

# **Water Quality and Food Production in Saskatchewan**

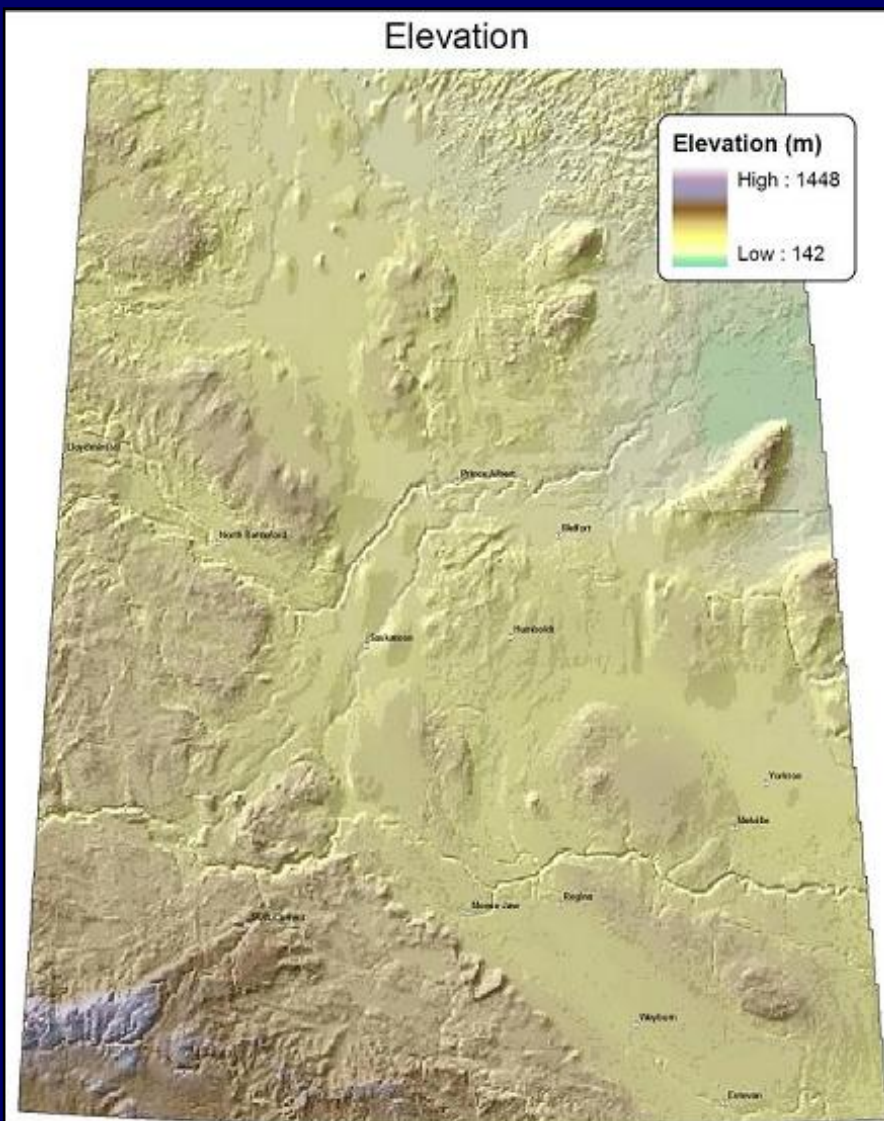
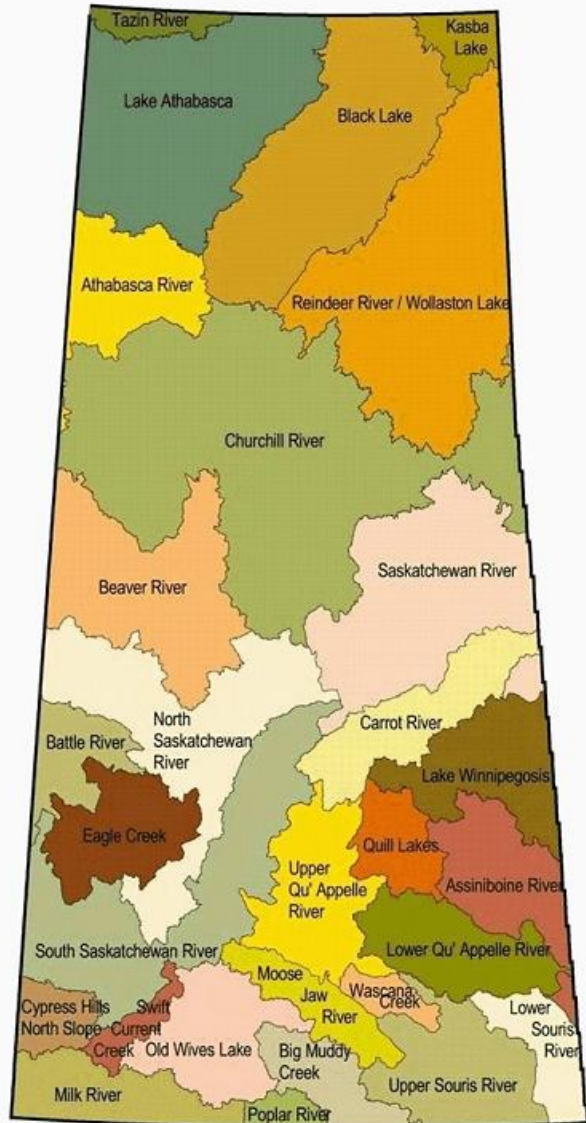
**Garth Weiterman, PAg**

**Frances Thauberger, AAg**



# **Presentation Outline**

- 1. Water & Irrigation in SK**
- 2. History of Water Quality Analysis**
- 3. Reservoir Sampling in Southwestern SK**
- 4. Water Quality of the Qu'Appelle River**
- 5. Salinity Research at Swift Current**
- 6. Future Goals**



Not all water sources in SK are as high a quality as the South Saskatchewan!

We must test the quality of all creeks, lakes, sloughs, wells & reservoirs.

Water quality can be influenced by:

- Groundwater
- Municipal treated water (effluent)
- Flow volume (spring runoff, dry weather...)
- Lands over which it passes or on which it collects

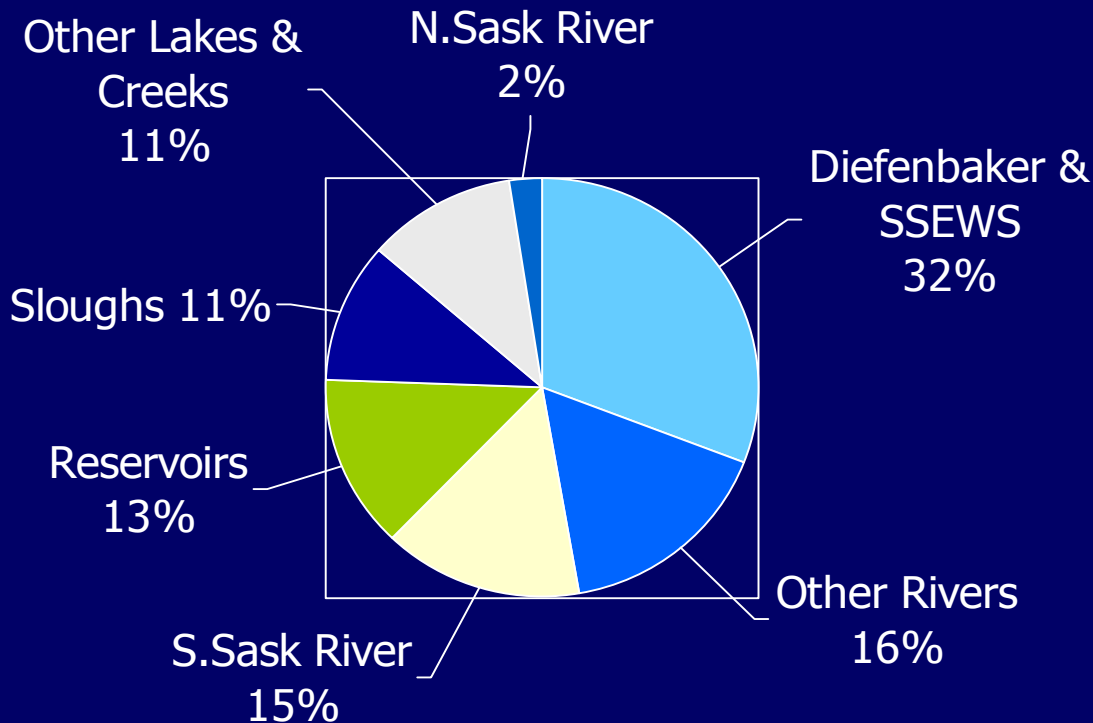
<b>Water Source*</b>	<b>EC (mS/cm)</b>	<b>TDS (mg/L)</b>	<b>SAR</b>
Lake Diefenbaker	0.4	275	0.6
North Saskatchewan River	0.4	250	0.6
Battle River	0.8	517	3.0
Frenchman River	0.8	525	2.0
Qu'Appelle River	1.1	713	2.9
Souris River	2.1	1352	9.5

\*values are June and July averages taken from Sask Water's water quality database.

\*water quality values will vary due to location of sampling along water course and time of year.

# Irrigation Projects by Source

**2254 Projects - 388,172 Acres**



**49% from N. & S. Saskatchewan River Systems**

# Water Quality Analysis

## Major Ion Analysis

- E.C.
- SAR
- Bicarbonate, Cl, Ca, K, Mg, Na, SO<sub>4</sub>
- pH
- Sometimes Boron, Nutrients or Biologicals



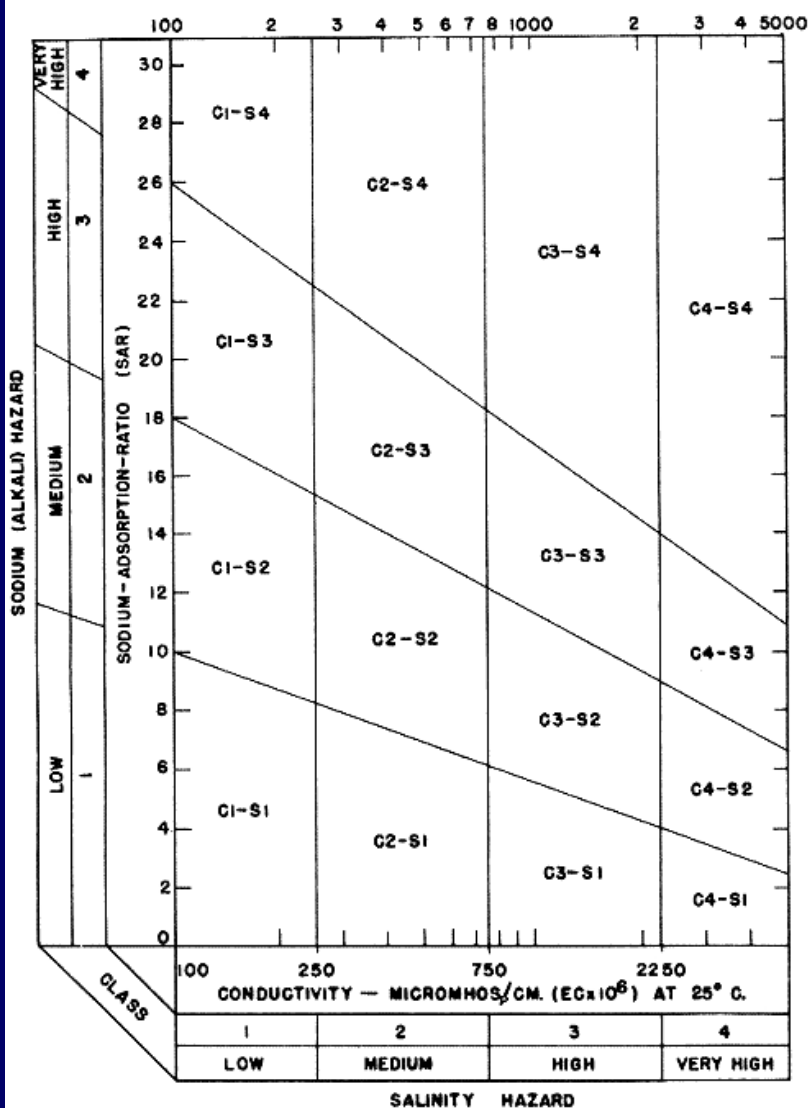
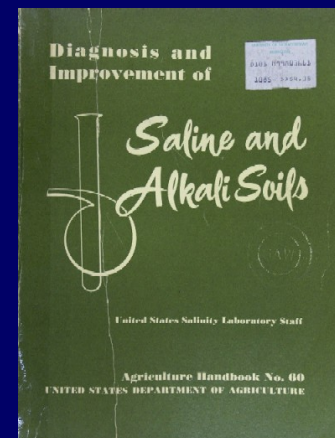


FIGURE 25.—Diagram for the classification of irrigation waters.

## Before 1989 – Handbook 60



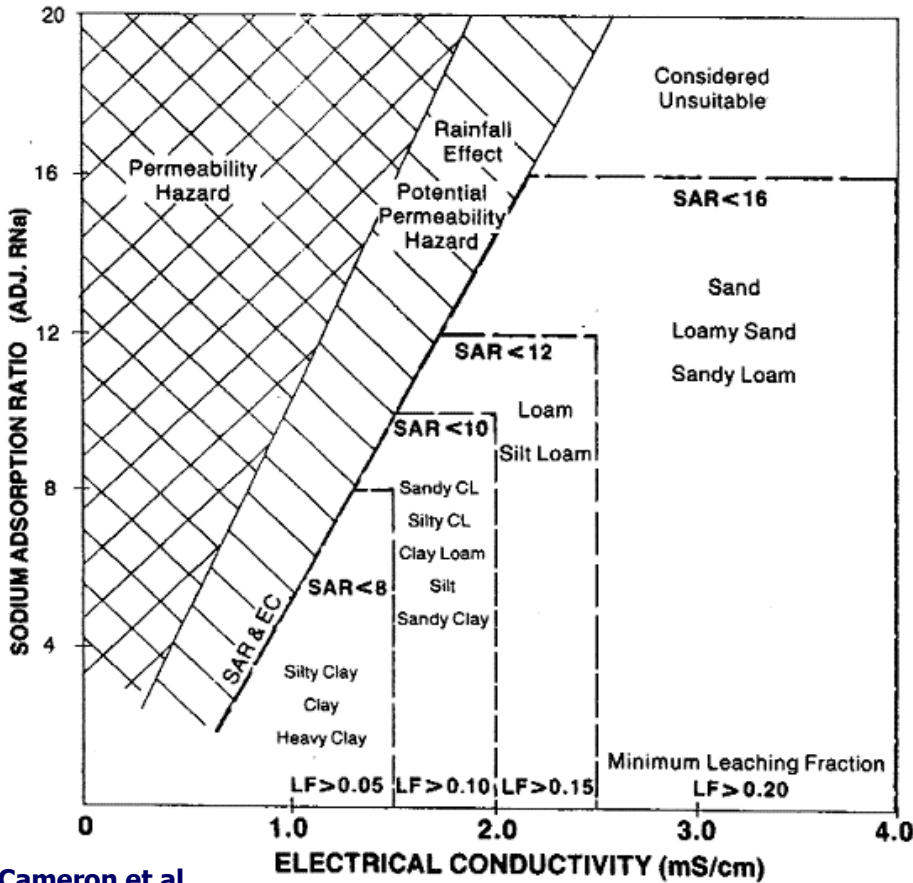
Ratings:

C1-S1 = Low Salinity,  
Low Sodicity

C4-S4 = High Salinity,  
High Sodicity



## 1989 to 1994 – Sask Water Guidelines



- ★ Coarse-textured soils are less sensitive to SAR & EC

★ Leaching improves soil quality

- ★ Greater EC lessens permeability problems

- ★ Rainfall increases soil structure hazard

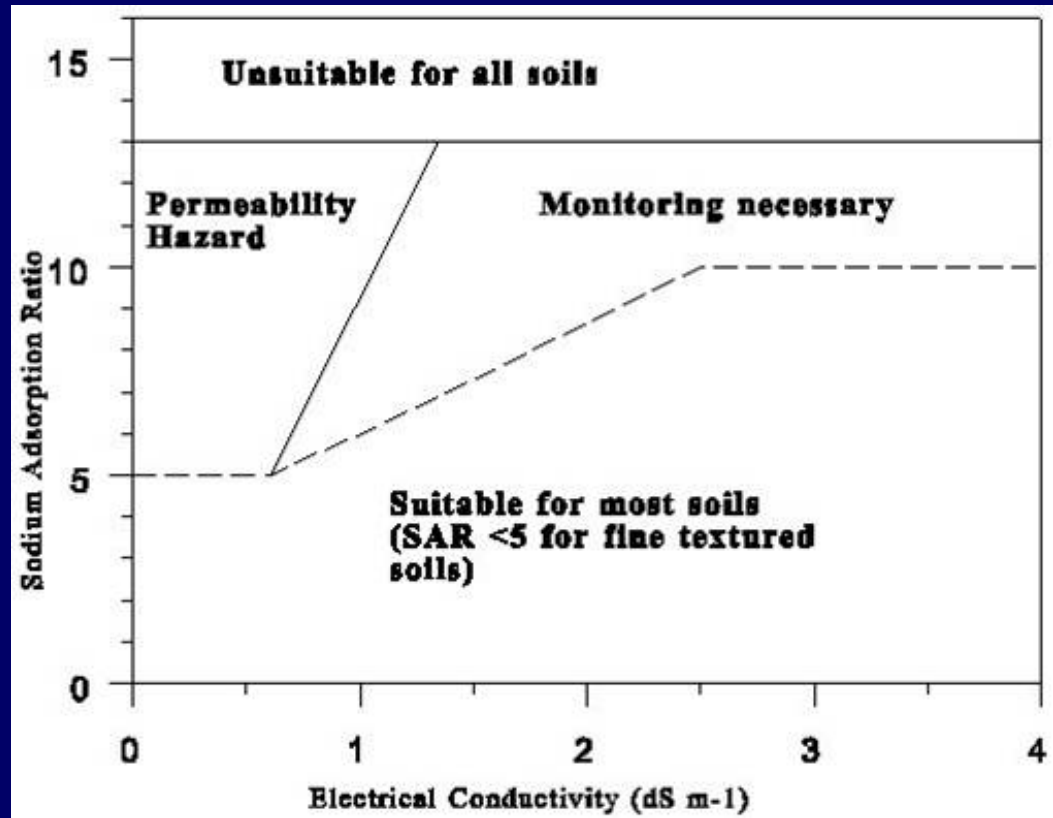
# Current Guideline

1994 to Present – Steppuhn & Curtin

Steppuhn &  
Curtin, 1993

Agriculture  
Canada,

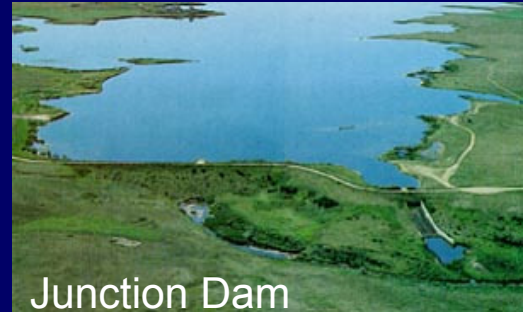
Swift Current

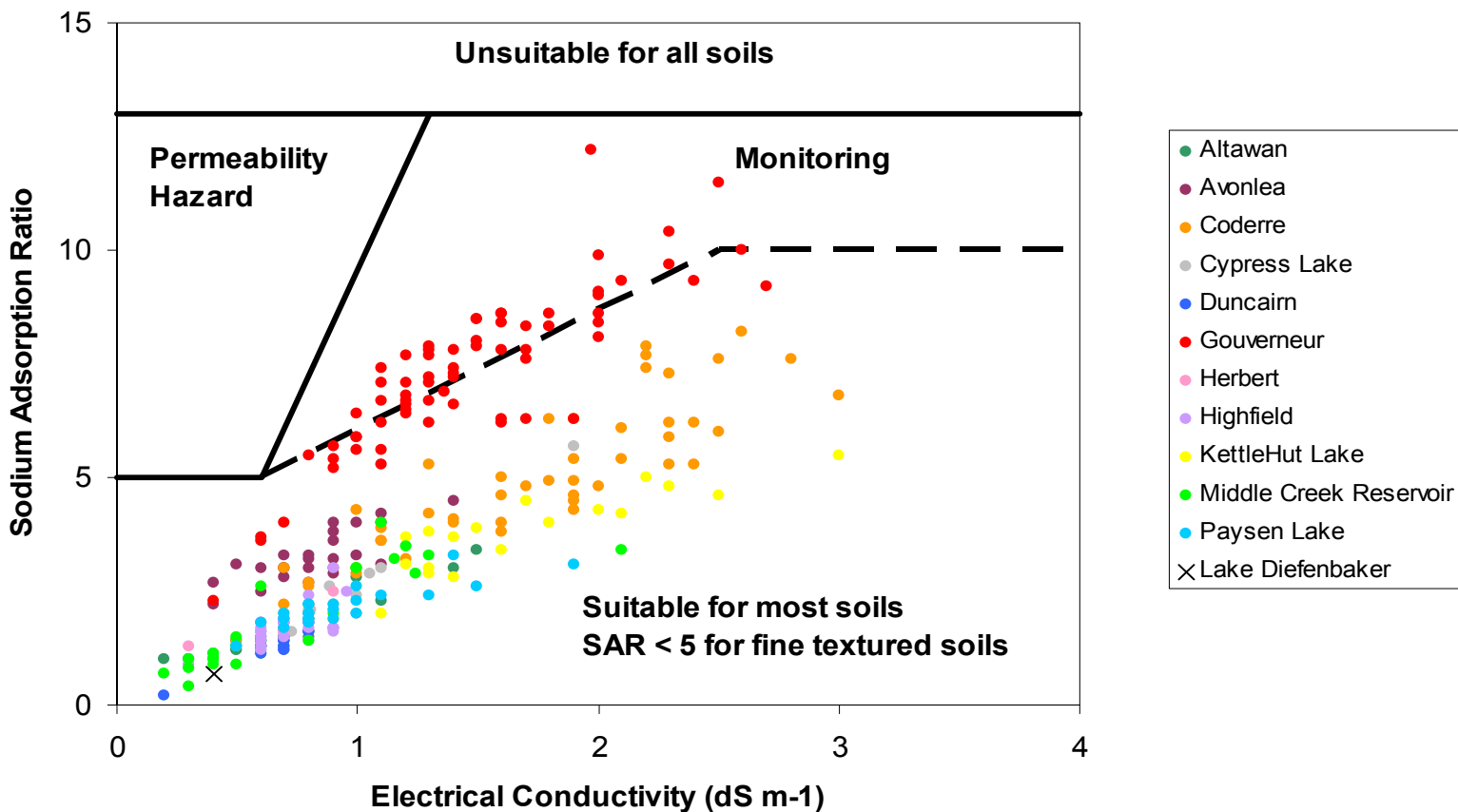


Guidelines for Use of Sodic Waters in Irrigation for 95% of  
Saskatchewan Soils

# Reservoir Sampling

- Southwest Saskatchewan has potential water quality problems.
- Reservoirs built in the 30's, 40's and 50's
- Runoff – volume and quality fluctuates
- 300 - 400 sample sites, reservoirs & associated creeks
- ~50 sites monitored every year or every few years





Irrigation Water Quality in Saskatchewan's Southern Reservoirs  
Sask Water AEU, 2002.

# Reservoir Data Show:

- Gouverneur Reservoir nears limit in some years
- Most reservoirs have acceptable quality
- Lake Diefenbaker used as a comparison



Eastend Reservoir

# The Qu'Appelle River



## Qu'Appelle River



Photo: W.O. Kupsch. The Saskatchewan Board of Archives and Archivists

# The Qu'Appelle River

- Only 1,973 acres; (74 projects)  
Small Farms, Specialized crops
- No towns using Qu'Appelle as a water source  
after Buffalo Pound
- SAR and EC increases as you move East
- Regina city effluent discharges into Wascana  
Creek
- Is there more irrigation potential? Yes, in areas.
- Also interest from First Nations groups.



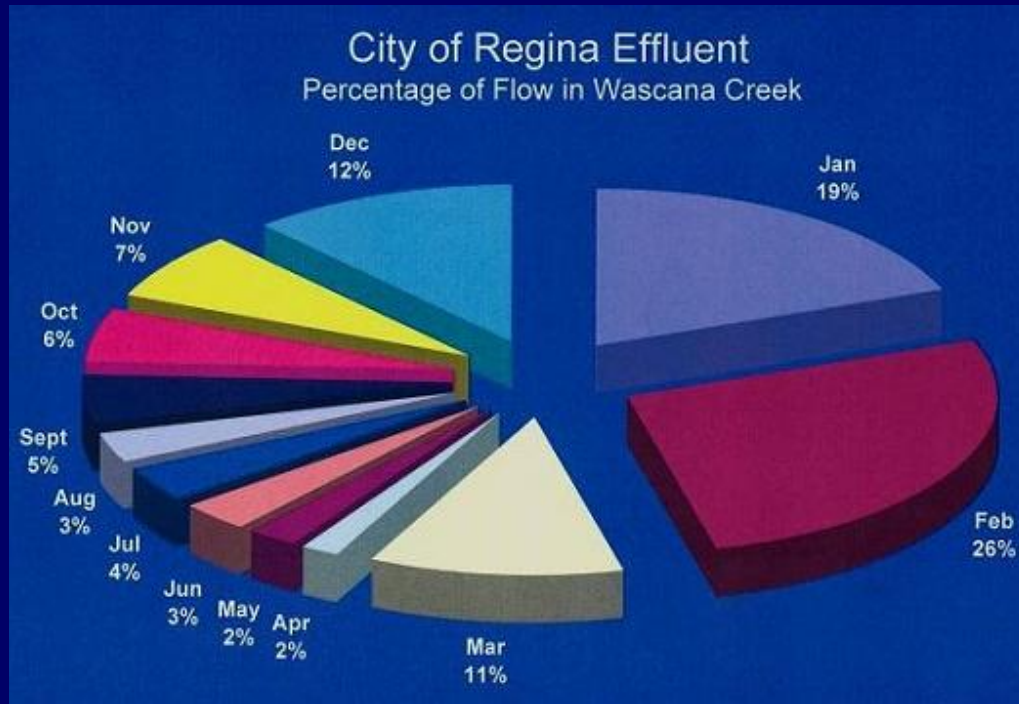
R. Pawson



# City of Regina Effluent

- Wascana Creek joins the Qu'Appelle River near Lumsden, Sk.
- Effluent is 26% of Flow in Wascana Creek in February.
- Then drops to 2-4% from April to August (which is the potential irrigation period).

**Regina Wastewater  
Treatment Plant Total  
System Monthly Flow,  
1999**





# Effluent Irrigation

- Guidelines for use of effluent on food crops is well defined.
- Saskatchewan Environment is responsible for licensing effluent irrigation.
  - Treated Municipal Wastewater Irrigation Guidelines

**Table 2. Guideline for Microbial Quality of Treated Municipal Wastewater for Irrigation**

Irrigation water – type of reuse	Irrigation Water Quality and Treatment requirements	Monitoring requirements	Other
Agricultural reuse - Non-Food crops	<p><i>Fodder, fiber, seed crops, and sod farm:</i></p> <ul style="list-style-type: none"> <li>• Treatment requirements as per section 2.2</li> <li>• Fecal coliform or <i>E. coli</i> &lt; 1000/100 mL</li> </ul> <p><i>Pasture for milking animals:</i></p> <ul style="list-style-type: none"> <li>• Treatment requirements as per section 2.2</li> <li>• Disinfection required</li> <li>• Fecal coliform or <i>E. coli</i> 23/100 mL (median)</li> </ul>	<p><i>Fodder, fiber, seed crops and sod farm:</i></p> <ul style="list-style-type: none"> <li>• Fecal coliform or <i>E. coli</i> - 1/month</li> </ul> <p><i>Pasture for milking animals:</i></p> <ul style="list-style-type: none"> <li>• Fecal coliform or <i>E. coli</i> - ½ weeks</li> </ul>	<ul style="list-style-type: none"> <li>• Grazing period – Dairy cattle – at least 30 days after last irrigation</li> <li>• Grazing period – other Livestock – at least 7 days after last irrigation</li> </ul>
Agricultural reuse - Food crops	<ul style="list-style-type: none"> <li>• Treatment requirements as per section 2.2</li> <li>• Disinfection required</li> <li>• Fecal coliform or <i>E. coli</i> 2.2/100 mL (median)</li> <li>• Fecal coliform or <i>E. coli</i> 23/100 mL (single sample)</li> </ul>	<ul style="list-style-type: none"> <li>• Fecal coliform or <i>E. coli</i> - 1/week</li> </ul>	<ul style="list-style-type: none"> <li>• Irrigation water use is not allowed for root crops or crops where edible portion contacts ground</li> <li>• Irrigation water use is not allowed for crops that may be eaten raw.</li> </ul>
Golf course	<ul style="list-style-type: none"> <li>• Treatment requirements as per section 2.2</li> <li>• Disinfection required</li> <li>• Fecal coliform or <i>E. coli</i> 200/100 mL (median)</li> <li>• Fecal coliform or <i>E. coli</i> 400/100 mL (2 consecutive samples)</li> </ul>	<ul style="list-style-type: none"> <li>• Fecal coliform or <i>E. coli</i> - 1/month</li> </ul>	

# Fecal Coliforms (*E.coli*)

Guideline for:	Food Crops (directly consumed)	Other Crops (hay, feed, seed)
Effluent Irrigation	2.2/100 mL	1000/100 mL
All Irrigation	100/100 mL	

Saskatchewan Environment, 2004 and 2005

# Current Research

- Larry Braul, Agriculture and Agri-Food Canada Water Quality Division
- University of Regina, Dalhousie University
- SK Vegetable Grower's Association
- CSWSEP

## **What is the survival rate of Pathogens after irrigation?**

- Pathogens are sensitive to sun, oxygen, and dryness
- 10 hrs sunlight completely eliminated fecal coliform on plants in Swift Current Effluent Study (Biederbeck, 1989)
- Other factors that may eliminate pathogenic bacteria include:
  - pressure shock during irrigation
  - storage in water tanks
  - aeration of reservoirs
  - UV and chlorination

# Salinity Tolerance

## *Local Salinity Research*

- Salinity tolerance studies often come from U.S.
- Salinity Laboratory in Swift Current, directed by Dr. Harold Steppuhn.

# ***Local Salinity Research***

**Radley Peas**

**Day 78**



**EC 2 mS/cm**

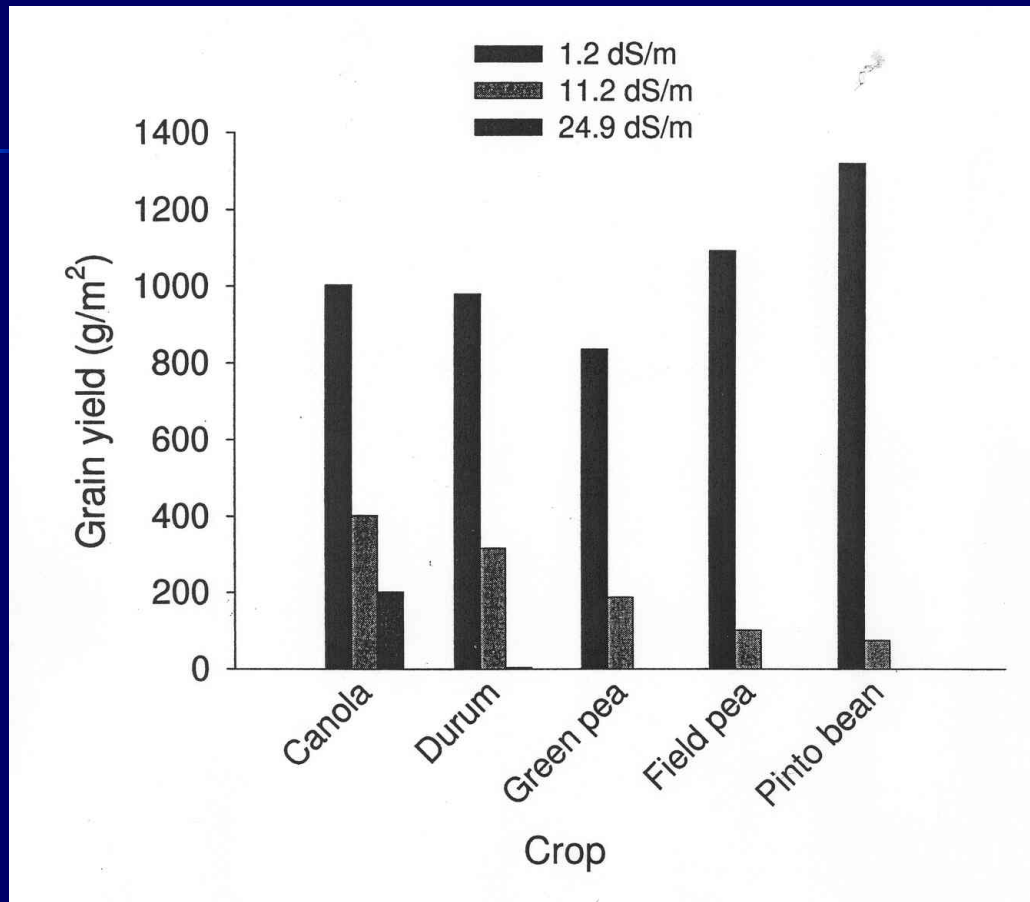


**EC 10 mS/cm**



**EC 20 mS/cm**

# Average yield at harvest for crops grown in three levels of saline root zones



Steppuhn, 1998

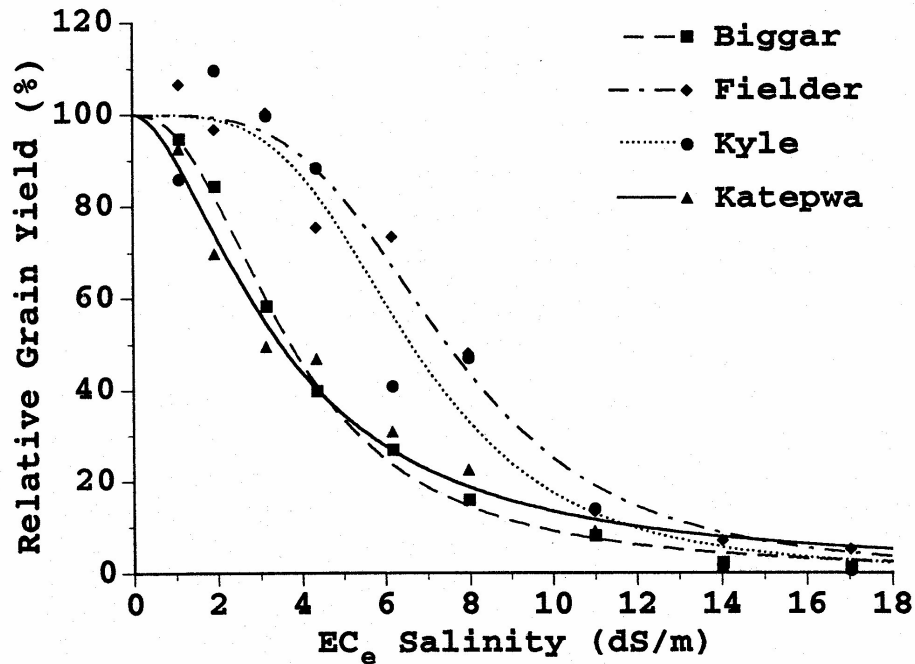


Figure 1. Relative grain yield responses (%) to salinity in four wheat varieties.

Average yield at harvest for crops grown in  
three levels of saline root zones

Steppuhn, 1998



# Future Goals in Water Quality

- Expand analysis of Piezometer Data?
- Include more parameters in regular water analysis?
- Select new monitoring sites?
- Cost of lab work & analysis is a problem
- Work to create more partnerships:
  - University of Saskatchewan
  - Masters/PhD programs
  - Alberta & Manitoba government
  - SK Water, SWA, Provincial and Federal Agencies

# References

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