Regional Assessment of Source Water Quality: A case study in the headwaters of the Oldman River Basin, Alberta

Jocelyn Howery
MSc. Candidate
Department of Renewable Resources
University of Alberta

Regional Water Quality Assessments

- Assessments traditionally carried out on a project basis
- Quantification difficult due to confounding nature of problem
- Frameworks today are qualitative in nature

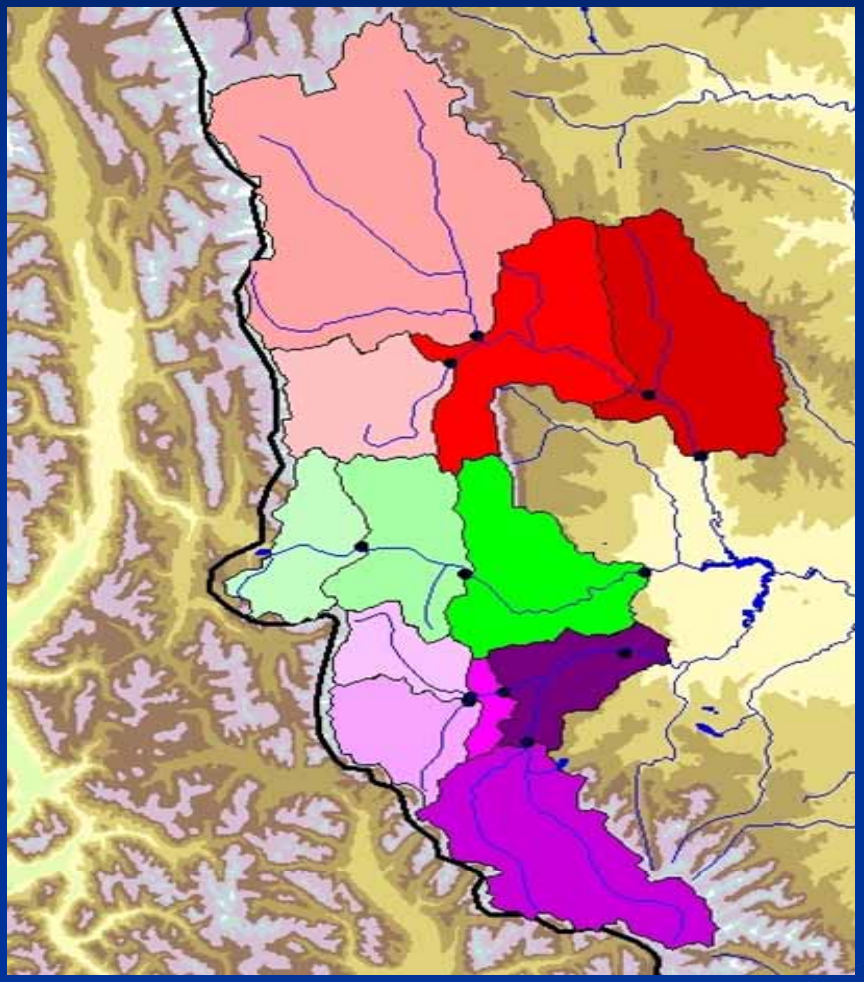
Study Objectives

- Characterize spatial and temporal patterns in water quality in the three headwater basins of the Oldman River Basin
- Identify “hot spots” on the landscape

Description of Study Region

www.oldmanbasin.org

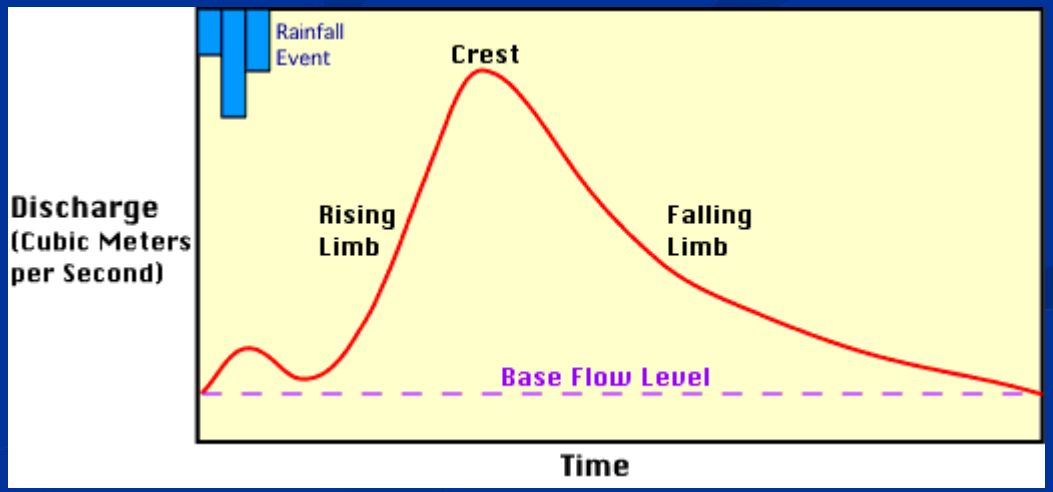
Description of Study Region



- 3 Headwater Basins
  - Oldman
  - Castle
  - Crowsnest
- 12 Sub-basins
  - Upper sites - forest
  - Lower sites - agricultural
  - Urban

Water Quality Sampling

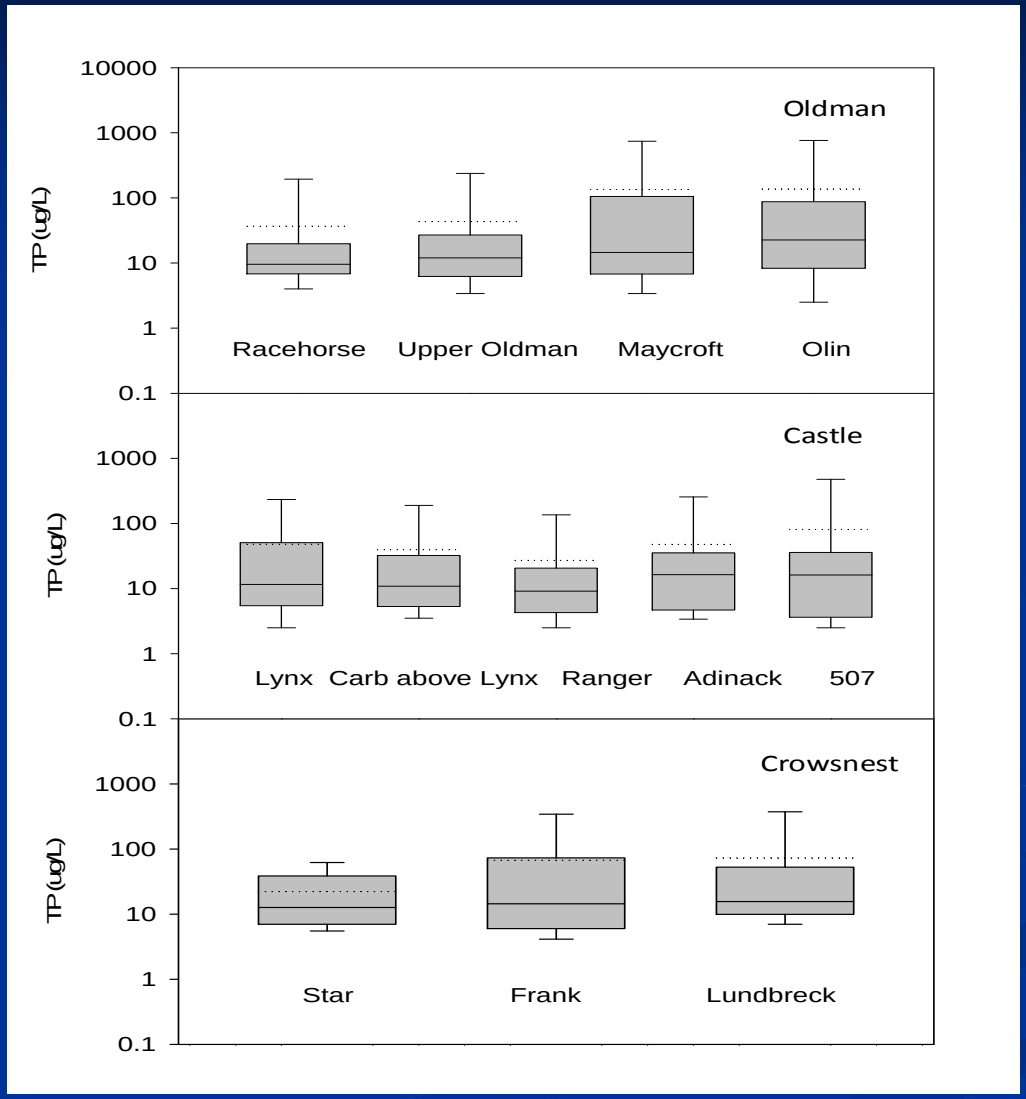
- Four years of data (2005-2008)
- Hydrological regimes sampled:
  - Baseflow
  - Spring freshet
  - Stormflow
- Parameters sampled:
  - TP and TN



Water Quality Sampling

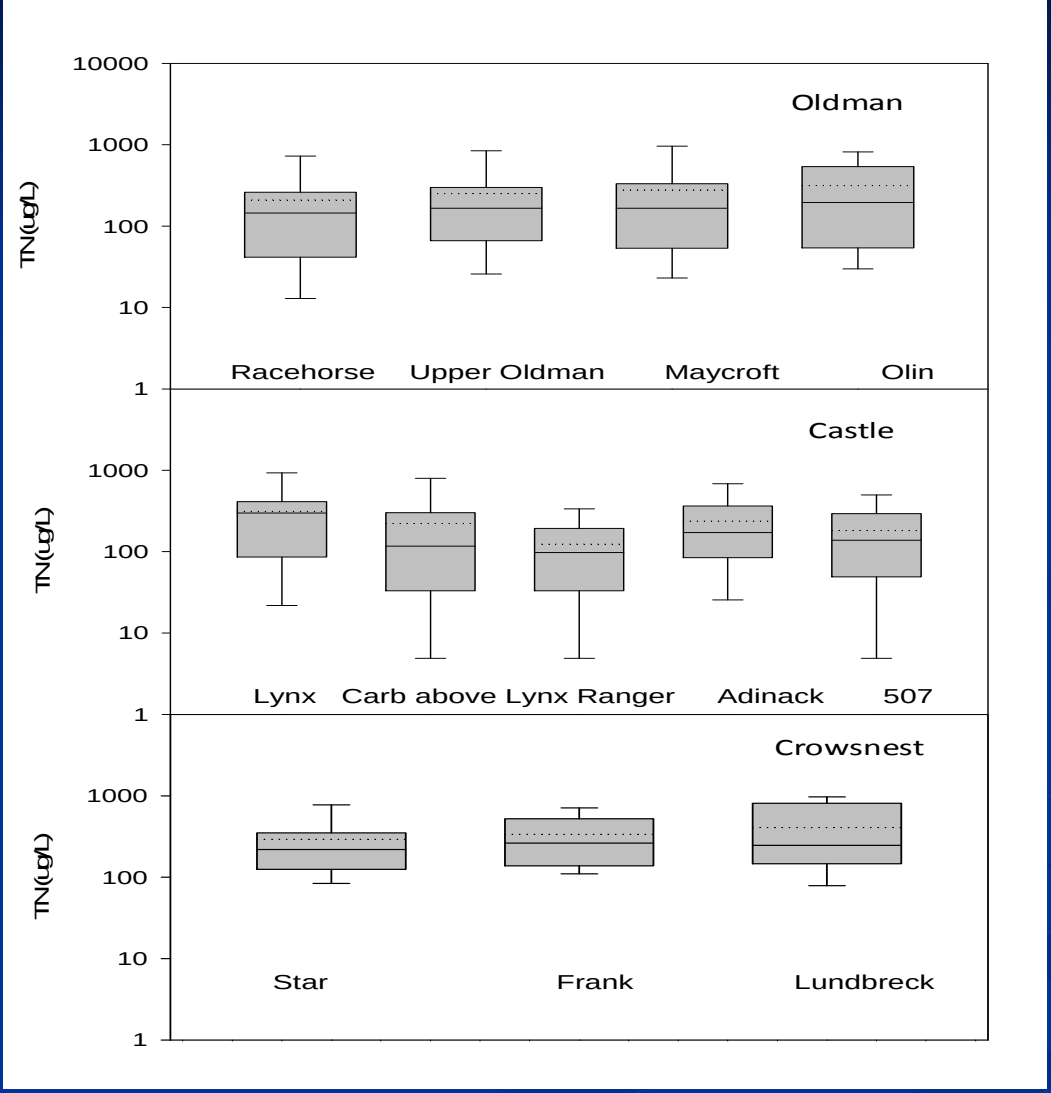
- Concentrations – (µg/L)
- Exports (Loading) – (kg/day)
- Nutrient Yields – (kg/ha/yr)
  - Links specific landscapes and water quality

Results: TP Concentrations



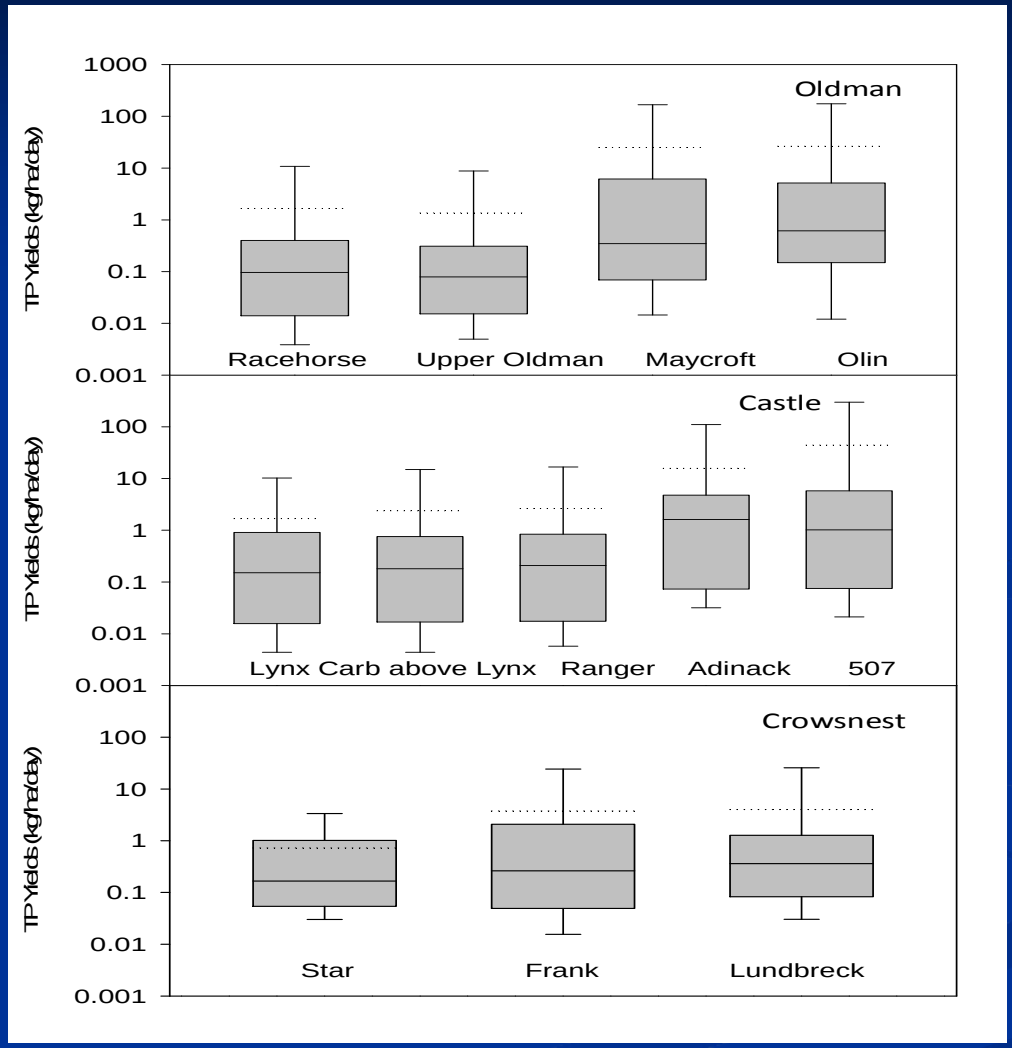
Upstream → **Downstream**

Results: TN Concentrations



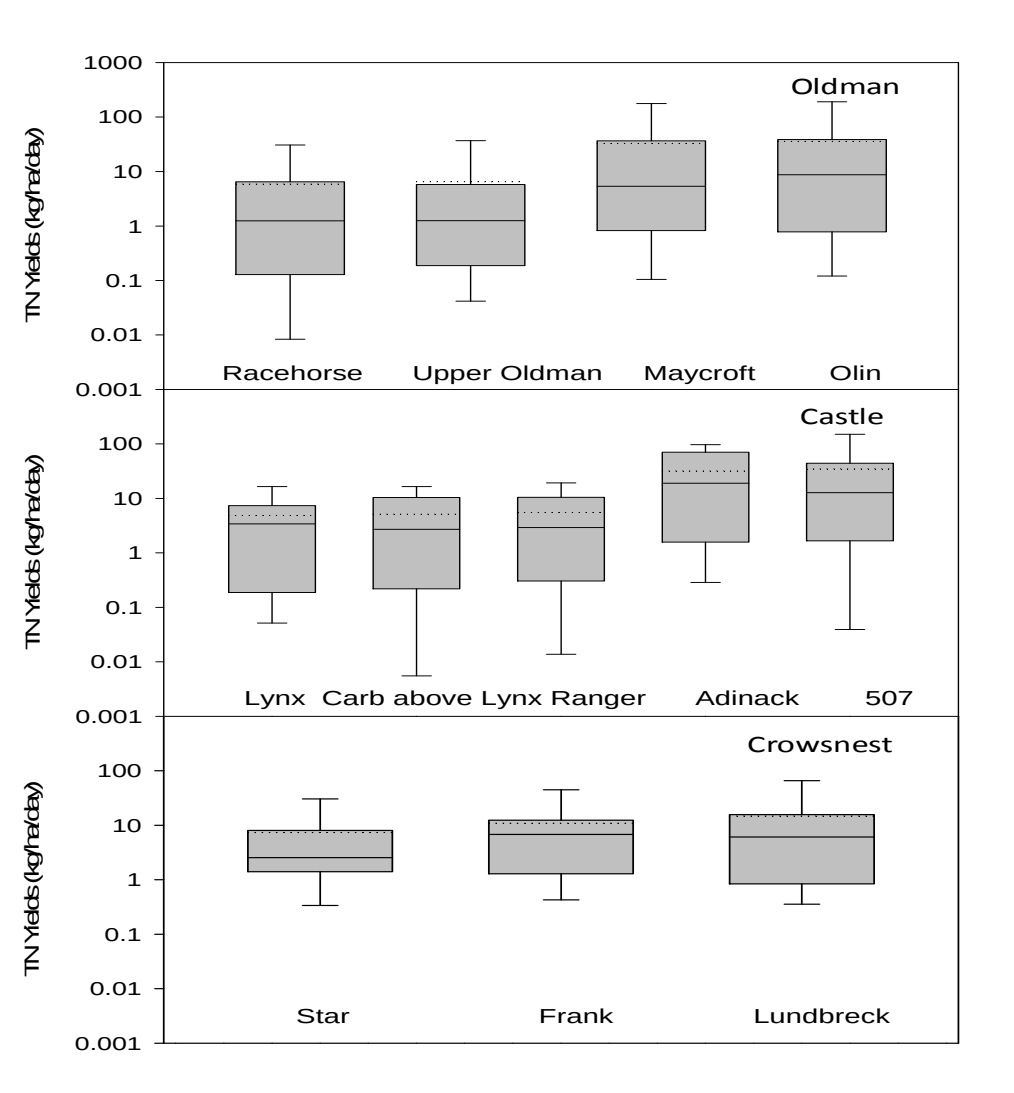
Upstream → **Downstream**

Results: TP Yields



Upstream → **Downstream**

Results: TN Yields



Upstream → Downstream

Some Perspective

- Concentration values from upstream and downstream sites

	LOCATION	LAND-USE	TN (µg/L)	TP (µg/L)
Current Study	**Southern Alberta**	**Forestry**	**186.5**	**10.9**
Johnson *et al.* (1997)	Central Michigan	Forestry	1670.0	47.0
Brett *et al.* (2005)	Seattle	Forestry	1155.0	30.4
Current Study	**Southern Alberta**	**Ag/Urban**	**184.2**	**21.7**
Johnson *et al.* (1997)	Seattle	Ag/Urban	4130.0	45.0
Tufford *et al.* (1998)	South Carolina	Ag/Urban	2100.0	100.0

Some More Perspective

- Nutrient yield values from Oldman and Castle

	LOCATION	LAND-USE	TN (kg/ha/yr)	TP (kg/ha/yr)
Current Study	**Southern Alberta**	**Agriculture**	**18.95**	**1.62**
Jordan *et al.* (1997)	Chesapeake Bay	Agriculture		0.93
Beaulac and Reckhow, (1982)	Meta Analysis	Agriculture	15.0	1.0

Some More Perspective

- Nutrient yield values from the Crowsnest Basin

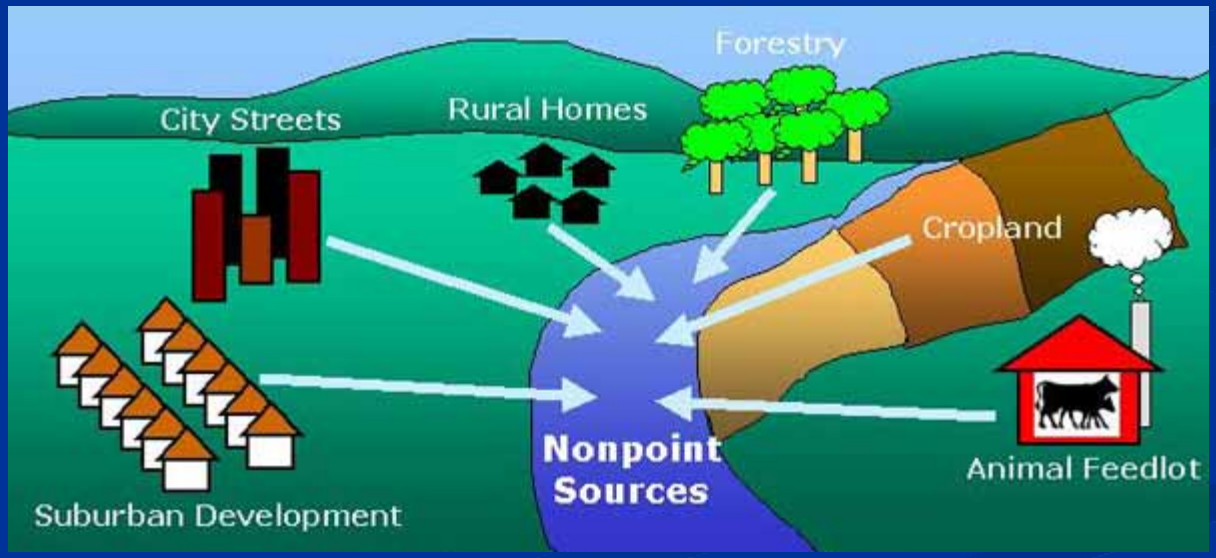
	LOCATION	LAND-USE	TN (kg/ha/yr)	TP (kg/ha/yr)
Current Study	**Southern Alberta**	**Forest / Urban**	**6.12**	**0.36**
Crim (2007)	Georgia	Forest / Urban		0.15
Groffman *et al.* (2004)	Chesapeake Bay	Forest / Urban	5.0	

What does this mean?

- Nutrient yields can locate “hot spots” within basins
- Valuable insights are missed by relying on concentration data
- Linking landscape to water quality - US EPA TMDL program

TMDL Program

- 1972 Clean Water Act - great success dealing with point-source pollution
- Now turning attention to non-point sources through the use of TMDLs (Total Maximum Daily Load)



TMDL Program

- States must now:
  - Identify watersheds that are impaired, prioritize based on use and severity
  - Establish TMDLs that:
    - Recognize the contributing contaminants
    - **Identify the source of contaminants**
    - Establish load reductions for contaminants (Boyd, 2001)

TMDL Implementation Challenges

- Models require considerable site specific information and time to produce
- Significant costs associated with collecting discharge data and developing models
- Development of site specific BMPs to reduce nutrient loads difficult

Take-home Messages

- Effective water management involves quantification of “problem areas”
- Results from this study show that valuable insights are missed by relying solely on concentration data

Acknowledgements

- Dr. Uldis Silins
- SRWP Hydrology Lab Crew Members
- NSERC
- Alberta Sustainable Resource Development
- Oldman Watershed Council
- Alberta Water Research Institute
- University of Alberta

Contact Information

Jocelyn Howery
MSc. Candidate, Watershed Management
University of Alberta
(780) 492-9091
Email – jhowery@ualberta.ca