

AIPA Conference  
February 5, 2019

An aerial photograph of a river, showing the winding path of the water and the surrounding landscape. The water is a deep blue, and the banks are a mix of green and brown, indicating a natural, somewhat rugged environment.

# **Bow River Water Management Project Past & Future**

Mike Kelly  
Chair, BRWG

# The Bow River Water Management Project

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Announced October 2015

Co-chaired by AEP and the City of Calgary

Completed April 2017

4 Advisory Committee sessions

7 Bow River Working Group (BRWG) sessions

3 Community group sessions

Sub committees as needed (Data, Drought)

Broad representation of water users, managers and stakeholders, including:

10 municipalities

2 First Nations

1 power generation company

3 irrigation districts

3 watershed groups

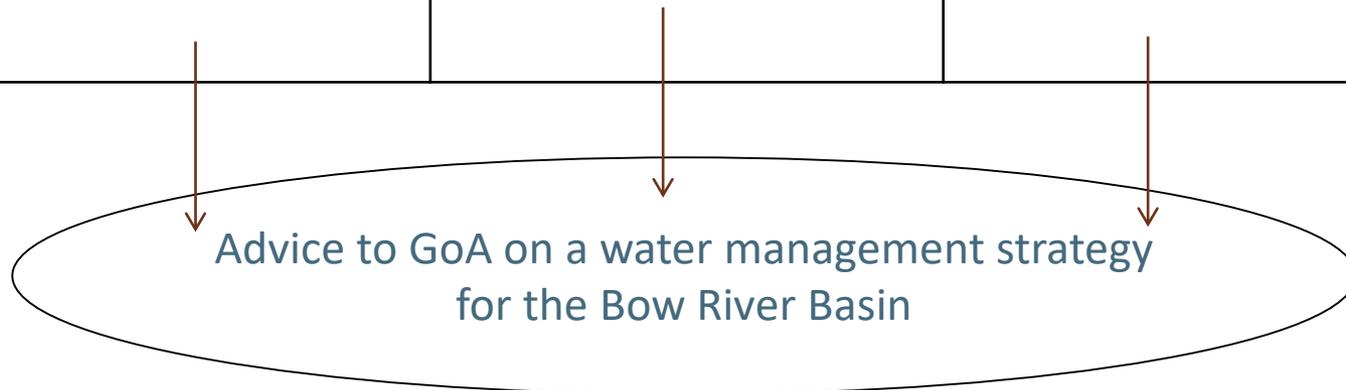
2 Environmental Non-Governmental Organizations

2 government ministries

This presentation and corresponding report summarize the findings of the Bow River Water Management Project and offers it as advice to the Minister of AEP in developing a robust, strategic plan for water management in the Bow River Basin

# Objectives: Inform a Bow River Basin water management strategy

<b>Flood mitigation</b>	<b>Balancing the system</b>	<b>Drought mitigation</b>
<p>Develop scenarios of potential operational and infrastructure flood mitigation opportunities in the upper Bow River Basin (above Calgary) to reduce peak flow during a defined range of synthesized flood events to approximately 1,200 and 800 cms measured on the Bow River above the confluence with the Elbow River, and assess how these scenarios affect flow thresholds along other reaches of the Bow River</p>	<p>Identify schemes required to offset any increased water management risk in the basin created by the flood mitigation scenarios upstream</p>	<p>Develop scenarios of potential operational and infrastructure drought mitigation opportunities to reduce the volume of licence shortages by at least 5% to 10%, while continuing to meet apportionment requirements, and with improvement, or at minimum no reduction, in ecosystem health (all relative to current operations in the same time period)</p>



# Flood mitigation: objective, schemes and synthesized events

Develop scenarios of potential operational and infrastructure flood mitigation opportunities in the upper Bow River basin to reduce peak flow during a defined range of synthesized flood events to 1200, 800 and 400 cms measured on the Bow River at Calgary and other reaches. And the scenarios will include additional measures required to offset any detriment to drought mitigation and watershed health.

15 potential schemes from 2 prior studies and from participants

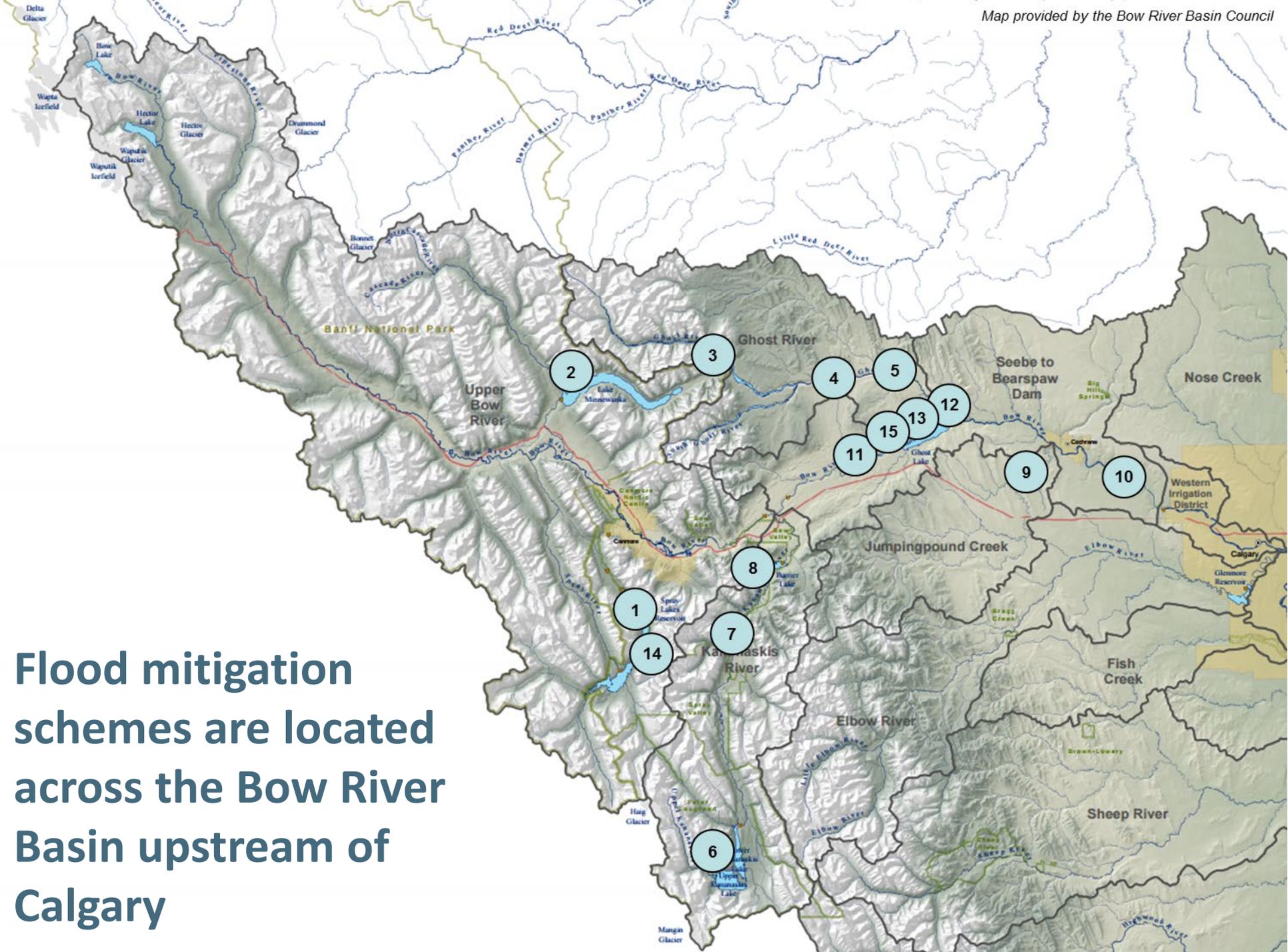
4 synthesized events:

(Event 1) the 2013 flood event of 2,400 cms naturalized peak hourly streamflow for the Bow River at Calgary (above the Elbow River)

(Event 2) the 2005 flood event of 1,250 cms naturalized peak flow scaled to approximately 2,000 cms peak hourly streamflow for the Bow River at Calgary (above the Elbow River)

(Event 3) the 2005 flood event scaled to approximately 2,400 cms peak hourly streamflow for the Bow River at Calgary (above Elbow River), and

(Event 4) the 2013 flood event scaled to approximately 3,300 cms peak hourly streamflow for the Bow River at Calgary (above the Elbow River).



**Flood mitigation schemes are located across the Bow River Basin upstream of Calgary**

# Bow River Water Management Project: Flood mitigation findings

The 1200 cms flood mitigation objective can be met in many flood events using a combination of operational changes and one major project.

There may be opportunity to push these same schemes to achieve close to the 800 cms objective; otherwise a second major project would be required.

The operational changes include:

Extend the 2016 agreement for flood operations at Ghost Reservoir.

Increase the Ghost Reservoir drawdown rate.

Flood operations at Barrier Dam.

The most attractive major projects are located low on the main stem of the Bow River, not on the tributaries:

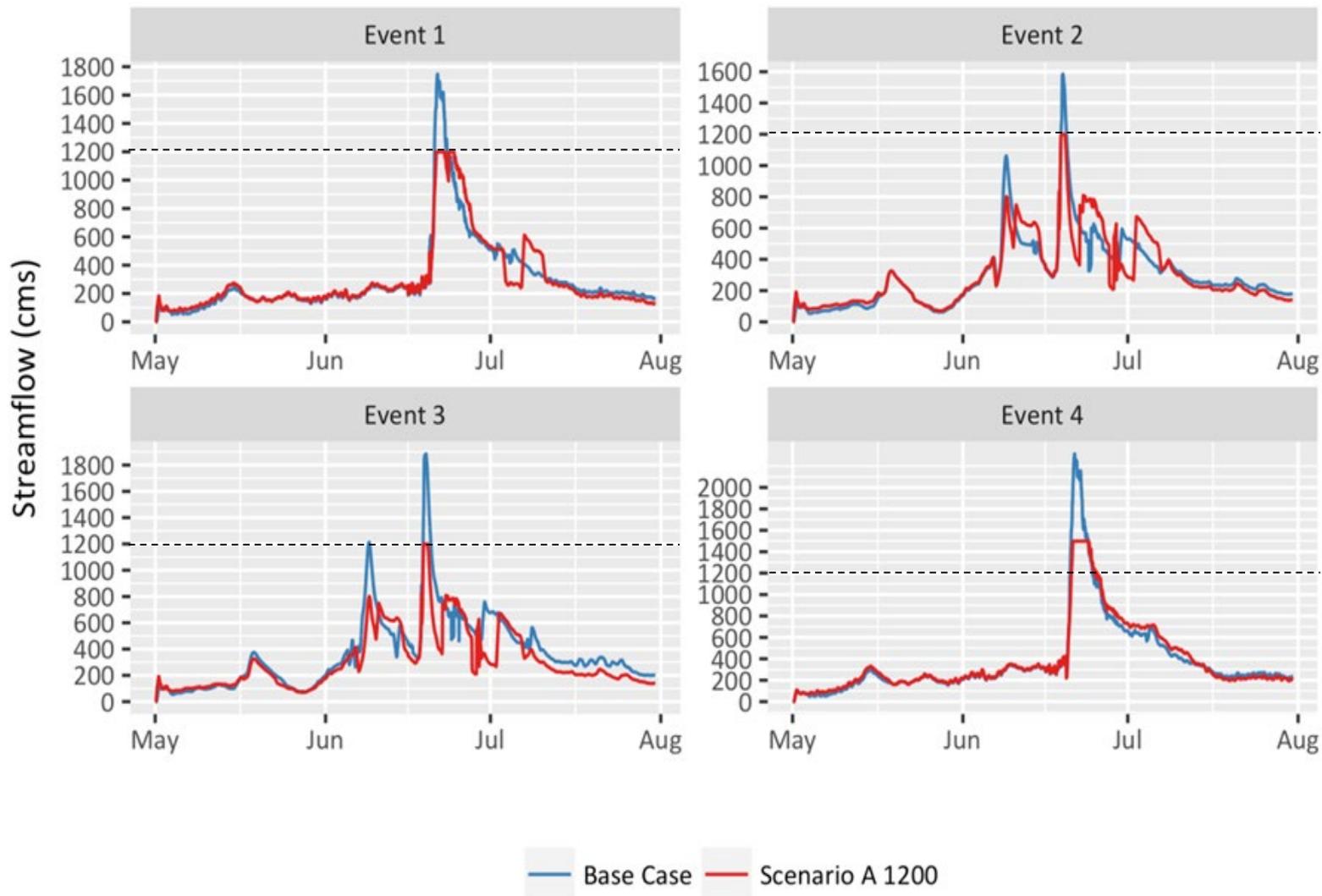
A new Glenbow reservoir on Bow River upstream of Bearspaw.

A new Morley reservoir on Bow River upstream of Ghost Reservoir.

Expansion of the existing Ghost reservoir through raising full supply level and/or installing a low-level outlet.

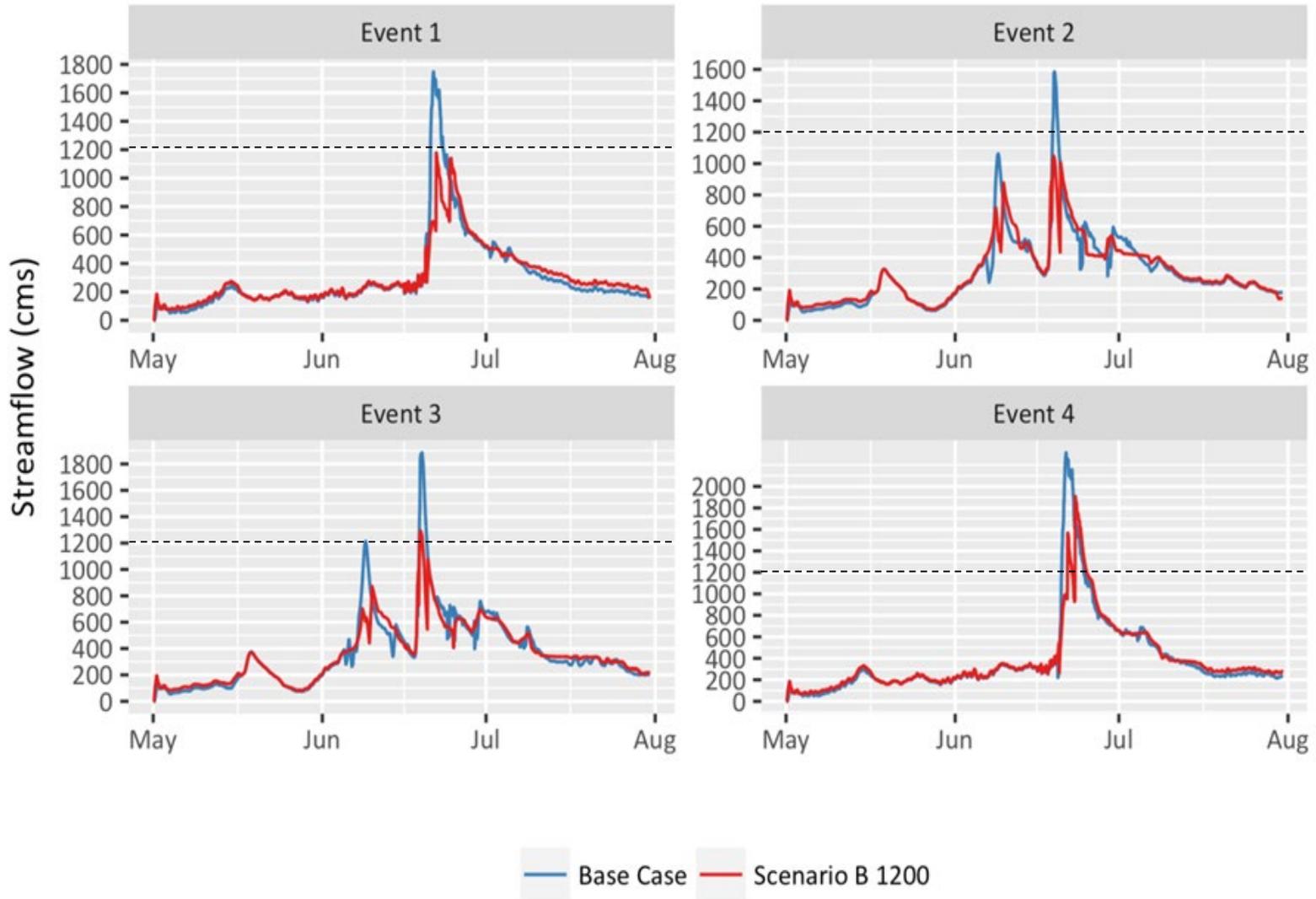
# 1200 cms Scenario A (ops + Glenbow)

*Met the target in each event except Event 4; substantial reduction in Event 4*



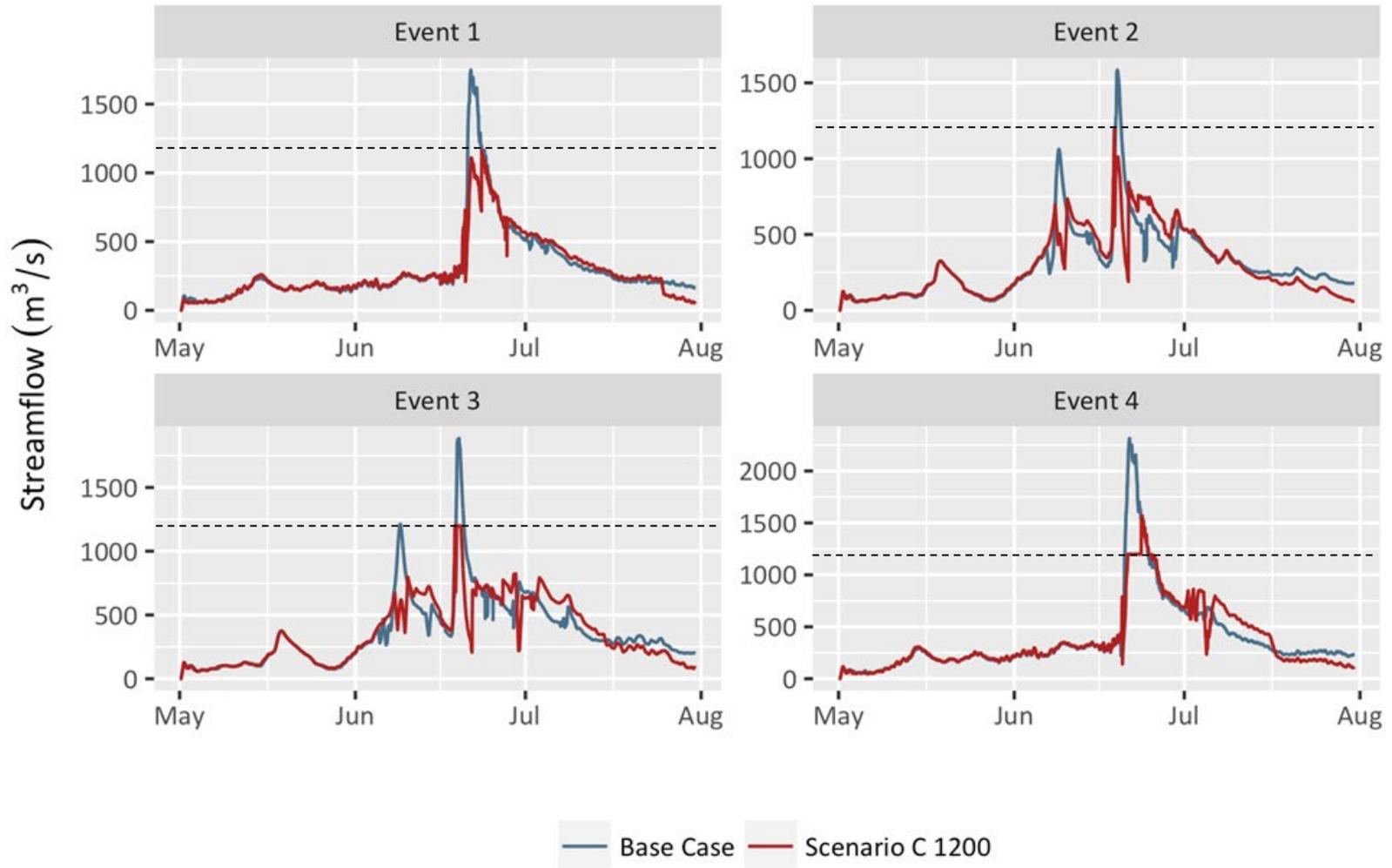
# 1200 cms Scenario B (ops + Morley)

*Met the target in Events 1 and 2; nearly in Event 3; substantial reduction in Event 4*



# 1200 cms Scenario C (ops + Ghost)

*Met the target in Events 1, 2 and 3; substantial reduction in Event 4*



# Flood mitigation in the Bow River Basin

Target: 1200 cms on the Bow River at Calgary

Extend Ghost Reservoir flood operations (2016 agreement)

*and*

Increase Ghost Reservoir drawdown rate

*and*

Barrier Lake flood operations

*and*

One major infrastructure scheme:

New  
Glenbow  
reservoir

*or*

New  
Morley  
reservoir

*or*

Expand  
Ghost  
Reservoir

*or*  
\*

New Kananaskis  
reservoir

+

New JPC reservoir  
or New Ghost  
River reservoir

\* If main stem infrastructure schemes are not possible, a less favourable scenario would require two new reservoirs on major tributaries

# Flood mitigation in the Bow River basin

Target: 800 cms on the Bow River at Calgary

Extend Ghost Reservoir flood operations (2016 agreement)

+

Increase Ghost Reservoir drawdown rate

+

Barrier Lake flood operations

+

One major infrastructure scheme:

New  
Glenbow  
reservoir

or

New  
Morley  
reservoir

or

Expand  
Ghost  
Reservoir

or

\*

New Kananaskis  
reservoir  
+  
New JPC reservoir  
or New Ghost  
River reservoir

\* If main stem infrastructure schemes are not possible, a less favourable scenario would require two new reservoirs on major tributaries

+

A second major infrastructure scheme:

New  
Glenbow  
reservoir

or

New  
Morley  
reservoir

or

Expand  
Ghost  
Reservoir

or

\*

New Kananaskis  
reservoir  
+  
New JPC reservoir  
+  
New Ghost River  
reservoir

\* If main stem infrastructure schemes are not possible, a less favourable scenario would require three new reservoirs on major tributaries

# Balancing the System

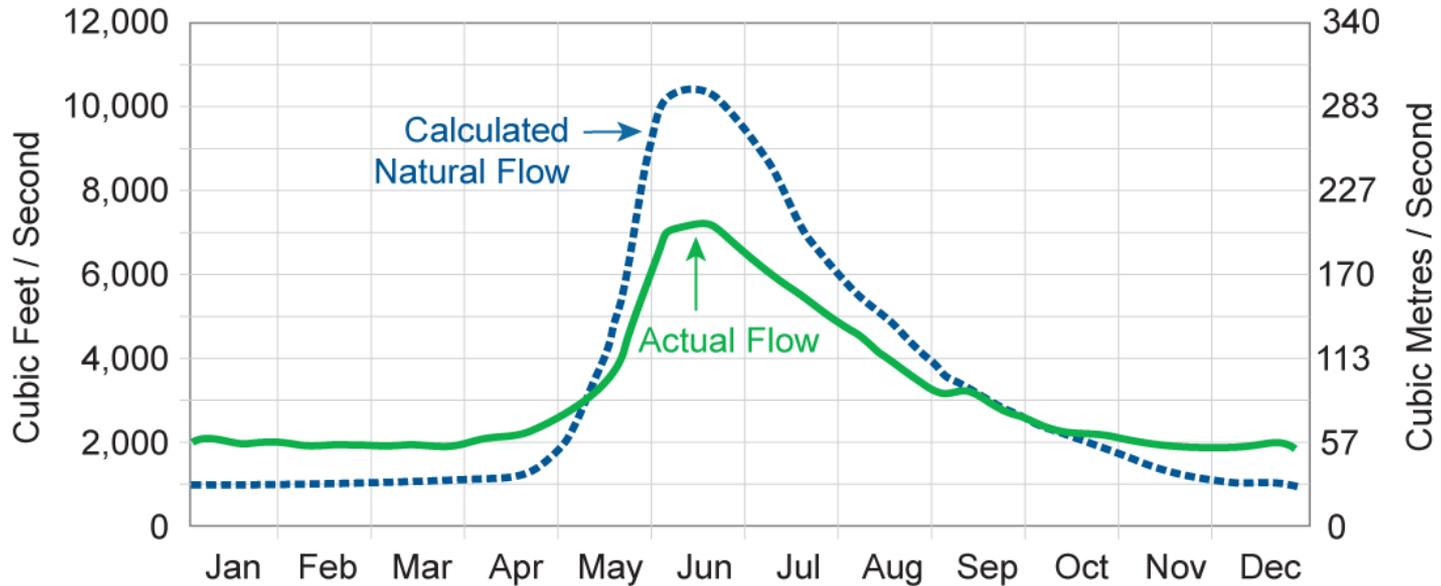
Target: Offset the increased risk from the flood mitigations schemes

Increase Ghost Reservoir drawdown rate  
+  
Drought storage in expanded Glenmore Reservoir\*  
+  
Increase diversion rate of the Carseland Canal and construct debris deflector\*  
+  
Raise winter carryover in downstream reservoirs (e.g. Travers/Little Bow, McGregor)  
+  
Fill downstream reservoirs earlier (e.g. Travers/Little Bow)  
+  
Extend Kananaskis System water shortage mitigation operations (2016 agreement)

\* Indicates scheme likely requiring a licence amendment

# Balancing the System

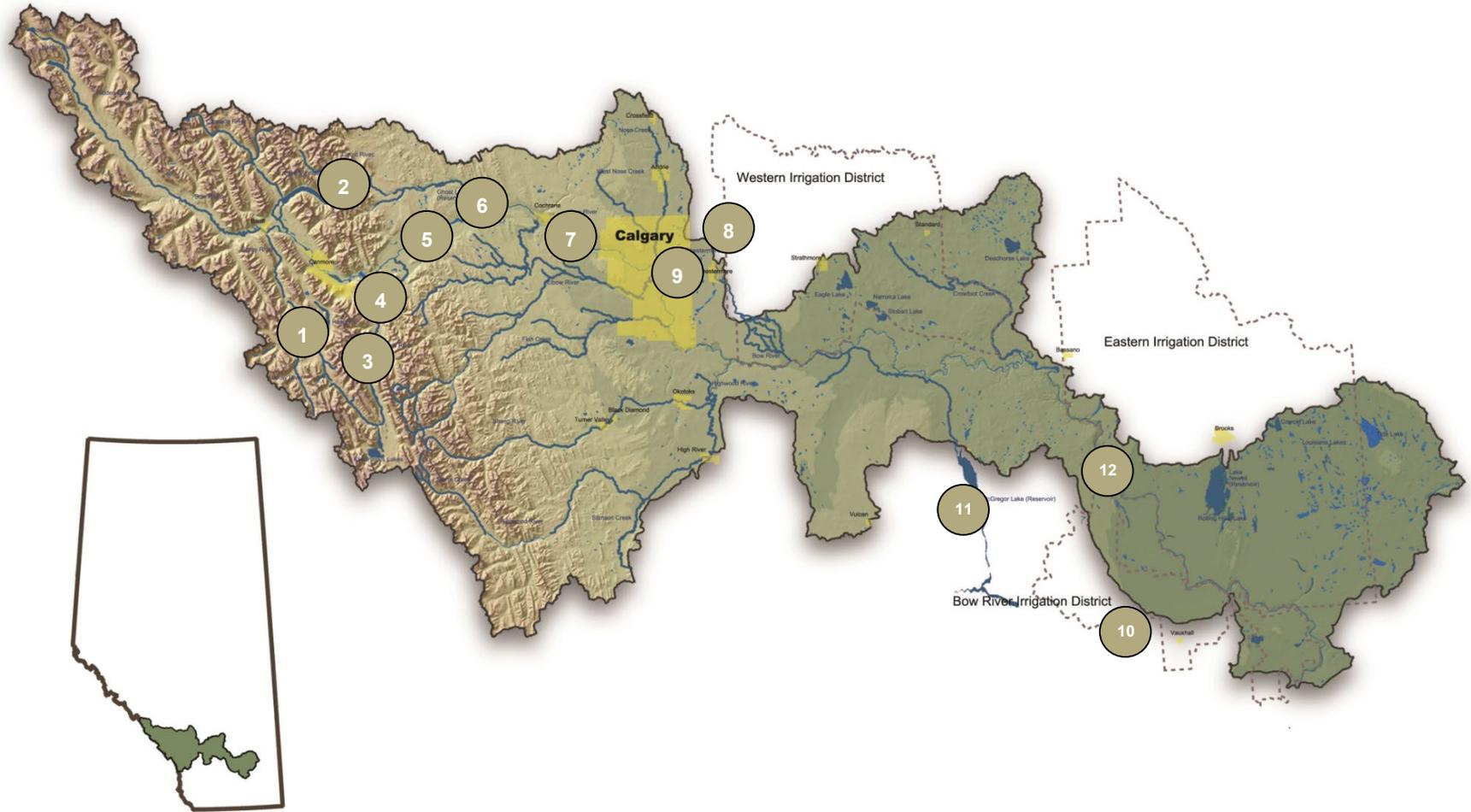
## Bow River at Calgary - Natural vs. Managed Flows



**It can be managed for both environmental and economic benefits**

*Source: BRBC State of Watershed Plan*

# Drought mitigation schemes are located across the Bow River Basin



*Map provided by the Bow River Basin Council*

# Drought mitigation in the Bow River Basin

**Target: More than 10% reduction in licensed shortages**

## **Operational changes at existing infrastructure**

Extend Kananaskis  
System water shortage  
mitigation operations  
(2016 agreement)

**and/or**

Increase WID  
diversion rate at all  
river stages without  
affecting licence  
priority date\*

**and/or**

Operate McGregor  
Reservoir at the design  
FSL

## **Minor infrastructure**

New Delacour  
reservoir in WID  
**and/or**

New Deadhorse  
Coulee reservoir in  
BRID

## **Major infrastructure (primarily for flood mitigation)**

New Morley  
reservoir  
**and/or**

Expand Ghost  
Reservoir  
**and/or**

New Glenbow  
reservoir

## **Major infrastructure (primarily for drought mitigation)**

New Eyremore  
reservoir low in Bow  
River Basin

\* Indicates scheme likely requiring a licence amendment

# Water management schemes for the Bow River Basin

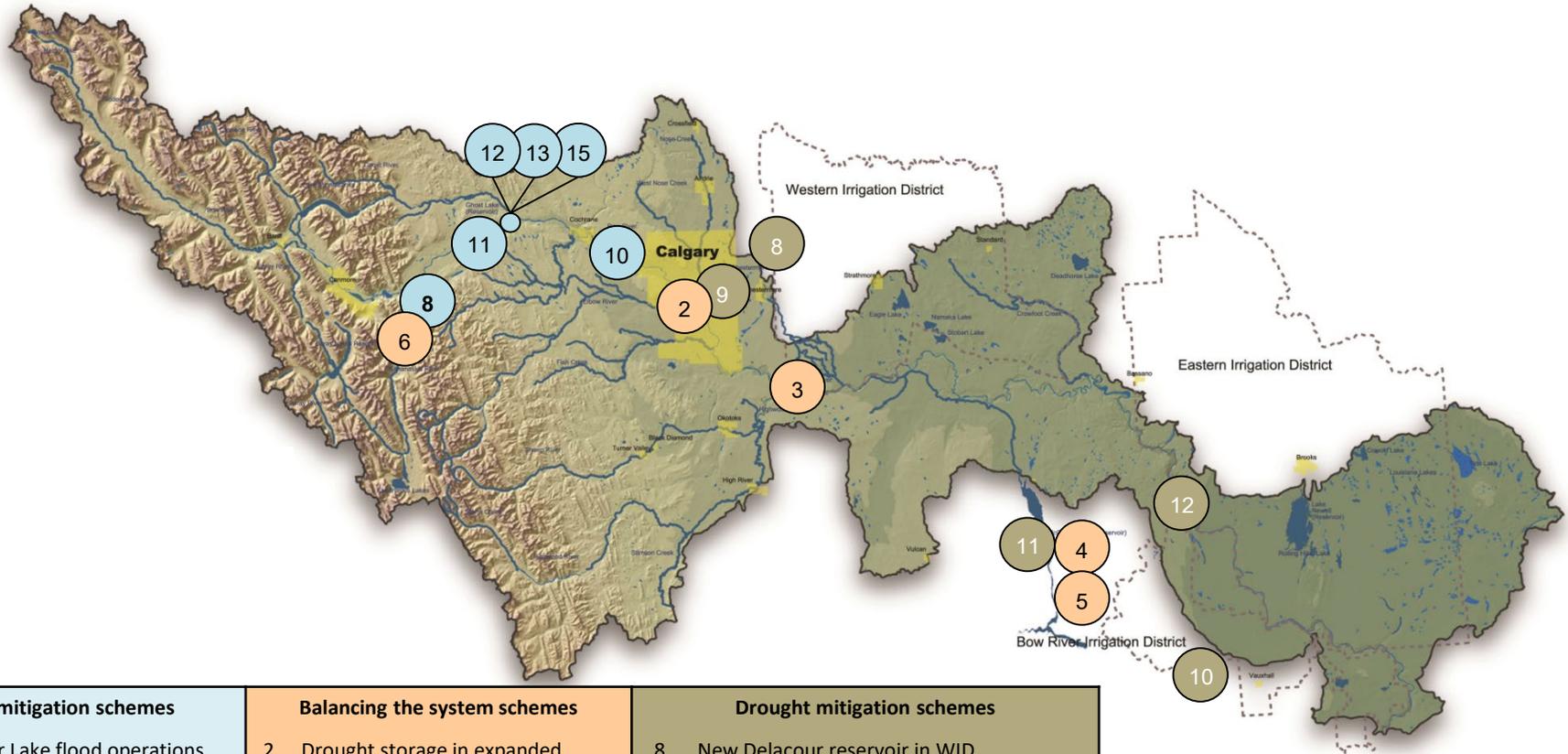
Target: Balancing flood mitigation and drought mitigation

	Flood mitigation	Balancing the system	Drought mitigation
Operational changes	<ul style="list-style-type: none"> <li>Extend Ghost Reservoir flood operations (2016 agreement)*</li> <li>Barrier Lake flood operations</li> </ul>	<ul style="list-style-type: none"> <li>Drought storage in expanded Glenmore</li> <li>Raise winter carryover in existing reservoirs</li> <li>Fill downstream reservoirs earlier</li> <li>Extend Kan. System water shortage mitigation operations (2016 agreement)*</li> </ul>	<ul style="list-style-type: none"> <li>Increase WID diversion rate at all river stages without affecting licence priority date</li> <li>Operate McGregor Reservoir at the design FSL</li> </ul>
Minor infrastructure projects	<ul style="list-style-type: none"> <li>Increase Ghost Reservoir drawdown rate</li> </ul>	<ul style="list-style-type: none"> <li>Increase Carseland diversion and construct debris deflector</li> </ul>	<ul style="list-style-type: none"> <li>New Delacour reservoir in WID</li> <li>New Deadhorse Coulee reservoir in BRID</li> </ul>
Major infrastructure projects**	<ul style="list-style-type: none"> <li>New Glenbow reservoir</li> <li>New Morley reservoir</li> <li>Expand Ghost Reservoir</li> </ul>		<ul style="list-style-type: none"> <li>New Eyremore reservoir low in Bow River Basin</li> </ul>

\*Ghost Reservoir flood operations and Kananaskis System water shortage mitigation operations are currently in place until 2021.

\*\*One major infrastructure project would be required to meet the 1200cms flood mitigation target at Calgary. Two major infrastructure projects would be required to meet the 800cms flood mitigation target at Calgary.

# Water management schemes for the Bow River Basin



Map provided by the Bow River Basin Council

Flood mitigation schemes		Balancing the system schemes		Drought mitigation schemes	
8	Barrier Lake flood operations	2	Drought storage in expanded Glenmore	8	New Delacour reservoir in WID
10	New Glenbow reservoir	3	Increase Carseland diversion and construct debris deflector	9	Increase WID diversion at all river stages without affecting licence priority date
11	New Morley reservoir	4	Raise winter carryover in existing reservoirs	10	New Deadhorse Coulee reservoir in BRID
12	Extend Ghost Reservoir flood operations (2016 agreement)	5	Fill downstream reservoirs earlier	11	Operate McGregor Reservoir at the design FSL
13	Expand Ghost Reservoir	6	Extend Kananaskis system water shortage mitigation operations (2016 agreement)	12	New Eyremore reservoir low in the Bow River Basin
15	Increase Ghost Reservoir drawdown rate				

# Next steps for flood and drought mitigation in the Bow River Basin (I)

1. Build on the 2016 GoA Modified Operations Agreement with TransAlta to put in place the prerequisite needed in the upper Bow system: a long-term flexible watershed agreement between the Province and TransAlta.
  
2. Implement the relatively quick wins, which can be completed while larger projects are assessed.
  - Extend Ghost Reservoir flood operations (2016 agreement) \*
  - Barrier Lake flood operations
  - Drought storage in expanded Glenmore Reservoir \*\*
  - Increase diversion rate of the Carseland Canal and construct debris deflector \*\*
  - Raise winter carryover in downstream reservoirs (e.g., Travers, McGregor)
  - Fill downstream reservoirs earlier (e.g., Travers/Little Bow)
  - Extend Kananaskis System water shortage mitigation operations (2016 agreement) \*
  - Increase WID diversion rate at all river stages without affecting licence priority date \*\*
  - Operate McGregor Reservoir at the design FSL

\* indicates scheme already in place or underway  
\*\* indicates scheme likely requiring a licence amendment
  
3. Complete conceptual assessments and feasibility studies of the minor infrastructure schemes within 1 year.
  - Increase Ghost Reservoir drawdown rate
  - Increase diversion rate of the Carseland Canal and construct debris deflector
  - New Delacour reservoir in WID
  - New Deadhorse Coulee reservoir in BRID

# Next steps for flood and drought mitigation in the Bow River Basin (II)

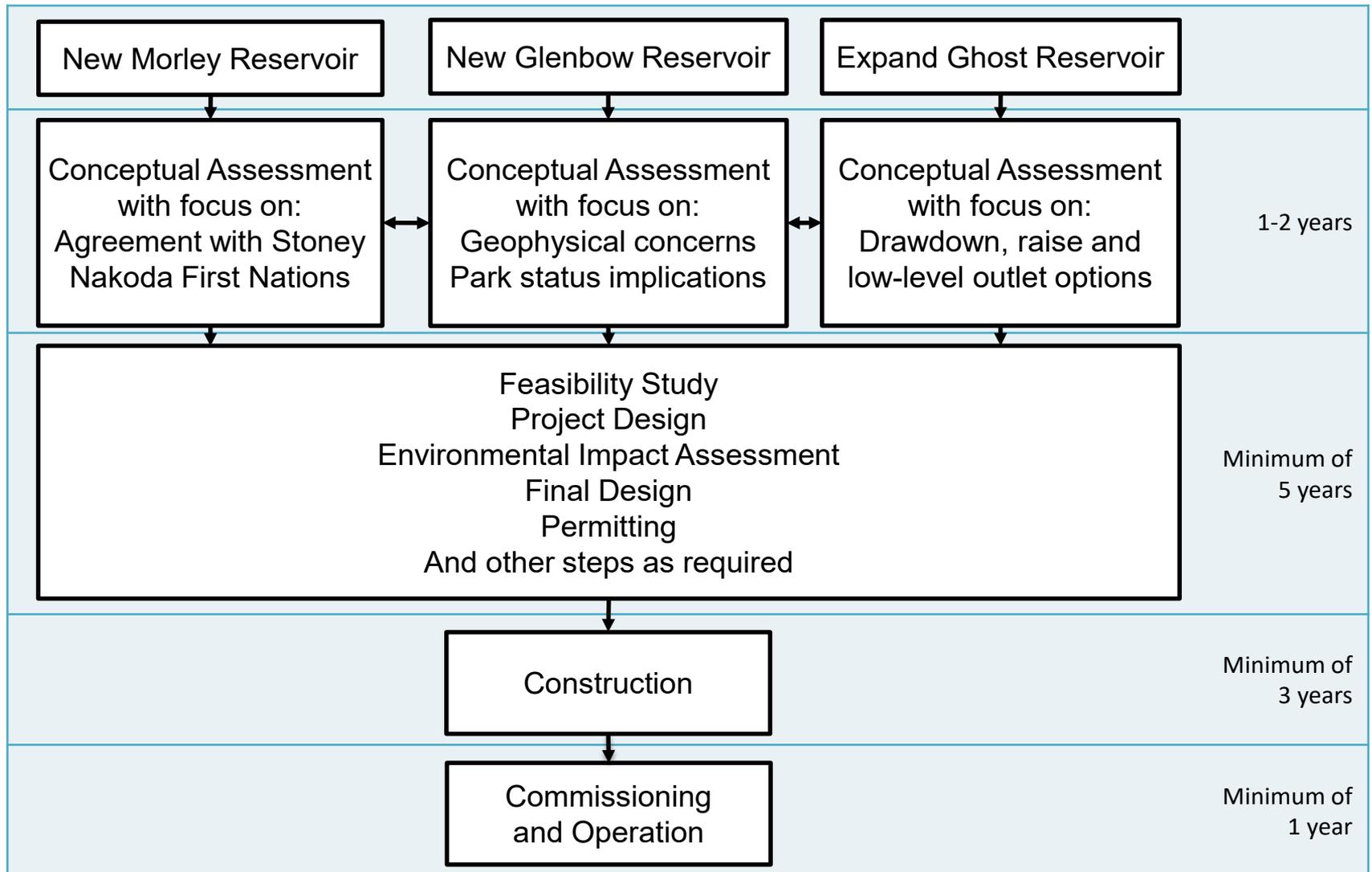
4. Complete conceptual assessments of the 3 major infrastructure flood schemes within 2 years to determine which to advance to feasibility study.
  - New Glenbow reservoir
  - New Morley reservoir
  - Expand Ghost Reservoir
5. Complete conceptual assessment for Eyremore scheme.
6. Ensure full risk management, feasibility, cost–benefit, and triple bottom line assessments are completed in subsequent steps as the schemes and scenarios are advanced.
7. Balance the system to mitigate the increased drought risk from the 2016 GoA Modified Operations Agreement with TransAlta and do not implement further flood mitigation schemes without implementing the accompanying schemes to balance the system and improve its adaptive capacity.

# Next steps for flood and drought mitigation in the Bow River Basin (III)

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8. Establish a process to set and achieve drought mitigation objectives for the Bow River Basin given that the most promising drought mitigation schemes assessed in this project can achieve far more than the original 5 to 10% objective.
9. Increase resourcing and support for precipitation monitoring and forecasting, flow monitoring, flood forecasting and drought forecasting to enhance the effectiveness and adaptability of water management operations.
10. Continue to invest in natural watershed functions, floodplain protection and local mitigation.
11. Commit to a continual collaborative process with stakeholders and policy makers for advancing and implementing these schemes as part of the water management strategy in the Bow River Basin.
12. Review and strengthen where possible the current water management operational protocols of both public and private operators.

# Project Life Cycle: conceptual assessments within 2 years



Note: Timing of these projects are resource dependent

## Next steps

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The next phase of work on drought and flood mitigation options on the Bow (officially referred to as the Bow Basin Water Management Options (BBWMO) Conceptual Assessment) was launched in November 2018 by Wood Group (AMEC Foster Wheeler). The work will include geotechnical, mapping, and hydrologic studies where needed. Conceptual engineering level detail specific to each infrastructure requirements will be conducted.

The Bow River Working Group (BRWG) will be engaged throughout the project via WaterSMART with the goal of soliciting feedback on the engineering assessments to further the study.

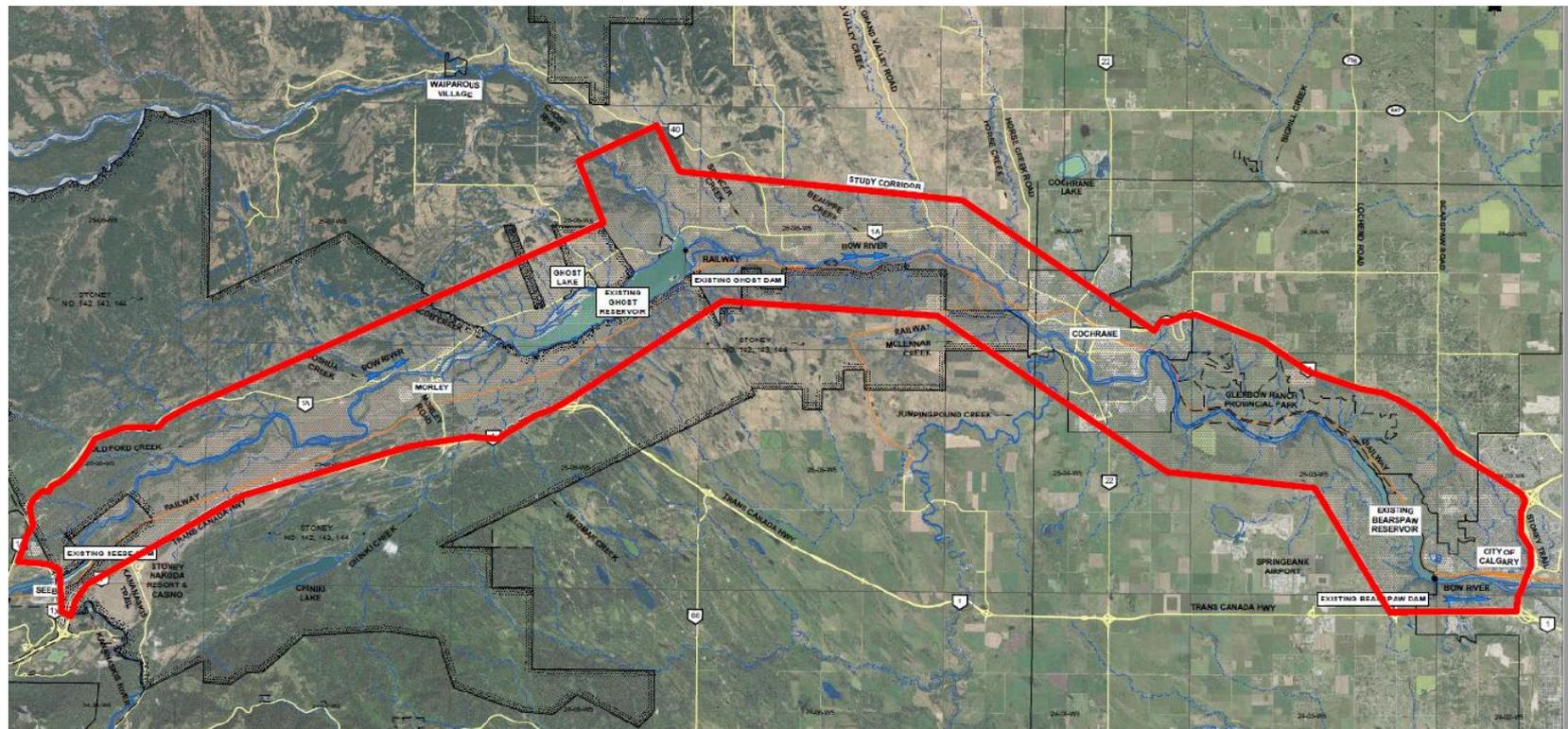
# Approximate locations of the Big Three

Three Sites will be assessed:

Morley (exact site TBD) between Seebe and Morley Townsite

Ghost Dam – raising FSL 3m and installing lower outlet

Glenbow – (site TBD) between Bearspaw Dam and Cochrane



# New York City OST

NYC DEPARTMENT OF ENVIRONMENTAL PROTECTION

## Operations Support Tool

Hazen and Sawyer led development of the Operations Support Tool (OST) to help NYCDEP meet the challenges of operating its 19-reservoir water supply system. OST is a data and modeling system that integrates near-real time data and ensemble inflow forecasts with reservoir operating rules and simulation modeling. NYCDEP uses OST to guide reservoir system operations decisions that reliably deliver 1.1 billion gallons of high quality water daily to over 9 million people.

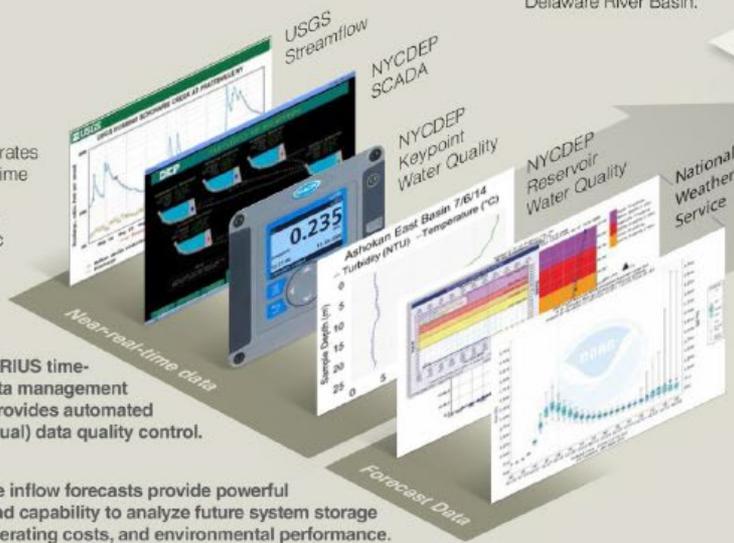
### How it works

#### 1 Data feeds

OST integrates near-real time data and ensemble hydrologic forecasts.

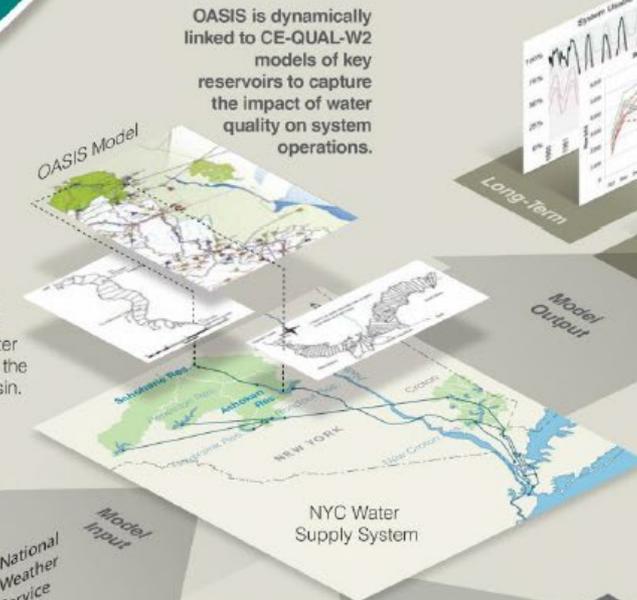
An AQUARIUS time-series data management system provides automated (and manual) data quality control.

Ensemble inflow forecasts provide powerful look-ahead capability to analyze future system storage levels, operating costs, and environmental performance.



#### 2 Operations Model

The core of OST is an OASIS model of New York City's water supply system and the Delaware River Basin.

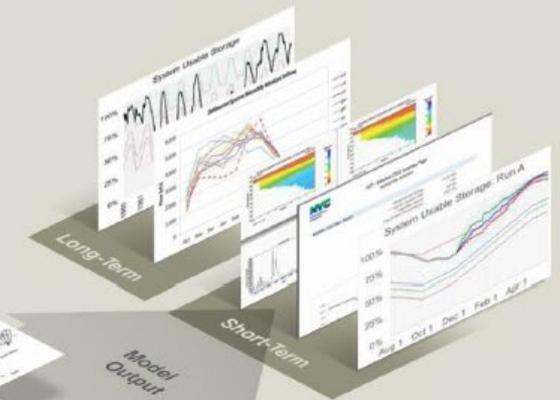


OASIS is dynamically linked to CE-QUAL-W2 models of key reservoirs to capture the impact of water quality on system operations.

The OASIS-W2 model simulates daily reservoir operations and water quality. Operators run what-if scenarios to select operations that best meet reliability, quality, environmental, and cost objectives.

#### 3 Planning, Operations Support

Create short-term ensemble simulations for operational guidance, or long-term runs for capital planning, rule testing, and climate change assessment.



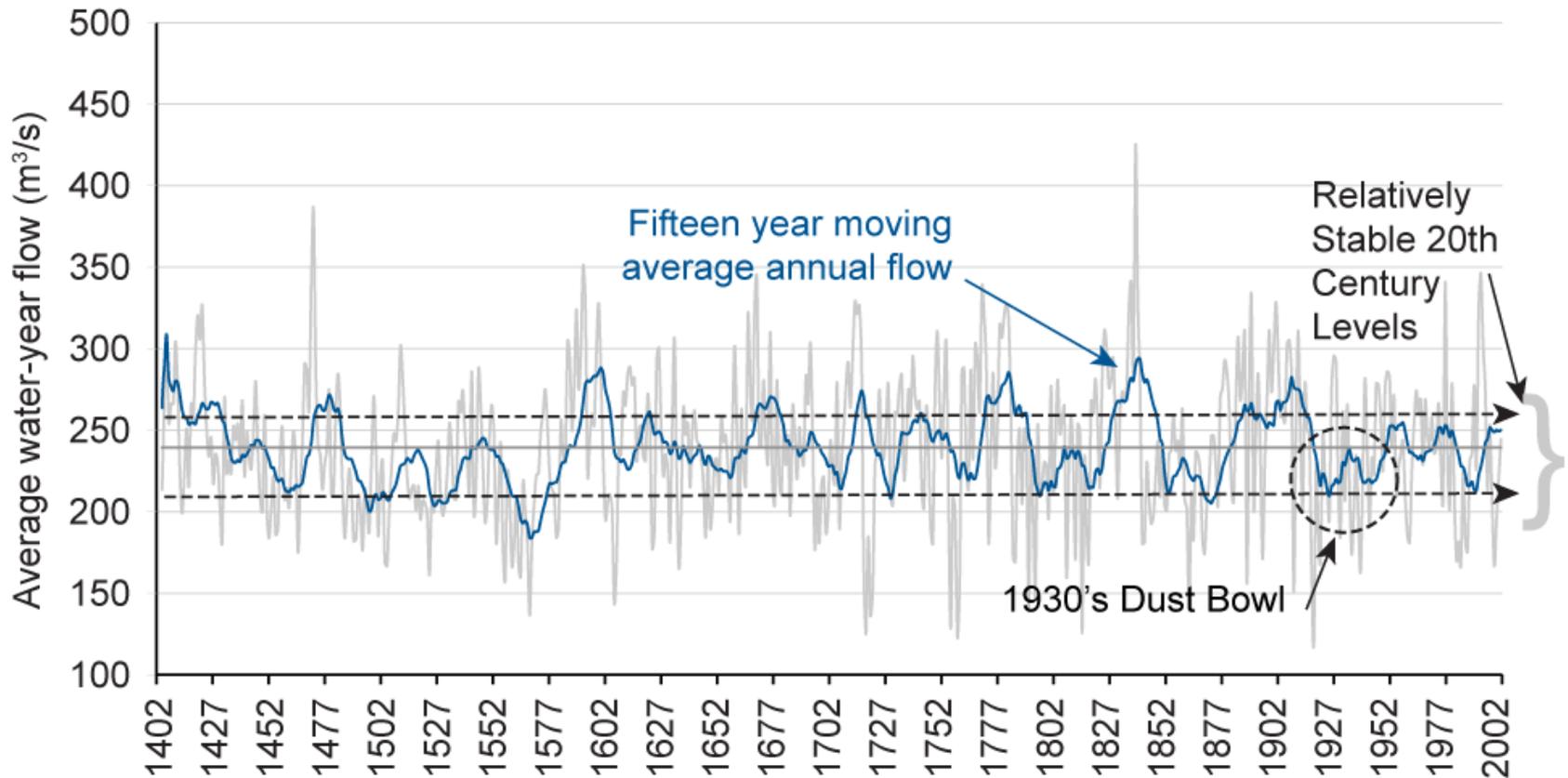
#### At the helm

Multiple users can access the system concurrently to review data inputs, create simulations, and analyze results through a user-friendly interface and interactive dashboard.



# History Demonstrates Extreme Climate Variability

## South Saskatchewan River Basin Flows (Bow + Oldman)



Source: David Sauchyn, University of Regina

Historic and tree ring data indicate future flood/drought events could be far more severe than recent record

A wide river flows through a valley with steep, eroded banks. The sky is blue with light clouds. The foreground shows green bushes and a gravelly bank.

**Thank you**

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