

Investigating Long-term Effects of Manure Management Activities on Groundwater Quality in Alberta

Kristen Lorenz (Mike Iwanyshyn)

Toward Sustainable Groundwater In Agriculture

Thursday, June 17, 2010
San Francisco, CA

Government of Alberta



Outline

- Background
 - Agriculture in Alberta
 - Alberta's Confined Feeding Operation Regulations
- Project: Livestock Manure Impacts on Groundwater Quality
 - Objectives
 - Project components
- Applications



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



Perception or Reality?

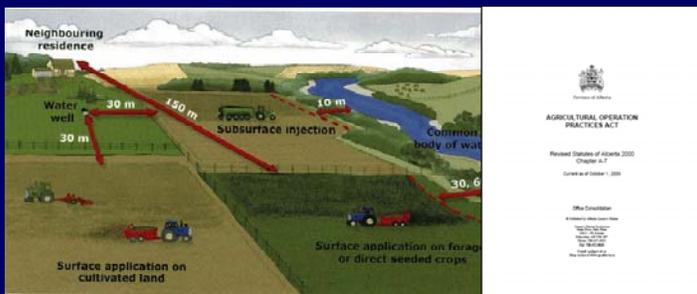
Hendry *et al.* Literature Reviews

- Reviewed comparative regulations throughout North America to understand how various jurisdictions manage the risk to groundwater from confined feeding operations.
- Reviewed scientific literature in Alberta and North America to assess the extent of present and future groundwater impacts from confined feeding operations.



Agricultural Operation Practices Act (AOPA)

- AOPA defines a confined feeding operation as "Fenced or enclosed land or buildings where livestock are confined for the purpose of growing, sustaining, finishing or breeding by means other than grazing and any other building or structure directly related to that purpose but does not include residences, livestock seasonal feeding and bedding sites, equestrian stables, auction markets, race tracks or exhibition grounds."

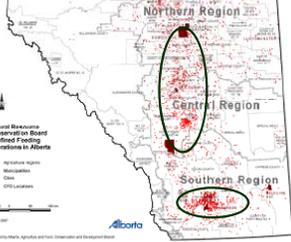


Hendry *et al.* Findings: AOPA

- Alberta's regulatory program is neither the most stringent nor the most lenient compared to other jurisdictions.
 - Require agency authorization for land application of manure and the preparation of a comprehensive plan for management of nutrients from animal wastes.
- Alberta bases its land-application rates for manure on the mass of N present in the soil.
 - Alberta: 30 and 60 Mg/ha (wet wt.) NO₃-N for cattle feedlot manure application on non-irrigated and irrigated land, respectively.
 - Other jurisdictions: base application rates on the mass of P, both N and P, or agronomic rates for P or N (e.g., Ontario, North Dakota).
- Alberta's manure application procedures are not as detailed as other jurisdictions.

Confined Feeding Operations in Alberta (AARD 2007)

Manure from commercial feed lots in Alberta is generally disposed of by land application and in close proximity to where its produced.



Manure Production



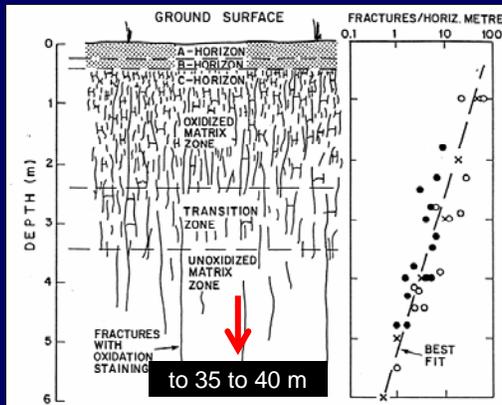
Hydrogeologically stable sites should be common in Alberta

- Relatively thick, clay till aquitards over much of landscape
- Lack of extensive, shallow aquifer systems

HIGH VULNERABILITY

LOW VULNERABILITY

Distribution of Fractures in Till



after McKay and Fredericia (1995)

Livestock Manure Impacts on Groundwater Quality Project

1. Earthen Manure Storage (EMS)

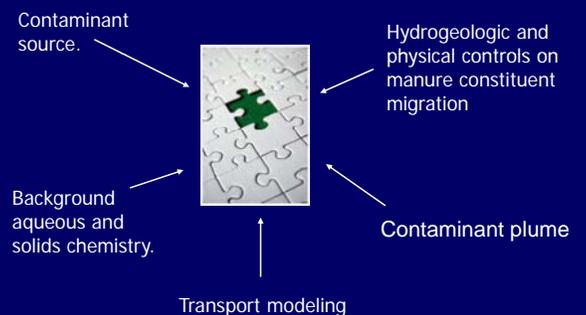


2. Manure Spreading

Overall Project Objectives

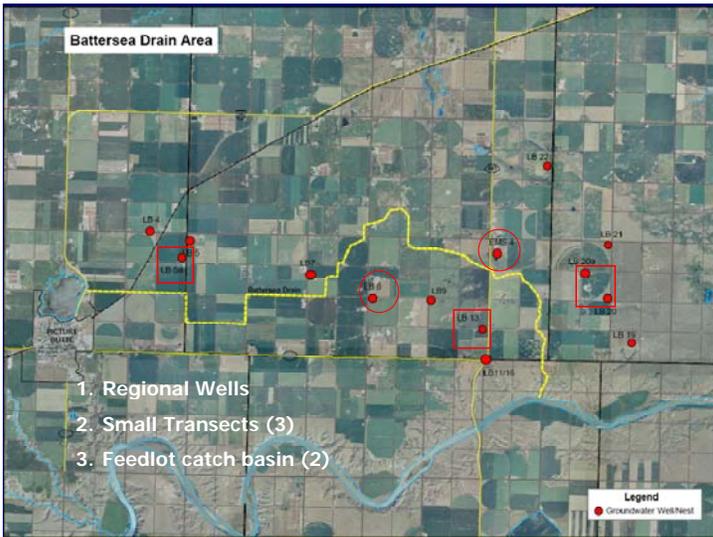
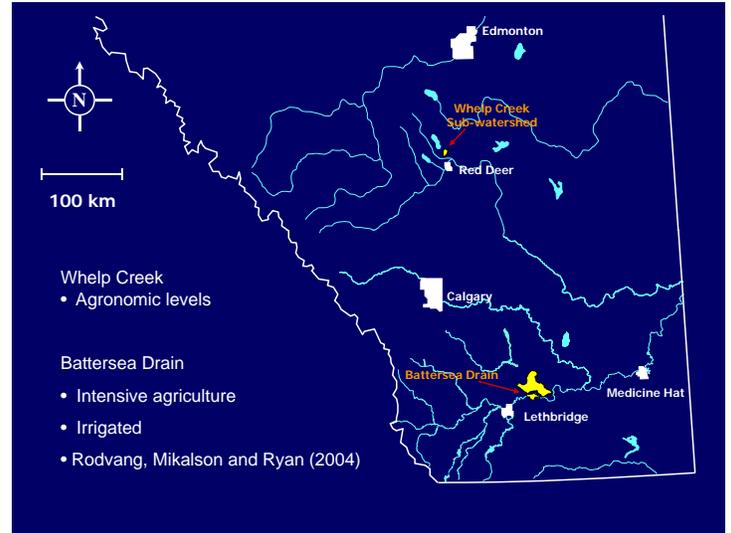
- To better understand the impact of manure management activities (earthen manure storage and manure spreading) on groundwater quality in Alberta.
- To understand the processes affecting the fate and transport of manure constituents in the groundwater environment.
- Develop scientifically defensible policy for confined feeding operations (CFOs) to improve management of groundwater and mitigate risks to the environment and public health.

What's involved to meet the objectives?



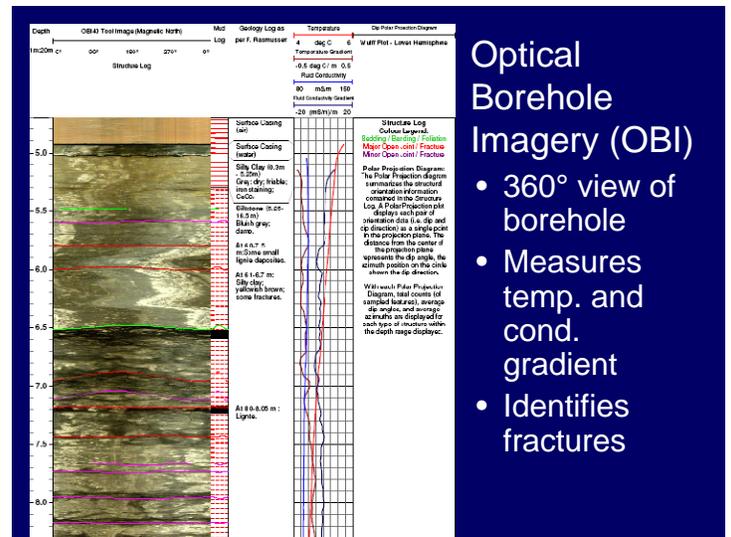
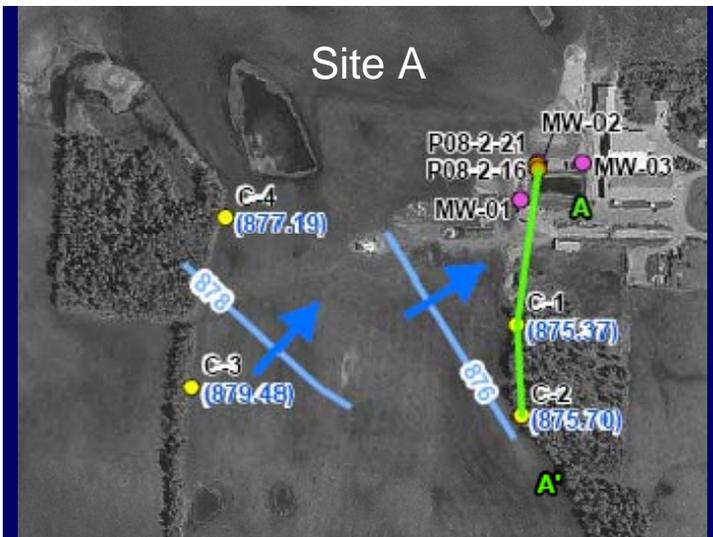
General Study Methods

- Water table well and piezometer installations.
- Water level measurements in wells and lagoons.
- Water Sample Collection and Analyses (field parameters, major ions, nutrients, isotopes, bacteria)
- High resolution coring
- Invasive (Direct push EC probe) and non-invasive techniques (EM31)

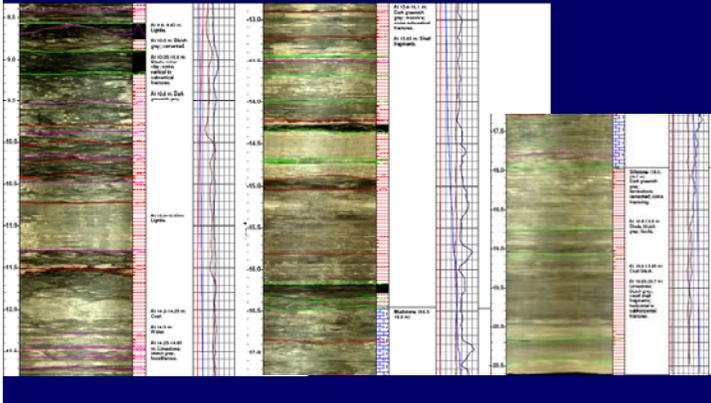


Impacts of Earthen Manure Storage (EMS) on Groundwater Quality

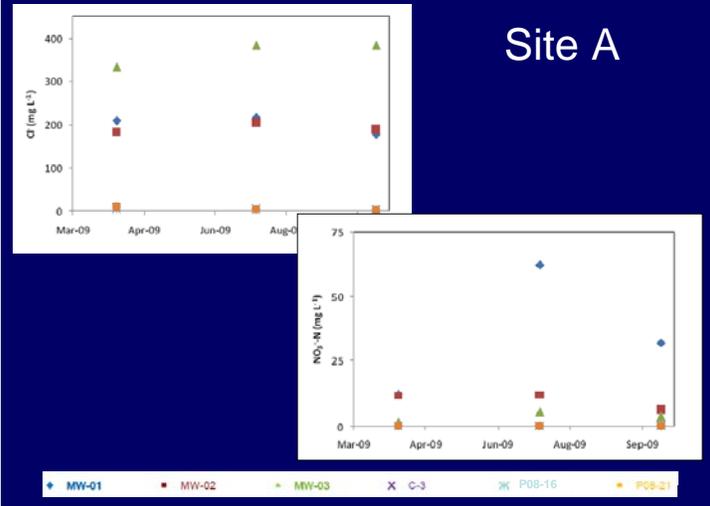
- Understand the impact of EMS (i.e., lagoons) on groundwater under different hydrogeologic conditions.
- 4 Dairies
 - Site A: thin till over bedrock
 - Site B: thin till over bedrock
 - Site C: sandy till
 - Site D: permeable/sand



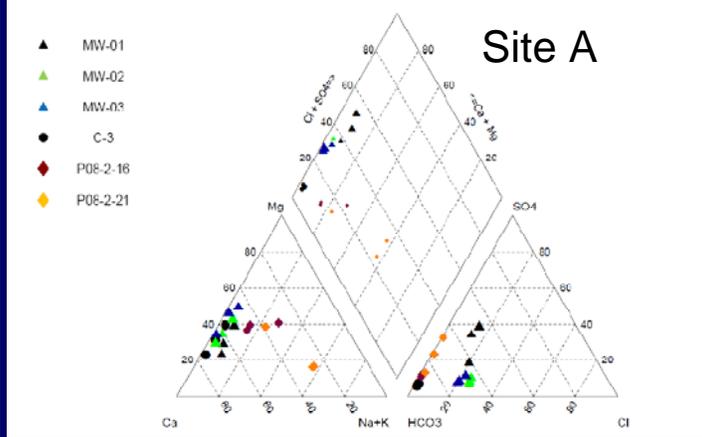
Relatively significant amount of horizontal fracturing suggests that vertical permeability may be less than horizontal.



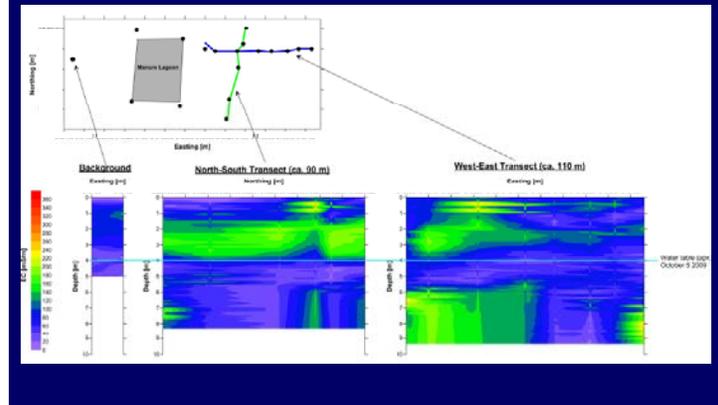
Site A



Site A



Site B: Direct Push EC



Application of Findings

- Improve our understanding of how manure management practices in the confined feeding operation industry have the potential to impact groundwater quality.
- **Provide information for the development of scientifically defensible policy relating to manure management.**
 - Improve management of groundwater.
 - Mitigate risks to the environment and public health.
- Enhance confined feeding operators' knowledge of the environmental impacts associated with manure management (i.e., enhance environmental stewardship).
- Improve public confidence in the environmental performance of confined feeding operations.

Application of Findings

- Findings may be used to predict the impact of earthen manure storage and associated activities in regions with similar hydrogeologic conditions.
 - Fate and transport processes.
 - Fracturing, medium and high permeability (thin till over bedrock and sand)
- The information may also be applied during land use planning through Alberta's Land Use Framework.
 - Under the Framework, confined feeding operations will have to compete with other land uses (e.g., industrial, protected areas).

Partners

- Alberta Agriculture and Rural Development
- Natural Resources Conservation Board
- University of Alberta
- University of Saskatchewan
- Agriculture and Agri-Food Canada
- Producers

Questions?

Contacts:

Kristen.Lorenz@gov.ab.ca

Mike.lwanyshyn@gov.ab.ca