When Oil Meets Water

How the Energy East pipeline threatens North Bay watersheds

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TransCanada Corporation is proposing a 1.1 million barrel per day pipeline from Alberta to New Brunswick that threatens to contaminate hundreds of watersheds along its 4,600-kilometre route, including both the Lake Nipissing and Trout Lake watersheds in Northern Ontario. The Energy East project is the largest tar sands pipeline proposed yet and would be larger than any existing pipeline in Canada. The proposal seeks to convert an existing, up to 40-year-old natural gas pipeline from Saskatchewan to Ontario. New pipeline would be added in Eastern Ontario, travelling through Quebec to a new major export port in Saint John, New Brunswick.

This briefing paper shows how the pipeline route puts watersheds at risk, provides a realistic estimate of the likelihood of a pipeline rupture, and uses modelling to determine the potential costs of an oil spill in the North Bay area.

Main findings:

- Energy East would have a 15 per cent chance of a full bore rupture per year. A catastrophic rupture could produce the largest oil spill in recent Canadian history.
- TransCanada is unable to detect oil spills of up to 2.6 million litres per day.[1]
- A spill in the Trout Lake watershed could cost more than $1 billion.
- TransCanada greatly underestimates the challenges posed by an oil spill in winter conditions.

Where oil meets water in North Bay

The City of North Bay is located between the two freshwater lakes – Lake Nipissing and Trout Lake – and has numerous smaller lakes in and around the city. There are more than 40 public beach access points and the community enjoys swimming, canoeing, sailing, water skiing and fishing. Lake Nipissing is an important economic driver and a drinking water source for the broader region. In North Bay, the local economy and community are closely tied to the health of Trout Lake, which is the only source of drinking water for more than 54,000 people.

The proposed Energy East pipeline project would cross the source water protection area for North Bay that extends east to the Mattawa River, crossing the escarpment on the northern shore of Trout Lake less than six kilometres from the city's main intake pipe in Delaney Bay. The line threatens both surface and groundwater recharge areas in the Trout Lake basin.

Energy East would pump crude through the municipalities of North Bay, Bonfield, Calvin and Papineau-Cameron. Locally, it would cross through 14 wetlands, including the Provincially Significant Wetland that forms the headwaters of Chippewa Creek. It also crosses 40 watercourses, including Duchesnay Creek, Chippewa Creek, Mattawa River, Kaibuskong River, Sharpes Creek, Amable du Fond River, Pautois Creek and Boom Creek.

The pipeline proposed for conversion transects some of the most rugged terrain of the Canadian Shield. The terrain south of Temagami to North Bay and the Mattawa River is comprised of rugged granitic bedrock. Shallow trenches were blasted in this bedrock to enclose the existing pipelines. These trenches were backfilled with sand, gravel and blast debris. This enclosing material is highly porous and readily allows water infiltration.

What are the chances of Energy East rupturing?

In the 30,000-page Energy East pipeline project application that TransCanada submitted to the National Energy Board, there is a section titled *Energy East Pipeline Project Volume 6: Accidents and Malfunctions – Section 2: Incident Frequency and Volume Analysis – Onshore Pipeline.* This section includes calculations on the likelihood of Energy East failing based on pipeline failure rates in North America from 2002 to 2013.[2]

To arrive at its results, TransCanada assumes that its pipelines are as safe as the industry average. This is like a student referring to the class average instead of his or her own grade.

Pipeline rupture data produced by the National Energy Board shows that TransCanada has the worst safety record in Canada, with 17 ruptures since 1992.[4] TransCanada's most recent history is even worse, with eight ruptures in the last six years between 2009 and 2014, and four ruptures in the five-month period from October 2013 to February 2014. TransCanada's rupture rate has gone from bad to worse.

TransCanada ruptures in the last six years

Feb. 18, 2014	Rocky Mountain House, AB	Ferrier North pipeline
Jan. 25, 2014	Otterburne, MB	Line 400-1
Nov. 26, 2013	Boyle, AB	Flat Lake Lateral pipeline
Oct. 17, 2013	Wabasca, AB	North Central Corridor pipeline
Feb. 19, 2011	Beardmore, ON	Mainline
Sept. 24, 2009	Marten River, ON	Mainline
Sept. 12, 2009	Englehart, ON	Mainline
July 20, 2009	Rainbow Lake, AB	Peace River Mainline

When TransCanada's actual rupture history in Canada is used to calculate the likelihood of Energy East failing, the result is a 15 per cent chance of rupture per year.

TransCanada's current annual rupture rate per kilometre of pipeline =

(number of ruptures / total length of pipelines) / number of years

Annual rupture rate per kilometre X Energy East pipeline length X 100% = chance of Energy East rupturing per year

"The Panel found the Energy East Pipeline Proposal assessment (EEPP) to be overly simplistic, with blanket assurances regarding mitigation, generalized assumptions that mitigation would always be effective, and a reliance on low probability to reduce risk... The EEPP assessment did not add any value with respect to risk-based prioritization of mitigation measures along the pipeline route."[3]

– Expert Panel Report on the Behaviour and Environmental Impacts of Crude Oil Released into Aqueous Environments, Royal Society of Canada.

To arrive at this result, the number of ruptures (8)[5] is divided by the number of kilometres of pipeline TransCanada operates in Canada (39,880 km).[6] Divide this by the number of years in the period examined (the last 6 years, 2009-2014)[7] to calculate the rupture rate per kilometre, per year. Multiply this by the number of kilometres of Energy East (4,600 km) times 100 per cent to calculate the likelihood of a rupture per year somewhere along the pipeline.

The final result is a 15.37 per cent chance of a rupture per year. Over the 40-year projected lifespan of the project, this equates to six major ruptures. TransCanada's rupture rate has been increasing for more than a decade.

TransCanada argues that the likelihood of a spill in North Bay is small, but Energy East also threatens hundreds of other drinking water sources along its 4,600-kilometre route. The question is not whether Energy East will spill, but rather how big will the spills be, how often will they occur, and to what extent can they be cleaned up?

Stop the presses: TransCanada's pipeline leaks again

On April 2, 2016, TransCanada's only operating oil pipeline, Keystone 1, was shut down when a passerby discovered a pool of oil in a farmer's field in South Dakota. TransCanada's early estimates of the size of the spill started at 693 litres,[8] but after one week of digging up hundreds of feet of pipeline that figure grew to 64,000 litres. Nobody knows how long the pipeline was leaking, or how long it may have continued to leak had it not been discovered by a member of the public. What is clear is that TransCanada's leak detection system failed.

Difficulty of detecting leaks and ruptures

TransCanada can only detect leaks that are greater than 1.5 per cent of pipeline capacity[9] because its "state of the art" monitoring system is actually less accurate than the average bathroom scale.[10] A leak of 1.5 per cent would release up to 2.62 million litres of crude oil per day.[11] In 48 hours this could cause the worst oil spill in Canadian history **– and TransCanada would still not have any idea that there was a problem.**[12]

In July 2015, a 5 million litre spill from a year-old Nexen pipeline went undetected by the company's leak detection equipment for as long as two weeks. "This is a modern pipeline. We have pipeline integrity equipment, in fact some very good equipment." – Nexen official.[13]

In North America, people passing nearby discover the majority of pipeline spills – not pipeline leak detection systems. Energy East would cross vast territories that are sparsely inhabited, making early detection of a spill by the public very unlikely. TransCanada says it will "mitigate" this weakness by using aerial overflights above the pipeline. Currently, TransCanada flies over its existing pipelines about once per month, so any spill discovered from the air will have been leaking for between one and 30 days. An undetected leak of less than 2.62 million litres per day could create a spill of over 78 million litres in 30 days. In winter even large spills can be hidden under ice and snow.

A massive pipeline will create a massive spill

Enbridge claimed it would shut down its pipelines within eight minutes of detecting a rupture. It took 17 hours to stop pumping after its pipeline in Kalamazoo, Michigan ruptured in 2010, causing the largest inland oil spill in U.S. history.[16]

TransCanada claims it can detect a rupture and stop pumping oil within 22 minutes.[14] The most crude oil that can escape from a ruptured Energy East pipeline in 22 minutes would be 2.67 million litres.[15] Adding to this is "drain-down," which is the volume of oil between the nearest valves that is released after the pumping is stopped as gravity pulls oil out of the pipe from elevations higher than the rupture. According to TransCanada's proposal, the maximum spill in the North Bay area would be about five million litres. But this assumes perfect performance in detecting the spill and shutting down the pipeline. For every minute of delay, an additional 120,000 litres of oil could spill out.

Challenges of diluted bitumen

"The behaviour of unconventional oils and bitumen blends currently cannot be predicted with confidence. This knowledge gap affects risk assessments, spill response planning and cleanup decisions."[19]

– Expert Panel Report on the Behaviour and Environmental Impacts of Crude Oil Released into Aqueous Environments, Royal Society of Canada.

The Energy East pipeline would ship diluted bitumen produced in the tar sands. Diluted bitumen, also known as dilbit, is created by diluting thick bitumen with various toxic and explosive chemicals that act as solvents to make it thin enough to transport.

In July 2010, an Enbridge pipeline ruptured in Michigan, spilling 3.2 million litres of diluted bitumen into the Kalamazoo River.[17] Much of the bitumen sank, making recovery not only extremely difficult but also damaging to the ecosystem as it required the dredging of vast areas of river bed.[18] Five years and $1.2 billion USD later, there was still submerged bitumen at the bottom of the river.

Modelling the costs of an oil spill in North Bay

Accuracy of the Basic Oil Spill Cost Estimation Model (BOSCEM)

The model used for estimating spill costs in this report was created based on a data set that included 42,860 spills of at least 50 gallons that occurred during the years 1980 through 2002 in the United States and is specific to freshwater oil spills. Its relative accuracy is shown through comparison with known per litre costs from the 2010 Kalamazoo spill and the 1988 Exxon Valdez disaster.

Using the BOSCEM, if there was an accident in North Bay spilling 5 million litres, the total cleanup, socioeconomic, and environmental costs would be more than $1 billion. The calculated cost per litre of such a spill is lower than the known cost per litre of the Enbridge pipeline spill in Kalamazoo, Michigan in 2010. This difference is predicted by the BOSCEM, which stipulates higher per litre cleanup costs for smaller spills. Similarly, the BOSCEM predicts a lower cost per litre for larger spills, such as the 35 million litre Exxon Valdez spill.

Oil Spill Incident		Spill size in litres	Cost (2016 CAD)	Cost per litre
Enbridge - Kalamazoo River	Michigan, 2010	3.2 million	$1.52 billion[20]	$476
Exxon Valdez	Alaska, 1989	35 million	$6.62 billion[21]	$189

Estimated costs for potential spills

Oil Spill Incident (Hypothetical)		Spill size in litres	Cost (2016 CAD)	Cost per litre
"Worst case scenario" from Energy East application	Jock River, ON[22]	3.145 million	$68 million	$22
BOSCEM estimation of same	Jock River, ON	3.145 million	$688 million	$219
BOSCEM estimation	Trout Lake	5 million	**$1.09 billion**	**$219**

(see Appendix for calculations)

TransCanada greatly underestimates the challenges posed by an oil spill in winter conditions

The North Bay area experiences winter conditions for much of the year with an average annual snowfall of 299.6 centimetres and significant snow cover for approximately four months in a typical year.[24]

Despite the fact that thousands of kilometres of the Energy East pipeline route will be snow and ice covered for much of the year, TransCanada's proposal contains little information about how winter conditions will affect the detection, containment and cleanup of oil spills. TransCanada's "worst credible spill scenarios" and cost estimates simply assume that the spills will only happen in ideal weather conditions. The company makes no attempt to explain or provide cost estimates about how it would deal with a spill complicated by snow, ice and freezing temperatures.

"The season in which a spill occurs also can dramatically influence spill behaviour, fate, effects, and cleanup response actions."[23]

– Expert Panel Report on the Behaviour and Environmental Impacts of Crude Oil Released into Aqueous Environments, Royal Society of Canada.

Only one paragraph of the 30,000-page Energy East pipeline application recognizes the difficulties of dealing with a spill complicated by ice and snow.

> *"Freeze-up is the transition time in the fall when the lakes and rivers begin to freeze over. Breakup or spring melt is the short transition period between winter and spring when thawing begins, ice thins and/or breaks up, and river flows increase substantively and quickly, often to flood stages. Major floods may cause bank erosion and ultimately pipeline failure, with the oil entering the river and likely being widely dispersed and difficult to contain or clean up. An oil spill that results in oil reaching water bodies during either freeze-up or breakup may be difficult to contain, remove and cleanup. The ice may not be strong enough to support people or equipment. In rivers, the oil may be transported several miles under the ice or in broken ice before it can be contained. Once the ice is strong enough to support people and equipment, it may be more difficult to detect the oil under the ice and to implement measures to affect rapid containment/cleanup at and near the spill site. Weather, especially rapid warming periods and heavy rainfall, may cause rapid ice melt in rivers, snowmelt and runoff. These could result in major flood flows that breach levees along larger rivers, erode river banks, alter channels, and expose the proposed pipeline to forces that may break or rupture it. If spilled oil is released to the flooded area, especially to flowing waters, more oil could be distributed to adjacent terrestrial, wetland, and aquatic habitats."*
>
> *– Energy East Pipeline Project Volume 6: Accidents and Malfunctions Section 4: Sites of Interest.*

In January 2015 a pipeline spilled oil into the ice-filled Yellowstone River. Less than five per cent of the oil was recovered because of the difficulty finding and containing it under the ice. Even though the oil spilled was Bakken crude – which is predicted to float much longer than diluted bitumen – the oil quickly sank and entered the town of Glendive's water intake 14 feet below the river's surface.[25]

> *"When oil is spilled in rivers with drifting ice floes, conventional containment booms and recovery apparatus have great difficulty in performing their functions. The ice floes will rip conventional booms apart if significant ice accumulates behind the boom and will jam the intakes of recovery machinery."*[26]
>
> *– Field manual for oil spills in cold climates*, U.S. Environmental Protection Agency, 1982.

Lake turnover would accelerate the sinking of a diluted bitumen spill

In the spring and autumn of every year, over a period of weeks, Trout Lake "turns over" as temperature changes cause water at the surface of the lake to become denser than the water at the bottom. This mixing of the waters would greatly accelerate the sinking of a diluted bitumen spill, making cleanup impossible. It would also bring diluted bitumen to the level of the City of North Bay's drinking water intake pipe.

"North Bay-2013-08-02-018" by Perry Quan via Flickr. CC BY-SA 2.0

Potential causes of catastrophic pipeline failure

Failure to physically protect the pipeline

In 1990, a massive landslide on the Nipigon River exposed a section of a buried TransCanada natural gas pipeline.[27] This pipeline is part of the same Mainline system to be converted for Energy East. The landslide left more than 70 metres of the pipeline exposed and hanging, unsupported. If the pipe had been filled with oil, the extra 58 tonnes of weight[28] would have easily broken the pipeline, spilling millions of litres of oil into the Nipigon River just a few kilometres upstream of Lake Superior. Pipeline companies are required to identify and stabilize areas where erosion, slumping or slides might threaten buried pipelines.

A recent École Polytechnique[29] study says there is an extreme risk of a similar landslide event along much of Energy East's proposed route beside the St. Lawrence River.

Failure in designing and building the pipeline

In October 2013, a TransCanada pipeline near Wabasca, Alberta ruptured and exploded, throwing large pieces of pipeline up to 130 metres away and leaving a smoking, five-metre-deep crater. Luckily, the pipeline was transporting natural gas and not oil as it ruptured just 150 metres from the Wabasca River. The pipeline was less than five years old. It ruptured due to a series of errors on the part of TransCanada and its contractors, such as installing significantly thinner pipe than specified and failing to design the pipeline to withstand expected operating temperatures.[30]

In April 2013, a mandatory inspection on TransCanada's Keystone 1 pipeline found a section of the pipeline's wall had corroded by 95 per cent, leaving it "paper-thin" and forcing the company to immediately shut it down.[31] It had been less than two years since the pipeline was built. Investigations revealed that the company had failed to properly install and operate the cathodic protection system, which led to the corrosion.

Failure to comply with important safety regulations

Former TransCanada engineer Evan Vokes raised specific concerns about TransCanada having a culture inconsistent with pipeline safety best practices, resulting in a National Energy Board (NEB) audit that found TransCanada non-compliant in four out of nine key safety areas.[32]

In June 2011, National Energy Board staff inspecting pump stations on TransCanada's Keystone pipeline discovered that the stations were operating without the required backup power supplies for each station's Emergency Shut-Down system.[33] This critical piece of safety equipment is needed to close valves if power is interrupted.

The danger from adjacent pipelines

In 1995 in Rapid City, Manitoba, one of TransCanada's natural gas Mainlines (100-4) ruptured and exploded, causing damage to an adjacent line (100-3).[34] For much of the planned route of Energy East, the converted gas pipeline will run within metres of other pipelines carrying natural gas.

The danger of a negligent federal regulator

Interprovincial pipelines in Canada are regulated by the National Energy Board. In 2011, the federal Commissioner of the Environment and Sustainable Development audited the National Energy Board and found that the NEB could only show that pipeline companies were complying with its orders seven per cent of the time. A second audit in 2015 put the rate at 53 per cent.[35] Ensuring compliance is arguably the most important task of any regulator. In 2014-15 the NEB cut its anticipated spending on inspections and regulation development by about $17 million while spending $14 million more than anticipated on communications and public relations and $1 million on office furniture.[36]

Conclusion

The Energy East pipeline project poses considerable risk to the Lake Nipissing and Trout Lake watersheds, to North Bay and to every other community along its route or situated downstream from where the pipeline crosses water bodies. As shown in this report, TransCanada has a long history of failing to safely design, build and operate pipelines. It underestimates the risks of a spill, it underestimates the potential costs of a spill, and it fails to show that it is prepared to deal with the extreme challenges involved in effectively cleaning up after a spill. TransCanada expects the public to take on the risks of the project while the company reaps the rewards.

"North Bay, November 2009" by Rob Pringle via Flickr. CC BY-NC 2.0

Modelling Appendix

Description of BOSCEM

"[The] Basic Oil Spill Cost Estimation Model (BOSCEM) was developed to provide [...] a methodology for estimating oil spill costs, including response costs and environmental and socio-economic damages, for actual or hypothetical spills. The model can quantify relative damage and cost for different spill types for regulatory impact evaluation, contingency planning, and assessing the value of spill prevention and reduction measures. [The] BOSCEM incorporates spill-specific factors that influence costs – spill amount, oil type, response methodology and effectiveness, impacted medium, location-specific socio-economic value, freshwater vulnerability, habitat and wildlife sensitivity, and location type. Including these spill-specific factors to develop cost estimates provides greater accuracy in estimating oil spill costs than universal per-gallon figures used elsewhere. The model's basic structure allows for specification of response methodologies, including dispersants and in situ burning, which may have future applications in freshwater and inland settings. Response effectiveness can also be specified, allowing for analysis of potential benefits of response improvements."[37]

BOSCEM applied to potential Trout Lake oil spill

Spill response cost (2002 USD)

The per-gallon response cost for heavy oils ($87) X medium modifier for open water/shore and wetland (1.3) X spill amount (1,322,000 gallons)

Total response cost $149,518,200

Socioeconomic cost (2002 USD)

The per-gallon socioeconomic cost ($175) X socio-economic cost modifier value rank average of high-very high (1.35) X spill amount (1,322,000 gallons)

Total socio-economic damage cost $312,322,500

Environmental cost (2002 USD)

The per-gallon environmental cost ($35) X 0.5 (freshwater modifier for drinking water (1.6) + the average of three modifiers River/Stream 1.5, Wetland 4.0, Lake/Pond 3.8 = 3.1) X spill amount (1,322,000 gallons)

Total environmental damage cost $108,734,500

Total spill cost $570,575,200 (2002 USD)

Response Method and Effectiveness Adjustment Factor (for 0% – no oil left remaining) X 1.15 = $656,161,480

Adjusted for inflation to 2016 USD = $868,555,005

Converted to CAD at 1.26 = $1,094,379,306 or $219/L

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