Irrigation Water Quality for Food Production: Alberta

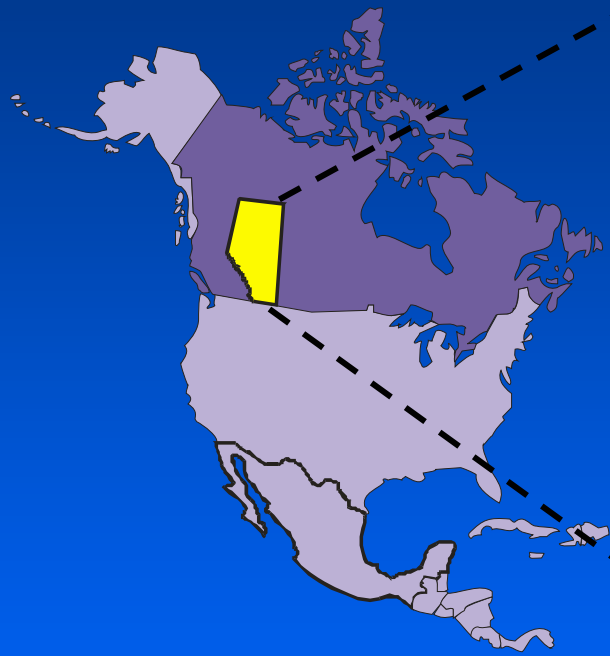
Rod Bennett and Andrea Kalischuk

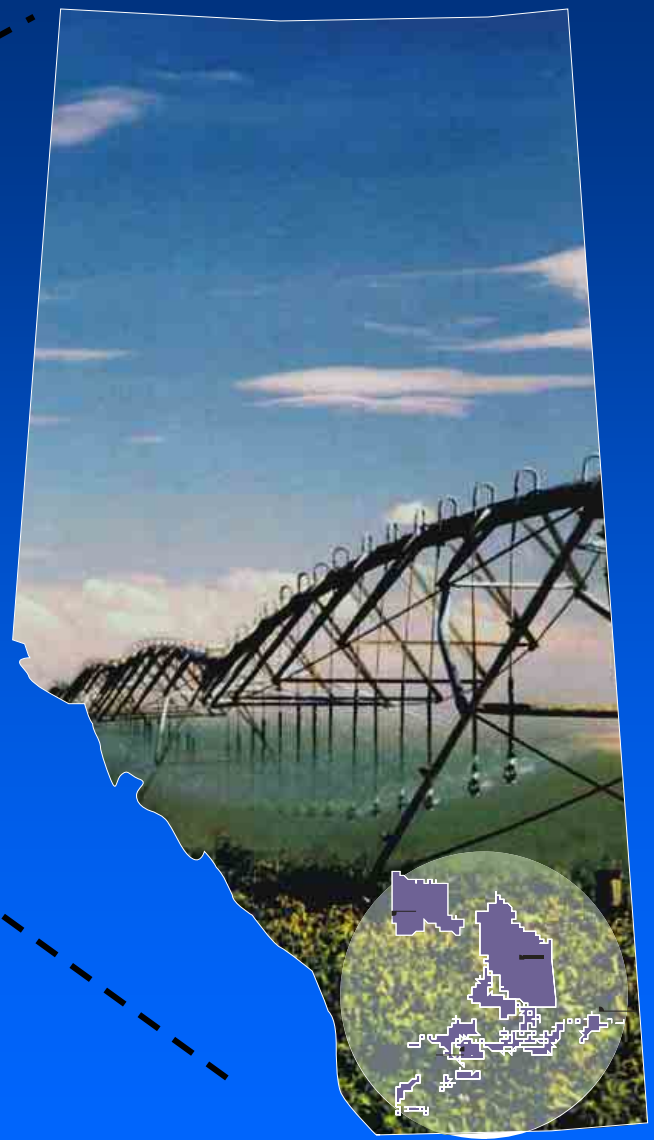
Irrigation Branch
Alberta Agriculture, Food & Rural Development
Lethbridge, Alberta

Sustainable Irrigation for the Prairies Workshop
Saskatoon, Saskatchewan
March 22 & 23, 2006

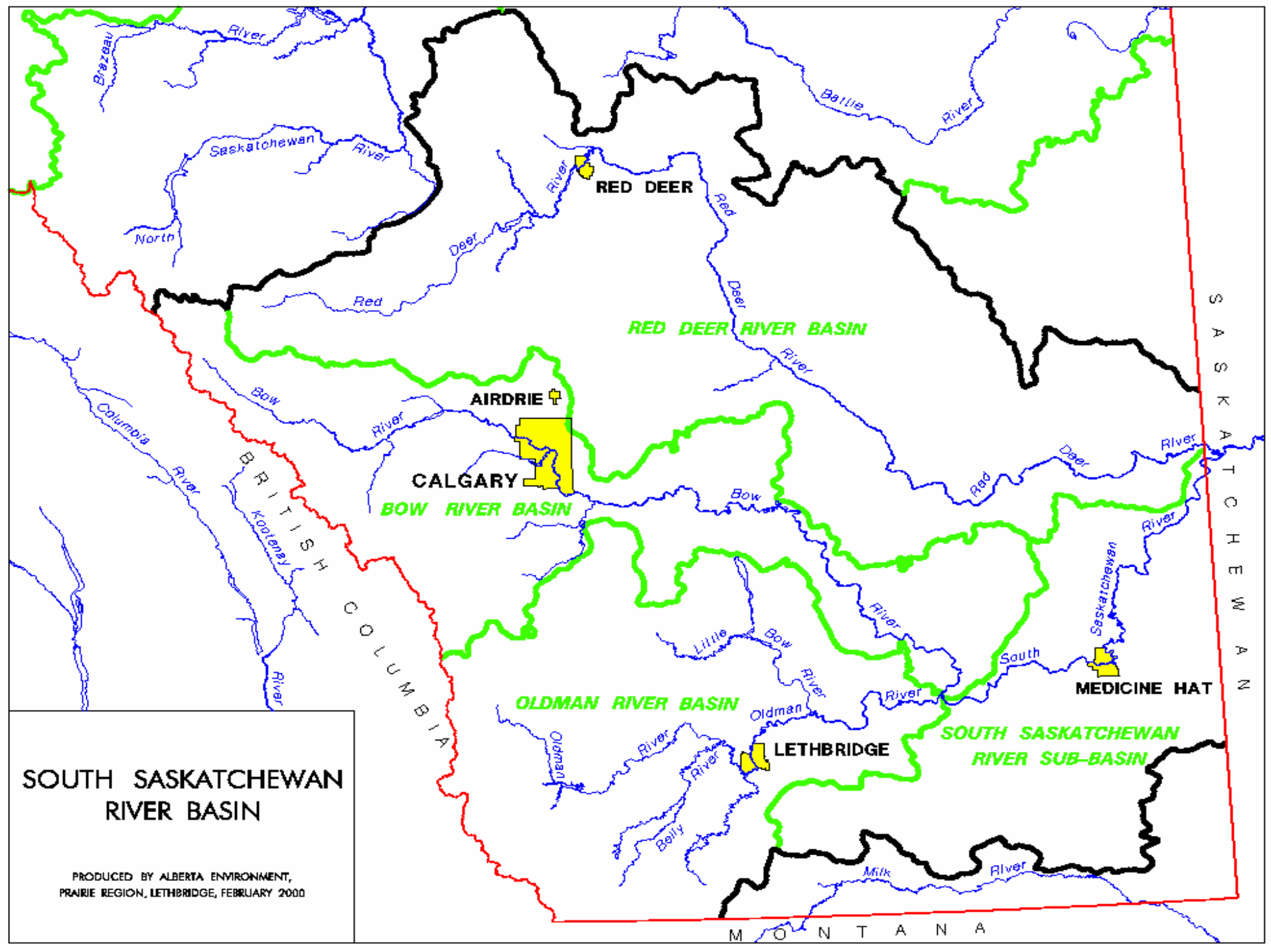
Alberta
AGRICULTURE, FOOD AND RURAL DEVELOPMENT

Irrigation in Alberta





Alberta
AGRICULTURE, FOOD AND RURAL DEVELOPMENT



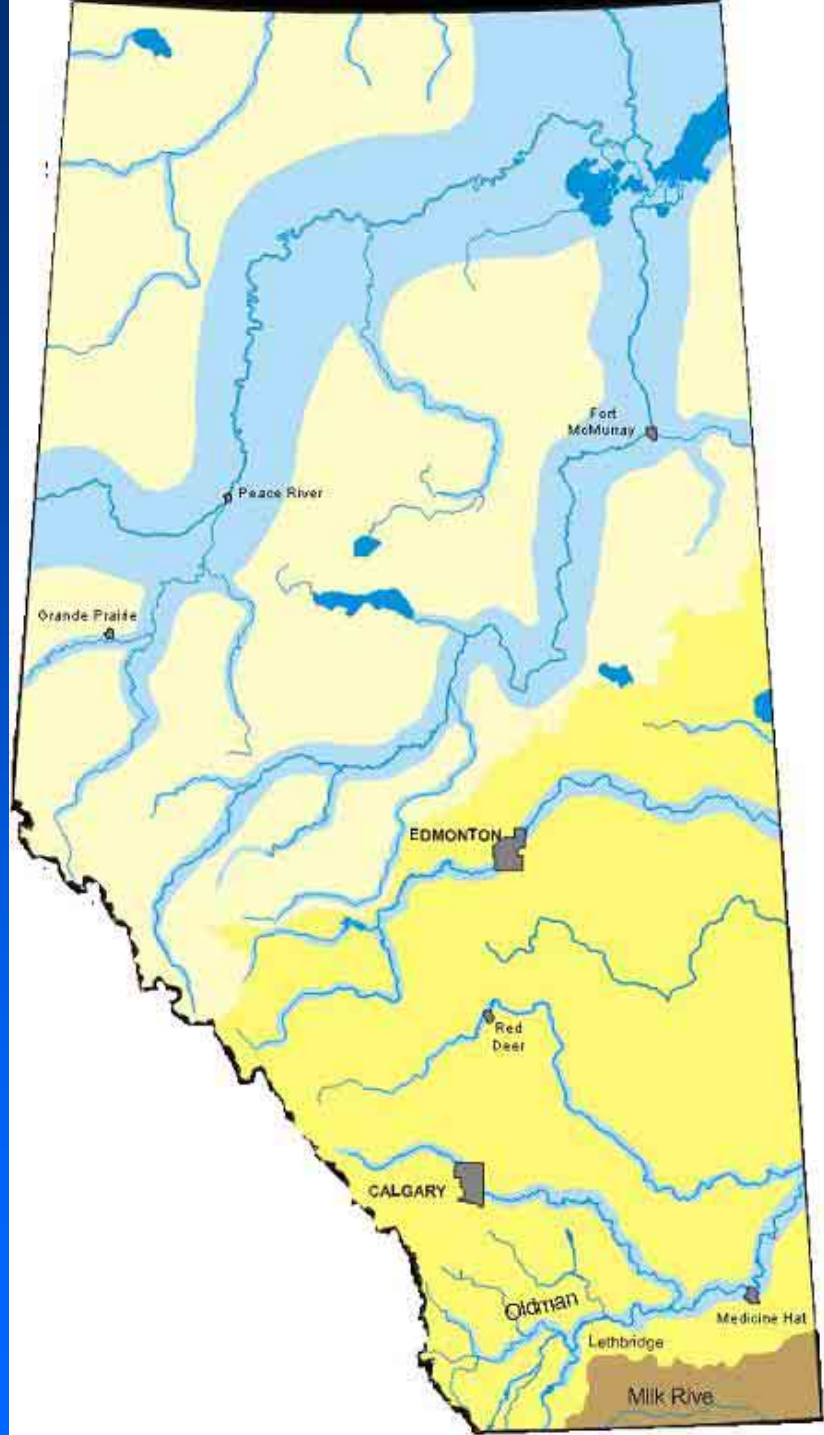
SOUTH SASKATCHEWAN RIVER BASIN

PRODUCED BY ALBERTA ENVIRONMENT,
PRAIRIE REGION, LETHBRIDGE, FEBRUARY 2000

Mean Annual Natural River Discharges ($m^3 \times 10^6$)

Total Inflow = 70 277
Total Outflow = 130 788

Based on available data to 2001.



Rocky Mountain Snow Pack

Waterton Reservoir

Mean Water Quality for Southern Alberta Rivers

*January 1990 to March 1990**

Sampling Site	EC ($dS\ m^{-1}$)	TDS ($mg\ L^{-1}$)	SAR
Bow River, Cochrane	0.32	173	0.08
Bow River, Carseland	0.37	212	0.31
Bow River, Ronalane	0.40	235	0.45
Oldman River, Lethbridge	0.37	215	0.48
S.Saskatchewan River, Medicine Hat	0.40	236	0.57

*** Alberta Environment (2000).**

Mean Water Quality of Irrigation Reservoirs In the St. Mary River Irrigation Project

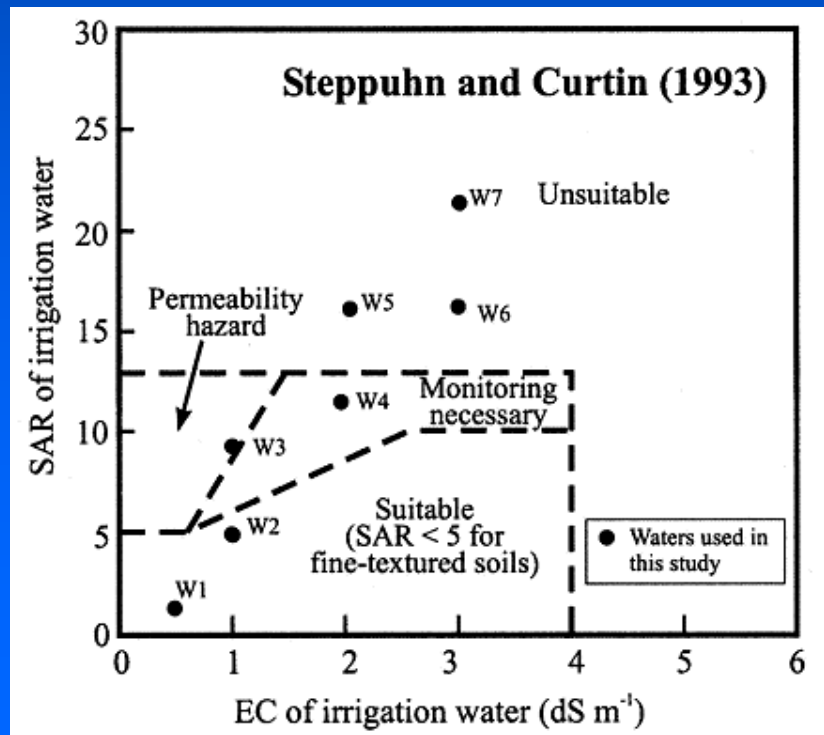
*April to November (1973 to 1977)**

Reservoir	EC (dS m^{-1})	SAR
Chin	0.39	0.38
Sauder	0.40	0.51
Taber	0.67	1.36
Seven Persons	0.52	0.95
Murray	0.50	0.80
Grassy Lake	0.51	0.78
Horsefly	0.80	2.22
Bullshead	0.52	0.95
Fincastle	0.50	0.88

*** D.N. Graveland (1978), Alberta Environment**

Irrigation Water Quality Study (Buckland et al. 2002)

- To examine the effects of alternate applications of saline-sodic waters and simulated rain on soil salinization and sodication, and on selected soil physical properties after five soft wheat crops.
- To assess the irrigation suitability of saline-sodic waters for the soil investigated.



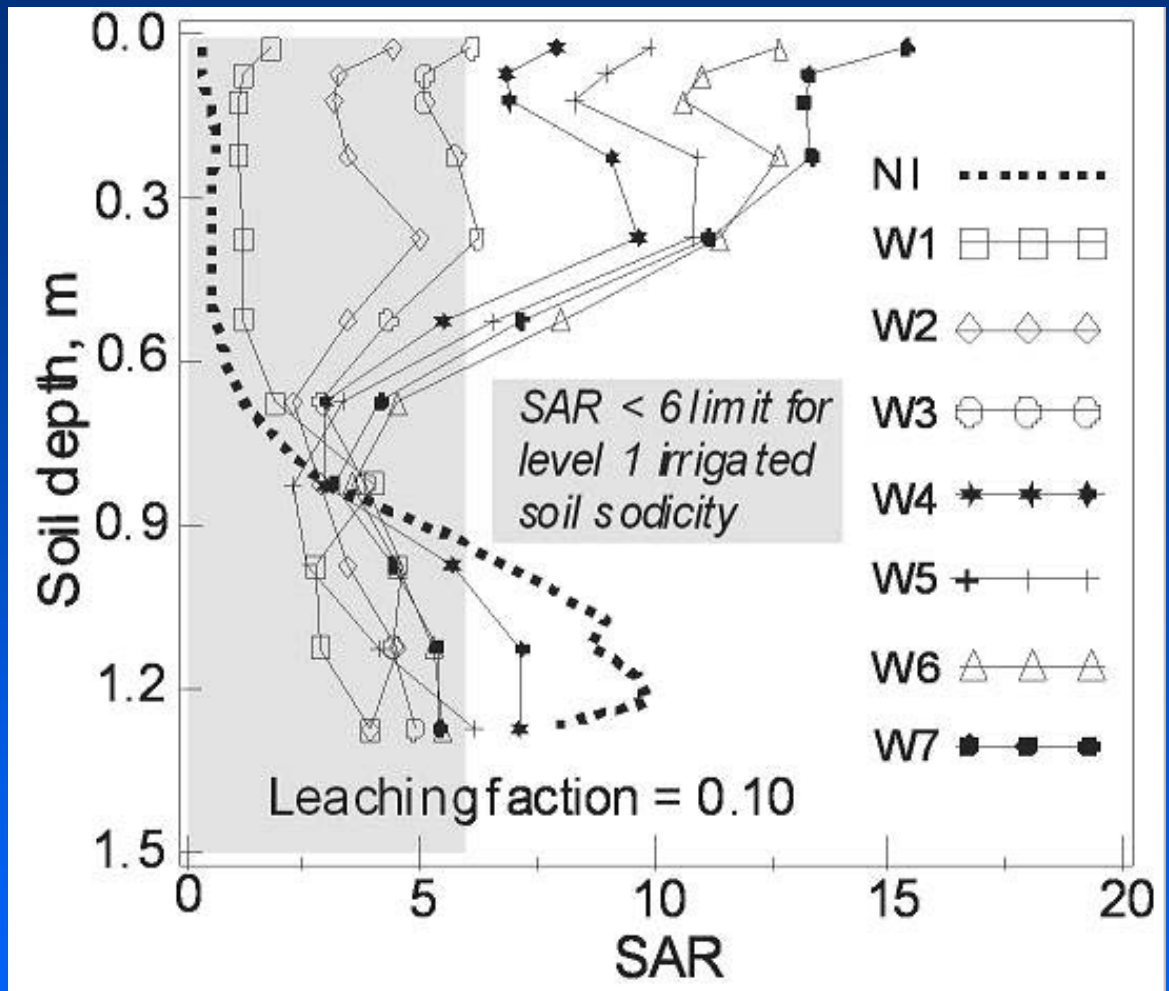


Fig. 5. SAR of saturated paste soil extract after five crops irrigated with W1 to W7 alternated with rainwater compared to non-irrigated (NI) soil.

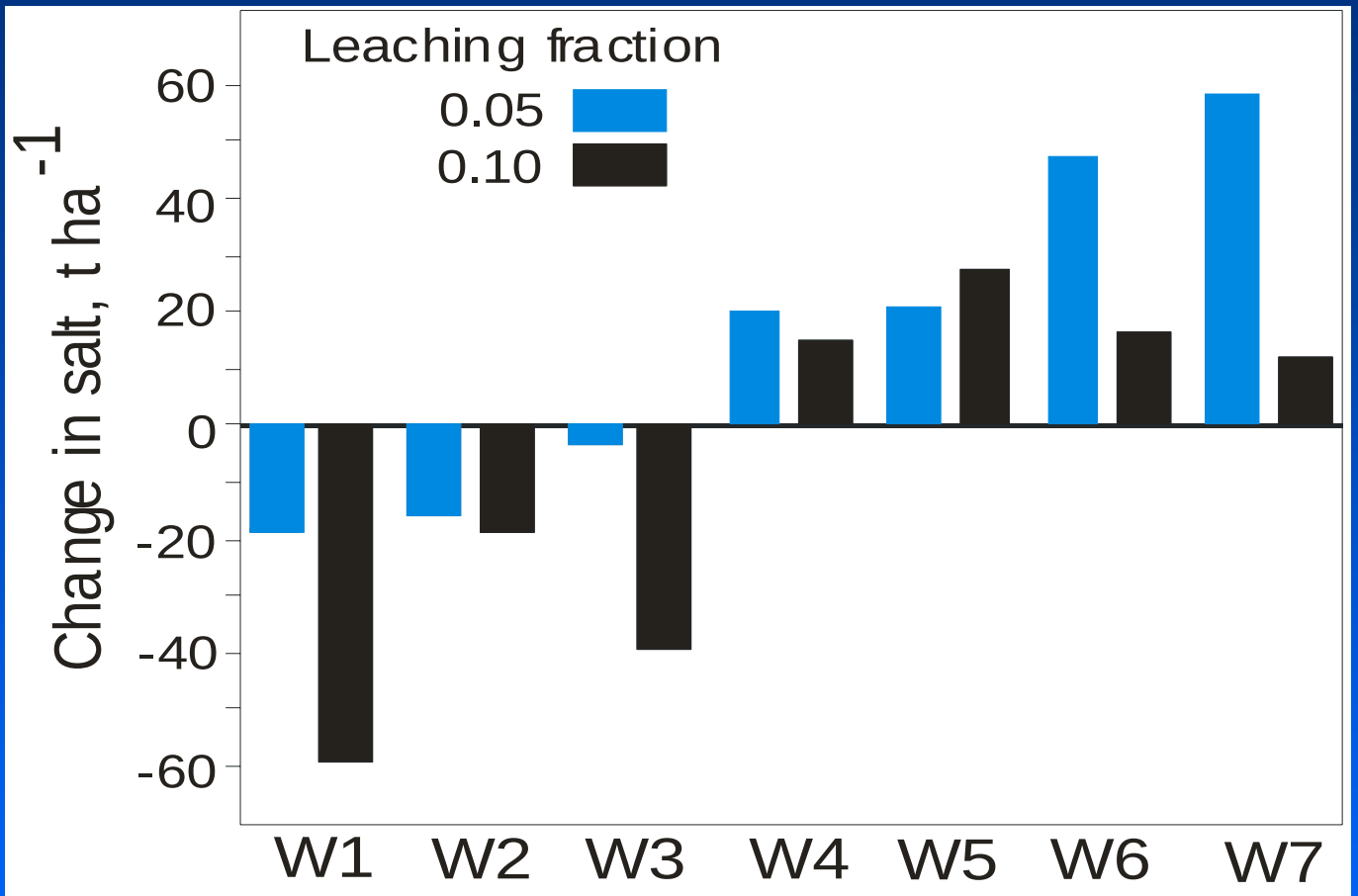


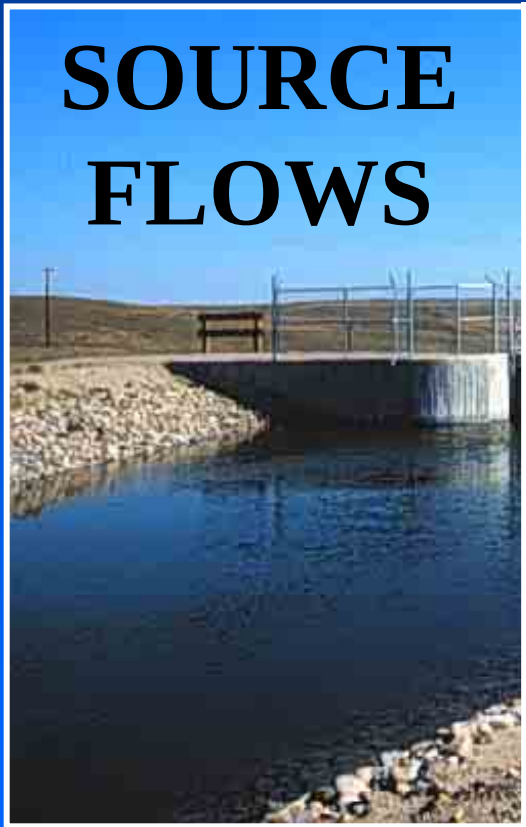
Fig. 6. Mean change in salt content of lysimeters (salt added by irrigation minus salt removed through drainage).

Conclusions:

- **Waters considered ‘safe’ for supplemental irrigation of the Masinasin soil have EC less than or equal to 1 dS m^{-1} and SAR less than or equal to 5.**
- **If EC values are greater than or equal to 2 dS m^{-1} and/or SAR values are greater than or equal to 10, the water is considered unsuitable for irrigation of the Masinasin soil.**
- Link to Alberta Irrigation District Water Quality Monitoring Map

Buckland et al. 2002

Irrigation District Water Quality

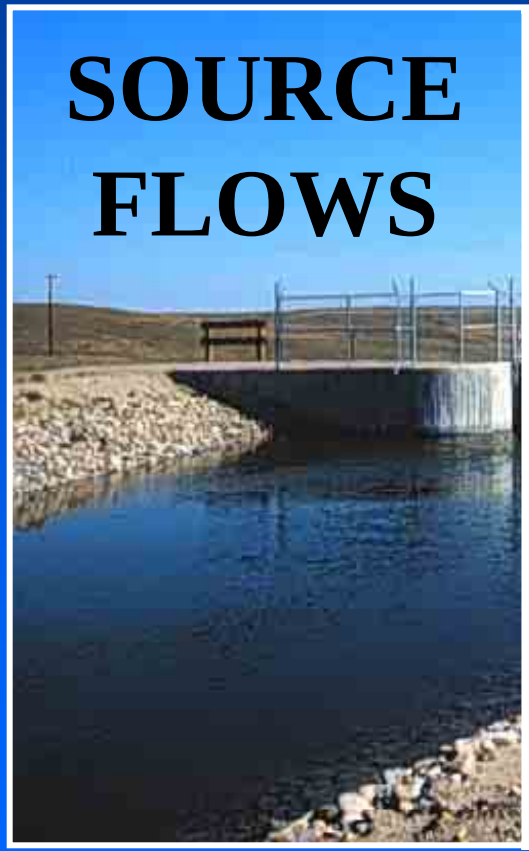


	EC ($dS\ m^{-1}$)	SAR
BRID	0.38 ✓	0.60 ✓
LNID	0.32 ✓	0.50 ✓
WID	0.32 ✓	0.24 ✓
SMRID	0.34 ✓	0.50 ✓
TID	0.33 ✓	0.56 ✓
EID	0.29 ✓	0.26 ✓

Patsy Cross 1997

✓ = met guideline X = does not meet guideline

Irrigation District Water Quality



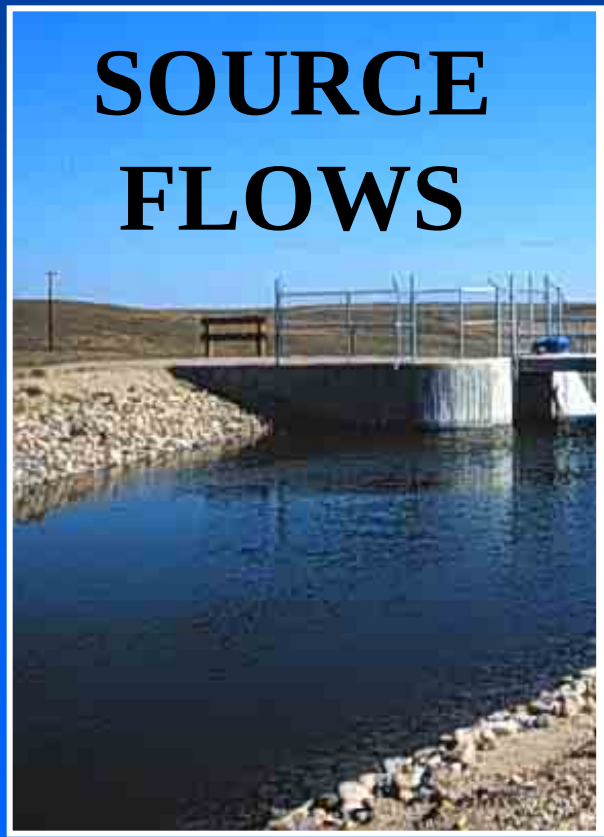
	Fecal Coliform Bacteria (100 counts/100 mL)	Livestock Water NO_2-N+NO_3-N, mg L^{-1}
BRID	12 ✓	0.004 ✓
LNID	20 ✓	0.006 ✓
WID	7 ✓	0.019 ✓
SMRID	18 ✓	0.019 ✓
TID	20 ✓	0.003 ✓
EID	44 ✓	0.428 ✓

Patsy Cross 1997

✓ = met guideline X = does not meet guideline

Irrigation District Water Quality

Protection of Aquatic Life
Total Phosphorus, mg L^{-1}

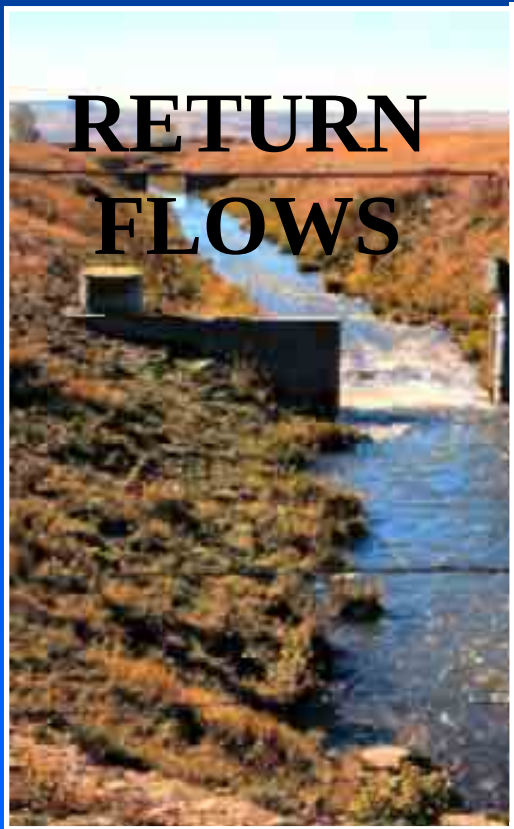


BRID	0.013 ✓
LNID	0.039 ✓
WID	0.019 ✓
SMRID	0.021 ✓
TID	0.017 ✓
EID	0.035 ✓

Patsy Cross 1997

✓ = met guideline X = does not meet guideline

Irrigation District Water Quality



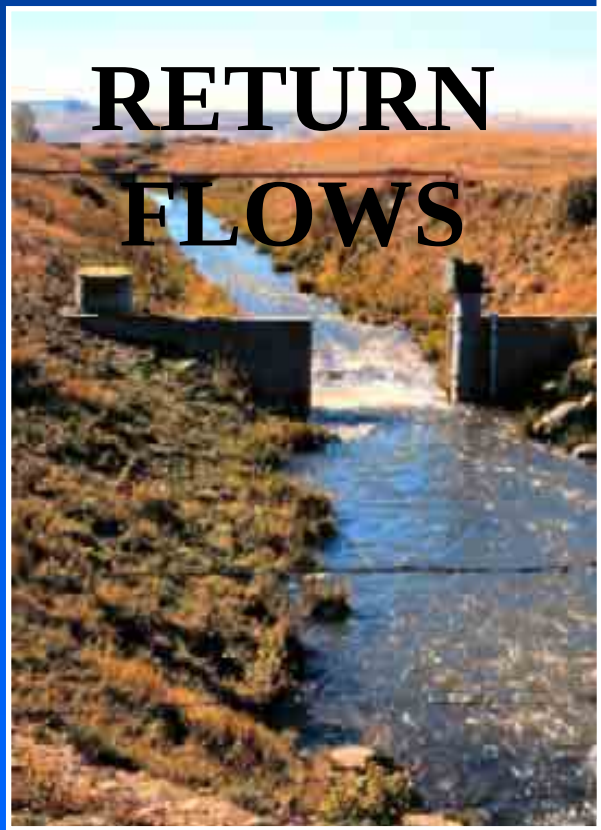
	EC (dS m^{-1})	SAR	TDS (mg L^{-1})
BRID	0.43 ✓	0.72 ✓	272 ✓
LNID	0.40 ✓	0.56 ✓	248 ✓
WID	0.50 ✓	1.16 ✓	325 ✓
SMRID	0.39 ✓	0.70 ✓	305 ✓
TID	0.34 ✓	0.50 ✓	233 ✓
EID	0.38 ✓	0.55 ✓	233 ✓

Patsy Cross 1997

✓ = met guideline X = does not meet guideline

Irrigation District Water Quality

Fecal Coliform Bacteria (100 counts/100 mL)

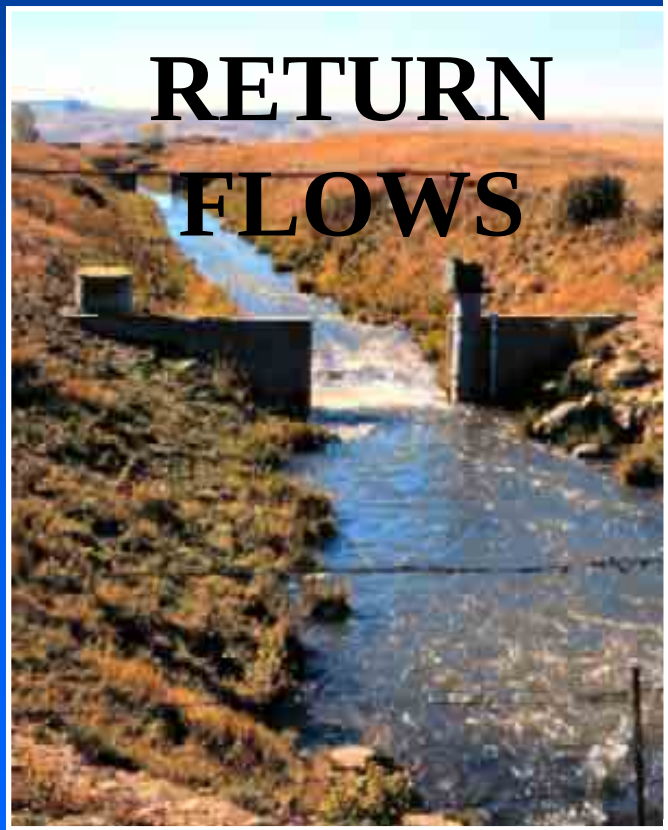


BRID	180	X
LNID	190	X
WID	310	X
SMRID	50	✓
TID	20	✓
EID	90	✓

Patsy Cross 1997

✓ = met guideline X = does not meet guideline

Irrigation District Water Quality

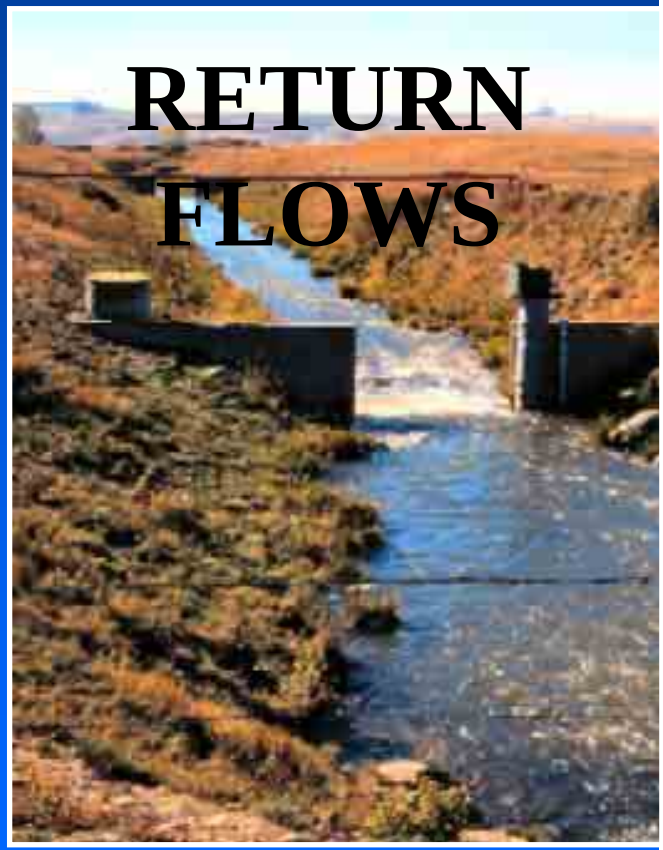


	Livestock Water NO_2-N+NO_3-N, mg L^{-1}
BRID	0.010 ✓
LNID	0.037 ✓
WID	0.010 ✓
SMRID	0.010 ✓
TID	0.029 ✓
EID	0.010 ✓

Patsy Cross 1997

✓ = met guideline X = does not meet guideline

Irrigation District Water Quality



Protection of Aquatic Life
Total Phosphorus, mg L^{-1}

BRID	0.054 ✓
LNID	0.140 ✓
WID	0.102 ✓
SMRID	0.057 ✓
TID	0.098 ✓
EID	0.047 ✓

Patsy Cross 1997

✓ = met guideline X = does not meet guideline

Pesticides Exceeding Water Quality Guidelines for:

District(s)	Year	# Pestidices Sampled	Frequency Sampled	Frequency of Detections	# Water Quality Violations
BRID, LNID, TID	1992	21 herbicides 3 insecticides 2 fungicides	2 or 3 (diversion and return)	1 trace bromoxynil (diversion) 1 trace dicamba (diversion) 1 trace 2,4-D (diversion) 7 2,4-D (return) 2 MCPA (return) 1 bromoxynil (return) 1 dichlofop-methyl (return) 1 dichlorprop (return)	2 MCPA (irrigation GL) 1 MCPA (aquatic GL) 1 dichlofop-methyl (irrigation GL)

Patsy Cross 1997

Pesticides Exceeding Water Quality Guidelines for:

District(s)	Year	Frequency Sampled	Frequency of Detections	# Water Quality Violations
SMRID	1995	60 (May to Sept)	87% 2,4-D 40% dicamba 43% MCPA 17% bromoxynil 17% triallate 8% diclofopmethyl 0% treflan 0% fenoxaprop	1 2,4-D (aquatic GL) 1 triallate (aquatic GL) 21 MCPA (irrigation GL)
SMRID	1996	60 (May to Aug)	67% 2,4-D 15% dicamba 5% MCPA 3% bromoxynil 2% triallate 0% treflan 0% fenoxaprop	2 2,4-D (aquatic GL) 1 triallate (aquatic GL) 1 MCPA (irrigation GL) 1 bromoxynil (irrigation GL)

Patsy Cross 1997

Pesticides Exceeding Water Quality Guidelines for:

District(s)	Year	# Pesticides Sampled	Frequency Sampled	Frequency of Detections	# Water Quality Violations
BRID	1995	8 herbicides	3 (June to mid July at 3 sites)	85% 2,4-D 50% MCPA 27% fenoxaprop 19% dicamba 19% bromoxynil 4% triallate 0% treflan 0% diclofop-methyl	1 triallate (aquatic GL) 4 bromoxynil (irrigation GL) 9 MCPA (irrigation GL)
BRID-Crowfoot Crk	1996	31	weekly (May to mid July at 3 sites)	100% 2,4-D 92% mecoprop 79% dicamba 63% MCPA 12% triallate 8% atrazine	all dicamba (irrigation GL) 3 MCPA (irrigation GL)

Patsy Cross 1997

Irrigation District Water Quality

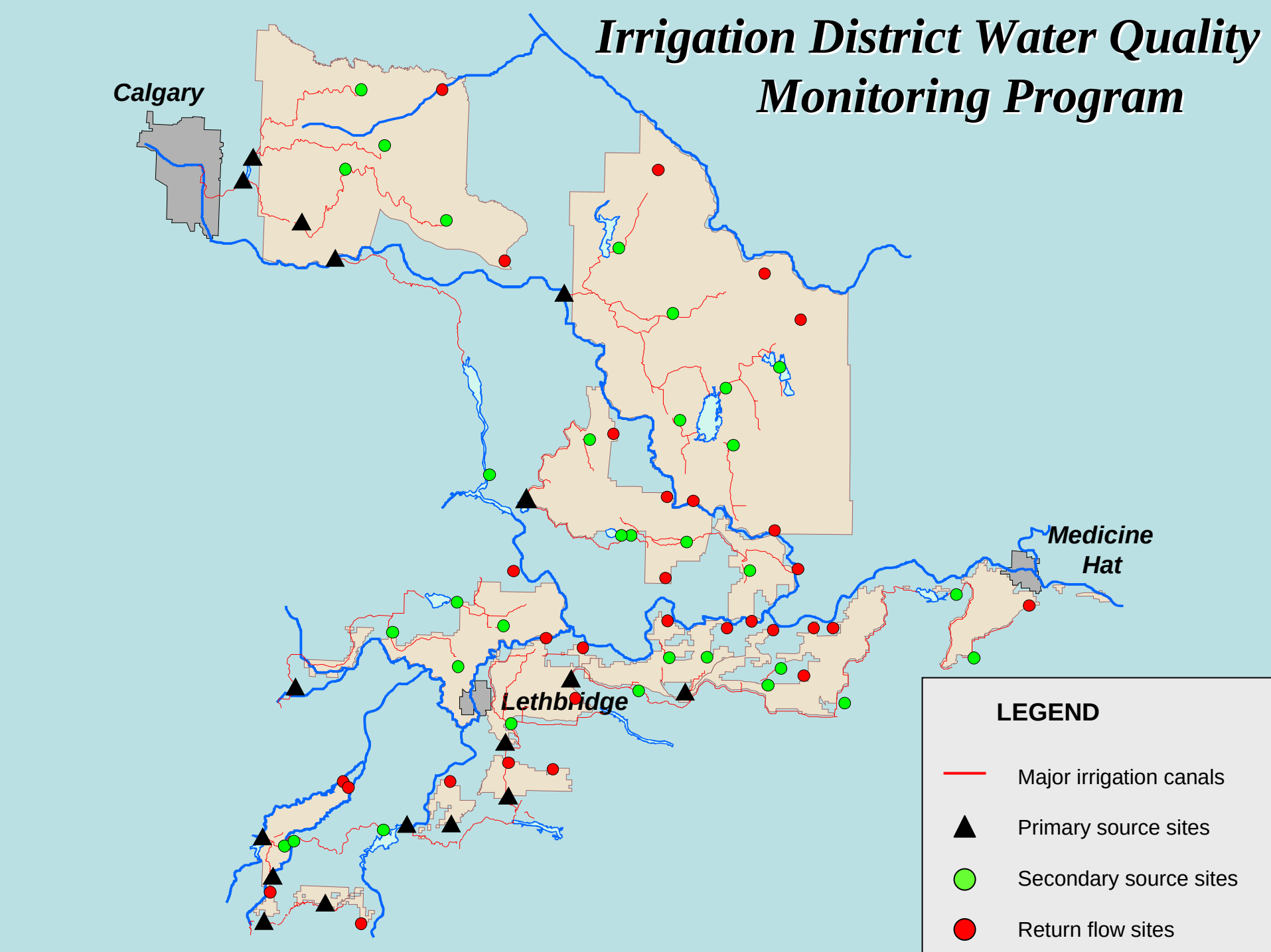
RETURN FLOWS

	Al	Co	Cu	Fe	Mn	Ni	Pb	Zn
BRID	0.1600 ✓	0.0005 ✓	0.0045 ✓	0.1600 ✓	0.0300 ✓	0.0020 ✓	0.0010 ✓	0.0065 ✓
LNID	0.6900 ✓		0.0045 ✓	1.0500 ✓		0.0111 ✓	0.0030 ✓	0.0375 ✓
WID	0.2835 ✓	0.0003 ✓	0.0050 ✓	0.1200 ✓	0.0500 ✓	0.0005 ✓	0.0010 ✓	0.0090 ✓
SMRID	0.0600 ✓		0.0030 ✓	0.1900 ✓	0.0220 ✓			0.0155 ✓
TID	1.2500 ✓		0.0039 ✓	0.2800 ✓		0.0031 ✓	0.0014 ✓	0.0170 ✓
EID	0.1000 ✓	0.0005 ✓	0.0050 ✓	0.3100 ✓	0.0340 ✓	0.0030 ✓	0.0010 ✓	0.0180 ✓

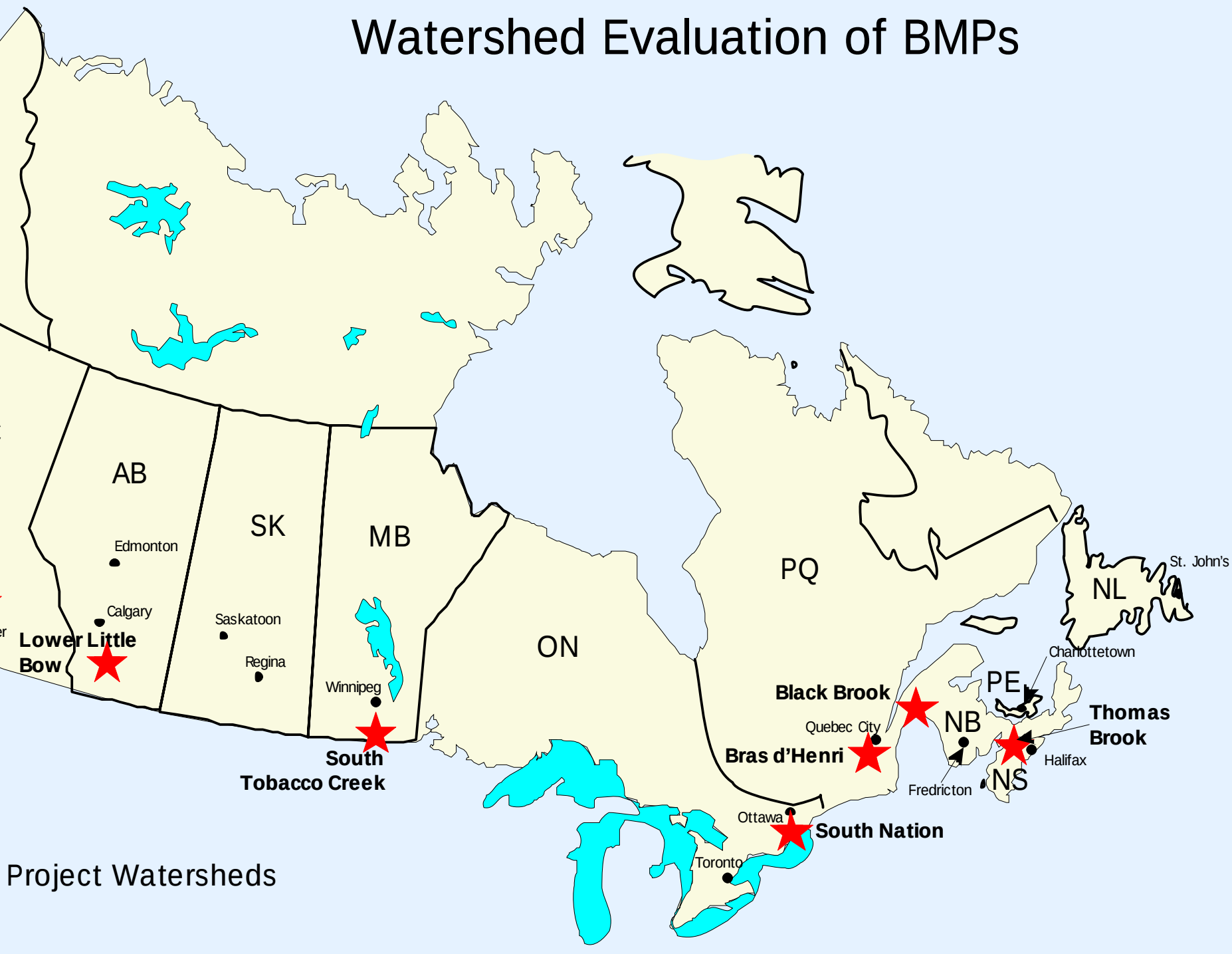
Patsy Cross 1997

✓ = met guideline X = does not meet guideline

Irrigation District Water Quality Monitoring Program



Watershed Evaluation of BMPs



Project Watersheds

Agriculture's Impact

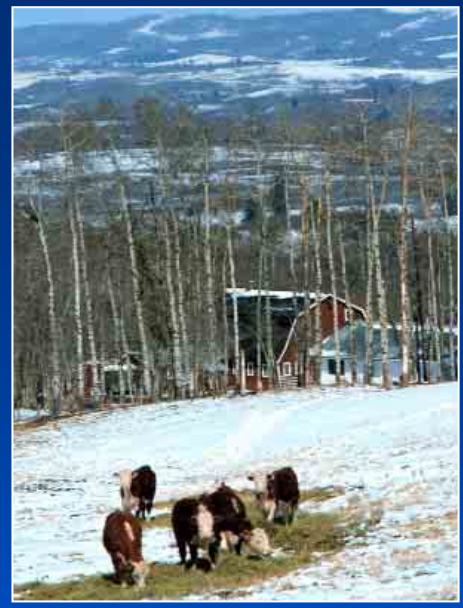
Livestock manure is considered to be the main agricultural contributor to water quality degradation.

Runoff From Manured Fields

Central Alberta manured field

Livestock Management

- **Prevent runoff from over-wintering sites entering surface water bodies.**



Wintering Site Improvements

Diversion berm

Riparian Pasture & Rotational Grazing

Specialized Cattle Crossings

Off-Stream Watering

Buffering Waterways

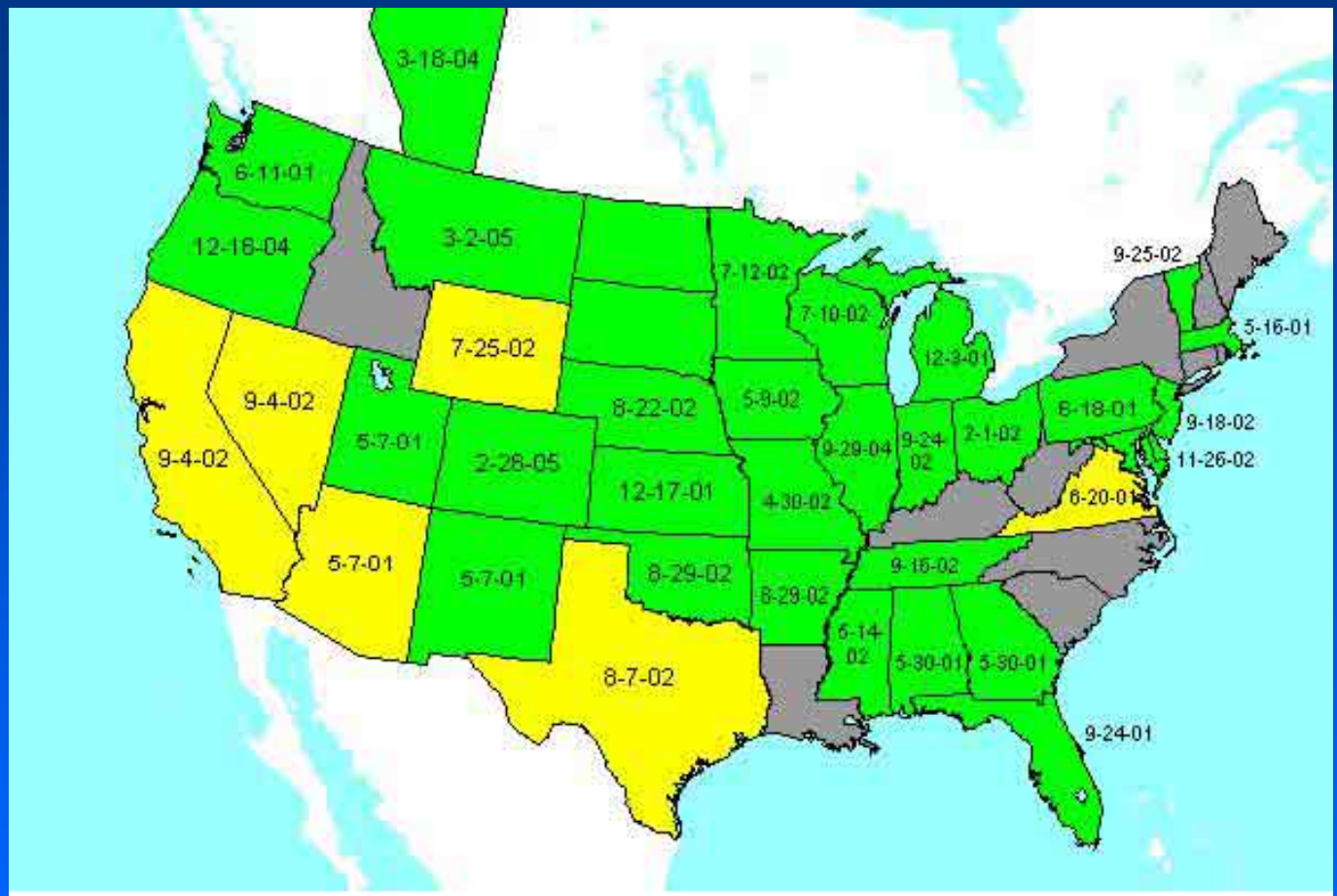
Healthy riparian corridors

Manure Management Planner

Developed by Purdue University, MMP is a computer-based calculator, which has been customized for Alberta.

http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/epw8834

Manure Management Planner



Status of MMP development (as of March 2005)

- State or province supported by MMP (calculates fert recs, manure N availability, etc.)
- State under development - collection of required state-specific data is underway

Note: Date of most recent meeting between MMP developers and state NRCS/Extension staff is indicated on map.