Athabasca River Basin: from Glacier to Delta

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Westlock, Alberta

Athabasca University

Objectives of Presentation

A. What is a river basin/watershed?
B. Overview of Water Planning and Advisory Councils
C. Why work with a river basin?
D. What is the Athabasca River Basin (ARB)?
E. What is known about the ARG?
F. Why the ARB is important?
G. Protection of the ARB
H. Concerns about the ARB
I. What you can do

A. What is a river basin/watershed?

An area of land where precipitation drains into a stream or lake:

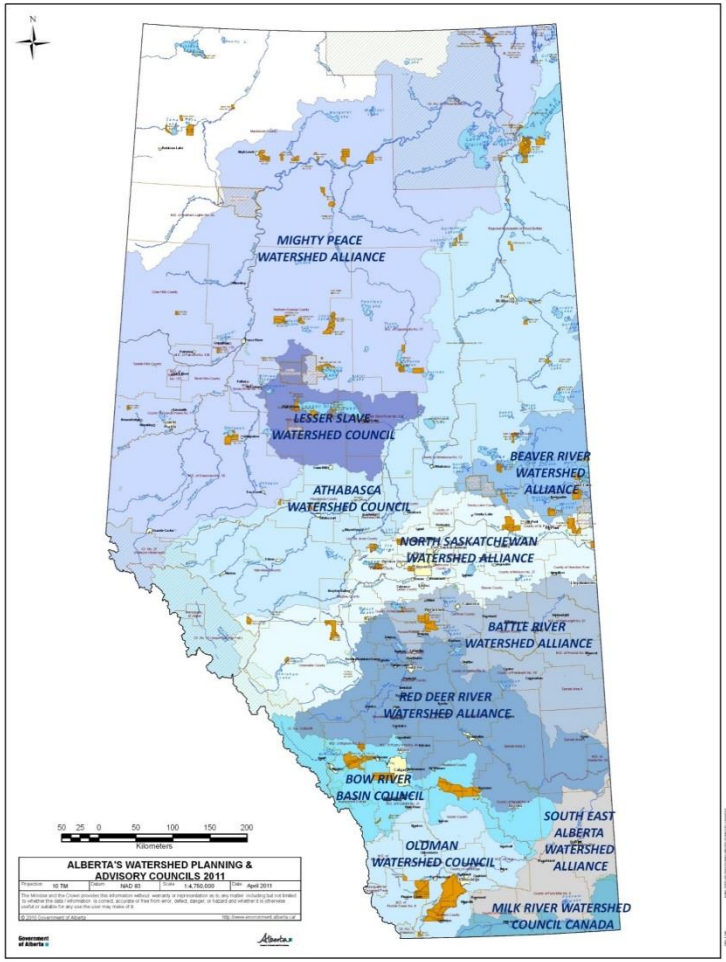
- Catchment area
- Drainage basin
- Watershed

Basin = Catchment Area = Watershed

B. Overview of Water Planning and Advisory Councils =(WPACs)

Alberta WPACs

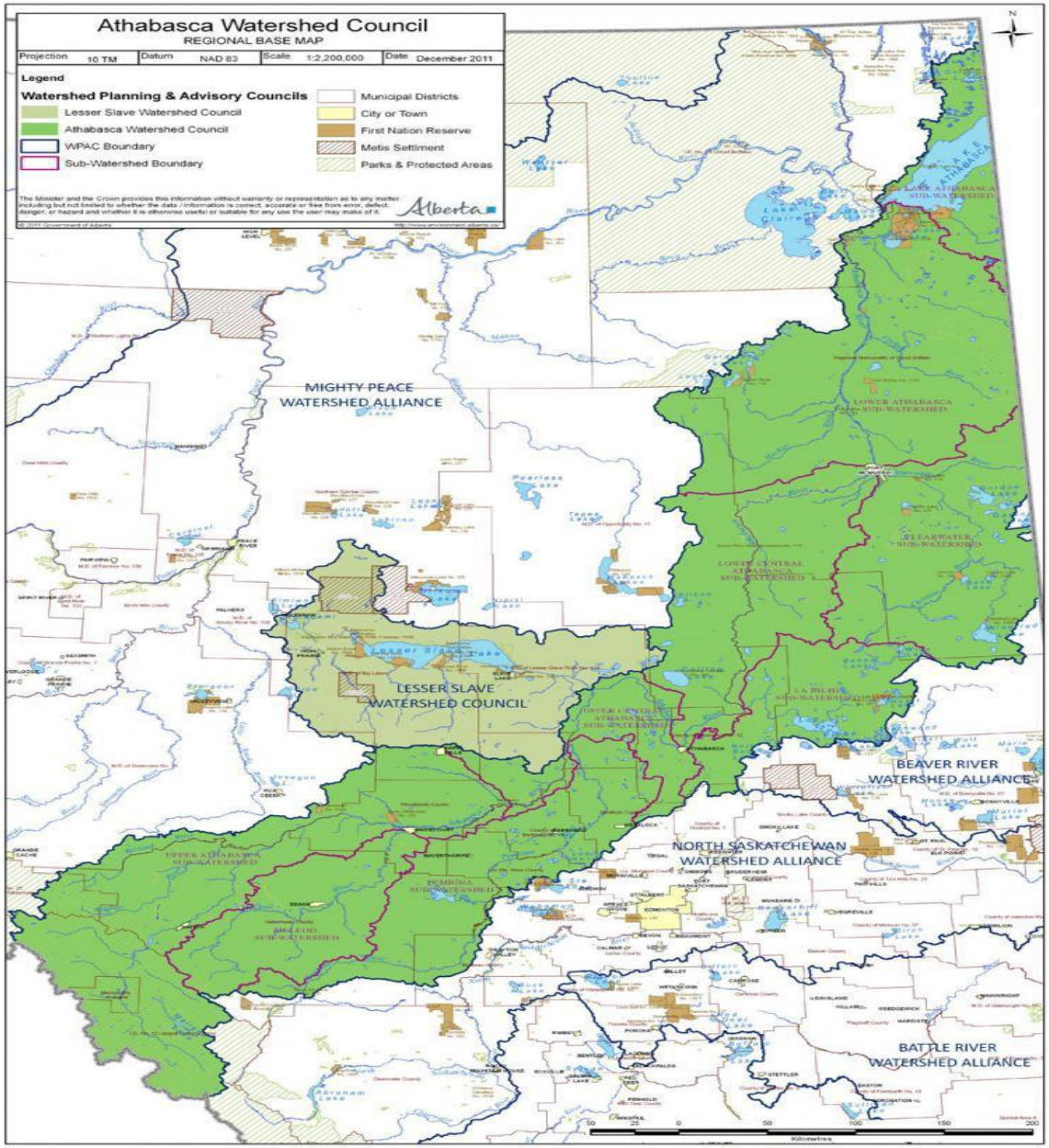
- 11 WPACs
- Created under the *Water for Life* strategy, WPACs:
  1. Engage the public and present educational programs on water-related issues
  2. Bring local water issues to the attention of the Province
  3. Report on the state of the watersheds
  4. Develop and implement integrated watershed management plans



Map source: Alberta Environment and Parks

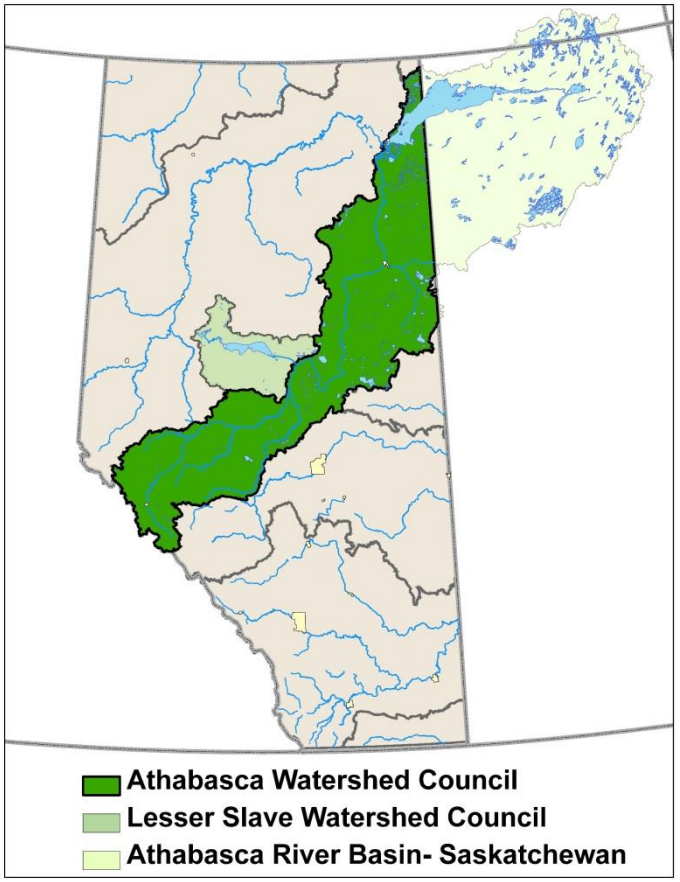
WPACs in the Athabasca River Area

- Lesser Slave Watershed Council
  - www.lswc.ca
- Athabasca Watershed Council
  - www.awc-wpac.ca



Athabasca Watershed Council (AWC-WPAC)

- Established 2009
- **Vision**The Athabasca watershed is ecologically healthy, socially responsible, and economically sustainable.
- **Mission:** The Athabasca Watershed Council demonstrates leadership and facilitates informed decision-making in the Athabasca watershed by bringing stakeholders and indigenous peoples together to promote, foster respect, and plan for an ecologically healthy watershed that supports social responsibility and economic sustainability.



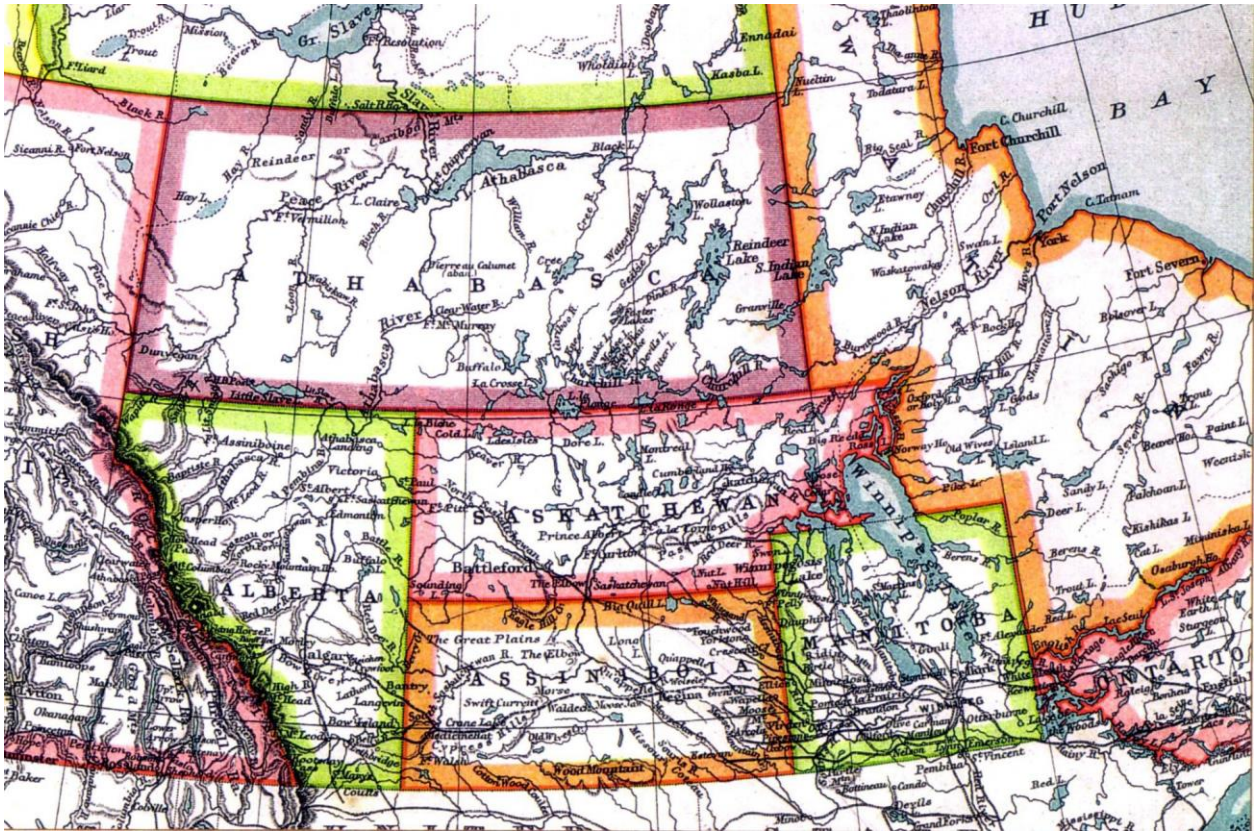
Map source: AWC-WPAC

Athabasca River Basin (ARB)

Map source: Science Outreach - Athabasca

C. Why work with a river basin?

1. **Stability of boundaries** versus changing political boundaries



Example 1: 1905, Western Canada

Stability: **Example 2:** Fort McMurray Boundaries

- 1870: Fort McMurray established by Hudson Bay Company
- 1947: Village of McMurray; merged with Waterways
- 1948: Town of McMurray
- 1962: Town of Fort McMurray
- 1980: City of Fort McMurray
- 1995: Regional Municipality of Wood Buffalo; merged with Improvement District 143

Data: Wikipedia, 30 Dec. 2009

Photo: Fort McMurray, 005, R.G. Holmberg

C. Why work with a River Basin?

2. **Integration and accumulation of impacts** on water, land and organisms.

3. **Implications for humans:**

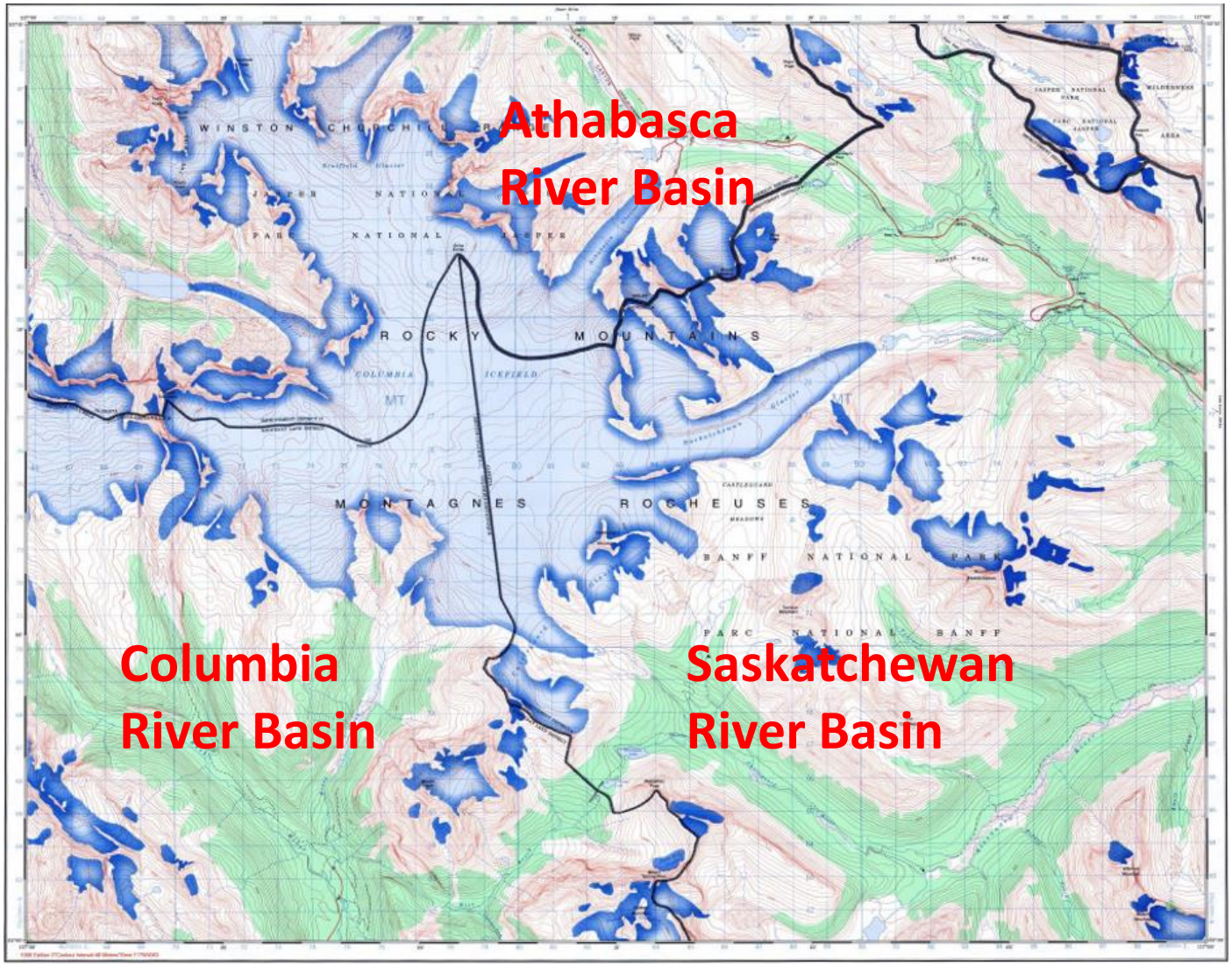
- Water, food, fibre, minerals and energy
- Health
- Ecological sustainability
- Economic sustainability

Photo: Athabasca River near Athabasca, 2007, R.G. Holmberg

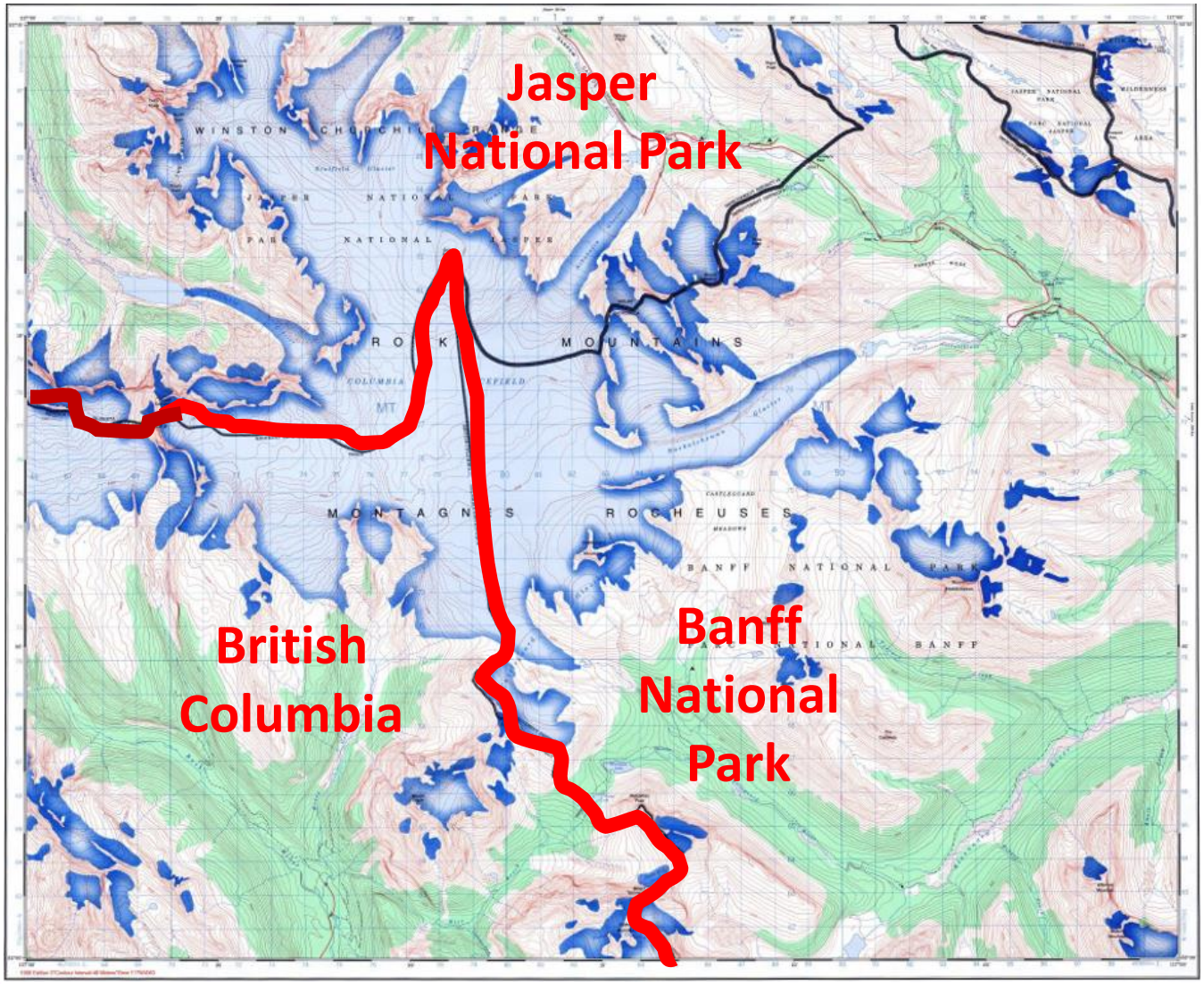
D. What is the Athabasca River Basin?

- 1,230 km long
- 159,000 km^2
  - 24% of Alberta
- >101 tributary rivers
- >307 named creeks
- >328 named lakes
- No major dams nor reservoirs on the main stem

Columbia Ice Fields: origin of three rivers:



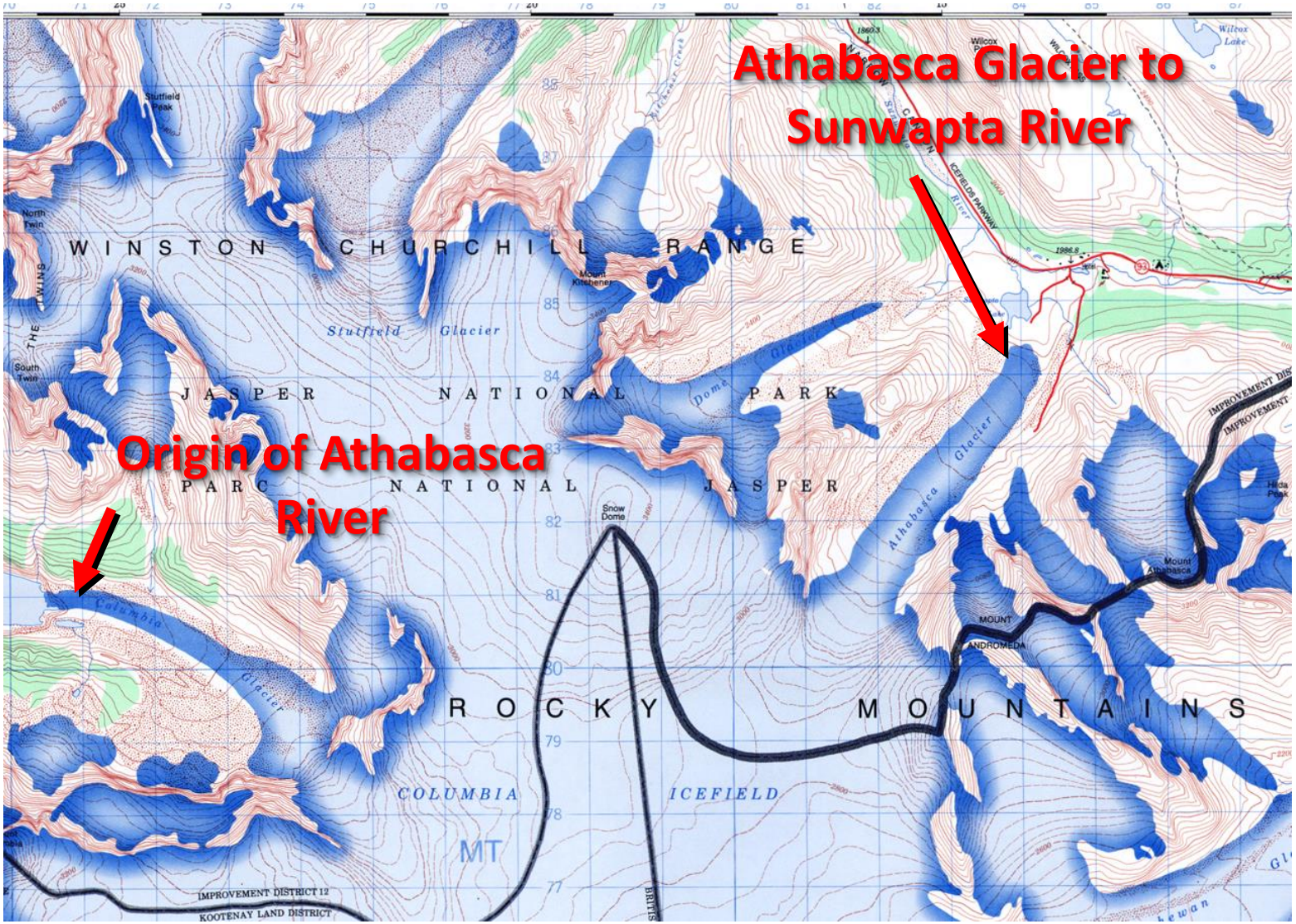
Some river basins are used as political boundaries…



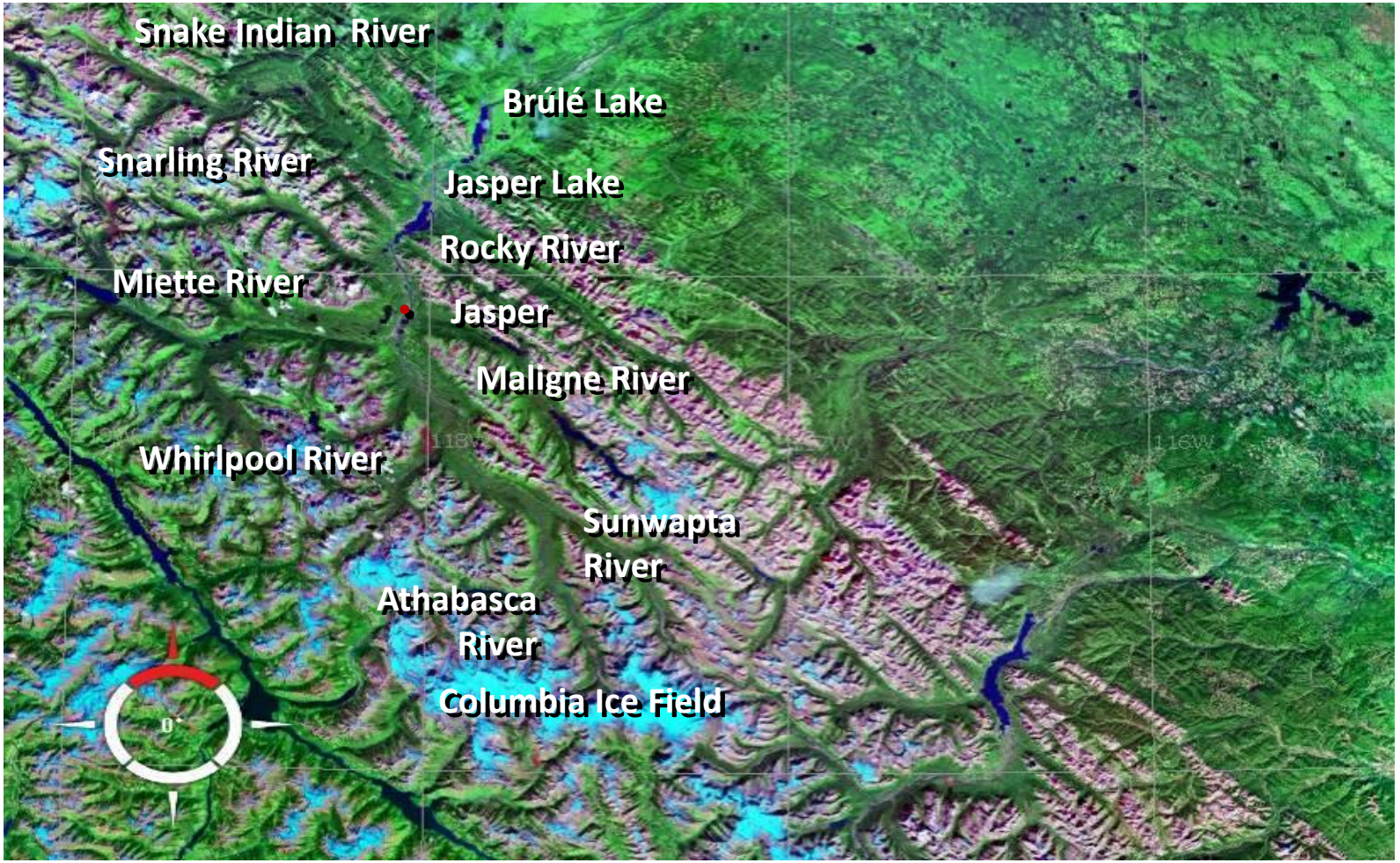
Athabasca Glacier, 2002

Photo: R.G. Holmberg

Origin of the Athabasca River



Upper Portion of the Athabasca River Basin with Major Tributaries and Lakes



Source: NASA, World Wind

Athabasca Falls, 2007

Photo: R.G. Holmberg,

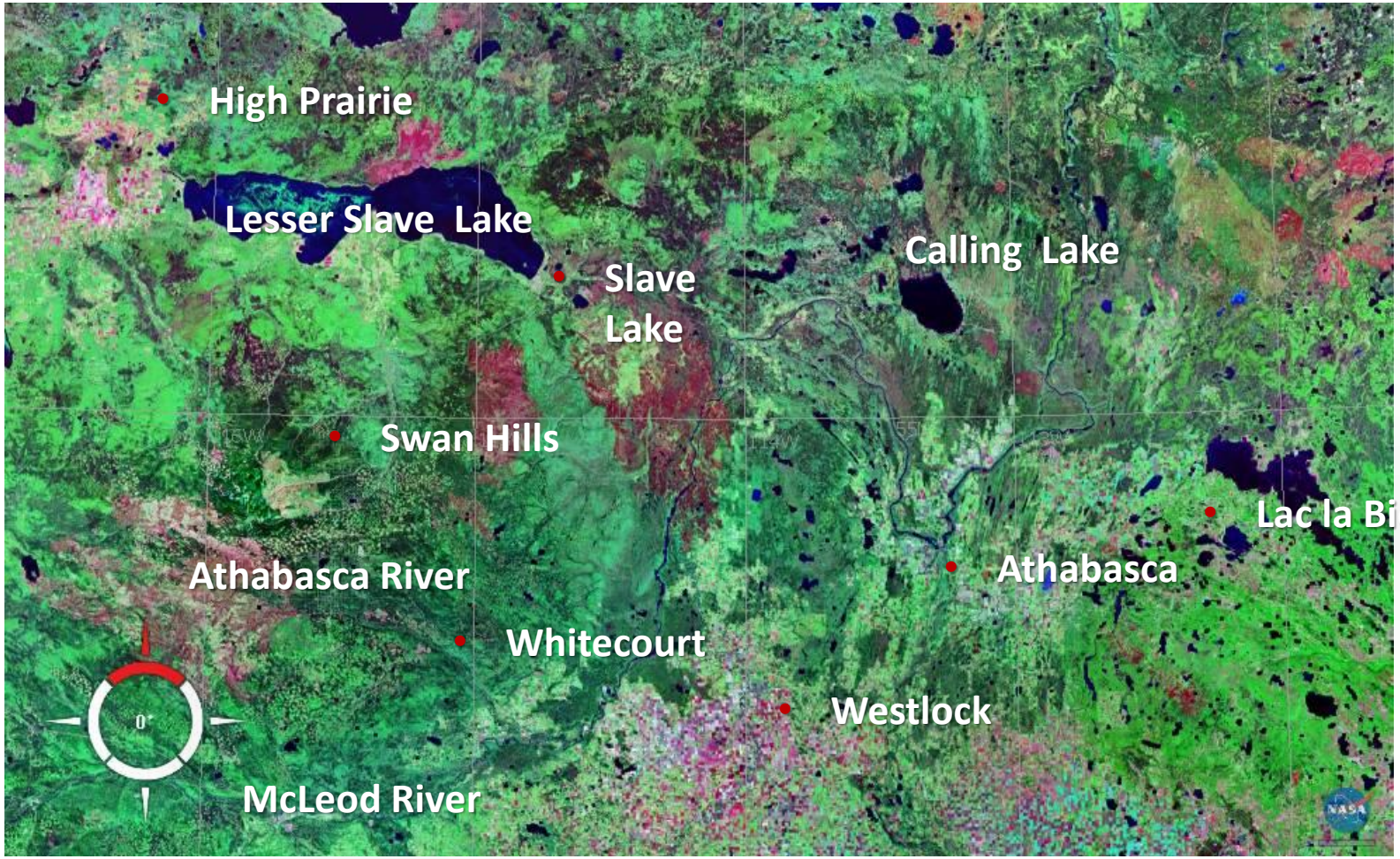
Athabasca River near Jasper, 2005

Photo: R.G. Holmberg,

Foothills Part of Athabasca River Basin

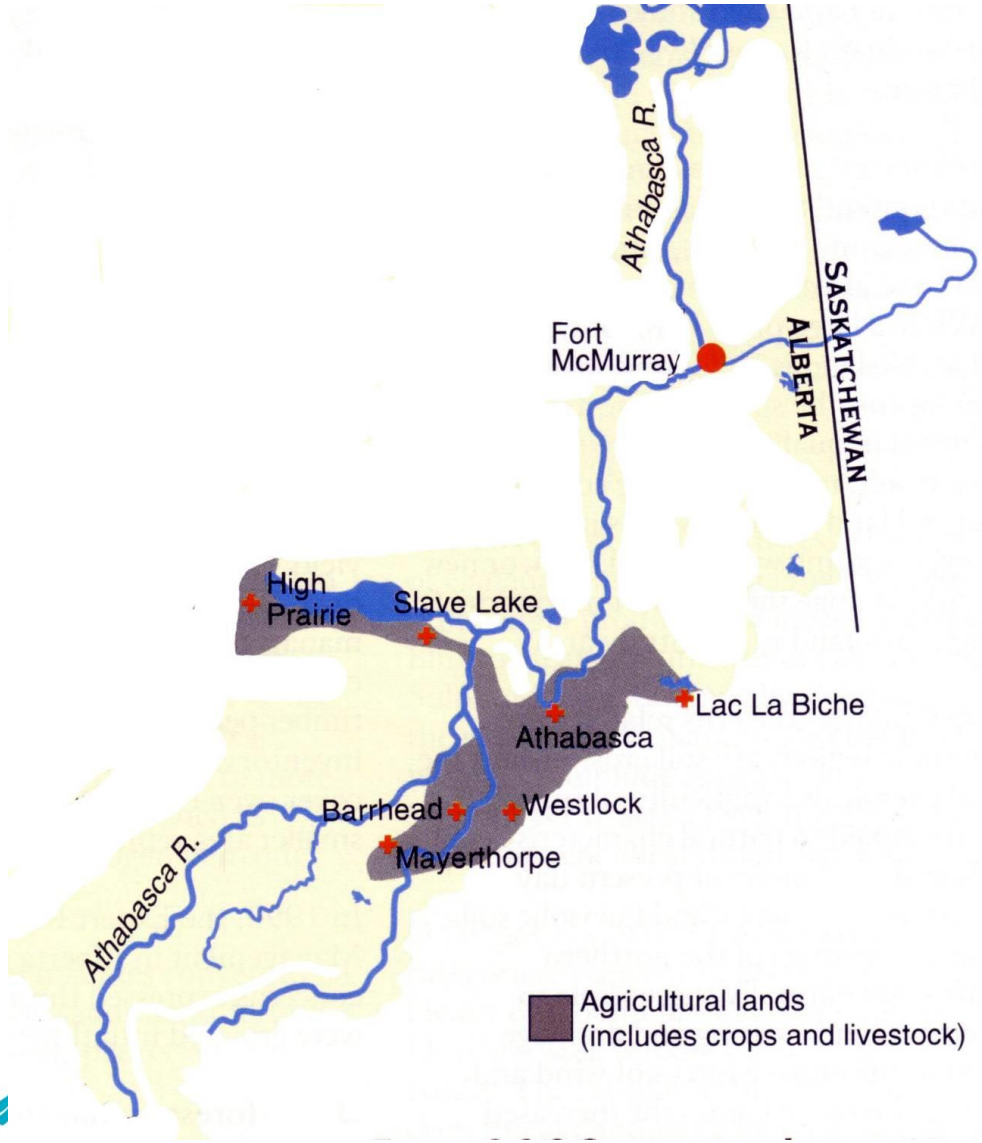
Source: Google Earth

Central Part of Athabasca River Basin



Source: NASA, World Wind

Agriculture in the Athabasca River Basin



Source: Northern River Basins Study, Report to the Ministers, 1996

Town of Athabasca from Athabasca River, 1991

Photo: R.G. Holmberg,

Athabasca River downstream from Athabasca, 1987

Photo: R.G. Holmberg,

Northward Stretch of Athabasca River Basin

Source: Google Earth

Portaging Grand Rapids (1.6 km) Athabasca River circa 1903-06

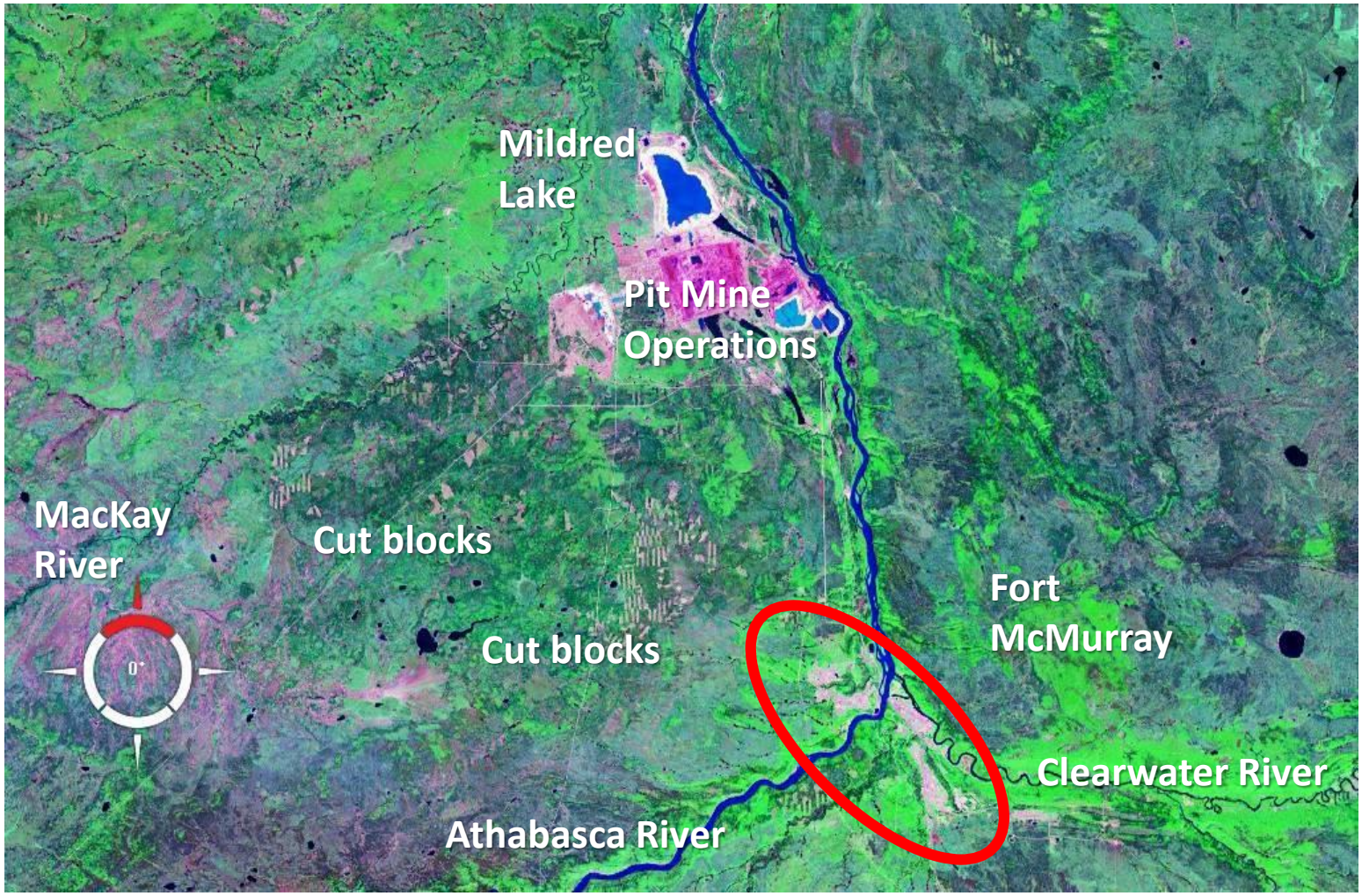
Big Cascade Rapids, Athabasca River, circa 1910

Photo: Canadian Department of the Interior, Library and Archives Canada PA-169585, http://www.collectionscanada.ca/archivianet/020115_e.html

Fort McMurray
Athabasca and Clearwater Rivers, 2005

Photo: R.G. Holmberg,

Fort McMurray Area

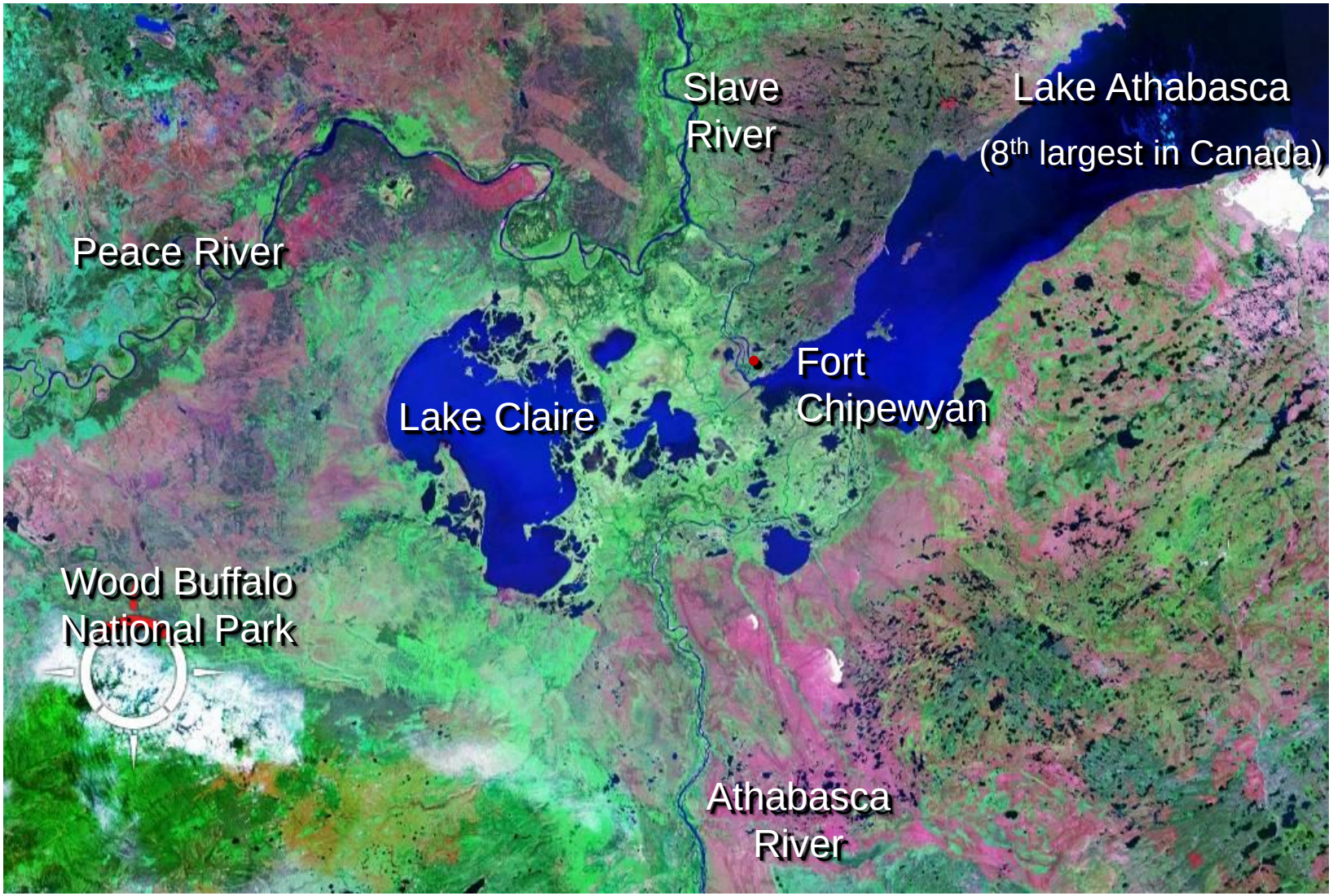


Source: NASA, World Wind

Athabasca River at Fort MacKay, 1996

Photo: R.G. Holmberg,

Peace-Athabasca Delta Area

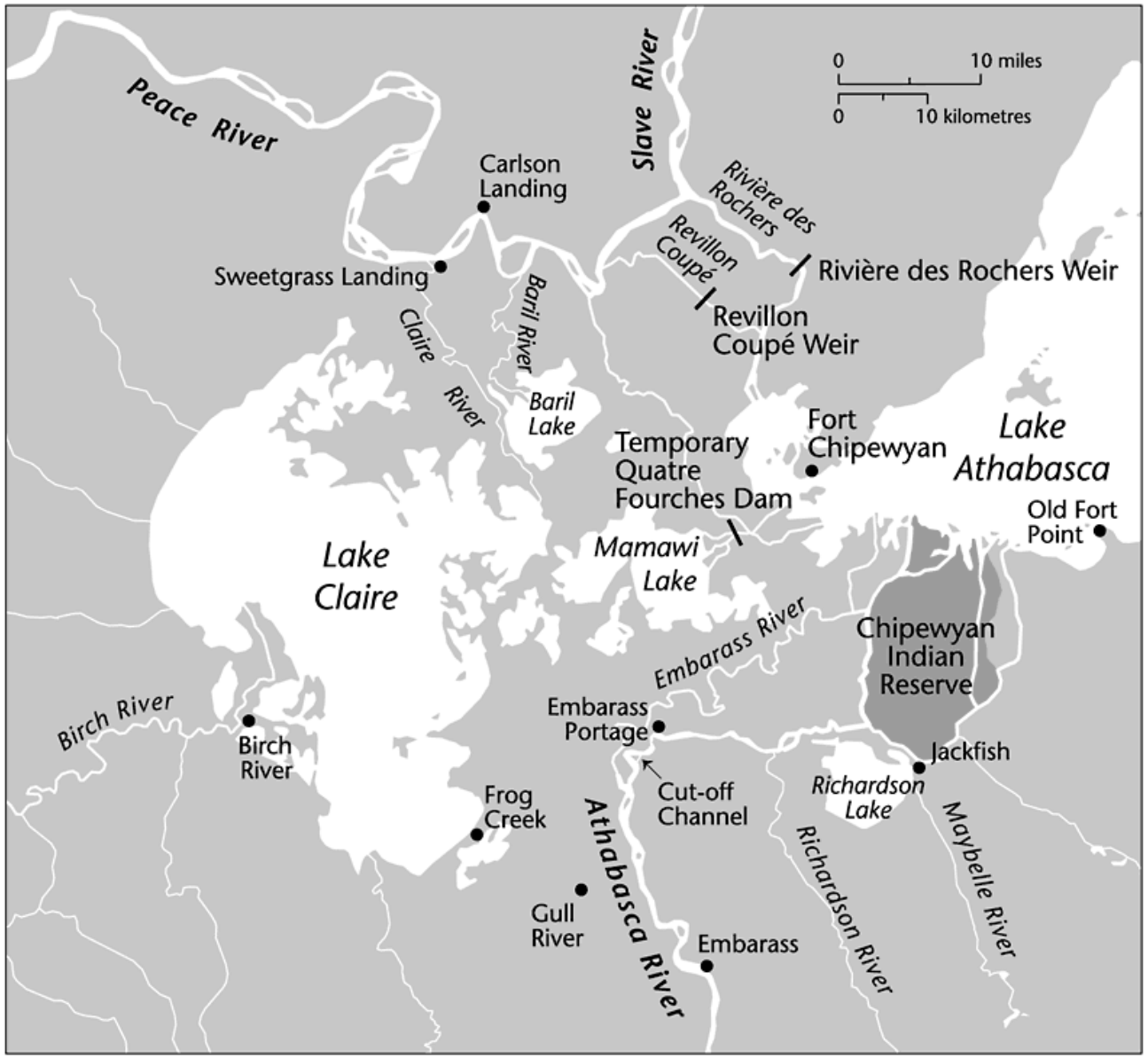


Source: NASA, World Wind

Sand Dunes near Athabasca River, 1998

Photo: R.G. Holmberg,

Peace-Athabasca Delta / Wetland



Source: Northern River Basins Study Final Report

Peace-Athabasca Delta / Wetland

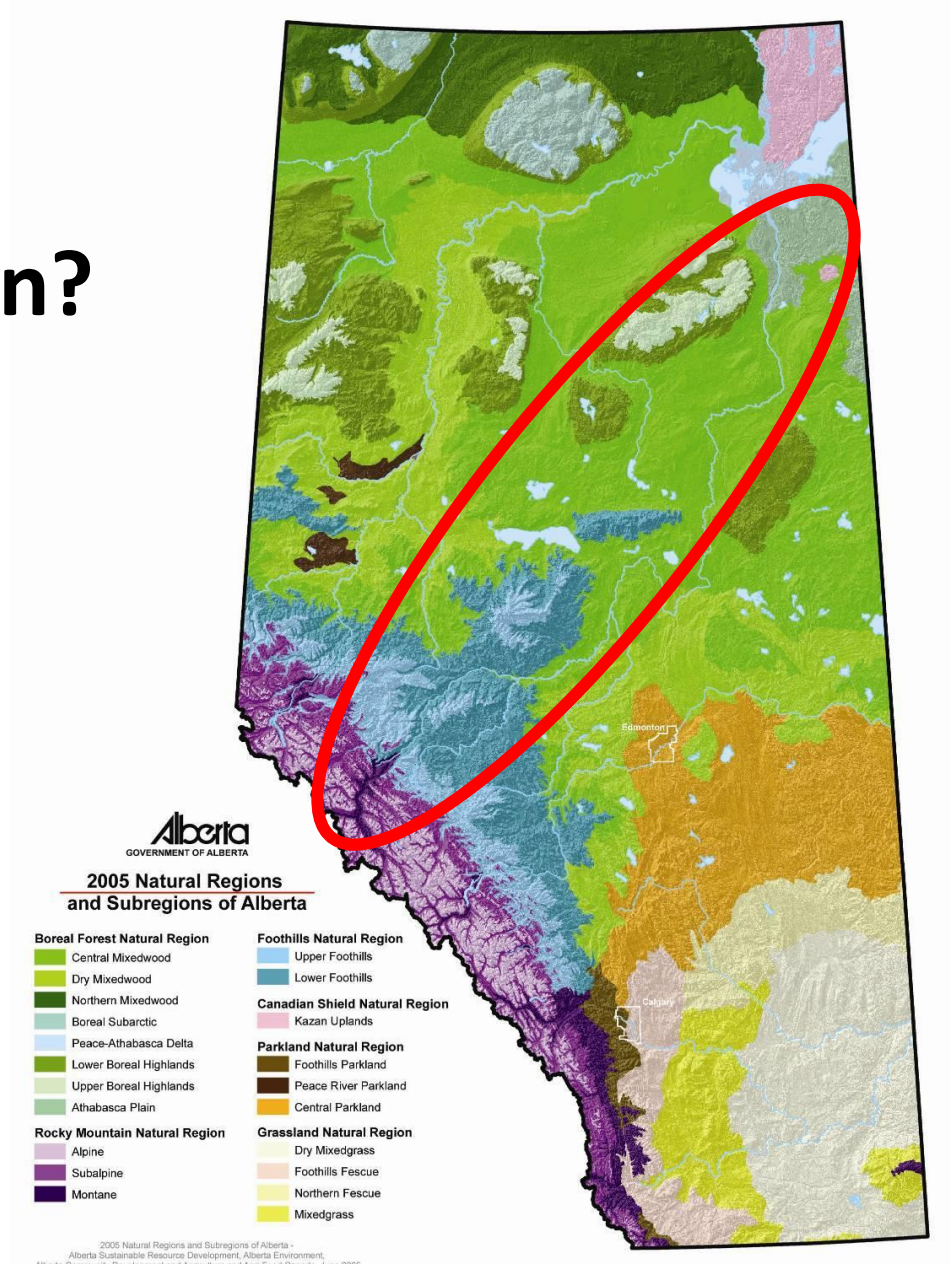
- 4,100km2
- Sensitive to water levels
- >1,000 lakes
- All 4 major North America bird flyways converge here

Photo: 1998, R.G. Holmberg

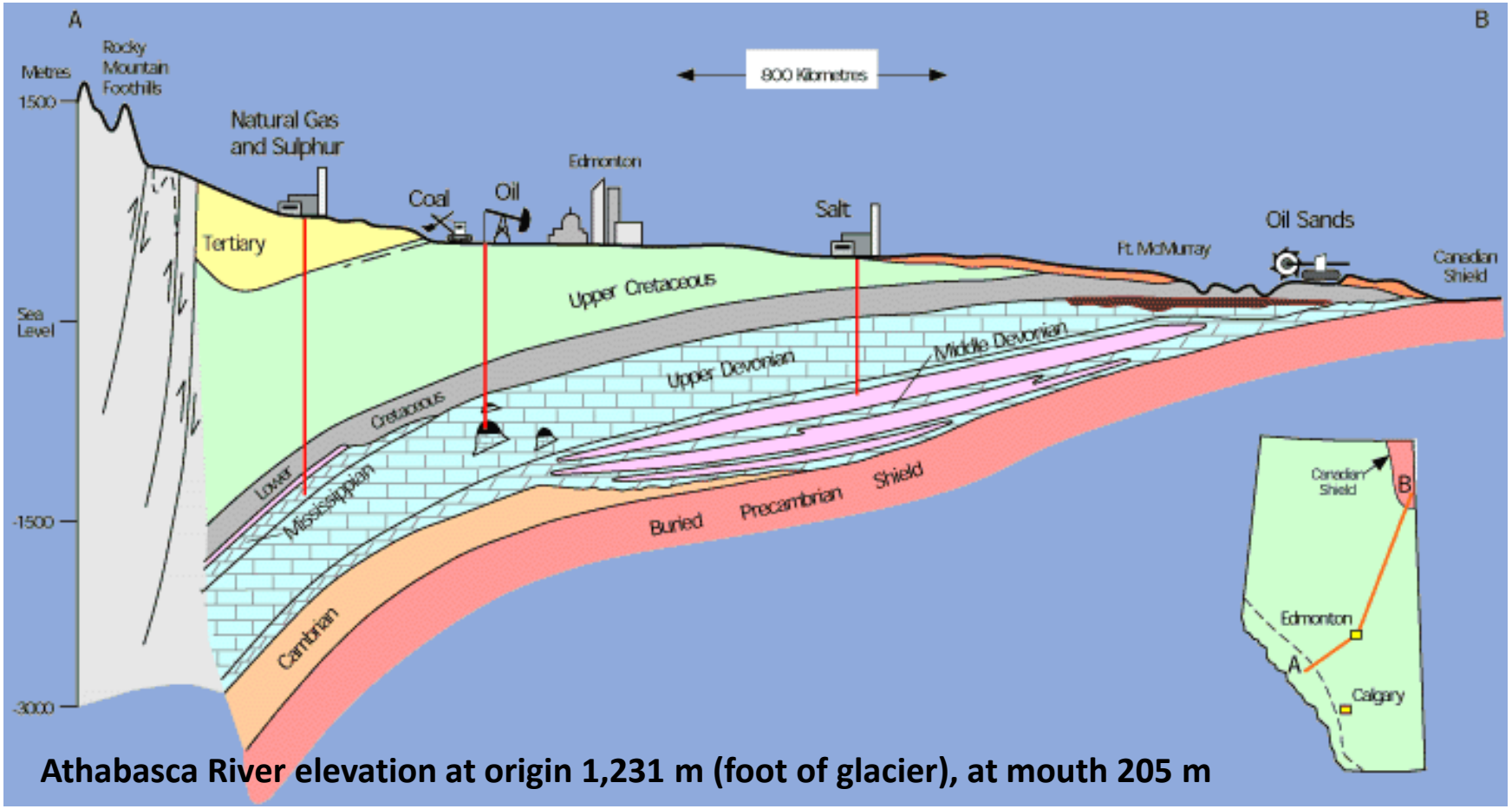
D. What is the Athabasca River Basin?

Ecology:

- 3 natural regions
- 11 sub-regions



Geology



Athabasca River elevation at origin 1,231 m (foot of glacier), at mouth 205 m

Source: www.abheritage.ca/abnature/geological/photos/... via Royal Alberta Museum; Mussieux, R. and M. Nelson. A Traveller's Guide to Geological Wonders in Alberta; artist Dan Magee

People

- ~160,000 people; 5% of Albertans
- 1 “city”
- 12 towns
- >75 villages and hamlets
- part of 22 Municipal Districts

Photo: Athabasca, 2003, R.G. Holmberg

Regional Municipality of Wood Buffalo

- 69,989 people
- 66,573 people in Fort McMurray

Data Source: Statistics Canada, 2016

Photo: Downtown Fort McMurray. 2004, R.G. Holmberg

Towns of the Athabasca River Basin

Data Source: Statistics Canada, 2016

Photo: Jasper, 2007, R.G. Holmberg

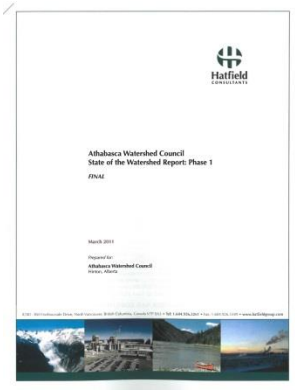
Town	Population
Whitecourt	10,204
Hinton	9,882
Edson	8,414
Slave Lake	6,651
Westlock	5,101
Barrhead	4,579
Jasper	3,948
Athabasca	2,965
High Prairie	2,564
“Lac la Biche“	2,314
Mayerthorpe	1,320
Swan Hills	1,301
Total	59,243

E. What is known about the Athabasca River Basin?

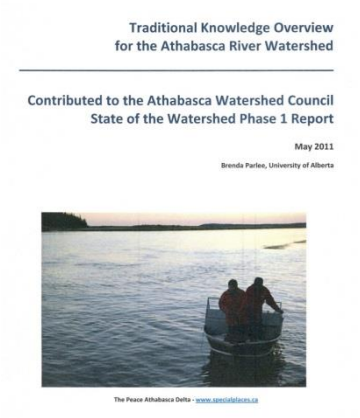
1. Major Research Studies – completed

- Agriculture Canada - black flies, methoxychlor, 1960s
- Alberta Oil Sands Environmental Research Program (AOSERP) - Syncrude EIA. 1970s
- Environmental Impact Assessments (EIAs) for AlPac and other pulp mills, 1990s
- Northern Rivers Basins Study, 1996
- Environment Canada: Northern Rivers Ecosystems Initiative, 1996-2003
- Cumulative Environmental Management Association (CEMA) recommendations about oil sands, 2016
- State of the Watershed Reports, AWC-WPAC, 2011- 2015
- Alberta Water SMART's Athabasca River Basin Initiative (ARBI) – sustainable water management, 2004-2018

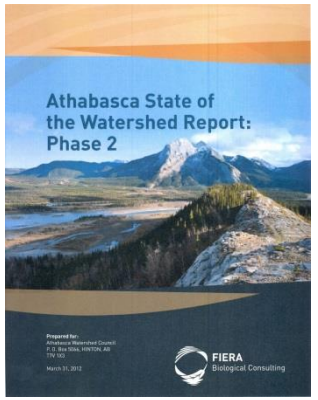
State of the Watershed Reports by the AWC-WPAC



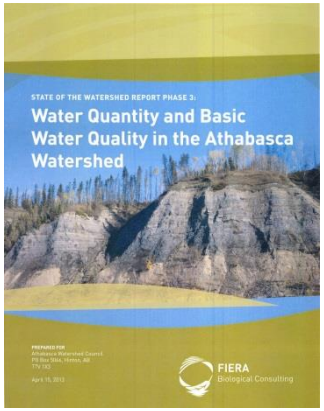
SOW 1, 2011, 124 pages



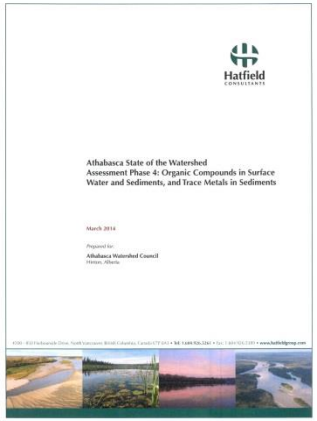
Traditional Knowledge, 2011, 80 pages



SOW 2, 2012, 113 pages



SOW 3, 2013, 802 pages



SOW 4, 2015, 212 pages

2.a.Major Research Studies – on going (oil sands)

- Reginal Aquatic Monitoring Program (RAMP)- monitors water in oil sands area, 1997-
- Canadian Oil Sands Network for Research and Development (CONRAD) - oils sands industries, government & universities, 1997-
- Wood Buffalo Environmental Association (WBEA) - monitors air in oil sands area, 1997-

2b. Major Research Studies – on going (mainly ecological)

- Foothills Research Institute, Hinton (formerly Foothills Model Forest), 1992-
- Ecological Monitoring and Assessment Network (EMAN), Environment Canada - ecological monitoring, 1994-
- Ecosystem Management Emulating Natural Disturbance (EMEND -- logging and fire, 1997-
- Alberta Biodiversity Monitoring Institute (AMBI), 2007-
- Athabasca River Basin Research Institute (ARBRI), 2008-

How can you access this research information?

- State of the Watershed reports by Athabasca Watershed Council (AWC-WPAC)
  - www.awc-wpac.ca
- Repository for the Athabasca River Basin (ARBRI)
  - www.barb.au
  - 30,000 references
  - URL links to some references
  - Some scanned documents available free
- Other university libraries, especially University of Alberta

F. Why is the Athabasca River Basin important?

1. Human survival
2. Resources: renewal and non-renewable
3. Ecological problems
4. Political issues
5. Intellectual interests

1. Human Survival

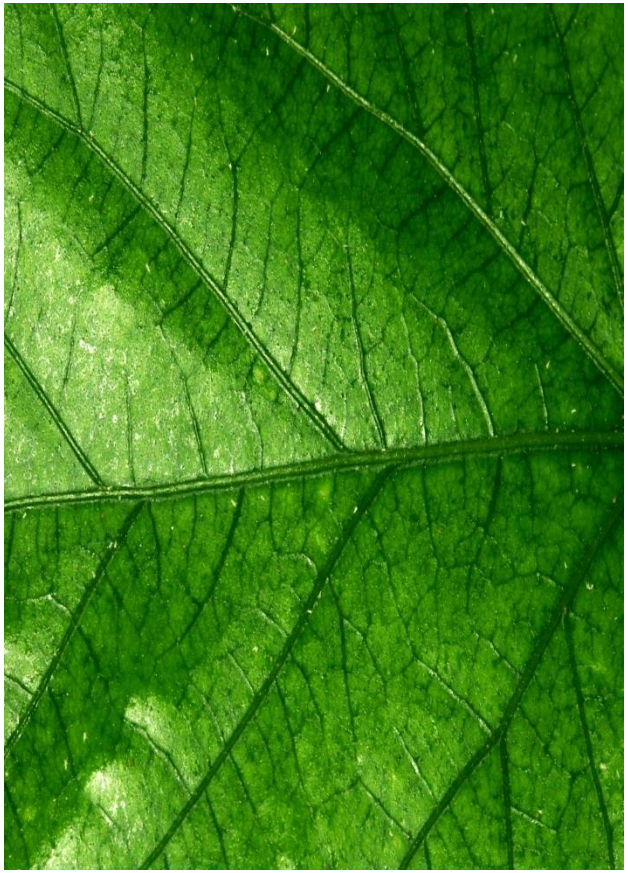


Photo: R.G. Holmberg

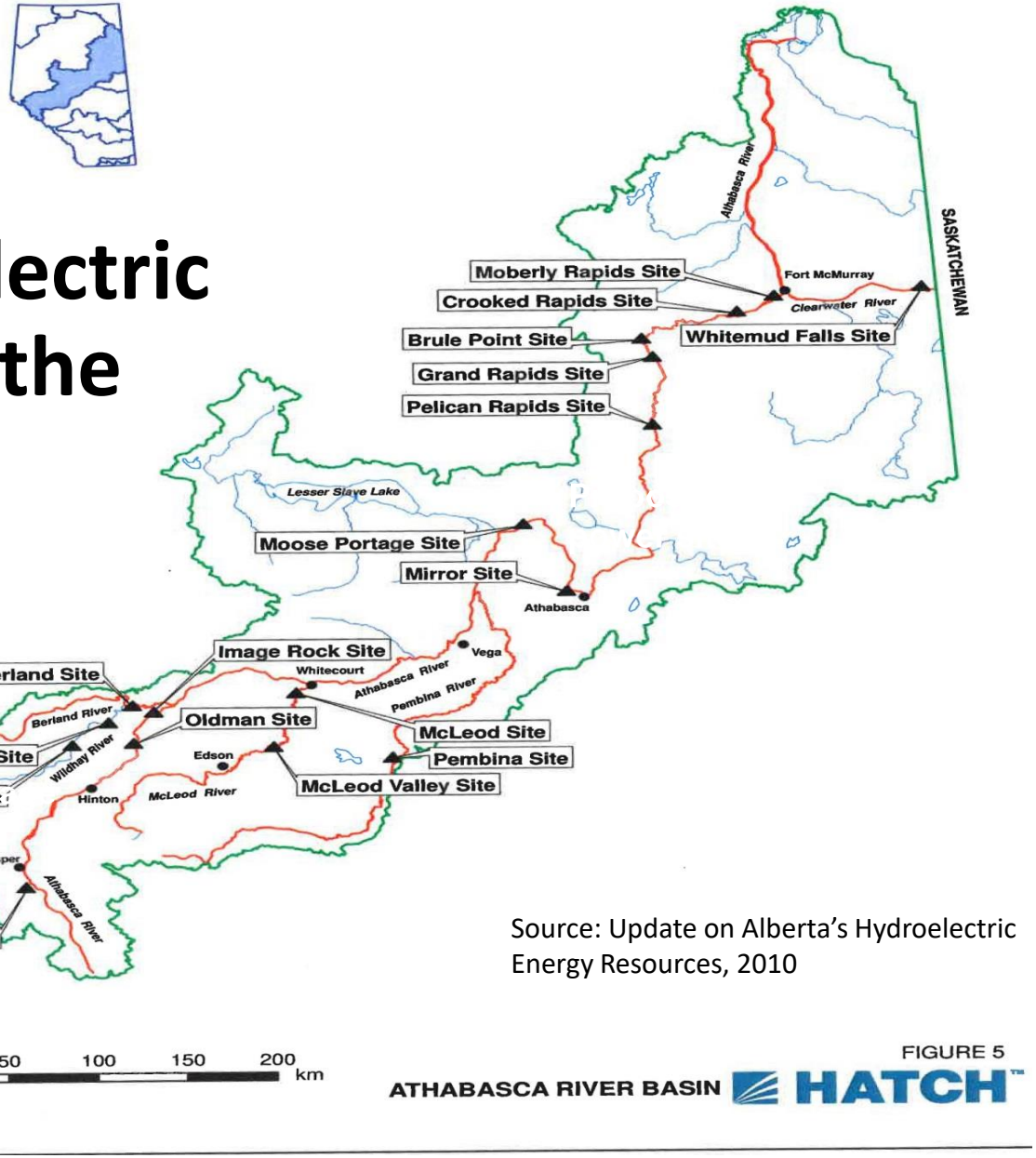
- Oxygen via photosynthesis
- Water for drinking, household use, industry
- Food –agriculture, wild
- Fiber – forestry, agriculture , wild

2a. Renewable Resources

Photo: R.G. Holmberg

- Air, water and soil as “free” raw materials for agriculture, forestry and other industries
- Air and water for waste “treatment” (= dilution)
- Hydroelectricity

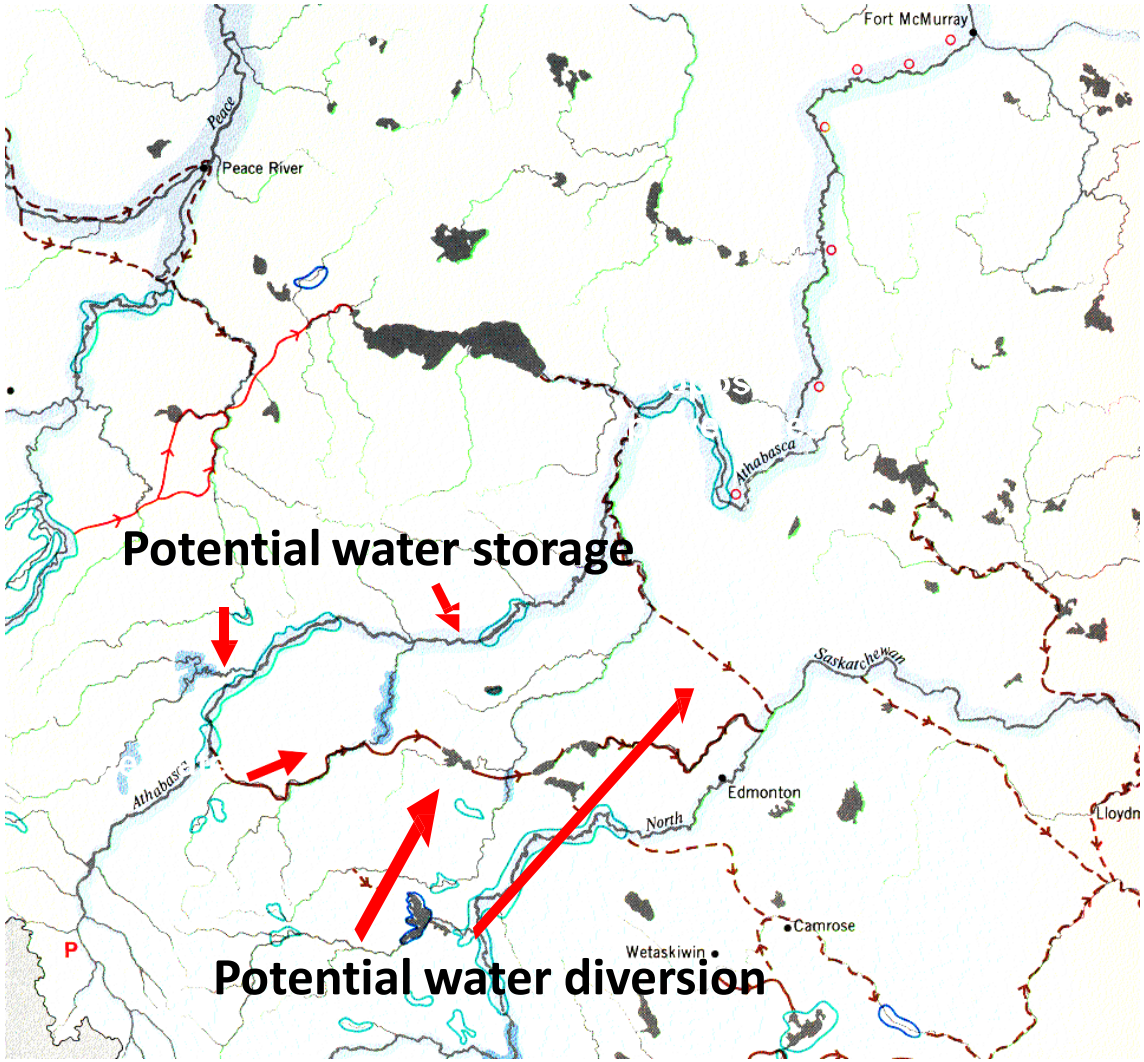
Potential hydroelectric development on the Athabasca River



Source: Update on Alberta's Hydroelectric Energy Resources, 2010

Other Potential Water Use

- Storage for industry
- Inter-basin transfer to export water to the south



Source: Atlas of Alberta 1969, p. 25

2a. Renewable Resources: Wood

- Lumber and plywood
- >12 mills in ARB

Photo: Sundance Forest Products, near Edson, 2007, R.G. Holmberg

2a. Renewable Resources: pulp

- Hinton, Weldwood of Canada, 1957
- Whitecourt, Millar Western Pulp, 1988
- Whitecourt, Alberta Newsprint Co., 1990
- Slave Lake, Slave Lake Pulp, 1991
- Athabasca, Alberta-Pacific Forest Industries, 1992

Photo: Alberta-Pacific Forest Industries, near Athabasca, 2007, R.G. Holmberg

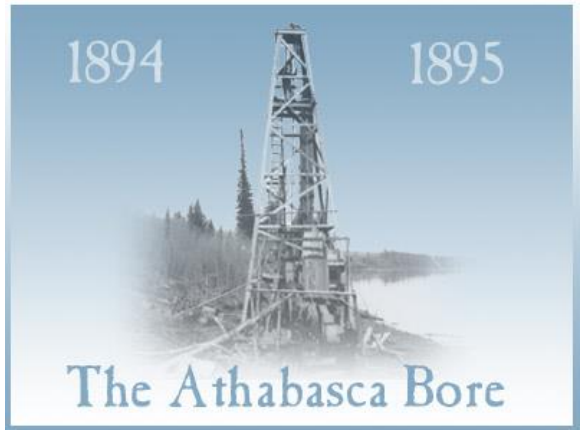
2a. Renewable Resources: wild life

- Large mammals and fish for food
- Hunting and fishing guides
- Tourism

Photo: R.G. Holmberg

2b. Non-renewable Resources: conventional oil and gas

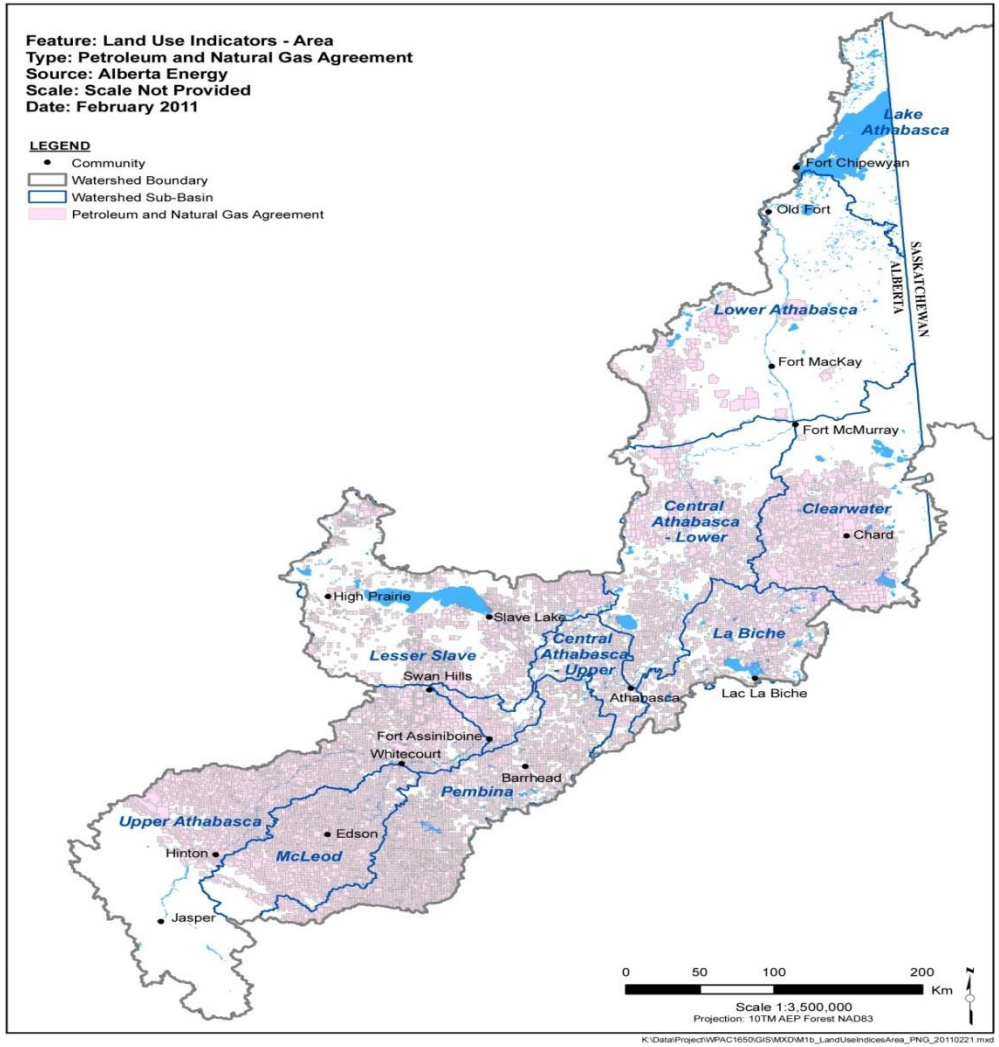
- First oil well sin Alberta on the Athabasca River



Source: Geological Survey of Canada, 1898

2b. Non-renewable Resources: conventional oil and gas

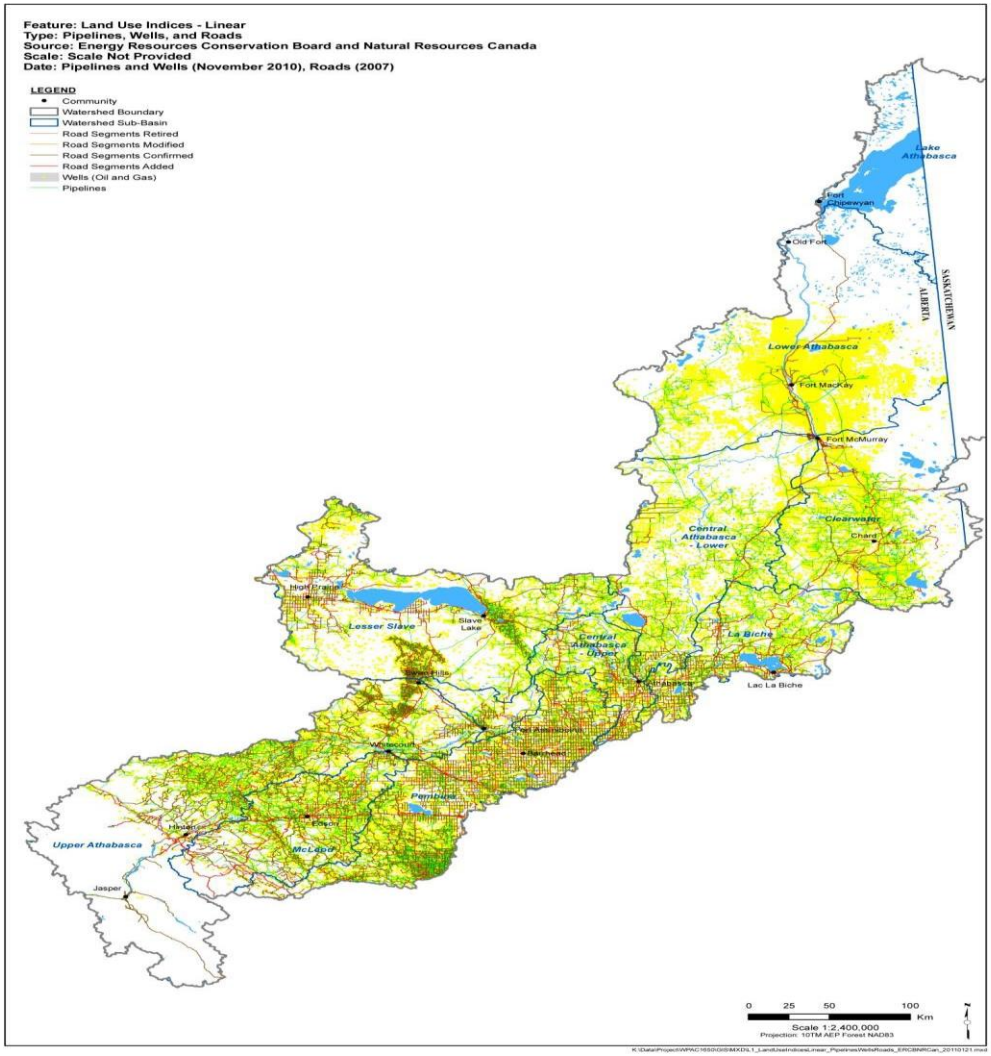
- Conventional oil and natural gas agreements and leases with in the ARB, 2011



Source: Athabasca Watershed Council, State of the Watershed Report, Phase 1, Appendix A2: Maps from the Preliminary Atlas, 2011

2b. Non-renewable Resources: conventional oil and gas

- Pipelines, Oil Wells, and Roads in the Athabasca River Basin, 2007/2010



Source: Athabasca Watershed Council, State of the Watershed Report, Phase 1, Appendix A2: Maps from the Preliminary Atlas, 2011

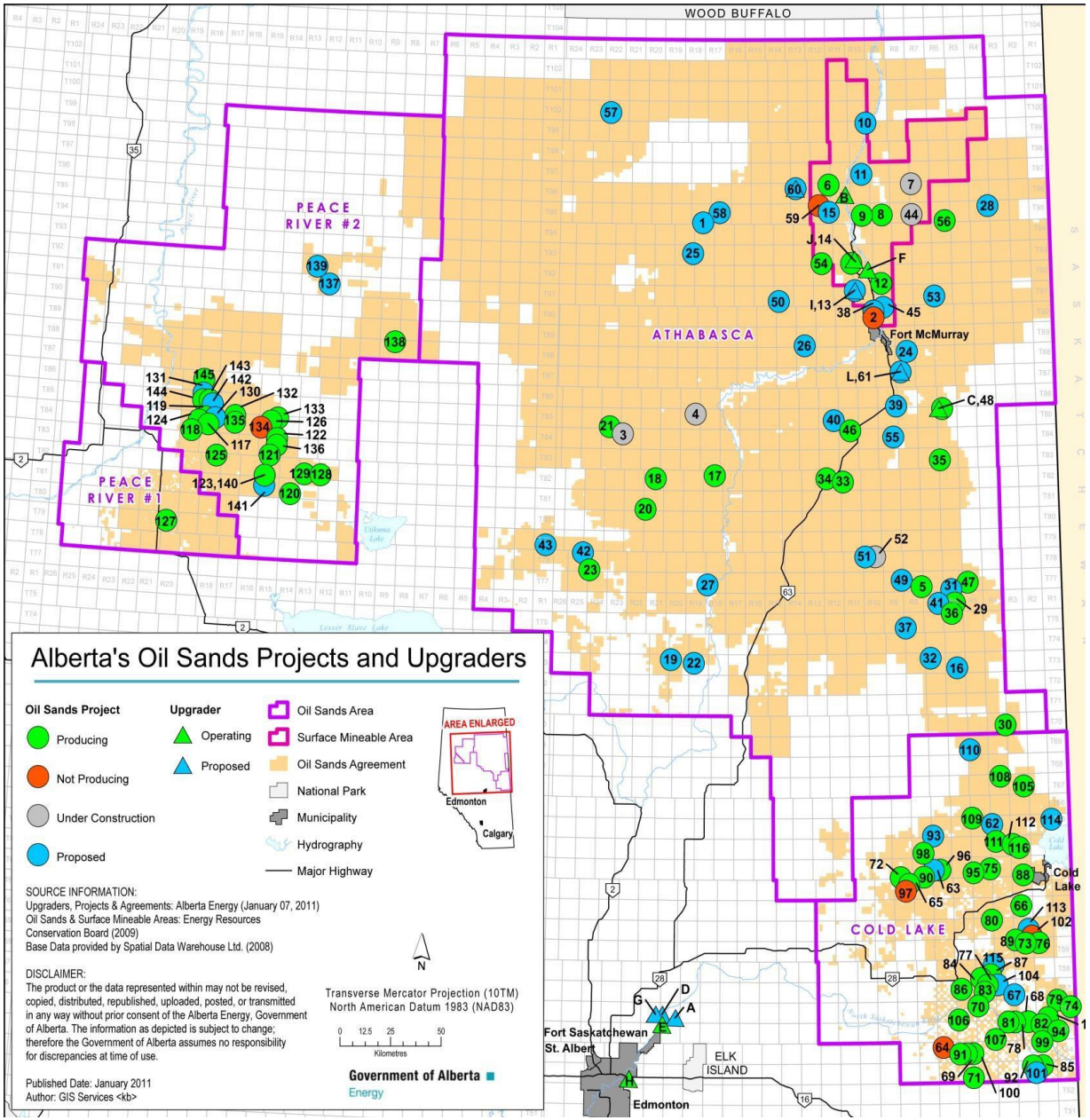
2b. Non-renewable Resources: oil sands

Source: Geological Survey of Canada, 1892

Oil Sands in Alberta

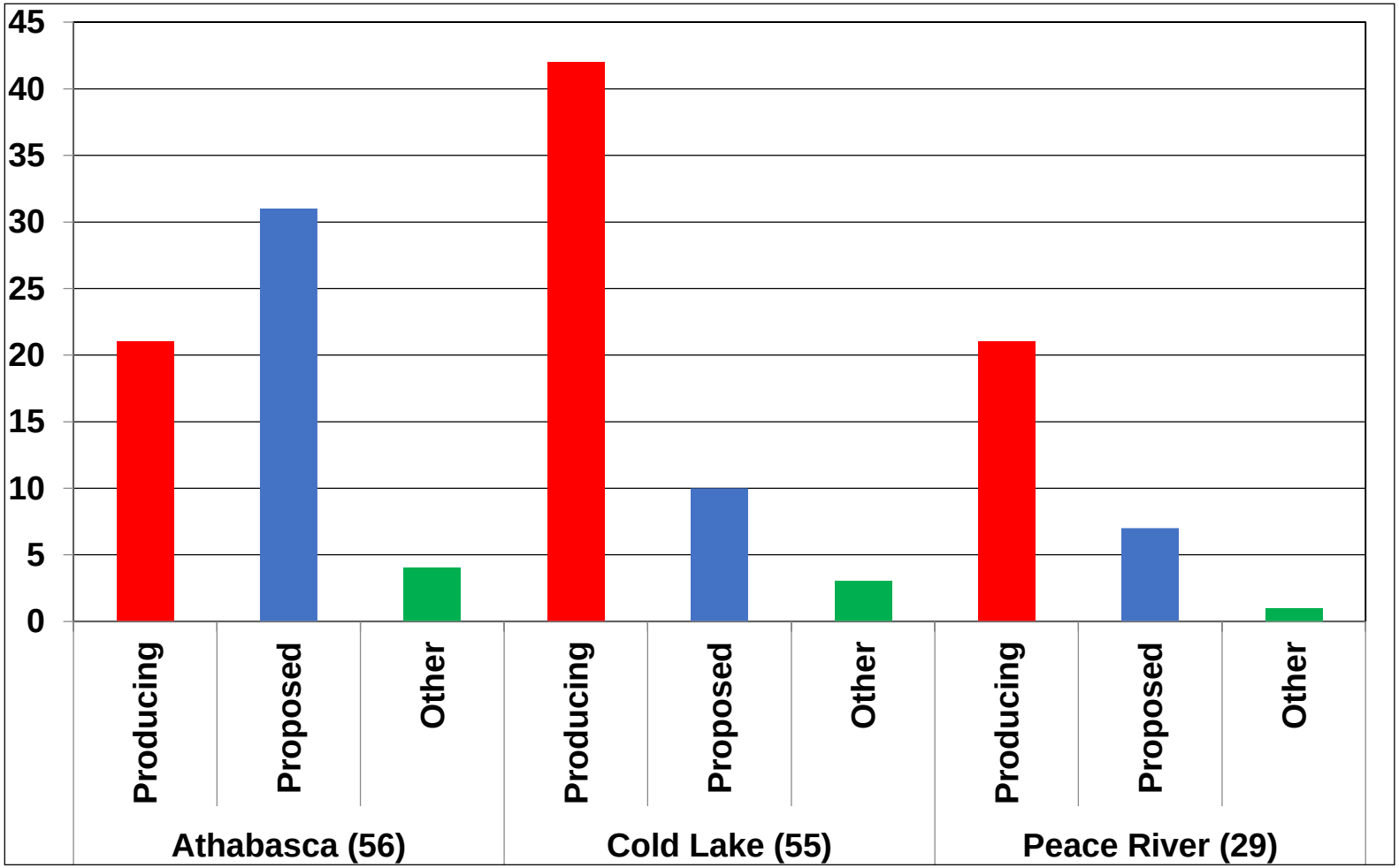
Source: Government of Alberta

Oil Sands in Alberta



Source: Government of Alberta, 2011

Oil sands “Mines” in Alberta, 2011



Source; Alberta Energy, January 2011

Oil Sands Surface / Pit Mining

Photo: Fort McMurray area, 2004, R.G. Holmberg

Oil Sands Surface / Pit Mining

- Pit mining restricted to bitumen less than 70 m deep

Photo: Fort McMurray area, 2004, R.G. Holmberg

Oil Sands Tailings Ponds

- Volume = 720 million m^3
- Area = 130 km^2

Data Source: ercb.ca/portal/server.pt/gateway/PTARGS_0_0_303_263_43/, October 2010.

Photo: Suncor plant, 1998, R.G. Holmberg

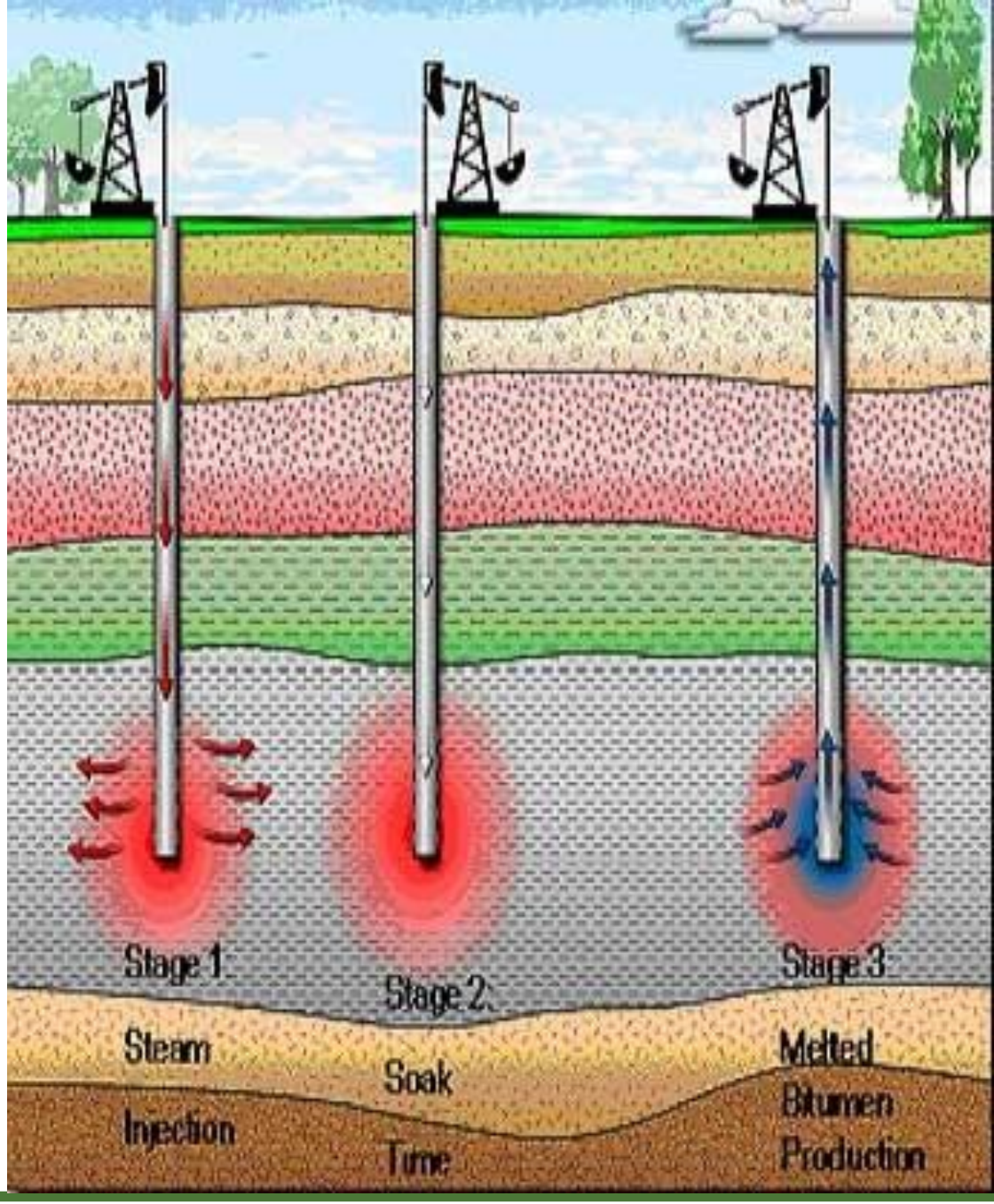
In situ Oil "Mines"

- 15% land disturbance but much fragmentation
- Uses lots of natural gas (13% of Canadian total in 2007, 60% by 2030?)
- Uses considerable amounts of water

Near Fort McMurray, 2005, R.G. Holmberg

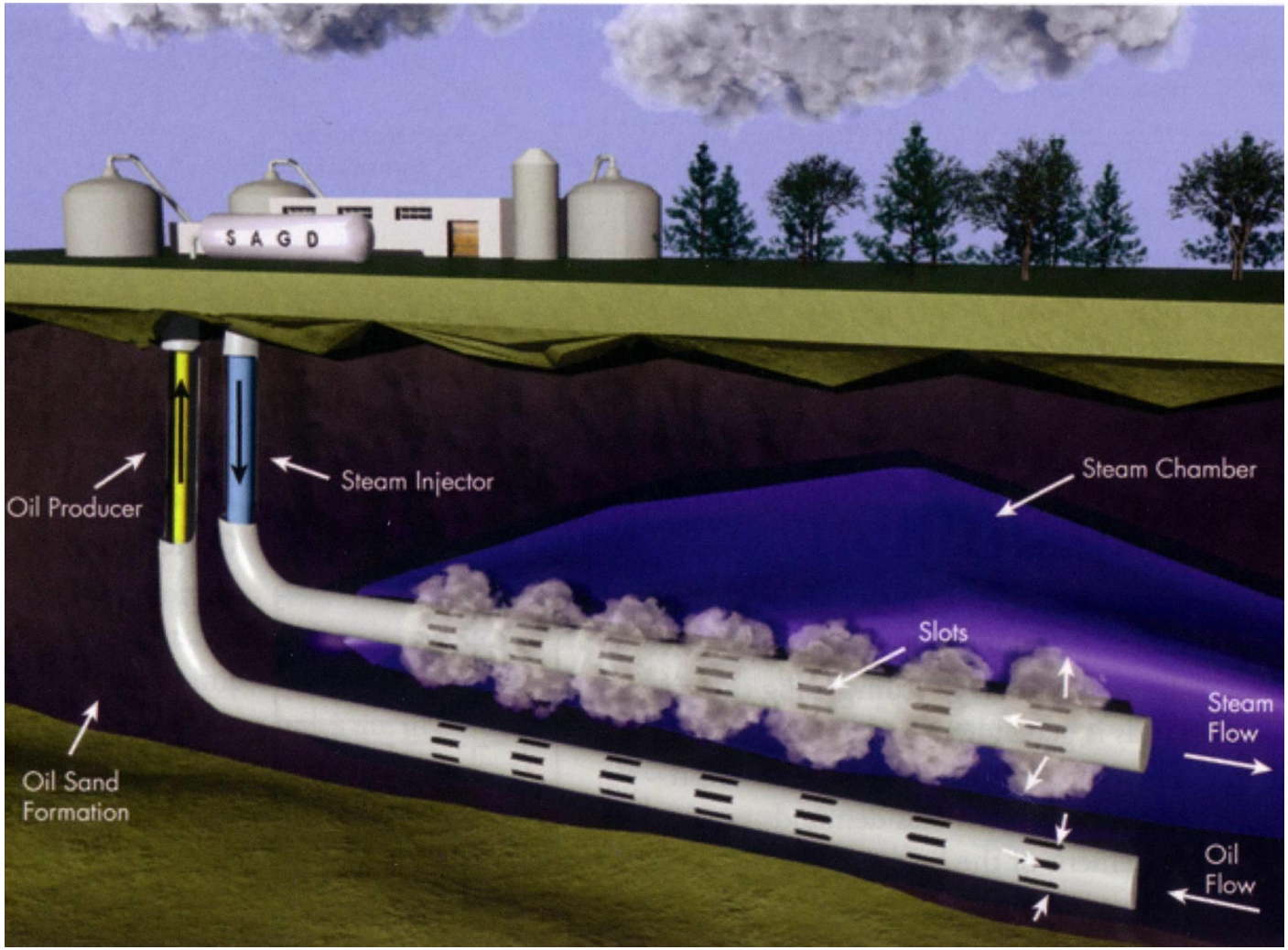
In situ Mining: Cyclic Steam Stimulation (CSS) = Primary

- 6-8 month cycles



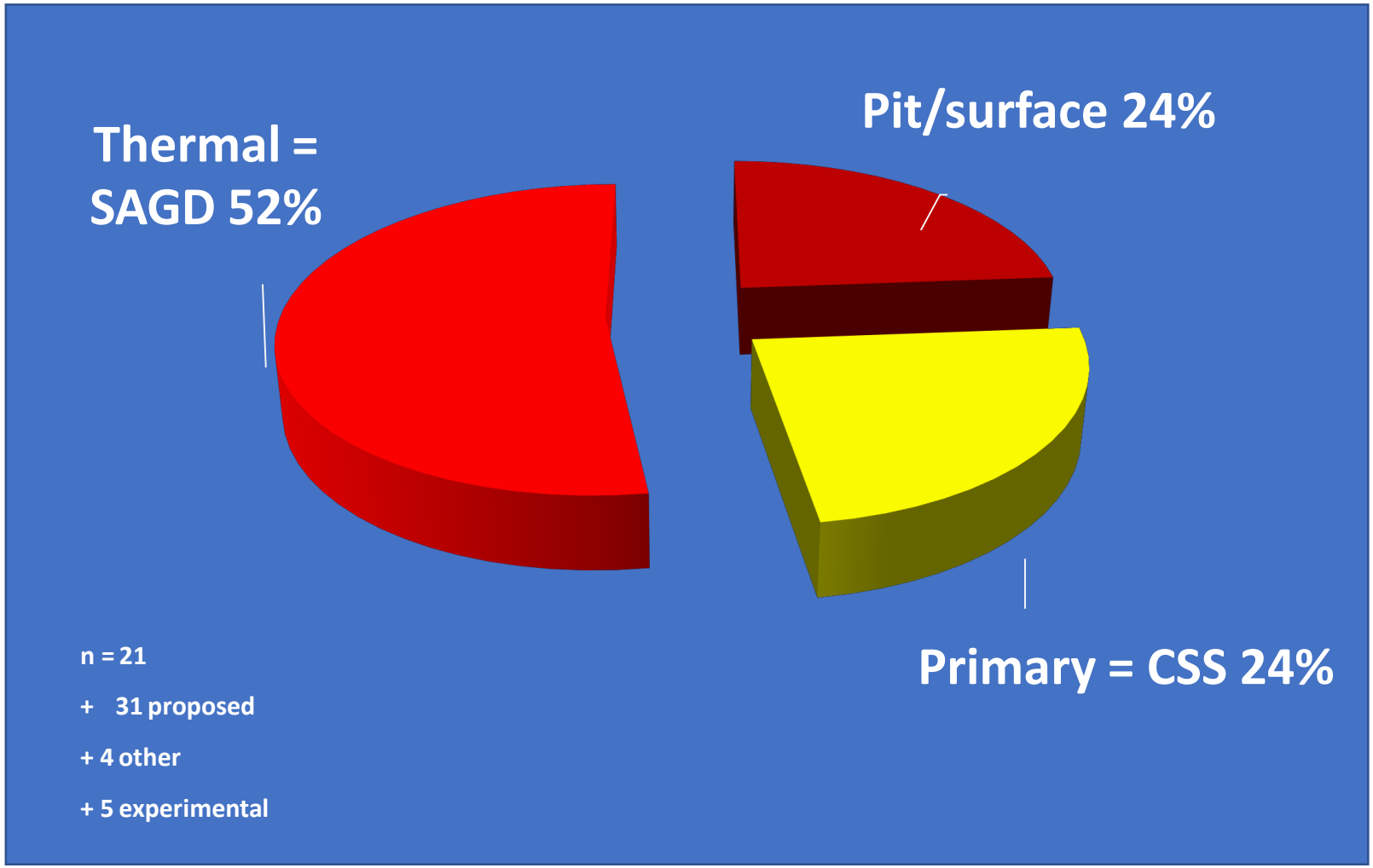
Source:www.alistairsweeny.com/blackbonanza/in dex.php/Roger_Butler

In Situ Mining:
Steam Assisted Gravity Drainage (SAGD)



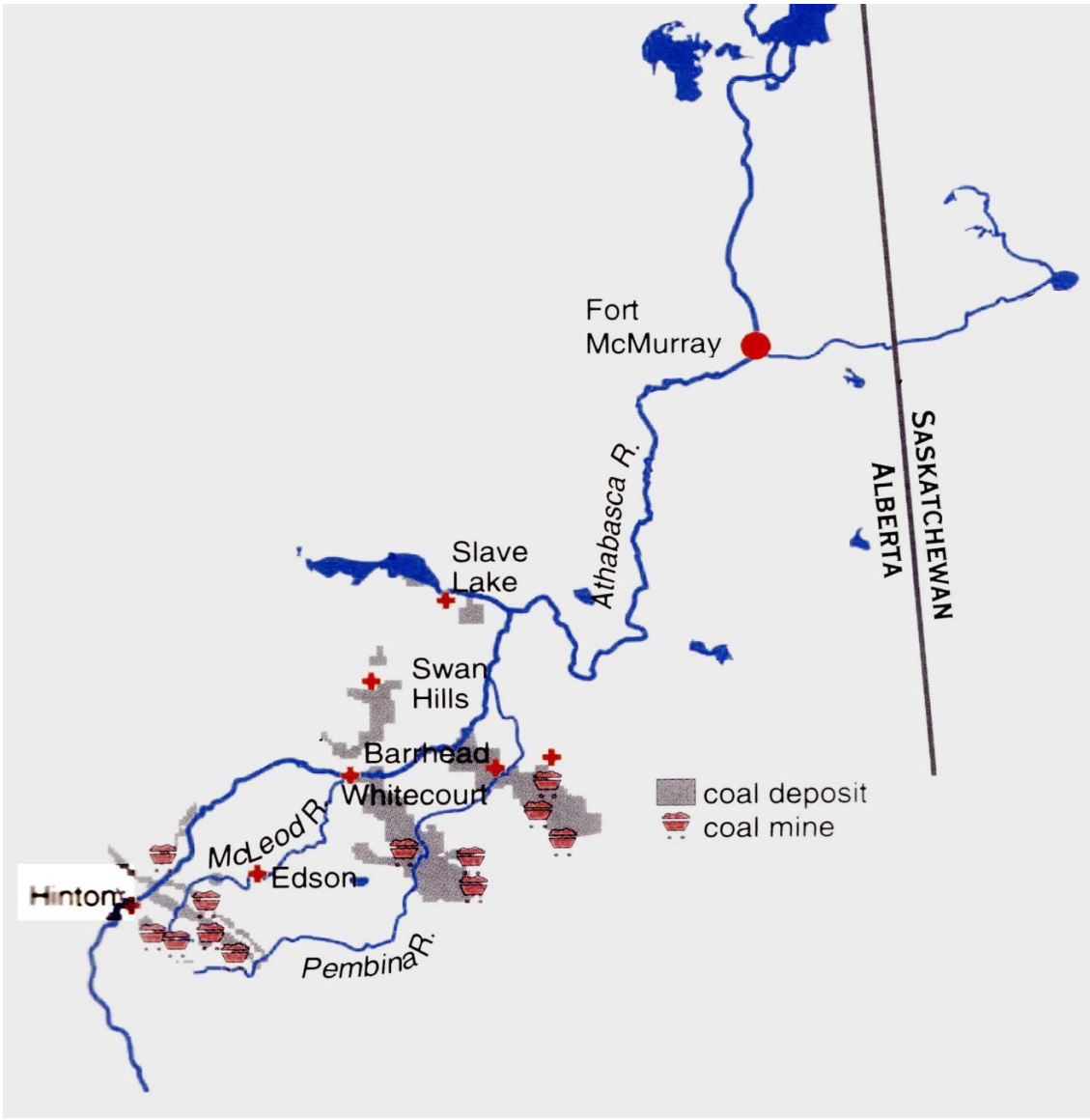
Source: J & W Communications, Pembina Institute

Types of Oil Sands “Mines” in ARB



Source: Alberta Energy, January 2011

2b. Non-renewable Resources: coal



Source: Northern River Basins Study,

Report to the Ministers, 1996

2b. Non-renewable Resources: peat

Source: www.turfdiag.com/rootzonr_amendments.htm

2b. Non-renewable Resources: gravel, limestone, other minerals

Photo: R.G. Holmberg

Fort Assiniboine area, 2007

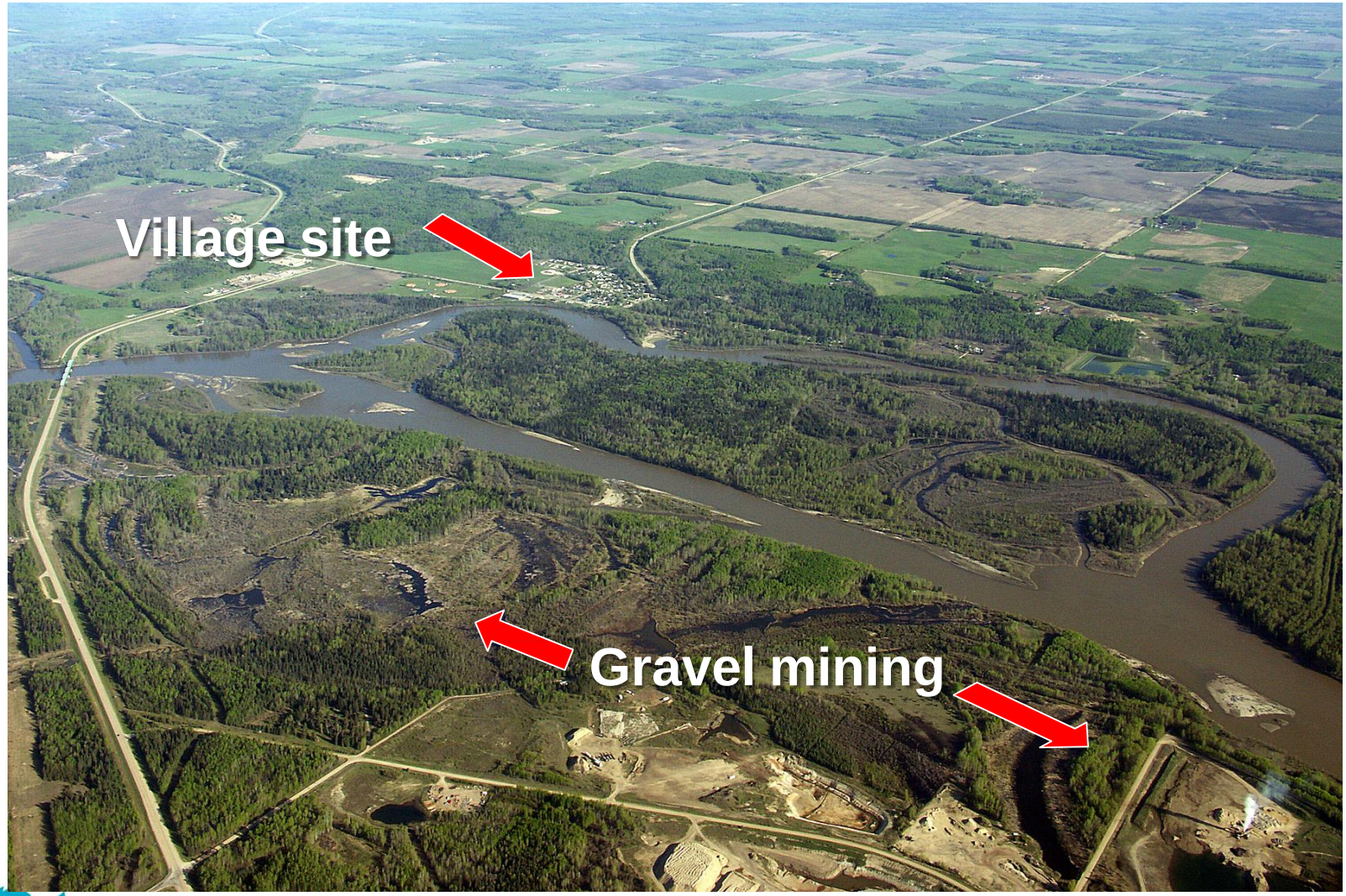


Photo: R.G. Holmberg

3. Environmental problems

- **Landscape deforestation and fragmentation** from resource exploration and extraction
  - Land clearing
  - Roads
  - Seismic line
  - Wells
  - Pipelines
  - Processing plants

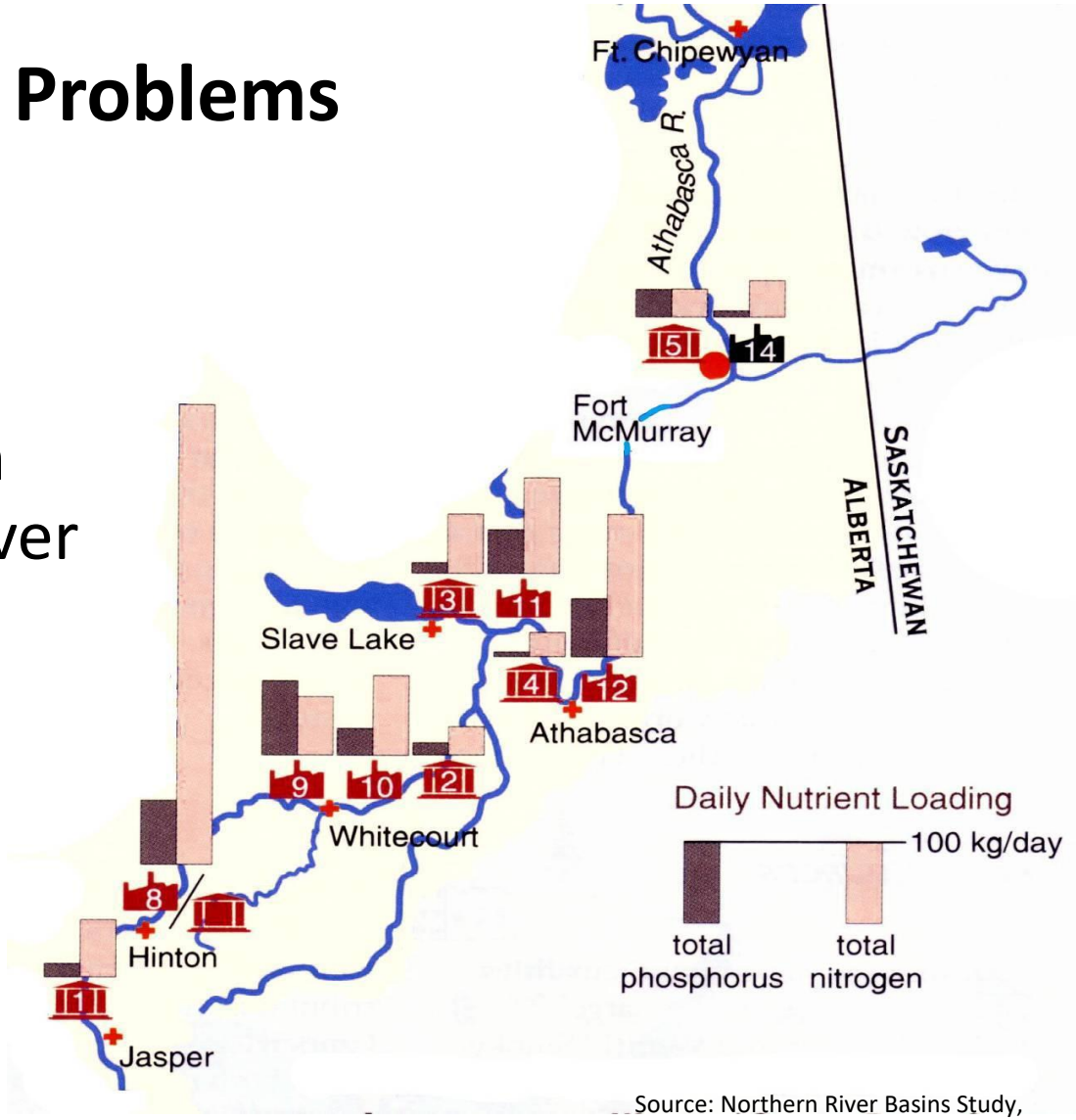
Photo: Alberta, 2003, R.G. Holmberg

3. Environmental Problems

- **Water quality**, especially toxic chemicals and disease-causing organisms but also erosion
  - **natura**l e.g. mercury, polycyclic aromatic hydrocarbons (PAHs), cyanobacterial toxins
  - **industrial** wastes e.g. chlorinated organics
  - a**gricultural** run-off and wastes
  - **municipa**l sewage and garbage

3. Environmental Problems

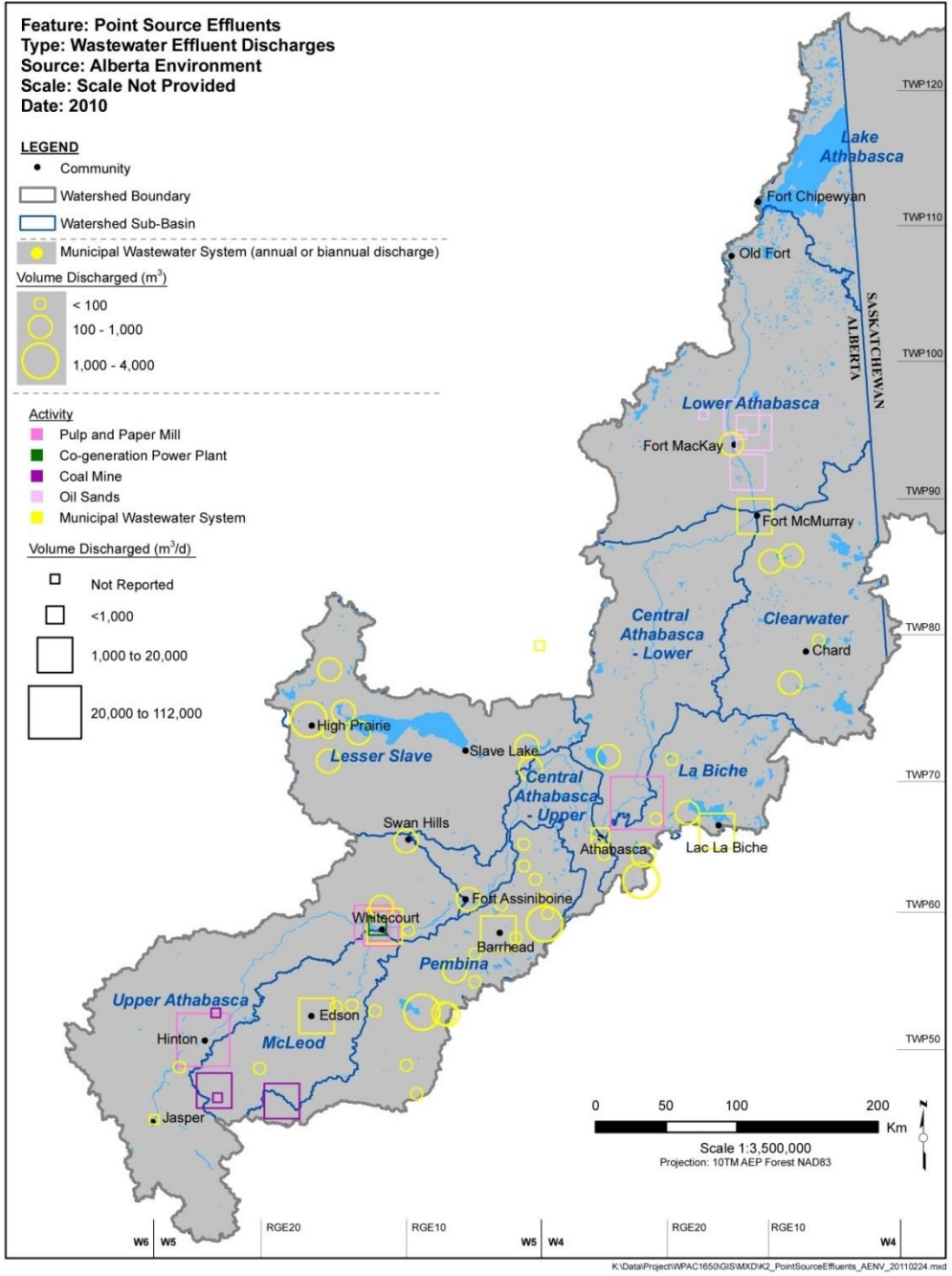
- Point source of nutrient inputs in the Athabasca River Basin. <1996



Source: Northern River Basins Study, Report to the Ministers, 1996

3. Environmental Problems

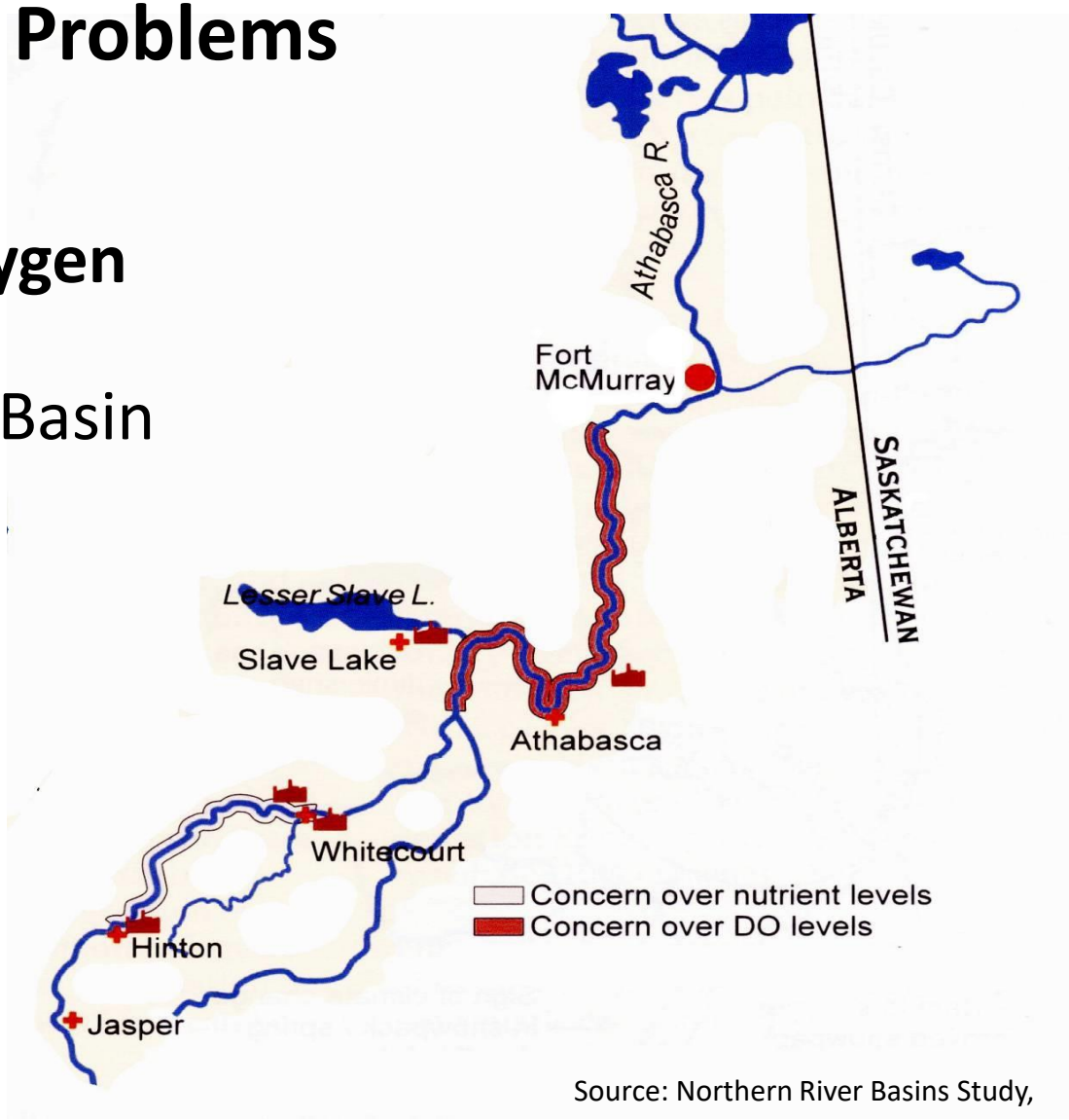
- Point sources of Wastewater Effluents in the Athabasca River Basin, 2010



Source: Athabasca Watershed Council, State of the Watershed Report, Phase 1, Appendix A2: Maps from the Preliminary Atlas, 2011

3. Environmental Problems

- **Nutrient and oxygen concerns** in the Athabasca River Basin



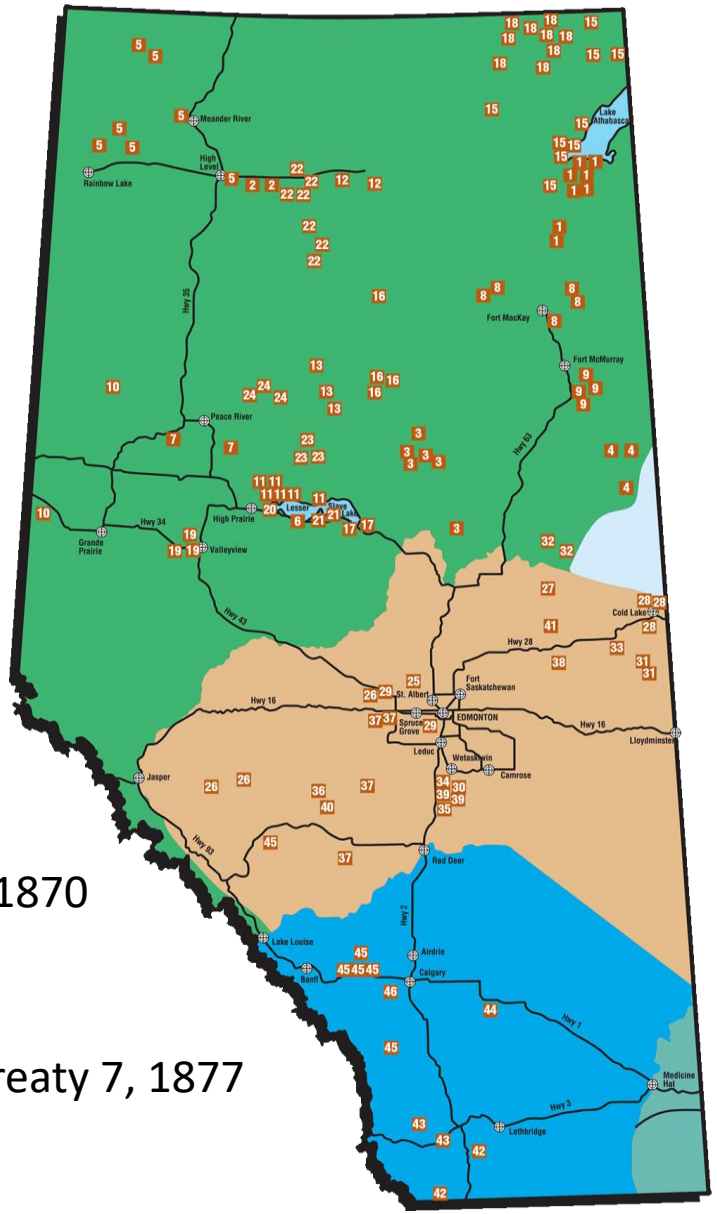
Source: Northern River Basins Study, Report to the Ministers, 1996

4. Political Issues

- Export of rural resources to urban areas
- Distribution of government taxes and benefits from those resources

4. Political Issues

- Treaties 6 and 8 used the Athabasca River as part of the boundary



Map: Indigenous and Northern Affairs Canada

5. Intellectual Interest

- **Archeology** and pre-history
- History: early explorers, fur trade transportation
- **Biology**: many unknown or poorly understood organisms
- **Geography**: Athabasca flowed south via the Tawatinaw Valley

G. If the ARB is so important, how is it protected?

Legislative Protection: Federal

- Fisheries Act
- Navigable Waters Act
- Environment Assessment Act
- Environmental Protection Act

- Many parts “streamlined” in 2012 and 2018

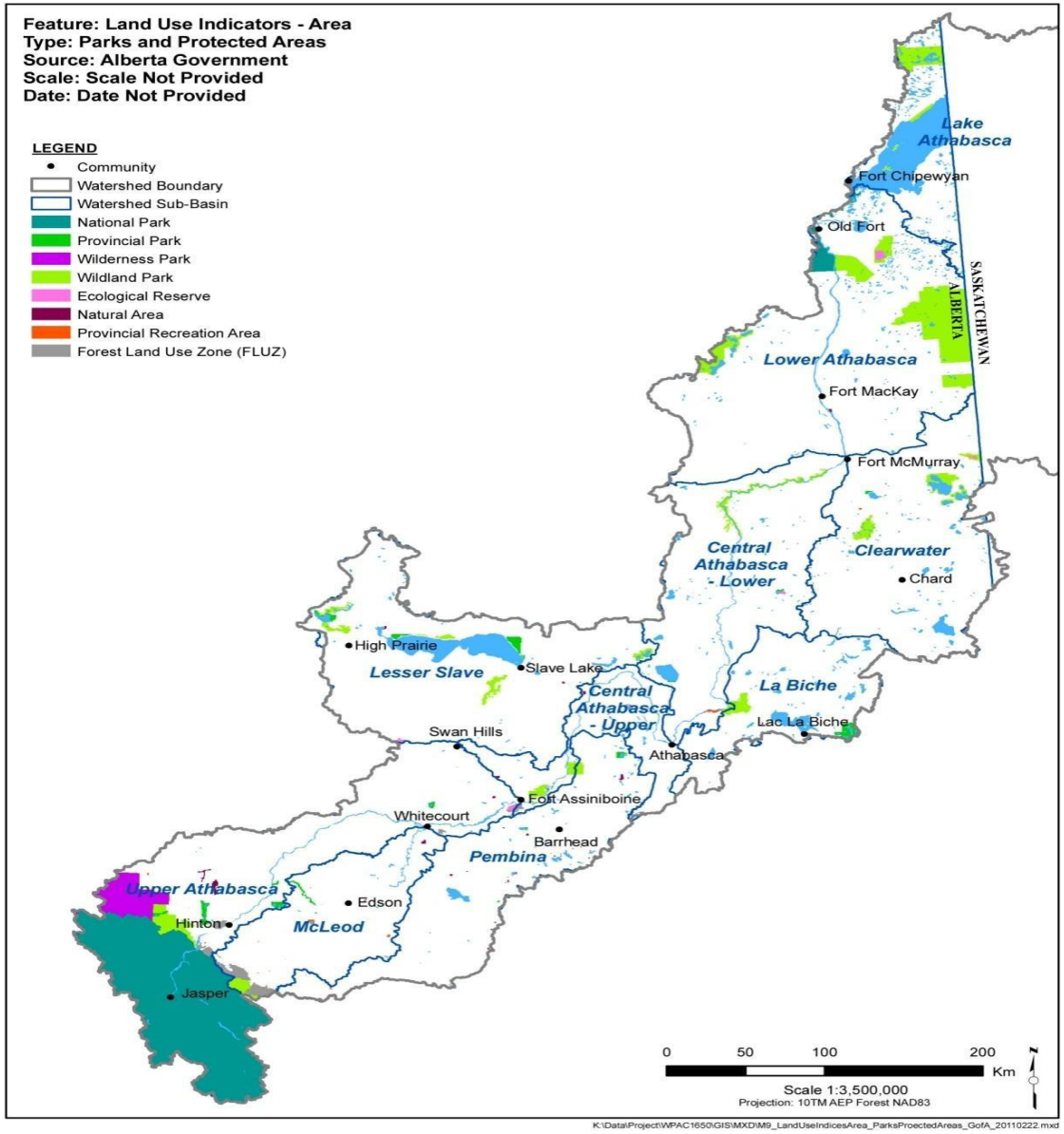
Legislative Protection: Provincial

- Water Act
- Public Lands Act
- Wildlife Act
- Forests Act
- Wilderness Areas, Ecological Reserves and Natural Areas Act
- Oil Sands Conservation Act

Legislative Protection

- Regulations and reporting (=monitoring)
- Enforcement

Parks & Protected Areas in the Athabasca River Basin



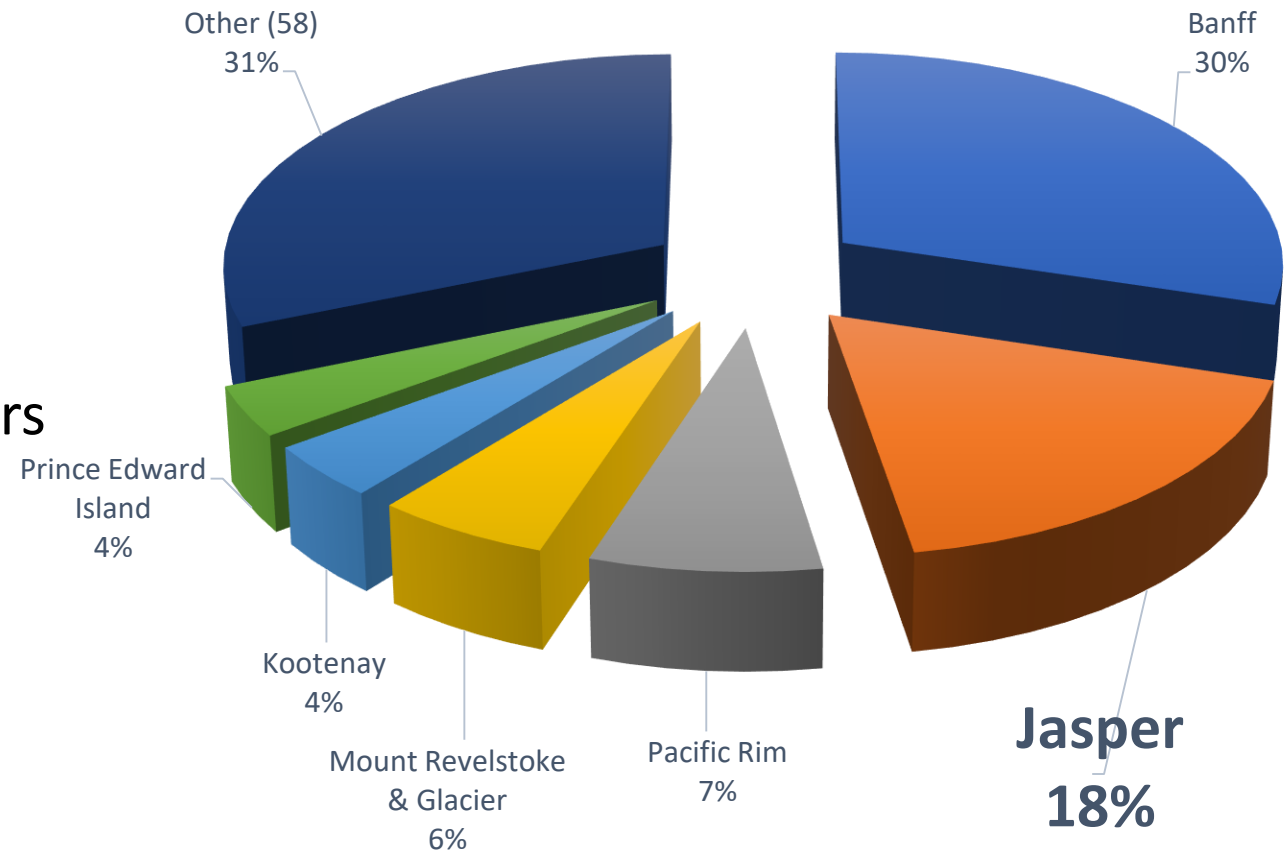
Source: Athabasca Watershed Council, State of the Watershed Report, Phase 1, Appendix A2: Maps from the Preliminary Atlas, 2011

Conservation Areas within ARB

CDN parks (Jasper & Wood Buffalo)	2
AB wildland parks	17
AB + SK (2,240 km^2) parks	11 + 1
AB wilderness park (part of Willmore)	1
AB ecological reserves	6
AB natural areas	29
AB bird sanctuaries & wildlife area	4

Visitors to 64 Canadian National Parks

- **Jasper:**
  - 2nd most visited federal park
  - 1,868,797 visitors in 2009-2010



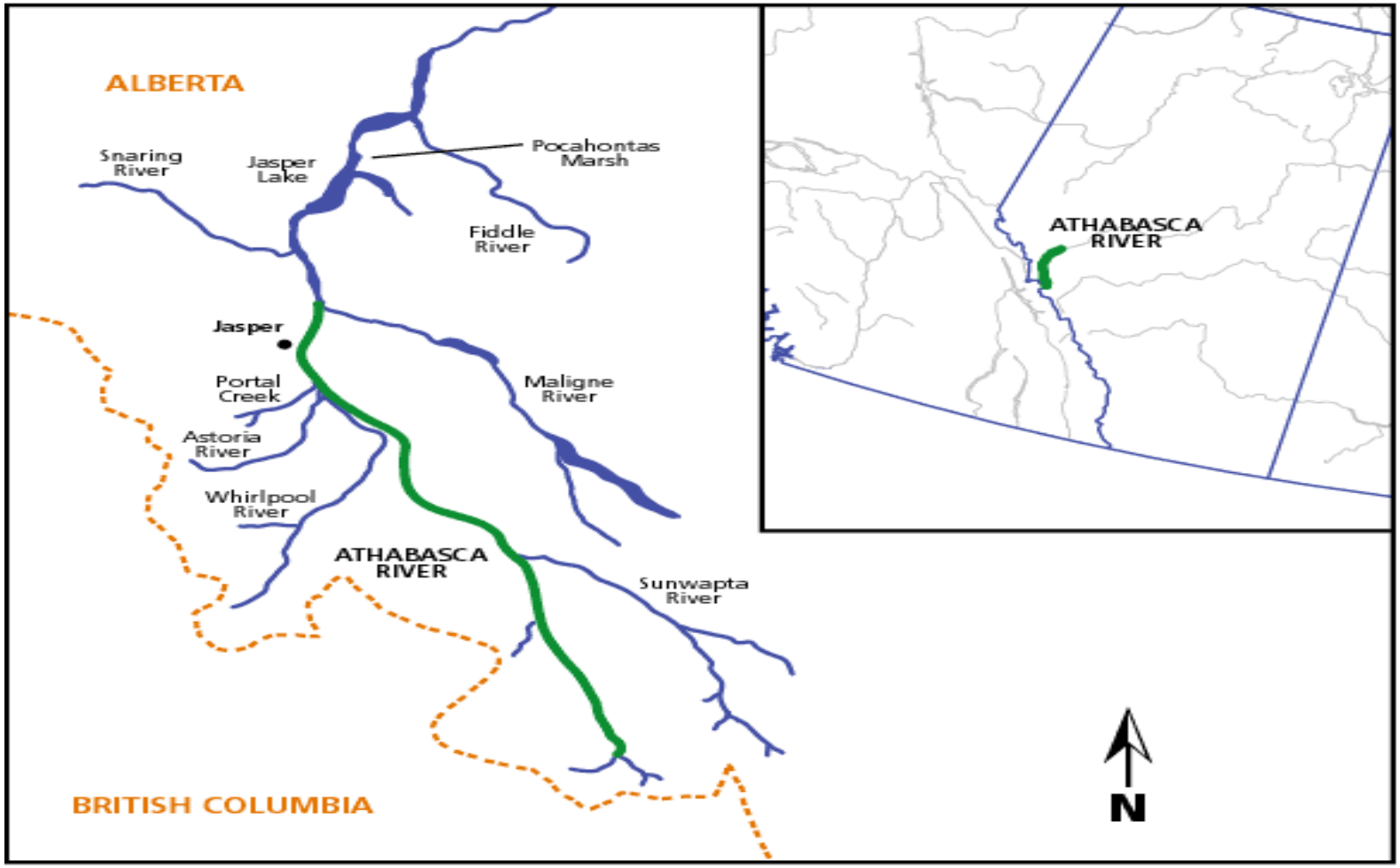
Source: Canadian Geographic, April 2011

Athabasca River: a Canadian Heritage River

- Nominated for natural features, historical significance & river recreation
- Jasper National Park (1989)
- Clearwater in Saskatchewan (1987) and Alberta (2004)

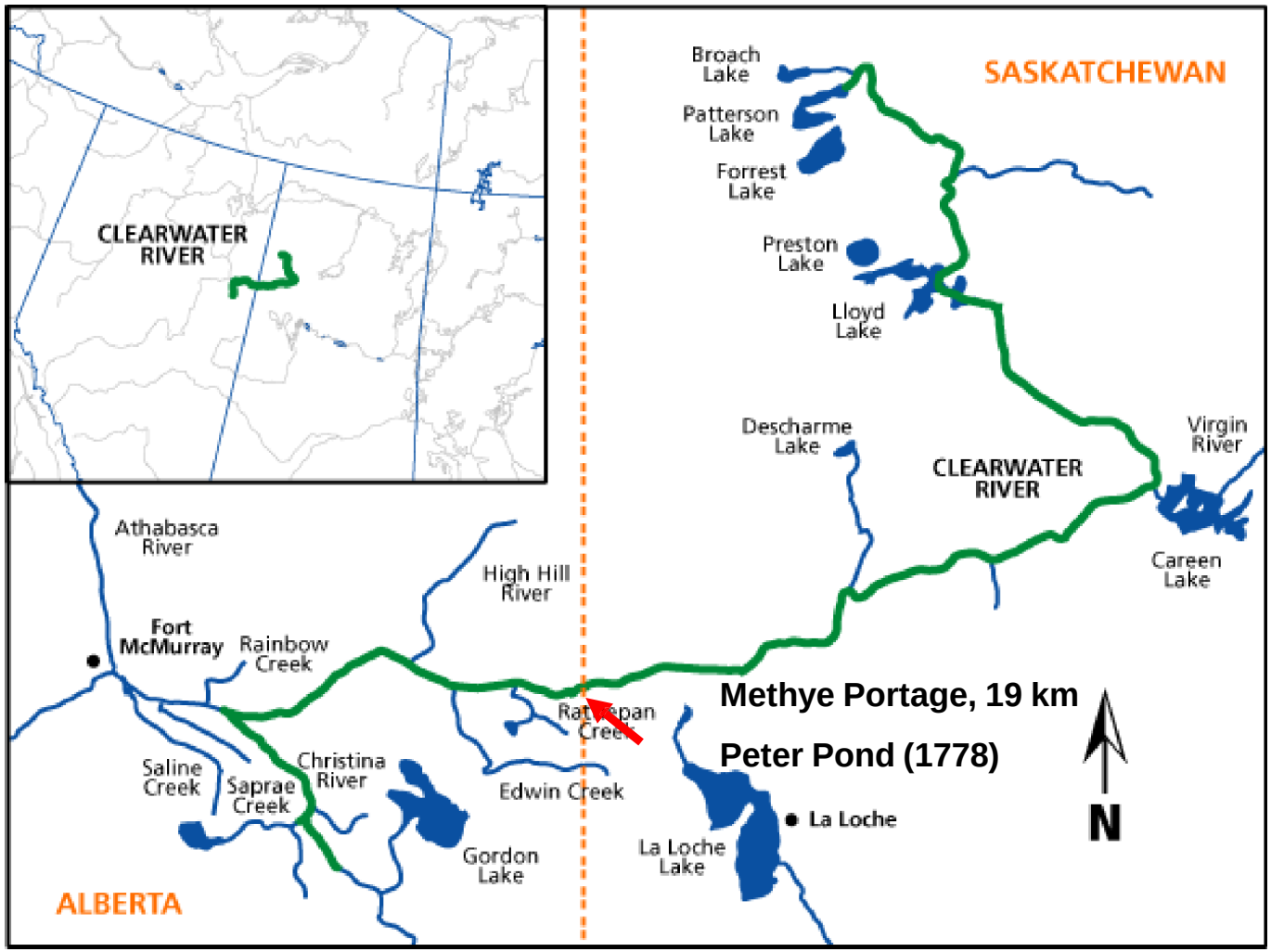
Source Canadian Heritage River System www.chrs.ca

Athabasca River: a Heritage Rivers of Canada



Source Canadian Heritage River System www.chrs.ca

Athabasca River: a Heritage River of Canada



Source Canadian Heritage River System www.chrs.ca

H. What are the concerns about the ARB?

1. Concerns about Water Quality

- Can I drink the water?

- Can I eat the fish?

- Can I swim in the water?

Images: Microsoft Clipart

2. Concerns about Water Quantity

- To much / too little
  - Flooding
    - Rainfall, snowpack, ice jams
  - Drought
- Timing: seasonal vs. year-to-year variation
- Transport of suspended and dissolved materials
- Maintenance of wildlife habitats

Photo: Flooding at Baptiste Lake, 2007, R.G. Holmberg

3. Concerns about Resources

- Over-exploitation of resources
  - Renewable → Non-renewable
  - Non-Renewable → Exhausted too quickly

Image: Microsoft Clipart

4. Concerns about Climate Change

- Global warming → may be less water (in certain locations) for:
  - natural, forestry and agricultural plant growth
  - water for municipalities and industries
  - dilution → increased concentrations of toxins
  - flooding of habitats with nutrients

Image: Microsoft Clipart

5a. Concerns: – Specific Groups: oil and pulp

- Sufficient water for processes via licenses, tradable rights and performance standards
- Storage of water
- Water quality and water treatment (pre- / post-)
- Enough water for effluent dilution
- Spills
- Aquatic organisms

Photo: Millar Western Pulp, Whitecourt 2007, R.G. Holmberg

5b. Concerns – Specific Groups: forestry

- Tree growth
- Drought
- Fire
- Tree-feeding insects
- Tree diseases
- Tree biodiversity
- Use of hybrids

Photo: Marten Lakes, 2009 R.G. Holmberg

5c. Concerns – Specific Groups: agriculture

- Precipitation for plant growth
- Water for livestock
- Nutrient run-off
- Crop and livestock diseases
- Insect pests / pollinations

Photo: Near Baptiste Lake, 2007, R.G. Holmberg

5d. Concerns – Specific Groups: municipalities

- Potable water
- Sewage treatment
- Flooding / drought
- Wise use of water

Photo: Athabasca Water Plant, 2017, M.B. Breiner

5e. Concerns – Specific Groups: tourism

- Water and land recreation

- Range of accessibility (easy to difficult)
- Diversity of experiences

Images: Microsoft Clipart

5f. Concerns – Specific Groups: anglers

- Timing of water quantity
- Water quality / toxicity
- Habitats
- Catch limits
- Exotics

Image: Microsoft Clipart

5g. Concerns – Specific Groups: conservationists

- Water (in-stream needs) and land for organisms and their habitats
- Toxins
- Biological diversity
- Habitat fragmentation
- River morphology via wide variation of water flow

Photo: Fort Assiniboine area, 2007, R.G. Holmberg

I. Three ways you can help

1. Be an engaged stakeholder about water-related issues

- **Express your concerns** with your WPAC
- **Share concern**s of other stakeholders (e.g. from your professional networks) with your WPAC
- **Share information** across your networks
  - When your municipality produces a report, **deposit a copy in Athabasca University Library**
- Become a member of a **local stewardship group**

Athabasca University

I. Three ways you can help

2. Become a partner with your WPAC

- Individual and organizational **memberships**
- Find ways to **cooperatively engage** your audience/clientele/network in water-related issues
  - Example: water-related educational programs

I. Three ways you can help

3. Become a donor to your WPAC

- Financial **contributions and in-kind support** will help us to realize a watershed that is:
  - ecologically healthy,
  - diverse, and
  - dynamic.

Acknowledgements

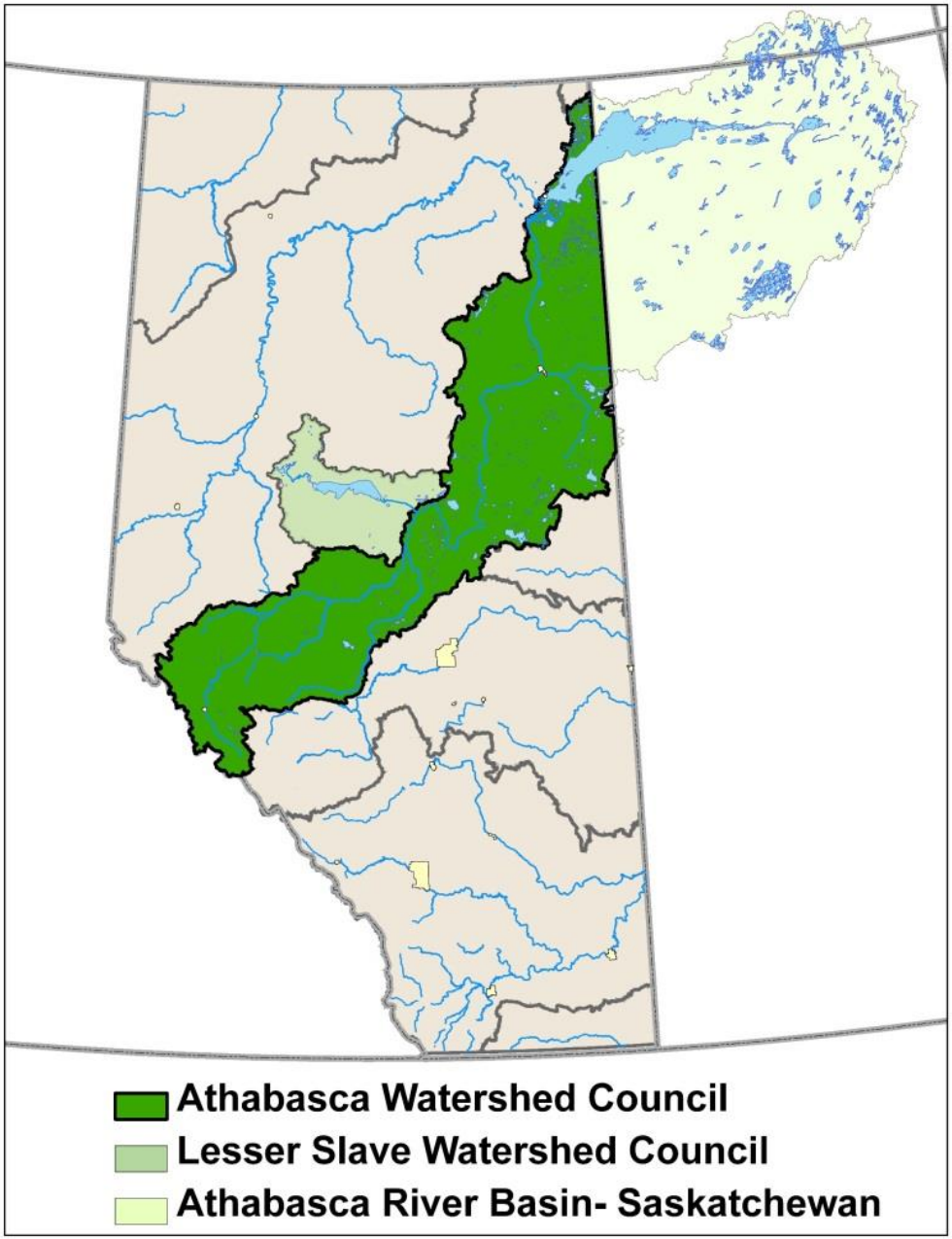
- Alberta Environment and Parks for their ongoing support

Alberta Environment and Parks

- Science Outreach – Athabasca provided a mechanism for collecting information and photographs fused in this presentation

Science Outreach – Athabasca

Questions?


Athabasca Watershed Council
Lesser Slave Watershed Council
Athabasca River Basin- Saskatchewan

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