Addressing water quantity and quality concerns in the Peace-Athabasca Delta, northern Alberta, from perspectives of the past

Brent Wolfe, PhD
Associate Professor
Department of Geography and Environmental Studies
Wilfrid Laurier University

...with contributions from
Roland Hall (Biology U Waterloo) and Tom Edwards (Earth U Waterloo)
and many others...

Funding Sources / Partners:
NSERC, BC Hydro, PREA, AANDC, PCSP, CFI/OIT, WBNP, Suncor Energy
It ain’t what you don’t know that gets you into trouble. It’s what you know for sure that just ain’t so.

[Mark Twain]
Peace Sector – a relict delta
(infrequently flooded landscape)
Athabasca Sector – an active delta (frequently flooded landscape)
Fort Chipewyan, Alberta
Peace-Athabasca Delta

- Internationally significant (UNESCO World Heritage Site).
- Many lakes and wetlands rely on periodic recharge from floods.
The Peace-Athabasca Delta: Water Level Fluctuations

- Desiccation
- Flooded trees
- High water marks
- Dead willow fringe
Peace-Athabasca Delta

- Concern over drying of the delta has developed due to construction of the WAC Bennett Dam on the Peace River in 1968 and the absence of a major flood for over 20 years from the mid-1970s to the mid-1990s.
Lake Sediments: Archives of Past Hydrology and Ecology

Gravity Coring
Lake Sediments:
Archives of Past Hydrology and Ecology

Russian Coring
Upland Peace Sector - Flood Frequency Record

PAD 15
(Pet's Creek)

PAD 15
(Pet's Creek)
PAD 15 Sediment Core

Section 1 (0-92 cm)
Section 2 (62-162 cm)
Section 3 (132-232 cm)
Section 4 (202-302 cm)
Section 5 (272-372 cm)
Section 6 (306-406 cm)
PAD 15: Flood Frequency Reconstruction

- Intervals of high flood frequency include ~1785-1815 and ~1875-1900
- Markedly low flood frequency during the 1700s
- Decline in flood frequency since about 1900
- Several multi-decadal intervals between major flood events

[Wolfe et al. 2006 Hydrological Processes]
Upland Peace Sector - Hydroecological Record
PAD 5: Hydroecological Reconstruction

isotope-inf. E/I

% relative abundance

Wet                  Dry

low diatom concentration

[Wolfe et al. 2005 Quaternary Research]
Major Findings

• Flood frequency has been in decline for many decades, beginning as early as the late 1800s.

• Several multi-decadal intervals without a major flood have occurred during the past 300 years.

• Hydrological and ecological conditions since 1968 are not outside the range of natural variability observed during the past 300 years.

• Evidence from lake sediments indicate that the 1700s were the driest period over the past 300 years.
Implications

- Lake sediment reconstructions have yielded no compelling evidence to suggest that ongoing flow regulation of the Peace River has had any discernable lasting effects on the hydroecology of the northern Peace sector of the delta.

→ rather, changes in the hydroecological state of the Peace sector appear to be driven predominantly by ongoing warming, drying and naturally declining Peace River discharge over the past century.
A 5200-year Record of Water-Level Variation in Lake Athabasca

[Wolfe et al. 2011
Geophysical Research Letters]
Water levels appear to correspond with glacier volume variations in the Rockies.

Shrinking glaciers since the 1900s correspond with declining river flow.

W. Canadian society developed during a period of unusually high river flow.

Periods of low water availability can persist for several centuries to millennia at a time → a finding that forecasts an urgent need for stringent water policy.

[Wolfe et al. 2011 Geophysical Research Letters]
A 5200-Year Perspective on Freshwater Availability

- 50 years of hydrometric data? → is this sufficient to develop effective water policy?

[Wolfe et al. 2011 Geophysical Research Letters]
Alberta oil sands since 1967

WAC Bennett Dam since 1968

Climate Change

Athabasca R mean monthly discharge (Apr-Aug m³/s)

sediment cores back in time
Alberta Oil Sands Development vs...
The Role for Studies of Lake Sediment Cores

- Determine concentrations of contaminants (before oil sands development) in lake sediments and recent trends.

- Assess role of river processes and human activities on the accumulation of contaminants in lakes of the Peace-Athabasca Delta.

An approach recommended by the Federal Expert Oil Sands Advisory Panel...

Lake Sediment Coring Sites (September 2010): Peace-Athabasca Delta

- PAD 18
- PAD 31
- PAD 23
PAD 31: Polycyclic aromatic compounds (PACs) ... from the river

Natural erosion of bitumen deposits along the Athabasca River and distributaries in the oil sands region appears to be the main source of these PACs.

[Hall et al. 2012 PLoS ONE]
PAD 18: Metals… from the atmosphere

[ Wiklund et al. 2012 Science of the Total Environment ]
Study finds little environmental impact from oil sands

NATHAN VANDERKLIPPE
CALGARY — The Globe and Mail
Published Monday, Oct. 08 2012, 11:28 PM EDT
Last updated Tuesday, Oct. 09 2012, 7:30 AM EDT

In 2010, a single oil-sands operation run by Suncor Energy released into the atmosphere 28,940 tonnes of volatile organic compounds, 22,210 tonnes of sulphur dioxide and 14,011 tonnes of particulate matter.

With those three types of substances combined, Suncor emitted into the air pollutants equivalent in weight to nearly 4,800 city buses — and the company operates just one of several mines sprawling across the landscape north of Fort McMurray, Alta.

MORE RELATED TO THIS STORY
- David Suzuki: An economy is a means, not an end
- COMMENT Jeff Rubin: ‘Oil’s collar on growth will leave us all poorer’
- India slow to invest in Canada’s oil sands: Joe Oliver

Yet when scientists drilled into lake bottoms 200 kilometres from those oil-sands mines, they discovered something surprising: At that distance, levels of those pollutants were negligible. In fact, the lake sediments, whose layers opened a window onto hundreds of years of air and water quality, showed that in many ways those lakes are cleaner today than they were decades, and even centuries, ago.
**Misrepresented tar sands**

**COMMUNITY EDITORIAL** OCT 13, 2012 • OPINION • BY STOP THE TAR SANDS KW

The recent publication of two studies on the effects of tar sands contaminants in the Peace-Athabasca Delta in Alberta, led by University of Waterloo Prof. Dr. Roland Hall, has received a great deal of media attention within the past couple of weeks.

Stop the Tar Sands KW, a student group based at the University of Waterloo, would like to take this opportunity to question the manner in which the publications have been framed not only by the media, but also by the university.

The reported findings have been politicized and sensationalized by several major media outlets. The Globe and Mail article that describes Hall’s research provocatively states in its headline: “Study finds little environmental impact from oil sands.” The article focuses on some aspects of Hall’s findings, such as lower than expected pollutants like polycyclic aromatic hydrocarbons downstream of tar sands development, but avoids emphasizing his paper’s call for increased study of Northern Alberta and the entire Athabasca watershed.

In similar fashion, the University of Waterloo released a statement reporting that the studies found that, “the Alberta oil sands are not a major source of long-distance air and water pollution.”

The dean of science, Dr. Terry McMahon, remarked, “This evidence is essential in guiding responsible development of the oil sands while recognizing its true impact and benefits.”

The argument that the tar sands can be “responsibly” developed is highly contentious, as is the idea that this study provides data on the “true” impacts of the tar sands.

Dr. Hall’s methodology has been scrutinized, and several prominent experts have argued against its conclusions. But even if Dr. Hall’s studies do report sound evidence on a lack of polycyclic aromatic compounds and other toxicants in the Peace-Athabasca Delta, many other factors at play have not been reported on.

Media coverage by news outlets and the university has reframed from mentioning the incomplete knowledge of tar sands pollution, poor monitoring of downstream areas, and the fact that long-distance air and water pollution from tar sands development may be occurring in many areas.

Studies such as these that draw media attention away from the significant pollution that surrounds Ft. McMurray, as well as the devastation that open pit mining has caused to the environment.

It is disheartening that the University of Waterloo, with such a prominent Faculty of Environment frames this type of research as a testament to the “benefits” of the tar sands.

We encourage students to think critically about the media coverage that interprets scientific research, but most importantly, to read the studies themselves in order to form their own conclusions.

Stop the Tar Sands KW

---

**Re: Tar sands rebuttal**

**LETTER TO THE EDITOR** OCT 26, 2012 • OPINION • BY ROLAND HALL, BRENT WOLFE

This letter addresses the Oct. 19 Community Editorial “Misrepresented tar sands” authored by Stop the Tar Sands KW. Our research targeted a key knowledge gap: the relative importance of industrial versus natural processes in determining the amount of contaminants in lakes of the Peace-Athabasca Delta, 200 km downstream of Alberta’s oil sands development at Ft. McMurray.

That knowledge gap was identified in several expert panel reports; namely, industrial elevation of contaminant levels remains unknown because monitoring of organic contaminants began 30 years after industrial development started. Based on 12 years of research on floodplain lakes in this deltaic ecosystem where materials carried by the Athabasca River accumulate and where human and ecosystem health concerns have centered, we now report the scientific tools to address this critical knowledge gap. Thus, we undertook the study to provide objective data that could be used by leaders in government, industry and NGOs, and by the public to better balance the benefits against the costs of oil sands development.

We undertook this study with great care for ethical conduct given the polarization of debate around the oil sands. It was a focused study to address long-distance transport of contaminants via air and water to an important ecosystem – a key topic of concern. Thus, other environmental topics were outside its scope. We provided key data that have not been possible to obtain for the past 40 years. As suggested by Stop The Tar Sands KW, we also encourage everyone to read our papers and judge the science for yourselves.

Roland Hall  
Professor, Department of Biology  
University of Waterloo,  
Principal Investigator of the Study

Brent Wolfe  
Associate Professor, Graduate Officer,  
Department of Geography & Environmental Studies,  
Wilfred Laurier University,  
Co-Principal Investigator
Conclusions

• *It ain’t what you don’t know that gets you into trouble. It’s what you know for sure that just ain’t so.* [Mark Twain]

• The processes that drive changes in the PAD operate over a broad range of spatial and temporal scales.
  → This feature has made it extremely difficult to identify correctly the causes of observed changes.
  → Long-term paleolimnological data identify that natural processes dominate the delivery of water and bitumen-derived PACs to the delta.
Societal Implications

• Impending water scarcity will be a greater threat to downstream ecosystems than issues related to contaminants from the oil sands industry, which have dominated public attention and government actions.