ENVIRONMENTAL | DEFENCE
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Panel Secretariat, Joint Review Panel
Joslyn North Mine Project
Energy Resources Conservation Board
2nd Floor, P.O. Box 15
9915 Franklin Avenue
Fort McMurray, AB T9K 2K4

August 11, 2010

RE: CEAR reference number 08-05-37519

Dear Sir/Madam:

As evidence to inform your deliberations on Total's Joslyn proposal, please find attached:

1. Our December 2008 report on leakage of toxic materials from tar sands tailings ponds
2. The background calculations for the numbers in the December 2008 report
3. A Citizens' Submission filed with the Commission for Environmental Cooperation regarding the failure of the Canadian Government to enforce the *Fisheries Act* with regards to tailings pond leakage
4. An addendum to the Citizens' Submission
5. Our May 2010 report on increasing air pollution from the tar sands and the failure of the Canadian Government to live up to its commitments in this regard

Taken together, we believe this information demonstrates the ongoing failure of regulators – and for this information in particular, federal regulators – to provide responsible management of tar sands impacts.

The fatal flaw in past Joint Review Panel rulings on tar sands strip mines has been the failure to require regulators to follow through on their responsibility to set and enforce hard limits on adverse impacts. Each time the Joint Panel allows process (eg. monitoring or "multi-stakeholder" discussions) to take the place of substance (eg. actual hard caps on pollution), it lets the regulators off the hook, with the end result that the significant adverse environmental impacts of tar sands activities continue to grow, contrary to the intent of the *Canadian Environmental Assessment Act*.

There is nothing different in the Total Joslyn proposal or in the stated intentions of the Canadian or Alberta governments that would remedy this situation. All of the adverse impacts would simply get worse. We therefore call upon the Joint Review Panel to reject this proposal until such time as the regulators begin to take their jobs seriously.

Yours sincerely,

<original signed by>

Matt Price
Policy Director

11 MILLION LITRES A DAY

THE TAR SANDS' LEAKING LEGACY

DECEMBER 2008

ENVIRONMENTAL | DEFENCE

ENVIRONMENTAL DEFENCE protects the environment and human health. We research solutions. We educate. We go to court when we have to. All in order to ensure clean air, clean water and thriving ecosystems nationwide, and to bring a halt to Canada's contribution to climate change.

ACKNOWLEDGEMENTS

Author – **Matt Price**

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ENVIRONMENTAL DEFENCE would like to thank supporters of its tar sands work, including the **EJLB Foundation** and the **Glasswaters Foundation.**

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Executive Summary

The Government of Alberta is telling the world that it is managing the vast toxic tailings ponds being created by tar sands mining so that toxic leakage from the ponds does not enter the groundwater.

This is untrue.

Virtually everyone close to the tar sands industry knows that all tar sands tailings ponds leak – even the new ones – and that while steps are taken to recapture the leakage, a significant portion of contaminated water still escapes into the environment.

For the first time, this report uses industry information to arrive at a conservative estimate of what the overall leakage from the tar sands tailings ponds is today, and also what it would likely be if proposed projects go ahead.

The results are staggering.

Already, the ponds are leaking over 11 million litres a day of contaminated water into the environment, which is equivalent to over 4 billion litres a year – enough to fill the Toronto Skydome two and a half times.

And, should proposed projects go ahead on schedule, by 2012 this annual leakage rate would increase five-fold to 72 million litres a day, or over 25 billion litres a year – enough to fill the Skydome over 16 times.

LEAKAGE LOST	2007	2012*
Litres Per Hour	465,800	3,006,900
Litres Per Day	11,179,200	72,165,600
Litres Per Month	335,376,000	2,164,968,000
Litres Per Year	4,024,512,000	25,979,616,000

* There have been significant delays in new projects, so timelines may change.

Adding up the annual leakage, the cumulative toxic leakage into the groundwater could reach almost a trillion litres by 2080, and that is without counting the new projects that will inevitably be proposed. This amount would fill Olympic swimming pools placed end to end from St. Johns, Newfoundland to Victoria, BC four times over.

Tar sands tailings water is widely acknowledged to be harmful to human health and the environment. Experiments with this water on fish have shown serious reproductive impacts. Studies on birds have found increased mortality rates, and experiments on plants have shown delayed germination and lower seedling weights. The tailings include naphthenic acids, which are acutely toxic and known to persist for many years, making tailings leakage a long-term contamination problem for the Athabasca watershed, the Mackenzie drainage it runs into, and the Boreal forest.

Tailings ponds leak because they are built on bare ground that conducts water, and their walls are made from the materials dug from the bitumen mining process, which also conduct water. Companies try to capture leaking water using ditches and intercept wells, but a portion escapes into the environment.

There are no public studies about the impacts of the overall toxic leakage today, nor are there public studies about the impacts of a five-fold expansion of this leakage that is projected over a short time span. Tar sands companies self-monitor groundwater contamination and give this information to the Alberta Government, but this is not made public. Monitoring of surface water in the tar sands region is done by an industry dominated body that independent experts have found lacking.

Both the Alberta and federal governments have jurisdiction over the discharge of harmful substances like tailings pond leakage. The Alberta Government is sanctioning the leakage through its permitting system. The federal government is failing to enforce its *Fisheries Act* by deferring to the province. Because Alberta refuses to act, tar sands tailings pond leakage will not end until the Canadian government enforces its own law.

Resumé

Le gouvernement de l'Alberta clame aux quatre horizons qu'il gère les énormes bassins de décantation toxiques qui sont le fruit de l'extraction des sables bitumineux, et que les fuites toxiques s'écoulant des bassins ne pénètrent pas dans l'eau souterraine.

C'est faux.

Pratiquement tous ceux qui vivent près de l'industrie d'extraction des sables bitumineux savent que tous les bassins de décantation ont des fuites – même les plus récents – et que, bien que des mesures soient prises pour récupérer l'eau qui s'échappe, une portion importante de l'eau contaminée réussit à se frayer un chemin dans l'environnement.

Pour la première fois, ce rapport présente, à l'aide des données de l'industrie elle-même, une estimation conservatrice de la quantité d'eau qui s'échappe actuellement des bassins de décantation et de la situation qui prévaudra vraisemblablement si les projets proposés voient le jour.

Les résultats sont bouleversants.

Déjà, plus de 11 millions de litres d'eau contaminée s'échappent chaque jour pour se perdre dans l'environnement, c'est-à-dire plus de 4 milliards de litres par an – de quoi emplir deux fois et demie le Skydome de Toronto…

Et, si les projets proposés vont de l'avant selon l'horaire prévu, d'ici 2012, ce taux de fuites annuelles quintuplerait, pour atteindre 72 millions de litres par jour, ou plus de 25 milliards de litres par an – de quoi emplir le Skydome plus de 16 fois.

FUITES	2007	2012*
Litres par heure	465,800	3,006,900
Litres par jour	11,179,200	72,165,600
Litres par mois	335,376,000	2,164,968,000
Litres par mois	4,024,512,000	25,979,616,000

* Les nouveaux projets connaissent des retards importants; il se peut que les dates diffèrent.

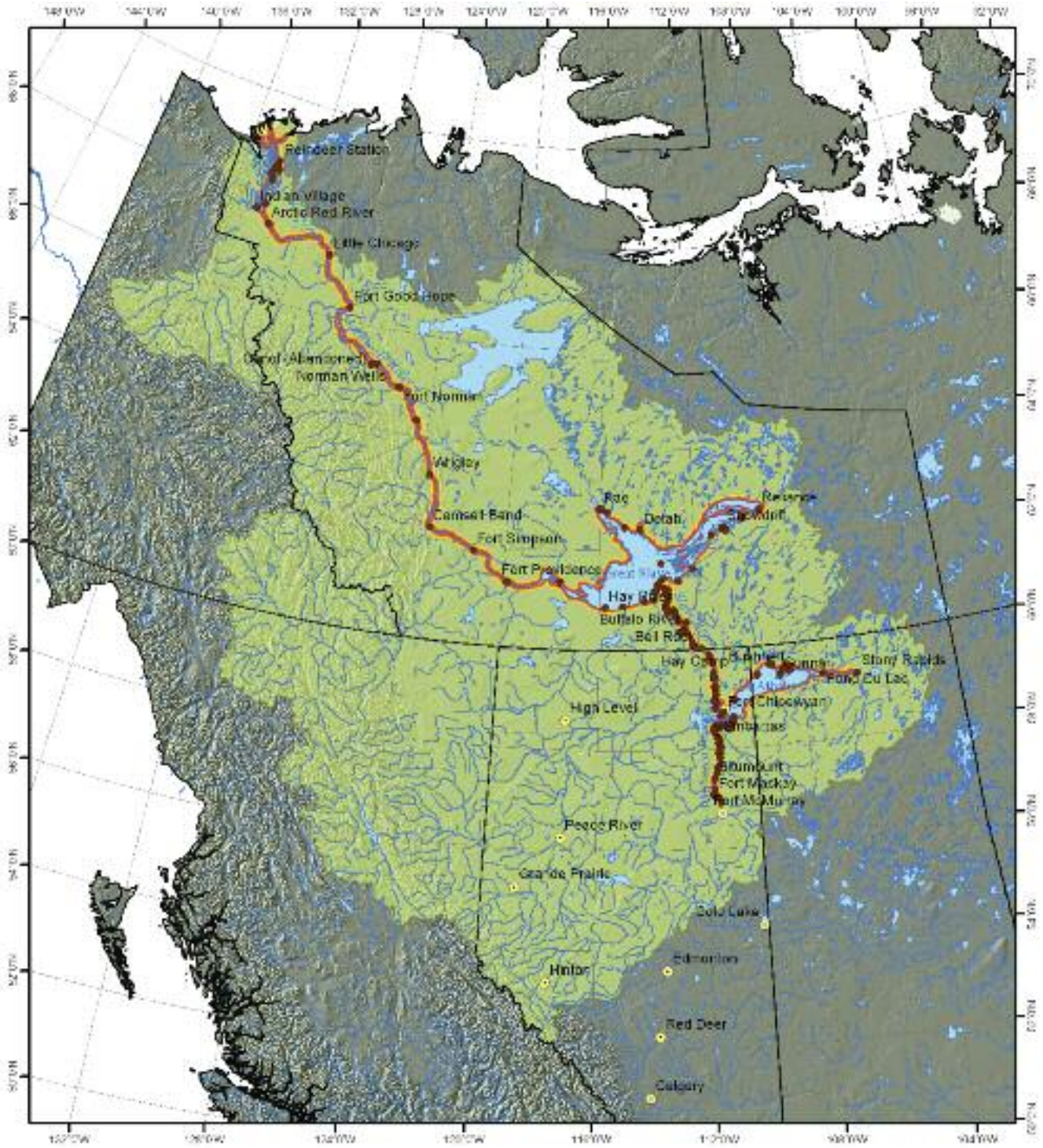
Si l'on additionne les fuites annuelles, la totalité de l'eau toxique qui se retrouve dans l'eau souterraine pourrait atteindre près d'un billion de litres d'ici 2080, et ce, sans même compter les nouveaux projets qui ne manqueront pas d'être mis de l'avant. Avec une telle quantité d'eau, on pourrait remplir des piscines olympiques, placées bout à bout, de St. Johns (Terre-Neuve) jusqu'à Victoria (C.-B) quatre fois.

Il est bien connu que l'eau des bassins de décantation des exploitations de sables bitumineux est néfaste pour la santé et pour l'environnement. Les expériences faites avec cette eau ont montré qu'elle avait des effets très graves sur la reproduction du poisson. Des études portant sur les oiseaux ont révélé des taux de mortalité accrus et les expériences sur les plantes ont montré un retard dans la germination et une taille inférieure de la plante. Les résidus contiennent des acides naphténiques, une matière toxique à effets aigus connue pour sa capacité de persister pendant de nombreuses années, ce qui fait de ces fuites un problème de contamination à long terme pour le bassin hydrographique Athabasca, le réseau hydrographique du Mackenzie dans lequel il se déverse, ainsi que la forêt boréale.

Les bassins de décantation fuient parce qu'ils ont été construits sur le sol dénudé, sur lequel l'eau peut s'écouler, et que les côtés des bassins sont faits de matériel obtenu lors de l'extraction du bitume qui, lui aussi, permet à l'eau de s'écouler. Les sociétés concernées tentent de récupérer les fuites en creusant des fossés et des puits pour les intercepter, mais une partie de ces eaux finit toujours par s'échapper.

Il n'existe actuellement aucune étude publique sur l'impact de toutes ces fuites toxiques, et il n'existe également aucune étude publique sur l'impact qui découlerait de la multiplication par cinq de ces fuites – ainsi que l'on projette de le faire – dans un court laps de temps. Les sociétés qui procèdent à l'extraction des sables bitumineux font elles-mêmes le suivi de la contamination de l'eau souterraine et transmettent ensuite cette information au gouvernement de l'Alberta, mais ces données ne sont pas rendues publiques. Le suivi de l'eau de surface dans la région des sables bitumineux est effectué par un organisme qui relève de l'industrie et que des experts indépendants n'ont pas trouvé à la hauteur de sa tâche.

L'écoulement de substances dangereuses, telles celles provenant des fuites des bassins de décantation, relève du gouvernement de l'Alberta et du gouvernement fédéral. Le gouvernement de l'Alberta approuve ces fuites par le biais de son système de licences. Le gouvernement fédéral évite de faire appliquer sa Loi sur les pêches en s'en remettant à la province. Et parce que l'Alberta refuse d'agir, les bassins de décantation continueront de fuir tant et aussi longtemps que le gouvernement du Canada ne fera pas appliquer sa propre loi.



Downstream Waterbodies from the Bituminous (tar/oil) Sands Area

10 km zone around downstream waterbodies

10 km

0 km

Populated places within 10 km of downstream waterbodies

Mackenzie River basin

Projection: 10 TM
Central Meridian: -115.0
Scale Factor: 0.9992
Origin: 0.0
Linear Unit: Meter
Easting: 500000
Datum: NAD 1983

Introduction

This study documents the existence of widespread and increasing leakage – often called "seepage" – of toxic chemicals from tar sands tailings ponds.

As part of its tar sands public relations campaign, the Government of Alberta is circulating a brochure on the tar sands with the claim that measures are taken in the tar sands "to prevent any seepage from entering groundwater systems or waterways."[1]

In the Alberta Legislature, the Alberta Premier and Environment Minister have dismissed evidence of tailings leakage by suggesting that this is only a problem with older tailings ponds, or that leaking water is captured.[2]

These statements contradict what virtually everyone close to the tar sands industry knows: that all tar sands tailings ponds leak, even the new ones, and that while steps are taken to capture this leakage, these steps are imperfect and there is a significant loss of contaminated water into the environment.

We therefore concluded that the truth about tailings ponds leakage would not penetrate until someone calculated *how much* they leak into the environment, so that the debate can progress to discussing the magnitude of the problem, rather than whether such a problem exists.

This study uses industry information to estimate what the overall leakage rate is for tar sands tailings ponds both now and into the future. This information is estimated on a project-specific basis by companies in their project applications, but it has never been publicly put together to come up with an overall leakage rate.

Requests to the Alberta Government regarding what the overall leakage rate is have so far gone unanswered. We welcome a public debate on the magnitude of the tailings ponds leakage problem in the tar sands. Such a debate is critical to the health of the Athabasca watershed, to the people who live there, and indeed to the entire Mackenzie Valley drainage into which the Athabasca empties – an area comprising a fifth the size of Canada and much of Canada's Boreal forest.

"…the principal environmental threats from tailings ponds are the migration of pollutants through the groundwater system and the risk of leaks to the surrounding soil and surface water…the scale of the problem is daunting…" **NATIONAL ENERGY BOARD** [3]

What are Tailings?

Many have seen pictures of the massive toxic tailings "ponds" – a misnomer considering they are now as big as lakes. A bright spotlight was shone on these toxic lakes in April, 2008 after five hundred ducks were killed after landing on one of them.

Tar sands companies want the dense bitumen that's mixed in with sand, silt, and clay. After digging up the mixture, they separate the materials from one another using hot water. Following the recovery of bitumen, there is a large quantity of unwanted water, sand, silt, and clay contaminated with leftover hydrocarbons and other toxic substances.

This waste stream is called "tailings" and is piped into giant pits that the companies build using the materials they dig out of the ground as part of mining. The tailings areas are constructed over the top of bare ground.

The theory is that the solids settle out from the liquids over time, allowing the water to be recycled and the solids to be buried during "reclamation." The reality, however, is that the settling process for the finest tailings has turned out to take much longer than expected – up to 150 years[4] – meaning that these tailings lakes will remain a toxic legacy long after industry has left.

THE PROBLEM IS MASSIVE

It is important to understand the scale of the tailings problem. The industry on average produces about 2,000 to 2,500 litres of tailings per barrel of bitumen, and given levels of production this results in the production of about 1.8 billion litres of tailings every day.[5]

Since mining began in 1968, one study estimates that there are five and a half trillion litres of tailings now on the landscape.[6] These huge toxic tailings lakes now cover an area over 130 square kilometers.[7]

With such massive numbers, there should be no surprise that there is a significant problem with leakage.

TAILINGS ARE TOXIC

Several studies have found tailings pond water to be acutely toxic. An experiment with goldfish in tailings waters found adverse impacts on endocrine functioning.[8] A study of tree swallows on wetlands that used tailings water found that the odds of dying on the sites using the most tailings water were ten times higher than those on the control site.[9] An experiment to assess the impacts of tailings water on plants found that it slows germination in several plant species, and led to reduced weight in seedlings.[10]

These are some of the contaminants of major concern in tailings water:

- **Naphthenic Acids:** Naphthenic acids can be found in tailings ponds at levels over a hundred times those found in nearby rivers.[11] In addition to being acutely toxic, the naphthenic acids associated with the tar sands ponds do not easily break down in the natural environment.[12] The combination of toxicity and slow breakdown rates means water contaminated with naphthenic acids poses a threat to the environment for decades.[13]

- **PAHs:** Polycyclic Aromatic Hydrocarbons (PAHs) are known to be carcinogenic and mutagenic. PAHs are relatively non-soluble, and are therefore known to settle in sediment and to degrade slowly. Exposure of aquatic organisms to PAHs is associated with liver tumours and Environment Canada has concluded that certain PAHs pose a threat to human life or health.[14]

- **Other Contaminants**[15]**:** Trace metals such as copper, zinc and iron can exist at concentrations that exceed the Canadian water quality guideline for freshwater aquatic life. Tailings have also been found to contain residual bitumen – for example, Suncor's tailings pond contained 9% residual bitumen and diluent.

TAILINGS PONDS ARE ALREADY LEAKING THE EQUIVALENT OF TWO-AND-A-HALF TORONTO SKYDOMES FULL OF CONTAMINATED WATER INTO THE ENVIRONMENT EVERY YEAR.

Tar Island Dyke – a special case

Tar Island Dyke was constructed in mid 1960's by Suncor and has been expanded several times. It is now 92 metres high and stands directly next to the Athabasca River. Tailings are no longer placed in the pond.

The current leakage rate of contaminated water from Tar Island Dyke into the river is estimated to be 67 litres a second or almost 6 million litres a day.[16]

The leakiest tar sands tailings pond gets most of the attention, but it is important to note that while Tar Island Dyke is probably the worst tailings pond for leakage – especially leaking directly into the Athabasca River – all tailings ponds leak, even the new ones.

How do Tailing Ponds leak?

ALL TAILING PONDS LEAK

Tailings ponds leak because they are built directly on ground that conducts water, and the ponds have walls that are built out of the material that tar sands companies take out of the ground, which also conducts water.

This means that contaminated water from the tailings ponds leaks through the base and the sides of the tailings ponds. Leakage through the base can also be more severe depending on the nature of the ground. Suncor's south tailings pond, for example, is built over glacial meltwater channels that provide faster pathways for leaking water.[17]

THE TAR ISLAND DYKE IS NOTORIOUS FOR LEAKING CONTAMINATED WATER DIRECTLY INTO THE ATHABASCA, BUT ALL TAILINGS PONDS LEAK.

STEPS TO SLOW AND RECOVER TAILINGS WATER ARE IMPERFECT

Tar sands companies do try to slow down leakage and to recapture contaminated water that does escape, but they do not get it all. These are some of the ways they do this:

- **Thickeners** – Companies are experimenting with various ways to make the fine tailings settle out faster and thereby reduce the overall amount of tailings available to leak.

- **Drainage Ditches –** Drainage ditches are dug around tailings ponds to collect leaking water, and it is pumped back into the ponds. But these ditches only catch leaking water at relatively shallow depths.[18]

- **Interception Wells –** Interception wells are dug beyond the drainage ditches to try to catch contaminated water before it leaves the company's lease boundary or enters rivers or lakes.

- **Barriers –** When leakage can be transported quickly in underground channels, barriers may be built such as the "grout curtain" installed at Syncrude's Aurora project.

How much leakage do these kinds of efforts catch? That is a hard question to answer since when company estimates do exist, they vary significantly, not just from company to company but also from year to year.

The information provided by CNRL (Horizon) and Shell (Muskeg River Mine) indicates they will capture all "shallow" leakage from their tailings ponds, but not the leakage to deep aquifers, which runs at about a third of the overall rate. PetroCan (Fort Hills) estimates that it will lose about 15 percent of its overall leakage.[19]

It should be noted that there are differences in terrain, meaning that there will be differences in how fast the tailings ponds leak depending on how fast any given piece of ground conducts water. One study suggests that industry is now encountering more shallow sand on new sites,[20] so leakage could speed up.

"SELF SEALING"

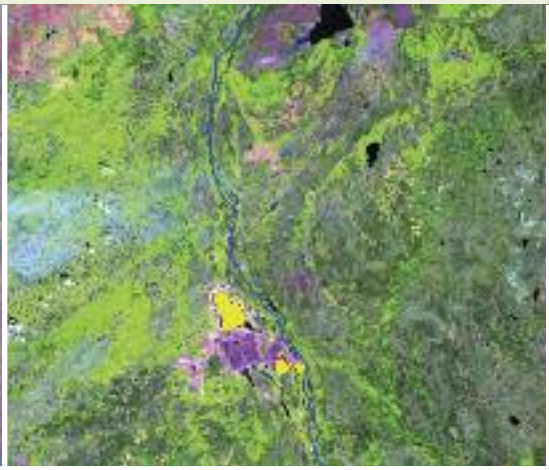
Industry claims that tailings ponds "self seal" over time. The University of Waterloo has found that leakage declines over time for two reasons. "First, clay and silt sized tailings accumulate at the bottom of the tailings impoundment and act to minimize seepage. Second, permeability is reduced as residual bitumen from the tailings stream forms bitumen mats in the beaches of coarser grained tailings along the edges of the tailings impoundment." [21]

Even though the concept of "self sealing" has not been adequately proven or measured, this study has given the benefit of the doubt to industry on this issue, assuming that this does indeed take place, and has reduced the estimated overall leakage rate accordingly. Industry does not claim, however, that tailings ponds entirely self-seal; they acknowledge there will always be some leakage.

The growth of tar sands mining and tailings ponds is exploding. Tailings ponds now cover 130 square kilometres. This is a sequence of satellite shots from 1974 to 2006, with the final one showing a projection of approved ponds not yet built. The ponds are in yellow.

Credit: Global Forest Watch Canada

1974



1992

THE LONG TERM – CAPPED TOXIC LAKES

Even when the tar sands industry realized it had a problem with the failure of finer tailings to settle out on a timeline to make reclamation possible, it barreled ahead with increased production of both bitumen and tailings, assuming that it could somehow figure things out.

The result is a proposed experiment with the lands and waters of Northern Alberta, putting toxic waste into something called "End Pit Lakes."

The basic idea is that towards the end of a useful bitumen mine, the company would decommission the tailings ponds and transfer the unsettled liquid tailings into the pits from which it has dug the bitumen in the first place. A layer of fresh water would be added over the top of the tailings, the landscape would be built so that water drains in and out of the End Pit Lakes, and then industry would walk away.

At least 25 End Pit Lakes are planned for the tar sands region within the next 60 years despite the fact that nobody really knows how they will perform.[22]

Each year tar sands tailings ponds are already leaking the equivalent of two and a half Toronto Skydomes full of toxic water into the environment, and this could quickly grow to 16 Skydomes.

2002 | 2006 | APPROVED PONDS

What is the overall leakage rate?

METHOD

There has not yet been a public attempt to come up with an estimate of how much tar sands tailings ponds are leaking overall, and what this rate could be if the many new mines go ahead using the same planned approach to tailings.

We therefore contracted Pembina Corporate Consulting to go through the industry proposals to put together this figure. Based on the companies' own data, Pembina produced several scenarios for leakage rates using different assumptions that can be found on the **Environmental Defence** website at **www.environmentaldefence.ca.**

This report has chosen a conservative scenario. This means the leakage problem could be much larger than this report estimates.

This is the method of the scenario we selected:

1. Wherever it exists, Pembina used the specific company information on leakage rates.
2. Where companies did not provide this information, Pembina applied an average leakage rate calculated using the numbers from the companies that did. These averages were applied on the basis of leakage per barrel of bitumen proposed to be produced.
3. Benefit of the doubt was given that tailings ponds largely "self seal" over time, and it was assumed that all ponds largely self seal after 18 years, but that some leakage still occurs. Pembina estimated that sealed ponds leak 85% less than un-sealed ponds.[23]

4. Due to lack of information, it was assumed that existing ponds have largely "self sealed," even though this is probably untrue and therefore under-estimates the current leakage rate. Tar Island Dyke, though, is a special case, and Pembina applied the leakage numbers calculated by the University of Waterloo, but assumed that leakage from Tar Island Dyke would reduce to a long term 'normal' leakage rate after 5 years.
5. The numbers were added together on an annual basis, using start-up dates and production numbers provided by the companies, and therefore arriving at overall leakage rate by year.
6. The final overall leakage rate is what escapes from the ponds after recovery steps have been taken. In other words, this is the leakage that the companies don't catch.

LIMITATIONS

Although the leakage values presented in this report are both rationally developed and conservative, there are several limitations to the calculations used. These are:

- **Slowdown:** With the recent pull back in the price of oil and delays by tar sands companies, the timelines in this analysis may need adjusting, depending on how this reduction in development actually plays out. In any event, a slowdown would not have any affect on calculated current leakage rates.

- **Use of Averages:** Determining leakage rates is a complex task. This analysis does not attempt to develop numbers based on the unique geological characteristics of each site. Where information was unavailable, averages were applied that were calculated from the companies that did provide it.

- **The Very Long-Term:** Mine closure includes the construction of End Pit Lakes (see above) and the burying of tailings into the landscape. Both will continue to leak contaminated water into the environment. This analysis does not attempt to quantify the very long-term – i.e. more than several decades into the future – leakage rates for these sources.

RESULTS – MASSIVE LEAKAGE

Even with a conservative methodology, the estimated cumulative leakage numbers are huge.

In 2007, the tailings ponds were already losing over 11 million litres a day to the environment, or about four billion litres a year.

Four billion litres a year is the equivalent of filling the Toronto Skydome to the roof about two and a half times.[24]

LEAKAGE LOST	2007	2012*
Litres Per Hour	465,800	3,006,900
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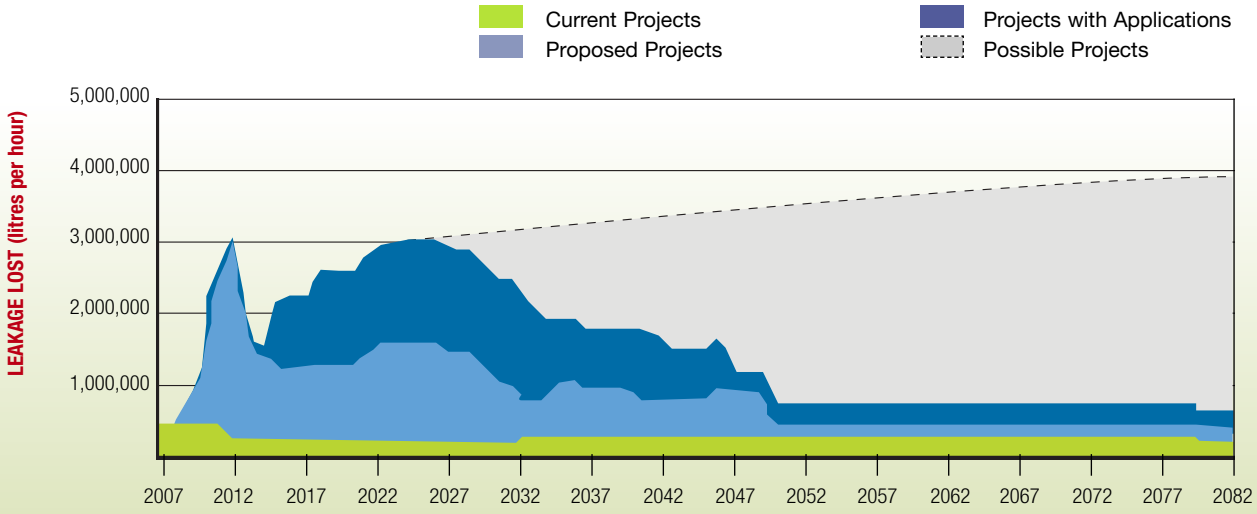
Litres Per Month	335,376,000	2,164,968,000
Litres Per Year	4,024,512,000	25,979,616,000

* There have been significant delays in new projects, so timelines may change.

Estimates of current and proposed projects – and there may indeed be more announced – show leakage rising rapidly. In 2012, overall leakage could grow five fold to about three million litres an hour, or over 25 billion litres a year – enough to fill the Skydome over 16 times.

Adding up the annual leakage, the cumulative toxic leakage into the groundwater could reach almost a trillion litres by 2080, and that is without counting the new projects that will inevitably be proposed. This amount would fill Olympic swimming pools placed end to end from St. Johns, Newfoundland to Victoria, BC four times over.[25]

AGGREGAGED RATE - LEAKAGE LOST TO ENVIRONMENT



This graph shows the estimated overall tailings ponds leakage rate for existing and proposed ponds starting up and "self sealing" at different times. New ponds will likely be proposed though, meaning that the overall rate would keep going up. The timelines in the graph will change due to recent project delays.

Source: Based in part on data from Pembina Corporate Consulting

Impacts

There has not been a public assessment of the existing cumulative contaminated leakage from the tar sands tailings ponds, nor has there been a public assessment of the likely impacts of the vastly increased future toxic leakage.

WHAT THE COMPANIES SAY

To date, the only public information comes from the tar sands companies themselves, who model the impacts of their specific leakage on the groundwater and associated surface waters as part of their project proposal processes. This raises several concerns, including:

- **Independence.** Tar sands companies are trying to get approvals and therefore have an incentive to reach conclusions that minimize concerns.
- **Incrementalism.** Each tar sands company models its own additional impact, but does not model the regional impact several years from now when cumulate leakage will be many times greater than today.
- **Reality.** Modeling of impacts is educated guesswork, and because companies use different models, this creates even greater uncertainty. In reality, groundwater flow is not yet well understood.

Despite these concerns, the project approval process has never rejected a tar sands mine or associated leaking tailings ponds. Some of the evidence presented on leakage during these processes, though, is instructive:

- The Suncor Millenium tailings pond proposal highlighted the existence of underground channels that conduct contaminated water, in this case towards McLean Creek. Suncor outlined how it would have to operate mitigation measures for 60 years after the closure of the pond to prevent contamination from reaching the creek.[26] The Alberta Energy and Utilities Board approved the application despite concluding that the information about groundwater was imperfect, that unknown pathways for the transport of leakage into McLean Creek could exist, and that regional groundwater modeling needed to be done.
- The Shell Jackpine proposal again showed leakage reaching surface water – this time Jackpine Creek.[27] Regarding changes in groundwater quality, Shell indicated "These changes will be long term and irreversible."[28] The joint federal-Alberta panel then went on to call for an initiative to assess the regional impacts on groundwater,[29] but approved the mine and leaking tailings pond anyway.
- The Shell Albian Sands proposal saw Shell disagreeing with Environment Canada's requests to update predictions as new data became available, to include public

reporting, and to include external scientific peer review. Shell also disagreed with recommendations to collect further baseline water and sediment samples from the Muskeg River watershed prior to project initiation.[30]

- The CNRL Horizon proposal predicted that it would exceed several parameters of the provincial water quality guidelines for the protection of aquatic life and/or human health guidelines.[31]
- The Imperial Kearl proposal acknowledged that understanding of groundwater flows was incomplete.[32] Imperial indicated leakage could reach 1,000 litres a second and that measures were needed to prevent this from reaching the Firebag River and its tributaries.[33] The tailings pond was proposed to lie atop permeable deposits.[34]

Overall, the proposals processes show decisions about tailings leakage being made based upon incomplete information, with the regulators repeatedly asking for more analysis but always giving approvals without it.

THE MONITORING MESS

Alberta Environment requires companies to self-monitor tailings pond leakage in groundwater. Companies drill monitoring wells around their leases and send this information to government. Pembina's attempts to access this information have so far been unsuccessful, adding concerns about transparency and accountability to the concern about the conflict of interest inherent in self-monitoring.

Since the basic approach to tailings pond leakage is to hope that it does not show up in surface waters, a key question is how surface water quality is monitored. Both the federal and Alberta governments have delegated much of their responsibility for surface water quality monitoring in the tar sands to the increasingly mischaracterized "multi-stakeholder" body called the Regional Aquatic Management Program (RAMP).

Despite calling RAMP a "multi-stakeholder" body, it is funded and dominated by the tar sands companies, and First Nations and environmental organizations have now distanced themselves from the organization due to concerns over impartiality and competence.[35]

An independent expert review of RAMP in 2004 found "significant concerns" with scientific leadership, effective design, and a failure to incorporate a regional approach.[36] Alberta journalist Andrew Nikiforuk followed up in 2008 to find the outside reviewers lamented the failure to fix the problems, with one noting that industry monitoring efforts such as RAMP often design things to find industrial activity acceptable.[37]

RAMP has so far concluded that surface water quality has not been significantly impacted by tar sands activity.

"These changes will be long term and irreversible."

— **SHELL** ON IMPACTS TO GROUNDWATER QUALITY

What's At Stake

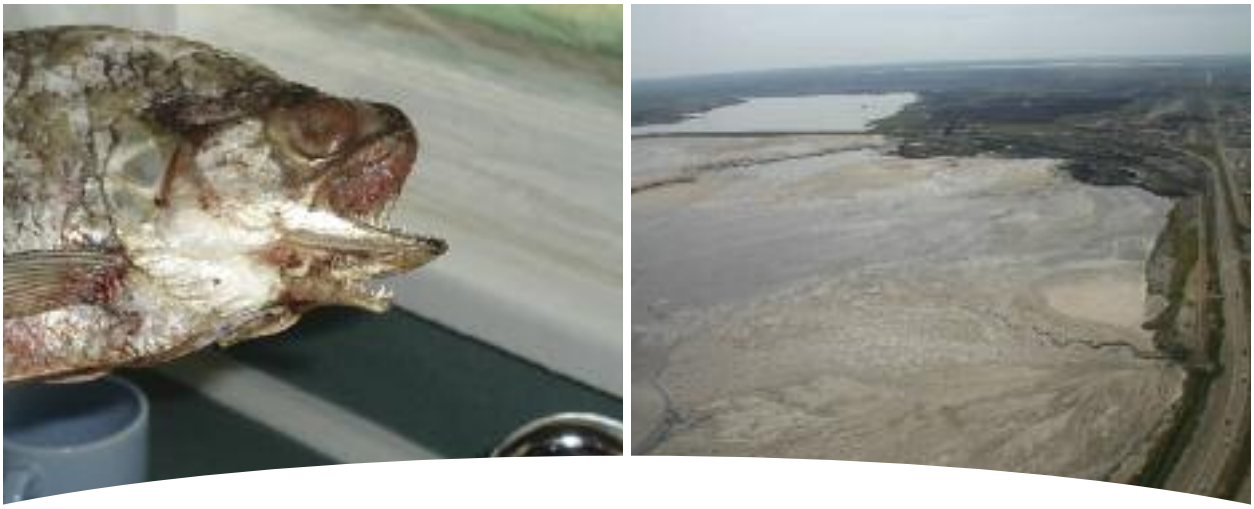
The people of Fort Chipewyan are living in fear of what tar sands pollution may be doing to their water, the fish and wildlife they depend on, and their health. The predominantly First Nations community sits on Lake Athabasca, about 200 km downstream of the tar sands mines.

Family doctor John O'Connor has become a hero in the community after speaking out about the high incidence of very rare cancers and being persecuted by government authorities as a result.

Dr. O'Connor found that at least three residents and likely two more have died of cholangiocarcinoma, a deadly cancer of the bile duct that occurs in one case for 100,000 people. Fort Chipewyan's population is about 1,000 people.

Alberta Health and Wellness and Health Canada brought misconduct charges against Dr. O'Connor in 2006 with the College of Physicians and Surgeons of Alberta. He has so far been cleared of most of the charges, with one pending.

Credit: Ron Plain



(left) DEFORMED FISH HAVE BEEN SHOWING UP DOWNRIVER FROM THE TAR SANDS. THIS TWO-JAWED FISH WAS CAUGHT IN FORT CHIPEWYAN IN THE SUMMER OF 2008. (right) UNLESS THINGS CHANGE, TOXIC TAILINGS PONDS LEAKAGE COULD INCREASE FIVE-FOLD WITHIN A DECADE.

Regulatory Responsibility

The failure of the relevant regulatory agencies to adequately deal with tailings ponds fits into the overall failure to protect the environment in the tar sands. Because environment is a shared jurisdiction in Canada, this failure belongs to both the Alberta and the federal governments.

EXPOSING THE ALBERTA GOVERNMENT'S "ZERO DISCHARGE" CLAIM

The Alberta Government monitors tailings ponds in two ways. First. the *Energy Resources Conservation Act* sets up the Energy Resources Conservation Board (ERCB) to approve tar sands projects under certain conditions. In June 2008, the ERCB proposed new directives on tailings management, none of which changed anything regarding tailings ponds leaking contaminated water. The ERCB is also responsible for ruling on environmental assessments for tar sands projects.

Second, the *Environmental Protection and Enhancement Act* (EPEA) prohibits the release of harmful substances into the environment, except where allowed by permit.[38] Alberta Environment therefore writes leakage into tar sands permits.

Some believe that because the EPEA prohibits the release of harmful substances that there is a "zero discharge" policy in the tar sands with regards to contaminated water. In fact, the billions of litres of contaminated water leaking from the tailings ponds are sanctioned by the Government of Alberta.

Because the Alberta government is in denial about the environmental impacts of the tar sands, it is unlikely to use its regulatory authority to end leakage from tar sands tailings ponds. Alberta Premier Stelmach called environmental concerns a "myth"[39] and instead ordered a $25 million public relations campaign to improve Alberta's image.[40] As seen above, part of that campaign includes materials saying that toxic leakage is prevented from entering groundwater.

THE FEDERAL GOVERNMENT'S FAILURE TO ENFORCE

The Canadian government has two laws pertaining to the discharge of contaminated tailings pond water into the environment.

First, the *Canadian Environmental Protection Act* (CEPA) is called by the Canadian government "the cornerstone legislation for preventing pollution in order to protect Canada's environment and the health of Canadians." Among the shortcomings of CEPA, however, is a reliance on the discretion of the government to officially name a substance as toxic and then to develop a regulatory response for it. CEPA therefore allows the federal government to regulate toxic tar sands ponds leakage, but does not compel it.

The Canadian *Fisheries Act,* however, has stronger provisions. Section 36(3) says:

> **…no person shall deposit or permit the deposit of a deleterious substance of any type in water frequented by fish *or in any place under any conditions where the deleterious substance or any other deleterious substance that results from the deposit of the deleterious substance may enter any such water* (emphasis added)**

Similar to the Alberta EPEA, the *Fisheries Act* allows the regulator to vary the prohibition through permitting or regulation-making activities, but in the case of toxic leakage from tar sands tailings ponds, neither is taking place.

Emphasis is added to the second part of 36(3) above because it is clear the *Fisheries Act* anticipates contaminants entering indirectly into waters frequented by fish. Environment Canada, which overseas enforcement of 36(3), says this about groundwater:

> **Any addition of undesirable substances to groundwater caused by human activities is considered to be contamination. It has often been assumed that contaminants left on or under the ground will stay there. This has been shown to be wishful thinking. Groundwater often spreads the effects of dumps and spills far beyond the site of the original contamination. Groundwater contamination is extremely difficult, and sometimes impossible, to clean up.** [41]

Environment Canada also acknowledges an ominous aspect of the tar sands tailings leakage problem – the impacts of today's groundwater contamination may take years to come to light:

> **Groundwater moves so slowly that problems take a long time to appear. Because of this, and because it is so expensive to clean up a contaminated aquifer (if it can be done at all), it is preferable by far to prevent contamination from happening in the first place.** [42]

Credit: Garth Lenz

TAR SANDS MINES FILL THE TAILINGS PONDS 24/7.

This is part of the reason some have characterized the tar sands as a "slow motion oil spill." It may take years to feel the full impacts of the pollution now taking place.

While there is a Canada-Alberta agreement on coordinating activities on deleterious substances,[43] the existence of a permit that sanctions tar sands tailings ponds leakage under the Alberta EPEA does not relieve the federal government of its responsibilities under s.36(3) of the *Fisheries Act*.

Factors that underline the duty of the federal government to step in on the tailings leakage issue include:

- Expressions of concern from federal officials in tar sands hearings about the weakness of information, modeling, standards, and monitoring with relation to water quality issues; [44]
- The trans-boundary nature of this problem given the proximity of downstream jurisdictions of Saskatchewan and the Northwest Territories;
- The double standard of having specific federal regulation of metals mining and tailings ponds, but not tar sands mining and tailings ponds; and
- The fiduciary duty the federal government has to First Nations, who have heightened concerns regarding water quality and health issues in the tar sands.

Left up to the Government of Alberta, the tailings leakage problem will only magnify. It is time for the Government of Canada to step in and enforce the *Fisheries Act*.

"It has often been assumed that contaminants left on or under the ground will stay there. This has been shown to be wishful thinking."

— ENVIRONMENT CANADA

ENDNOTES

1 "Alberta's Oil Sands. Opportunity. Balance," Government of Alberta, 2008, p. 6.

2 See Alberta Hansard, May 27, May 28, and June 4, 2008.

3 "Canada's Oil Sands: Opportunities and Challenges to 2015," National Energy Board, 2004.

4 "Fact or Fiction: Oil Sand Reclamation," Jennifer Grant et al, Pembina Institute, May 2008, p. 13.

5 "Fact or Fiction," p. 14 and p. 30.

6 Richard Nelson, "Cumulative Fine Tailings Inventory and Pace of Development," Alberta Energy Research Institute presentation at CONRAD 2006 Water Usage Workshop, March 28–29, 2006; cited in "Fact or Fiction," p. 14.

7 Backgrounder to press release, "ERCB releases draft directive on oil sands tailings management and enforcement criteria," June 26, 2008, Energy Resources Conservation Board and Government of Alberta.

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10 "Effects of an industrial effluent on plant colonization and on the germination and post-germinative growth of seeds of terrestrial and plant species," by A.U. Crowe et al, *Environmental Pollution*, volume 117, 2002, pp. 179-189.

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12 See: "Napthenic Acids in Athabasca Oil Sands Tailings Waters Are Less Biodegradable than Commercial Naphthenic Acids," Angela C. Scott et al, *Environ. Sci. Technol.* 2005, 39, 8388-8394.

13 Imperial Oil Resource Ventures Limited: Kearl Oil Sands Project - Mine Development Application and Supplemental Information," Imperial Oil Ltd., 2005, Volume 6.

14 See: http://www.ec.gc.ca/toxics/wood-bois/over/pah_e.htm

15 "Fact or Fiction," p. 36.

16 "Attenuation of Contaminants in Groundwater Impacted by Surface Mining of Oil Sands, Alberta, Canada," Jim Barker et al, November, 2007, slide 12.

17 "Design of Tailings Dams on Large Pleistocene Channel Deposits: A Case Study – Suncor's South Tailings Pond," by Brett Stephens et al, date unknown.

18 "Integrated Solid Phase, Aqueous Phase and Numerical Investigation of Plume Geochemistry at an Oil Sand Mining Facility" by Alexander Avraham Louis Oiffer, Master Degree Earth Sciences – Thesis: 257, Earth Sciences, University of Waterloo, Section 1.0 Introduction, p. 122.

19 See the sheets for these companies provided in the accompanying scenarios from Pembina. Available at www.environmentaldefence.ca

20 "Attenuation of Contaminants in Groundwater Impacted by Surface Mining of Oil Sands, Alberta, Canada," by Jim Barker et al, November 2007, slide 20.

21 "Integrated Solid Phase, Aqueous Phase and Numerical Investigation of Plume Geochemistry at an Oil Sand Mining Facility" by Alexander Avraham Louis Oiffer, Master Degree Earth Sciences – Thesis: 257, Earth Sciences, University of Waterloo, Section 1.0 Introduction, p. 4.

22 "Fact or Fiction," p. 31.

[23] Shell projected reduced leakage rates for ponds at their propsed Muskeg River Mine expansion, Jackpine Phase 1 and Jackpine Expansion. The average reduction in leakage rates for tailings ponds at these mine sites is 84% compared with leakage rates during the first 18 years of operation.

[24] This is based on the estimated volume of the Skydome at 1.6 billion litres. See: www.rogerscentre.com/about/facts/index.html

[25] This assumes filling a 50m long Olympic swimming pool requires 2.5 million litres, which divided into a trillion is 400,000 pools worth, laid end to end is 20,000 km worth. St. Johns to Victoria as the crow flies is about 5,000 km.

[26] Decision 2004-113, Suncor Energy Inc., Application for an External Tailings Pond, for the Millennium Mine, Fort McMurray Area, December 30, 2004, p. 17.

[27] Joint Panel EUB Decision 2004-009, Shell Canada Limited, Applications for an Oil Sands Mine, Bitumen Extraction Plant, Cogeneration Plant, and Water Pipeline in the Fort McMurray Area, February 5, 2004, p. 43.

[28] Ibid, p. 44.

[29] Ibid, p. 49.

[30] Joint Panel Report, EUB Decision 2006-128, Albian Sands Energy Inc., Application to Expand the Oil Sands, Mining and Processing Plant Facilities at the Muskeg River Mine, December 17, 2006. p. 43

[31] Joint Panel Report, EUB Decision 2004-005, Canadian Natural Resources Limited, Application for an Oil Sands Mine, Bitumen Extraction Plant, and Bitumen Upgrading Plant in the Fort McMurray Area, January 27, 2004. p. 47.

[32] Joint Panel Report, EUB Decision 2007-013, Imperial Oil Resources Ventures Limited, Application for an Oil Sands Mine and Bitumen Processing Facility (Kearl Oil Sands Project) in the Fort McMurray Area February 27, 2007, p. 37.

[33] Ibid, p. 37.

[34] Ibid, p. 37.

[35] Both the Athabasca Chipewyan First Nation and the Chipewyan Prairie First Nation wrote to RAMP expressing their concern in 2008, and the Pembina Institute has asked RAMP to remove its name from the RAMP website.

[36] "Oil Sands Regional Aquatic Monitoring Program (RAMP), Scientific Peer Review of the Five Year Report (1997-2001), Submitted to: RAMP Steering Committee, February 13, 2004, G. Burton Ayles et al., p.iv.

[37] "Tar Sands: Dirty Oil and the Future of a Continent," by Andrew Nikiforuk, Greystone Books, Vancouver, 2008, p. 72-3.

[38] *Alberta Environmental Protection and Enhancement Act*, Part 5, Division 1, 109.

[39] "Stelmach fights 'dirty' image of oilsands in Washington," Jason Markusoff, Canwest News Service, Wednesday, January 16, 2008.

[40] "Alberta the underdog in oilsands PR battle: Stelmach," Jason Markusoff, edmontonjournal.com, Wednesday, April 30, 2008.

[41] See: http://www.ec.gc.ca/water/en/info/pubs/FS/e_FSa5.htm

[42] See: http://www.ec.gc.ca/water/en/info/pubs/FS/e_FSa5.htm

[43] See: http://www.mb.ec.gc.ca/pollution/e00s62.en.html

[44] See for example: "Submission of the Department of the Environment (Environment Canada), Alberta Energy and Utilities Board, Canadian Environmental Assessment Agency Joint Panel Hearings, Imperial Energy Inc, Kearl Oil Sands Project, EUB Applications 1408771 and 1414891, 2 October 2006, pp. 82-86.

Appendix 1 – Methodology and Sample Calculations

Jeremy Moorhouse E.I.T.

December 2008

About the Pembina Institute

The Pembina Institute creates sustainable energy solutions through research, education, consulting and advocacy. It promotes environmental, social and economic sustainability in the public interest by developing practical solutions for communities, individuals, governments and businesses. The Pembina Institute provides policy research leadership and education on climate change, energy issues, green economics, energy efficiency and conservation, renewable energy and environmental governance. More information about the Pembina Institute is available at http://www.pembina.org or by contacting info@pembina.org.

Appendix 1 – Methodology and Sample Calculations

Table of Contents

List of Tables

List of Figures

1. Data and Detailed Methodology

1.1 Introduction

Environmental Defence contracted Pembina Corporate Consulting (Pembina) to quantify seepage from current and proposed oil sands mining operations. For the purposes of this report seepage is defined as process-affected water that seeps from current and proposed tailings ponds that by-passes proposed mitigation measures. Process-affected water is defined in this report as any water that is contained within external or in pit tailings areas.

Pembina developed five seepage scenarios to understand the range of seepage rates possible using a range of assumptions. The results of one of the more conservative scenarios, scenario 3, are presented in the final report. The methodology, assumptions and data used to develop scenario 3 is discussed in detail in this appendix. A summary of the remaining four scenarios, including key assumptions and a comparison of the results with scenario three is also presented in this document.

For all scenarios Pembina used data from environmental impact assessments whenever possible. However, actual seepage rates that are expected to by pass mitigation measures are not always clear and in some instances do not exist. Table 1 lists the projects included in this assessment, data availability and the estimation technique used.

Table 1: Summary of projects included in assessment and data availability

Project	Data Availability	Estimation Technique
Albian – Muskeg current and expansion	Detailed seepage estimates available in project application	Application values used
Canadian Natural – Horizon Phase 1 and 2	Detailed seepage estimates available in project application.	Application values used
Canadian Natural – Horizon Phase 3 and 4	No publicly available values	Average value used
Imperial – Kearl	Detailed seepage estimates available in project application.	Application values used
Petro-Canada Oil Sands – Fort Hills	Detailed seepage estimates available in project application.	Application values used

Shell Canada Inc. – Jackpine Expansion	Detailed seepage estimates available in project application.	Application values used
Shell Canada Inc. – Jackpine phase 1	Detailed seepage estimates available in project application.	Application values used
Shell Canada Inc. – Pierre River	Detailed seepage estimates available in project application.	Application values used
Suncor - Current	Publicly available records available but not accessible[1]	Average value used
Suncor - Expansions (Voyageur South)	Detailed seepage estimates available but in incompatible format.	Average value used
Syncrude – Announced	No publicly available values	Average value used
Syncrude - Current	Publicly available records available but not accessible	Average value used
Synenco – Northern Lights	Estimates available but not in detail required	Average value used
Total – Deer Creek Announced	No publicly available values	Average value used
Total - Deer Creek Application	Seepage discussed in application but values no provided.	Average value used
UTS/Tek Cominco – Announced	No publicly available values	Average value used

The appendix is divided in to four primary sections. The first section, "Seepage Data from Environmental Impact Assessments" lists reported seepage rates and sources and discusses key assumptions and uncertainties. This section is followed by the "Factor Calculation" sections which illustrates the methodology and calculations used to estimate seepage for projects without publicly-disclosed seepage factors. The third section presents the key assumptions for the other four scenario and compares the results with the third scenario. The final section discusses the limitations associated with the seepage calculations.

[1] Current operations are required to report seepage rates and water quality.

Pembina invite feedback on the data and methodology used. Feedback on the data should be directed towards Jeremy Moorhouse (jeremym@pembina.org, 403-269-3344 ext. 123). The primary goal of this research and report is to determine a realistic and publicly available cumulative value for current and proposed oil sands projects.

1.2 Seepage Data from Environmental Impact Assessments

The following data are used for all scenarios.

1.2.1 Canadian Natural - Horizon

The data used to estimate seepage that escapes mitigation measures associated with the operation of the Canadian Natural – Horizon project are provided in Table 2. The primary assumptions with this data are provided below the table.

Table 2: Seepage lost to deep aquifers

Seepage to Deep Aquifers - Lost		
Year	Value	Unit
2007	0	m3/hr
2008	0	m3/hr
2009	0	m3/hr
2010	0	m3/hr
2011	0	m3/hr
2012	0	m3/hr
2013	0	m3/hr
2014	0	m3/hr
2015	0	m3/hr
2016	0	m3/hr
2017	0	m3/hr
2018	0	m3/hr
2019	0	m3/hr
2020	0	m3/hr
2021	175	m3/hr
2022	346	m3/hr
2023	346	m3/hr
2024	346	m3/hr
2025	346	m3/hr
2026	315	m3/hr
2027	285	m3/hr
2028	284	m3/hr
2029	232	m3/hr
2030	180	m3/hr
2031	180	m3/hr
2032	180	m3/hr
2033	180	m3/hr
2034	500	m3/hr
2035	500	m3/hr

2036	500	m3/hr
2037	500	m3/hr
2038	500	m3/hr
2039	462	m3/hr
2040	347	m3/hr
2041	347	m3/hr
2042	347	m3/hr
2043	347	m3/hr
2044	347	m3/hr
2045	466	m3/hr
2046	466	m3/hr
2047	466	m3/hr
2048	466	m3/hr

Source

Canadian Natural. "Horizon Oil Sands Project: Application for Approval" 2003.

Assumptions:

- Seepage to deep aquifers is assumed to be lost from the mine site and not recoverable by mitigation methods.

1.2.2 Imperial Oil Ventures Ltd. - Kearl

The data used to estimate seepage that escapes mitigation measures associated with the operation of the Imperial Oil Ventures Ltd. – Kearl project are provided in Table 3. The primary assumptions with this data are provided below the table.

Table 3: Seepage lost from site

Seepage Lost to Overburden		
Year	Value	Unit
2007	0	m3/hr
2008	0	m3/hr
2009	0	m3/hr
2010	296.8	m3/hr
2011	1221.5	m3/hr
2012	1929.2	m3/hr
2013	639.3	m3/hr
2014	388.1	m3/hr
2015	285.4	m3/hr
2016	239.7	m3/hr
2017	205.5	m3/hr
2018	205.5	m3/hr
2019	182.6	m3/hr
2020	137.0	m3/hr
2021	91.3	m3/hr
2022	79.9	m3/hr
2023	45.7	m3/hr
2024	45.7	m3/hr
2025	45.7	m3/hr
2026	45.7	m3/hr
2027	45.7	m3/hr
2028	45.7	m3/hr
2029	45.7	m3/hr
2030	34.2	m3/hr
2031	22.8	m3/hr
2032	22.8	m3/hr
2033	11.4	m3/hr
2034	11.4	m3/hr
2035	0	m3/hr
2036	0	m3/hr
2037	0	m3/hr
2038	0	m3/hr

Source

Imperial Oil Resource Ventures Ltd. "Kearl Oil Sands Project - Mine Development: Regulatory Application." 2005. Volume 2, Section 9, Table 5-4

Assumptions:

- Imperial labels seepage as “Seepage to Overburden Sands at ETA”. It is unclear how this seepage escapes the mine site. However, it is assumed to escape as it is included in the outflows of the mine site water balance.
- Imperial assumes no seepage to deep aquifers.

1.2.3 Petro-Canada Oil Sands Inc. – Fort Hills

The data used to estimate seepage lost to the environment associated with the operation of the Canadian Natural – Horizon project are provided in Table 4. The primary assumptions with this data are provided below the table.

Table 4: Seepage lost to deep aquifers

Expected to Pass Interception Wells		
Year	Value	Unit
2007	0	m3/hr
2008	0	m3/hr
2009	0	m3/hr
2010	0	m3/hr
2011	0	m3/hr
2012	0	m3/hr
2013	0	m3/hr
2014	0	m3/hr
2015	0	m3/hr
2016	0	m3/hr
2017	0	m3/hr
2018	0	m3/hr
2019	0	m3/hr
2020	0	m3/hr
2021	574.85	m3/hr
2022	574.85	m3/hr
2023	574.85	m3/hr
2024	574.85	m3/hr
2025	574.85	m3/hr
2026	574.85	m3/hr
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2072	574.85	m3/hr
2073	574.85	m3/hr
2074	574.85	m3/hr
2075	574.85	m3/hr
2076	574.85	m3/hr
2077	574.85	m3/hr
2078	574.85	m3/hr
2079	574.85	m3/hr
2080	574.85	m3/hr
2081	574.85	m3/hr

Source

Fort Hills Energy Corporation. "Fort Hills Oil Sands Amendment Application." 2 (2006). Volume 2, Table 8-5 and 8-6 and text.

Assumptions:

- Petro-Canada provided total seepage rates from all ponds that are expected to by pass interception wells.
- This assessment assumes that all seepage that by-passes the interception wells will not be intercepted by other means.

1.2.4 Albian – Muskeg River Mine and Expansion

The data used to estimate seepage that escapes mitigation measures associated with the operation of the Albian – Muskeg River Mine and Expansion project are provided in Table 5. The primary assumptions with this data are provided below the table.

Table 5: Seepage lost to deep aquifers

ETDA Seepage - Basal Aquifer		
Year	Value	Unit
2007	0	m3/hr
2008	0	m3/hr
2009	0	m3/hr
2010	29.17	m3/hr
2011	29.17	m3/hr
2012	29.17	m3/hr
2013	29.17	m3/hr
2014	29.17	m3/hr
2015	29.17	m3/hr
2016	29.17	m3/hr
2017	29.17	m3/hr
2018	29.17	m3/hr
2019	29.17	m3/hr
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2033	29.17	m3/hr
2034	29.17	m3/hr
2035	10.00	m3/hr
2036	10.00	m3/hr
2037	10.00	m3/hr
2038	10.00	m3/hr
2039	10.00	m3/hr
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2072	10.00	m3/hr
2073	10.00	m3/hr
2074	10.00	m3/hr
2075	10.00	m3/hr
2076	10.00	m3/hr
2077	10.00	m3/hr
2078	10.00	m3/hr
2079	10.00	m3/hr
2080	10.00	m3/hr
2081	10.00	m3/hr

Source

Shell Canada Ltd. "Application for the Approval of the Muskeg River Mine Expansion Project." 2005.

Assumptions:

- External Tailings Disposal Area (ETDA) pit seepage is not intercepted by any method. All other seepage is assumed to be captured by mitigation measures.

- Backfilled pits do not seep.
- The 10 m^3/hr seepage rate continues into the far future

1.2.5 Shell Canada Inc. – Jackpine Mine

The data used to estimate seepage that escapes mitigation measures associated with the operation of the Canadian Natural – Horizon project are provided in Table 6. The primary assumptions with this data are provided below the table.

Table 6: Seepage lost to basal aquifer

ETDA Seepage - Basal Aquifer		
Year	Value	Unit
2007	0	m3/hr
2008	0	m3/hr
2009	282.500	m3/hr
2010	282.500	m3/hr
2011	282.500	m3/hr
2012	282.500	m3/hr
2013	282.500	m3/hr
2014	282.500	m3/hr
2015	282.500	m3/hr
2016	282.500	m3/hr
2017	282.500	m3/hr
2018	282.500	m3/hr
2019	282.500	m3/hr
2020	282.500	m3/hr
2021	282.500	m3/hr
2022	282.500	m3/hr
2023	282.500	m3/hr
2024	282.500	m3/hr
2025	282.500	m3/hr
2026	282.500	m3/hr
2027	282.500	m3/hr
2028	282.500	m3/hr
2029	282.500	m3/hr
2030	282.500	m3/hr
2031	282.500	m3/hr
2032	4.25	m3/hr
2033	4.25	m3/hr
2034	4.25	m3/hr
2035	4.25	m3/hr
2036	4.25	m3/hr
2037	4.25	m3/hr
2038	4.25	m3/hr
2039	4.25	m3/hr
2040	4.25	m3/hr
2041	4.25	m3/hr
2042	4.25	m3/hr
2043	4.25	m3/hr
2044	4.25	m3/hr

2045	4.25	m3/hr
2046	4.25	m3/hr
2047	4.25	m3/hr
2048	4.25	m3/hr
2049	4.25	m3/hr
2050	4.25	m3/hr
2051	4.25	m3/hr
2052	4.25	m3/hr
2053	4.25	m3/hr
2054	4.25	m3/hr
2055	4.25	m3/hr
2056	4.25	m3/hr
2057	4.25	m3/hr
2058	4.25	m3/hr
2059	4.25	m3/hr
2060	4.25	m3/hr
2061	4.25	m3/hr
2062	4.25	m3/hr
2063	4.25	m3/hr
2064	4.25	m3/hr
2065	4.25	m3/hr
2066	4.25	m3/hr
2067	4.25	m3/hr
2068	4.25	m3/hr
2069	4.25	m3/hr
2070	4.25	m3/hr
2071	4.25	m3/hr
2072	4.25	m3/hr
2073	4.25	m3/hr
2074	4.25	m3/hr
2075	4.25	m3/hr
2076	4.25	m3/hr
2077	4.25	m3/hr
2078	4.25	m3/hr
2079	4.25	m3/hr
2080	4.25	m3/hr
2081	4.25	m3/hr

Source:

Shell Canada Ltd. "Application for Approval of the Jackpine Mine - Phase 1." 2002. Volume 3, page 4-49, and Table 4.4-8

Assumptions:

- The seepage rates presented above are assumed to by pass mitigation measures.
- The values above are based on snap shots provided in the EIA

- The seepage rate of 4.25 m^3/hr is assumed to continue into the far future

1.2.6 Shell Canada Inc. – Jackpine Expansion

The data used to estimate seepage that escapes mitigation measures associated with the operation of the Canadian Natural – Horizon project are provided in Table 7. The primary assumptions with this data are provided below the table.

Table 7: Seepage lost to deep aquifers

ETDA Seepage - Seepage to Aquifer from ETDA		
Year	Value	Unit
2007	0	m^3/hr
2008	0	m3/hr
2009	0	m3/hr
2010	0	m3/hr
2011	0	m3/hr
2012	0	m3/hr
2013	0	m3/hr
2014	0	m3/hr
2015	78.767	m3/hr
2016	157.534	m3/hr
2017	264.840	m3/hr
2018	374.429	m3/hr
2019	476.027	m3/hr
2020	583.333	m3/hr
2021	692.922	m3/hr
2022	801.370	m3/hr
2023	864.155	m3/hr
2024	864.155	m3/hr
2025	864.155	m3/hr
2026	0.000	m3/hr
2027	0.000	m3/hr
2028	0.000	m3/hr
2029	0.000	m3/hr
2030	0.000	m3/hr
2031	0.000	m3/hr
2032	0.000	m3/hr
2033	0.000	m3/hr
2034	0.000	m3/hr
2035	0.000	m3/hr
2036	0.000	m3/hr
2037	0.000	m3/hr
2038	0.000	m3/hr
2039	0.000	m3/hr
2040	0.000	m3/hr
2041	0.000	m3/hr
2042	0.000	m3/hr

2043	0.000	m3/hr
2044	0.000	m3/hr
2045	0.000	m3/hr
2046	0.000	m3/hr
2047	0.000	m3/hr
2048	0.000	m3/hr
2049	0.000	m3/hr
2050	0.000	m3/hr
2051	0.000	m3/hr
2052	0.000	m3/hr
2053	0.000	m3/hr
2054	0.000	m3/hr
2055	0.000	m3/hr
2056	0.000	m3/hr
2057	0.000	m3/hr
2058	0.000	m3/hr
2059	0.000	m3/hr
2060	0.000	m3/hr
2061	0.000	m3/hr
2062	0.000	m3/hr
2063	0.000	m3/hr
2064	0.000	m3/hr
2065	0.000	m3/hr
2066	0.000	m3/hr
2067	0.000	m3/hr
2068	0.000	m3/hr
2069	0.000	m3/hr
2070	0.000	m3/hr
2071	0.000	m3/hr
2072	0.000	m3/hr
2073	0.000	m3/hr
2074	0.000	m3/hr
2075	0.000	m3/hr
2076	0.000	m3/hr
2077	0.000	m3/hr
2078	0.000	m3/hr
2079	0.000	m3/hr
2080	0.000	m3/hr
2081	0.000	m3/hr

Source

Shell Canada Limited. "Application for Approval of the Jackpine Mine Expansion & Pierrer River Mine Project - Environmental Impact Assessment." Calgary, 2007. Volume 1 Table 10-2, pg. 10-14

Assumptions:

- Seepage to Aquifer from the external tailings disposal area is the only source of seepage on site.
- Far future seepage is not included in this assessment.

1.2.7 Suncor – Tar Island Dyke

The data used to estimate seepage that escapes mitigation measures associated with the operation of the Suncor – Tar Island Dyke project are provided in Table 8. The primary assumptions with this data are provided below the table.

Table 8: Seepage lost to deep aquifers

Seepage to Deep Aquifers - Lost			Construction Water Seepage		
Year	Value	Unit	Year	Value	Unit
2007	7.2	m3/hr	2007	234	m3/hr
2008	7.2	m3/hr	2008	234	m3/hr
2009	7.2	m3/hr	2009	234	m3/hr
2010	7.2	m3/hr	2010	234	m3/hr
2011	7.2	m3/hr	2011	234	m3/hr
2012	7.2	m3/hr	2012	0	m3/hr
2013	7.2	m3/hr	2013	0	m3/hr
2014	7.2	m3/hr	2014	0	m3/hr
2015	7.2	m3/hr	2015	0	m3/hr
2016	7.2	m3/hr	2016	0	m3/hr
2017	7.2	m3/hr	2017	0	m3/hr
2018	7.2	m3/hr	2018	0	m3/hr
2019	7.2	m3/hr	2019	0	m3/hr
2020	7.2	m3/hr	2020	0	m3/hr
2021	7.2	m3/hr	2021	0	m3/hr
2022	7.2	m3/hr	2022	0	m3/hr
2023	7.2	m3/hr	2023	0	m3/hr
2024	7.2	m3/hr	2024	0	m3/hr
2025	7.2	m3/hr	2025	0	m3/hr
2026	7.2	m3/hr	2026	0	m3/hr
2027	7.2	m3/hr	2027	0	m3/hr
2028	7.2	m3/hr	2028	0	m3/hr
2029	7.2	m3/hr	2029	0	m3/hr
2030	7.2	m3/hr	2030	0	m3/hr
2031	7.2	m3/hr	2031	0	m3/hr
2032	7.2	m3/hr	2032	0	m3/hr
2033	7.2	m3/hr	2033	0	m3/hr
2034	7.2	m3/hr	2034	0	m3/hr
2035	7.2	m3/hr	2035	0	m3/hr
2036	7.2	m3/hr	2036	0	m3/hr
2037	7.2	m3/hr	2037	0	m3/hr
2038	7.2	m3/hr	2038	0	m3/hr
2039	7.2	m3/hr	2039	0	m3/hr
2040	7.2	m3/hr	2040	0	m3/hr
2041	7.2	m3/hr	2041	0	m3/hr
2042	7.2	m3/hr	2042	0	m3/hr
2043	7.2	m3/hr	2043	0	m3/hr

2044	7.2	m3/hr	2044	0	m3/hr
2045	7.2	m3/hr	2045	0	m3/hr
2046	7.2	m3/hr	2046	0	m3/hr
2047	7.2	m3/hr	2047	0	m3/hr
2048	7.2	m3/hr	2048	0	m3/hr

Source

Grace P. Hunter. "Investigation of Groundwater Flow within an Oil Sand Tailings Impoundment and Environmental Implications." University of Waterloo, 2001.

Jim Barker, Dave Rudolph, Trevor Tompkins, Alex Oiffer, Francoise Gervais, . "Attenuation of Contaminants in Groundwater Impacted by Surface Mining of Oil Sands, Alberta, Canada." Paper presented at the IPEC 2007.

Assumptions:

- Seepage of construction water will reduce to zero m^3/hr over the next five years.
- Seepage through the base of the pond will continue into the far future 2080

1.3 Factor Calculation

1.3.1 Introduction

Several oil sands mines do not have seepage data for a variety of reasons. Proponents of projects in early stages of development have not completed detailed water balances. In other instances projects with impact assessments did not provide detailed information on seepage rates expected to by-pass mitigation measures. Current projects do report seepage rates and seepage water quality to the Government of Alberta. In spite of numerous requests for this information Alberta Environment did not make this information available for this assessment.

The methodology and key assumptions discussed below are for scenario three. The remaining four scenarios used a similar methodology; however, some key assumptions are different. The differences between scenario three and the other four scenarios is discussed in the Other Scenarios section.

1.3.2 Methodology

This assessment estimated seepage for these projects using the following methodology.

The following describes Pembina's methodology to develop seepage rates for current and proposed oil sands mines:

1. Pembina first converted the available seepage rates into production intensity basis (m^3 seepage / m^3 production).
2. Pembina then developed two average seepage factors: one for the beginning of a project (the beginning seepage rate) and the other for the end of project (the end seepage rate). This technique is used to simulate the sealing of ponds overtime.
    a. The beginning seepage rate is based on the average seepage intensity *over the life of the project*. Pembina used the average seepage intensity over the life of the project to make the calculations more conservative. Some of the EIA data project that tailings ponds will seep more at the beginning of operations than at the end. The average seepage rate over the life of a tailings pond is, therefore, lower than the seepage at the beginning of operations. Table 9 contains the calculated average seepage rate based on the data provided for each mine in the section above.

Table 9: Average seepage rates for six proposed oil sands mines

Project	Average Seepage Rate (m^3 Seep / m^3 bitumen produced)
Canadian Natural – Horizon	0.20
Imperial Oil Resources Ventures Limited (Imperial Oil) - Kearl	0.12
Petro-Canada Oil Sands Inc. – Fort Hills	0.46

Albian Sands – Muskeg River Mine (Current and Expansion)[2]	0.04
Shell Canada Ltd. – Jackpine	0.39
Shell Canada Ltd. – Jackpine Expansion and Pierre River	0.37
Average	**0.26**

b. The end seepage rate is based on a seepage reduction factor. Pembina used this method to address sealing in current tailings ponds. For example, a University of Waterloo study found that at Suncor's Pond 1 (Tar Island), "The thick sequence of fine tailings and residual bitumen below the pond, and the unsaturated zone that has developed in the underlying sand tailings, form an effective hydraulic barrier to flow. As a result, drainage flows form the oil sand tailings impoundment are lower and will approach steady state sooner than if pond water were freely flowing into the sand tailings."[3] Projected seepage rates for the Muskeg River Mine Expansion, Jackpine and Jackpine expansion[4] demonstrate this reduced seepage rate. The average seepage reduction rate based on these three projects is 84%. Using the average seepage rate calculated above the end of project seepage rate is 0.04 m^3/m^3 production.

3. Pembina then estimated seepage rates based on bitumen production for current and proposed oil sands mines without seepage data using the two seepage factors (0.26 m^3/m^3 and 0.04 m^3/m^3). The beginning seepage rate is applied during the first 18 years of operations.[5] The end seepage rate is used during the remaining years of operation.
4. Pembina then aggregated the seepage rates to generate total seepage rates per year.

[2] The seepage reported by Albian Sands is significantly lower than other projects. Pembina is unclear as to why this value is lower.

[3] Grace P. Hunter (2001). Investigation of Groundwater Flow Within an Oil Sand Tailings Impoundment and Environmental Implications. Earth Sciences, University of Waterloo. **Master of Science:** 363.

[4] The data presented in the data tables for Jackpine Expansion does not demonstrate this reduced seepage rate. However, specific pond seepage rates are discussed in more detail in the project application, see Shell Canada Limited. "Application for Approval of the Jackpine Mine Expansion & Pierrer River Mine Project - Environmental Impact Assessment." Calgary, 2007. ETDA seepage, pg. 6-211 table 6.3-18

[5] Three project clearly projected reduced seepage over time (Muskeg River Mine Expansion, Jackpine and Jackpine expansion). For these three projects the average time period until a reduced seepage rate is projected in a given tailings pond is 18 years.

1.3.3 Example Calculations

The following demonstrates the calculation methodology used for developing estimated seepage values for one proposed mine, Suncor Voyageur South. The expected start up time for Suncor Voyageur South is 2011 with production of 18,216 m^3 bitumen/day.[6]

Where,

BP = Bitumen Production (m^3/d)

SF_b = Beginning seepage factor (m^3 seepage / m^3 production)

SF_e = End seepage factor (m^3 seepage / m^3 production)

S_e = Estimated Seepage (m^3/d)

Then,

$$S_e = SF_b \times BP$$

Given,

BP = 18,216(m^3/day)

SF_b = 0.26 (m^3/m^3)

SF_e = 0.04 (m^3/m^3)

Then seepage for the first 18 years will be calculated using the beginning seepage factor as below,

$$S_e = 18{,}216(m^3 / day) \times 0.26(m^3 / m^3)$$

$$S_e = 4736(m^3 / day)$$

The seepage for the remainder of the project will be calculated using the end seepage factor as below,

$$S_e = 18{,}216(m^3 / day) \times 0.04(m^3 / m^3)$$

$$S_e = 728(m^3 / day)$$

The analysis made similar calculations for all proposed projects.

[6] Dunbar, B. (2008). "Existing and Proposed Canadian Commercial Oil Sands Projects." Retrieved November 20, 2008, from http://www.strategywest.com/downloads/StratWest_OSProjects.pdf.

Table 10: Summary of estimated seepage rates per project

Project	Production (m^3/day)	Beginning Seepage Rate (m^3/day)	End Seepage Rate (m^3/day)
Canadian Natural – Horizon Phase 3 and 4	48,800	12,816	2,054
Suncor – Current[7]	46,728[8]	1,968	1,968
Suncor – Expansions (Voyageur South)	19,000	5,016	804
Syncrude Current[9]	64,713	2,724	2,724
Syncrude – Announced	29,568	7,776	1,246
Synenco – Northern Lights	18,206	4,788	765.6
Total – Deer Creek Announced	15,900	4,180	669.6
Total - Deer Creek Application	15,900	4,180	669.6
UTS/Tek Cominco – Announced	33,391	8,784	1,404

1.4 Other Scenarios

Pembina developed 4 other scenarios in order to assess the range of seepage values possible by varying key assumptions in the model. As all scenarios use the same base EIA information (see the Seepage Data from Environmental Impact Assessments section) the differences between the scenarios result from how Pembina used the EIA data to develop generic seepage factors. The seepage factor is the most influential variable on the results of each scenario in Pembina's

[7] Excludes Tar Island. Also, all of Sunco'r current ponds are considered as sealed because they have been in operation for a longer period of time.

[8] Assumed maximum current production. Actual production may be lower.

[9] Production is based on maximum potential production as per Dunbar, B. (2008). "Existing and Proposed Canadian Commercial Oil Sands Projects." Retrieved November 20, 2008, from http://www.strategywest.com/downloads/StratWest_OSProjects.pdf. Actual production may be lower. All Syncrude ponds are assumed to be sealed.

seepage model. These differences are discussed in detail below. This discussion is followed by a comparison of the results for each of the scenarios.

Scenario 3 is the scenario used in the report and is summarized first below, followed by the other scenarios.

1.4.1 Scenario 3 – Report Scenario

There are three main assumptions associated with scenario 3 that are varied for the other assumptions.

1. **Beginning and End Seepage Factor:** Scenario 3 uses two seepage factors. One used to estimate the seepage at the beginning of a project and the other to estimate the seepage near the end of the project. The intent of the two seepage factors is to incorporate the concept of tailings ponds sealing over time.
2. **Seepage Factor Basis:** The beginning seepage factor is based on an average of projected seepage rates available in EIAs (0.26m^3 seepage/m^3 production). The end seepage factor is based on an 85% reduction in this seepage rate (0.04 m^3 seepage / m^3 production). The 85% reduction value is calculated from the projected decrease in seepage from three proposed tailings ponds (see the factor calculation section above for more details).
3. **Sealing:** Scenario 3 assumes all current ponds are sealed and that future ponds will seal after 18 years[10]. Sealed ponds are still assumed to seep but at a much reduced rate (85% lower).

1.4.2 Scenario 1 – Average

Scenario 1 differs in two important ways in comparison with Scenario 3:

1. **Beginning and End Seepage Factor:** Scenario 1 does not disaggregate seepage rates into beginning and end. Only one seepage rate is used over the life of proposed and current projects without seepage data.
2. **Seepage Factor Basis:** As in Scenario 3, Scenario 1 uses a seepage factor based on the average seepage of all projects with EIAs. This seepage factor is 0.26 m^3/m^3 production. However, unlike scenario 3, scenario 1 does not assume ponds seal over time. The average seepage factor is applied over the entire project life.

[10] Three project clearly projected reduced seepage over time (Muskeg River Mine Expansion, Jackpine and Jackpine expansion). For these three projects the average time period until a reduced seepage rate is projected in a given tailings pond is 18 years.

3. **Sealing:** Scenario 1 assumes current tailings ponds have not sealed and applies the average seepage factor to current operations as well.

1.4.3 Scenario 2 – Current Ponds Sealed

Scenario 2 is very similar to scenario 3 but does not apply an end seepage factor. Specific differences and similarities are discussed below.

1. **Beginning and End Seepage Factor:** Scenario 2 uses two seepage factors. One used to estimate the seepage at the beginning of a project and the other to estimate the seepage of current projects. The intent of the two seepage factors is to address the fact that current tailings ponds at Suncor and Syncrude's facilities have likely sealed over time and so seep less then a new tailings pond would.
2. **Seepage Factor Basis:** The beginning seepage factor is based on an average of projected seepage rates available in EIAs (0.26m^3 seepage/m^3 production). This factor is applied to all future projects without seepage data. A different seepage factor is applied to current operation and is calculated in the same way as the end seepage factor is calculated for scenario 3. That is it is 85% lower than the average seepage rate (0.04 m^3 seepage / m^3 production).
3. **Sealing:** Scenario 2 assumes all current ponds are sealed but future ponds will seep at the average rate over their lifetime.

1.4.4 Scenario 4 – Most conservative

Scenario 4 is also very similar to scenario 3; however, it uses the lowest reported seepage rate in place of the average seepage rate used in scenario 3.

4. **Beginning and End Seepage Factor:** Scenario 4 uses the beginning and end seepage factors in the same manner as scenario 3. However, the factors themselves are different.
5. **Seepage Factor Basis:** The beginning seepage factor is based on the lowest reported seepage rate (Albian Sands – Muskeg River Mine Expansion – 0.04 m^3 seepage / m^3 production). The beginning seepage factor is applied during the first 18 years of the projects life. The end seepage factor is 85% lower then this value (0.006 m^3 seepage / m^3 production). The end seepage factor is applied for the remaining years of the project.
6. **Sealing:** Scenario 4 assumes all current ponds are sealed and future ponds will seal after 18 years of operation. Sealed ponds will seep 0.006 m^3 per m^3 of production.

1.4.5 Scenario 5 – Match Profile

Scenario 5 is also very similar to scenario 3; however, it attempts to match the seepage profile of reported seepage rates.

7. **Beginning and End Seepage Factor:** Scenario 5 also uses beginning and end seepage factors; however they are calculated differently than in scenario 1.
8. **Seepage Factor Basis:** The beginning seepage factor is based on the average reported seepage rate of projects with EIAs during their startup period. The seepage value calculated using this methodology is 0.73 m^3 seepage / m^3 production. Similarly an end seepage rate is calculated from reported seepage rates. The seepage value is 0.161 m^3 seepage per m^3 production. The beginning seepage factor is applied during the first 18 years of the projects life (for projects without seepage rates reported in EIAs). The end seepage factor is applied for the remaining years of the project.
9. **Sealing:** Scenario 5 assumes all current ponds are sealed and future ponds will seal after 18 years of operation. Sealed ponds will seep 0.161 m^3 per m^3 of production.

1.4.6 Comparison

Table 11 presents a summary of key assumptions and seepage results for each scenario.

Table 11: Summary of key assumptions and results for each scenario

Scenario	Beginning Seepage Factor (m^3 seepage / m^3 production)	End Seepage Factor (m^3 seepage / m^3 production)	Total Seepage (Mm^3 present – 2080)	Peak Seepage (Mm^3 /yr)	Year of Peak Seepage
1 – Average	0.26	0.26	2293	36	2012
2 – Current Ponds Sealed	0.26	0.04[11]	1587	26	2012
3 – Report	0.26	0.04	945	26	2012
4 – Conservative	0.04	0.006	405	21	2012
5 – Mirror	0.73	0.161	1967	57	2024

Total seepage (the sum of seepage from all projects between now and 2080) is estimated to be between 405 Mm^3 and 2293 Mm^3. Scenario 3, the scenario used in the report, estimates total seepage at 945 Mm^3 which is relatively conservative given the range of seepage values.

Figures 1 to 5 below profile the annual seepage rates per scenario for current projects, projects with applications and proposed projects. Current projects include Suncor, Syncrude and Albian.

[11] Only applied to current ponds

Projects with applications include all approved projects and those with approvals pending but with project applications. Proposed projects include all other projects. A total list of projects included in this assessment is available in Table 1.

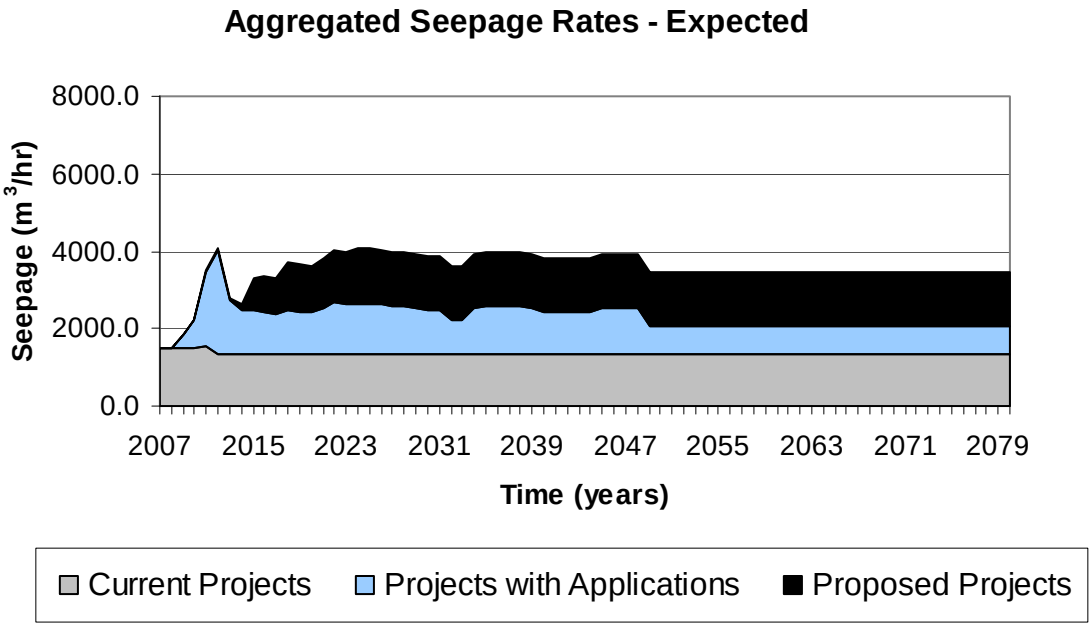

Figure 1: Scenario 1 – Projected seepage rates for current and proposed projects

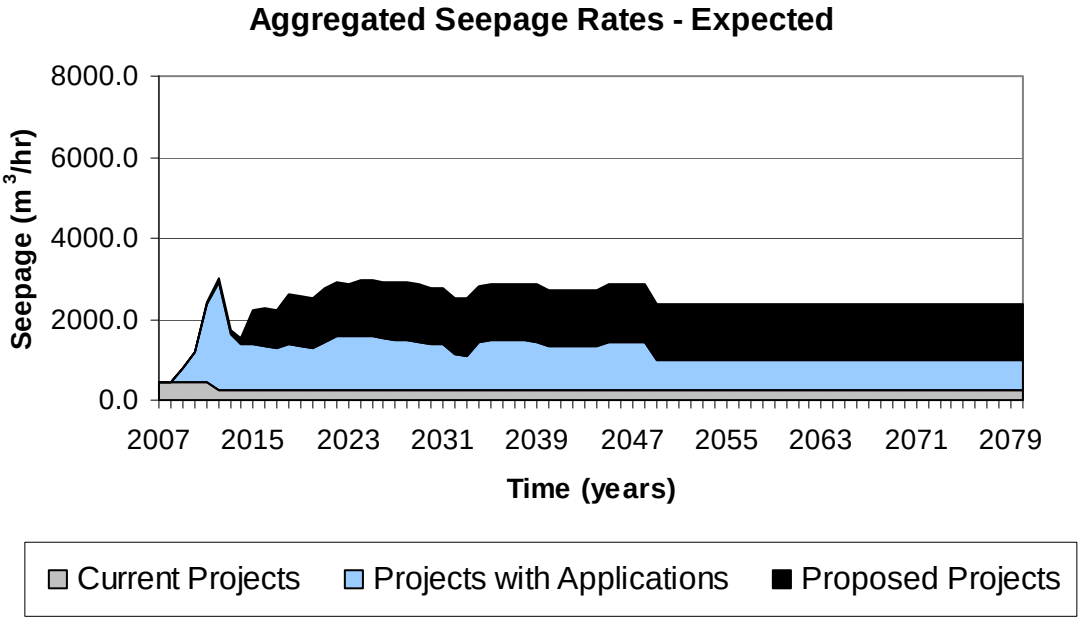

Figure 2: Scenario 2 – Projected seepage rates for current and proposed projects

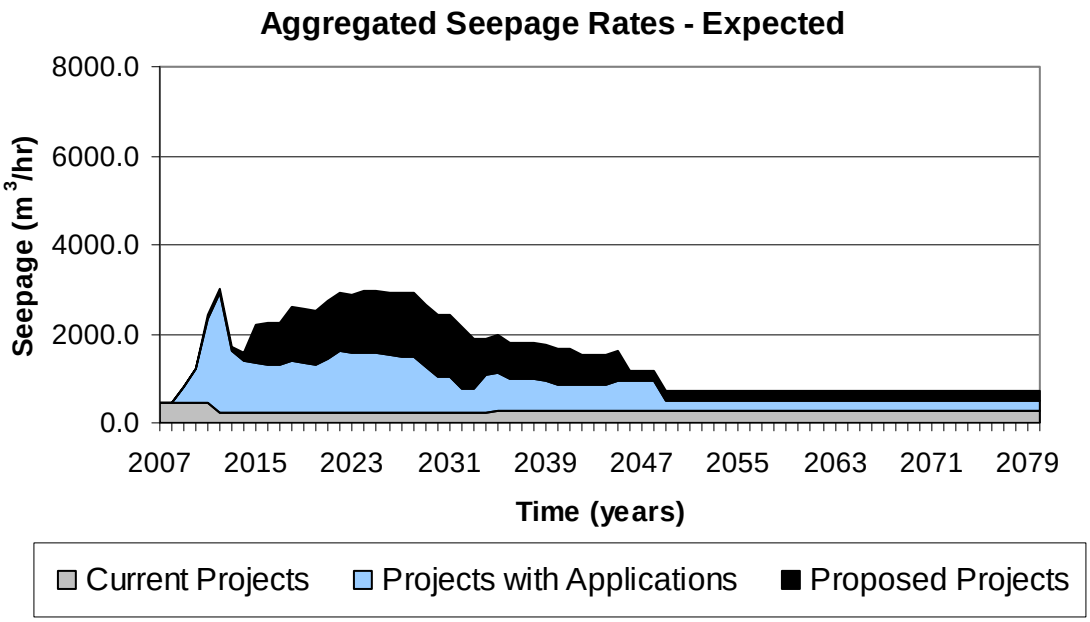

Figure 3: Scenario 3 - Projected seepage rates for current and proposed projects

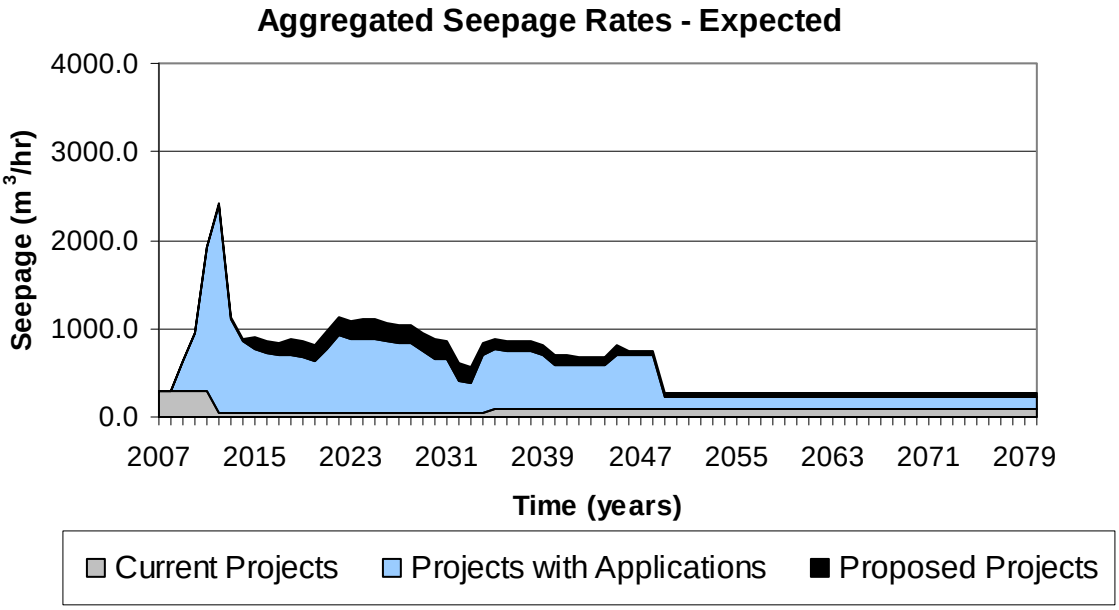

Figure 4: Scenario 4 – Projected seepage rates for current and proposed projects

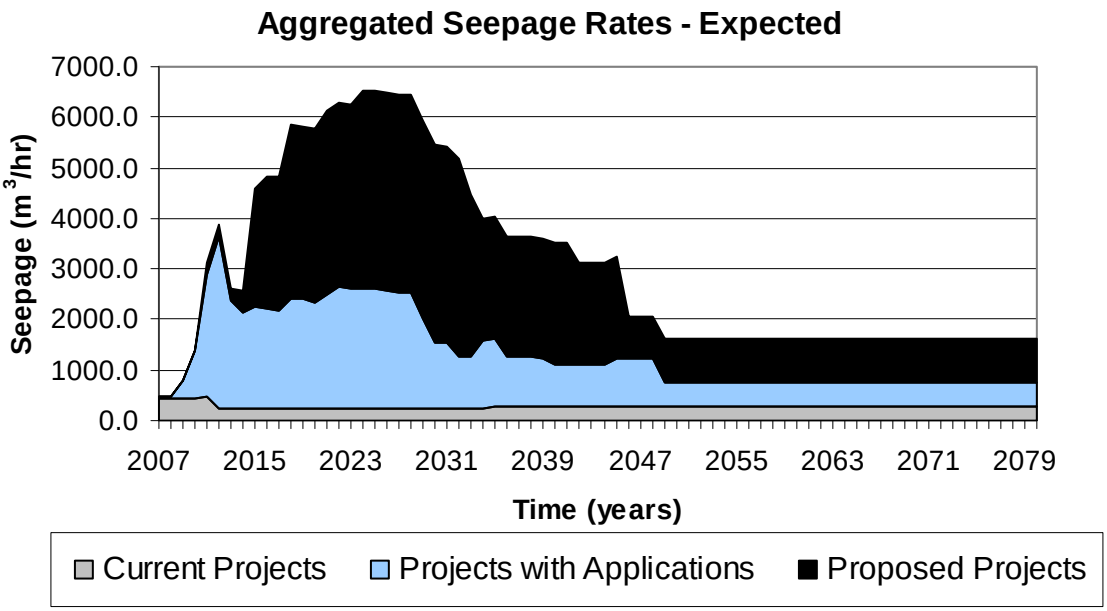

Figure 5: Scenario 5 – Projected seepage rates for current and proposed projects

For information on Pembina's methodology and data used please contact Jeremy Moorhouse at jeremym@pembina.org or at 403-269-3344 ext. 123.

1.5 Limitations

Although the methodology and calculations described and presented above are intended to be conservative estimates of current and proposed seepage rates, there are several limitations in their calculation. These are:

- Slowdown: Changes in project timelines as a result of the current financial uncertainty are not incorporated into this analysis.
- Use of Averages: The analysis used herein to estimate seepage rates for projects without seepage data does not account for the geological characteristics of each individual site. Where information is unavailable at the time of writing, averages are based on information published by the project proponents.
- Fate of the Seepage: This analysis does not attempt to determine the final (receiving water bodies), or even the immediate fate of the seepage (specific receptors such as the basal aquifer). The intent of this analysis is to estimate the rate of process affected seepage that is projected to by-pass mitigation measures.
- The Very Long-Term: Decommissioning a mine includes constructing end pit lakes and incorporating tailings into the landscape. Both end pit lakes and tailings will seep process-affected water into groundwater. This analysis does not attempt to quantify seepage rates for these sources over the very long term (i.e. more than several decades into the future).
- Current Tailings Ponds: Seepage rates for current ponds should be based on reported seepage rates that are publicly available information. Pembina requested these public documents on seepage rates from current tailings facilities from Alberta Environment. However, Alberta Environment did not provide these documents. In the absence of this data Pembina generated estimates as described in the methodology above.

SUBMISSION TO THE COMMISSION FOR ENVIRONMENTAL COOPERATION

Pursuant to Article 14, NORTH AMERICAN AGREEMENT ON ENVIRONMENTAL COOPERATION

April 14, 2010

THE SUBMITTING ORGANIZATIONS AND INDIVIDUALS

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Daniel T'seleie [Contact details confidential]	

I. SUMMARY OF SUBMISSION

This submission requests that the Commission on Environmental Cooperation prepare a factual record of the allegation that the Government of Canada is in breach of its commitment under the North American Agreement on Environmental Cooperation to effectively enforce subsection 36(3) of the Canadian *Fisheries Act* against the practice of leaking deleterious substances from oil sands tailings ponds.

Oil sands tailings ponds result from the extraction of bitumen from mined oil sands deposits in Northern Alberta. The tailings ponds currently have a surface area of 130 square kilometers (50 square miles), with a volume of 720 billion litres (190 billion gallons).

Tailings ponds contain a large variety of substances that are deleterious to fish, including naphthenic acids, ammonia, benzene, cyanide, oil and grease, phenols, toluene, polycyclic aromatic hydrocarbons, arsenic, copper and iron.

Tailings ponds are constructed from the earthen materials that oil sands companies mine from the area. They are not lined and therefore leak contaminated substances into the environment. Companies attempt to recapture the leakage, but do not recapture it all.

One study used industry data to estimate that the tailings ponds already leak four billion litres (1 billion gallons) each year, with projections that this figure could reach over 25 billion litres (6.6 billion gallons) within a decade should proposed projects go ahead. This contamination can migrate to reach surface waters due to a hydrogeological setting that is punctuated by downcutting glacial and post-glacial meltwater channels and modern stream courses.

There are documented cases of contaminated tailings substances reaching or projected to reach surface waters in Jackpine Creek (from Shell), Beaver Creek (from Syncrude), McLean Creek (from Suncor) and the Athabasca River (from Suncor).

Subsection 36(3) of the Canadian federal *Fisheries Act* establishes a general prohibition on the deposition of deleterious substances into waters frequented by fish. The second half of subsection 36(3) also prohibits the indirect deposition of deleterious substances and has a preventative element of prohibiting deposition "in any place under any conditions where the deleterious substance may enter into such waters."

The Canadian federal government is on record several years ago with concerns regarding contaminated tailings leakage in the area, and has been present at environmental assessment hearings when companies have projected surface water contamination and water quality degradation.

The Canadian government has neither prosecuted any company for documented surface water contamination, nor has it pursued regulation governing tailings pond leakage. It relies on the Government of Alberta to alert it to possible violations of the *Fisheries Act*, and Alberta in turn relies on industry self-reporting. An industry-funded regional water monitoring body that Canada relies on – the Regional Aquatic Monitoring Program – has been discredited as scientifically inadequate and for failing to identify significant water pollution in the region.

II. SUBSECTION 36(3) OF THE *FISHERIES ACT*

A. Subsection 36(3) of the *Fisheries Act*

Subsection 36(3) of the Canadian federal *Fisheries Act* deals with pollution prevention, and establishes a general prohibition on the deposition of "deleterious substances" into waters frequented by fish.

Subsection 36(3) provides that:

> Subject to subsection (4), no person shall deposit or permit the deposit of a deleterious substance of any type in water frequented by fish or in any place under any conditions where the deleterious substance or any other deleterious substance that results from the deposit of the deleterious substance may enter any such water.[1]

Subsection 36(4) of the *Fisheries Act* provides that a deposit of a deleterious substance is not an offence if permitted by regulation.[2] Subsection 36(5) provides that the Governor in Council may make regulations that permit the discharge of certain deleterious substances in certain locations and under certain conditions.[3]

Pursuant to subsection 36(5), the Governor in Council has made regulations prescribing the allowable deposits from facilities within specific industry classes such as the pulp and paper industry and the petroleum refining industry.[4] The Governor in Council has not made any regulations pertaining to oil sands mining, oil sands tailings ponds or any effluent types released by those operations. Therefore, there are no regulatory exemptions from the requirements of subsection 36(3) of the *Fisheries Act* that are relevant to oil sands mining or tailings ponds resulting from oil sand mining.

In addition to prohibiting the direct deposit of deleterious substances into water frequented by fish, the second half of subsection 36(3) clearly prohibits the *indirect* deposition of deleterious substances and has a preventative element of prohibiting deposition "in any place under any conditions where the deleterious substance may enter into such waters" (emphasis added).

B. Subsection 36(3) is an Environmental Law

Subsection 36(3) of the *Fisheries Act* prohibits the release, discharge or emission of pollutants or environmental contaminants for the primary purpose of the protection of the environment or the prevention of danger to animal or human life or health and as such falls within the definition of an environmental law in Article 45(2) of the *North American Agreement on Environmental Cooperation.*

C. Interpretation of Subsection 36(3)

Canadian case law has clarified that it is not necessary that the receiving water be rendered deleterious to fish – it is the substance itself being deposited that is deleterious or not. In *R. v. Kingston (Corporation of the City)*, (2004) 70 O.R. (3d) 577, (2005) D.L.R. (4th) 734 (Ont. C.A.) ("Kingston"), the Court stated:

> [64] I agree with the interpretation of s. 36(3) given by Seaton J.A. in *MacMillan Bloedel* [*R. v. MacMillan Bloedel (Alberni) Ltd.* (1979) 47 C.C.C. (2d) 118 (B.C.C.A.)]. As he noted at pp. 121-22: "What is being defined is the substance

> that is added to the water, rather than the water after the addition of the substance."
>
> [65] The focus of s. 36(3) is on the substance being added to water frequented by fish. It prohibits the deposit of a deleterious substance in such water. It does not prohibit the deposit of a substance that causes the receiving water to become deleterious. It is the substance that is added to water frequented by fish that is defined, not the water after the addition of the substance. A deleterious substance does not have to render the water into which it is introduced poisonous or harmful to fish; it need only be likely to render the water deleterious to fish. The actus reus is the deposit of a deleterious substance into water frequented by fish. There is no requirement in s. 36(3) or paragraph (a) of the definition of the term "deleterious substance" in s. 34(1), of proof that the receiving waters are deleterious to fish.

In Canada, jurisdiction over environmental matters is shared between the provincial and federal governments. Therefore, the issue can arise as to whether provincial permitting can serve as a defence to the contravention of a federal law. However, under the doctrine of federal paramountcy, where there is an inconsistency or conflict between a federal law and a provincial law, the federal law prevails.[5]

A provincial approval cannot excuse the proper enforcement of federal law. Furthermore, the existence of a federal-provincial cooperation agreement does not excuse the federal government from the responsibility to enforce its legislation.

III. EVIDENCE OF TAILINGS POND LEAKAGE

A. Oil Sands Tailings Ponds Leakage

Canada's oil sands are a large deposit of thick hydrocarbons trapped in sand and clay in Northern Alberta. Once considered uneconomic, successive Canadian and Albertan governments have actively encouraged their exploitation, to the point where the oil sands industry is now a major one in Canada.

The thick hydrocarbons, called "bitumen," are currently extracted by one of two methods: (1) strip mining or (2) melting it in place (in situ) by injecting steam into the ground and pumping the bitumen out of the ground.

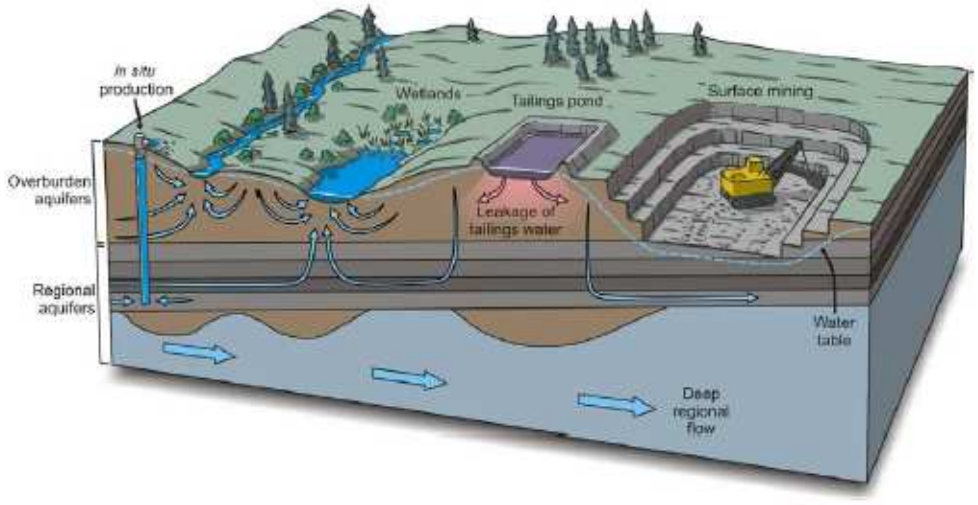
In the strip mining method, hot water is used to help separate the bitumen from the clay, sand, and other materials. This results in a large stream of contaminated liquid waste that is put into holding areas called "tailings ponds," although they are more like lakes in size.

Oil sands tailings ponds already have a surface area of 130 square kilometers (50 square miles), with a volume of 720 billion litres (190 billion gallons).[6] The volume is expected to exceed a trillion litres (264 billion gallons) by 2020.[7]

The containment areas for tailings ponds in the oil sands are built from materials the companies excavate from the surrounding area – earthen materials – and are not lined. In their project proposals,[8] companies assume that tailings ponds will systematically leak into the surrounding area, and the companies deploy a range of measures to recapture some of the leakage.

These recapture methods, however, are imperfect. As outlined below, there have been documented cases of contaminated tailings materials reaching surface waters, and leakage to deeper aquifers is not recaptured.[9] The following diagram is from the Council of Canadian Academies' Expert Panel on Groundwater report in 2009.[10]

Figure 6.9: Schematic Diagram of Key Groundwater Issues in the Athabasca Oil-sands Region



In December 2008, Environmental Defence Canada released a report that for the first time publicly estimated how much contaminated water the tailings ponds leak. The report compiled company data from environmental assessment reports to conservatively estimate that the tailings ponds already leak four billion litres (1 billion gallons) each year, with projections that this figure could reach over 25 billion litres (6.6 billion gallons) within a decade should proposed projects go ahead. The report is included as Appendix I.

There are also documented cases of contaminated tailings water reaching surface water. As noted below, in an environmental assessment Shell Canada Ltd. projected that contaminated tailings from its operations would reach Jackpine Creek.[11] An academic study from the University of Waterloo estimates that Suncor Energy's Tar Island pond had been leaking almost 6 million litres a day into the Athabasca River.[12]

Another incident is documented in correspondence between the Alberta government and Syncrude. In correspondence dating across the mid 2000's, it is clear that leakage occurred from the Mildred Lake tailings pond into Beaver Creek, a tributary of the Athabasca River.[13]

An academic account of the Suncor South Tailings Pond acknowledges that leakage into the adjacent McLean Creek will not be stopped, but rather than the company would try to manage the concentrations of deleterious substances in the creek.[14]

With regards to the medium to long term issue of what happens to the leakage to deeper aquifers from tailings ponds, migration of contaminants in tailings leakage from groundwater into surface water over time can be facilitated by the hydrogeological setting of the oil sands. A case study on the oil sands by the Council of Canadian Academies' Expert Panel on Groundwater, states:

> The land cover in the Athabasca oil-sands area is primarily wetlands and boreal forest. These are underlain by varying thicknesses of overburden, comprising a range of coarse materials in buried valleys or glacial deposits and modern organic deposits sitting atop thick clay tills and sandy tills. The overburden is vertically punctuated by downcutting glacial and post-glacial meltwater channels and modern stream courses.[15]

The issue of more permeable underlying settings for tailings ponds can be seen with the example of Suncor's South Tailings Pond of its Millenium mine. There, the Pleistocene meltwater channel deposits underneath the pond have led to a management strategy of letting contaminated leakage into an adjacent creek, as referenced above.[16]

Given that the second half of subsection 36(3) of the *Fisheries Act* prohibits the indirect discharge of deleterious substances from areas that "may" lead to surface waters frequented by fish, deep leakage into deeper aquifers in an area "punctuated by downcutting glacial and post-glacial meltwater channels" is as much of an issue as leakage into surface water in the oil sands region, since over time they could be one and the same.

B. Evidence of Harm

Tailings ponds contain a large variety of substances that are deleterious to fish. A recent scientific article compiles the results of several studies of the inorganic chemistry, organic chemistry and toxicity of oil sands tailings waters and finds the waters exceed the Canadian Council of Ministers of the Environment (CCME) Canadian Environmental Quality Guidelines: Surface Water Quality Guidelines for the Protection of Aquatic Life[17] for several substances including ammonia, benzene, cyanide, oil and grease, phenols, toluene, polycyclic aromatic hydrocarbons, arsenic, copper and iron. The author concludes that:

> Chemicals of environmental concern in oils sands process water include NA's [naphthenic acids], bitumen, ammonia, sulphate, chloride, aromatic hydrocarbons,

> and trace metals. While NA's are the main contributors of acute toxicity to aquatic biota, various compounds have exceeded CCME water quality guidelines at some point during oil sands operations and could contribute to chronic toxicity in reclaimed aquatic environments.[18]

Naphthenic acids are of particular concern not just because of their toxicity, but also because of their longevity, taking many decades to break down.[19]

While the case law cited above confirms that it is the deposited substance itself that is classified as "deleterious" rather than the receiving waters, there is nonetheless emerging evidence that the surface waters of the region are rendered more harmful to fish by oil sands activities. An independent water monitoring study conducted in 2008 found concentrations of polycyclic aromatic compounds (PAC) at levels several times over the levels considered toxic to fish embryos in areas most heavily impacted by industry, and concluded:

> PAC may contribute to a greater prevalence of abnormal juvenile and adult fish captured in the Athabasca near and downstream of oil sands mining.[20]

IV. CANADA'S FAILURE TO ENFORCE SUBSECTION 36(3)

A. Environment Canada's Monitoring Failure

In 1994, Canada and Alberta signed the *Administrative Agreement for the Control of Deposits of Deleterious Substances under the Fisheries Act* ("*Agreement*"). While the *Agreement* provides for a sharing of responsibility for responding to and investigating releases that may contravene subsection 36(3) of the *Fisheries Act*, the *Agreement* designates Alberta Environment as the lead agency in responding to and investigating releases within Alberta. However, Annex 3 of the *Agreement* confirms that:

> 2.1 The Parties are responsible for inspections under their respective legislation…
>
> 3.1 [Environment Canada and Alberta Environment] will conduct investigations into alleged contraventions of their respective legislation…
>
> 3.2.8 The parties recognize that both federal and provincial Attorneys General retain their discretion to prosecute violations of their respective legislation.

The *Agreement* confirms that the federal government will continue to have the responsibility to conduct inspections, investigations, and prosecutions under the *Fisheries Act*.

In practice, Environment Canada has relied on Alberta Environment to monitor, report and investigate releases from tailings ponds that may contravene subsection 36(3),[21] and as such has abdicated its responsibility to enforce this provision of the *Fisheries Act*.

Further, Alberta Environment relies on industry self-reporting of tailings leakage.[22] Both the provincial and federal levels of government have delegated regional monitoring of releases to an organization called the Regional Aquatic Monitoring Program (RAMP).[23] RAMP is funded by the oil sands operators, and despite being billed as having a "multistakeholder" governance structure, key First Nation and environmental participants have distanced themselves from RAMP.[24]

An independent expert review of RAMP in 2004 found "significant concerns" with scientific leadership, effective design, and a failure to incorporate a regional approach.[25] A recent independent monitoring study in the oil sands by leading water specialists found high levels of contamination unreported by RAMP and concluded that:

> Our study confirms the serious defects of the RAMP…More than 10 years of inconsistent sampling design, inadequate statistical power, and monitoring-insensitive responses have missed major sources of [polycyclic aromatic compounds] to the Athabasca watershed.[26]

Environment Canada's reliance on the discredited RAMP program for monitoring of tailings pond leakage is a further abdication of its responsibility to monitor, investigate and enforce subsection 36(3).

B. Environment Canada's Failure to Enforce Subsection 36(3)

Despite the failure to directly monitor and investigate subsection 36(3) violations, Environment Canada has known for several years about the problem of contaminated tailings pond leakage. In 2004, the National Energy Board wrote:

> …the principal environmental threat from tailings ponds are the migration of pollutants through the groundwater system and the risk of leaks to the surrounding soil and surface water…the scale of the problem is daunting...[27]

Under the *Canadian Environmental Assessment Act,* each proposal for a new oil sands mine and associated tailings ponds goes through a Joint Review Panel (in partnership with the Alberta Energy Resources Conservation Board). The proponent provides all relevant federal agencies with information regarding the project.

As outlined below, notable about the environmental assessment process is that the companies themselves predict to relevant agencies tailings leakage into surface waters and water quality impacts, yet Environment Canada does not enforce subsection 36(3) or regulate the releases pursuant to subcetion 36(4) of the *Fisheries Act*. For example, the Joint Review Panel in the Shell Jackpine project noted that:

> Shell stated that it would construct a 6 m deep perimeter ditch to intercept seepage flow from the tailings disposal area, but that some seepage would discharge to the

> ground surface between the tailings area and Jackpine Creek and that half of this seepage would enter the creek.[28]

In the CNRL Horizon decision, the Joint Review Panel noted the company's admission regarding overall impacts on water quality:

> CNRL acknowledged that it predicted some chemical substances would exceed chronic effects levels for fish and other aquatic biota, but it did not believe that there would be any effects on fish health as a result of those exceedances.[29]

In a January 2009 Memorandum to Canada's Environment Minister from his Deputy Minister (see Appendix II), Environment Canada acknowledges the leakage ("seepage") issue, and the fact that the agency is alerted to it by oil sands companies:

> Seepage would not likely be directly into surface waters, but move first into groundwater. It may take decades to reach surface waters. In their environmental assessments, many oil sands companies acknowledge that this may occur.[30]

Two things are notable about this statement. First is the qualification of "not likely" in the first sentence regarding leakage into surface waters, which is an acknowledgement of the prospect of it taking place. Second is an acknowledgement that the leakage may reach surface waters in "decades," well within the life span of naphthenic acids, one of the key pollutants from tailings ponds.

The federal government claims that "Alberta has a zero-discharge policy for oil sands tailings ponds,"[31] yet the Alberta government sanctions the leakage from tailings ponds under its *Environmental Enhancement and Protection Act*. The Alberta legislation is structured similarly to the *Fisheries Act* in that it states a general prohibition on the release of pollution unless authorized by the regulator.

In March, 2009, Environment Canada communicated with the Canadian Parliament's Standing Committee on the Environment and Sustainable Development where the specific question regarding how Environment Canada enforces the *Fisheries Act* with regards to tailings leakage was taken up (see Appendix III). In its communication, Environment Canada indicates that despite the fact that "Alberta Environment inspectors are not designated as Fisheries Inspectors under the *Fisheries Act,*" it is the practice of Environment Canada (EC) to wait for a referral from Alberta Environment should the latter suspect a *Fisheries Act* violation. And,

> To date, EC Enforcement has not received a referral from Environment Alberta indicating that they suspect any possible *Fisheries Act* violations.[32]

To repeat, no referrals from Environment Alberta have been forthcoming, and this is despite the documented instances of contaminated tailings pond leakage reaching surface waters outlined above.

It is also clear that Environment Canada is fully aware of the general issue of groundwater contamination and migration to surface waters, and in other circumstances is an advocate against the practice. On its webpage on groundwater contamination, Environment Canada states:

> It has often been assumed that contaminants left on or under the ground will stay there. This has been shown to be wishful thinking.[33]

Environment Canada is also aware of the issue of migration of groundwater pollution:

> Several studies have documented the migration of contaminants from disposal or spill sites to nearby lakes and rivers as this groundwater passes through the hydrologic cycle, but the processes are not as yet well understood. In Canada, pollution of surface water by groundwater is probably at least as serious as the contamination of groundwater supplies. Preventing contamination in the first place is by far the most practical solution to the problem.[34]

Environment Canada's failure to enforce the pollution prevention provisions of the *Fisheries Act* has been taken up more than once by Canada's Commissioner of the Environment and Sustainable Development. In a 1999 report, the Commissioner found several shortcomings in the approach of Environment Canada,[35] yet a subsequent 2009 review found that the problems persisted. In 2009 the Commissioner concluded:

> Environment Canada does not have a *Fisheries Act* compliance strategy for the industries and activities that must comply with the Act's prohibition requirement against the deposit of harmful substances in water frequented by fish.[36]

In 2009, the Commissioner also specifically addressed Environment Canada's enforcement with regards to its administrative agreement with Alberta and oil sands tailings pond contamination. It's conclusion in this regard was:

> Environment Canada relies on the Agreement and the arrangements with Alberta to meet its Fisheries Act responsibilities. However, the Agreement's Management Committee has not provided its oversight role in over two years and Environment Canada has not formally assessed the extent that the arrangements with Alberta fulfill the Department's Fisheries Act responsibilities.[37]

C. Submitters' Past Requests for Enforcement

As outlined above, the Canadian federal government has known about the problem of oil sands tailings leakage for several years, and has also participated in environmental assessment processes where specific instances have been identified.

When Environmental Defence released its December 2008 report on tailings pond leakage and failure to enforce the *Fisheries Act*, there was extensive media coverage

across Canada. A national newspaper, *the Globe and Mail,* ran an editorial that concluded that "the federal government has failed to enforce the *Fisheries Act*."[38]

In January 2009, Environmental Defence Canada (EDC) began direct written correspondence with Environment Canada (EC) to request enforcement of the *Fisheries Act* with regards to tailings pond leakage (see Appendix IV). Here is a summary:

- January 26, 2009: EDC to EC. EDC summarizes findings of its report and requests enforcement.

- April 7, 2009: EC to EDC. EC claims no evidence of particular point of leakage into Athabasca watershed and says will visit oil sands sites to investigate.

- May 8, 2009: EDC to EC. One letter to Deputy Minister regarding the narrow-casting of the leakage issue into specific surface water incidents rather than considering long-term groundwater leakage. Another letter to enforcement division outlining specific instances of surface water leakage and the law.

- May 29, 2009: EDC to EC. Enclosed copies of Syncrude groundwater monitoring report and Expert Panel on Groundwater of the Council of Canadian Academies that flags risk to Athabasca River of oil sands operations. Again flags indirect leakage issue.

- July 6, 2009: EC to EDC. Reports that its studies are inconclusive to date.

- September 28, 2009: EC to EDC. Sylvie Ladouceur, Executive Assistant to the Deputy Minister declined via email an in-person meeting with EDC

- January 13, 2010: EDC to EC. Request results of studies and flags new independent monitoring report of Dr. David Schindler finding elevated pollution levels in Ahtabasca and tributaries near oil sands.

- February 22, 2010. EC to EDC. Indicates that studies are still underway.

- March 25, 2010. EDC to EC. Flags that studies at this point are unlikely to capture information about past surface water incidents. Also flags that EC has known about the leakage problem for several years. Outlines what enforcement of the *Fisheries Act* would look like.

Finally, regarding the sincerity of the leadership of Environment Canada to address this issue, during a water conference at McGill University on March 26, 2010, federal Environment Minister Jim Prentice, responsible for the enforcement of subsection 36(3), responded to a specific question about the amount of contaminated tailings leaking into the groundwater by saying it was "garbage science."[39] This comment exposes the lack of commitment at the highest level of Environment Canada to enforce the *Fisheries Act* when it comes to pollution from oil sands tailings ponds.

V. ARTICLE 14 REQUIREMENTS

A. This is a Submission the Secretariat May Consider – Article 14.1

This Submission meets the threshold requirements established under Article 14.1 of the NAAEC.

Article 14.1(a). The Submission is presented in English.

Article 14.1(b). Environmental Defence Canada presents the Submission on behalf of itself, the Natural Resources Defence Council, John Rigney, Don Deranger, and Daniel T'seleie (the "Submitters").

Article 14.1(c). This Submission is based on information and documentary evidence contained in environmental assessment submissions, regulatory correspondence, academic papers, and other sources.

Article 14.1(d). The Submitters have a long-standing interest in the health of natural ecosystems, including water pollution issues. The Submitters do not have a financial interest in oil sands operations or their competitors. The Submitters present this Submission with the aim of promoting enforcement.

Article 14.1(e). This matter has been communicated in writing to Environment Canada in a series of correspondence dating back to January 2009 (see Appendix IV). The Submitters believe this lengthy correspondence is failing to result in enforcement measures, and as outlined above, question the sincerity of the responsible Minister.

Article 14.1(f). The Submitters are not-for-profit organizations and individuals based or residing in the territory of Canada and the United States.

B. The Issues Raised in this Submission Merit a Response from the Government of Canada – Article 14.2

The Submitters respectfully submit that they have met the criteria set out in Article 14.1, and ask that the Secretariat request a response from the Government of Canada.

Article 14.2(a) - Harm to the Submitters

The individual Submitters are people who have lived, hunted, and fished downriver from the oil sands for decades. The non-governmental Submitters are organizations whose members include over 1 million individuals who have a shared interest in protecting the ground and surface waters of Canada and North America, including the reduction and elimination of pollution from industry.

The Submitters and their members make use of these waters and water pollution harms the entire ecosystem, including people, fish and their habitat. The harm that the contaminants found in tailings ponds can do is not in dispute, and as outlined above, contaminants like naphthenic acids are very long-lived, with their toxic legacy extending into many decades. Given the amount of tailings being generated, the scale of the problem is of national, if not international concern.

Article 14. 2(b) - Advancing the Goals of the NAAEC

This Submission raises matters whose further study in this process would advance the goals of the NAAEC. In particular, the preparation of a factual record would:

- Foster the protection and improvement of the environment for present and future generations (Preamble par.1, Article 1(a));

- Promote sustainable development based on cooperation and mutually supportive environmental and economic policies (Article 1(b));

- Increase cooperation between governments to better conserve, protect, and enhance the environment (Articles 1(c), and 10(2)(i));

- Avoid trade distortions by Canada's failure to enforce the *Fisheries Act* – a U.S. organization called Domestic Energy Producers Alliance is already on record alleging unfair trade practices from "cheap, dirty Tar Sands"[40] (Article 1(e));

- Strengthen cooperation on the development and improvement of environmental laws, regulations, procedures, policies and practices (Article 1(f));

- Enhance compliance with, and enforcement of, environmental laws and regulations (Articles 1(g), and 10(2)(p)); and

- Promote pollution prevention policies, practices, techniques and strategies (Articles 1(j), and 10(2)(b)).

Article 14. 2(c)-Private Remedies

There are no realistic alternative private remedies available. The Submitters either do not have status for civil remedies or they would be impractical to pursue. While Canadian citizens do have the right to commence private prosecutions under the *Fisheries Act* and its regulations where the government refuses to enforce the law, the evidentiary burden is hard to meet for actors without access to significant resources, and such proceedings do not address the systemic problem of persistent non-enforcement by the authorities.

Also, private prosecutions can be stayed by the Crown. Private prosecutions are beyond the financial capacity of most citizens, and are not a viable option for effective enforcement where there are numerous violations of federal law. The Government of

Canada has the resources and the obligation to effectively enforce these domestic environmental laws.

Article 14. 2(d)-Mass Media Reports

This Submission is based primarily upon information obtained from governments, industry, and academic research resources, and not simply mass media reports.

Remedy

The Submitters therefore respectfully ask that the CEC prepare a factual record of the allegation that the Government of Canada is in breach of its commitment under the NAAEC to effectively enforce subsection 36(3) of the *Fisheries Act* against the practice of leaking deleterious substances from oil sands tailings ponds.

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[1] *Fisheries Act*, R.S.C. 1985, c. F-14, s. 36(3).
[2] *Ibid.*, s. 36(4).
[3] *Ibid.*, s. 36(5).
[4] *Pulp and Paper Effluent Regulations*, S.O.R./92-269; *Petroleum Refinery Liquid Effluent Regulations*, C.R.C. c. 828.
[5] Peter W. Hogg, *Constitutional Law of Canada*, 2005 Student Ed. (Toronto: Thomson Carswell, 2005) at 16.1.
[6] Backgrounder: Oil Sands Tailings and Directive 074, Pembina Institute, Dec. 1, 2009.
[7] Backgrounder: Oil Sands Tailings and Directive 074, Pembina Institute, Dec. 1, 2009.
[8] For a summary of company estimates of tailings ponds leakage rates, see "Appendix 1 – Methodology and Sample Calculations," by Jeremy Moorhouse, Pembina Institute, December 2008 at http://www.environmentaldefence.ca/reports/pdf/Seepage%20Appendix%20rA.pdf
[9] See "11 Million Litres a Day," by Matt Price, Environmental Defence Canada, December 2008, p. 11.
[10] "The sustainable management of groundwater in Canada," Expert Panel on Groundwater, May 2009, 3915.
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[14] "Design of Tailings Dams on Large Pleistocene Channel Deposits, A Case Study – Suncor's South Tailings Pond," by B. Stephens et al, date unknown.
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[21] See: "Follow-Up On Committee Hearings," by Environment Canada to the Standing Committee on the Environment and Sustainable Development, House of Commons, March 20, 2009. See Appendix III.
[22] See: "Follow-Up On Committee Hearings," by Environment Canada to the Standing Committee on the Environment and Sustainable Development, House of Commons, March 20, 2009 at page 72 as marked on the document in Appendix III.
[23] See: http://www.ramp-alberta.org/RAMP.aspx
[24] The Athabasca Chipewyan First Nation released a Media Release on May 9, 2008 titled "ACFN Withdraws from R.A.M.P and W.B.E.A." Personal communication on November 18, 2008 from Shannon Crawley with the Chipewyan Prairie First Nation confirms that Band wrote to RAMP in 2008 to withdraw. Personal communication with Simon Dyer of the Pembina Institute on April 9, 2010 confirmed that Pembina asked RAMP to remove its name from the RAMP website in 2009.
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[27] "Canada's Oil Sands: Opportunities and Challenges to 2015," National Energy Board, 2004.
[28] Joint Panel Report, EUB Decision 2004-009, Shell Canada Limited, Applications for an Oil Sands Mine, Bitumen Extraction Plant, Cogeneration Plant, and Water Pipeline in the Fort McMurray Area, February 5, 2004, page 43.
[29] Joint Panel Report, EUB Decision 2004-005, Canadian Natural Resources Limited, Application for an Oil Sands Mine, Bitumen Extraction Plant, and Bitumen Upgrading Plant in the Fort McMurray Area, January 27, 2004, page 49.
[30] "Memorandum to the Minister, Oil Sands Tailings Ponds," MIN-118731, revised Jan. 19, 2009, signed by Ian Shugart, Deputy Minister, Environment Canada. See Appendix II.
[31] "Memorandum to the Minister, Oil Sands Tailings Ponds," MIN-118731, revised Jan. 19, 2009, signed by Ian Shugart, Deputy Minister, Environment Canada. See Appendix II.
[32] "Follow-Up On Committee Hearings," by Environment Canada to the Standing Committee on the Environment and Sustainable Development, House of Commons, March 20, 2009.
[33] See: http://www.ec.gc.ca/eau-water/default.asp?lang=En&n=6A7FB7B2-1
[34] See: http://www.ec.gc.ca/eau-water/default.asp?lang=En&n=6A7FB7B2-1
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[36] Report of the Commissioner of the Environment and Sustainable Development—Spring 2009 Chapter 1 p. 35. See also: http://www.oag-bvg.gc.ca/internet/English/parl_cesd_200905_01_e_32511.html#hd4b
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[39] "Conservatives work hard to avoid dealing with tarsands," by Cameron Fenton, *the Concordian*, March 30.
[40] See: http://depausa.org/dyn/showpage.php?id=15

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Doris Millan
Submissions on Enforcement Matters Unit
Commission for Environmental Cooperation
393 St-Jacques Street West, Suite 200
Montreal, QC H2Y 1N9

April 20, 2010

Dear Ms. Millan:

We wish to submit a point of clarification regarding our submission SEM-10-002 (Alberta Tailings Ponds).

It has come to our attention that a quote attributed to Canadian Environment Minister Jim Prentice in our submission was misreported by the media source we cited. Following a water conference at McGill University, the Minister did not use the words "garbage science" to refer to a report of tailings leakage, as the newspaper article claimed. On reviewing video tape by CPAC, this is what the Minister said in response to the relevant question:

> "I'm happy to respond to your question, it was a fairly long question. The tailings ponds that you referred to are governed and regulated by the Province of Alberta. I have met with our officials, I have met with our scientists. The information that you've just forward, that there's leakage from those tailings ponds into the Athabasca River is completely unsupported by our science, by our monitoring of the Athabasca River, and is simply not the case."

We regret this error, but believe that the correct quotation equally supports the point that the appropriate authority is refusing to accept the evidence and to enforce the law.

Yours sincerely,

<original signed by>

Matt Price
Policy Director
Environmental Defence

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04/23/2010

Cc Hon. Jim Prentice, Minister of the Environment

DIRTY OIL DIRTY AIR

Ottawa's broken pollution promise

ENVIRONMENTAL | DEFENCE

Above: Syncrude tar sands mine (David Dodge, the Pembina Institute).

Cover photo: © Greenpeace / Eamon Mac Mahon.

DIRTY OIL, DIRTY AIR

OTTAWA'S BROKEN POLLUTION PROMISE

May 2010

Environmental Defence would like to thank the EJLB Foundation for its support.

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SUMMARY

- There has been a recent spike in air pollution "exceedances" in the tar sands region from 47 in 2004 to 1,556 in 2009.
- The exceedance spike is consistent with increased air pollution in the tar sands region, with many more polluting projects already approved.
- Alberta has lower standards than the European Union, U.S. Environmental Protection Agency and World Health Organization for what qualifies as an "exceedance".
- The tar sands industry is allowed to largely self-monitor air pollution, creating a multi-billion dollar conflict of interest.
- In 2006 the Canadian government promised mandatory pollution requirements for all industry sectors, including specific caps for the tar sands industry, and has failed to follow through.

Above: Air pollution in the tar sands region will continue to get worse with over two dozen polluting new projects or expansions already approved (© Greenpeace / Eamon Mac Mahon).

OTTAWA'S BROKEN PROMISE ON CLEAN AIR

In October, 2006, the Harper government announced its intention to pass a new federal *Clean Air Act*.[1] The government said:

> Past governments relied on voluntary measures, satisfied that industry could set their own standards. Those days are over - from now on, **all industry sectors will have mandatory requirements and we will enforce those requirements**. Our plan puts the health of Canadians and the health of our environment first.[2] (emphasis added)

The government set about designing sector-specific reduction targets for pollutants such as sulphur oxides, nitrogen oxides, and volatile organic compounds (VOCs). In the case of the tar sands, Ottawa modeled[3] ongoing growth in oil production in conjunction with the application of emission control technologies, to arrive at the following tar sands caps:

	Level in 2006 (kilotonnes/year)	2015 Projection (kt/y)	**Proposed Cap (kt/y)**	Change from 2006 levels
Sulphur oxides	158	108	**70**	-55%
Nitrogen oxides	76	134	**80**	+5%
VOCs	63	200	**100**	+60%

The weak VOC target reflected a failure to address the major source – tar sands tailings ponds, an outdated technology that even Alberta Premier Ed Stelmach has said must be eliminated.[4] A key VOC of concern is benzene, a human carcinogen that is linked to leukemia, and for which there is no safe level of exposure. Environment Canada estimated that left unchecked, benzene emissions from the tar sands could multiply eight-fold by 2015.[5]

Yet, whether or not the tar sands air pollution caps are strong enough to protect human health in the region, the fact remains that three and a half years later, we are still waiting for any mandatory federal industry requirements on air pollution from the tar sands.

Ottawa's broken promise on clean air is situated within the context of the federal government repeatedly saying that better environmental management is necessary in the tar sands, yet failing to back words up with any action. Prime Minister Stephen Harper said, "To be frank on the oil sands, we've got to do a better job environmentally."[6] Federal Environment Minister Jim Prentice also said:

> And for those of you who doubt the Government of Canada's willingness, that we lack either the willingness or the authority to protect our national interests as a "clean energy superpower," think again. We do and we will.[7]

Where, then, are the actions to match the words?

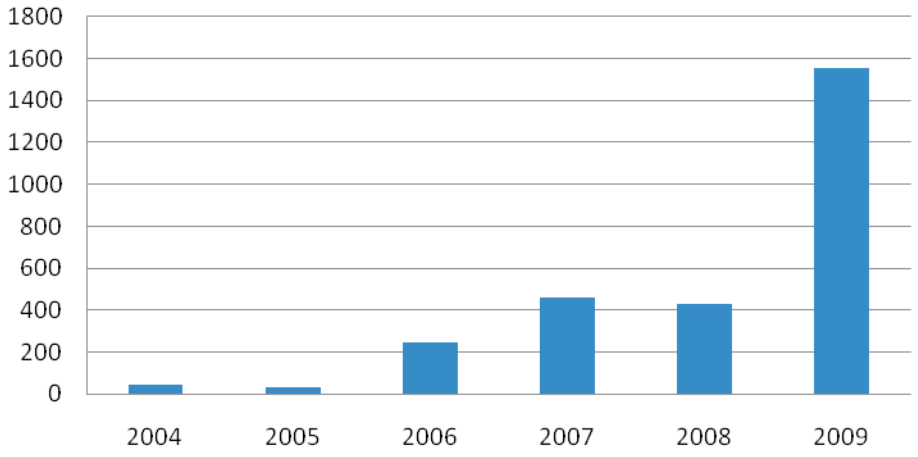
POLLUTION SPIKE

The Wood Buffalo Environment Association (WBEA) has 14 air monitoring stations in the tar sands region. These stations test the outside air for several pollutants, including particulate matter, nitrogen and sulphur dioxides and hydrogen sulphide.

The Alberta Government has established Ambient Air Quality Objectives, which set standards for key air pollutants.[8] If a pollutant is found to be at a higher level than the limit set for it, it's called an 'exceedance.'

According to WBEA data, the number of exceedances has recently spiked in the tar sands region, rising to 1,556 in 2009 from 47 in 2004.

GRAPH 1. AIR POLLUTION EXCEEDANCES

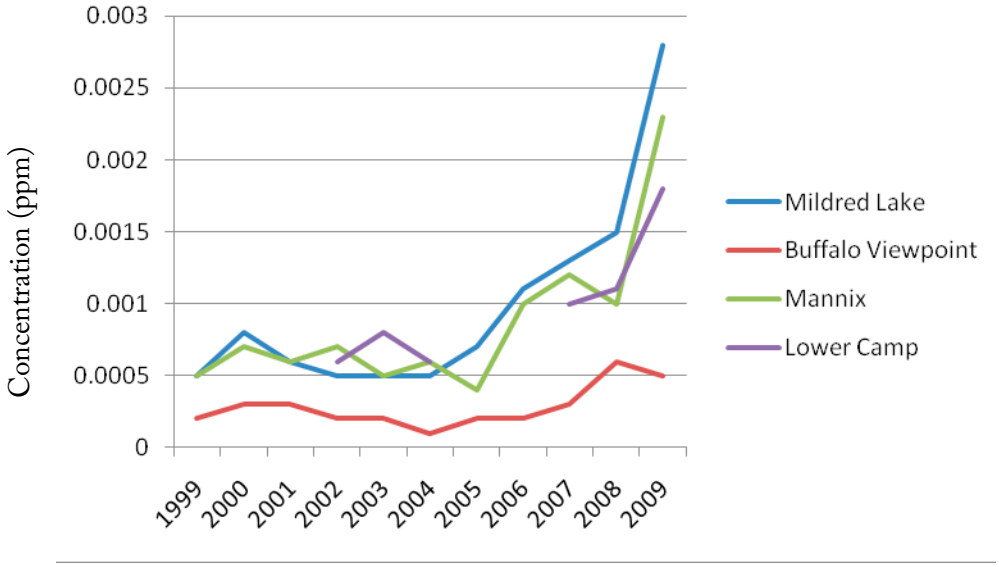


Data source: Clean Air Strategic Alliance

Alberta government officials have said that the spike in exceedances comes largely from a rise in hydrogen sulphide associated with one of Suncor's tailings ponds.[9] The rotten egg smell of hydrogen sulphide now wafts into the community of Fort McKay on a regular basis, causing community members to raise concerns about the impacts of the polluted air on their health and the health of the land.[10]

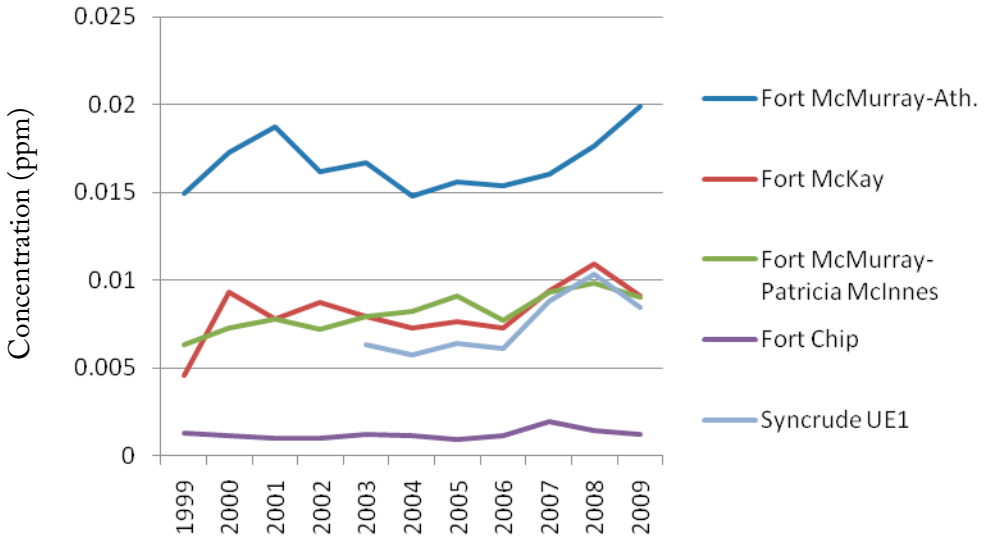
Several of the monitoring stations around the tar sands region have detected rising levels of hydrogen sulphide and nitrogen oxides in the air since 2004.

GRAPH 2. HYDROGEN SULPHIDE IN THE TAR SANDS REGION



Data source: Clean Air Strategic Alliance

GRAPH 3. NITROGEN OXIDES IN THE TAR SANDS REGION



Data source: Clean Air Strategic Alliance

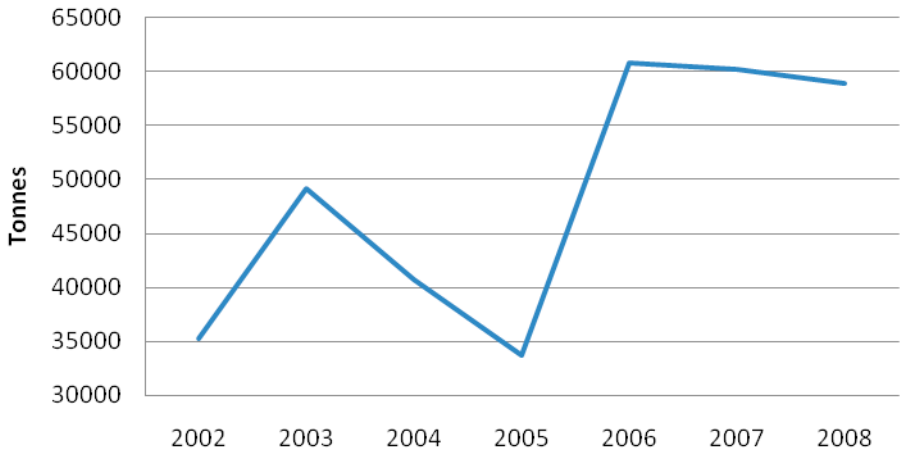
POLLUTION SPIKE PART OF TREND

Even if the problems with Suncor's tailings pond are brought under control, the spike in exceedances is part of a trend of increasing air pollution in the tar sands region – and with 29 new projects or expansions already on the books,[11] the failure of the federal government to follow through on binding air pollution caps will ensure the situation continues to gets worse.

Many larger facilities in Canada that release or transfer certain pollutants over specific thresholds must report to the National Pollutant Release Inventory (NPRI), a national database overseen by Environment Canada. There are troubling questions regarding the accuracy of the data that petroleum facilities submit to the NRPI (see below), but even so, according to the program there is an unmistakable rise in the amount of air pollutants being released in the tar sands region.

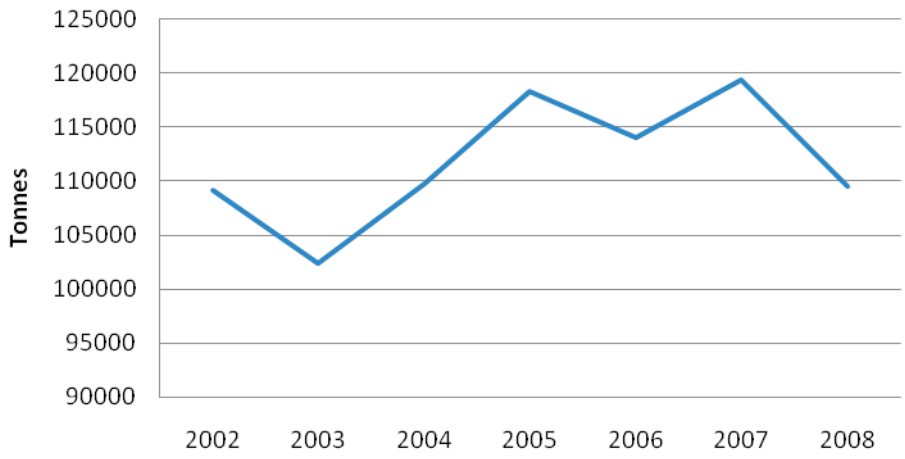
The emissions of key air pollutants were tallied for 24 facilities in the tar sands region using the NPRI database (see Appendix for methodology). Between 2002 and 2008, industry reported a near doubling of volatile organic compounds and particulate matter. Nitrogen oxides have gone up by 50 per cent and sulphur dioxide has remained roughly the same. Hydrogen sulphide emissions were14 times greater in 2008 than 2002.

GRAPH 4: VOLATILE ORGANIC COMPOUNDS



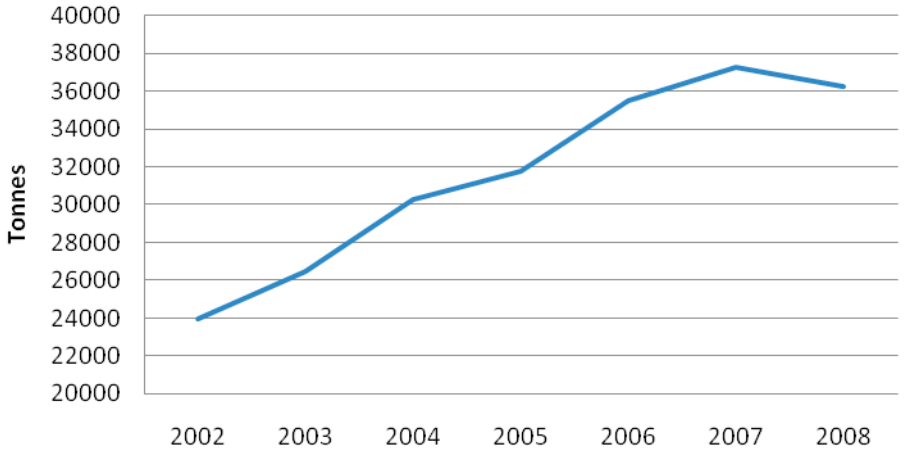
Tar sands facilities, data source: NPRI

GRAPH 5. SULPHUR DIOXIDE



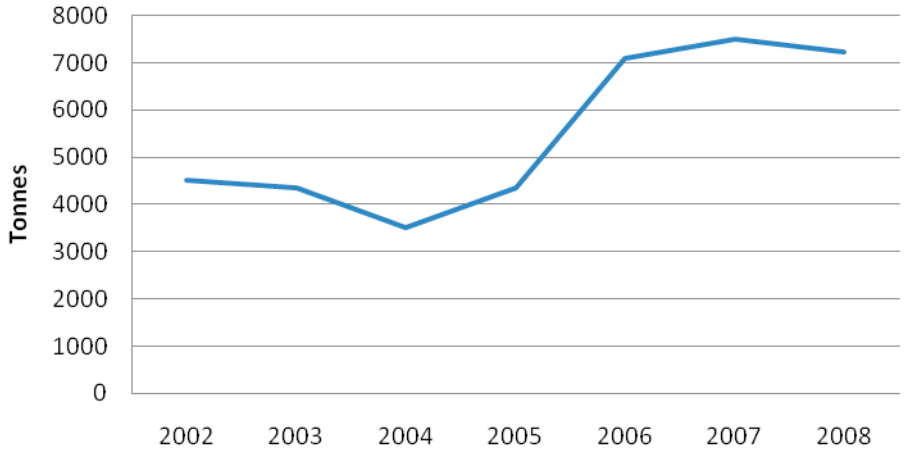
Tar sands facilities, data source: NPRI

GRAPH 6. NITROGEN OXIDES



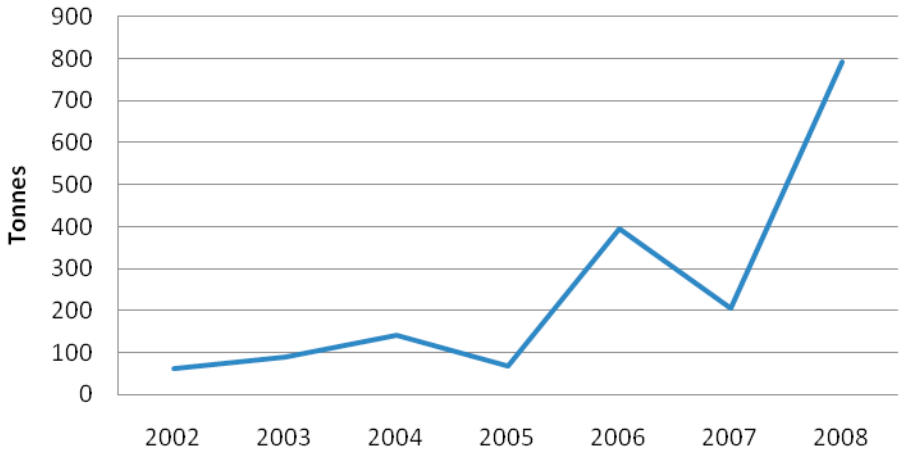
Tar sands facilities, data source: NPRI

GRAPH 7. PARTICULATE MATTER



Tar sands facilities, data source: NPRI

GRAPH 8. HYDROGEN SULPHIDE



Tar sands facilities, data source: NPRI

The industry has reduced air emissions of sulphur dioxide by stripping out sulphur into solid form, but as a result has created another problem in the form of massive yellow pyramids of sulphur that it doesn't know what to do with. One estimate is that over the next 75 years, the tar sands industry could create 500 million tonnes of sulphur[12] - about equivalent to the weight of 5,000 cruise ships. The short-term storage of sulphur is complicated by errant sulphur dust contaminating groundwater and acidifying soils, not to mention being an explosion hazard.[13] The long-term disposal of the equivalent of 5,000 cruise ships of sulphur is truly daunting.

In terms of acid rain, relative success with one acidifying emission – sulphur dioxide – is undermined by the steady rise in another acidifying emission – nitrogen oxides. While studies on the existing damage to regional lakes by acid rain are inconclusive,[14] future damage seems inevitable given the example of La Loche lake in Saskatchewan across from the tar sands, where falling rain has been measured as having three times the acid level as unpolluted rain, about the same acidity as coffee.[15]

Without federal regulation, given the projected growth in tar sands production over the next decade, the industry will keep adding to air pollution. Twenty-nine project expansions or new projects are already under construction or been approved, which will triple tar sands production and increase air pollution.[16]

HEALTH IMPACTS OF AIR POLLUTION

SULPHUR DIOXIDE: Health effects caused by exposure to high levels of sulphur dioxide include breathing problems, respiratory illness, changes in the lung's defences, and worsening respiratory and cardiovascular disease. Sulphur dioxide, along with nitrogen oxides, are the main precursors of acid rain.[17]

NITROGEN OXIDES: Exposure to nitrogen oxides impacts the respiratory system, including airway inflammation in healthy people and increased respiratory symptoms in people with asthma. It can cause or worsen emphysema and bronchitis, and can aggravate existing heart disease, leading to increased hospital admissions and premature death.[18]

VOLATILE ORGANIC COMPOUNDS: Key symptoms associated with exposure to VOCs include conjunctival irritation, nose and throat discomfort, headache, allergic skin reaction, nausea, epistaxis, fatigue, dizziness. Some VOCs, like benzene, are highly carcinogenic in humans.[19]

PARTICULATE MATTER: Exposure can affect both your lungs and your heart, and has been linked to irritation of the airways, coughing, or difficulty breathing, aggravated asthma, development of chronic bronchitis, irregular heartbeat, nonfatal heart attacks and premature death in people with heart or lung disease.[20]

HYDROGEN SULPHIDE: People working in industries where hydrogen sulfide exposure is common may have decreased lung function and increased risk of spontaneous abortion and impaired neurological functions. People living near industries that emit hydrogen sulfide have an increased risk of eye irritation, cough, headache, nasal blockage and impaired neurological function (including reaction time, balance, color discrimination, short-term memory and mood).[21]

SETTING THE BAR LOW

According to the World Health Organization (WHO), nitrogen dioxide is a toxic gas with significant health effects when people and animals are exposed to over 200 ug/m3 for a short period of time. Asthma can be triggered when levels are higher, and long-term exposure is linked to reduced lung capacity and asthma in children.

Yet, the Alberta government sets the bar for 'safe' levels of nitrogen dioxide at double the rate as the WHO. The same holds true for fine particulate matter and sulphur dioxide. The WHO limit for exposure to sulphur dioxide is lower than Alberta's – 20 compared to 150ug/m3. Alberta's air pollution limits are also lower than the U.S. Environmental Protection Agency and the European Union.

	Alberta[22]	U.S. EPA[23]	WHO[24]	EU[25]
Nitrogen Oxides				
1-hr average	400	200	200	200
Annual average	60	40	40	40
Fine Particulate Matter				
24-hr average	30	35	25	25
Sulphur Dioxide				
1-hr average	450	350		350
24-hr average	150	125	20	125
Annual average	30	20		

This means that red flags for air quality in the tar sands region are only raised when concentrations of a pollutant reach a level in excess of levels where other jurisdictions would have raised red flags. As a result, people living and working in the tar sands region are being put at higher risk than people elsewhere.

THE FOX AND THE CHICKENS

The oil industry is notoriously unreliable when it comes to monitoring and reporting on its own pollution. A 2006 study by the Alberta Research Council on an unnamed refinery used more reliable methods to measure pollution and found the refinery released 19 times more benzene than reported, 15 times more volatile organic compounds, and nine times more methane.[26] Facilities, however, are still allowed to use the methods at fault when submitting data to the NPRI, referenced above. This means that the reality of pollution levels could be much higher.

The tar sands industry itself dominates pollution reporting and monitoring for both air and water in the tar sands region. The conflict of interest in this regard runs into the billions of dollars – the clear incentive is to find nothing wrong so that business as usual can proceed. At the very minimum, it creates a perception of bias, if not the reality of one.

Both regional air and water monitoring are carried out by so-called "multi-stakeholder" bodies, the Wood Buffalo Environmental Association (WBEA) in the case of air, and the Regional Aquatic Management Program (RAMP) in the case of water. Both bodies are almost entirely industry funded, and their governance structures, with tar sands companies present, lend themselves to doing only those things that industry agrees with.

RAMP has come under repeated critique by regional First Nations, stakeholders, independent peer reviewers, and by scientists conducting their own monitoring in the region.[27] WBEA has faced less criticism to date, yet has the same structure as RAMP. In 2008 – its latest reporting year – WBEA reported contributions from tar sands companies in excess of $8.5 million, up significantly from the almost $3 million given by the industry in 2007.[28]

Recently, a study by the University of Alberta commissioned by WBEA was released with the message that residents of the oil sands region could "breathe easy." Yet, despite being released in April 2010, the study analyzed WBEA data only up to 2007, whereas exceedances spiked in 2008 and 2009. To its credit, WBEA attempted to point out the recent exceedances,[29] but media focused on the "breathe easy" message.

There has yet to be truly independent air pollution testing in the tar sands region, yet a cautionary tale is provided from a related geographic area. An award winning air pollution scientist conducted independent air testing around the Upgrader Alley near Edmonton, Alberta, where a good deal of tar sands bitumen gets processed. He found higher levels of pollution than the industry air monitoring body, the Fort Air Partnership, and concluded that either the industry was placing monitoring stations in the wrong places, or it had analytical problems, or both.[30]

RECOMMENDATIONS

There is no escaping the fact that tar sands production is highly polluting. In the face of criticism, however, the reaction of regulators has been to invest more heavily in public relations efforts instead of working to fix the problem. Until this changes, the tar sands will continue to face growing criticism.

With regards to air pollution in the tar sands, two things are needed:

1. The federal government must follow through on its promise to enact mandatory air pollution caps for the tar sands industry.
2. Credible air monitoring that is completely arms-length from industry must be established in the tar sands region, subject to regular scientific peer review and enhanced reporting that presents data accurately and includes exceedances.

Above: Over the next 75 years, the tar sands industry could create 500 million tonnes of sulphur like the yellow pyramids shown here, about equivalent to the weight of 5,000 cruise ships.
(© Greenpeace / Eamon Mac Mahon).

APPENDIX: NATIONAL POLLUTANT RELEASE INVENTORY METHODOLOGY

The trends of emissions from tar sands facilities were determined using the National Pollutant Release Inventory – Pollution Data Library (http://www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=B85A1846-1).

The facilities were identified by:

1. Selecting the "Oil Sands and Heavy Oil" category under Key Industrial Sectors, and identifying oil sands facilities from that list by name; and

2. Using a list of existing oil sands operations compiled by Strategy West (available at http://www.strategywest.com/downloads/StratWest_OSProjects_201005.pdf); the NPRI database was searched by facility name for facilities not included under the "Oil Sands and Heavy Oil" sector. Some tar sands operations on the Strategy West list do not report to NPRI.

In 2002, eight tar sands facilities reported to NPRI. By 2008, this had grown to the 25 facilities listed below. The list includes pipeline terminals in the tar sands region that have been built to transport tar sands oil.

NPRI ID	Facility Name
4136	CANADIAN NATURAL RESOURCES - Wolf Lake and Primrose Plant
21110	CANADIAN NATURAL RESOURCES - Cold Lake
6625	Cenovus FCCL Ltd. - Christina Lake SAGD Bitumen Battery
6627	Cenovus FCCL Ltd. - Foster Creek SAGD Bitumen Battery
22750	Connacher Oil and Gas Limited - Great Divide
22141	ConocoPhillips Canada - Surmont SAGD Commercial Battery
22267	Devon Canada Corporation - Jackfish SAGD Plant
6902	ENBRIDGE PIPELINES - Athabasca Terminal
6915	ENBRIDGE PIPELINES - Kirby Lake Terminal
442	IMPERIAL OIL - Cold Lake Heavy Oil Plants
17122	JAPAN CANADA OIL SANDS - Hangingstone SAGD Demonstration Project
22346	MEG Energy Corp. - MEG Christina Lake Regional Project
22378	NEXEN INC. - Long Lake Project
17630	PETRO-CANADA - MacKay River
17884	SHELL CANADA - HAIG LAKE TERMINAL
22493	Shell Canada - Orion 13-16
2128	SHELL CANADA - Peace River Complex
18352	Shell Canada - Seal Lake Battery 1-26
6647	Shell Canada Energy - Shell Albian Sands Muskeg River Mine
2230	SUNCOR ENERGY - Suncor Energy Inc. Oil Sands
19181	Suncor Energy Inc. - Firebag

6572	SYNCRUDE CANADA - Aurora North Mine Site
2274	SYNCRUDE CANADA - Mildred Lake Plant Site
21884	Total E&P Joslyn Ltd - Joslyn Creek SAGD Facility
22544	WHITESANDS INSITU PARTNERSHIP - WHITESANDS PROJECT
6620	WILLIAMS ENERGY - Fort McMurray Hydrocarbon Liquids Extraction Facility

For each facility, the NPRI database was used to extract emissions levels for sulphur dioxide, total particulate matter, oxides of nitrogen, volatile organic compounds and hydrogen sulphide from 2002-2008. The number of facilities reporting grew in that time, and not all facilities reported on all of those substances.

The total emissions, by substance, for each year were then tallied by adding the emissions from each facility reporting for that substance in that year.

ENDNOTES

1. See: http://www.ec.gc.ca/default.asp?lang=En&n=6F2DE1CA-1&news=549643B6-B2BD-42B8-A6D8-B85B7493F7DF
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4. "Stelmach to oilsands: no more wet tailings ponds," by Jason Fekete and Lisa Schmidt, Calgary Herald April 23, 2010
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10. http://www.edmontonjournal.com/business/Cleanup+emissions+could+risky/2593090/story.html
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13. "Are We There Yet," Paul Crawford, *Hydrocarbon Engineering*, reprinted from October, 2009.
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28. Wood Buffalo Environmental Association, Annual Report 2008, p. 11.

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