that enhance the aquatic environment.
- Use the information that is provided in existing reports. AEP’s 2007 Aquatic and Riparian Condition Assessment (ARCA) report identifies knowledge gaps concerning how the aquatic environment (including riparian vegetation) responds to changes in river flow regimes. It also provides information about hydrological variability/alteration that can be used to determine where research efforts should be focused. At the time of the Plan’s approval, WCOs were established without the benefit of the science needed to predict a given flow regime’s impacts on the aquatic environment. The ARCA report and other studies have since been made available and support a renewed effort to develop the science needed for effective protection of the aquatic environment.

*The take-away ...*

*The Plan set the stage for future changes to how watershed management is conducted. Since its approval, significant work has been undertaken, including many reports and plans. It is now time to more fully utilize the insights and directions of these reports and plans to improve the long-term health of the aquatic environment.*

## 2.2.2 Theme: Measuring, monitoring and managing the watershed system

### Integrated Theme Statement

The majority of the rivers in the SSRB are heavily allocated and the Red Deer River sub-basin remains open to new water allocation applications. Some tributaries in particular are stressed. The demands on these systems and their water resources are growing and competing more than ever. There are still significant gaps in the data and knowledge about the water and watershed.

The ability to properly assess plans and policies requires long-term resource commitments to data collection and exchange, monitoring, modeling, evaluation, and clear definition of specific watershed outcomes. Moreover, data collection and exchange, monitoring, modeling and evaluation must link to a cumulative effects management approach.

### *Context*

Throughout Phase One and Phase Two of the Plan, AEP conducted many background studies to support BAC deliberations and its own decision-making processes, including, for example, *Instream Flow Needs Determination for the SSRB* and a *Strategic Overview of Riparian and Aquatic Condition of the SSRB*. AEP also recognized that, in some cases, decisions must be made within a context of incomplete information and data, and with limited overall understanding of key environmental processes. The department acknowledged that, concerning WCOs, “the science needed to predict the impacts on the aquatic environment of a given flow regime has not been developed.”<sup>11</sup> This context of making decisions based on best available data and science continues to shape watershed management planning today, providing both challenges and opportunities not only in charting the path towards a sustainable environment and economy, but also in assessing the extent to which plans and policies further our progress along that path.

### *Challenge*

#### ***Challenge 1: Identifying and understanding the critical linkages between watershed outcomes/objectives, information/data, and monitoring/modeling.***

A significant challenge facing the SSRB is the identification of those areas where more concentrated efforts and resources would contribute to a clearer, more holistic understanding of the effects (intended and unintended) of watershed management decisions in the SSRB. To this end, the BACs focused much of their discussions on the linkages between the Plan’s objectives and outcomes, the information relevant to those objectives and outcomes, and the activities and tools (specifically, monitoring and modeling) that are critical in interpreting and delivering that information. While details of these discussions are provided in the BAC meeting notes (Appendix E), a summary is also provided below.

## Opportunities

Since the Plan's approval in 2006, AEP has striven to manage the cumulative effects of development on air, water, land and biodiversity. As an early example of cumulative effects management, the Plan was foundational to this progress. Moving forward on the Plan's intention to accelerate steps towards a sustainable environment and economy – and building on AEP's commitment to CEMS – the BACs identified the following opportunities:

### **Opportunity 1: Provide the resources necessary to continually work towards filling critical gaps in information about water and watershed management**

As stated in the introduction, the Plan intended to enable stronger linkages between water quality, land use and water quantity. It was, essentially, a step towards a cumulative effects management approach. In the time since the Plan's approval, cumulative effects management has gained traction within AEP and it is now well established that part of the foundation of this approach is a reliable and comprehensive knowledge base. To this end, while AEP has provided much of the information requested to conduct this review, the BACs noted the following gaps:

- Naturalized flow data
  - Naturalized flow data is currently only available up to 2009. There is a need for post-2009 naturalized flow data and for naturalized flow data to be made publicly available in a timely manner going forward.
- Water usage data
  - While large licences are required to report their actual water use, not all actual water use is reported (e.g., smaller licences are not required to report their water use). While water usage by smaller licences is assumed to be low, the consequence of not fully knowing this usage is unknown. This information gap is a particular concern on the tributaries and in rural areas (e.g., the Highwood) as the impacts of smaller licences in these systems can be significant.
- Net diversion data
  - Net diversion data is listed in the Plan's Matters and Factors tables and is therefore something that must be considered in making decisions on transfers, licences, preliminary certificates and approvals. However, this data is not consistently available. Data should be available on a watershed basis in order to enable better management decisions.
- Return flow data
  - Return flow data is not consistently monitored and reported. Return flow data is taken into account in determining net diversion.
- Biological and hydrological data
  - During the development of the Plan, AEP recognized that the science needed to predict the impacts on the aquatic environment of a given flow regime had not yet been developed.

#### **Elements of a Cumulative Effects Management System (CEMS)**

(From the Alberta Environment and Parks website, 2018.)

**Outcomes-based:** Driven by clearly defined outcomes for the desired quality or state of the environment now and in the future, while recognizing the economic, environmental and social implications of meeting those objectives. Activities will be managed to achieve outcomes.

**Place-based:** Different regions may have different needs and outcomes.

**Knowledge-based:** Foundation of the system is a sound knowledge base and performance management, composed of information and evaluation to determine if outcomes are being met or management actions required.

**Adaptive:** The system can adapt to change when performance results are not achieving outcomes, or there is a risk of not achieving outcomes in the future or when circumstances change.

**Shared Stewardship:** A collaborative process to inform development of outcomes and build commitment for the shared responsibility to achieve outcomes.



The BACs noted that there continue to be gaps in the hydrological and biological data (data that would support the development of this science).

- Groundwater data
  - There is limited comprehensive and current groundwater mapping in the SSRB. The Alberta Geological Survey (AGS) released a groundwater atlas for the Calgary-Edmonton corridor in 2011 and subsequent work has been done between Calgary and Lethbridge. Better understanding is needed of groundwater-surface water interactions, and groundwater availability and its sustainable use in areas of the SSRB where groundwater use is currently high and/or projected to increase in the future due to expected growth patterns. For example, the Highwood-Sheep River sub-basin HMP-PAC/AMEC 2012 study indicated that the Sheep, Highwood and Upper Little Bow watersheds appear to have sufficient groundwater resources on a basin scale at the current state of development; however, concerns exist that the balance between supply and demand will begin to narrow in the near future. Areas near population centres (urban and intensive rural developments) in the Sheep and Highwood watersheds show levels of groundwater consumption that are near to or exceed mapped long-term aquifer yields.

#### *The take-away ...*

*AEP is commended for providing much of the requested SSRB information for this review. However, in light of the Plan's intention of enabling stronger linkages between water quality, land use and water quantity, the BACs noted key information gaps (i.e., naturalized flow, water use, net diversion, return flow, and biological and hydrological data) that, if addressed, would better support SSRB watershed management within a cumulative effects management system (CEMS). There is recognition that increased monitoring and reporting on water use by all water users in the basin would address some of these information gaps.*

#### **Opportunity 2: Provide the resources necessary to continually develop the monitoring and modeling capability and capacity in the SSRB**

Data collection and exchange must be addressed in tandem with monitoring and modeling. As noted above, although the Plan pre-dates CEMS, it does include elements that align with it and AEP cites the Plan as an early CEMS example.<sup>12</sup> Accordingly, in reviewing the Plan, the BACs discussed monitoring and modeling in strategic terms, identifying the following general challenges:

- Monitoring:
  - Tributaries:
    - Mainstems typically respond differently than tributaries to watershed management decisions (e.g., transfers, holdbacks). While a trend analysis might be sufficient for making decisions concerning mainstems, such analysis might not fully capture details of impacts on tributaries (e.g., how tributaries respond under low-flow conditions).
  - Water Conservation Objectives:
    - WCOs refer to the amount and quality of water established by the Director (AEP), based on the information available, to be necessary for: (i) protection of a natural water body or its aquatic environment, or any part of them; (ii) protection of tourism, recreational, transportation or waste assimilation uses of water; or (iii) management of fish or wildlife; and may include water necessary for the rate of flow of water or water level requirements. The BACs determined, however, that key metrics that would support WCO and holdback decisions are often not

monitored, including water quality, riparian health and impacts of flow restoration efforts.

- **Modeling:**

- Integration:

- Currently, it is difficult to integrate the output from different models that have been used in the SSRB (e.g., water quality and water quantity models), and it is therefore difficult to make decisions that reflect due consideration of cumulative effects and climate change. These models include, but are not limited to: Water Resources Management Model (WRMM); Bow River Operational Model (BROM-OASIS); Cold Region Hydrologic Model; Irrigation Demand Model; and Oldman, South Saskatchewan Operational Model.

- Scenarios:

- Future population, industry growth and climate change scenarios are currently not modeled and evaluated as part of watershed management decisions (e.g., allocations and holdbacks).

*The take-away...*

*Within a CEMS context, water and watershed monitoring and modeling in the SSRB must provide a more detailed and integrated account of how watershed management decisions impact both the mainstems and tributaries, and under varying scenarios.*

***Opportunity 3: Clearly define specific watershed outcomes to enable more effective performance assessment***

Identifying data requirements, and the type of monitoring and modeling they entail, is ultimately a function of an overall performance assessment strategy, which should reflect Plan outcomes. However, the Plan's outcomes are not explicitly defined. For example, the Plan indicates that WCOs, combined with the set limits on water allocations, are the first steps toward restoration of the aquatic environment<sup>13</sup> – yet an explicit definition of “restoration of the aquatic environment” is not provided.

Within a CEMS context, assessment of outcomes that are not explicitly defined is a challenge. Nevertheless, the Plan did provide direction on performance monitoring of the aquatic environment, including water quality monitoring, flow monitoring, and assessment of fish populations and riparian vegetation. The BACs support this direction, noting the following challenges:

- Assessing unintended consequences is important but difficult (how can we manage what we do not know?). For example, efficiencies are being achieved through infrastructure that improves water conveyance (e.g., the use of pipelines instead of canals). However, such infrastructure improvements can result in unintended impacts on the ecosystems that were supported by canals.
- There is currently an inability to fully assess recent WCO performance on reaches of the various rivers in the SSRB and what the potential impacts of that performance might be.
- There is infrequent monitoring of fish populations, even for the renowned Bow River trout fishery downstream of Calgary.

*The take-away...*

*Performance assessment of the Plan's outcomes is difficult due to the fact that they are not explicitly defined. The expected outcomes should be better defined (thereby enabling a more effective assessment strategy). The Plan's direction on performance monitoring of the aquatic environment provides a good starting point for an effective assessment strategy, but performance monitoring could be improved by also considering, e.g., unintended consequences, WCO performance, etc.*

### 3. Next Steps

This review has resulted not only in key findings, but strengthened basin-wide relationships and a shared understanding of the challenges and opportunities at both the sub-basin and SSRB levels. To maintain this momentum and leverage the groundwork that the four sub-basin BACs have established, potential next steps could include:

- Continue to involve collaborative groups in watershed planning
  - Next step: WPAC initiatives:
    - Bow River Basin Council: *Bow River Watershed Conservation Priority Mapping Project* - revisit the 2018 Watershed Resiliency and Restoration Program (WRRP) project *Watershed Simulation Tool-Methods and Outcomes for the Bow River Basin* recommendations for a prioritised mitigation strategy to address identified current and future threats to watershed resiliency.
    - Oldman Watershed Council: 2020 State of the Watershed Report.
    - Red Deer River Watershed Alliance: Build an improved understanding of how the allocation limit numbers (550,000 and 600,000 dam<sup>3</sup>) were determined, together with the economic, social and environmental opportunities these limits provided, as well as the risks potentially associated with them. As well, consider the consequences of increasing the allocation limits, including the opportunities and risks associated with increased allocations, when the net use of water allocated throughout the basin is better understood.
  - Next step: Support the Calgary Metropolitan Region Board as it develops the growth plan for the Calgary region.
  - Next step: Revitalize the IWCC by augmenting its purpose and role through the development of an updated Terms of Reference.
- Continue to provide clarity, transparency and information on the decision-making processes implemented through the Plan.
  - Next step: Conduct a case study for applying the Matters and Factors in the Plan. A case study could be based on an application for transfers of portions and/or total allocations of licences, from locations on the Highwood, Bow and South Saskatchewan rivers. A

detailed review of a potential case study was undertaken by Shirley Pickering, Chair of the Highwood Management Plan Public Advisory Committee. A case study represents an opportunity for basin stakeholders to gain insights on how Matters and Factors are applied in an “indicator” sub-basin (the Highwood-Sheep area is showing signs of water supply-demand stress), and highlights many of the challenges identified in this review.

- Next step: Provide clarity on how Alberta Environment and Parks and the Alberta Energy Regulator approval processes are reconciled to achieve similar desired outcomes. This will help towards process transparency and assuring consistency in protecting water supply and aquatic ecosystems.
  - Next step: AEP to utilize WPACs as an informed and effective resource to prioritize, identify and trial communication pieces that provide clarity, transparency and information.
- Implement programs and actions beyond the Plan that will not only prevent further degradation of the aquatic environment, but improve its long-term health. Continue to implement the strategies and actions identified in the South Saskatchewan Regional Plan for advancing watershed management.
- Next step: Hold a workshop with AEP and WPACs to prioritize opportunities to improve aquatic health. This workshop could revisit the benchmark *Aquatic and Riparian Condition Assessment of the SSRB* report (Alberta Environment, 2007), and the *Provincial Ecological Criteria for Healthy Aquatic Ecosystems* report (Alberta Water Council, 2009). The workshop could also review possible alternatives to WCOs (not as replacements for WCOs, but to improve the long-term health of the aquatic environment).
- Provide the resources necessary to continually work towards filling critical gaps in information about water and watershed management
- Next step: Collate and provide data/information in a meaningful way to understand the state of the health of the SSRB and the opportunities to restore it where it is degraded. Continue to support monitoring. (Collation and provision of data for this review was limited by scope, time and resource constraints.)
  - Next step: AEP complete the water reuse and stormwater policy. This is a key gap in the current policy portfolio. The policy is currently being worked on.
  - Next step: Ensure budget is secured to continue monitoring at existing stations, and consider increasing and/or improving monitoring capabilities throughout the basin (secure additional budget, improve stakeholder coordination and collaboration).
  - Next step: Ensure budget and resources are secured for future review of the Plan.

BAC members look forward to discussing the findings of this review with AEP, and exploring next steps towards a sustainable environment and economy for the SSRB.



## References

- Alberta Environment. "Approved Water Management Plan for the South Saskatchewan River Basin (Alberta)." 2006. <https://open.alberta.ca/publications/0778546209>.
- Government of Alberta. "Alberta Implements Water Management Plan for the South Saskatchewan River Basin." Alberta.ca, 30 Aug. 2006, [www.alberta.ca/release.cfm?xID=2043260C967C4-CBB8-C14F-FOEFFFCE8EF4EF81](http://www.alberta.ca/release.cfm?xID=2043260C967C4-CBB8-C14F-FOEFFFCE8EF4EF81).
- Alberta Environment. "South Saskatchewan River Basin Water Management Plan Phase Two: Background Studies." 2003. <https://open.alberta.ca/dataset/1d151c3b-7a0a-4e63-aa37-f6f8a85245c5/resource/0a3fc02d-e053-45b9-b0ea-3d45642a03fc/download/backgroundstudies-ssrbplan-jun2003.pdf>.
- Alberta Environment. "Aquatic and Riparian Condition Assessment of the SSRB." 2007. <https://open.alberta.ca/dataset/274d8f92-9dde-4fb9-85c7-c783fadb5969/resource/93661e85-3cd3-4d0f-a6f9-b9c8c20f6ee0/download/aquaticriparianassessment-ssrb-jun2007.pdf>.
- Alberta Agriculture and Forestry. "Water Quality in Alberta's Irrigation Districts." 2014. [https://www1.agric.gov.ab.ca/\\$Department/deptdocs.nsf/all/irr14080/\\$FILE/wq\\_%202014\\_progress\\_report.pdf](https://www1.agric.gov.ab.ca/$Department/deptdocs.nsf/all/irr14080/$FILE/wq_%202014_progress_report.pdf)
- Alberta Water Council. "Provincial Ecological Criteria for Healthy Aquatic Ecosystems." 2009. [https://www.awchome.ca/LinkClick.aspx?fileticket=1LxcW7\\_lqQ%3d&tabid=117](https://www.awchome.ca/LinkClick.aspx?fileticket=1LxcW7_lqQ%3d&tabid=117).
- Alberta Agriculture. "Assessment of Environmental Sustainability in Alberta's Agricultural Wetlands." 2008. [https://www1.agric.gov.ab.ca/\\$department/deptdocs.nsf/all/irr12647/\\$file/vol1\\_aesa\\_assessmentofenvironmentalsustainabilityinalbertasagriculturalwatersheds\\_rtw.pdf?OpenElement](https://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/irr12647/$file/vol1_aesa_assessmentofenvironmentalsustainabilityinalbertasagriculturalwatersheds_rtw.pdf?OpenElement).
- Red Deer River Watershed Alliance. "The Planning Process." [www.rdrwa.ca/node/200](http://www.rdrwa.ca/node/200).
- Government of Alberta. "Guide to Watershed Management Planning in Alberta." (2015) <https://open.alberta.ca/dataset/5a8bc71a-e08a-476e-abb3-f7454597797b/resource/97053643-777e-407e-800c-79e2a5975dfd/download/guidewatershedmanagementplanning-2015.pdf>.
- Government of Alberta. "South Saskatchewan Region – Surface Water Quality Management Framework." 2014. <https://open.alberta.ca/publications/9781460118603>.
- Government of Alberta. "Bow River Phosphorus Management Plan." 2014. <http://aep.alberta.ca/land/programs-and-services/land-and-resource-planning/regional-planning/south-saskatchewan-region/subregional-plans/bow-river-phosphorus-management-plan.aspx>.

Golder Associates, "Strategic Overview of Riparian and Aquatic Condition of the SSRB." 2004. <http://aep.alberta.ca/water/programs-and-services/south-saskatchewan-river-basin-water-information/studies/documents/OverviewRiparianAquatic-SSRB-Report-2003.pdf>.

Mannix Elinam Inc., Amy, and Alberta Environment and Sustainable Resource Development. "Report on Cumulative Effects Management in Alberta for the Bow River Phosphorus Management Plan." (2014). <https://open.alberta.ca/dataset/8f139749-31bf-4eca-8e5c-5b20d3f83a3e/resource/0dd3c754-075f-4b36-a176-38a87184a846/download/2014-Report-Cumulative-Effects-Management-Alberta-Bow-River-Phosphorus-Plan-BRPMP-2014-10-31.pdf>.

Alberta Environment, "Towards Environmental Sustainability: Proposed Regulatory Framework for Managing Environmental Cumulative Effects." <https://www.assembly.ab.ca/lao/library/egovdocs/2007/al/en/162068.pdf>.

WATER ACT - Alberta. 1996, [www.qp.alberta.ca/documents/Acts/w03.pdf](http://www.qp.alberta.ca/documents/Acts/w03.pdf).

*Groundwater Supply and Demand Audit of the Sheep, Highwood, Little Bow Watersheds*: AMEC Environment & Infrastructure Technical Memo 3, 2012 (Highwood Management Plan Public Advisory Committee Document- contact 403-652-3534) Summary page ii and Section 1.3 pages 17-23.

Alberta Water Council, "Looking Back: Evaluating Sector Improvements in Water Conservation, Efficiency and Productivity." 2017. <https://awchome.ca/LinkClick.aspx?fileticket=TduvZKyu-d4%3d&tabid=209>.

Alberta Regulation 171/2007, *Water Act*, "Bow, Oldman and South Saskatchewan River Basin Water Allocation Order." [http://www.qp.alberta.ca/1266.cfm?page=2007\\_171.cfm&leg\\_type=Regs&display=html](http://www.qp.alberta.ca/1266.cfm?page=2007_171.cfm&leg_type=Regs&display=html).

Alberta Environment and Parks, "*Water for Life Strategy*." 2003. <https://open.alberta.ca/publications/0778530582>.

Government of Alberta, "South Saskatchewan Regional Plan, 2014 – 2024." Amended 2017. <https://www.landuse.alberta.ca/LandUse%20Documents/South%20Saskatchewan%20Regional%20Plan%202014-2024%20-%20February%202017.pdf>.

Alberta Water Council, "Water Allocation Transfer System Upgrade Project." 2009. <https://www.awchome.ca/Projects/WATSUP/tabid/107/Default.aspx>.

Alberta Water Council, "Looking Back: Evaluating Sector Improvements in Water Conservation, Efficiency and Productivity." 2017. <https://awchome.ca/LinkClick.aspx?fileticket=TduvZKyu-d4%3d&tabid=209>.

Clipperton, et al, "Instream Flow Needs Determinations for the South Saskatchewan River Basin, Alberta, Canada." 2003. <https://open.alberta.ca/publications/0778530450>.

## Glossary

(The definitions provided below are from the Approved Water Management Plan for the South Saskatchewan River Basin. Not all terms below are referred to in this report, but are included here for information purposes.)

**AEP** ~ Alberta Environment and Parks

**Allocation** ~ The volume, rate and timing of a diversion of water. When water is diverted for a use other than for household purposes (use by an owner of property adjacent to a water body or from an aquifer), it is referred to as an allocation. All water users (except for household users) apply to Alberta Environment and Parks for a licence to use a set allocation of water.

**Apportionment** ~ (see Master Agreement on Apportionment)

**Approval** ~ Under the *Water Act*, an approval provides authority for constructing works or for undertaking an activity within a water body. The approval includes conditions under which the activity may take place.

**Aquatic Environment** ~ (As defined in Alberta's *Water Act*) 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 but not limited to all organic and inorganic matter, and living organisms and their habitat, including fish habitat, and their interacting natural systems.

**BAC / Basin Advisory Committee** ~ Established in each of the four sub-basins of the South Saskatchewan River Basin to provide advice for the SSRB Water Management Plan. BACs were also established for the purpose of this project (reviewing the implementation of the SSRB Water Management Plan). Members of the BACs represent sectors interested in water management in the sub-basin. Typical sectors represented in a BAC include irrigation agriculture, non-irrigation agriculture, ecosystem protection/environmental, First Nations, industry, municipal and recreation.

**cms** ~ cubic metres per second

**Condition on Licences** ~ The terms of the licence that must be followed.

**Crown Reservation** ~ Section 35(1) of the *Water Act* states that "the Minister may by order reserve water that is not currently allocated under a licence or registration or specified in a preliminary certificate

- (a) in order to determine how the water should be used, or
- (b) for any other purpose."

**dam<sup>3</sup>** ~ decametres cubed (1,000 cubic metres). 1 dam<sup>3</sup>= 0.81 acre feet.

**Director** ~ For purposes of administration of the *Water Act*, certain staff in Alberta Environment, such as Approvals Managers, are designated as "Directors". Under the *Water Act* a Director has sole authority to make decisions concerning a number of specified subjects, e.g., transfers, holdbacks and establishing WCOs.



**Dissolved Oxygen** ~ Amount of available oxygen contained in the water, but not including the oxygen that is part of the water molecule (H<sub>2</sub>O). Expressed as milligrams per litre.

**Groundwater** ~ Water located beneath the ground surface in soil pore spaces and in the fractures of geologic formations. A formation of rock/soil is called an aquifer when it can yield a useable quantity of water. Groundwater that is in an aquifer that readily (drawdown cone for a well intersects a surface water body) flows naturally under the ground to surface water bodies is considered surface water for licencing purposes in Alberta.

**Instream Flow** ~ The rate of flow in a river, without reference to its purpose.

**Instream Needs / Instream Flow Needs (IFN)** ~ This is the scientifically determined amount of water, flow rate, water level, or water quality 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.

**Instream Objectives** ~ Regulated flows that should remain in the river via dam operations or as a restriction on licences. Below dams, Instream Objectives are in place throughout the SSRB, although some offer only limited protection of the aquatic environment. Instream Objectives have usually been set in response to fish habitat instream needs (the Fish Rule Curve) and/or water quality.

**Irrigation District** ~ An organization/corporation that owns and manages a water delivery system for irrigation for a given region. In Alberta, there are 13 irrigation districts. Some districts convey water for other purposes, such as municipal use and stockwatering.

**Licence In Good Standing** ~ This term is used in Alberta's *Water Act*, but is not defined. One of the issues that must be determined by the Director is whether or not the allocation of water to be transferred is held "under a licence in good standing" (*Water Act*, s. 81(7)(c)). The licence has to be in good standing at the time the Director considers the application (that is, it already exists in good standing or the licence holder brings the licence into good standing prior to the time when the Director considers the application to transfer.) Examples of a licence not in "good standing" are a licence that is:

- In breach of the *Water Act*
- Subject to an investigation under the *Water Act*
- Subject to an enforcement tool or prosecution
- In breach of terms and conditions of the licence
- In non-compliance with the terms and conditions of the licence (e.g. did not build the diversion site within the specified period)

**Master Agreement on Apportionment** ~ Schedule A of the 1969 Master Agreement on Apportionment for the South Saskatchewan River between Alberta and Saskatchewan allows Alberta to "divert, store or consume" from the river system each year, a volume of water equal to one-half of the apportionable flow of the South Saskatchewan River at the Alberta-Saskatchewan boundary. The remaining volume of flow must be allowed to pass downstream into Saskatchewan. The exception to this general rule is that Alberta is entitled to divert, store or consume a minimum of 2.1 million-acre feet in any year. The effect of this exception is that during years when the volume of natural flow is less than 4.2 million-acre feet (a rare occurrence), Alberta may pass less than one-half of the apportionable flow to Saskatchewan. If at any time during a year Alberta wants to divert, store or consume more than half the apportionable flow, a flow rate of 1,500 cubic feet per second (cfs) must be maintained at the

Saskatchewan border, unless the natural flow is less than 3,000 cfs, in which case half the natural flow must be passed. (There is no policy in Alberta as to the amount of water each sub-basin of the SSRB must contribute to the Saskatchewan apportionment.)

**Natural Flow / Natural Rate of Flow** ~ Natural flow is the flow in rivers that would have occurred in the absence of any man-made effects on, or regulation of, flow. For purposes of water management, natural flow is a calculated value based on the recorded flows of contributing rivers; a number of factors concerning the river reaches (e.g. evaporation, channel losses, etc.); and water diversions. This is also known as “re-constructed flow” and “naturalized flow.”

**Net Diversion** ~ A licence that allows the licensee to receive credit for returning water to the source of the diversion. The water must be of a reasonable quality and be returned with suitable timing. The credit permits increased diversion equivalent to the volume returned, provided the net diversion does not exceed the total licence allocation.

**Preliminary Certificates** ~ An authorization issued by the Director to certify that a licence will be issued if certain conditions are met.

**Retrofit Provision** ~ Water licences issued in recent years contain a condition indicating that once a water conservation objective is established, the licence may be amended to include the WCO. The licence holder would then not be permitted to withdraw water when river flow is less than the objective.

**Riparian Area** ~ The area along streams, lakes, and wetlands where water and land interact. These areas support plants and animals, and protect aquatic environments by filtering out sediments and nutrients originating from upland areas.

**River Basin** ~ An area of land drained by a river and its associated streams or tributaries.

Alberta’s Water Act identifies seven major river basins within the province:

- Peace/Slave River Basin
- Athabasca River Basin
- North Saskatchewan River Basin
- South Saskatchewan River Basin
- Milk River Basin
- Beaver River Basin
- Hay River Basin

**SSRB** ~ South Saskatchewan River Basin. The South Saskatchewan River Basin includes the sub-basins of the Red Deer River, Bow River, and Oldman River (including the South Saskatchewan).

**Southern Tributaries** ~ This term refers to the St. Mary, Belly and Waterton rivers, which are also collectively referred to as the southern tributaries of the Oldman River.

**Sub-basin** ~ A part of a river basin drained by a tributary or having characteristics that are significantly different from other areas in the basin.

**Surface Water** ~ Water bodies such as lakes, ponds, wetlands, rivers, and streams. It may also refer to sub-surface water or groundwater with a direct and immediate hydrological connection to surface water (for example, water in a well beside a river).

**Voluntary Action** ~ Performing an activity freely, without compulsion.

**WCO** ~ Water Conservation Objective

**WPAC** ~ Watershed Planning and Advisory Council (see *Water for Life: Alberta's Strategy for Sustainability*). In the SSRB, WPACs include the Bow River Basin Council, the Oldman Watershed Council, the Red Deer River Watershed Alliance and the South East Alberta Watershed Alliance.

**Water Act** ~ The purpose of Alberta's *Water Act* is to support and promote the conservation and management of water, including the wise allocation and use of water (s.2).

**Water Allocation Transfer** ~ A water allocation transfer occurs when the holder of an existing water licence agrees to sell all or part of the amount they are allocated to another person or organization. Alberta Environment and Parks must approve a transfer. When this occurs, the allocation is separated from the original land, and a new licence, with the seniority of the transferred allocation, is issued and attached to the new location. Under the *Water Act*, Alberta Environment and Parks may place conditions on the new licence. Water allocation transfers may occur only if authorized under an approved water management plan, or by the Lieutenant Governor in Council. See Sections 81, 82 and 83 of the *Water Act*.

**Water Conservation Holdback** ~ If the Director is of the opinion that withholding water is in the public interest to protect the aquatic environment or to implement a Water Conservation Objective, and the ability to withhold water has been authorized in an applicable approved water management plan or by order of the Lieutenant Governor in Council, the Director may withhold up to 10% of an allocation of water under a licence that is being transferred. The withholding occurs at the time the new licence created for the transferred allocation is issued (section 82(2) of the *Water Act*).

**Water Conservation Objective (WCO)** ~ As defined in Alberta's *Water Act*, a Water Conservation Objective is the amount and quality of water necessary for the protection of a natural water body or its aquatic environment. It may also include water necessary to maintain a rate of flow or water level requirements. From the *Water Act*: "Water Conservation Objective" means the amount and quality of water established by the Director under Part 2, based on information available to the Director, to be necessary for the

- (i) protection of a natural water body or its aquatic environment, or any part of it;
- (ii) protection of tourism, recreational, transportation or waste assimilation uses of water; or
- (iii) management of fish or wildlife, and may include water necessary for the rate of flow of water or water level requirements.

A licence may be issued by the Director to the Government of Alberta for the purpose of implementing a Water Conservation Objective.

**Water Licence** ~ A water licence provides the authority for diverting and using surface water or groundwater allocation. The licence identifies the water source, the location of the diversion site, an amount of water to be diverted and used from that source, the priority of the "water right" established by the licence, and the condition under which the diversion and use must take place.

**Water Management Plan** ~ Alberta's *Water Act* and Framework for Water Management Planning outlines the process for water management planning and the components required for water management plans in the province.

**Water Use Efficiency** ~ To use the least possible water to accomplish an objective, such as growing a crop.

**Water Use Effectiveness** ~ To use water for purposes that provide the maximum desired benefits for society.

**Watershed** ~ An area of land that catches precipitation and drains into a body of water, such as a marsh, stream, river or lake.

## Endnotes

---

<sup>1</sup> Alberta Environment, 2006. Approved Water Management Plan for the South Saskatchewan River Basin, p 1.

<sup>2</sup> Op. cit. p 18.

<sup>3</sup> See [South Saskatchewan River Basin Water Management Plan, Phase Two: Background Studies](#) for information on the government-led studies conducted for Phase Two.

<sup>4</sup> Reports accessed included:

- Appendix C (Summary of Water Use Data by Sector) from “Looking Back: Evaluating Sector improvements in Water Conservation, Efficiency and Productivity” (Alberta Water Council, 2017).
- Table 7: Gross Annual Diversions, Expansion Limits, and License Allocations to Irrigation Districts; and Table 8: Irrigation Districts Water Balance in 2016, from Alberta Agriculture and Forestry’s report, “Alberta Irrigation Information 2016.”
- Summary charts from Calgary, Medicine Hat and Lethbridge showing total diversion, allocation and returns – data submitted to AEP.

<sup>5</sup> The specific WCOs for the Bow, Oldman and South Saskatchewan river sub-basins are detailed on pages 8 - 9 of the Plan.

<sup>6</sup> The specific WCOs for the Red Deer River sub-basin is detailed on pages 9 - 10 of the Plan.

<sup>7</sup> The Integrated Watershed Management Plan and technical reports can be found at <http://www.rdrwa.ca/node/200>.

<sup>8</sup> Government of Alberta, [Guide to Watershed Management Planning in Alberta](#) (2015).

<sup>9</sup> Government of Alberta, [Water for Life](#) (2003).

<sup>10</sup> Government of Alberta, South Saskatchewan Regional Plan 2014 – 2024 (2014).

<sup>11</sup> From an undated Alberta Environment SSRB WMP WCO Fact Sheet.

<sup>12</sup> “Report on Cumulative Effects Management in Alberta for the Bow River Phosphorus Management Plan,” p 13, (AEP, 2014).

<sup>13</sup> Alberta Environment, 2006. Approved Water Management Plan for the South Saskatchewan River Basin, p 9.