

Capacity of Poplar and Willow Clones to Withstand High Levels of Wastewater Application

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Oral Paper to 24th Session IPC Dehradun, India

Canadians generate wastewater lots of wastewater

- On average 300 litres/person/day



New Canadian Regulations

- 2010 – new regulations governing wastewater discharge
- Many municipalities that have secondary treated sewage will need to upgrade to tertiary treatment prior to discharge which means \$\$\$\$\$\$

There is an economical solution

Land-Based Wastewater Treatment

- Not new technology
 - Croydon-Beddington, England - 1860
 - Berlin, Germany – 1896
 - Vineland, USA – 1901
- Techniques Refined but Same Concept
 - Discharge treated wastewater onto land-based crops instead of into surficial receiving waters
- Mainly perennial crops (alfalfa)

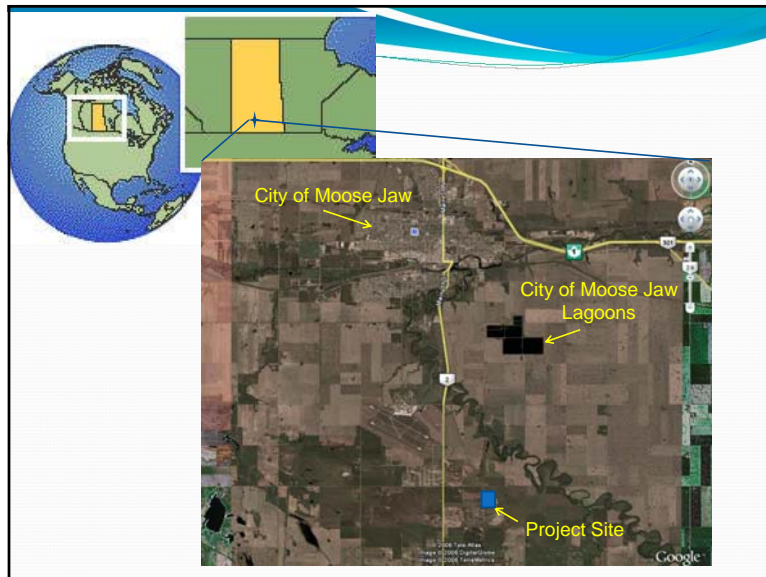
Why Poplar and Willow

- High water uptake rates
(up to 2m/yr vs 0.4 m/yr for alfalfa)
- Carbon sequestration
- Income generation



Key Questions

- Which poplar and willow clones?
- What is the sustainable irrigation rate?
- How much land is required?
- What are the groundwater and soil impacts?
- What are the costs?



Project Site before Development




Baseline data

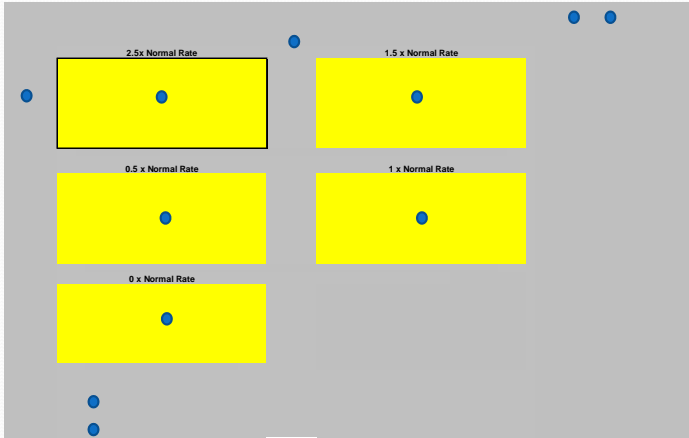
- Soil characteristics (0-15, 0-30, 30-50 cm)
- Groundwater (shallow and deep aquifer)
 - 11 monitoring wells (3m, 12.2m and 27.4m)
 - Levels and water analysis
- Effluent quality

Baseline Data

Monitoring Wells and Soil Characteristics

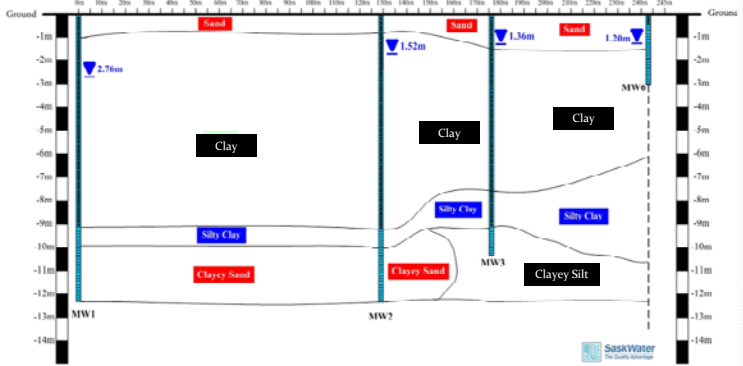


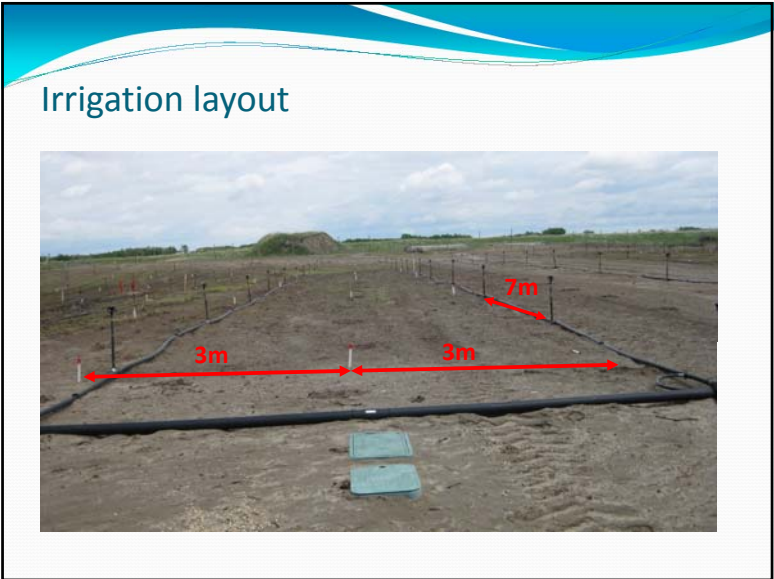
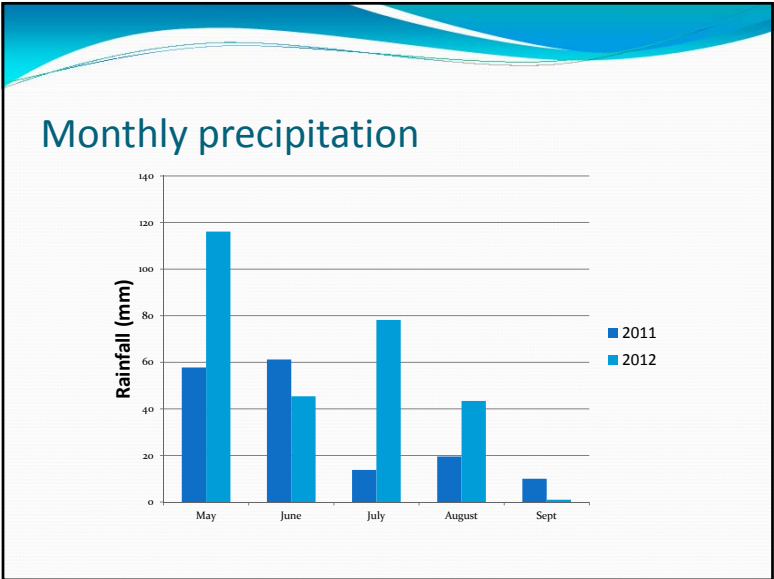
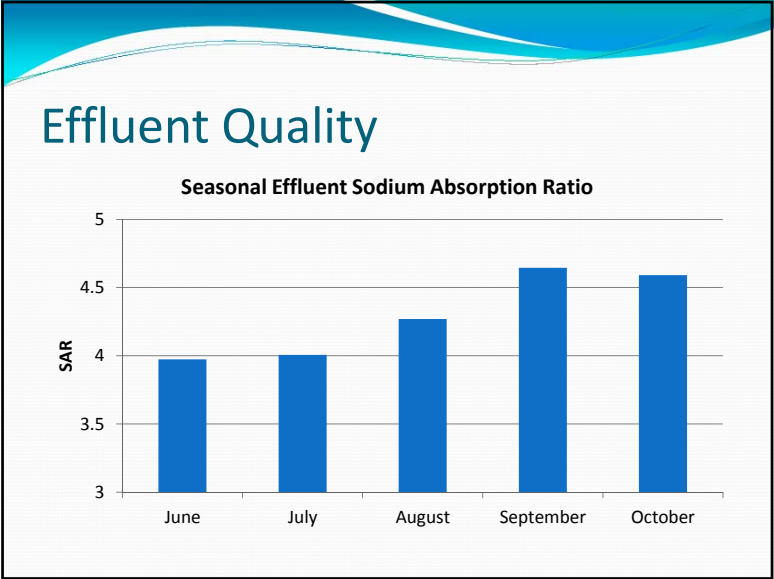
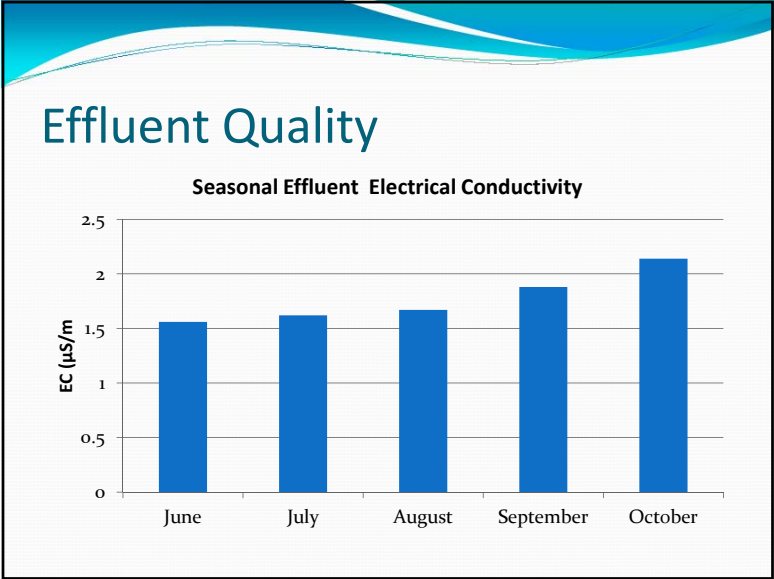
Baseline Data - Monitoring well locations



Baseline Data


Soil Characteristics





Planting and weed control

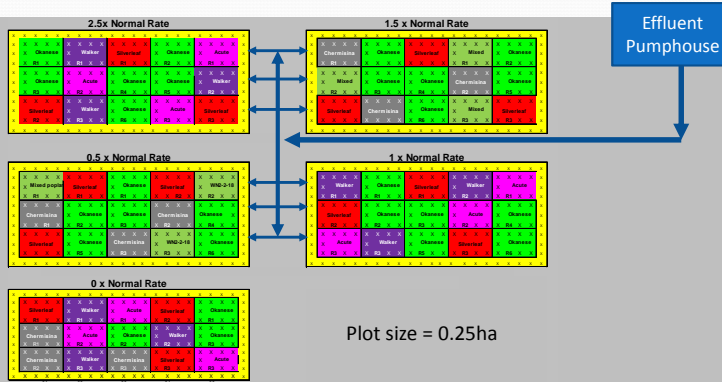
- Planted June 2011 (rooted plugs)
- 3 x 3 m spacing
- In-row weed control straw with mulch mats (50 cm²)
- Between row – orchard grass



Poplar and willow clones


Poplar	Willow
Okaneze (<i>P. xWalker</i> x <i>P. xpetrowskyana</i>)	Silverleaf (<i>S. alba</i> var. <i>sericea</i>)
Walker (<i>P. deltoides</i> x <i>P. xpetrowskyana</i>)	Acute (<i>S. acutifolia</i>)
Mixed poplar clones	

Plotplan



Plot size = 0.25ha

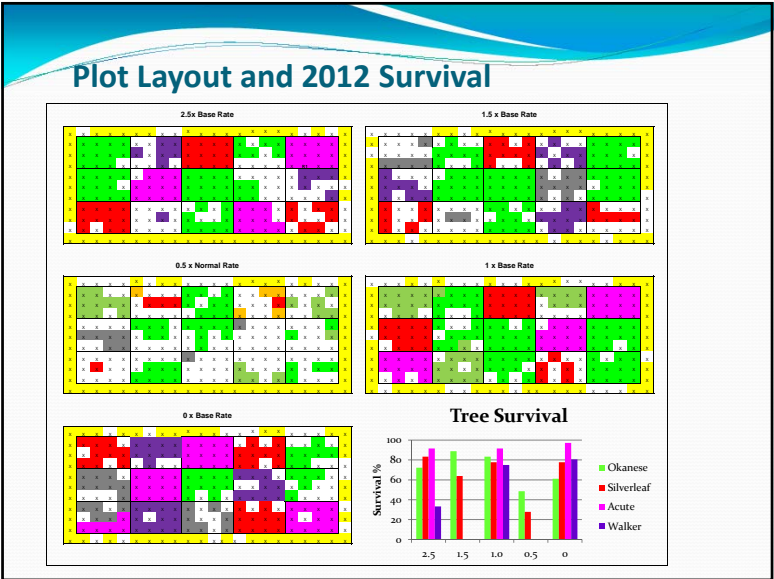
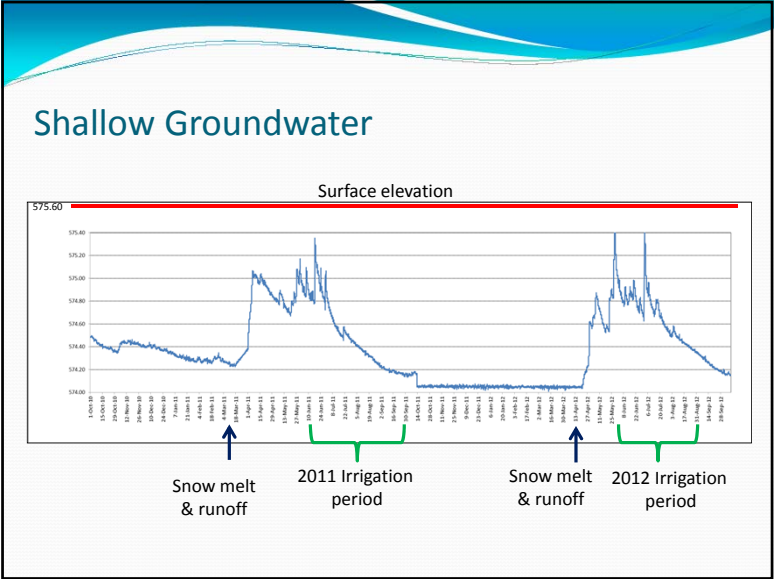
Irrigating effluent – June 2011

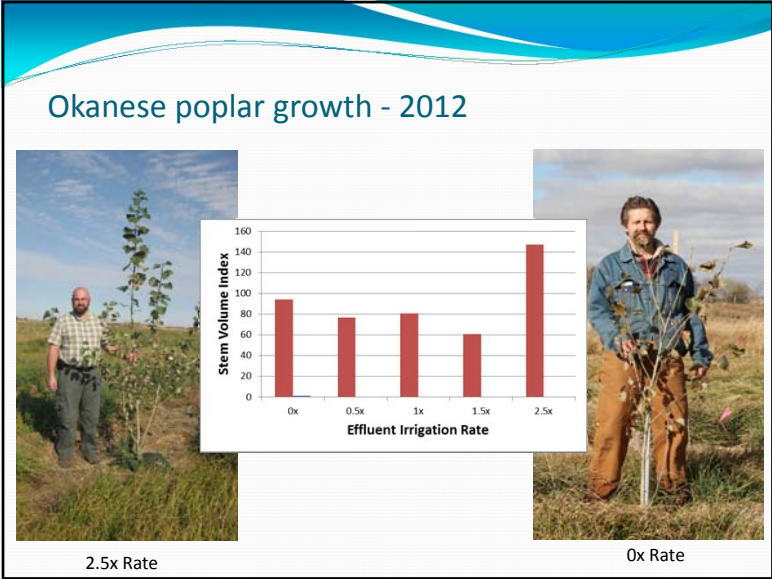


Irrigation – 2x every 2nd day (base total = 100m³/irrigation day)
2011 - June 2 to Sept 27
2012 – June 1 to August 28

Irrigated effluent applied (m³)

Plots	2011	2012	2013 Target
0 X Plot	0	0	0
0.5 x Plot	771	694	460
1.0 x Plot	885	797	920
1.5 x Plot	1351	1216	1380
2.5 x Plot	1624	1462	2300
Total	4631	4169	5060





Effluent irrigation area requirement

Area Required Per 1,000 People*			
	Wet Years Maximum	Avg. Years Average	Dry Years Minimum
Poplar (ha)	15	10	6

*Based on 2.0m/yr uptake and 300 lcd/person
Equivalent to 9 -10 poplars per person

- Consider annual effluent discharge of **500,000 m³**
- Poplar / Willow needed:
 - The 0.5 x plot (0.46 m/year) = 107 ha
 - The 1 x plot (0.92 m/year) = 54 ha
 - The 1.5 x plot (1.38 m/year) = 36 ha
 - The 2.5 x plot (2.30 m/year) = 21 ha

- ### Lessons learned
- Late season irrigation winterkilled sensitive juvenile clones
 - Walker > Silverleaf > Okanese > Acute
 - Poplar / Willow suitability
 - Okanese > Silverleaf > Acute > Walker
 - Weed control and grass
 - Straw led to severe vole damage
 - Effluent stimulated grass growth especially in high application plots
 - Engineering
 - Above-grade irrigation lines limited access
 - Soil and groundwater
 - After two years – no change from baseline
 - some change in shallow groundwater levels

