Engineering and a Water-Short Economy

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President, Fossil Water Corporation

Alberta's Water Debate

- Declining Supply
- Increased Demand
- Global Microscope
- Emerging Market

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Trouble Brewing in Alberta Watersheds?

- **In 2006 - all four SSRB rivers failed provincial water quality objectives**
- **Freshwater quality across Canada is "fair to marginal" at >50% of sites**
- **Only 28% of riparian zones along Bow are healthy**

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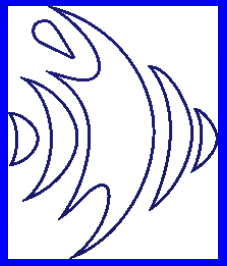
Alberta's River Constraints

- **Bow and Oldman - Quantity**
- **Red Deer – Economic Opportunity**
- **North Saskatchewan - Quality**
- **Athabasca - Social License**



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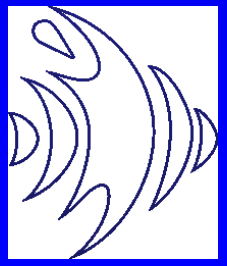
Bow River System



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Bow Glacier's Century-Long Recession

1898

2002

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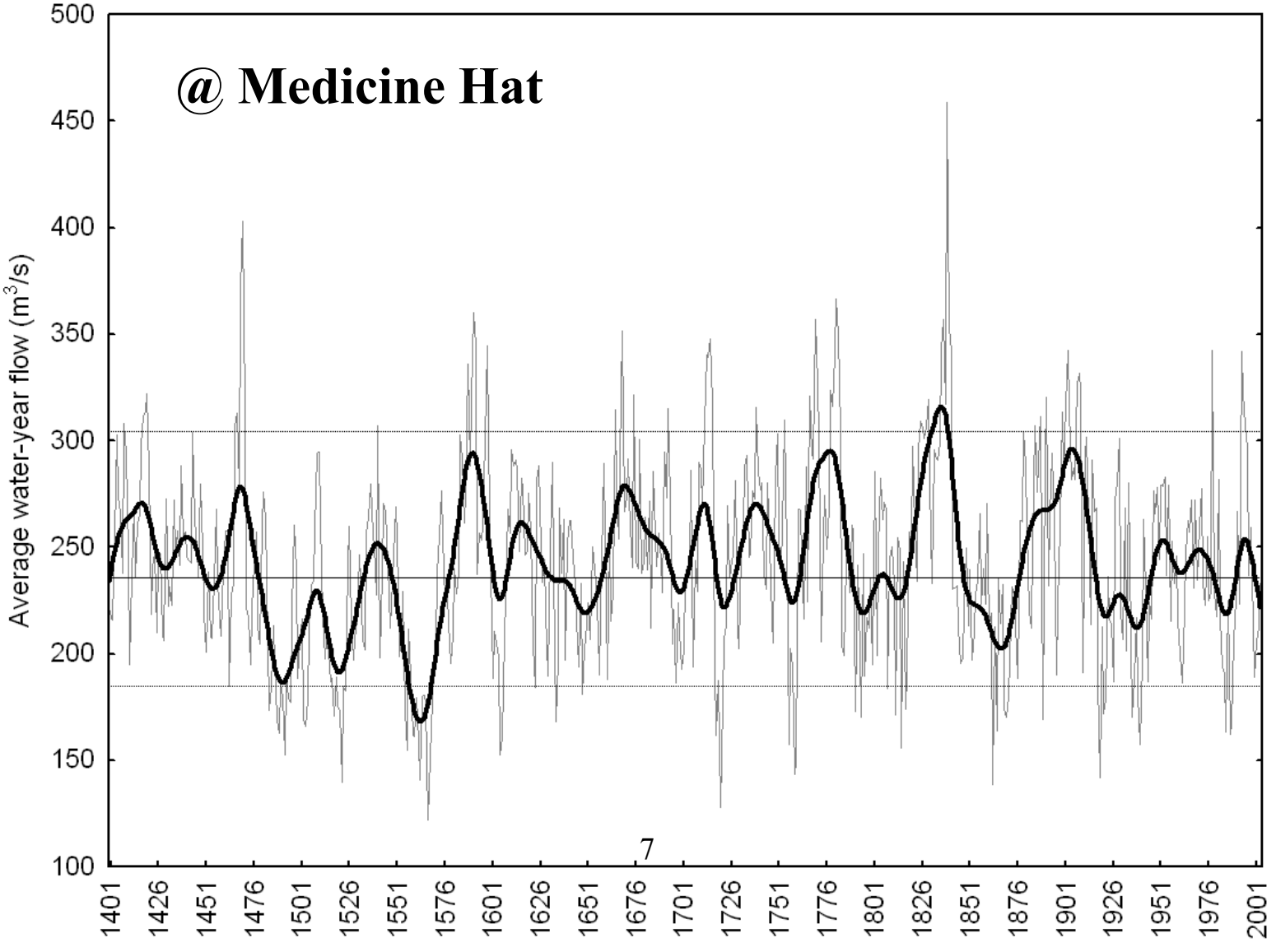
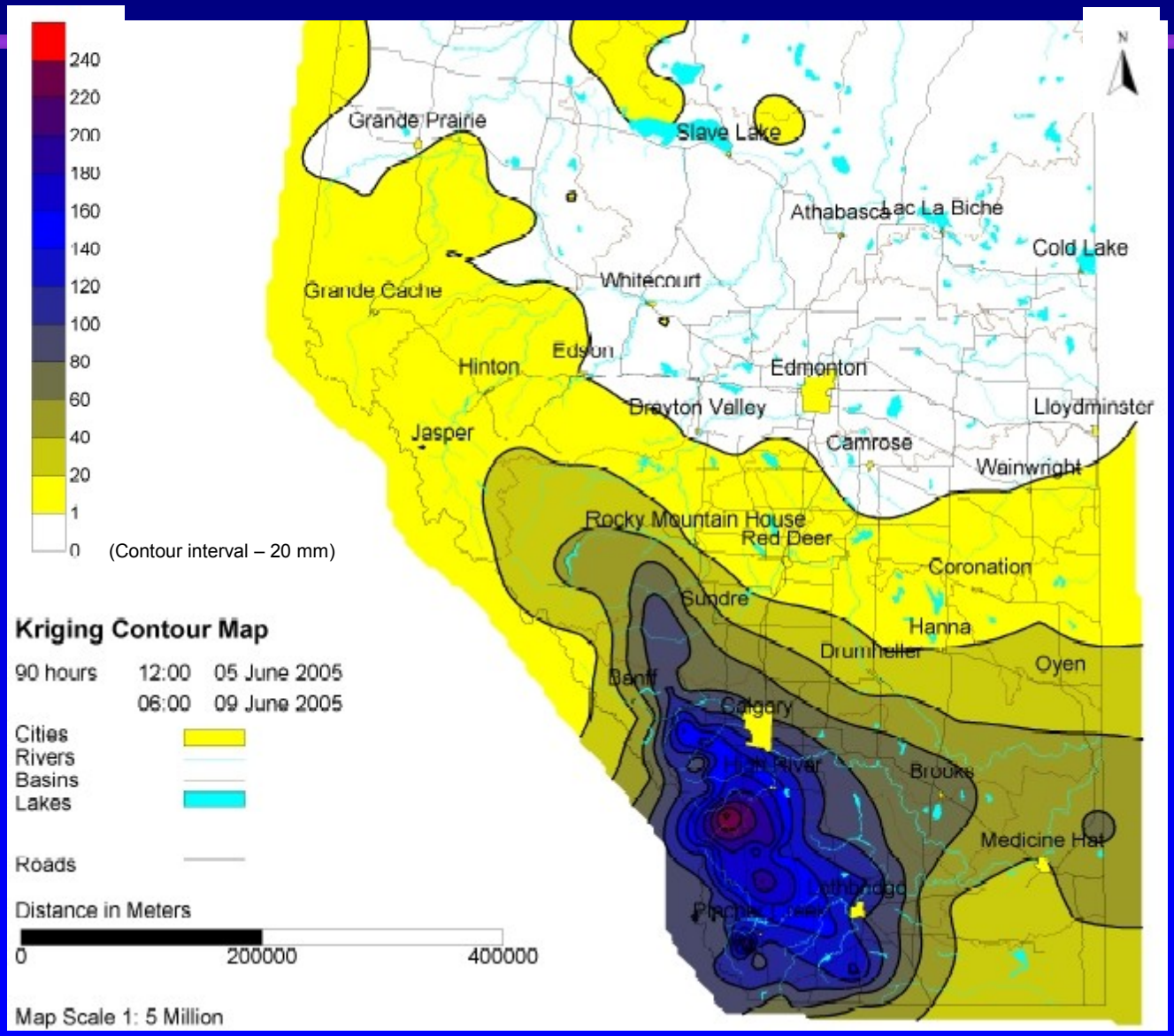
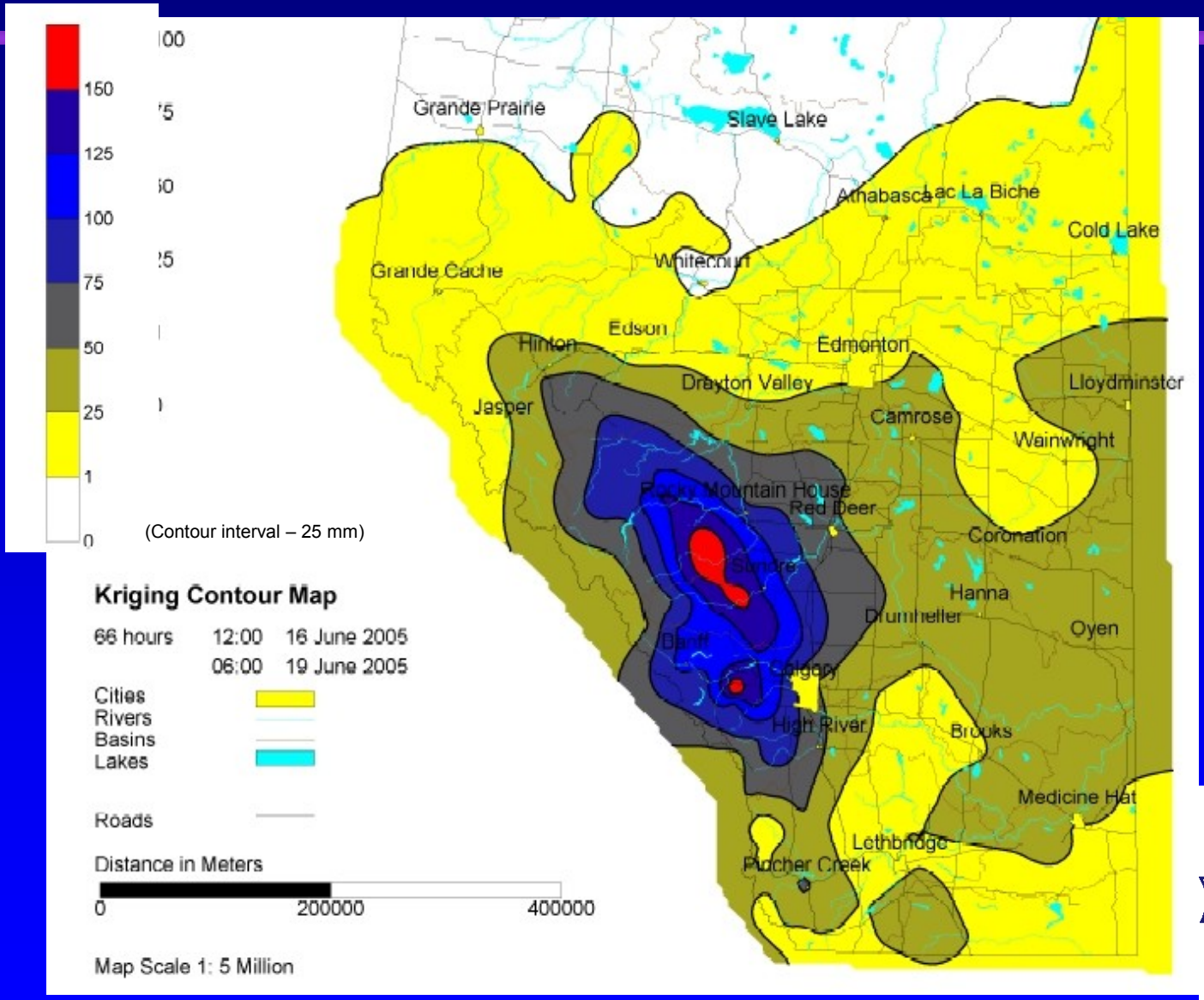
Flow In South Saskatchewan



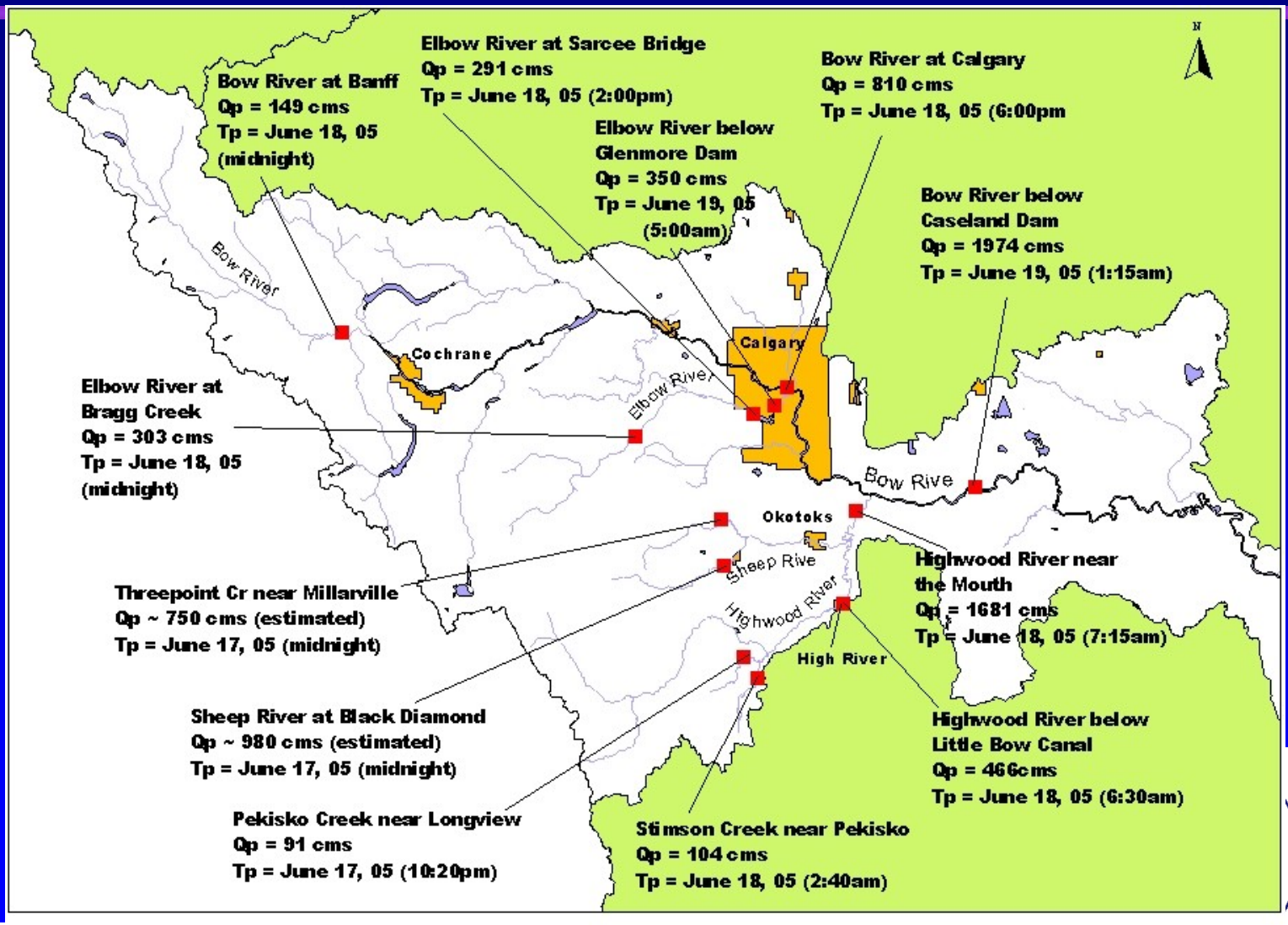
June 5-7 2005 - Precipitation Totals (1st Event)



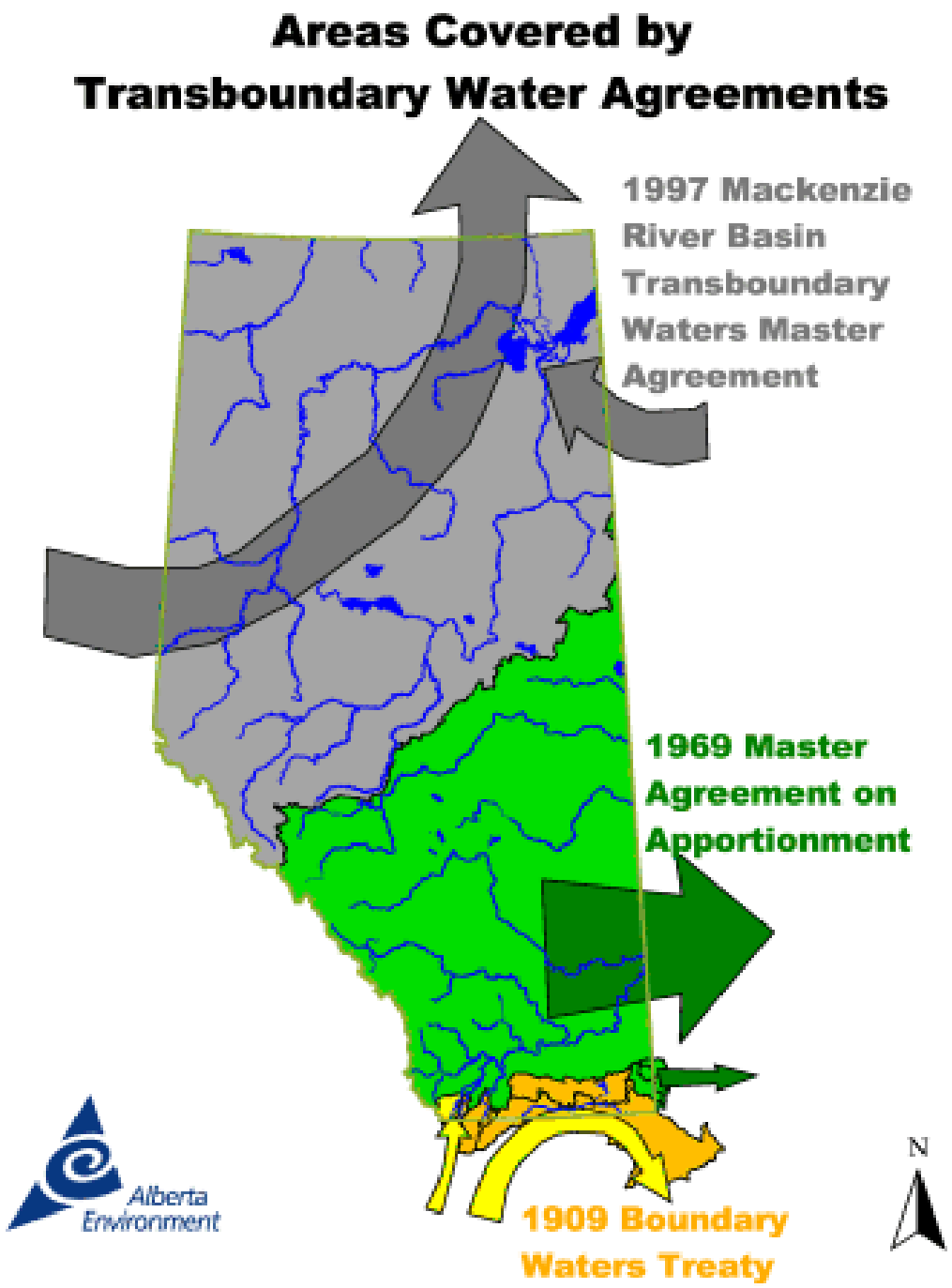
Precipitation Totals (2nd Event): June 16-19, 2005



Peak Discharge Assessment: June 16-19, 2005

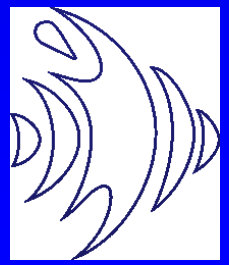


June 22, 2005



Cooperative Water Agreements

- 1909: US to pass ¾ of natural flow
- 1969: Alberta to pass ½ of natural flow
- 1997: Maintenance of Ecological Intregrity



Engineered River System

- 11 hydro-electric control structures constructed between 1911 and 1956 (537,000 acre feet storage)
- 25% of flow through Calgary controlled by Transalta
- 3 irrigation control structures: Bassano (EID), Carseland (BRID), Bow Weir (WID) (637,000 acre feet)
- 2 drinking water control structures: Glenmore, Bearspaw

EID
Eastern Irrigation District

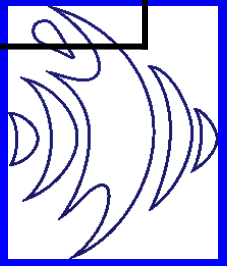
WID

BOW
RIVER
IRRIGATION
DISTRICT

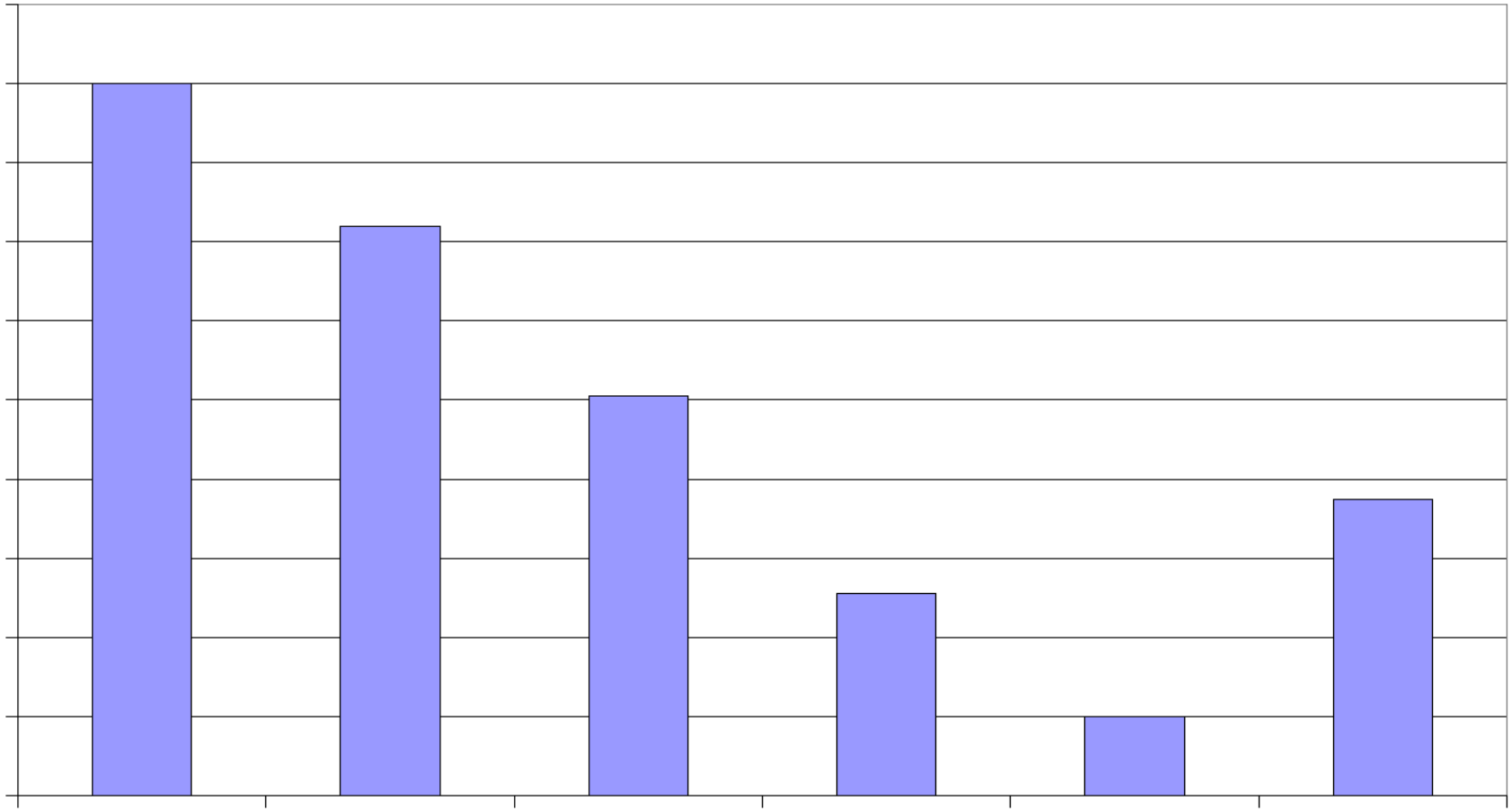
TransAlta

Irrigation District Water Allocations

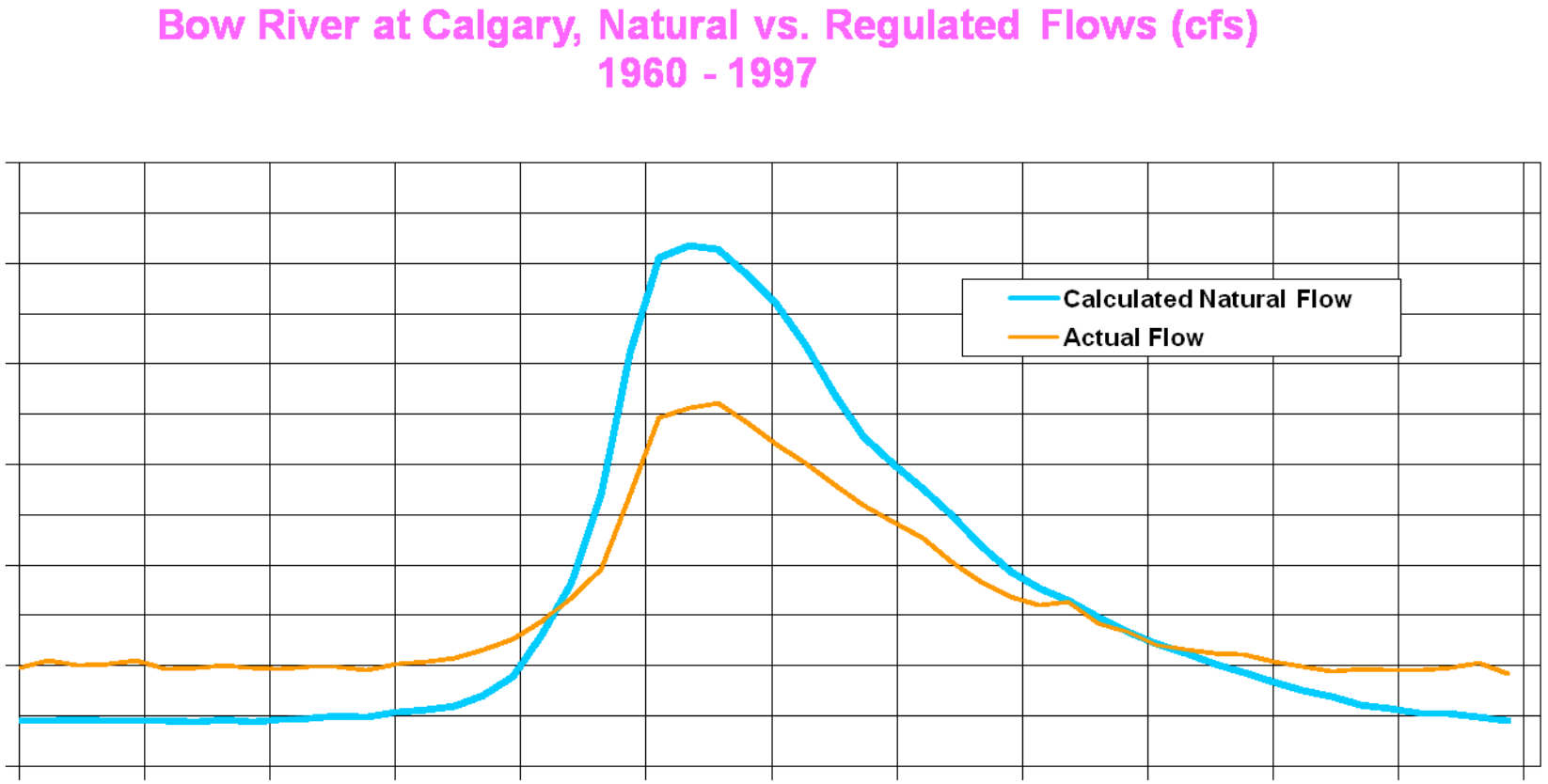
	BRID	EID	WID
Water License Allocation (AF)	450,000	762,000	160,400
Used in 2003	280,000	460,000	129,000
Off-Stream Storage (AF)	390,000	240,000	6,500



Bow Hydro - Reservoir Storage (AF)



Impact of Reservoir Operation on Bow River Flows



Bow Basin Demand: 1 million served

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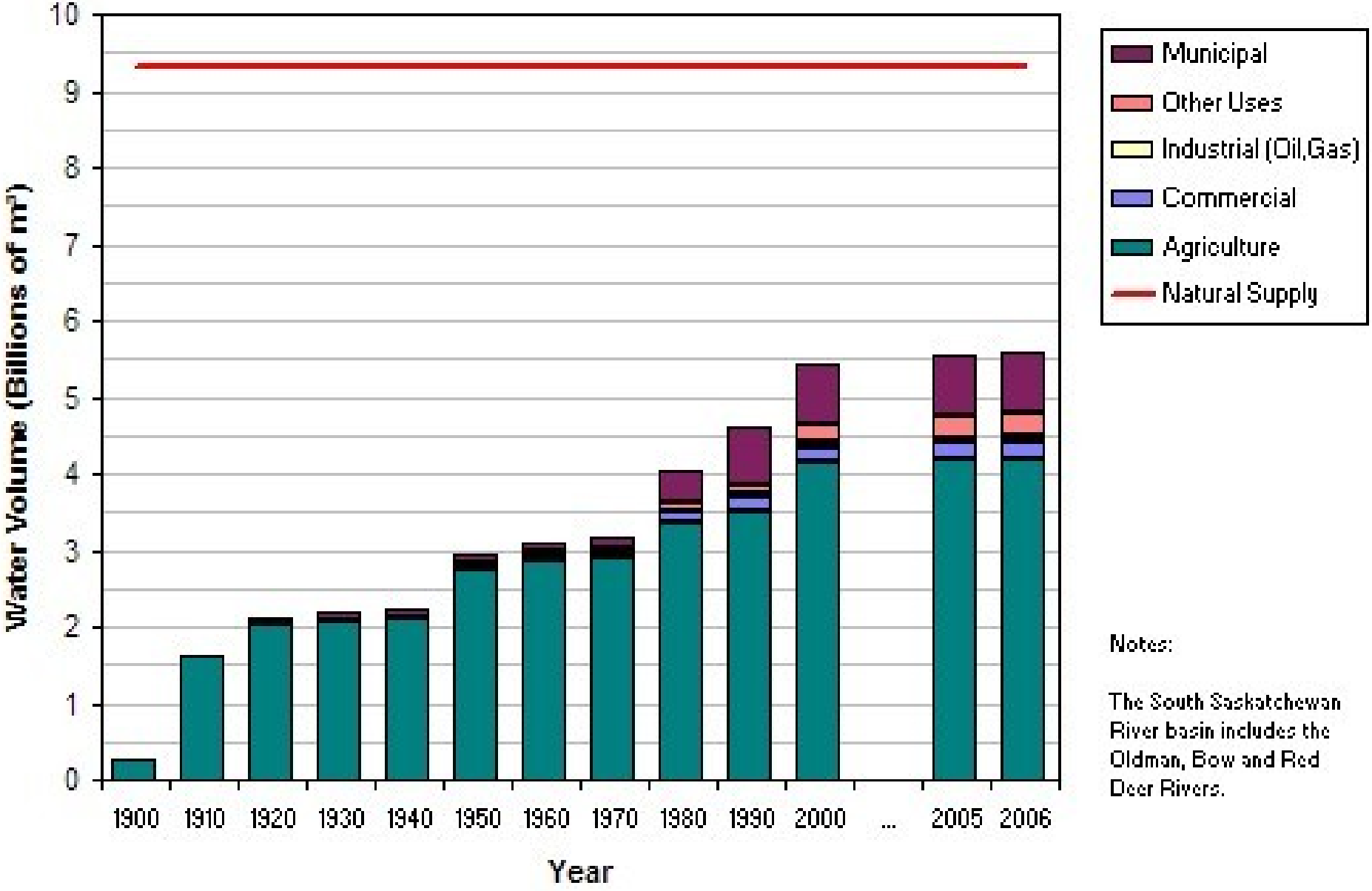
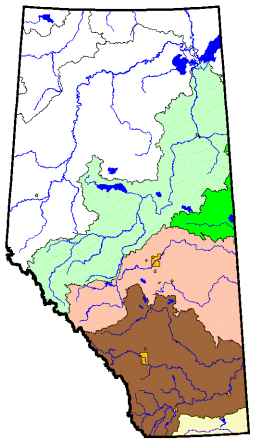
Sectoral Water Allocations Index - South Saskatchewan River Basin



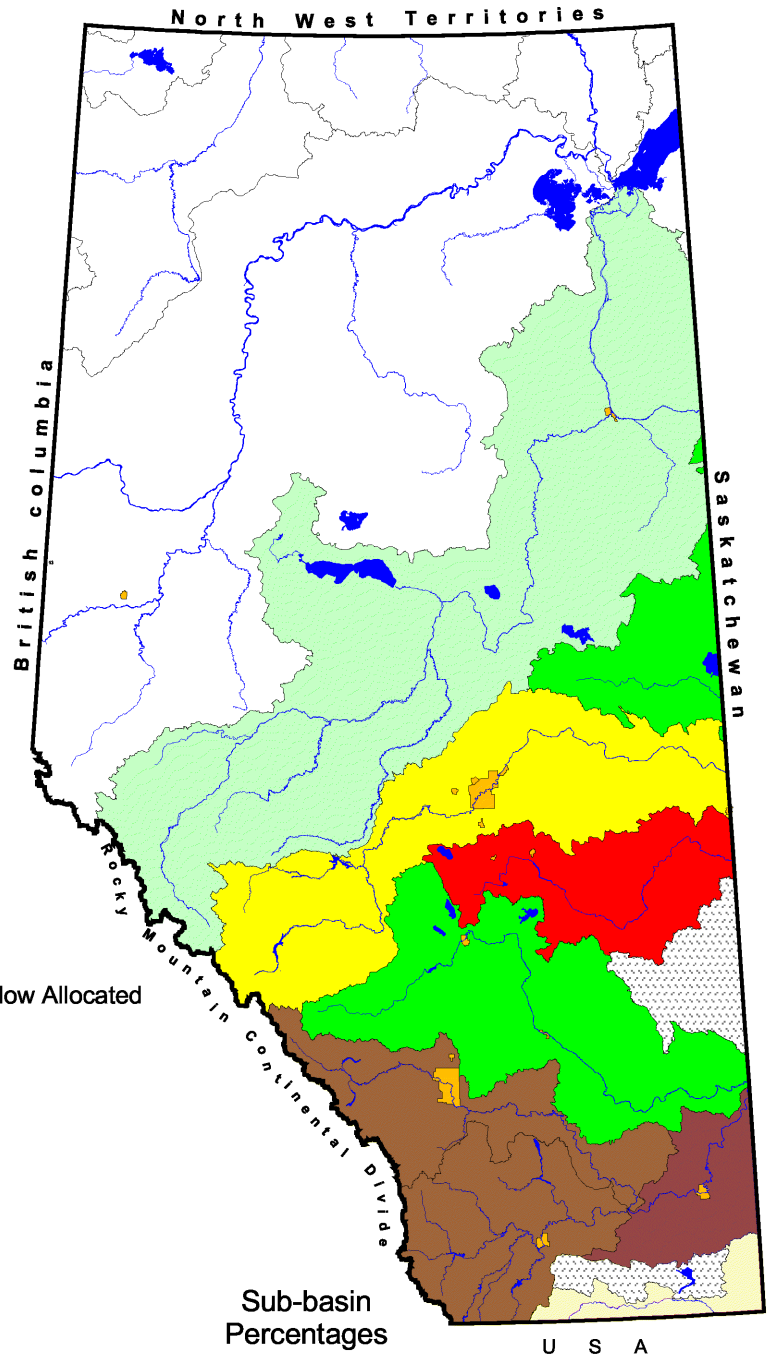
Notes:

The South Saskatchewan River basin includes the Oldman, Bow and Red Deer Rivers.

% of Natural Flow Allocated



Major Basin Percentages



Sub-basin Percentages

Alberta Environment

2001

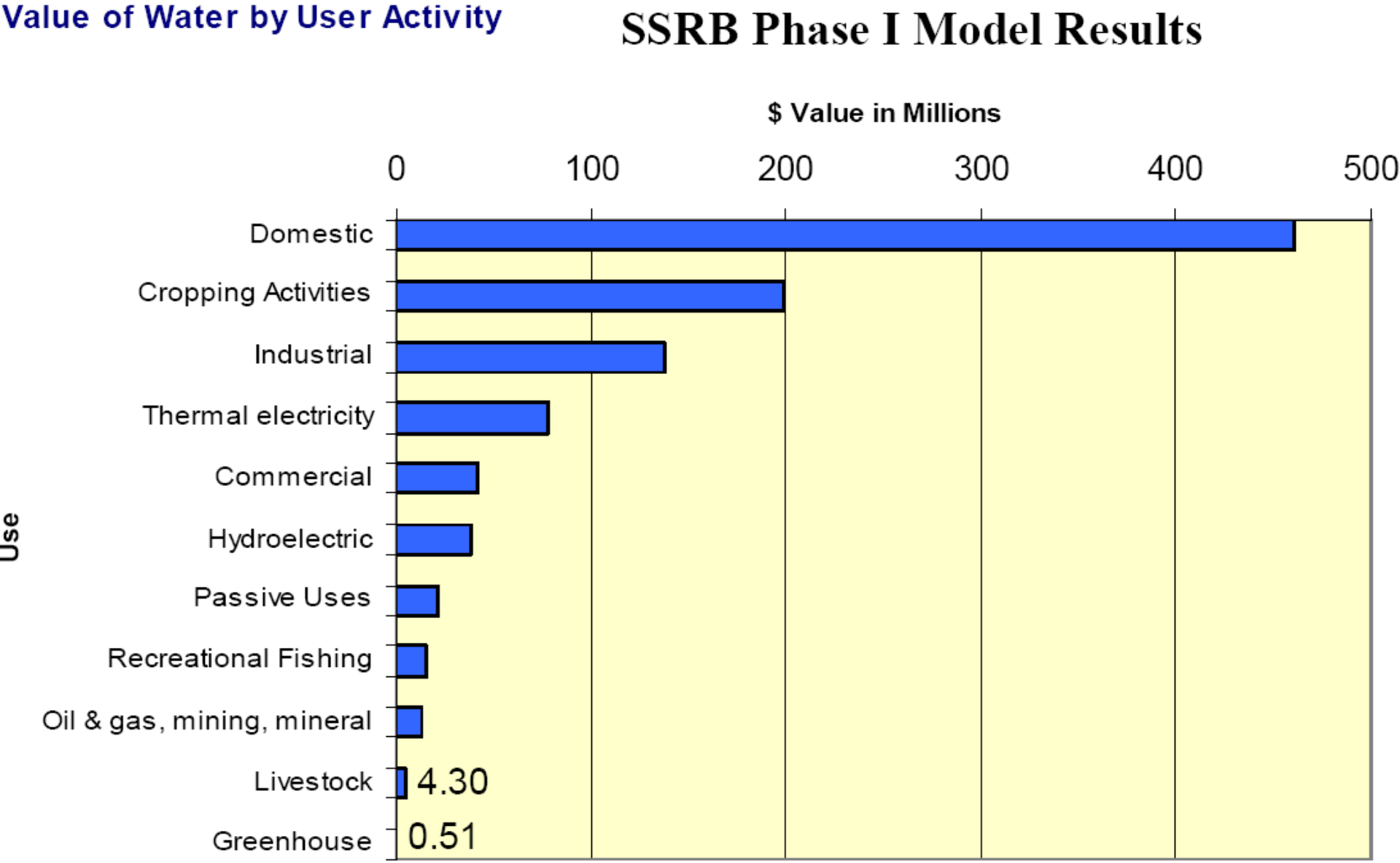
% of Mainstem Natural Flow Allocated

- Less than 1%
- 1 to 10%
- 10 to 20%
- 20 to 30%
- 30 to 40%
- 40 to 50%
- 50 to 60%
- 60 to 70%
- 70 to 80%
- 80 to 90%
- 90 to 100%
- More than 100%
- n/a

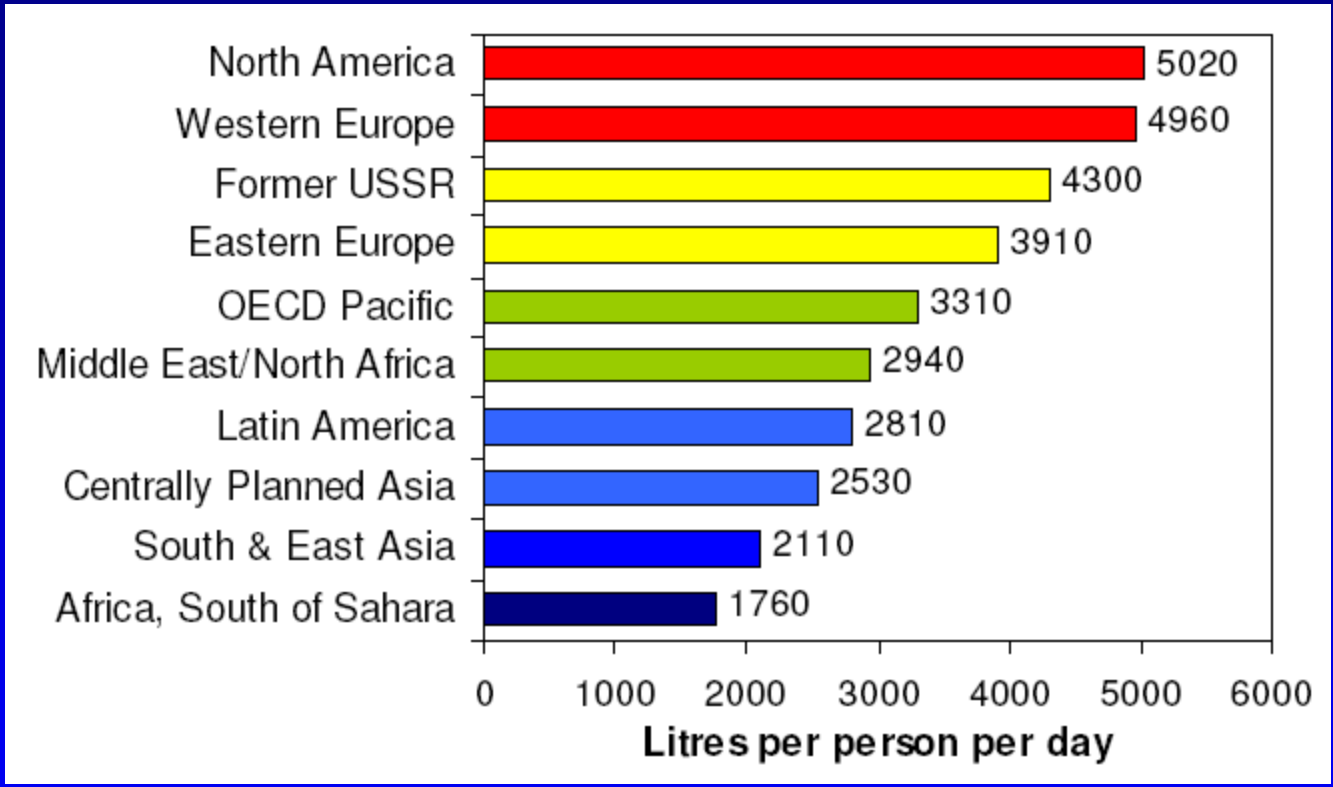
- Apportionment agreements cover minimum flow to be passed
- Battle River allocation to power p

Value of Water in SSRB

Value of Water by User Activity



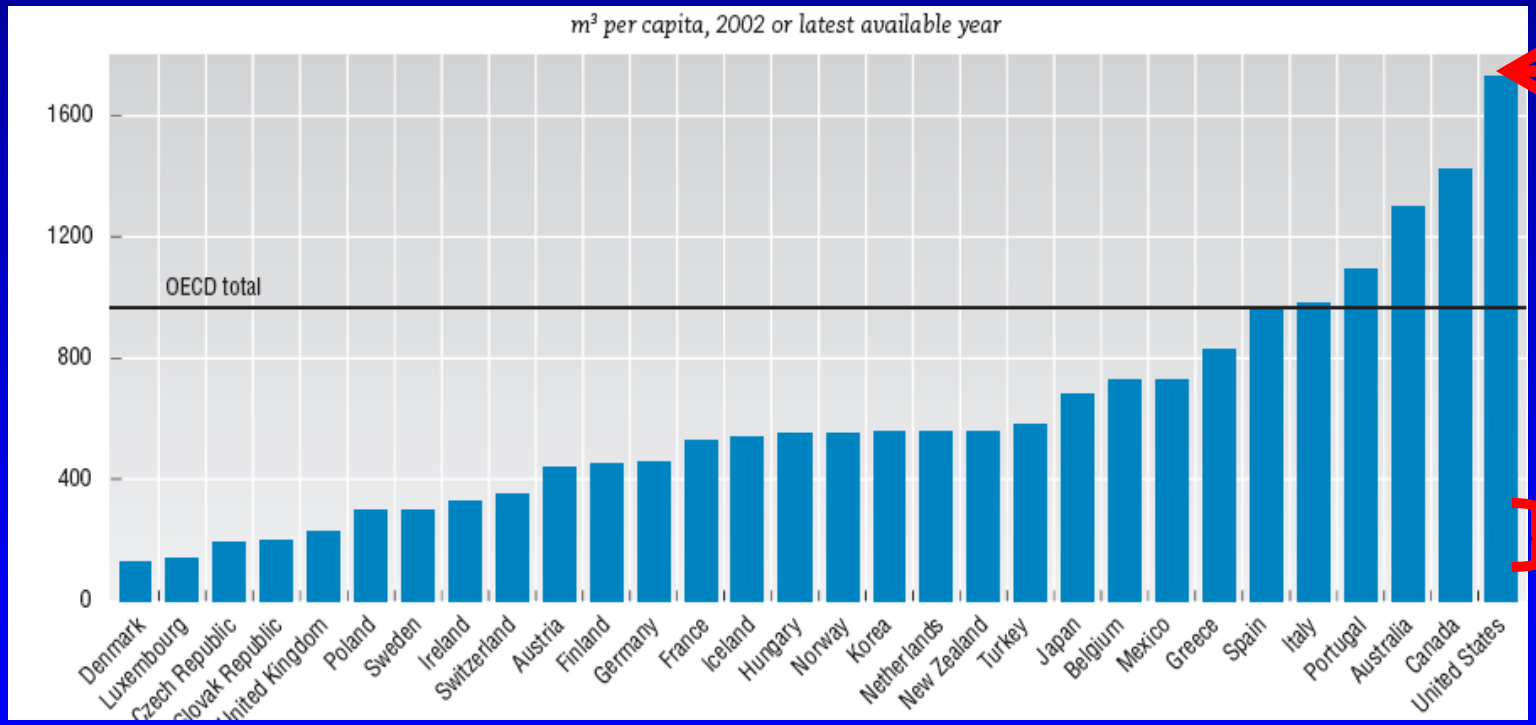
Our diets are water intensive



- The Basin's 1.2 million people require 2.1 billion cu.m. per year to sustain diet

Per Capita Consumption

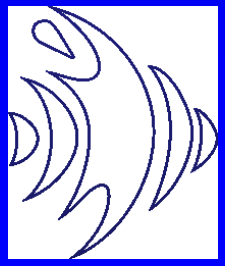
Bow River Economy 1,200 to 1,800 cu.m. per year



CRP Members 120 to 280 cu.m. per year

How Do We Move Forward?

- **Historical Paradigm – find ways to use more**
- **New Paradigm - greater efficiency and value of use**
- **Requires:**
  - **Markets ?**
  - **Policy ?**
  - **Engineering ?**
- **Answer - Leadership**



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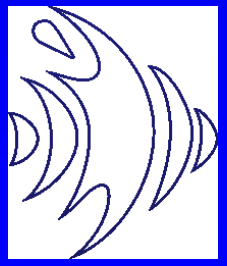
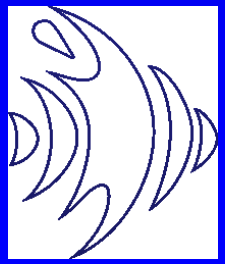
Leadership Around the World in Water

- **Securing Headwaters: New York, Seattle**
- **Reclaim Wastewater: Australia, Middle East**
- **Aquifer Recharge: California, Nevada**
- **Low-Water Landscapes: Las Vegas**
- **Water Conservation: Europe**
- **Water Markets: Australia, California**



Market Solutions



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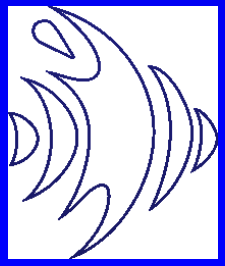
Market Solutions?

- Water is priceless – but has no value
- Is a market a threat to the right to water?
- Can we trust the private sector?



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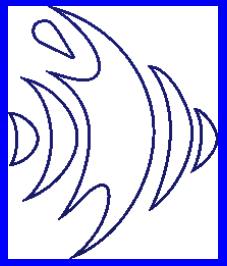
Should There Be a Market?

- **Are we satisfied with the outcomes of the current system of regulation and law?**
- **Will Albertans act voluntarily to serve collective interest?**
- **Will the electorate allow public officials to choose winners and losers in a water-short economy?**



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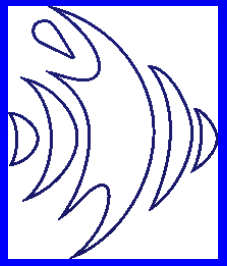
Market Responses Around the World

- Supply Side
  - Purchase Headwaters (New York, Seattle)
  - Aquifer Recharge (California, Nevada)
- Demand Side
  - Reclaim Wastewater (Australia, Middle East, Arizona);
  - Low-Water Landscapes (Las Vegas)
  - Water Conservation (Europe, Australia)



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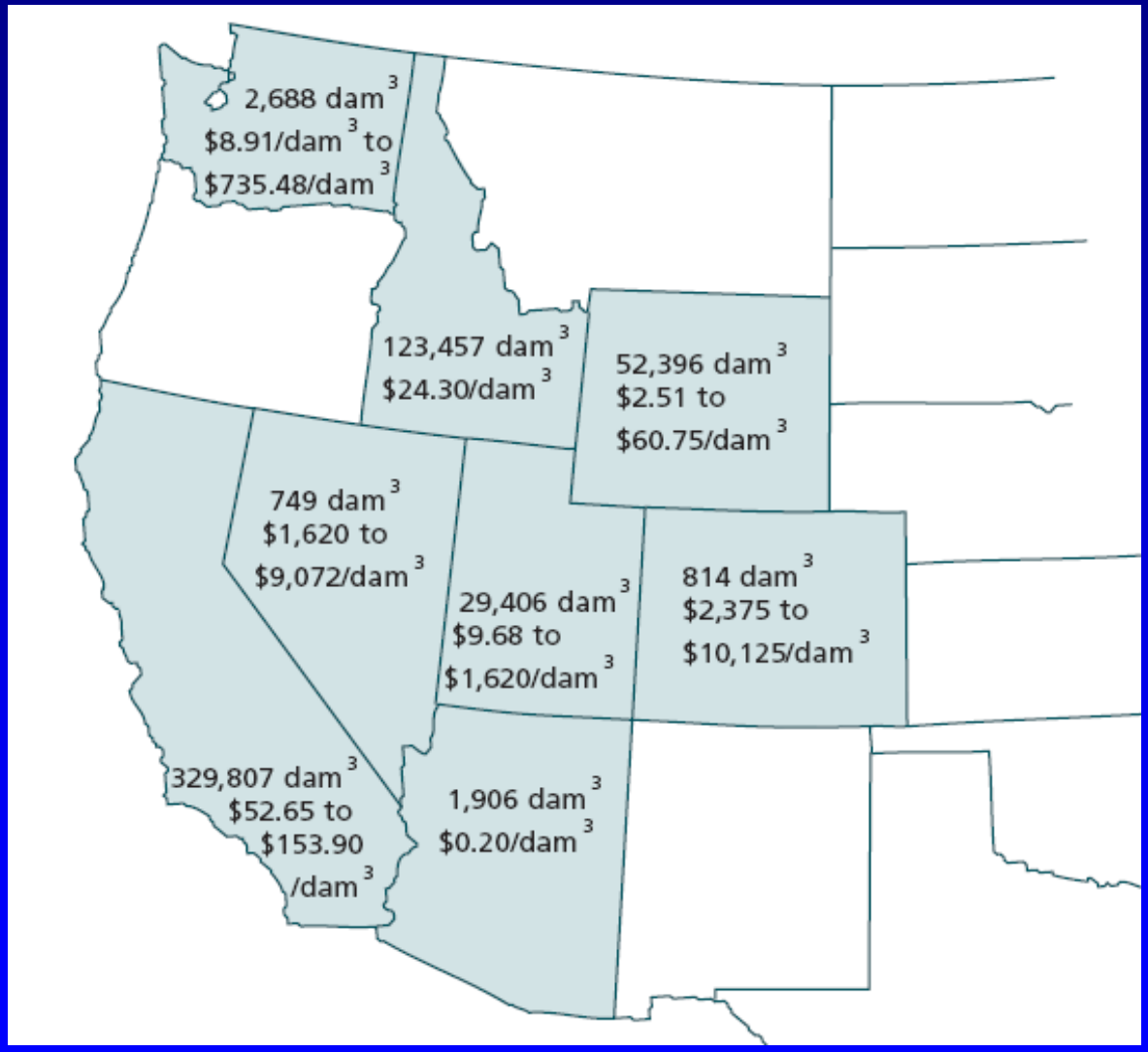
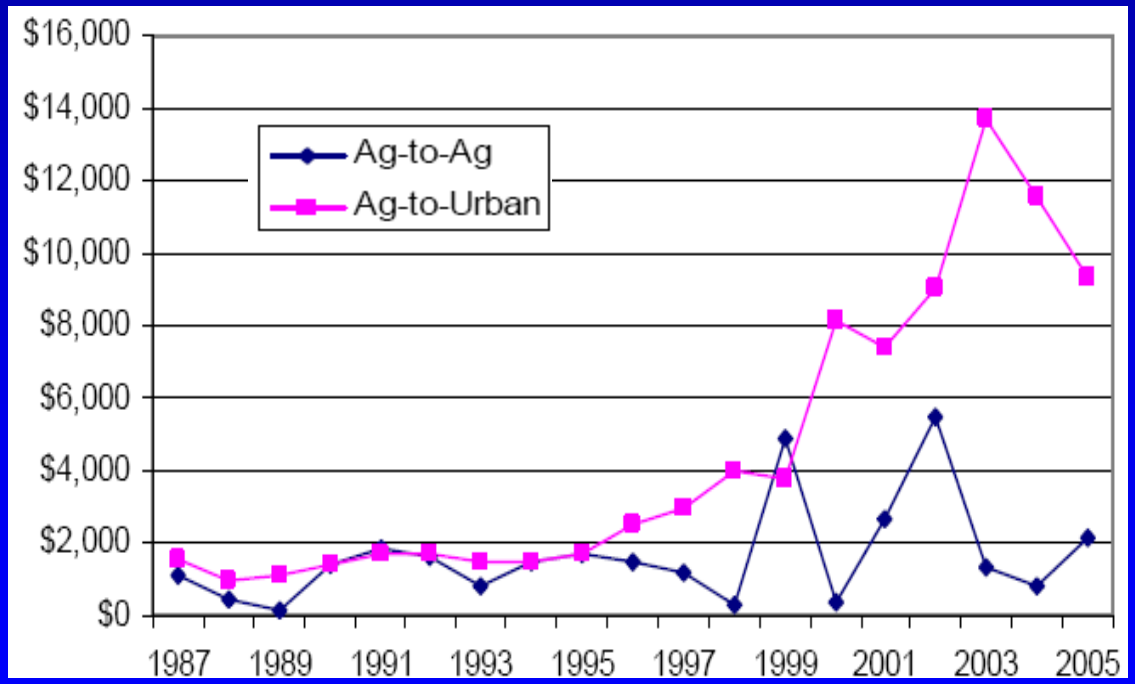
US Water Markets in 2004



Recent Western US Water Rights

2007 Prescott Valley Wastewater Auction



source: Brewer et al, 2007

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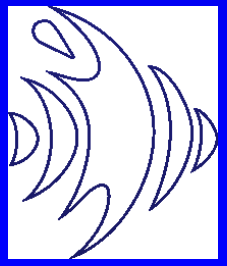
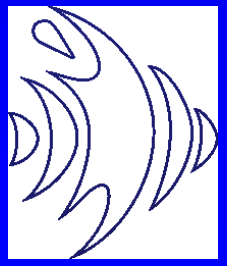
North America Water Rights

- Oldman Irrigation Contracts = $300/AF
- Bow River (Normal) = $2,000 to $2,500 /AF
- Bow River (Special Circumstances) = $7,500 / AF
- Nevada (Normal) = $10,000 / AF
- Arizona Reclaimed Wastewater = $22,500 / AF
- Nevada (Special Circumstances) = $50,000 / AF
- Rights are worth 24¢ to $41 per m^3
- Service charges range from 64 ¢ to $3 per m^3



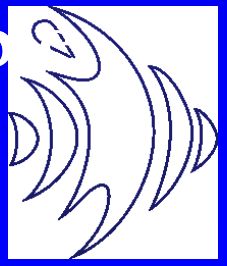
Water Rights in SSRB

- Water owned by Crown – right to use issued under Water Act 1999
- FITFIR administration of right to use
- Moratorium on new licenses: August 2006
- SSRB Totals:
  - 4196 licenses = 295,000,000 m^3 allocated = 239,000 AF
  - Only 28 transfers since 1999
  - Transfers take up to 2 years: Balzac
- Conclusion: market is illiquid



Market Solutions

- Incentives for water conservation to free up transfers
- Mechanisms to share water
- Encourage recovery, recycle and reuse of water
- Capture and additional storage of water – proposed Bruce Lakes reservoir examp



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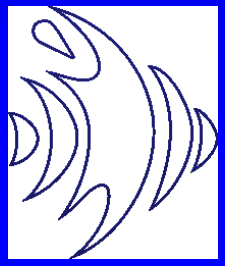
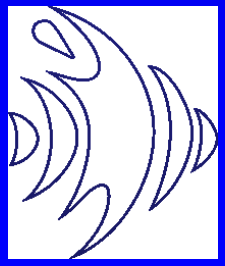
Markets?

- Much work to be done…



Policy Solutions



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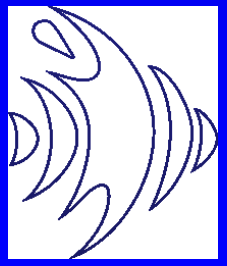
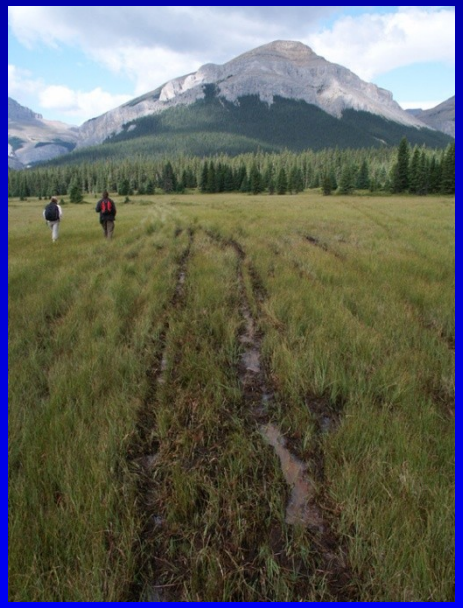
Policy Answers?

- Plan for next 7 generations - we do not inherit the Earth from our Ancestors, we borrow it from our Children
- New partnership models to deliver portfolio of solutions
- Choose priorities and act in collective interest



Ghost Waiporous Headwaters



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Work on Many Fronts

- Calgary Regional Partnership
- Government of Alberta: Water For Life, Land Use Framework
- Alberta Water Council
- Volunteer Organizations: Watershed Councils
- Trust Organizations
  - Water Conservation Trust of Canada
  - Wetland Trust
- Societies
  - Alberta Water Portal www.albertawater.com

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GoA Water For Life

- Safe Drinking Water, Healthy Aquatic Ecosystems, Reliable Water Supplies
- Focus on Foundations and Frameworks and Partnerships
- 30% conservation ar efficiency goal by 20

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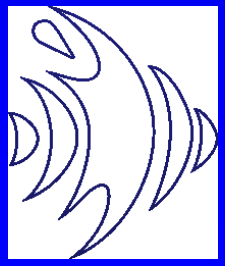
Engineering Solutions



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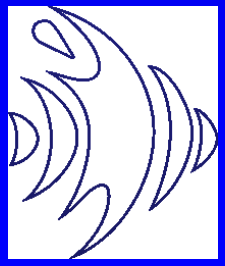
Engineering Solutions

- Engineer society
- Engineer physical works
  - Conservation for existing uses
  - Efficient design for new uses
  - Management of water life-cycle



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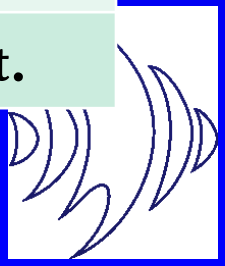
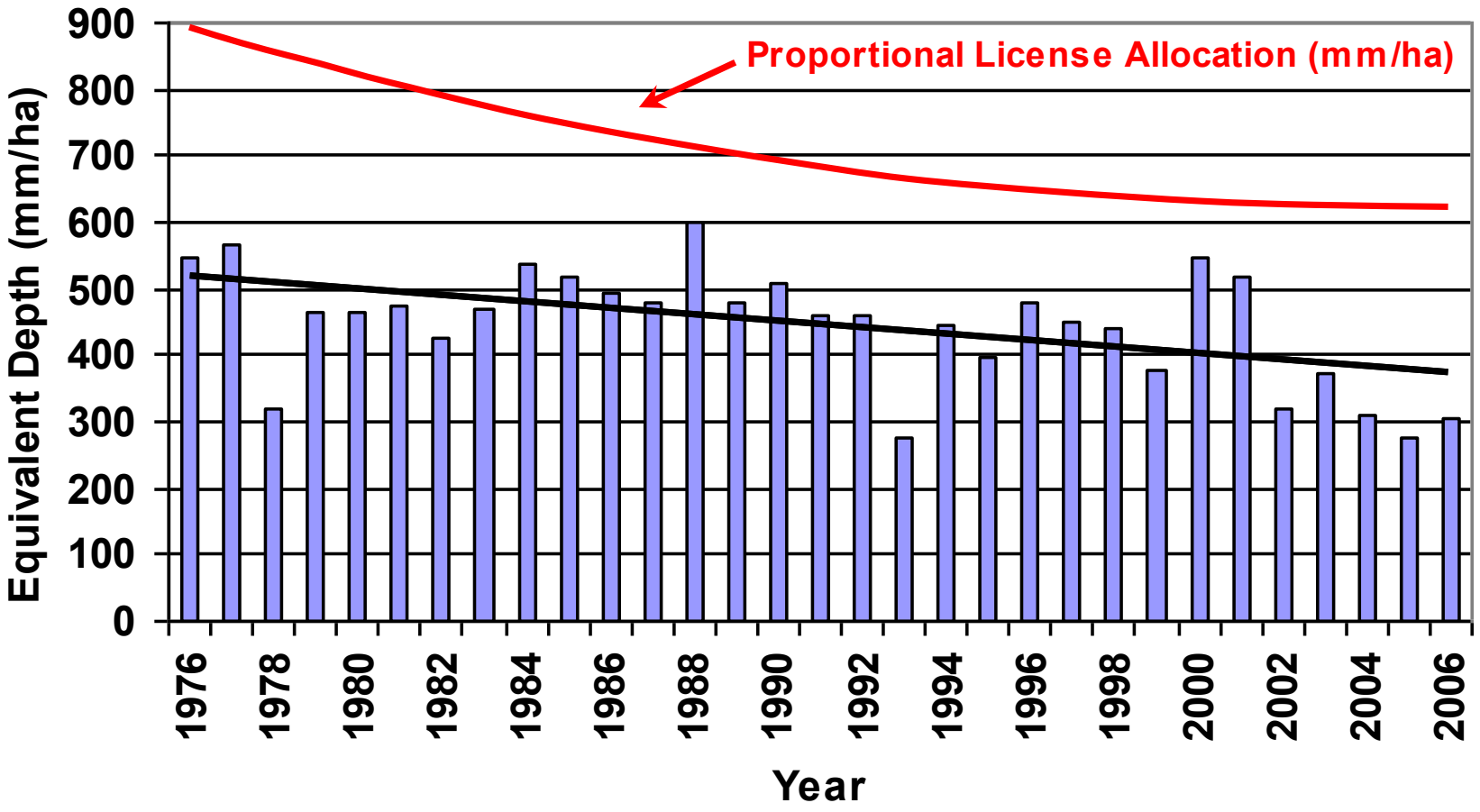
Irrigation Efficiency

Method of Irrigation	Application Efficiency
Surface Irrigation(undeveloped)	30 %
Surface Irrigation (developed)	65 %
Side-roll Wheel Moves	68 %
Centre Pivots (high-pressure)	74 %
Centre Pivots (low-pressure)	80 %
LEPA Pivots	85 % + est.
Drip Lines	95 % + est.



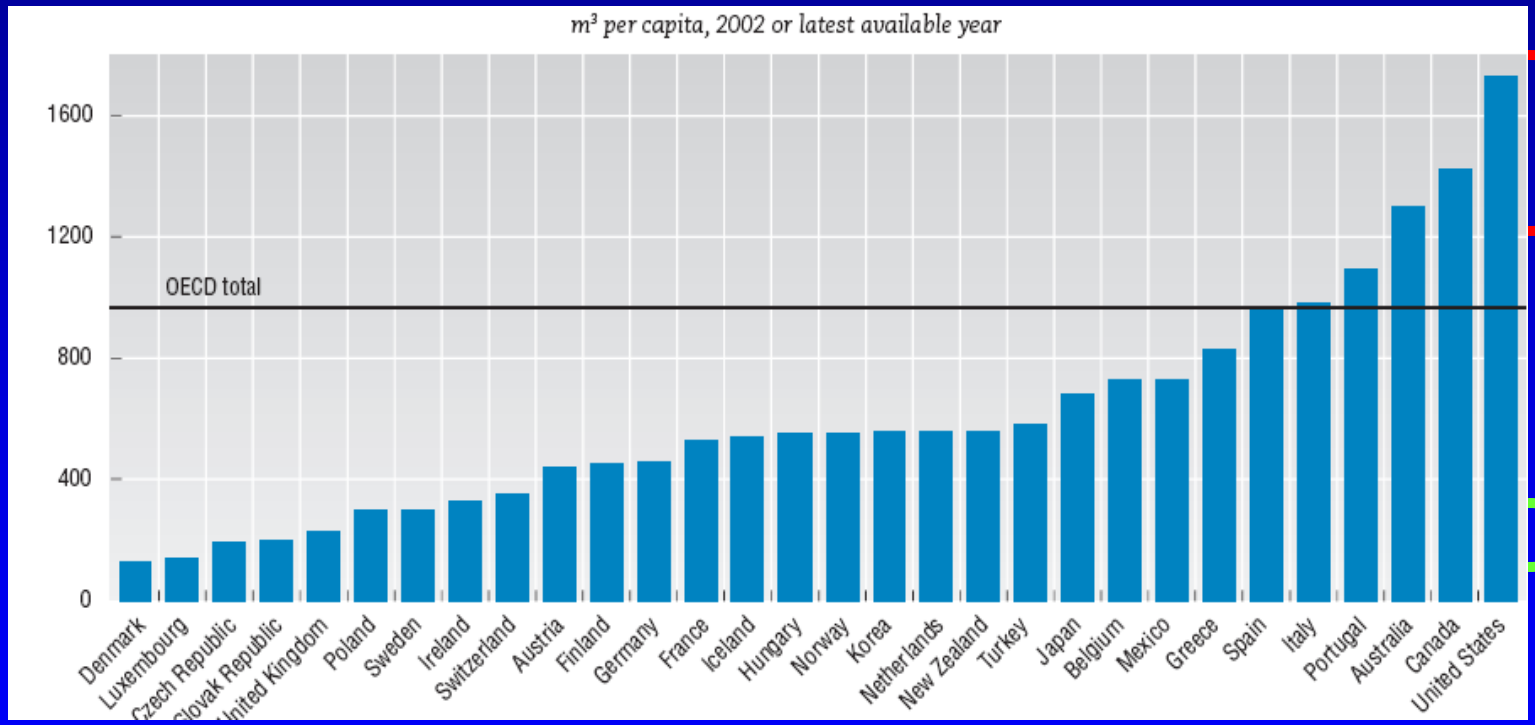
Irrigation District Water Use and Allocation Trends

Assessed Area



Per Capita Consumption

Bow River Economy 1,200 to 1,800 cu.m. per year



Calgary Region Municipalities 120 to 280 cu.m. per year

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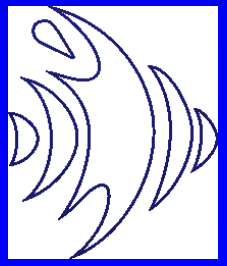
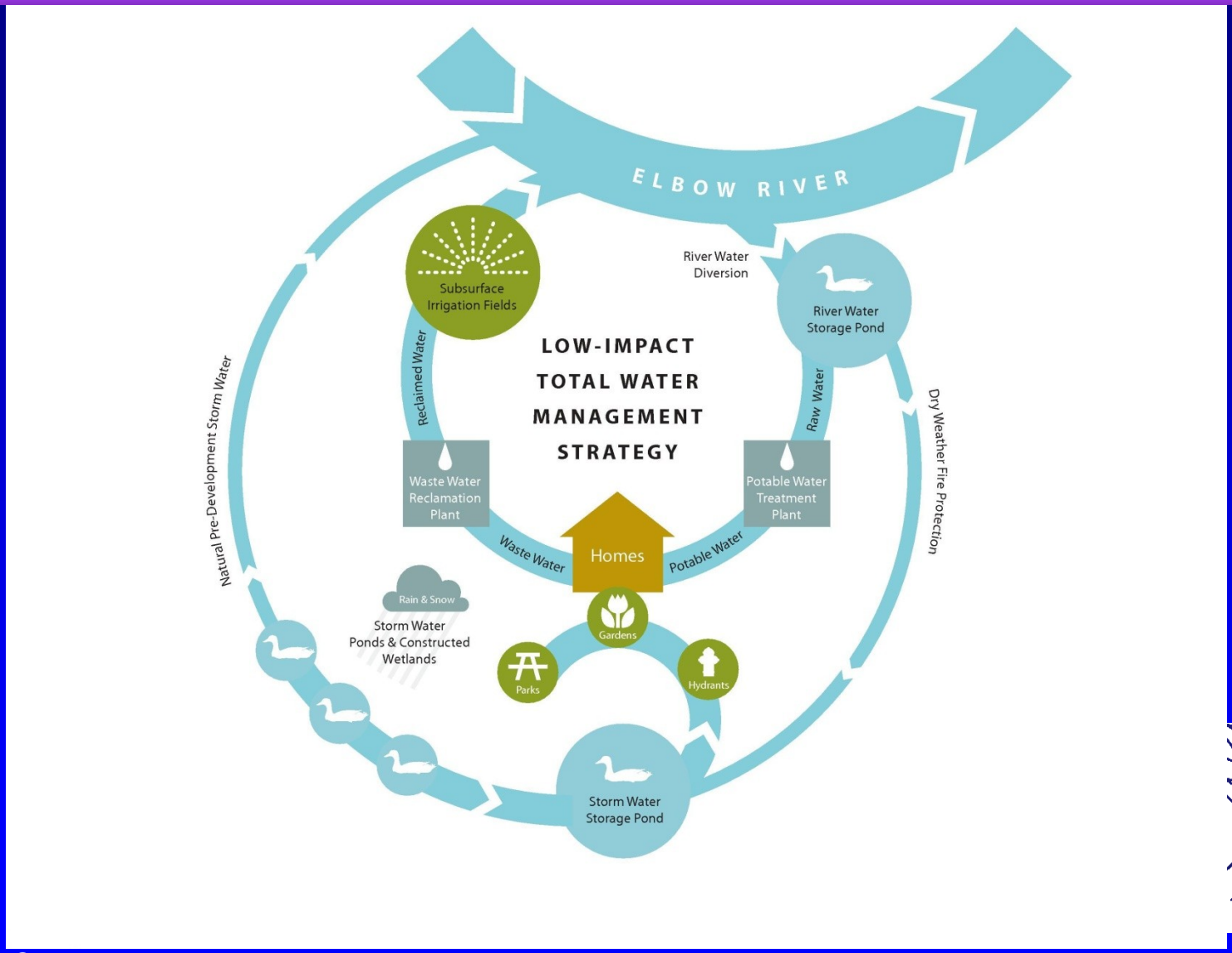
Developers

- Low impact development
- Lower per-capita consumption
- Innovations: reclaimed wastewater for irrigation; stormwater for non-potable; metered consumption



New: Low Impact Water Management



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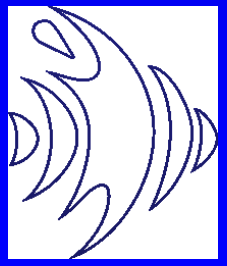
Engineering Solutions

- Plenty of opportunities to engineer physical works
- True breakthroughs require social engineering



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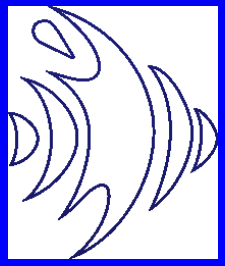
Conclusions

- Markets
- Policy
- Engineering
- Leadership



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