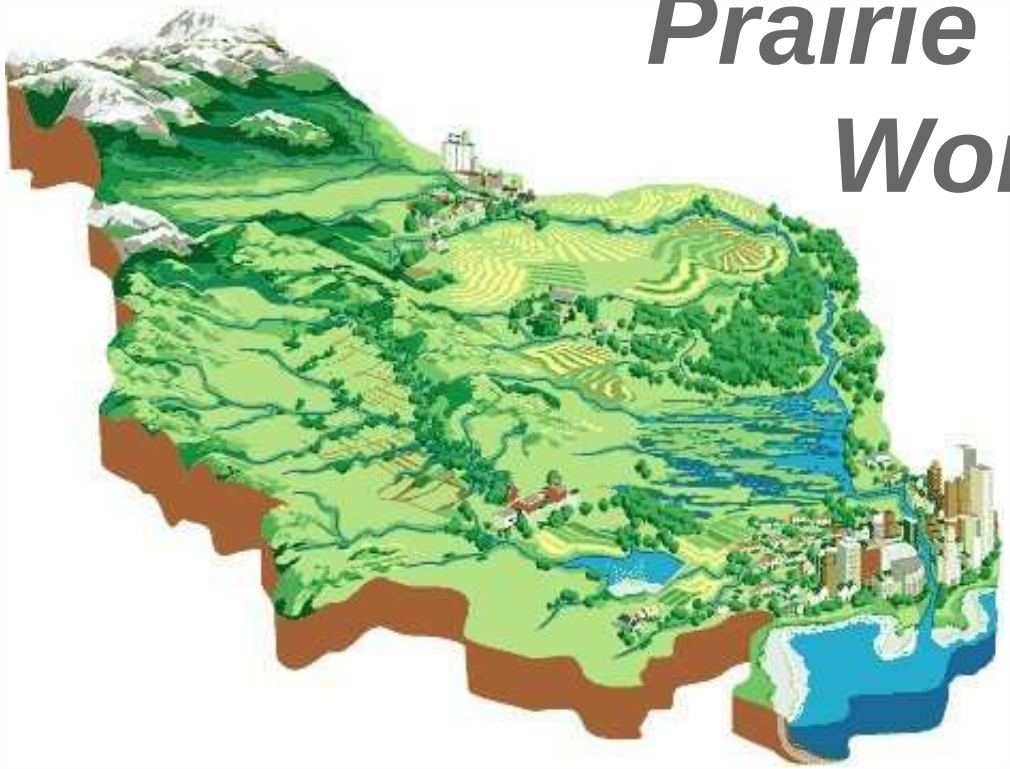
(WEBs)
Watershed Evaluation of BMPs



Prairie Hydrology Workshop

November 18, 2009

Jim Yarotski,

Agriculture and Agri-Food Canada | Agriculture et Agroalimentaire Canada

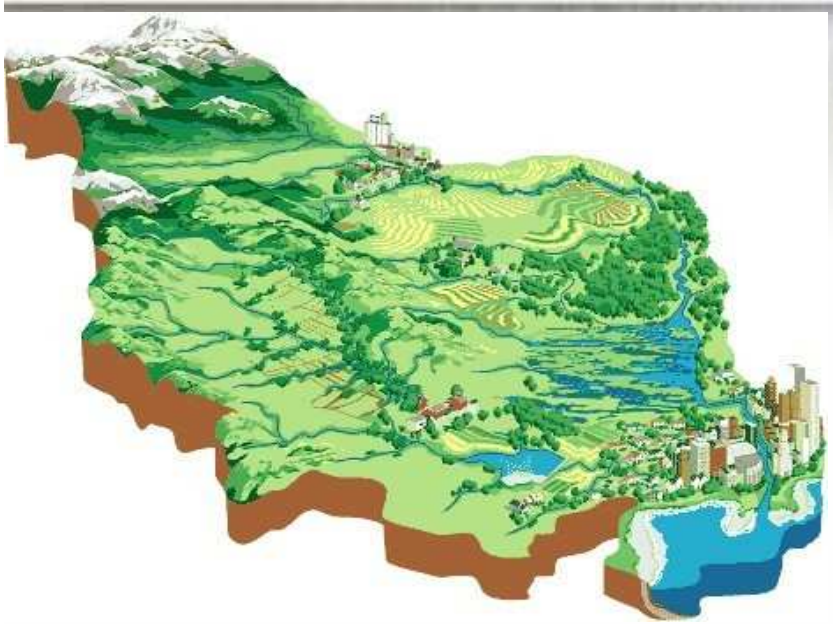
What's a beneficial management practice (BMP)?

- **Definition:** "A farming method that minimizes risk to the environment without sacrificing economic productivity"


Cattle exclusion fencing


Grassed waterway

Why evaluate BMPs at watershed-scale?



- **Past 20 years AAFC has invested significant resources into BMP-type programming**

- **Very little validation at watershed scale**

- **Estimates are largely based on literature values and model extrapolations**

- ***Ultimately, need to identify those practices & lands that will give greatest return on investment***

WEBs - *Objectives:*

- **Evaluate both the *environmental* and *economic* performance of BMPs….***for the environmental performance water quality (N, P & sediment) is the primary indicator. Other indicators have been used….soil, air quality, groundwater, etc.*

- ***Modeling is used to extrapolate the small watershed research to a regional/watershed scale.***

Agriculture and Agri-Food Canada | Agriculture et Agroalimentaire Canada

WEBs – Timelines & Collaboration

- **Start date** - *April 1, 2004*
- **End date** – *March 31, 2008*
- **Interim Funding Year** – *08/09*
- **4-year future funding** – *2009-12/13*

Collaboration -

- **Over 40** ***Provincial and Federal Agencies, conservation groups, academia, farmers and others, are participating in the WEBs work.***
- ***The research watersheds are also part of other programs***
- ***USDA***

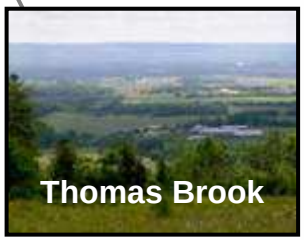
9 Regional 'Living Laboratories':

Pipestone Creek (new)

BC AB SK MB ON QC NL NB PE NS

Souris (new)

WEBs Watershed Sites



Agriculture and Agri-Food Canada | Agriculture et Agroalimentaire Canada

Biophysical Approach

Standard experimental designs include:

- **Before and after**
  - Historic benchmark data compared to post-BMP
- **Upstream/downstream**
- **Paired watersheds**
  - One has BMPs implemented (intervention vs. control)
- **Monitoring of various environmental parameters** *(flows, soil sampling, water sampling, etc.)*

The experimental design has to be scientifically sound such that it is defendable in a peer reviewed journal.

BMPs applied by watershed:

WEBs BMPS	Salmon River	Lower Little Bow	South Tobacco Creek	South Nation	Bras d'Henri / Fourchette	Black Brook	Thomas Brook
Riparian – Cattle exclusion fencing (and off-stream watering)	X	X		X			X
Riparian – Off-stream watering without fencing	X	X					
Riparian – Grazed versus mechanical harvesting			X				
In-field – Manure Management		X			X		X
In-field – Zero versus conventional tillage			X				
In-field – Crop rotation					X		
In-field –Perennial cover		X	X				
In-field – Reduced herbicide use					X		
Runoff – Diversion terraces and grassed waterways						X	
Runoff – Stormwater diversion (farmyard runoff)							X
Runoff – Holding pond (cattle containment runoff)			X				
Runoff - Small reservoirs			X				
Runoff – Buffer strips		X				X	
Runoff – Suite of surface runoff control measures					X		
Drainage – Controlled tile drainage				X			

Not a test of BMP effect across watersheds

Agriculture and Agri-Food Canada | Agriculture et Agroalimentaire Canada

Economics Approach

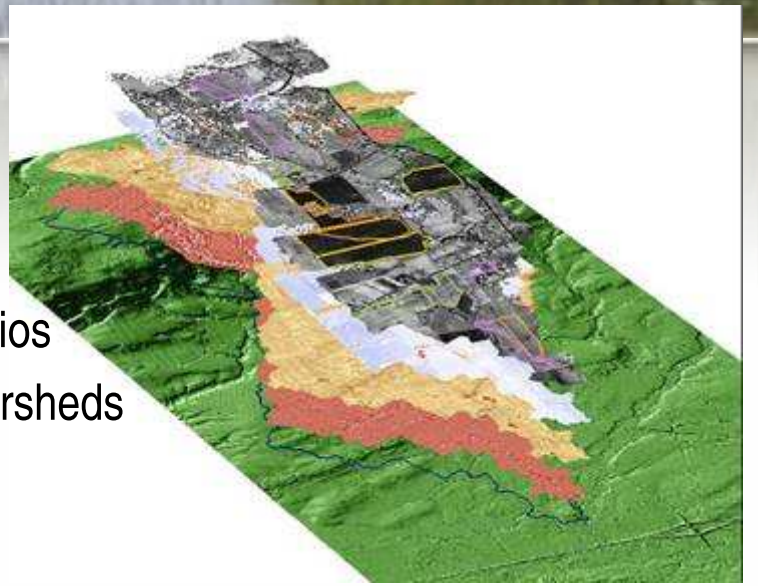
- **Economics**
  - Assess the cost of the BMPs
  - Look at the benefits
  - Next step is we need to look at the environmental benefits

- **Behavioral assessment**

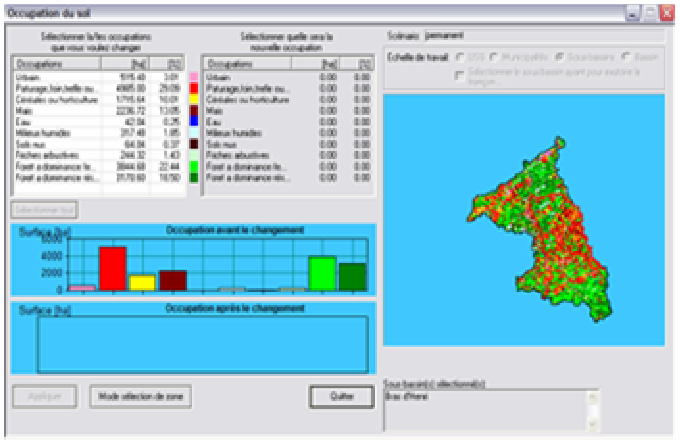
  - Studies to investigate social or behavioral factors

  that influence adoption and maintenance

Modeling Approaches



- **Hydrologic modeling:**
  - Collect real data from project watersheds
  - Create a ‘virtual watershed’, run different BMP scenarios
  - “Nested Approach” Extrapolate findings to larger watersheds
- **Integrated modelling:**
  - Link the above two components



Models used to date in WEBs' Projects

- **SWAT (Soil & Water Assessment Tool) Modelling –** was chosen for 5 of 7 WEBs1 sites
- **GIBSI Model** (Laval University) **–** used for Bras d'Henri Watershed
- **MACRO (1-D) Groundwater Model –** used for South Nation
- **Model Enhancements** are key to matching local conditions

Model Enhancements

Watershed/Primary Model	Models/modules/enhancements	Function
Black Brook/SWAT	Flow Diversion Terrace Model	Estimate P-factors
	Event Based Grass Buffer Model	Model hydrologic impact of grass buffer strips.
	ANN model for soil drainage characteristics and soil organic carbon	Estimate soil parameters from coarse soil data
Lower Little Bow/SWAT	Auto-calibration routine	Selection of hydrologic parameters
Salmon River/SWAT	Bacteria model	Model transport of fecal coliforms and *e coli* from livestock operations
	Hydrology module (part of bacteria model)	Estimating runoff from a rain event
South Tobacco Creek/SWAT	Small storage modules	Runoff detention from feedlots
	Auto-calibration	Calibration of parameters
	REMM equivalent	
Bras d'Henri /Beaurivage/GIBSI	PHYSITEL GIS	Watershed delineation and drainage patterns
	TransPath	Coupling with GIBSI to model transport of pathogens (fecal coliforms) from pasture to stream

Next steps for Modelling

First Phase of WEBs was a good start and more is planned

- **Future activities include filling in the gaps in WEBs, and investigating the spatial and temporal application of the model.**
- **Some deficiencies identified relating to missing or lack of data, lack of capacity (models) and problems within the selected models.**
- **Use model "pro-types" and incorporate bio-physical field information.**
- **Need to do a better job of validating the models at the field level.**
- **Continued work on model integration (economic and hydrology).**

Future Thrusts In WEBs

- **Long-term sites, add new components**
  - Fill watershed data gaps, add Innovative Studies component
- **Enhance linkages**
  - Environmental performance, on-farm economics, off-farm benefit, farm behavioral motivators
- **Scaling up findings**
  - Biophysical, economic, modelling conclusions
  - Expanded analysis & further integration

WEBs1 Modelling Reports

- **Lower Little Bow -** *Michel Rahbeh, Jim Miller and David Chanasyk*
- **Thomas Brook -** *Rob Jamieson, Michael MacEachern, Mark Greenwood, Graham Waugh*
- **Black Brook -** *Fan-Rui Meng and Qi Yang*
- **Bras d'Henri and Beaurivage -** *Alain N. Rousseau, Stéphane Savary, Sébastien Tremblay, Paul Thomassin, Laurie Baker, Sébastien Rivest, Bruno Larue, Pascal Ghazalian, Eric van Bochove*
- **Salmon River -** *John Zhu, Klaas Broersma, Cindy Meays and Asit Mazumder*
- **South Tobacco Creek (hydrology) -** *Wanhong Yang, Yongbo Liu, Jing Yang, Chunping Ou, Jim Yarotski, and Jane Elliott*
- **South Tobacco Creek (integrated modelling)** - *Wanhong Yang, Jing Yang, Yongbo Liu, Chunping Ou, Peter Boxall, Marian Weber, Jim Yarotski, and Mohammad Khakbazan*
- **South Nation** – *David Lapen*

Questions?

For additional information:

www.agr.gc.ca/webs

Agriculture and Agri-Food Canada | Agriculture et Agroalimentaire Canada