

Irrigation Water Quality Study

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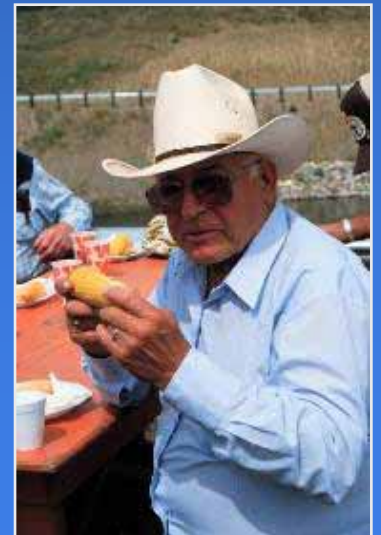
2010 Irrigation Technical Conference

**Government
of Alberta** 

Water Quality

Agriculture

- Good water quality is important to ensure safe, quality food production.
 - Ability to produce food
 - Human health
 - Market access



Water Quality

Agriculture

Perception or Reality?

Alberta's increasingly urban public perceives agriculture as the major cause of environmental degradation.



Purpose:

To assess water quality throughout Alberta's Irrigation Districts and determine possible impacts on food safety and the aquatic environment.



Specific objectives

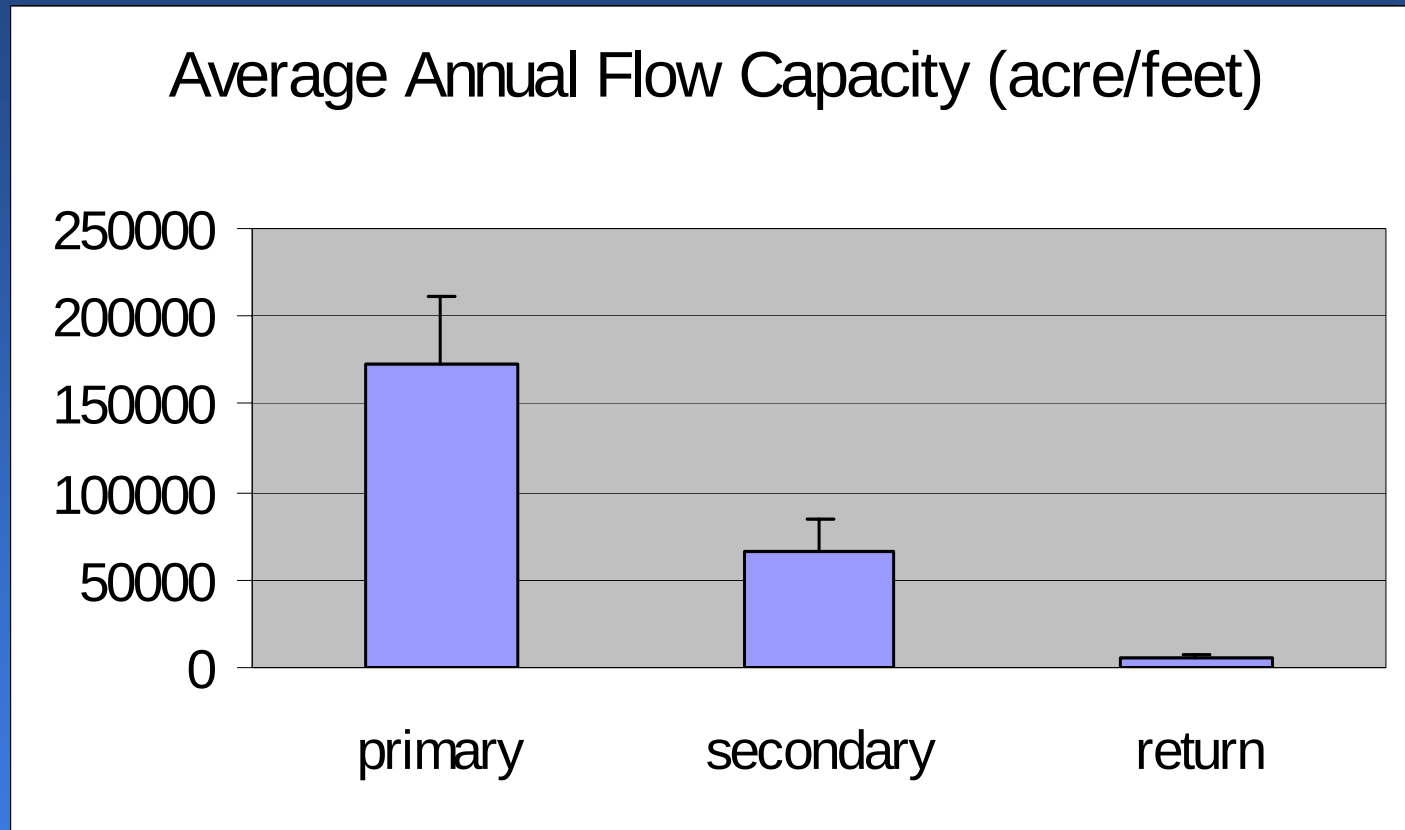
- Assess quality of source water
 - Food production perspective
- Assess changes from source to return flow
- Determine if there are differences between irrigation districts
- Determine if there are differences between conveyance systems

Water Quality Assessment:

- 2006, 2007
- 79 sampling sites
- 12 irrigation districts
- grab samples 4x per year
- Parameters:
 - Physical characteristics
 - Nutrients
 - Metals
 - Bacteria
 - Pesticides



Types of sampling sites:



- n = 17 ▲ Primary Source
- n = 33 ■ Secondary Source
- n = 29 ● Return

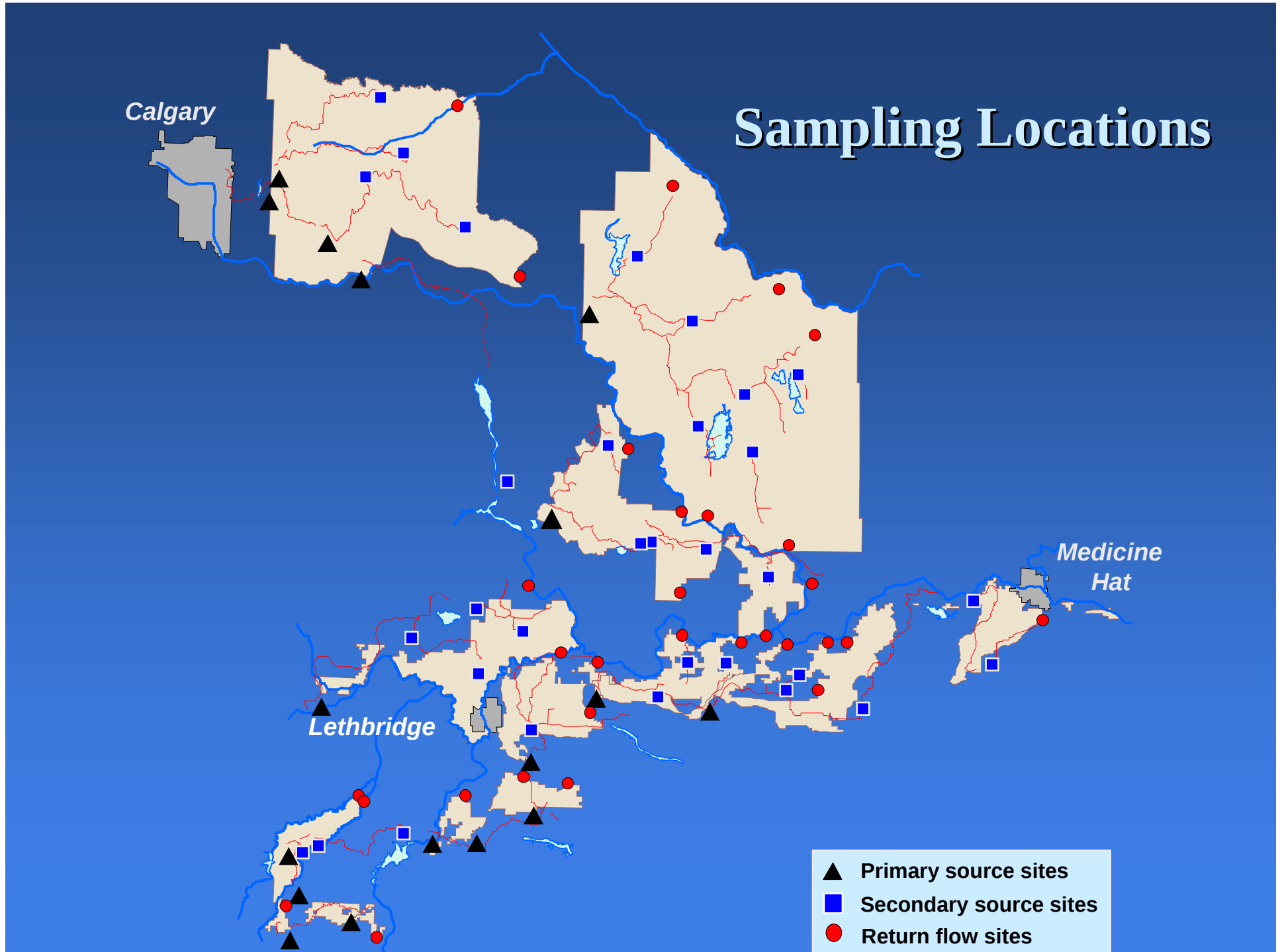
Sampling Locations

Calgary

Medicine
Hat

Lethbridge

- ▲ Primary source sites
- Secondary source sites
- Return flow sites



Nutrients & Physical

Ammonia
Nitrate-Nitrogen
Nitrite-Nitrogen
Total Kjeldahl Nitrogen
Total Phosphorus
Orthophosphate
Total Suspended Solids
Alkalinity
Temperature

Bacteria

Total coliforms
Fecal coliforms

Metals

Aluminum (Al)
Antimony (Sb)
Arsenic (As)
Barium (Ba)
Beryllium (Be)
Boron (B)
Cadmium (Cd)
Chromium (Cr)
Cobalt (Co)
Copper (Cu)
Iron (Fe)
Lead (Pb)
Lithium (Li)
Manganese (Mn)
Mercury (Hg)
Molybdenum (Mo)
Nickel (Ni)
Selenium (Se)
Silver (Ag)
Strontium (Sr)
Tellurium (Te)
Thallium (Tl)
Titanium (Ti)
Uranium (U)
Vanadium (V)
Zinc (Zn)

Pesticides

Herbicides

2,4-D
2,4-D,B
Atrazine
Bromacil
Bromoxynil
Chlorpyrifos
Clopyralid
Dicamba
Dichlorprop (2,4-DP)
Diclofop
Ethalfuralin
Fenoxaprop
Imazethapyr
MCPA
Mecoprop
Picloram
Quinclorac
Triallate
Trifluralin

Insecticides

Aldrin
DDE
Dieldrin
Dimethoate
Heptachlor
Heptachlor-Epoxy
Lindane
Methoxychlor



Water Quality Guidelines:

- Canadian Water Quality Guidelines
- Surface Water Quality Guidelines for use in Alberta
 - target specific use (e.g. agricultural, protection of aquatic life)
 - no observable effects / most sensitive species is protected
 - assume chronic exposure and safety factor of 10, 20, or 100X
 - Irrigation rate = 1200mm/yr (worse case scenario)



Water Uses

- Irrigation guidelines
 - Protect crop species that might be exposed to toxic substances
 - Based on max irrigation rates and toxicity of most sensitive crop to pollutants
- Livestock watering guidelines
 - Protect all livestock
 - Based on most sensitive specie and on possible accumulation in the animals' bodies
- Protection of aquatic life guidelines
 - Protect all plants and animals that live in lakes, rivers and oceans
 - Based on toxicity data for 100% protection of all species 100% of the time

Surface Water Quality Guidelines

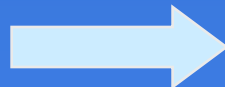
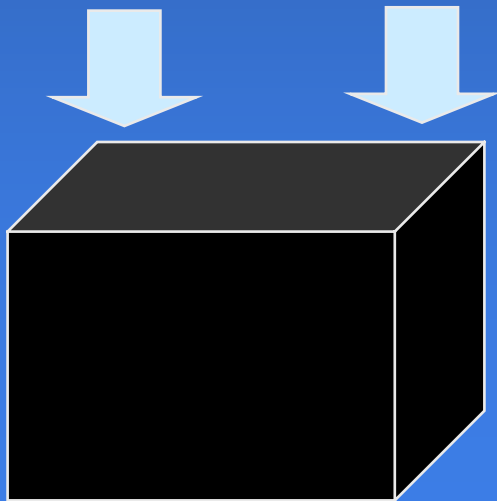
Parameter	Irrigation	Livestock watering	Recreation	Freshwater Aquatic Life	Drinking water
Nitrite (mg/L)		10		0.06	3.2
Fecal coliforms (#/100 mL)	100		200		
Aluminum (ug/L)	5000	5000		5 - 100	100
Arsenic (ug/L)	100	25		5	25
Copper (ug/L)	200 - 1000	500 - 5000		2 - 4	1000
Selenium (ug/L)	20 - 50	50		1	10
Zinc (ug/L)	1000 - 5000	50 000		30	5000
Atrazine (ug/L)	10	5		1.8	5
Bromacil (ug/L)	0.2	1100		5	
Bromoxynil (ug/L)	0.33	11		5	5
Chlorpyrifos (ug/L)		24		0.0035	90
Dicamba (ug/L)	0.006	122		10	120
MCPA (ug/L)	0.025	25		2.6	
Picloram (ug/L)		190		29	190
Trifluralin (ug/L)		45		0.2	45
Dimethoate (ug/L)		3		6.2	20
Lindane (ug/L)		4		0.01	

Canadian Water Quality Index (CWQI):

- how **many** guidelines are exceeded
- how **often** guidelines are exceeded
- by how **much** guidelines are exceeded

Observed data

Guidelines (IRR, LIVE, PAL)

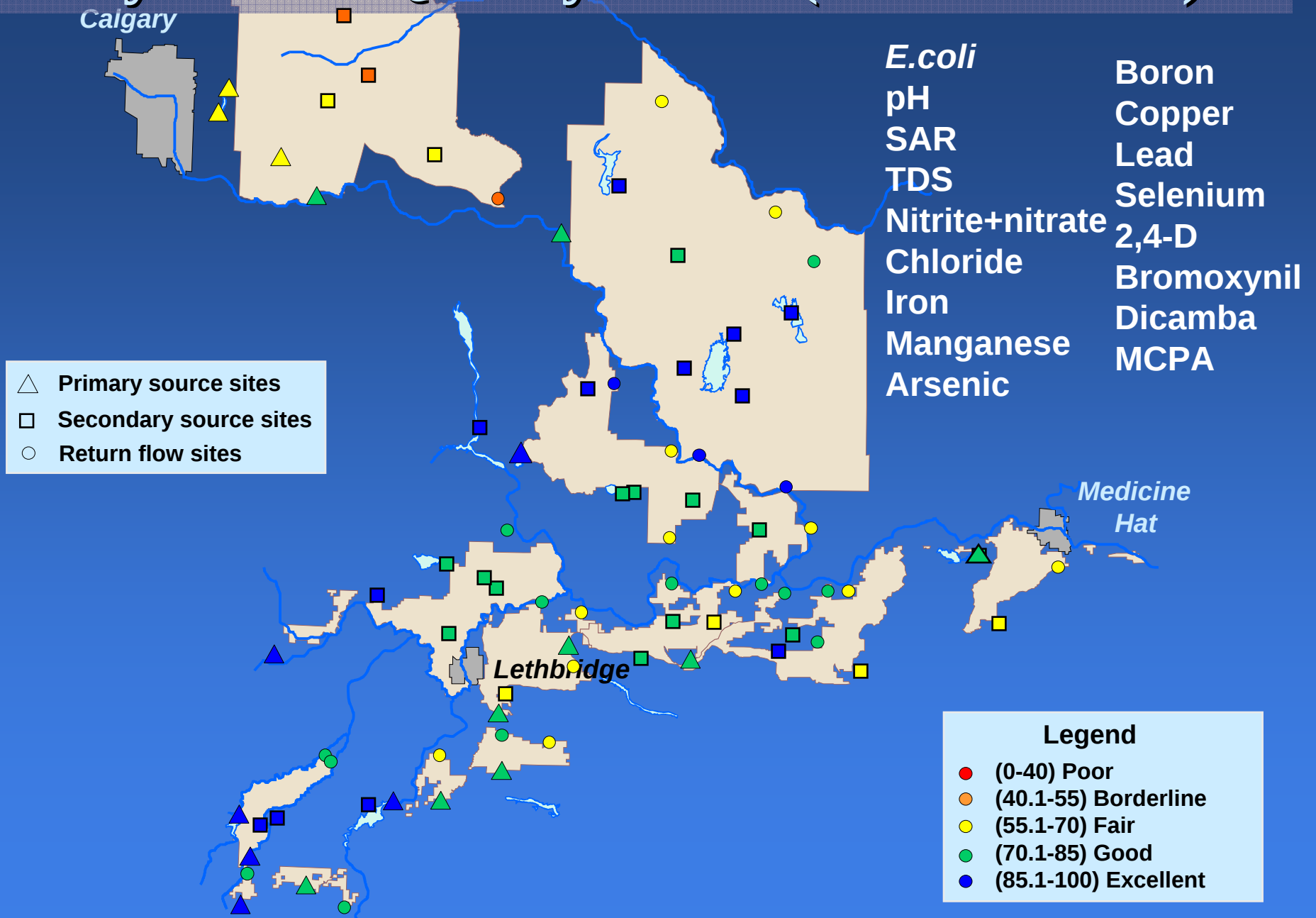


	Excellent	86 - 100%
	Good	71 - 85%
	Fair	56 - 70%
	Borderline	41 - 55%
	Poor	0 - 40%

What is the quality of water for irrigation?

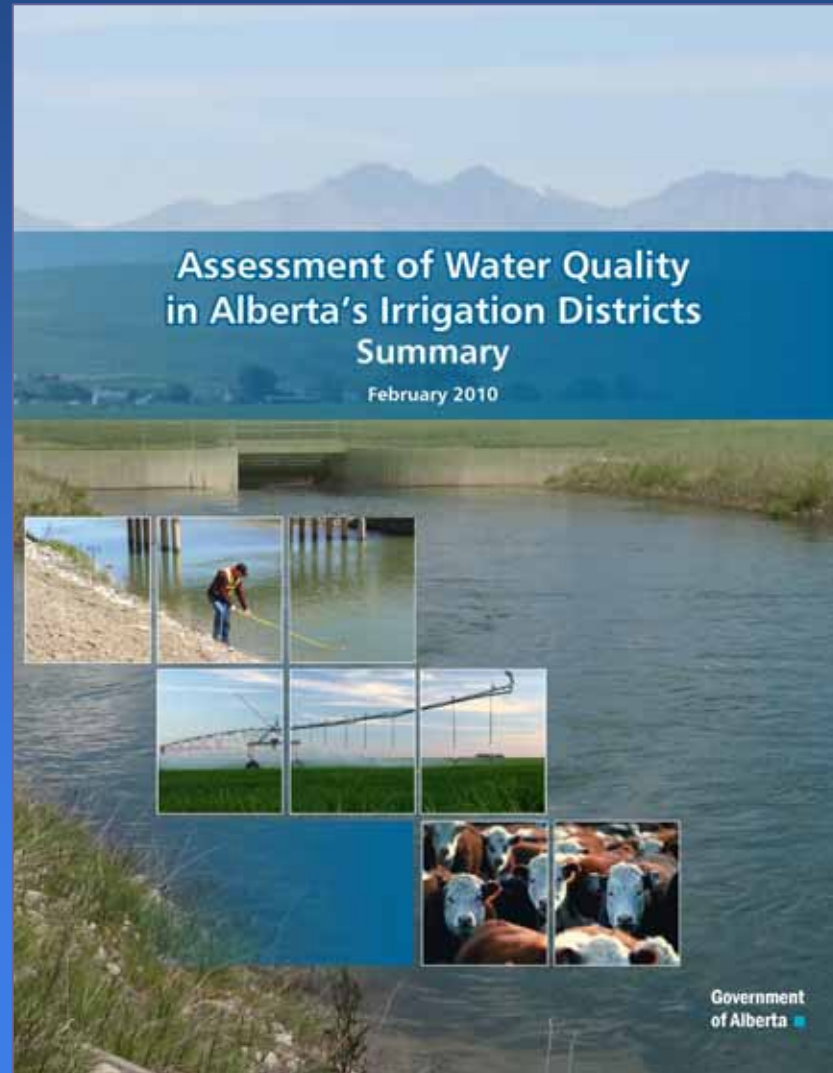


Study Water Quality Index (2006 & 2007)



7 Key findings

- Available online
www.agric.gov.ab.ca



Key findings

- 1. Water quality for irrigation was generally good or excellent.
 - WID source water was rated fair
 - Pesticides and salinity from Calgary
 - Return flow had poorer quality than source water

Key findings

- 2. Guidelines for nutrients and metals were met the majority of the time.
 - Agricultural uses
 - Nitrate, nitrite, boron, nickel, uranium, vanadium 100% compliant
 - Iron, Manganese, aluminum, arsenic 99% compliant
 - Protection aquatic life
 - Nitrite and ammonia 99%
 - Arsenic 98%
 - Total phosphorus 78%
 - Aluminum 37%

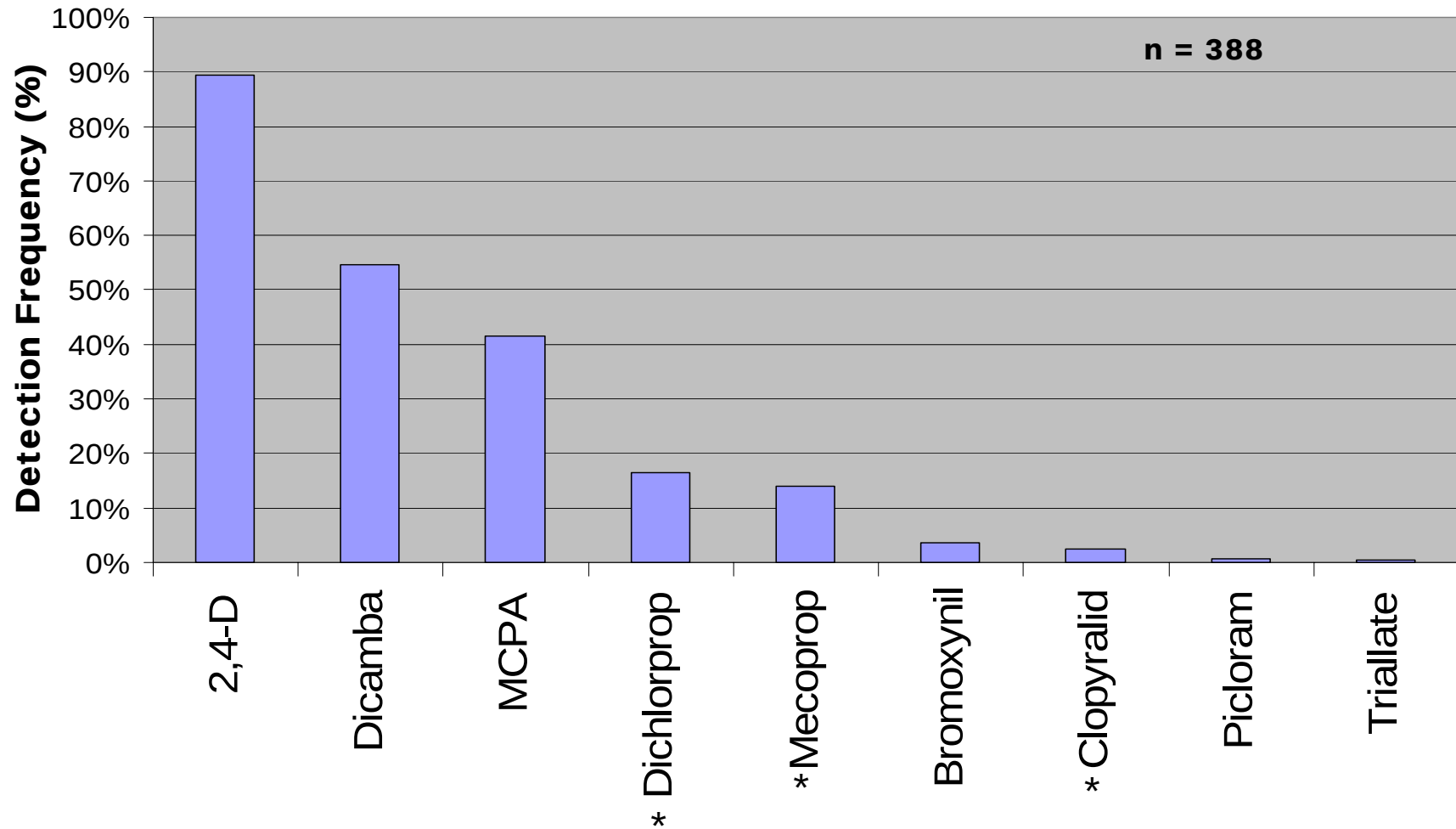
Key findings

- 3. Some herbicide guidelines for irrigation were consistently exceeded.
 - Of 27 pesticides, 9 herbicides detected
 - No guideline exist for 3 detected herbicides



Pesticides Detection Frequency

27 herbicides and insecticides tested for

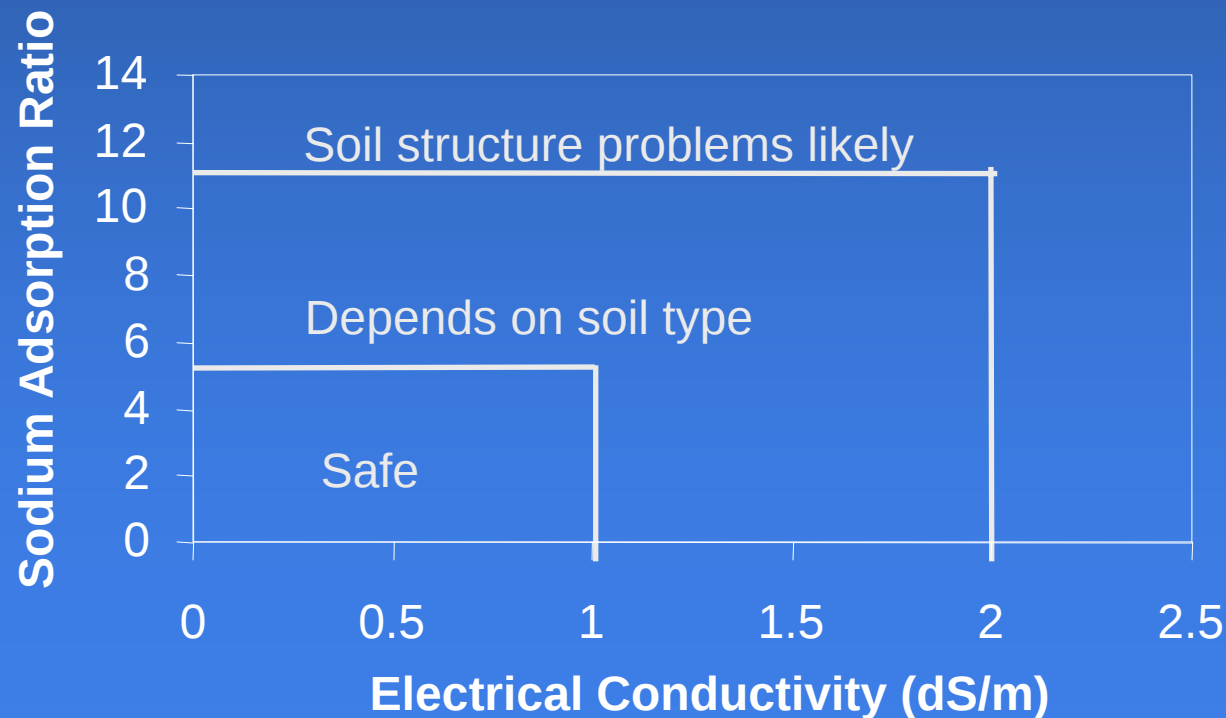


Key findings

- 4. Source water quality varied among the district.
 - Even from district within the same basin
 - EID nitrogen
 - WID pesticides, nutrients, TSS
 - Nutrients is a concern for algae growth

Key findings

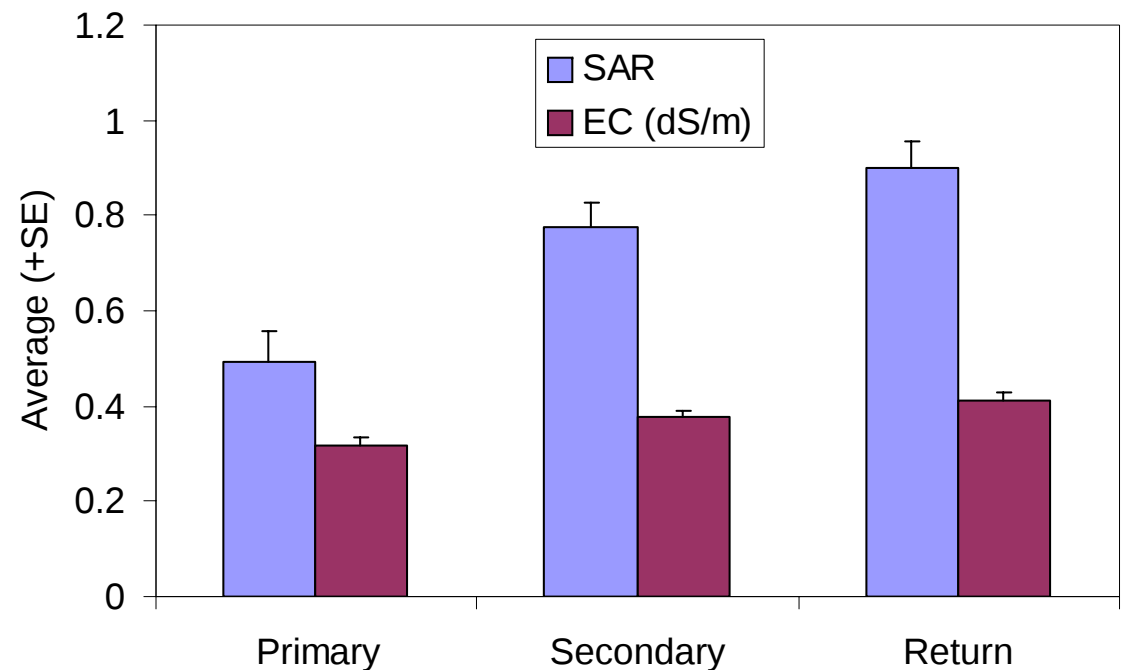
- 5. Salinity and sodicity were not a concern for most district
 - SAR & EC, 97% compliant (BRID and WID)



Key findings

- 6. Some degradation of water quality occurred as water flowed through the distribution system.

- Phosphorus
- Nitrogen
- SAR, EC
- Pesticides



Key findings

- 7. Pipelines had a minimal effect on water quality, except for bacterial indicators.



Support:

- Canada-Alberta Water Supply Expansion Program (CAWSEP) AAFC
- Alberta Agriculture & Rural Development
- Irrigation Districts
- Alberta Environment



Questions ?



Conclusions:

- CWQI with guidelines for irrigation, livestock, and the protection of aquatic life suggests the order of concern:

Bacteria > Pesticides > Nutrients > Metals

- Water quality for irrigation is good to excellent in the source waters.
- Return flows have the poorest water quality but load contributions to aquatic ecosystems may be negligible.