Alberta

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Present and Future Water Uses in the South Saskatchewan River Basin

Saskatchewan Institute of Agrologists

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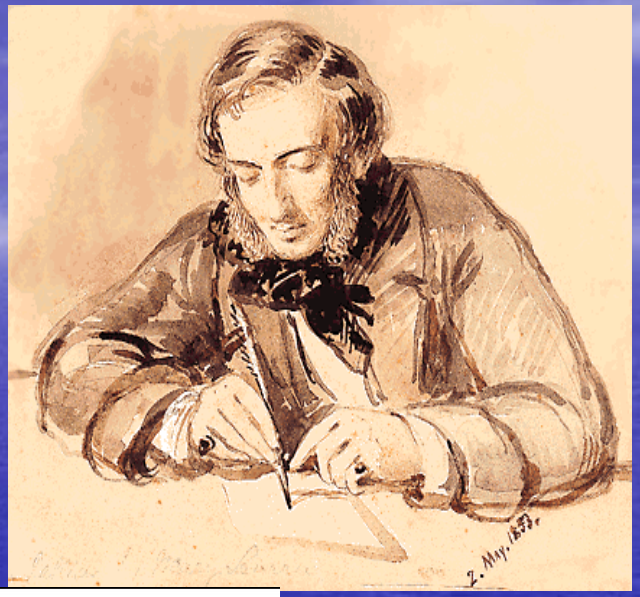
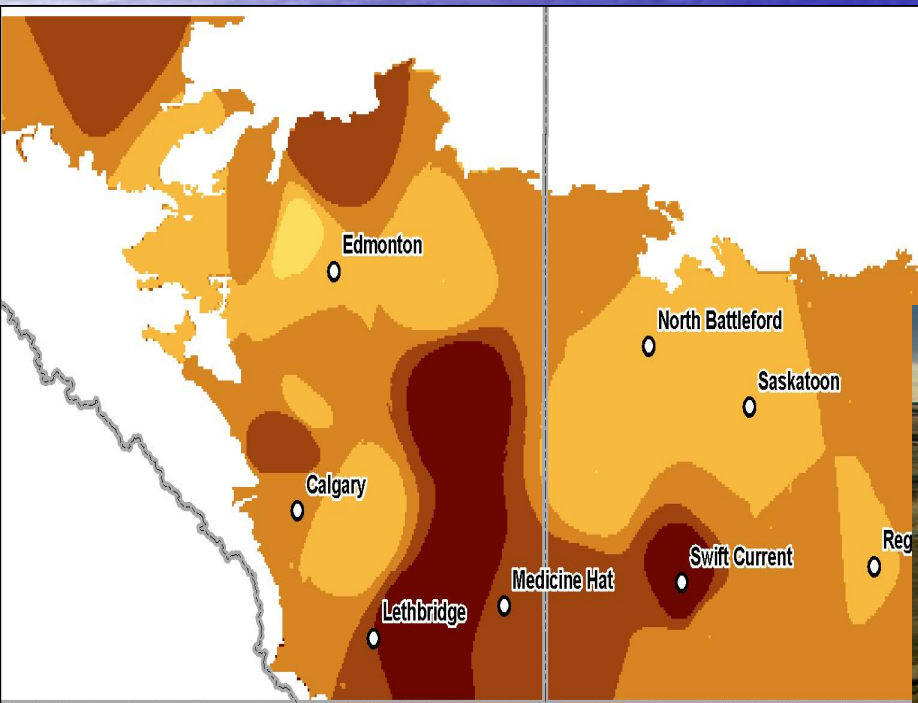
Roger Hohm, P.Ag.
Head, Basin Water Management
Head Irrigation Secretariat
Alberta Agriculture and Rural Development
roger.hohm@gov.ab.ca

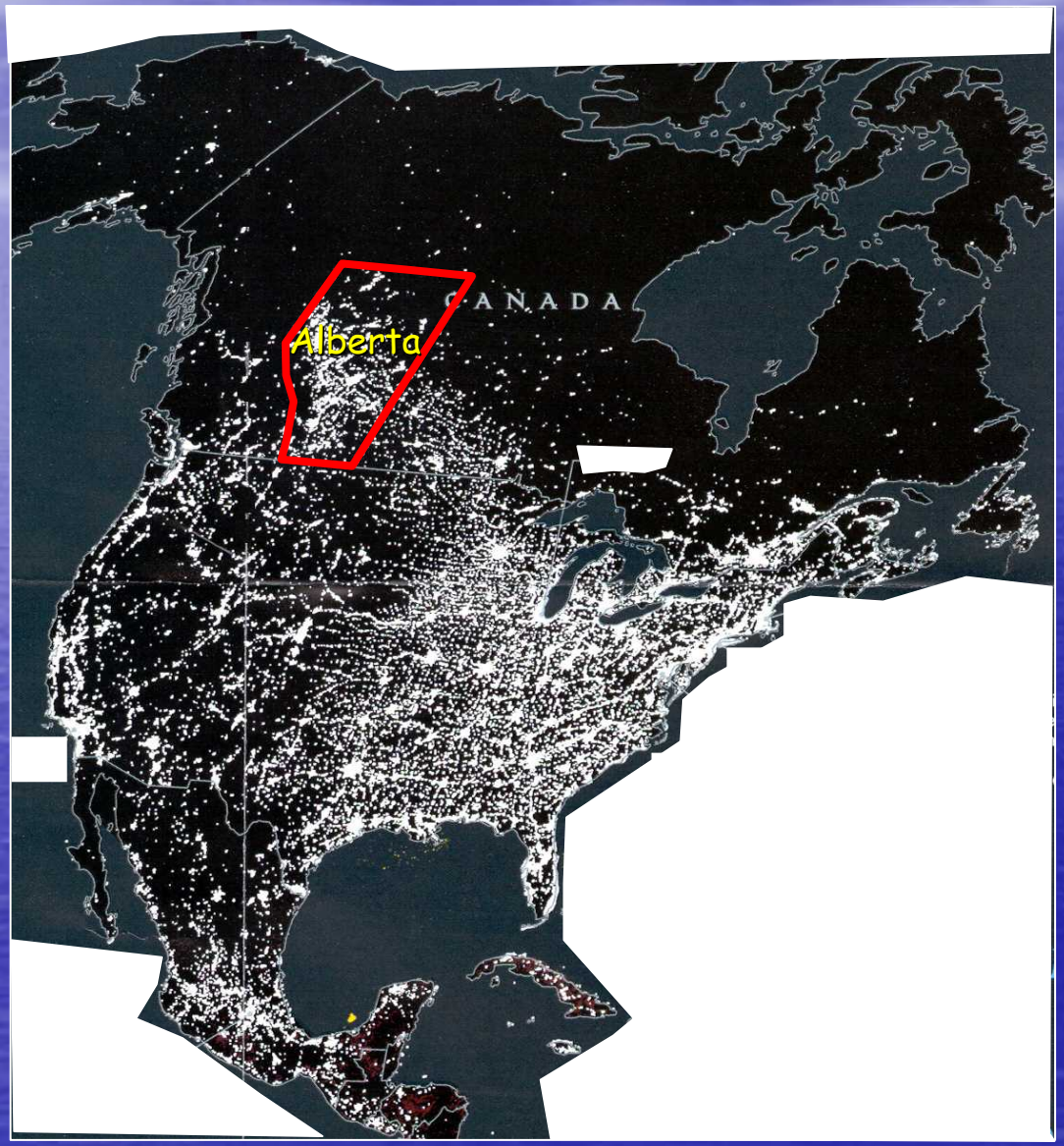
1858 Palliser Declares the Prairie as a Dry Waste Land

It was dry then and it's still dry today.



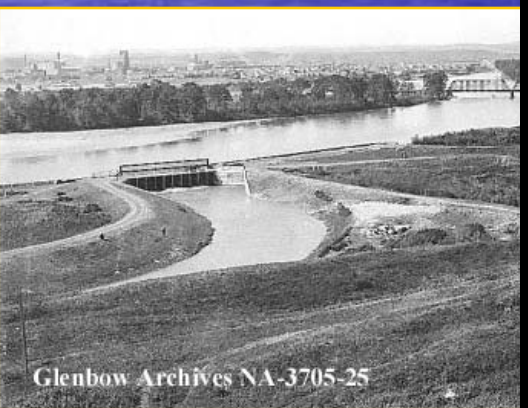


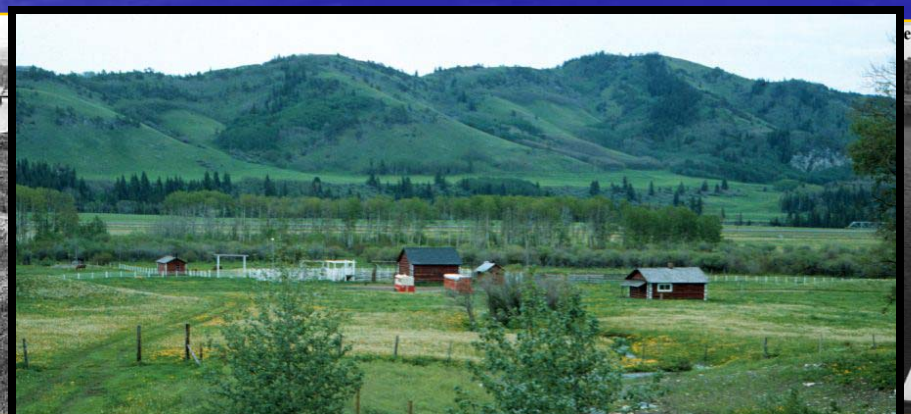
Alberta's Landuse Luminescence

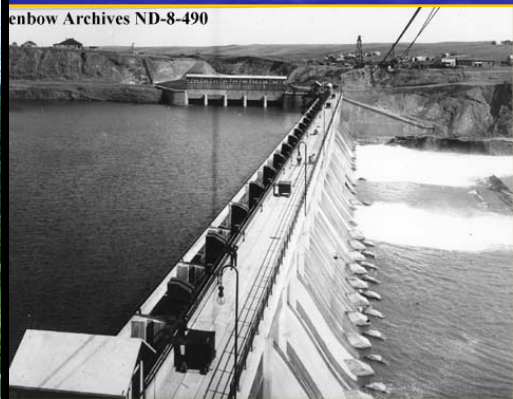


HISTORICAL PRIORITY

- People located near water
- Agriculture was the foundation
- Traditionally, agriculture and rural communities had broad public support
- Agriculture was a large economic contributor to the prairie's economy







- Alberta -
Renewable Water Supply

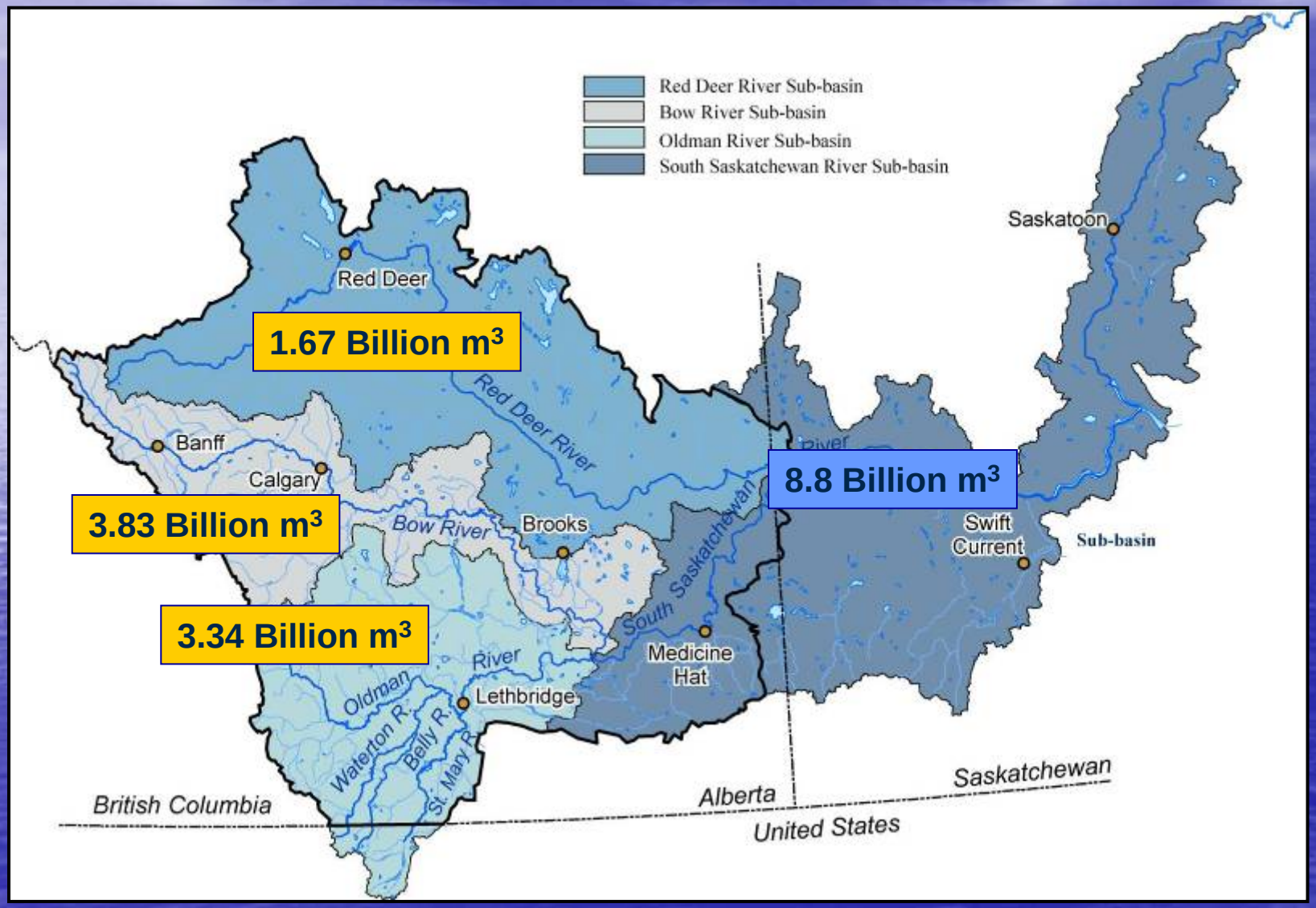
- Total outflow from Alberta's rivers is about 130 Billion m^3 per year.
- Total volume withdrawn – 4.7 Billion m^3 (3.6%)
- Total volume consumed – 2.6 Billion m^3 (2%)

Renewable Water Supply

Only 10 % of the renewable water supply serves more than 90 % of the province's population.

South Saskatchewan River Basin

Average annual natural flow volumes



WHAT IS HAPPENING IN THE SSRB

South Saskatchewan River Basin

The Alberta SSRB

This is the most developed basin in the Prairie Provinces.

- Population of ~ 1.4 Million
- Less than 20% of Alberta's area, but produces almost 50% of the economic activity.
- Agriculture, petroleum, petroleum refining and manufacturing are the major industrial activities.
- City of Calgary - ~70% of this region's major spending.

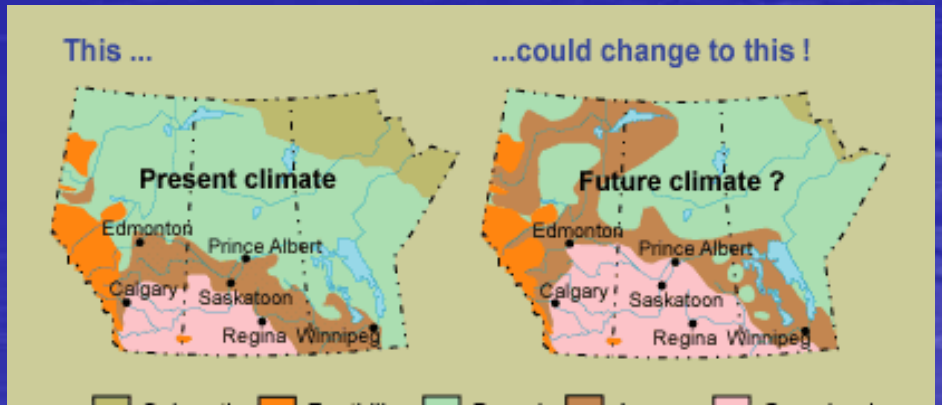
2006 Water Management Plan for the SSRB

- 2006 – SSRB water management plan
  - Set Water Conservation Objectives for each sub-basin (45% of natural or (In stream Objectives IO+10%)
  - Closed Bow, Oldman, South Sask. sub-basins to further allocations, Crown Reservation on unallocated water
- 2007 – Water from Crown Reservation may be used for:
  - First Nations Reserves
  - Water Conservation Objectives
  - Licences for pending applications
  - Storage of peak flows to mitigate impacts on aquatic environment, support existing licences

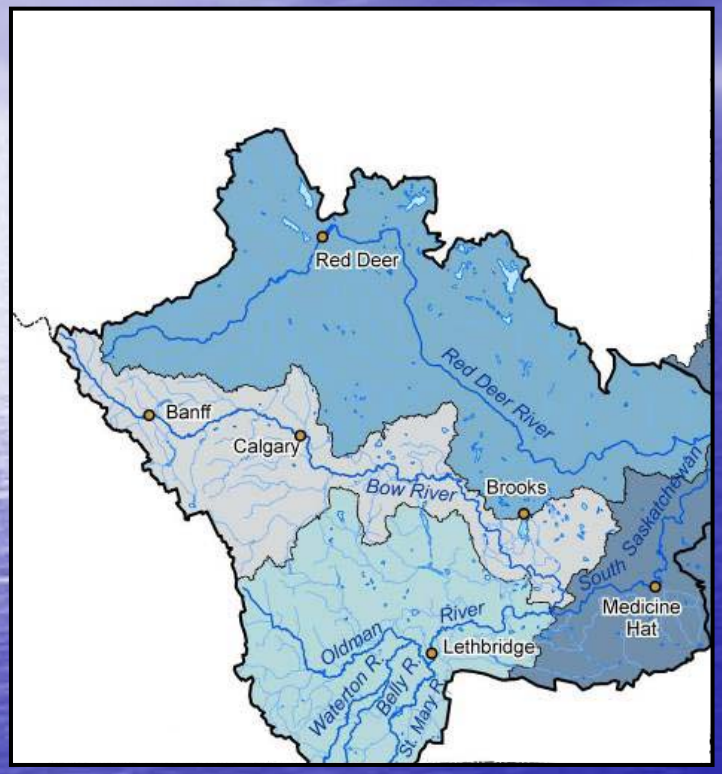
Why a Water Supply Study?

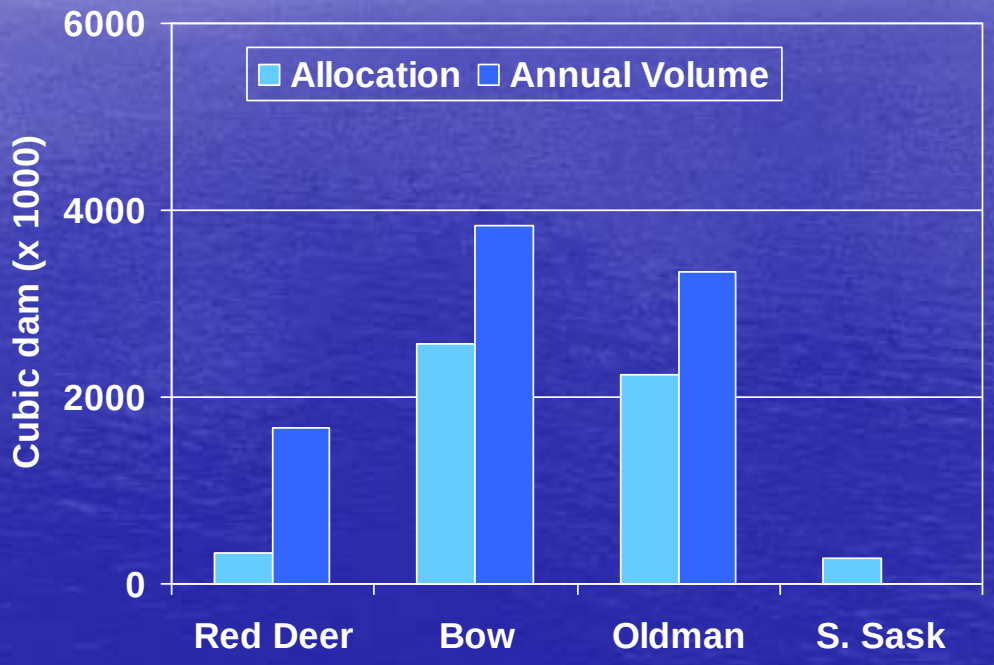
Science Based - Future Water Supply in the SSRB

- Recognized that future demand for water could outstrip supply.
- Demands for water will continue to increase.
- Global Warming will change the flow system in the major rivers.



Water is Highly Allocated in the Basin

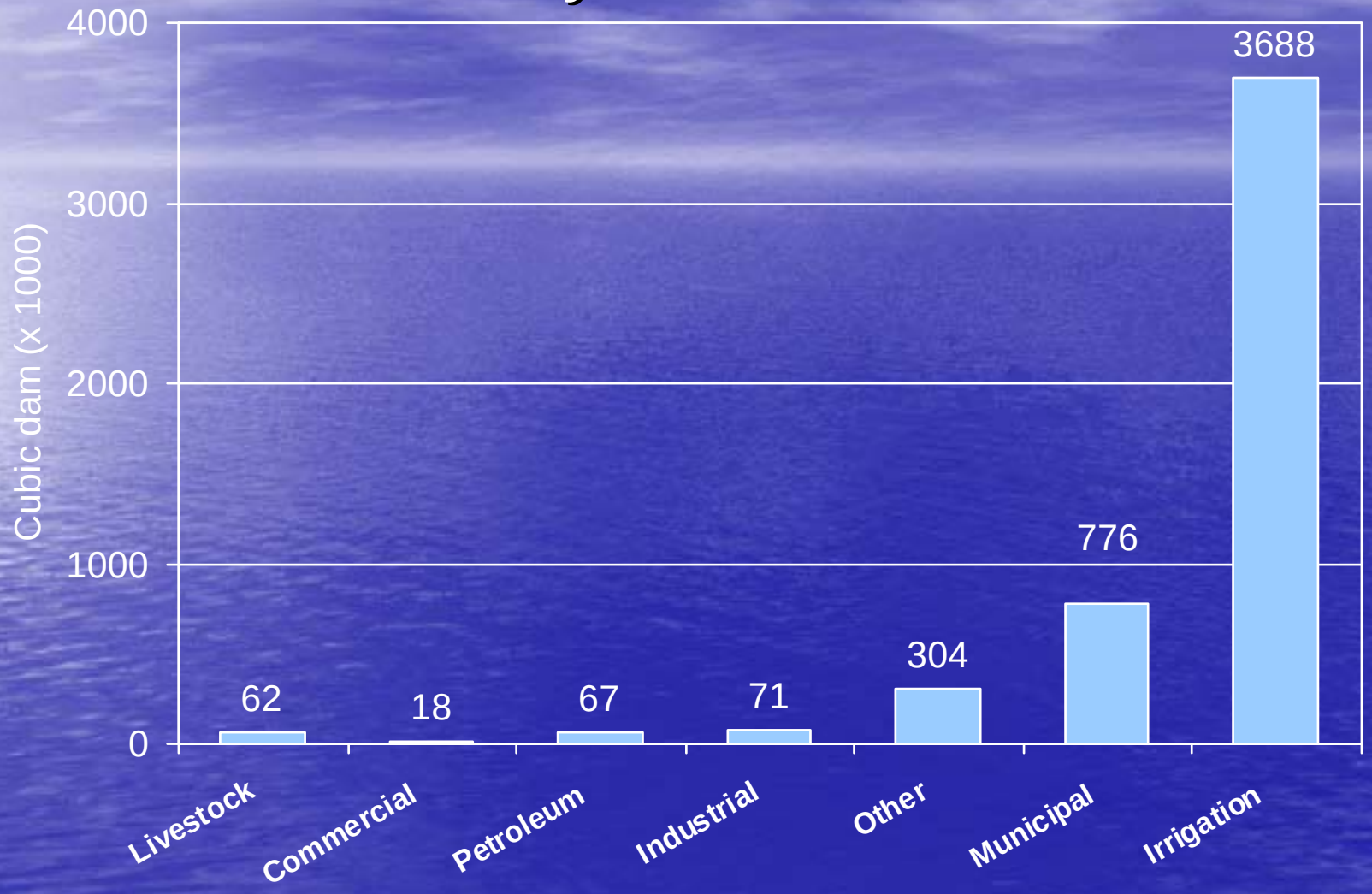




Actual water use is estimated to be 54% of allocation

Long term Alberta has passed 81% of the apportionable flow to Saskatchewan

Water allocation by sector in SSRB



Study Objectives

Science Based Study

- Assess Current and Future Water Supply and Demand
- Identify Constraints to Water Supply and Economic Growth
- Identify and Analyze, Structural and Non-Structural Water Management Constraints and Opportunities

Studies Components

- Detailed assessment of current and projected future (25 year) water supply and demand including impacts of Climate Change
- Simulation modelling to determine magnitudes, frequency and location of deficits
- Identification of structural and non-structural measures to improve water supply security

Study scenarios

1: Current conditions

3: Year 2030 demands +25% district expansion

Water supply

Historical

Additional infrastructure

Water demand

Future (2030) uses for all sectors

Irrigation: high growth scenario – 25% district expansion – within existing allocations – plus private expansion

Climate Change Scenario

3: Year 2030 demands +25% district expansion

4: Scenario 3 plus climate change

Water supply

Decreased flows (4 to 13%)

Water demand

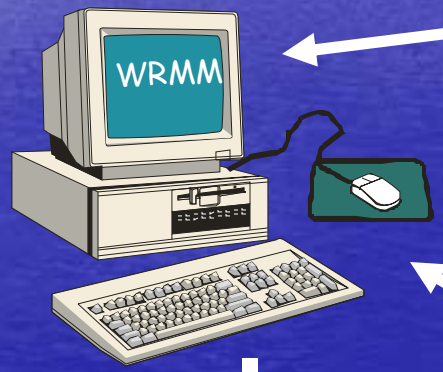
Future (2030) uses for all sectors

Irrigation: high growth scenario (scenario 3)

plus 10-16% water for warmer temperatures

Water Supplies
Weekly natural river flows
precipitation

Water Management Infrastructure
Reservoirs, weirs, canals



Water Demand
Daily consumptive,
Weekly diversions,
Consumption Losses,
in-stream requirement

River Basin Configuration
Rivers, major tributaries

Priority
Water licences

Simulation Modelling Results

Simulations Modelled

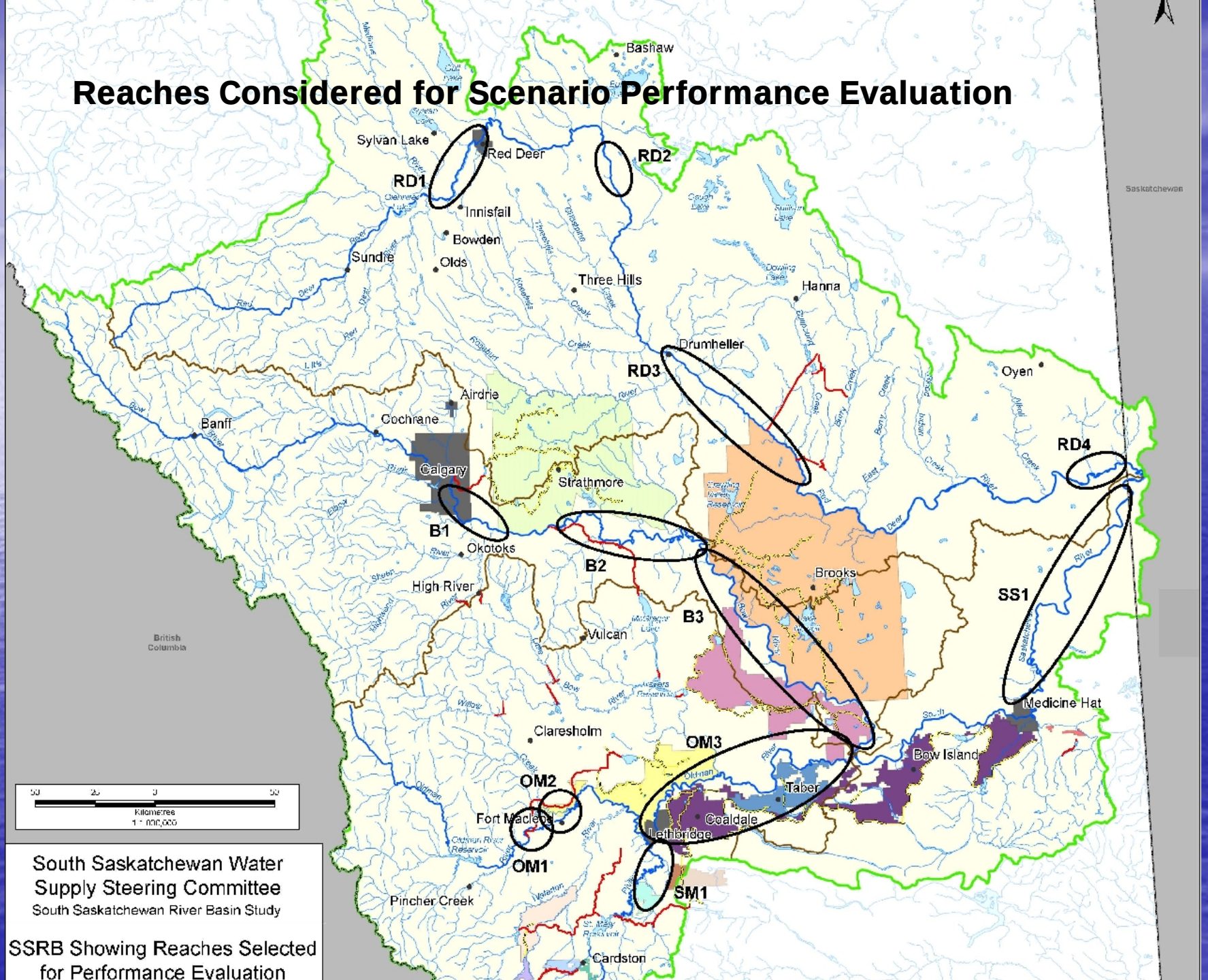
- **Scenario 1:** Current conditions
- **Scenario 2:** 2030 non-irrigation demands, meeting of all outstanding commitments, 10% irrigation expansion
- **Scenario 3:** 2030 non-irrigation demands, meeting of all outstanding commitments, 32% expansion of Bow districts, 19% expansion of Oldman districts, improved on-farm efficiencies, optimal (higher) on-farm applications
- **Scenario 4:** Same as scenario 3 plus climate change conditions

*All simulations were required to be meet existing licence allocations and apportionment commitments

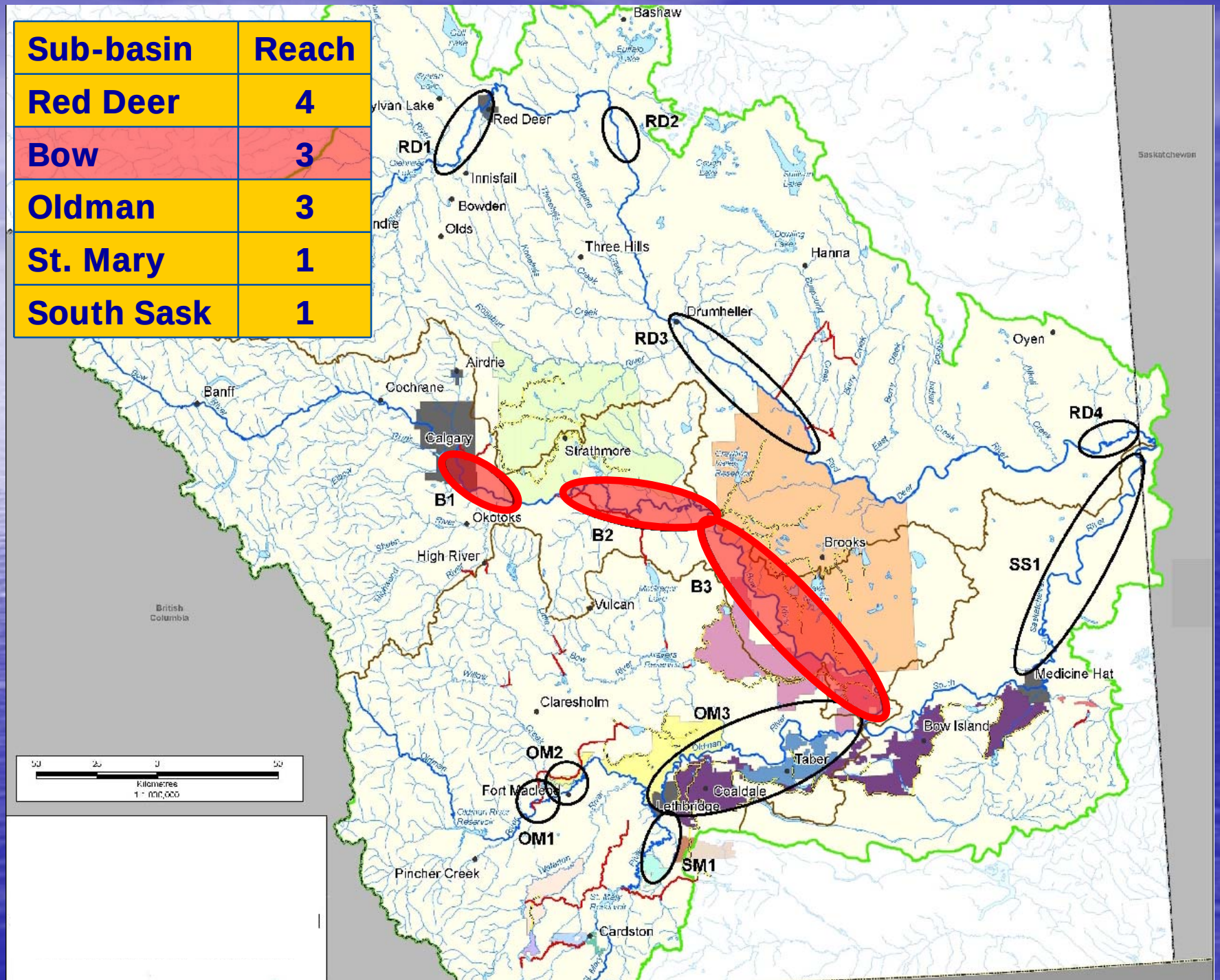
Irrigation District Irrigated Area for Scenarios 1,2 & 3

SSRB Sub-Basin	Scenario 1 Irrigated ha.	Scenario 2 Irrigated ha.	Scenario 3 Irrigated ha
Bow River	217,094	239,169	287,003
Oldman River	276,629	300,279	330,307
Total	493,723	539,448	617,310

Reaches Considered for Scenario Performance Evaluation

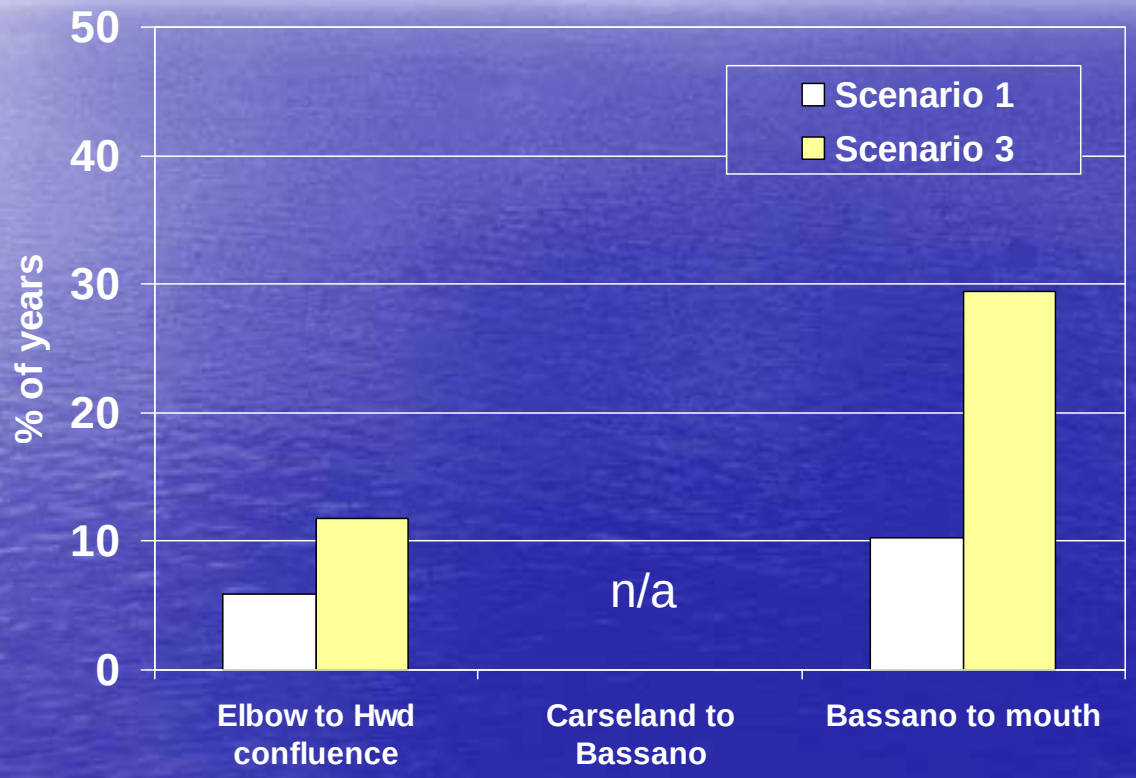


Sub-basin	Reach
Red Deer	4
Bow	3
Oldman	3
St. Mary	1
South Sask	1



Bow River Sub-basin

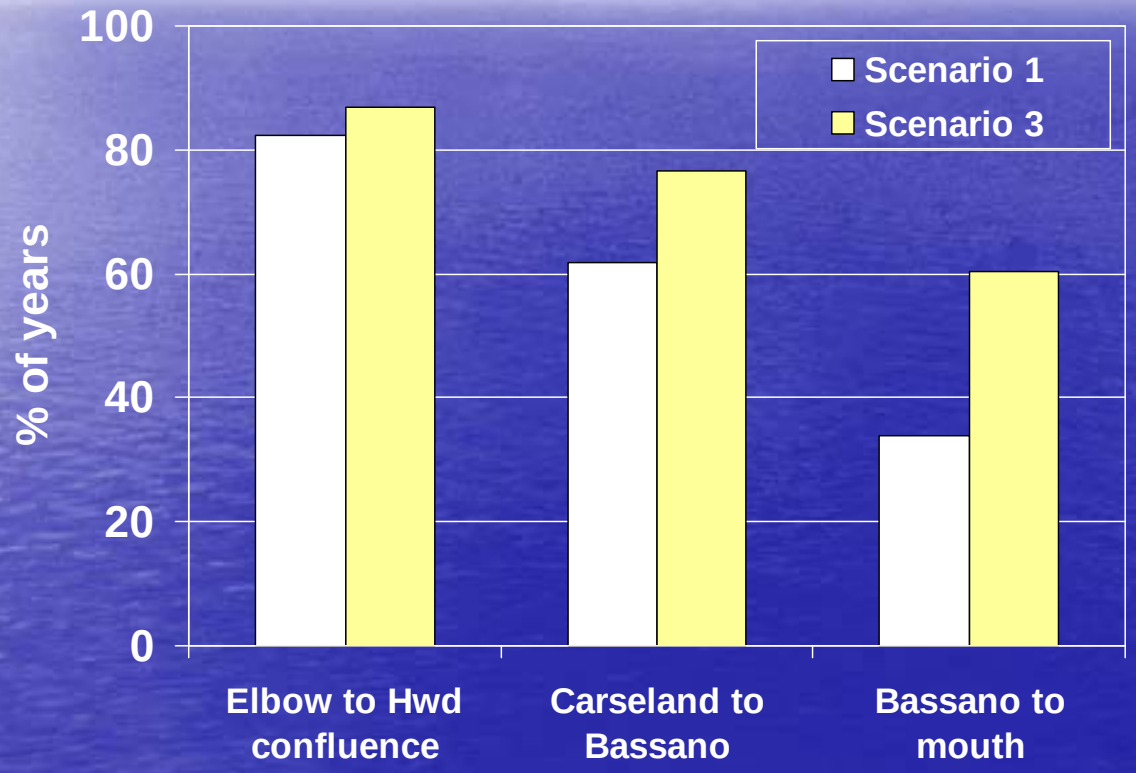
Junior Private Irrigation Deficits greater than 100 mm



Scenario 1 Current conditions

Scenario 3 Year 2030 demands + 25% district expansion

Bow River Sub-basin
Junior Non-irrigation Deficits



Scenario 1 Current conditions
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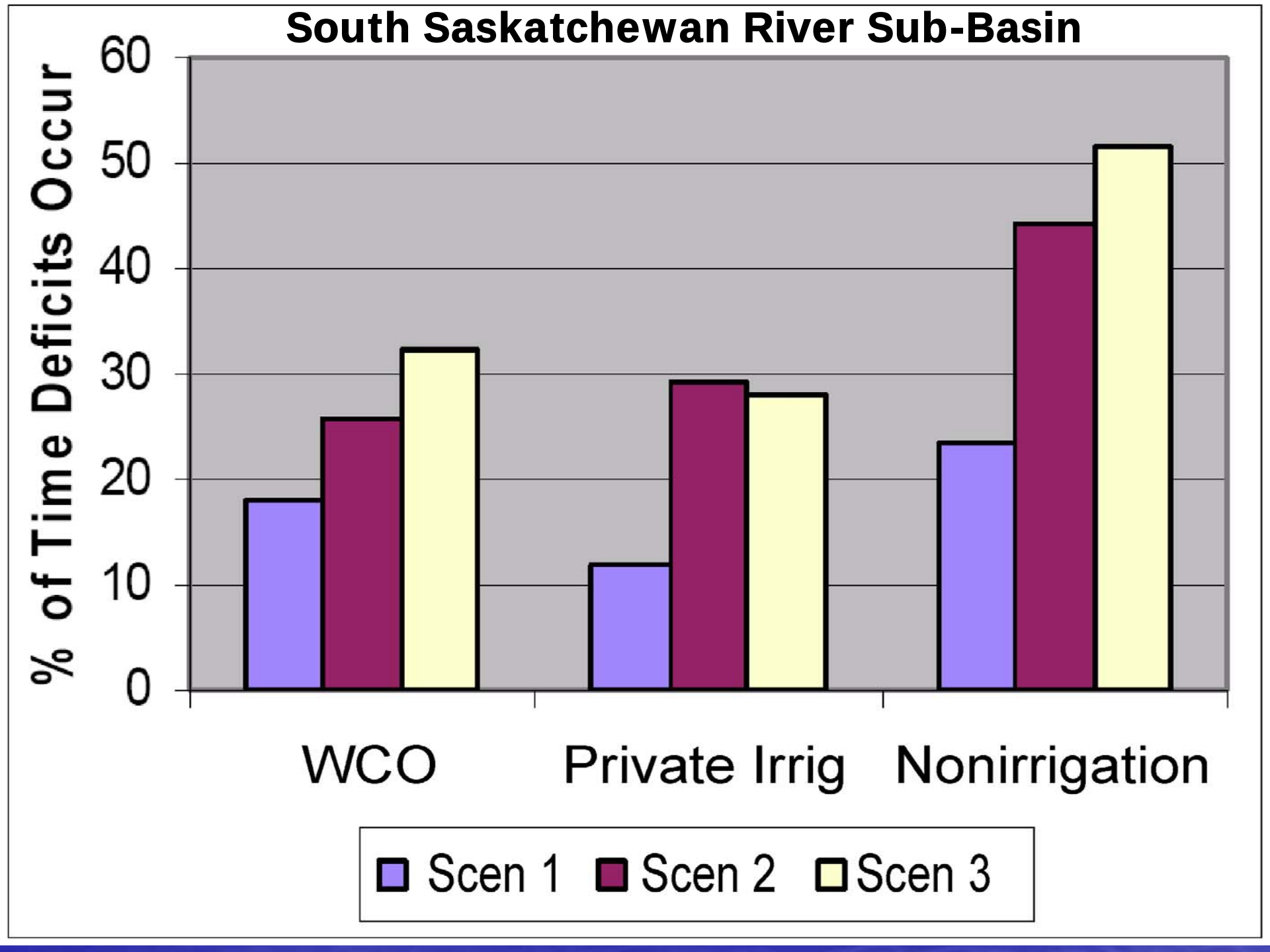
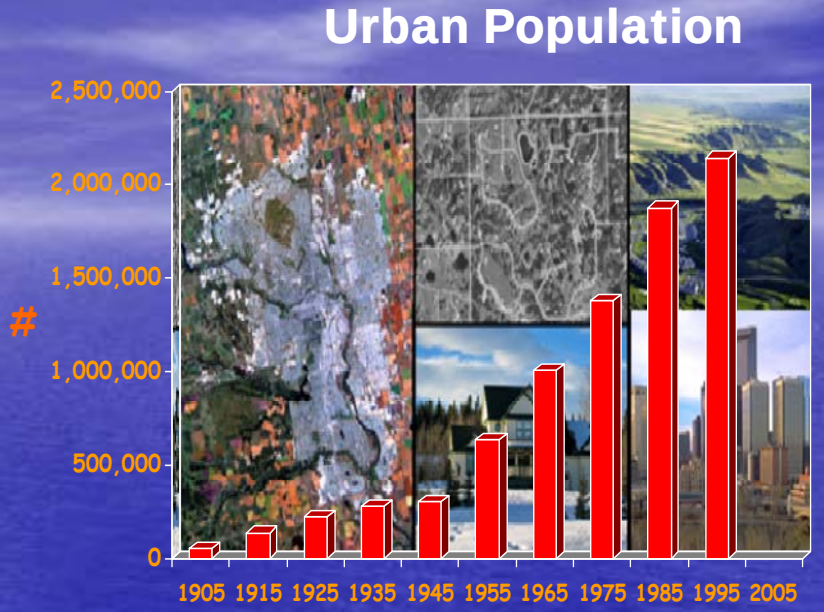

South Saskatchewan River Sub-Basin
% of Time Deficits Occur
60
50
40
30
20
10
0
WCO
Private Irrig
Nonirrigation
Scen 1
Scen 2
Scen 3

Modelling Results

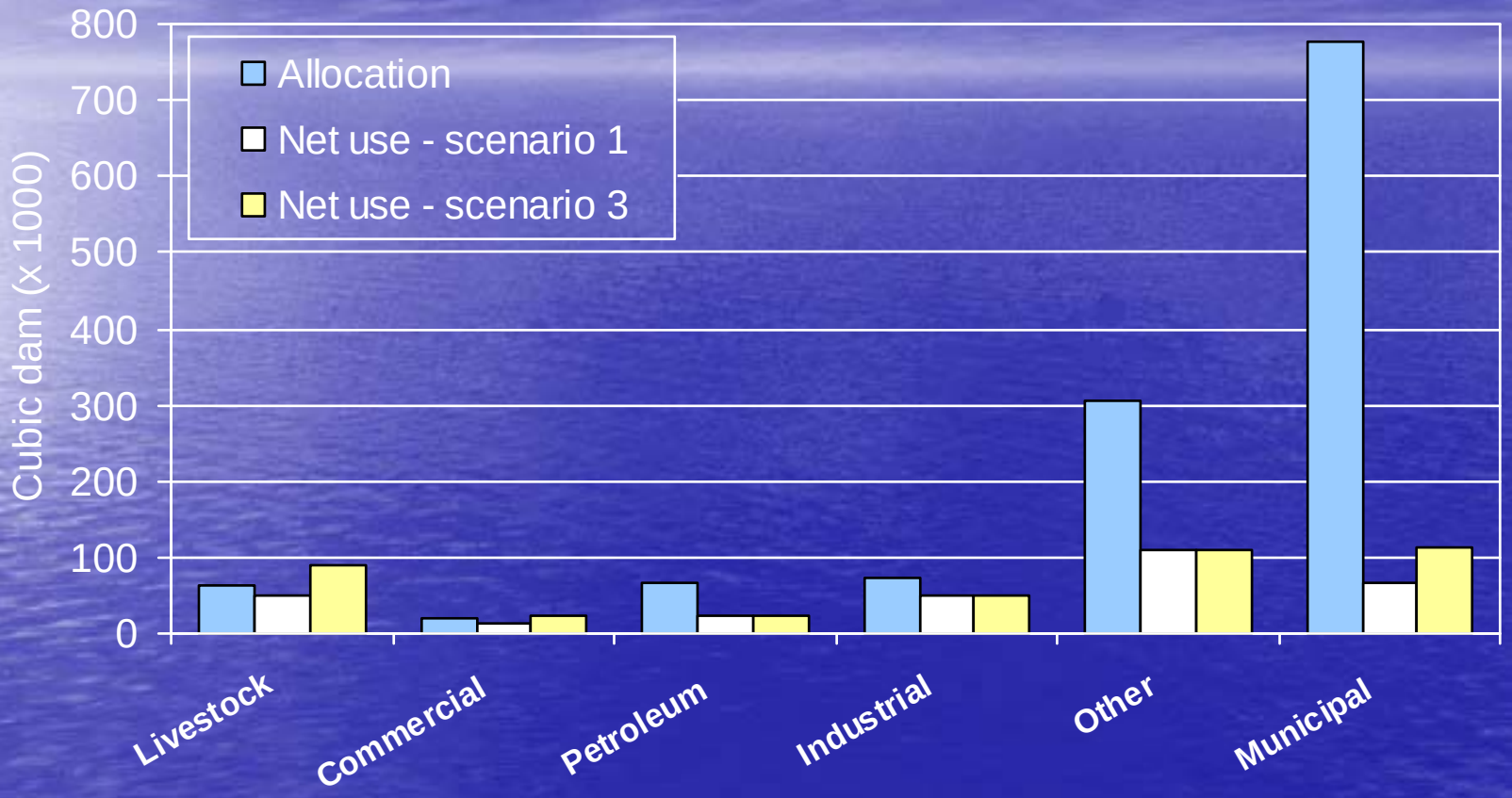
- Increased deficits to WCO's and junior licences are observed for Scenarios 2, 3 and 4 in every segment modelled.
- The St. Mary river is most severely impacted, Red Deer river is least impacted
- Irrigation Districts and senior municipal licence holders perform adequately in all scenarios and for all segments.

Key Findings:
Water Demand



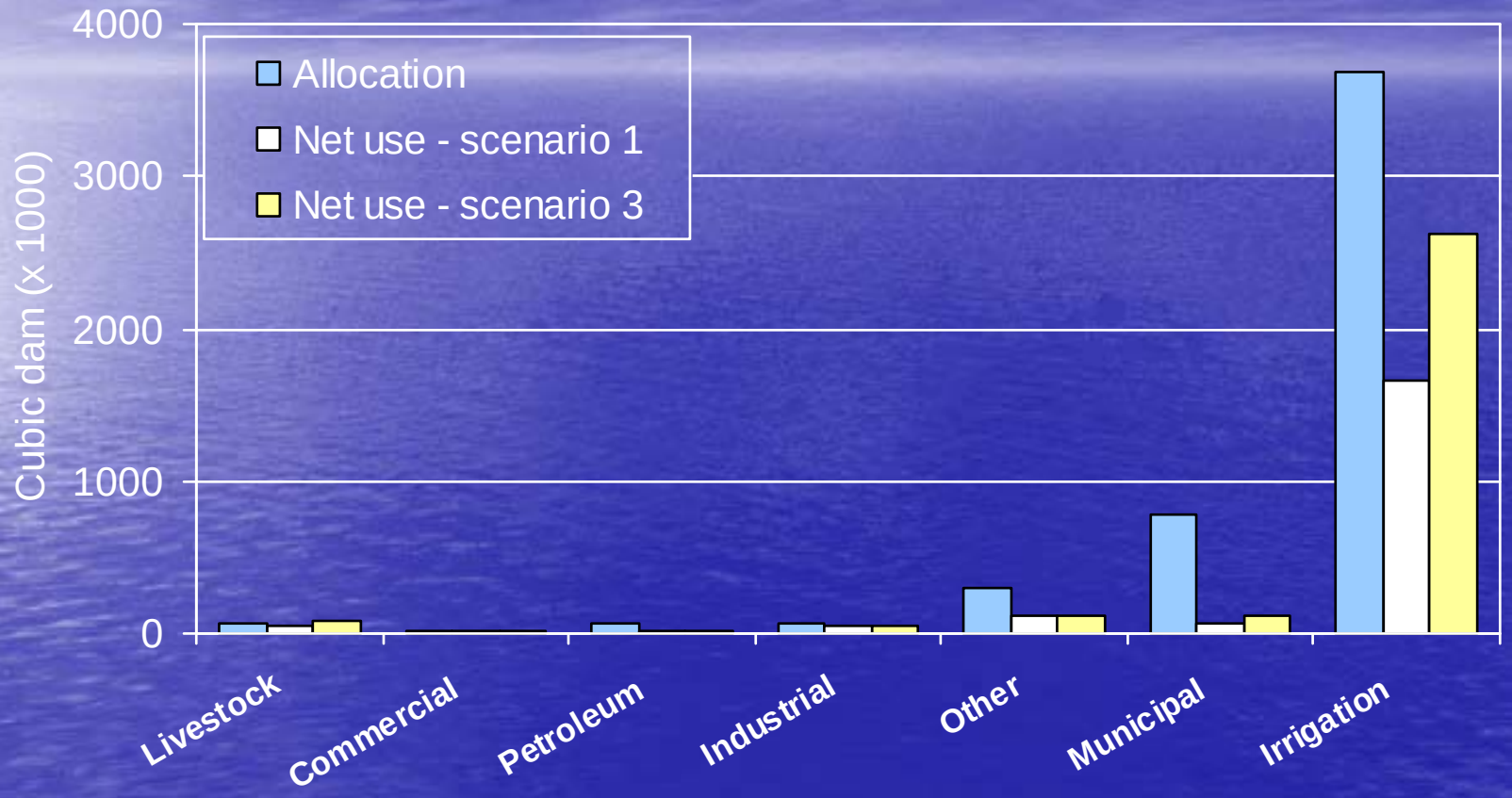
- Current water use is estimated to be 1.98 billion cubic meters
- 2030 demand is expected to be 3.04 billion cubic meters
- 2030 non-irrigation use to increase from current 315 million to 410 million cubic meters

Current and future net water use in SSRB



Scenario 1 Current conditions
Scenario 3 Year 2030 demands + 25% district expansion

Current and future net water use in SSRB



Scenario 1 Current conditions
Scenario 3 Year 2030 demands + 25% district expansion

Climate Change Scenario

3: Year 2030 demands +25% district expansion

4: Scenario 3 plus climate change

Water supply

Decreased flows (4 to 13%)

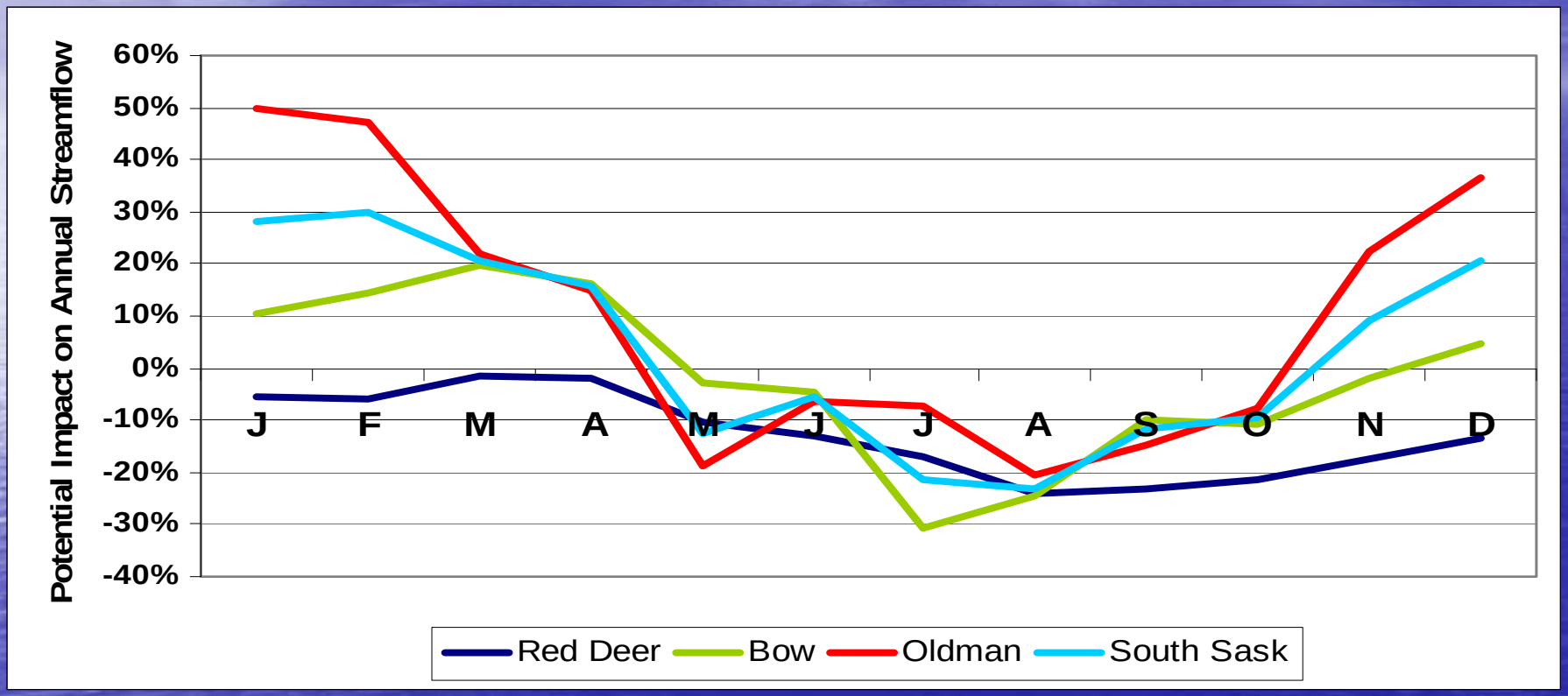
Water demand

Future (2030) uses for all sectors

Irrigation: high growth scenario (scenario 3)

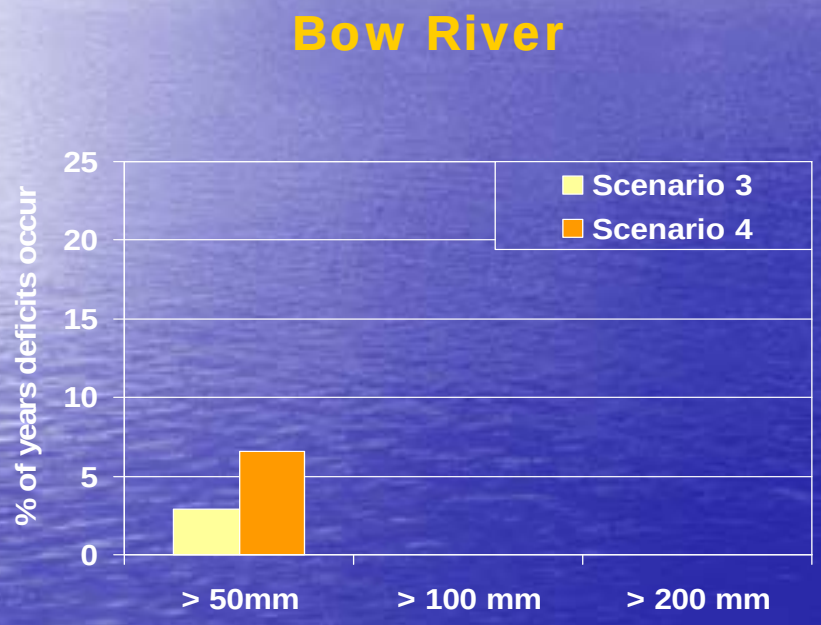
plus 10-16% water for warmer temperatures

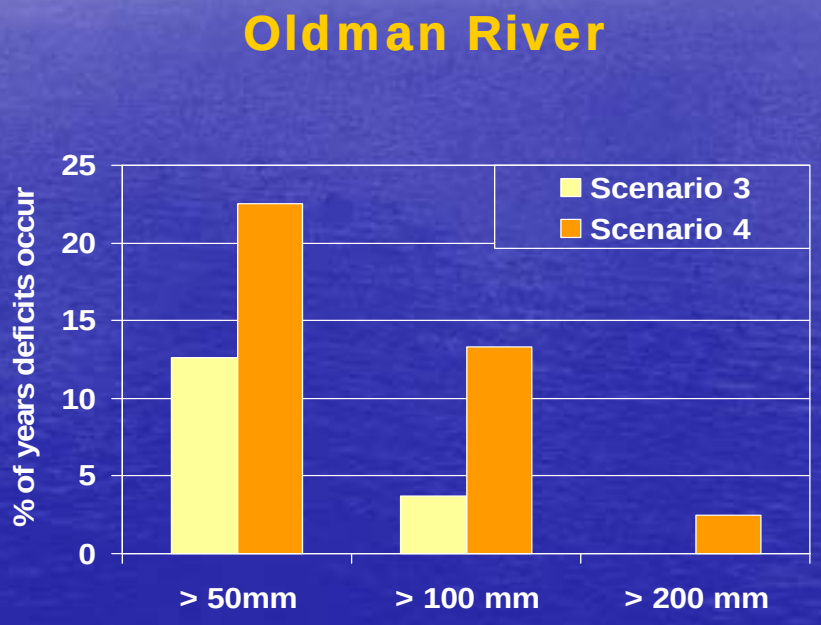
Potential climate change impacts on natural flows



(based on research by Martz *et al.*, 2007)

Irrigation district deficits





Scenario 3 Year 2030 demands + 25% district expansion

Scenario 4 Scenario 3 and climate change

Climate change modelling results

Assuming lower flows in the SSRB with climate change:

- Red Deer - Acadia irrigation marginal (major irrigation expansion)
- Bow River - district irrigation
  - occasional deficits, but less than 100 mm threshold
- Oldman River - district irrigation
  - deficits greater than 100 mm in 13 out of 100 years
- All sub-basins - Junior users
  - substantial increases in deficits

Considerable uncertainty around climate change impacts on future water supply and demands

Non-structural Initiatives

- Optimization of existing infrastructure operations on Red Deer (Dickson) and Bow (TransAlta)
- Improved irrigation efficiency and reduced return flows have considerable impact on supply and demand
- Streamline water allocation transfers to support needs of juniors
- Deficit sharing (2001)

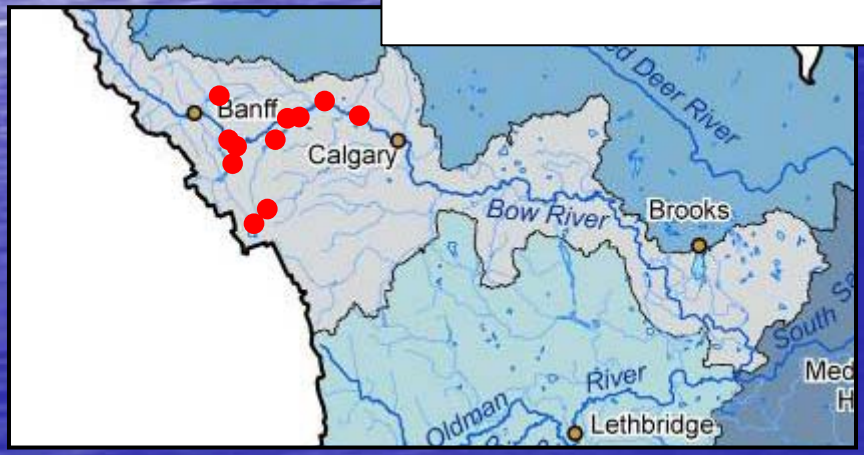
Non-structural management options
1. Refine or modify existing infrastructure operations

- **Red Deer Sub-basin**
  - **Modify operation of Gleniffer Reservoir (Dickson Dam) to increase winter releases**
  - **Minor changes could resolve the WCO and junior user deficits**
- **Bow River Sub-basin**
  - **Modify operation of hydro-electric reservoirs**
  - **Reservoirs currently operated to store water in spring and summer and release in remainder of year**
  - **Tested scenario to operate reservoirs for IO's and consumptive uses**

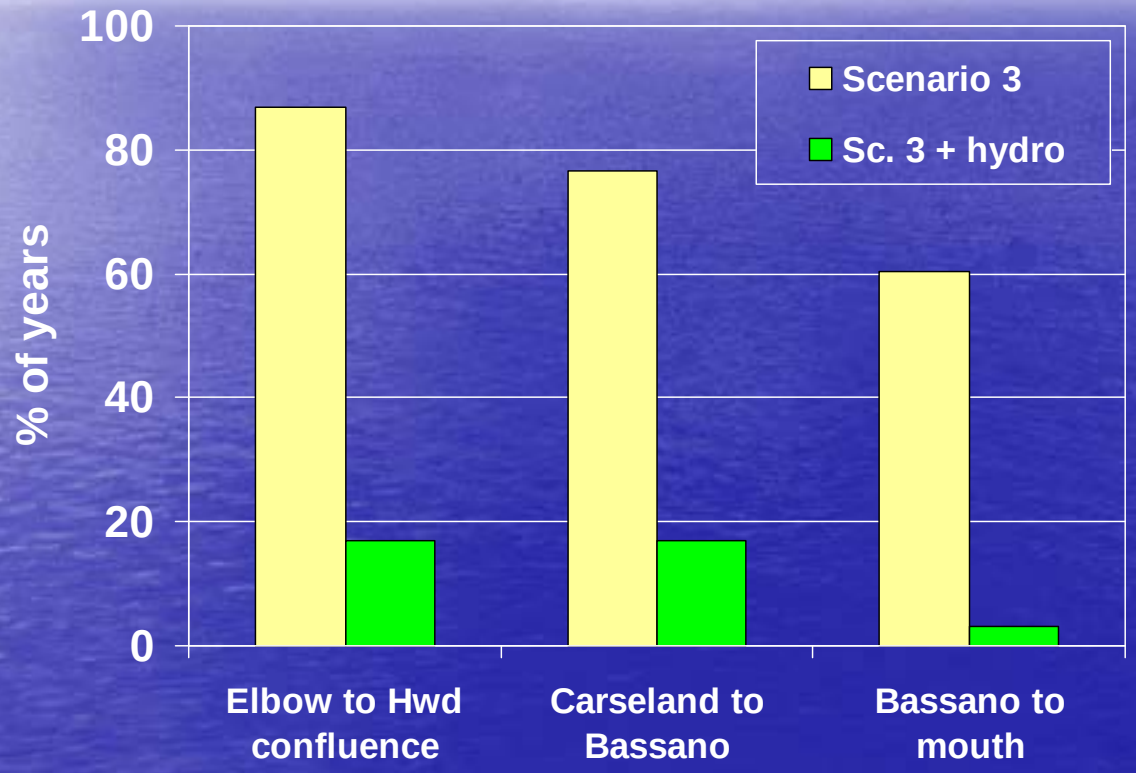
TABLE 6.1
TransAlta Hydro-electric System Basic Information

Plant	Reservoir	Primary Reservoir Supply	Installed Capacity (MW)	Reservoir Storage (dam^3)
Cascade	Lake Minnewanka	Cascade, North Ghost	34	221 900
Spray Group (Three Sisters, Spray, Rundle)	Spray Lake	Spray River	155	177 600
Interlakes	Upper Kananaskis Lake	Kananaskis River	5	124 500
Pocaterra	Lower Kananaskis Lake	Kananaskis River	15	63 100
Barrier	Barrier Lake	Kananaskis River	13	24 800
Kananaskis	Forebay	Bow River	19	--
Horseshoe	Forebay	Bow River	16	--
Ghost	Ghost Lake	Bow River	56	92 500
Bearspaw	Forebay	Bow River	17	--
Bow Basin Total			**330**	**704 400**

Source: TransAlta



Bow River Sub-basin
Preliminary analysis of hydro reservoirs
Junior Non-irrigation Deficits

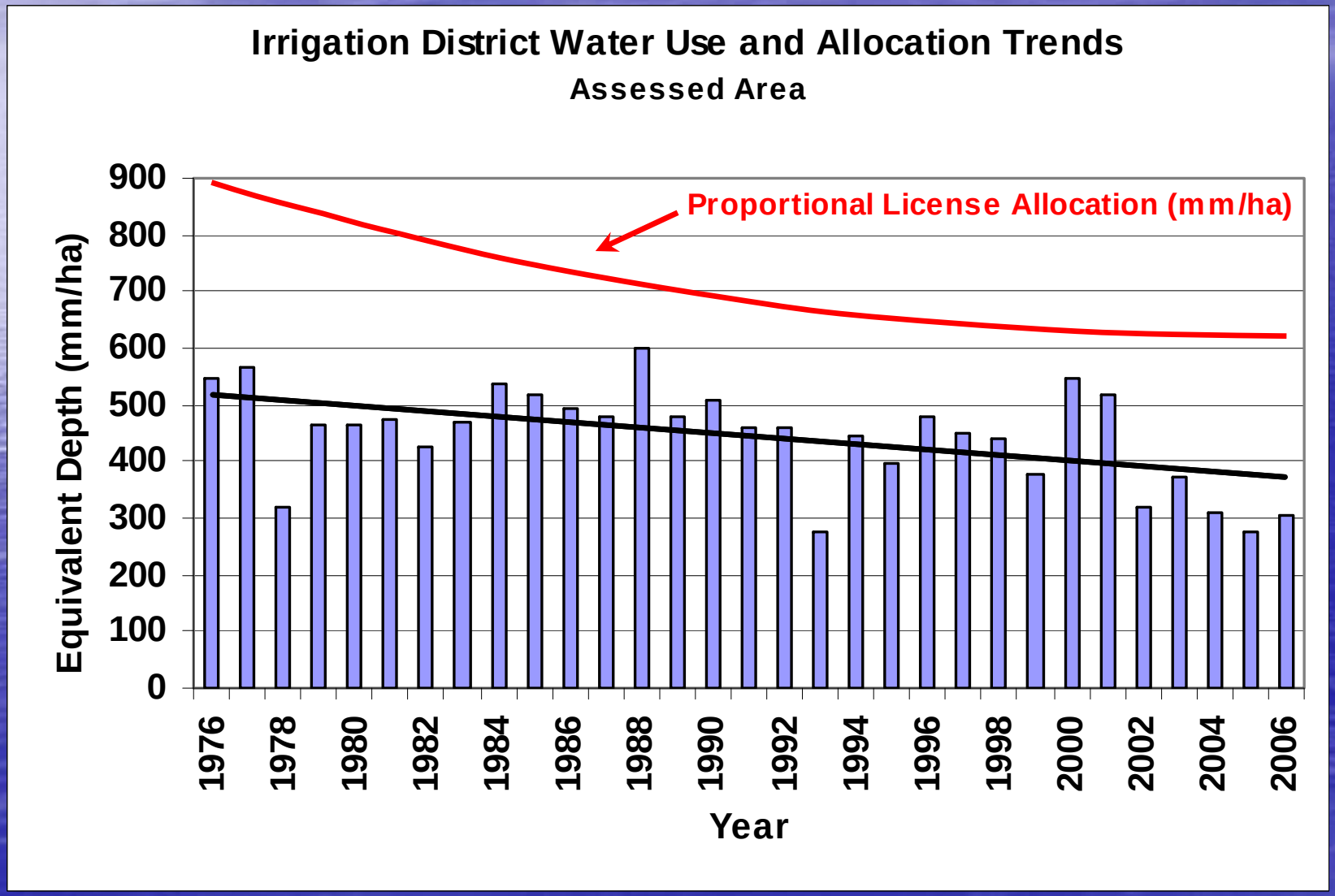


Non-structural management options

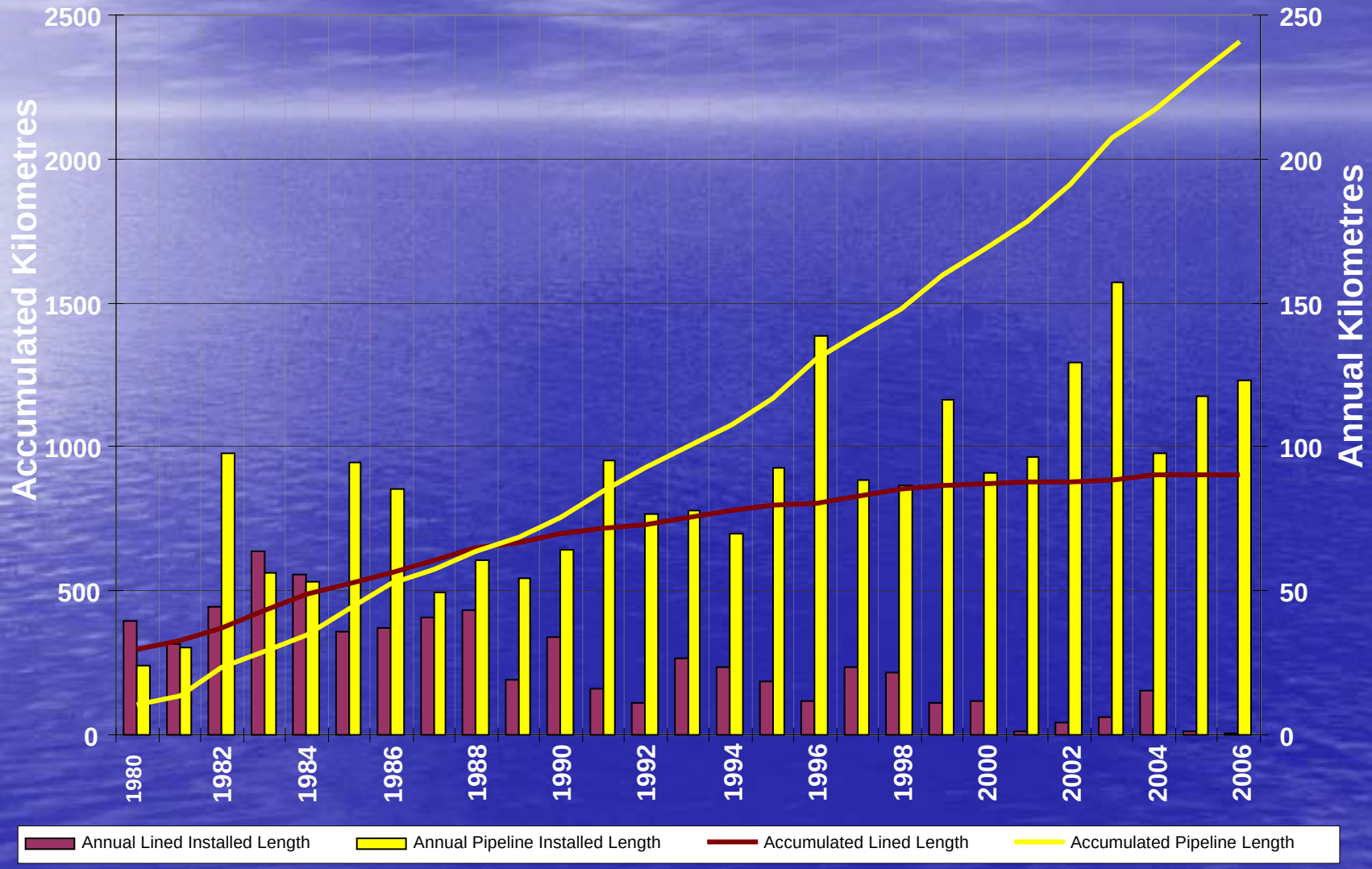
- **2. Improved irrigation efficiencies, reduced return flows**
  - Increase to 63 % (from 53 %) would conserve 326 000 dam^3 yearly
- **3. Water allocation transfers**
  - Minor contribution of transfers to reducing basin-wide deficits if current level of market activity remains
- **4. Deficit sharing**
  - Temporary assignments during past droughts were successful and could be useful in future

2. Improved irrigation efficiencies, reduced return flows

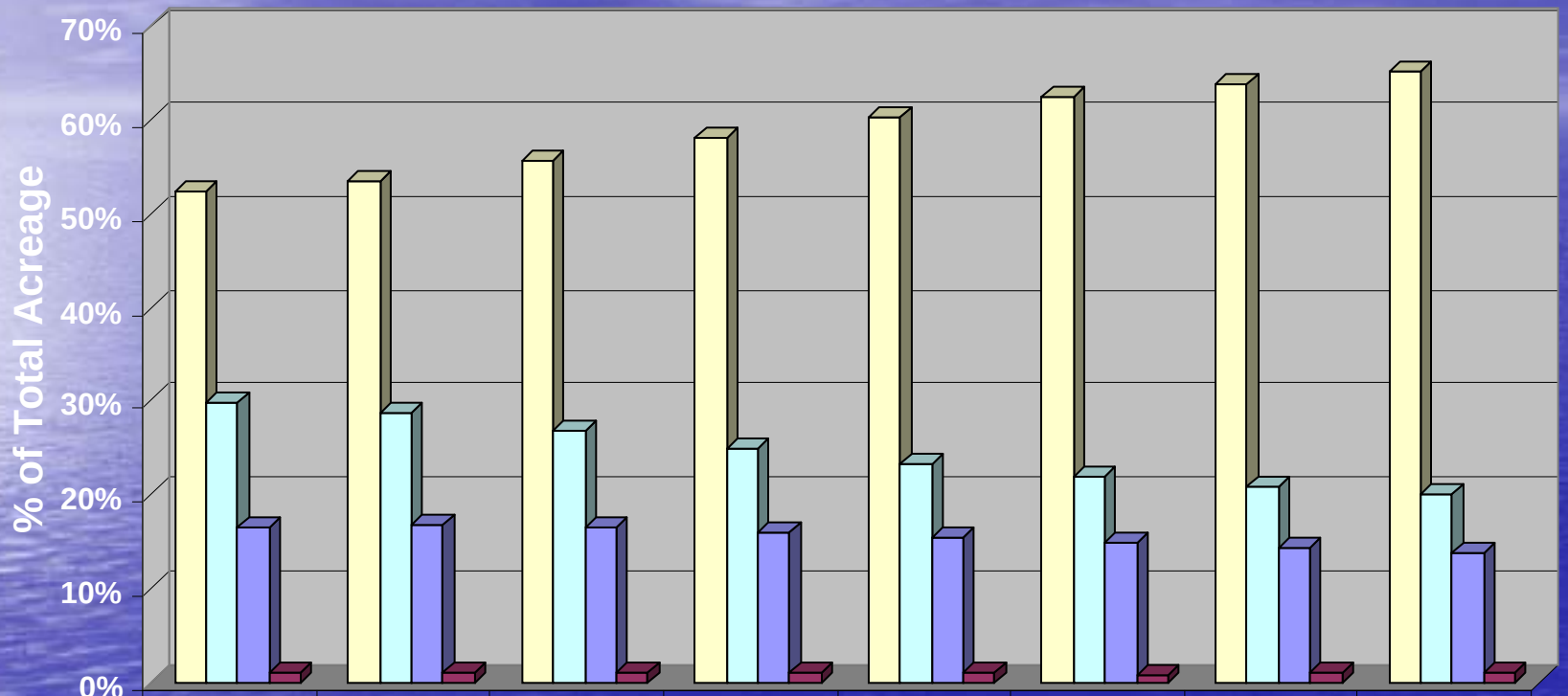
Increase to 63% (from 53%) would conserve 326 000 dam^3 yearly



IRP Lined Canals & Pipelines
All Districts



All Districts System Trends by % Area

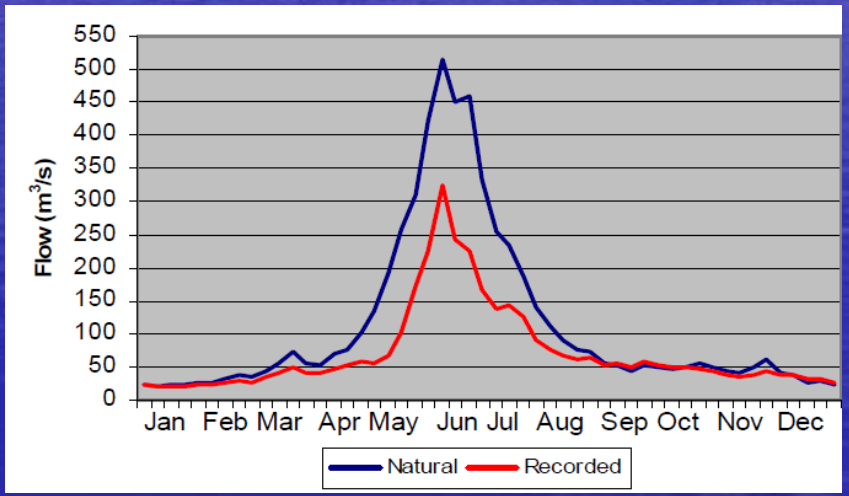


	1999	2000	2001	2002	2003	2004	2005	2006
Pivot	52.5%	53.4%	55.8%	58.1%	60.3%	62.6%	63.9%	65.3%
Wheelmove	30.0%	28.9%	26.8%	25.1%	23.3%	21.9%	21.0%	20.1%
Gravity	16.5%	16.7%	16.5%	16.0%	15.5%	14.7%	14.3%	13.8%
Other	1.1%	1.0%	0.9%	0.9%	0.9%	0.7%	0.8%	0.8%

Actual Water Saving 99 to 06 – approximately 3.2%

Structural Management Options

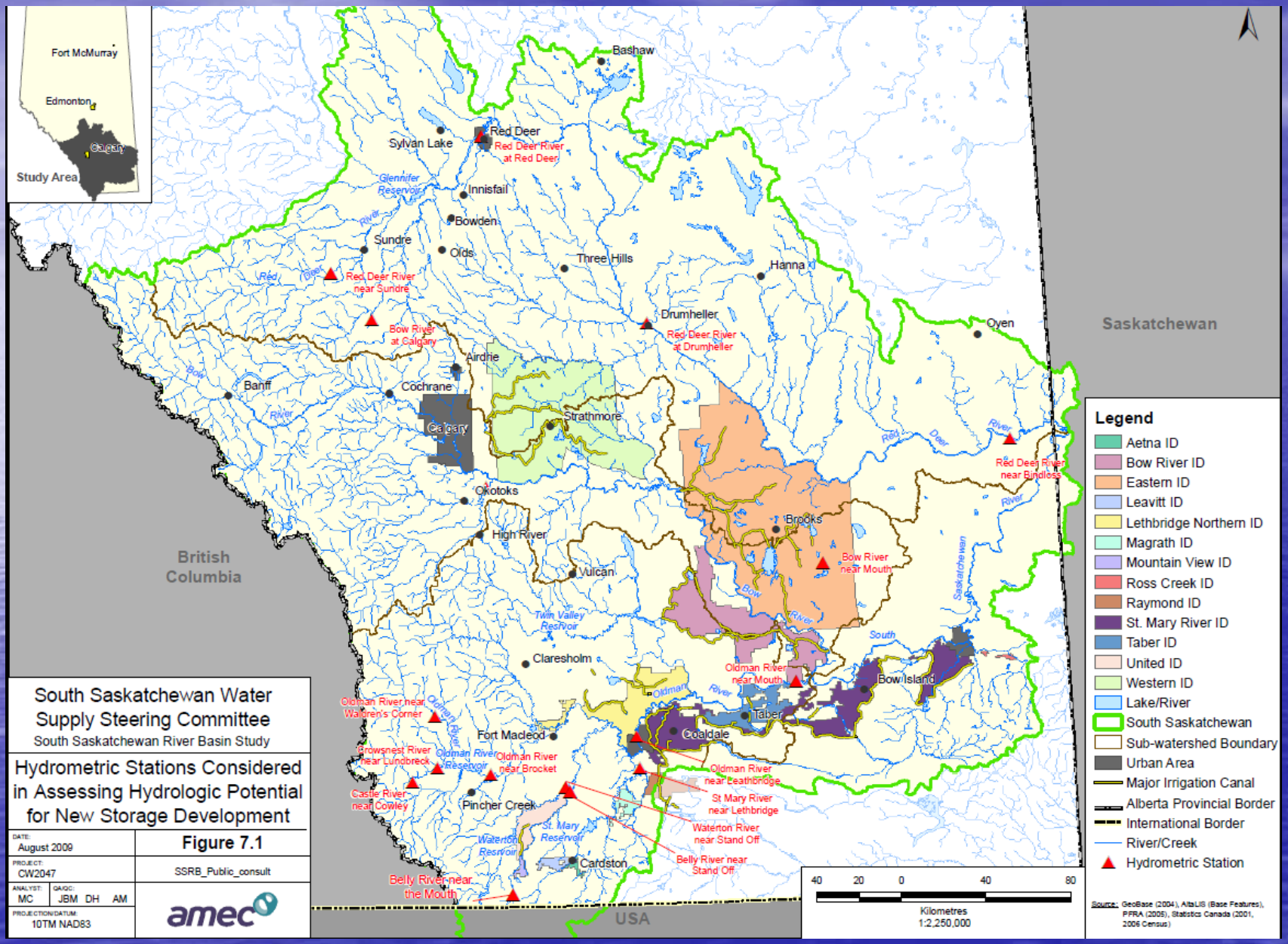
- Study focused on on-stream storage
- On-stream storage benefits
  - Capture peak river flows
  - Flood flow protection
  - Flow regulation capacity



Oldman River

Structural Opportunities

- Considerable storage potential exists on the southern Tributaries, Oldman, Bow and Red Deer.
- New storage must be used to meet WCO and junior allocation deficits
- Existing infrastructure needs to be optimized prior to new storage considerations.



South Saskatchewan Water Supply Steering Committee

South Saskatchewan River Basin Study

Hydrometric Stations Considered in Assessing Hydrologic Potential for New Storage Development

DATE: August 2009	**Figure 7.1**
PROJECT: CW2047	SSRB_Public_consult
ANALYST: MC; QA/QC: JBM DH AM	
PROJECTION/DATUM: 10TM NAD83	amec

Summary of key findings for structural measures

- Preliminary analysis of potential for new on-stream storage
  - Additional storage potential of 1 Billion m^3 in SSRB
  - “Location, location, location”
- Additional on-stream storage
  - Could improve water supply in the Oldman sub-basin for instream and consumptive users

Key Findings:

Water Supply

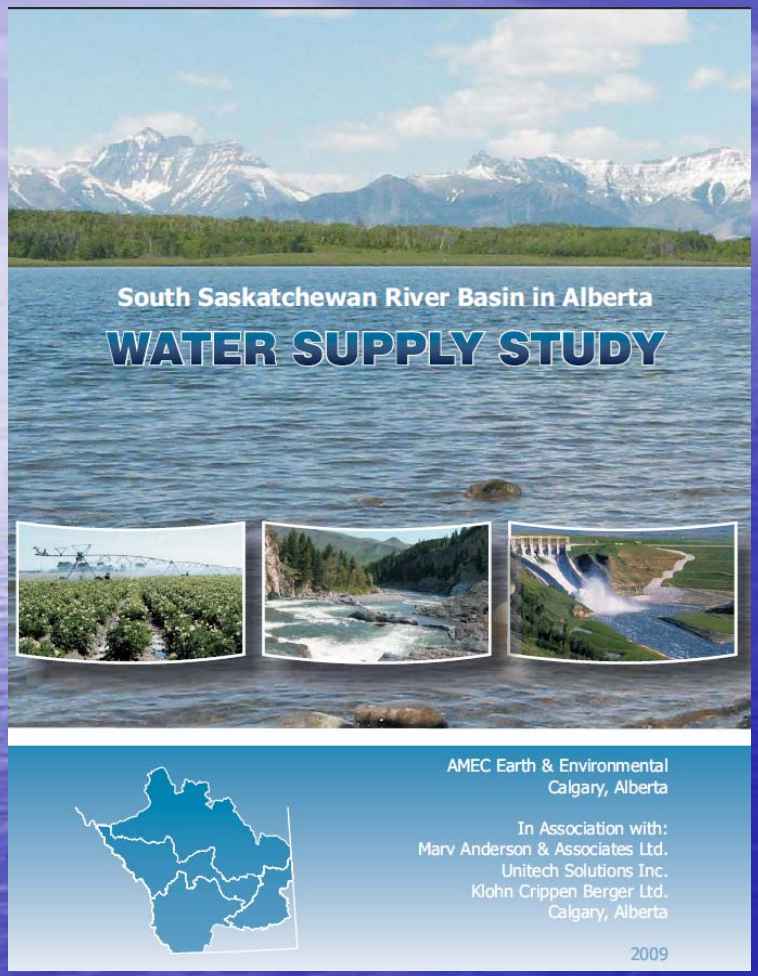
- Water regulation and use (reservoirs and diversion) has had a significant impact on flows in the Bow, Oldman and South Saskatchewan Rivers
- Summer Flows are lower
- Winter Flows in the Bow are higher
- Water, surplus to the Prairie Province Master Agreement, has been delivered to Sask. in every year.
    - There may be water available for additional use in Alberta

Conclusions

- Expansion within irrigation district for all basins performs well
- Irrigation expansion has an impact on instream flows
- Deficits to junior priority users increases in each scenario
- Additional storage would reduce or eliminate deficits is the Oldman sub-basin
- Additional storage is not a requirement in other sub-basins

Conclusions

- Water consumption could increase by 53% by 2030
- Increased water use efficiency could reduce risk due to expansion of the irrigation districts.
- One billion m^3 of additional storage may be required if climate change results in less snow and earlier spring flows.



South Saskatchewan River Basin in Alberta Water Supply Study

Conclusions and Recommendations

Government of Alberta

Agriculture and Rural Development


Thank You
Questions?