Summary of Environmental Management Policy Deficiencies in the Canadian Oilsands

Implications for U.S. Decision Makers

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Executive Summary

"The current visibility of relevant provincial and federal agencies, in particular in dealing with the major environmental challenges [of Canada's oilsands] is low, and is generally not in line with those challenges."

—The Royal Society of Canada Expert Panel on Oilsands, 2010[1]

As international criticism of Canada's oilsands grows, there are questions about the effectiveness of environmental regulation and policy to address growing impacts to air, land and water resources. As this briefing note outlines, steps taken by the Government of Canada and the Province of Alberta to manage these impacts have failed to address the cumulative impacts of oilsands development. In the absence of responsible environmental policy, greenhouse gas emissions from the oilsands will triple from 2005 levels by 2020, caribou could become locally extinct, water quality will deteriorate, and lack of cumulative effects management will lead to unrestrained boreal forest disturbance. While there are limited rules in place to address oilsands water withdrawals, toxic tailings lakes and greenhouse gas emissions, these systems fall far short of what is needed to keep up with the extraordinary pace of development.

U.S. decision-makers should carefully consider the risks posed by oilsands development and scrutinize claims by oilsands proponents to determine whether the existing efforts to manage oilsands impacts are as effective as claimed. While there are new plans and frameworks *in development* that strive to "use a cumulative effects management approach to balance economic development opportunities and social and environmental considerations,"[2] these plans are not capable of achieving the environmental outcomes consistent with the expectations of both Canadian and American citizens. To date, the governments of Alberta and Canada have failed to limit the environmental impacts of oilsands development in northeastern Alberta, and as a result that impact *is worsening* as modest technological improvements are outstripped by significant increases in oilsands production.

Greenhouse gases

Oilsands are a major and growing source of greenhouse gas emissions.

- Oilsands are the fastest growing industrial source of greenhouse gas (GHG) emissions in Canada.[3] Oilsands GHG emissions more than doubled between 1990 and 2009 and emissions are forecast to triple between 2005 and 2020.[4]
- While the oilsands sector reduced its GHG emissions intensity (emissions per barrel) by 29% between 1990 and 2009,[5] the rate of performance improvement has stalled in recent years. Furthermore, an increasing proportion of oilsands production is forecast to come from in situ techniques,[6] which result in significantly higher GHG emissions per barrel of bitumen produced.[7]
- According to industry projections, under business-as-usual conditions, oilsands production could nearly triple in the next 15 years.[8] Regardless of emission intensity, absolute oilsands GHG emissions will increase as a result of the rapid pace of projected oilsands development.[9]
- Carbon capture and storage (CCS) is not likely to result in significant emissions reductions in the oilsands over the next two decades. To date there are no operating CCS projects in the oilsands. The cost of capturing emissions from many of the sources is likely to be prohibitive unless governments are willing to implement carbon prices an order of magnitude higher than they have contemplated to date.

Federal climate policies will fail to meet the country's 17% emissions reduction target unless the government increases its efforts tenfold.

- Canada has not regulated GHG emissions from the oilsands.[10] Canada's federal climate policies will fail to meet the country's emissions reduction target unless the government increases its efforts tenfold.[11]

Alberta's climate regulations are weak and will not counteract the growing GHG emissions from the oilsands sector

- The Government of Alberta's climate regulations make no attempt to achieve absolute reductions over the next decade and instead allow growth until 2020. Furthermore, Alberta's plan is a growth plan over the longer term, with an emissions target of 16% *above* 1990 levels by 2050.[12] Scientific consensus suggests that industrialized countries need to reduce greenhouse gases 25% to 40% below 1990 levels by 2020, and 80% to 90% by 2050, to avoid dangerous climate change.[13] Accordingly, Alberta's climate plan makes no attempt to align with any science-based targets.
- Alberta's climate policies are likely to achieve only about one fifth of the emission reductions the province's climate plan calls for by 2020, due to weaknesses in the policies and the accounting for emissions reductions.[14]

For more information, please refer to *Oilsands and Climate Change: How Canada's oilsands are standing in the way of effective climate action* at http://www.pembina.org/pubs.

Land Impacts

There is no regional plan in place that sets acceptable limits on levels of cumulative environmental impact to manage the pace and scale of oilsands development.

Alberta's land use planning process for the oilsands region is still in development, and efforts to date fail to protect biodiversity, manage tailings waste and put absolute limits on Athabasca River withdrawal.

Alberta's proposed regional plan for the Lower Athabasca region has yet to be approved, and while it acknowledges that a cumulative effects management approach is required and that objectives must be set for environmental, social and economic outcomes, it fails to deliver effective solutions for a range of issues in the region. For instance, while the provincial government's proposed new conservation areas have been welcomed by many in the public, the total proposed area to be conserved is smaller than that recommended by the government's own Regional Advisory Council, by the multi-stakeholder Cumulative Environmental Management Association (CEMA) and by the Canadian Boreal Forest Framework. In addition, the locations of the majority of these sites appear to be determined by what remains after existing lease sales to the forestry or petroleum sectors, instead of what scientists have determined to be of highest priority for protection based on environmental value.

Overall, the environmental objectives being sought in the draft Lower Athabasca Regional Plan (LARP) have been compromised by commitments made to oilsands developers prior to the proposal of the LARP, allowing past decisions that favoured accelerated development to undermine the ability of the regulator to protect the public interest.[15] Contrary to what has been thus far proposed in the LARP, an effective management approach would:

- protect sufficient habitat (size and location) to protect habitat for any woodland caribou herds in the Lower Athabasca region;
- prevent logging and/or oil and gas activities within many conservation areas;
- set a total limit on oilsands disturbance;
- identify how tailings will be managed;
- support a credible monitoring system by including the monitoring of hydrocarbon contaminants and ensuring there are multiple monitoring systems in place;
- halt water withdrawals from the Athabasca River during low-flow periods.

Given these deficiencies, Alberta is a long way from having a regional land use plan that will protect the environment or stand up to international scrutiny.

Species at Risk: Woodland Caribou

Woodland caribou face the possibility of local extinction because of industrial development in northeastern Alberta.

Neither Alberta nor Canada has been willing to propose meaningful and effective habitat protection strategies to recover this threatened species.

- Woodland caribou is listed as a threatened species, both provincially and federally, reflecting declines in population size, contraction of range, and sensitivity to industrial activities.[16]
- Significant cumulative effects from oilsands development have contributed to the herds' decline. Environment Canada reports that all herds in northeastern Alberta are non-self-sustaining.[17] Cleared paths such as seismic lines, roads and pipelines from in situ production have fragmented the forest and made it far easier for wolves and other predators to access areas where the caribou are located.[18]
- Habitat restoration and protection is necessary if these populations are to recover. In the absence of a strong federal recovery strategy and an effective provincial land use plan, the species is predicted to be extirpated, or locally extinct in northeastern Alberta, within 30 to 40 years.[19]

Four years overdue, the federal government issued a draft recovery strategy in August 2011.[20] More legal action may ensue however as the strategy allows for 95% of woodland caribou habitat in northeastern Alberta to be lost in order to promote oilsands expansion. Rather than placing limits on oilsands development to protect caribou, the federal government's draft recovery strategy instead relies on killing wolves as a predator control strategy. The culling of wolves is insufficient to protect caribou in northeastern Alberta for the long term. Maintaining caribou populations will only be achieved by protecting large tracts of land, restoration, and the setting of maximum levels of development.

Aboriginal Concerns

Aboriginal peoples' concerns regarding pollution of the Athabasca watershed and the possible linkage to human health have not been thoroughly investigated.

Despite significant concerns raised by a broad network of aboriginals, there has still not been a comprehensive health study that investigates the cause of the higher incidence of rare cancers in communities downstream of oilsands development.[21]

In February 2009, the Alberta Cancer Board released a study that determined that the overall cancer rate in Fort Chipewyan was approximately 30% higher than expected. While Alberta Health Services has indicated there was no problem,[22] the study revealed:

- A 30% increase in cancers in Fort Chipewyan compared with expected rates over the last 12 years;
- A three-fold increase in leukemias and lymphomas in Fort Chipewyan;
- A seven-fold increase in bile duct cancers;
- Other cancers, such as soft tissue sarcomas and lung cancers in women, also found in elevated numbers in Fort Chipewyan.

According to Natural Resources Defence Council senior scientist Dr. Gina Solomon, "Leukemias and lymphomas have been linked in the scientific literature to petroleum products, including VOCs (volatile components of petroleum), dioxin-like chemicals and other hydrocarbons. Biliary cancers have been linked to petroleum and to polycyclic aromatic hydrocarbons (PAHs) (chemicals in tar and soot)."[23] Independent research suggests concentrations of dissolved polycyclic aromatic compounds (PAC) are higher downstream of oilsands development, in comparison to upstream, in tributaries to the Athabasca.[24]

For more information, please refer to *Canadian Aboriginal Concerns With Oil Sands: A compilation of key issues, resolutions and legal activities* at http://pubs.pembina.org/reports/briefingnoteosfntoursep10.pdf.

Water Management Issues

The current approaches and efforts in place to monitor water quality in the Athabasca region have been widely discredited.

To date, a number of independent commentators and government reports have indicated that water monitoring in the Athabasca region is inadequate.[25] As a result, governments are unable to effectively assess the impacts of oilsands development on water quality because of reported problems with the existing sampling programs, a general lack of understanding of baseline conditions and inadequate analytical capabilities.

Most recently, Environment Canada and a team of independent experts concluded that the current monitoring system for the Athabasca region "did not deliver data of sufficient quantity or quality to detect or quantify the effects of oilsands development."[26] Furthermore, independent research has indicated a positive pollution signal downstream of oilsands development, in comparison to upstream, in tributaries to the Athabasca.[27]

Groundwater monitoring needs to be in place as the in situ sector ramps up and furthers its reliance on saline and nonsaline aquifers for steam generation and yet, to date, monitoring for groundwater quality in the oilsands region as a whole has yet to be done.[28] The rate of approvals for in situ projects has outpaced the Alberta Government's development of legislative and regulatory controls around groundwater.[29] The supply and quality of groundwater for the oilsands region is unknown and as a result the cumulative effects of mining and in situ oilsands operations are unknown.[30]

Responsible regulatory decision-making cannot occur in the absence of effective monitoring programs and limits on pollution. While new monitoring plans have been announced, there will be a significant time lag between when these plans actually are implemented and when the information they provide will inform regulatory decision-making. And while monitoring is necessary to ensure environmentally sustainable development, in itself it is not sufficient.

There is a weak voluntary framework to manage water withdrawals from the Athabasca River that could result in river damage during periods of low flow.

- The current Athabasca Water Management Framework that boasts strict cut-off of water withdrawals is actually backstopped only by a voluntary agreement rather than existing provincial water legislation.[31]
- According to the awarded water licenses, current and proposed projects could withdraw more than 15% of the Athabasca River's water flow during its lowest-flow periods.[32]
- Water withdrawals during winter low-flow periods risk reducing the availability of fish habitat and could reduce the health of the river's ecosystem.[33] This is especially a risk for the Lower Athabasca River as it has experienced a 30% decrease in average low flows over a 40-year period.[34]

Tailings

The current regulatory efforts to manage growing tailings lakes are ineffective in preventing massive increases in overall tailings volume.

Initial regulations introduced in 2009[35] designed to reduce the growing volume of tailings are not being enforced. There are no comprehensive rules to address the legacy of the 843 million cubic metres (223 billion gallons) of toxic waste, covering an area of 170 square kilometres (66 square miles).

Oilsands mining operations produce immense quantities of liquid waste materials called tailings – a fluid mixture of water, sand, silt clay, unrecovered hydrocarbons and dissolved chemicals. Tailings are toxic and cannot legally be released into the environment.

While oilsands companies are expected to reclaim liquid tailings, 40 years of voluntary management has allowed a significant long-term liability to accumulate. To date, there has been no successful reclamation of tailings. Although Suncor's Pond 1 has achieved the preliminary step of a solid surface and revegetation, this represents just over 1% of the total area occupied by tailings ponds today.[36]

It is estimated that one and a half barrels of mature fine tailings are created for every barrel of oil that is produced. The growing legacy of toxic tailing lakes on the landscape pose a mortality risk to waterfowl and other wildlife and are an ongoing threat to surface water and groundwater through seepage.[37] In addition, tailings lakes could become a significant public liability if a company cannot cover the cleanup costs.

Modelled estimates suggest that 11 to 12.6 million litres (2.9 to 3.3 million gallons) of tailings leak into the environment from tailings ponds each day.[38] The fact that no information is available on the rates or the composition of seepage points not to a lack of seepage, but rather to a lack of transparency.

With respect to the Alberta Energy Resources Conservation Board's tailings directive, only two of the nine tailings plans submitted met the requirements of the regulations and yet the ERCB has approved all nine plans.[39] Even if regulations were followed, the volume of tailings will grow from 843 million cubic metres (223 billion gallons) in 2010 to over 1.1 billion cubic metres (290 billion gallons) in 2020, an increase of 30%.[40] The volume of tailings will still be over 1.1 billion cubic metres (290 billion gallons) in 2065.[41]

Turning to Solutions

The pace and scale of Canada's oilsands development and its resulting impact to the environment has attracted international attention. With each additional oilsands project approved and constructed, there are additive impacts to air quality, forest health, wildlife population, and quality and quantity of water resources. To date, neither the provincial nor federal governments have been effective in implementing a comprehensive environmental management system. By allowing oilsands development to grow at a rapid pace in the absence of clear limits to protect the environment, the federal and provincial governments are setting up the industry to face even greater controversy and risk in the future.

The Pembina Institute maintains that Canada must establish science-based environmental limits on greenhouse gas emissions, tailings production, water withdrawals and pollution and land disturbance – just some of the key elements of an effective environmental management system. Without this management system in place, oilsands development will continue to proceed at an irresponsible pace and the international scrutiny of the oilsands will continue.

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[1] Pierre Gosselin, Steve E. Hrudey, M. Anne Naeth, André Plourde, René T Errien, Glen Van Der Kraak, and Zhenghe Xu, The Royal Society of Canada Expert Panel: Environmental and Health Impacts of Canada's Oil Sands Industry (2010) 296. http://www.rsc.ca/documents/expert/ RSC%20report%20complete%20secured%209Mb.pdf.

[2] Government of Alberta, *Draft Lower Athabasca Integrated Regional Plan 2011 – 2021* (2011), 1, http://landuse.alberta.ca/RegionalPlans/LowerAthabasca/documents/DLARP%20. Regional%20Plan_FINAL_March%2029%202011_1%20 44%20pm.pdf

[3] Environment Canada, *Canada's Emissions Trends* (2011). http://www.ec.gc.ca/Publications/E197D5E7-1AE3-4A06-B4FC-CB74EAAAA60F/CanadasEmissionsTrends.pdf

[4] Ibid., 25, Table 5.

[5] Note: due to back-corrections made by Environment Canada, intensity improvements are 29% rather than 39% as previously thought. Environment Canada, *Canada's Emissions Trends.*

[6] Ibid.

[7] Marc Huot, Danielle Droitsch and P.J. Partington, *Canadian Oilsands and Greenhouse Gas Emissions: The Facts in Perspective* (The Pembina Institute, 2010) 7, http://www.pembina.org/ pub/2057.

[8] Canadian Association of Petroleum Producers, Crude Oil - Forecast, Markets & Pipelines, Figure 2.2 and Appendix B.1. http://www.capp.ca/getdoc.aspx?DocId=173003

[9] IHS CERA, "Summary," *Oilsands Technology: Past, Present, and Future (Special Report)* (2011). http://www2.cera.com/cos_form/

[10] Federal regulations are expected out within the next year for the oil and gas sector; regulations for other sectors may follow.

[11] Note: It could be argued that federal emission emission-reduction efforts only need to be increased fourfold, because the 32.5 Mt impact of current federal policies in 2020 needs to be increased to 32.5+89=121.5 Mt to meet Canada's target (see the numbers at the right-hand side of Figure 1). But to make a fair comparison of the effort entailed in two sets of policies, you have to compare their impact on emissions over similar time periods. This is because policies generally have a bigger impact on emissions over a longer time period, without any extra effort by government (the key government effort is at the beginning in getting the policies adopted and implemented).

[12] Environment Canada, *National Inventory Report: Greenhouse Gas Sources and Sinks in Canada, 1990–2007*, http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/4771.php.

[13] Matthew Bramley, *The Case for Deep Reductions: Canada's Role in Preventing Dangerous Climate Change* (The David Suzuki Foundation and The Pembina Institute, 2005). http://www.pembina.org/pub/536

[14] Further details will be provided in a forthcoming report from the Pembina Institute that will provide an in-depth assessment of Alberta's GHG reduction policies (anticipated release Fall 2011).

[15] The Pembina Institute cautioned the Alberta government that selling leases before land use planning was complete was a recipe for conflict and would result in costly compensation battles that would burden Alberta taxpayers. See Dan Woynillowicz, Peggy Holroyd and Simon Dyer, *Haste Makes Waste: The Need for a New Oilsands Tenure Regime* (The Pembina Institute, 2007) http://www.pembina.org/pub/1409. Industry responses to the draft LAIRP are varied, depending on whether a company's lease is affected or not. See Nathan Vanderklippe and Carrie Tait, "Producers prepare for oil sands battle," *Globe and Mail*, April 06, 2011, http://www.theglobeandmail.com/globe-investor/ alberta-plan-should-be-minor-hit-to-oil-sands-firms-analyst/ article1972903/

[16] Richard Schneider, Grant Hauer, W.L. Adamowicz, and Stan Boutin, "Triage for conserving populations of threatened species: The case of woodland caribou in Alberta," 2010, *Biological Conservation*, 143 (7), pp. 1603-1611.

[17] Lee PG, Hanneman M, Cheng R, Hackenbrook D., *Anthropogenic and Fire Disturbances in Woodland Caribou Herd Ranges in the Lower Athabasca Regional Plan Area, Alberta* (Global Forest Watch, 2011) Canada International Year of Forests #8. Available at: www.globalforestwatch.ca.

[18] Alberta Woodland Caribou Recovery Team, Alberta Woodland Caribou Recovery Plan 2004/05-2013/14. (2005).

[19] Piotr Weclaw and Robert J Hudson, "Simulation of conservation and management of woodland caribou," 2004, *Ecological Modelling*, 177 (1-2), pp. 75-94. Environment Canada, *Scientific Review for the Identification of Critical Habitat for Woodland Caribou (Rangifer tarandus caribou), Boreal Population, in Canada* (2008). https://www.registrelep-sararegistry.gc.ca/virtual_sara/files/Caribou%5FFull%5F0409%5Fe%2Epdf

[20] Environment Canada, *Recovery Strategy for the Woodland Caribou, Boreal population (Rangifer tarandus caribou) in Canada [Proposed]* (2011). http://www.registrelep-sararegistry.gc.ca/document/default_e.cfm?documentID=2253

[21] Alberta Health and Wellness is currently in discussions with communities in Fort Chipewyan and Fort McKay in order to reach an agreement on how to best proceed with a long-term health study for the region. CBC News, "Cancer rates downstream from oilsands to be probed," August 19, 2011. http://www.cbc.ca/news/canada/edmonton/story/2011/08/19/edm-cancer-oilsands-fort-chipewyan-study.html.

[22] Alberta Health Services, "Fort Chipewyan cancer studies finding released," Press release, February 6, 2009. http://www.albertahealthservices.ca/500.asp.

[23] Gina Solomon. "The Other Oil Disaster: Cancer and Canada's Tar Sands." Opinion-editorial, Natural Resources Defense Council, May 3, 2010. http://switchboard.nrdc.org/blogs/gsolomon/the_other_oil_disaster_cancer.html. For more about cancer rates in Ft. Chipewyan see the February 2009 report *Cancer Incidence in Fort Chipewyan, Alberta 1995-2006* by the Alberta Cancer Board – Division of Population Health and Information Surveillance: http://www.albertahealthservices.ca/files/rls-2009-02-06-fort-chipewyan-study.pdf. Summary of Alberta Cancer Board report by NRDC can be found at http://switchboard.nrdc.org/blogs/gsolomon/the_other_oil_disaster_cancer.html (http://www.albertahealthservices.ca/500.asp).

[24] Erin N. Kelly, Jeffrey W. Short, David W. Schindler, Peter V. Hodson, Mingsheng Ma, Alvin K. Kwan and Barbra L. Fortin, "Oil sands development contributes polycyclic aromatic compounds to the Athabasca River and its tributaries," *Proceedings of the National Academy of Sciences of the United States of America* 107 (2009). http://www.pnas.org/content/early/2009/12/04/0912050106.abstract

[25] The critical reviews focused on either provincial or federal responsibilities in the management of surface and/or groundwater in the Athabasca region: 1) *Royal Society of Canada Expert Panel*; 2) Oilsands Advisory Panel, *A Foundation for the Future: Building an Environmental Monitoring System for the Oilsands*, report to the Minister of the Environment (2010) http://www. ec.gc.ca/pollution/default.asp?lang=En&n=E9ABC93B-1; 3) Commissioner of the Environment and Sustainable Development, Auditor General of Canada, "2010 Fall Report of the Commissioner of the Environment and Sustainable Development," http://www.oag-bvg.gc.ca/internet/English/ parl_cesd_201012_e_34435.html; 4) Alberta Innovates – Technology Futures, 2010 *Regional Aquatics Monitoring Program (RAMP) Scientific Review* (2011). http://www.ramp-alberta.

org/UserFiles/File/RAMP%202010%20Scientific%20Peer%20 Review%20Report.pdf. 5) Water Monitoring Data Review Committee, *Evaluation of Four Reports on Contamination of the Athabasca River System by Oilsands Operations*, report to the Government of Alberta (2011) http://environment.alberta. ca/03380.html and 6) Environment Canada, *Lower Athabasca Water Quality Monitoring Program: Phase 1. Athabasca River Mainstem and Major Tributaries* (2011), 5. http://www.ec.gc.ca/Content/C/C/D/ CCD671FE-57FE-4030-B205-9478C7640982/WQMP_ENG. pdf

[26] Environment Canada, Lower Athabasca Water Quality Monitoring Program: Phase 1.

[27] Kelly et al., "Oil sands development contributes polycyclic aromatic compounds to the Athabasca River and its tributaries."; Erin N. Kelly, David W. Schindler, Peter V. Hodson, Jeffrey W. Short, Roseanna Radmanovich, and Charlene C. Nielsen, "Oil sands development contributes elements toxic at low concentrations to the Athabasca River and its tributaries," *Proceedings of the National Academy of Sciences of the United States of America* 107 (2009). http://www.pnas.org/content/107/37/16178.full.pdf+html

[28] Work is underway to complete a framework: Groundwater Working Group, Athabasca Oilsands (AOS) Groundwater Quality Study, 10.

[29] Julia Ko and William F. Donahue, *Drilling Down: Groundwater Risks Imposed by In Situ Oil Sands Development* (Water Matters, 2011). http://www.water-matters.org/docs/drilling-down.pdf

[30] Royal Society of Canada Expert Panel, 136, and Oilsands Advisory Panel, *A Foundation for the Future*, 13.

[31] Alberta Environment and Fisheries and Oceans Canada, *Water Management Framework: Instream Flow Needs and Water Management System for the Lower Athabasca River* (2007). http://environment.alberta.ca/documents/Athabasca_RWMF_Technical.pdf

[32] Imperial Oil Limited, Imperial Kearl Oilsands Mine Application (no. 1408771 & 1414891, volume 4), (2005), 3-31.

[33] *Royal Society of Canada Expert Panel*.

[34] A.J. Squires, C. Westbrook, and M. G. Dube, "An approach for assessing cumulative effects in a model river, the Athabasca River basin," *Integrated Environmental Assessment and Management* 6 (1) (2009). http://homepage.usask.ca/~cjw842/images/Squires%20et%20al%202010.pdf

[35] ERCB, "Directive 074: Tailings Performance Criteria and Requirements for Oil Sands Mining Schemes," (2009). http://www.ercb.ca/docs/documents/directives/Directive074.pdf.

[36] The reclaimed area represents just 2.2 km^2 of the 171.6km^2 currently occupied by toxic tailings lakes.

[37] Andrea Grant and Lynne C. Myers, *Canada's Oil Sands* (Parliamentary Information and Research Service, 2004). http://dsp-psd.pwgsc.gc.ca/Collection-R/LoPBdP/PRB-e/PRB0437-e.pdf.

[38] M. Price, 11 Million Litres a Day: *The Tar Sands' Leaking Legacy* (Environmental Defence, 2008), http://www.environmentaldefence.ca/reports/tarsands_dec_2008.html; *Royal Society of Canada Expert Panel*.

[39] Pembina Institute and Water Matters, *Tailings Plan Review* (2009). http://www.pembina.org/pub/1934

[40] Calculations completed by the Pembina Institute and Water Matters based on data from company submissions to the ERCB. See Jennifer Grant, Simon Dyer, Nathan Lemphers and Jennifer Dagg, *Northern Lifeblood* (The Pembina Institute, 2010). http://www.pembina.org/pub/2051

[41] Ibid.