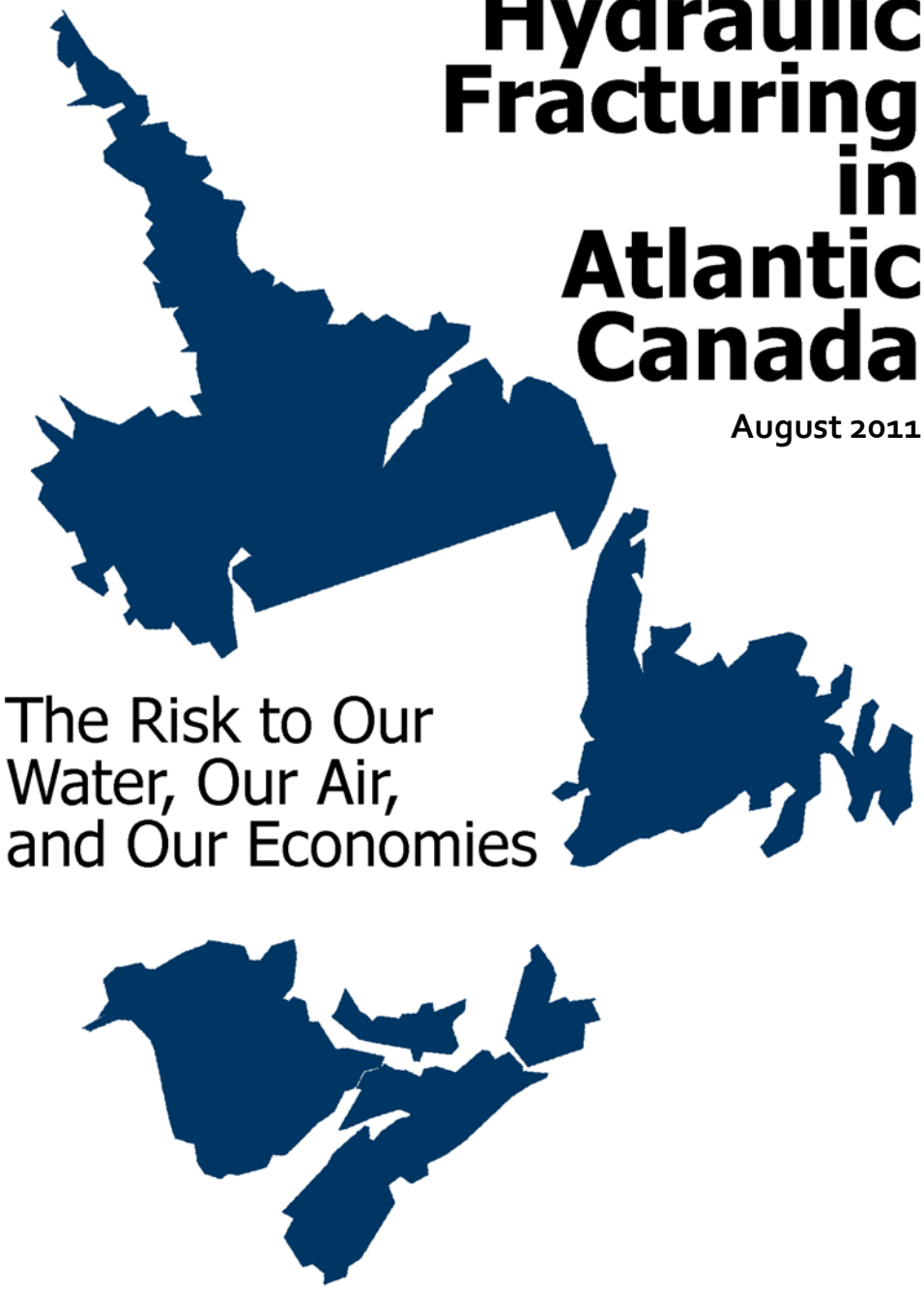
Hydraulic Fracturing in Atlantic Canada

August 2011



The Risk to Our Water, Our Air, and Our Economies

Sierra Club Atlantic

When an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically.

In this context the proponent of an activity, rather than the public, should bear the burden of proof.

The process of applying the Precautionary Principle must be open, informed, democratic and must include potentially affected parties. It must also involve an examination of the full range of alternatives, including non action.

Wingspread Conference on the Precautionary Principle
January 26, 1998

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"Unconventional Natural Gas" Extraction has become a contentious issue in Atlantic Canada. Recent advancements in technology in this field have made previously inaccessible natural gas deposits accessible. With vast fields of natural gas now available, this industry could become a source of much needed economic development for this region.

Hydraulic fracturing, the process used to extract natural gas, is not without its risks to human health, environmental integrity, and future sustainable development.

What is "Fracking?"

The process of hydraulic fracturing or "fracking" is a completion step that follows the drilling of a deep well vertically, and sometimes horizontally, into shale rock or coal bed formations. Once the well is drilled and prepped with casing and perforated with holes in the targeted section, large volumes of water, grit, and chemicals are forced down into the well at high pressure. This enormous pressure causes fractures to form in the targeted rock formation. From these cracks natural gas is able to collect and flow up and out of the well.

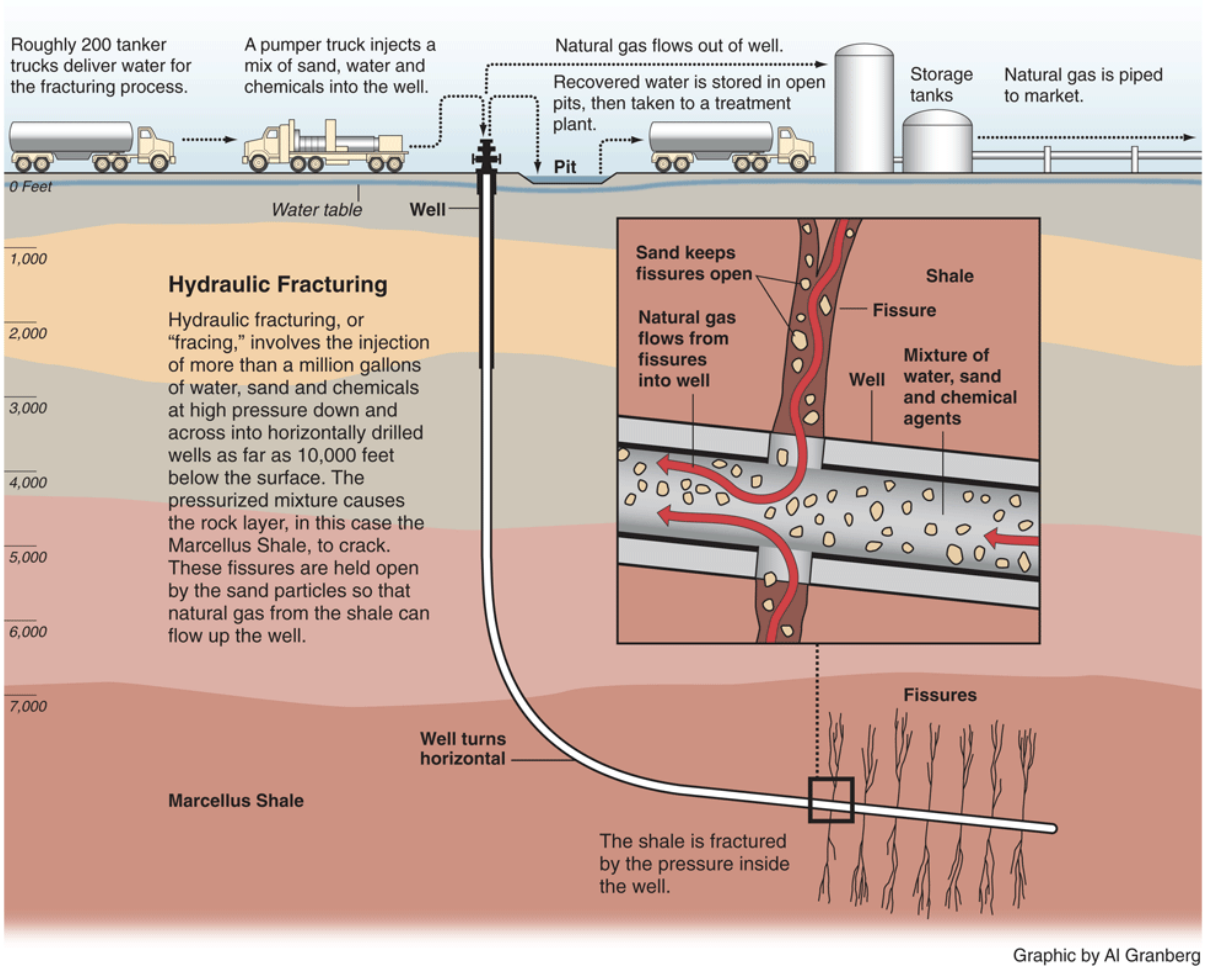

Figure 1: Overview of Hydraulic Fracturing [1]

This process sounds simple enough, however there are very serious issues that need to be considered. Hydraulic fracturing uses massive volumes of water and creates large amounts of highly toxic waste that needs to be diligently handled and disposed of. Drilling pad sites and access roads are a major source of air quality issues for residents in the immediate vicinity. Hydraulic fracturing also requires serious economic investment by governments and may jeopardize other economic streams such as tourism and real estate.

Hydraulic fracturing for natural gas must also be considered in the larger context of climate change as it is being hailed as a bridging energy source. Industry claims that it will meet our immediate energy needs while renewable energy sources like wind and solar are developed and brought online.

When considering the combustion of natural gas to generate energy, natural gas does generate less greenhouse gases than conventional petroleum products. However, when the entire method of extraction is considered, it may release up to twice as much greenhouse gases as coal.[2] In this context, this fossil fuel is less likely to be a bridging fuel, but more appropriately a delaying tactic by the oil and gas industries.

Governments should be encouraging the development of truly clean renewable energy sources that will be needed to meet energy demands and reduction targets of greenhouse gas emissions.

The Risk to Our Water

Water is essential to all life on Earth. On July 28, 2010 the United Nations declared safe and clean water and sanitation as a human right. Hydraulic fracturing can jeopardize the rights of citizens to safe clean water. Many communities in areas that have welcomed the industrial development of this energy sector have faced serious problems with their water resources.[3]

Depleting Fresh Water Resources

Water is the primary solvent used to deliver grit and/or chemicals into drilled wells. As huge volumes of this mixture are pumped into the prepped well, it creates the pressure which fractures the rock and frees the gas. Each time a well is fracked, it requires millions of litres of fresh water and each individual well is usually fracked multiple times.[4]

Without proper mapping and measurement of water resources, large scale industrial use of water may jeopardize residential and community water access. The last complete assessment of Canada's groundwater resources was collected in 1967 [5] . Without updated critical information, this industry may deplete community and residential water resources. Updated mapping and complete measurements of local water resources need to be in place before any water intensive industry is granted permission to extract freshwater from surface or subsurface water reservoirs.

Oil, gas, and coalbed methane exploration are excluded from groundwater legislation and as such, hydraulic fracturing operations in Canada do not require the publication of water extraction and use.[6] Without proper public disclosure about the use of this critical resource, residents, community leaders, and government are unable to properly assess the potential impacts of fracking and give free and informed consent.

Communities are at risk of losing their access to freshwater by water intensive industries including natural gas exploration and development involving hydraulic fracturing.

Contamination of Freshwater

Contamination of freshwater is another serious risk that may have impacts on freshwater resources. This contamination can happen underground via the movement of gases and hydraulic fracturing fluid through leaky well casings, abandoned well bores, or eventually up through fissures, fault lines, and porous layers in the rock strata into underground water resources. Contamination may also occur above ground through accidental spills, leaks, or

other incidents from waste hydraulic fracturing fluid that has flowed back out of the fractured well.

Hydraulic fracturing fluid is a mixture that contains mostly water, but also grit and numerous chemical agents. The grit, which can be sand, ceramic, or other particulate material helps prop the fissures open when they are created by pressure of the injected fluid. The chemicals in the fluid help the natural gas flow into the well and then up out of the well.

The specific chemicals that are used in hydraulic fracturing are not publicly available in Canada despite industry claims to the contrary. Industry often lists the general of classes of chemicals, what they do, and what they are commonly used for[7]. However, the actual identities of the chemicals used at specific drill sites are considered trade secrets and not made available to the public. Documents released in United States indicate that some of the chemicals used in hydraulic fracturing fluids are known to cause cancer, disrupt hormones, mutate DNA, cause reproductive and developmental problems, are neurotoxins and also cause severe negative impacts on the environment.[8,9,10]

Industry contends that the chemicals they use are only a small percentage of the total amount of fluid used. Using their percentages, if 1,000,000 litres of hydraulic fracturing fluid is used and 0.5% of that is composed of chemicals, that means 5,000 litres of unknown chemicals will be injected into the ground each time a well is fractured. If a well is fractured 10 times and uses 1,000,000 litres of fluid each time, this means that 50,000 litres of chemicals will have been injected underground. A report recently unearthed yet published in 1987 by the Environmental Protection Agency in the United States, conclusively documents a case in which hydraulic fracturing fluids contaminated a water well in West Virginia.[11]

The migration of natural gas into water wells and aquifers has also been conclusively documented. In May of 2011, a study from Duke University published in the Proceedings of the National Academy of Sciences found methane in the deep rock formations of water wells in areas where hydraulic fracturing activities occurred.[12] Quebec's Ministry of Natural Resources found natural gas leaks in 19 of the 31 wells it inspected[13] and place a moratorium on hydraulic fracturing for oil and gas in June of 2011.[14]

In April of 2011, Jessica Ernst of Rosebud, Alberta launched a $33 million lawsuit against EnCana, Alberta Environment, and Energy Resources Conservation Board, charging them with negligence and unlawful activities that contaminated her water supply.[15] Her water supply is so badly contaminated she can light it on fire.

Figure 2: Jessica Ernst of Rosebud, Alberta lighting her water on fire [16]

When a well is hydraulically fractured, the volume of the amount of fluid returned varies widely. As little as 3% to as much as 80% will return as flowback waste[17] and the remaining thousands or millions of litres of fluid will be left underground, untreated.

Despite industry claims that hundreds of metres of rock strata between aquifers and the fractured rock strata, the potential for gas and fracking chemicals to migrate slowly upwards into underground water resources still exists. The increased size of natural fractures, introduction of new fractures, increased pressure on underground fluids, and a reduction of pressure closer to the surface causing the release of gases from solution are variables that could contribute to vertical migration of contaminates.[18] This process could take years after a company has abandoned the well and may only be apparent after the industry has completed the extraction of the natural gas resources.[19]

Surface and ground water can also be contaminated by the improper storage, transport, and treatment of hydraulic fracturing fluid that is reclaimed from wells. Not only does the fluid contain the toxic chemicals that that were originally injected into the well, the flowback fluid that returns to the surface is generally very high in mineral and salt content from the rock strata and may contain naturally occurring radioactive elements.

This waste is often stored in temporary storage pits or tanks at the drill site. These tanks and pits need to be very large due to the massive volumes of waste that will need to be stored before transporting. Storage pits have been known to leak causing serious environmental damage[20] and risks to livestock.[21] One research project studied the effect of application of over 300 000 litres of hydraulic fracturing waste on a quarter of an acre of forest; ground vegetation died within days and more than half the trees within two years.[22]

It is common practice in this industry to re-inject waste fluid back into wells and then cap the well. This practice leaves billions of litres of untreated highly toxic fluid underground and under pressure.

Figure 3: Waste Pit of Hydrofracking mud[23]

In other regions, such as the state of New York, hydraulic waste fluid has been sent to sewage treatment plants, despite the fact that these plants are not equipped to handle the toxic chemicals and radioactive materials often found in the flowback. In New Brunswick and Nova Scotia some rock formations contain naturally occurring uranium and radon that can make the produced water radioactive.[24] There is evidence in the US of illegal dumping and inadequate disposal of waste hydraulic fracturing fluids have lead to the radioactive contamination of rivers.[25]

Hydraulic fracturing poses serious threats to water resources. Depletion and contamination of water puts communities and our environment in harm's way, with unanticipated impacts that may arise immediately or even decades into the future. The costs of mitigating environmental and human health concerns could be economically devastating and incredibly detrimental to communities in this region.

The Risk to Our Air

Enjoying the solitude and fresh clean air is a part of life in rural communities across Atlantic Canada. Concerns regarding diminished air quality represent another important area of concern in when it comes to expanding industrial hydraulic fracturing operations.[26]

During the process of hydraulic fracturing, each well pad requires hundreds of large diesel trucks making countless trips to and from a single drill pad. Fracking one well involves steep increases in heavy truck traffic delivering tons of heavy drilling and construction equipment, millions of litres of water, and thousands of litres of chemicals and grit that they need to drill, hydraulic fracture, operate productive wells, and to decommission old wells.

Figure 4: Container Trucks with Fracking Liquids at a Drilling Site, Dimock, PA[27]

Emissions from these trucks mark the beginning of reduction in air quality in these communities. The increase of fossil fuel burning engines from trucks, the construction of drill pad sites and roads, along with the running of diesel engines to power the drilling rig contribute to particulate matter that will have negative health impacts on residents in communities.[28]

In the process of exploring and operating a fractured well, there are numerous air emissions that can escape the well or be vented from the variety of equipment on site.[29] Equipment on site can include tanks that hold waste fluid, dehydrators that remove water from the natural gas, condensers and compressors that remove impurities from the gas.

Residents in areas who have lived through the proliferation of drilling pads and operating wells from hydraulic fracturing have reported noxious fumes emanating from on-site equipment. They strongly believe that these fumes are the source of a variety of health complaints including respiratory afflictions (including sudden massive nose bleeds), headaches, dizziness, and a suite of other ailments.[30]

In July of 2011 the Global Community Monitor released a report that supports the claims from citizens who are experiencing health impacts from toxic emissions from hydraulic fracturing.[31] Community members were trained and equipped to sample air emissions when fumes were prevalent and were instructed to document symptoms at time of exposure. The air samples were analyzed to identify what chemical components were in the air.

The report identifies 22 toxic chemicals present at high levels in the air emissions from four sites that were sampled. Included in the list of the 22 chemical found to be present, were known carcinogens and neurotoxins.[32] Some of the chemicals found are known constituents of natural gas, but others are suspected of being used in hydraulic fracturing fluid, but cannot be confirmed due to the non-disclosure of chemicals used at specific drill sites. In this report, the most disturbing discovery was the level of benzene at one site found to be 3000 times higher than the amount known to contribute to serious health impacts, including cancer, with long term exposure.

Air quality concerns and their impact on the health of residents in areas near hydraulic fracturing operations pose real and serious threats. Residents in areas near well pads are exposed to health risks from the beginning of well construction through to the natural gas production phase of a well pad.

The Risk to Our Economy

Atlantic Canada has been hit hard economically as traditional natural resource industries have dwindled and collapsed. Attracting lucrative industries that provide good jobs and economic benefits to rural regions has been a challenge for governments in the Atlantic Region federally, provincially, and municipally.

The economic pressure to access the natural gas locked deep underground as a means of securing an energy resource for provincial economic benefit has been high. To help sell this industry to governments and the citizens, there has been a general willingness to overestimate economic potential for this industry, while underestimating the costs which includes the maintenance infrastructure, impacts of serious and chronic health conditions, and environmental consequences of this industry.

A report released in March of 2010 looked at the economic benefits to shale gas development in New York found the economic benefits to be no more than simple claims without backing of current or unbiased information.[33] The economics regarding the development of this industry does not include the costs of maintaining infrastructure (including road costs), the cost of proper oversight and regulation enforcement, the cost of health impacts to residents, and the cost of environmental mitigation and restoration. The economic picture also often fails to consider the negative impact that this industry will have on other important sectors of the economy including tourism, diminished property values, and outdoor pursuits like hunting and fishing. When the full economic picture is considered, the net economic benefit may be far from positive.

Investment into renewable energy sources and energy efficiency measures exist now that could help the province reduce emissions, create local long-term employment, and generate ongoing economic potential. Through the implementation of feed-in tariff legislation, which guarantees a fixed rate of return for renewable energy producers, in all four Atlantic Provinces would achieve far greater economic gains for our region. Ontario's feed-in tariff legislation is predicted to create 50,000 jobs by the end of 2012[34]. Investment and support for bringing renewable energies online will create good jobs that will support a more vibrant economic future for communities and for the region.

A more complete analysis of true economic benefits needs to be undertaken for regions and provinces where fracking is proposed, considered, or ongoing. This analysis must be independent in nature and provide full cost accounting to truly assess the economic impacts of this industry.

Hydraulic Fracturing in New Brunswick

New Brunswick has seen the most impact regarding natural gas exploitation by hydraulic fracturing. These operations are currently underway in New Brunswick and roughly 1/7th of the province is leased for oil and gas exploration,[35] which is administered by the Department of Natural Resources. As of June 23, 2011, oil and gas developers are required to undergo a phased Environmental Impact Assessment administered by the Department of Environment.[36]

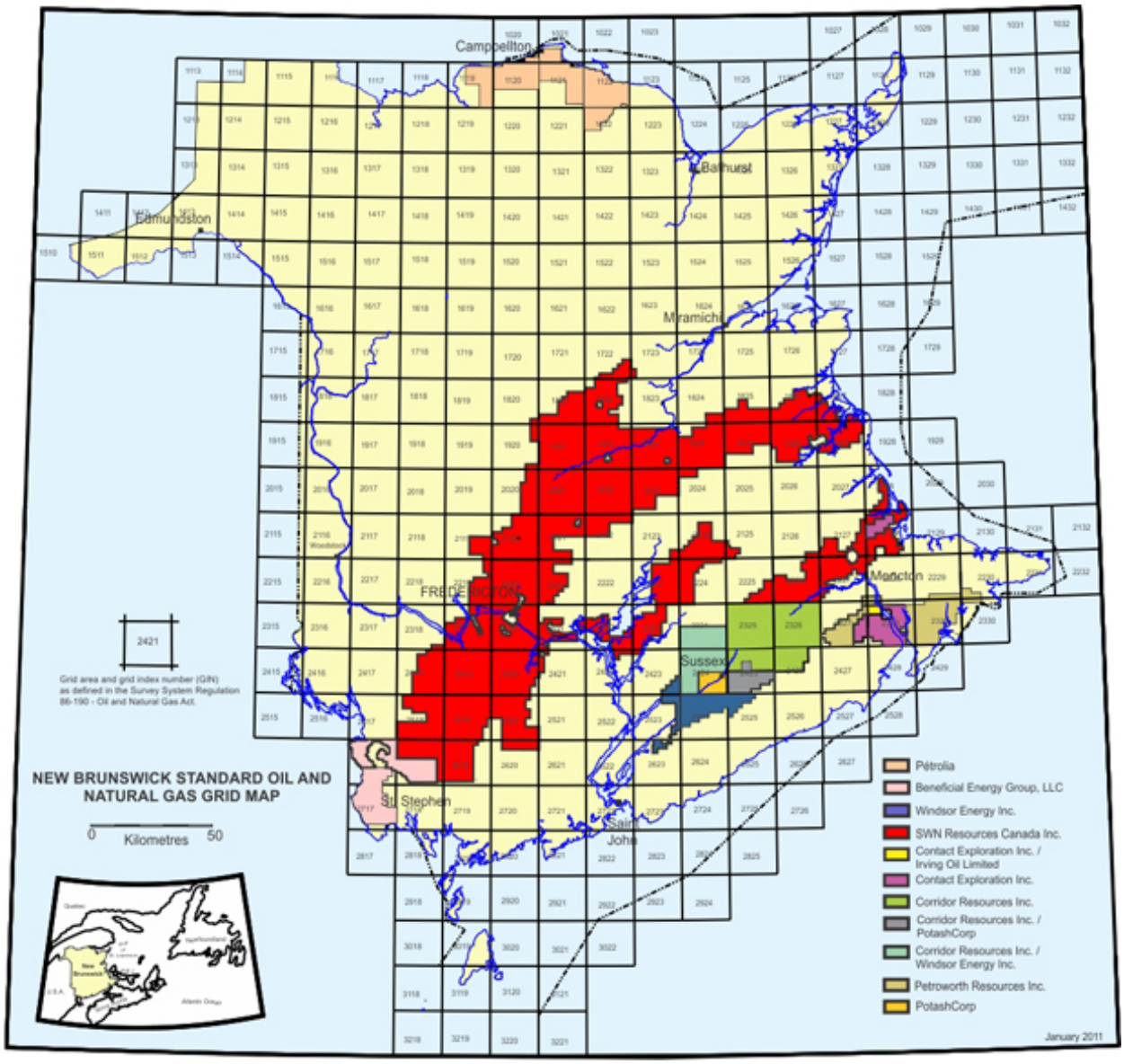

Figure 7: New Brunswick Standard Oil and Natural Gas Grid Map[37]

Since 1990, there have been approximately 80 wells drilled in New Brunswick and 49 have been hydraulically fractured in New Brunswick.[38]

Natural gas development in New Brunswick has not been without incident. On August 23, 2006, 3,000 litres of fracking fluid was spilled in Penobsquis, NB.[39] The fluid contained sand laced with a radioactive tracer is used to map the underground fissures created by fracking. Corridor Resources claim they disposed of the waste by burying it, but there are lingering concerns regarding the disposal of this material brought forward by community members.

The Conservation Council of New Brunswick, along with many other concerned community groups, want a moratorium on shale gas development until certain risks, including destruction of quality of life in rural communities, water use, and technological issues, can be addressed.[40] Public opposition to natural gas development in New Brunswick is growing.

Hydraulic Fracturing in Nova Scotia

Currently in Nova Scotia, onshore oil and gas development is being administered by the Department of Energy, with support from Nova Scotia Environment and the Department of Natural Resources.

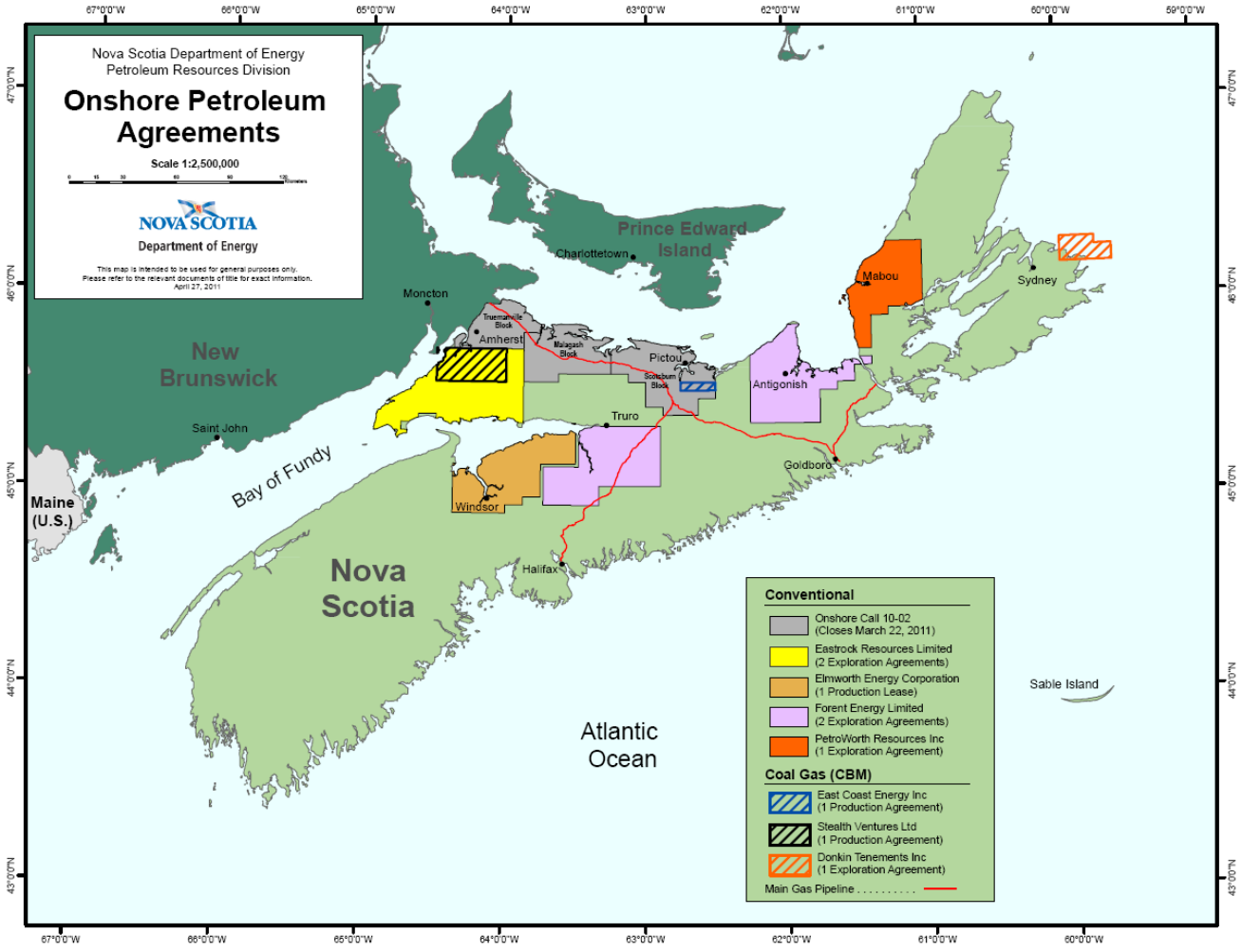

Figure 5: Onshore Petroleum Agreements in Nova Scotia[41]

In June of 2011, Nova Scotia began conducting a final review of hydraulic fracturing and expect to release their report in early 2012. The scope of this review, being carried out jointly by the Deptartment of Energy and Environment, was determined after a public comment period. Overwhelmingly, public comments on hydraulic fracturing articulated a very negative view of hydraulic fracturing and clearly many do not want this type of energy production to occur in their communities[42]; however, a ban or moratorium is not included in the scope for the review.[43]

Meanwhile, even as the government's review continues, there are active leases for onshore for drilling and exploration of gas in Nova Scotia.

In March of 2011, Premier Darrell Dexter commented that it was too soon to regulate hydraulic fracturing and that he would like to see what is being done in other regions before regulating hydraulic fracturing in Nova Scotia.[44] This statement was based on the erroneous assumption that hydraulic fracturing had *not* been carried out in Nova Scotia.

In December of 2007, Stealth Ventures completed a hydraulic fracturing operation in Springhill to test a well for coal-bed methane production.[45] From 2007 to 2009 Elmworth Energy, a subsidiary of Triangle Petroleum, proceeded to drill and hydraulically fracture wells in the Windsor Block Area of Nova Scotia. On Triangle Petroleums website they state that at one location up to 85% of the hydraulic fracturing fluid had been lost due to a fault line and two other drilling sites had their fractures comingle and they were unable to assess the capacity for gas.[46]

While Nova Scotia is conducting its review on hydraulic fracturing, it is receiving, treating, and discharging waste fluid from hydraulic fracturing operations in New Brunswick.[47] The information on how much waste material, what tests are done on treated waste water to ensure it is safe before discharging, and air quality monitoring information is not readily available to the public. In fact most people in Truro and surrounding area do not know that this waste is being treated in Debert.

Hydraulic Fracturing in Prince Edward Island

In Prince Edward Island, Energy, Environment, and Forestry are in one department and it is this department that is responsible for the administration for oil and gas development. Exploration rights for fracking have been granted to 440,000 acres of PEI, which is equivalent to 1/3 of PEI's land mass.[48]

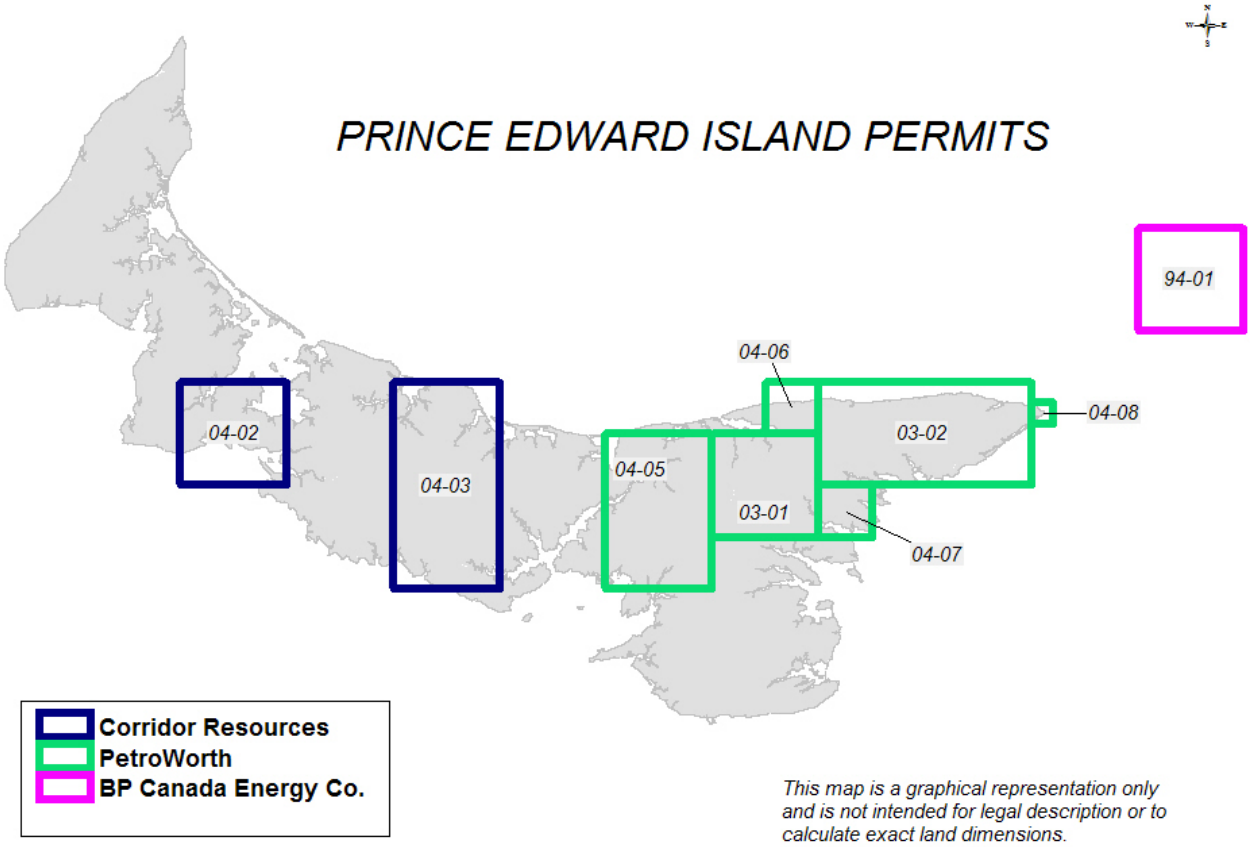

Figure 6: PEI 2010 Rights Holders Map[49]

Despite the limited development of natural gas operations on PEI, it has also been the site of a spill of radioactive sand. In 2007, Corridor Resources hydraulically fractured a well near Green Gables. During the procedure, a broken pipe resulted in a spill that leaked radioactive material.[50] Currently, any company that wants to undertake hydraulic fracturing activities in PEI must first complete an environmental impact assessment and a public consultation process and there are no plans to conduct a full scale review of this industry.

Hydraulic Fracturing in Newfoundland and Labrador

The Department of Natural Resources in Newfoundland and Labrador administers the oil and gas exploration activities.

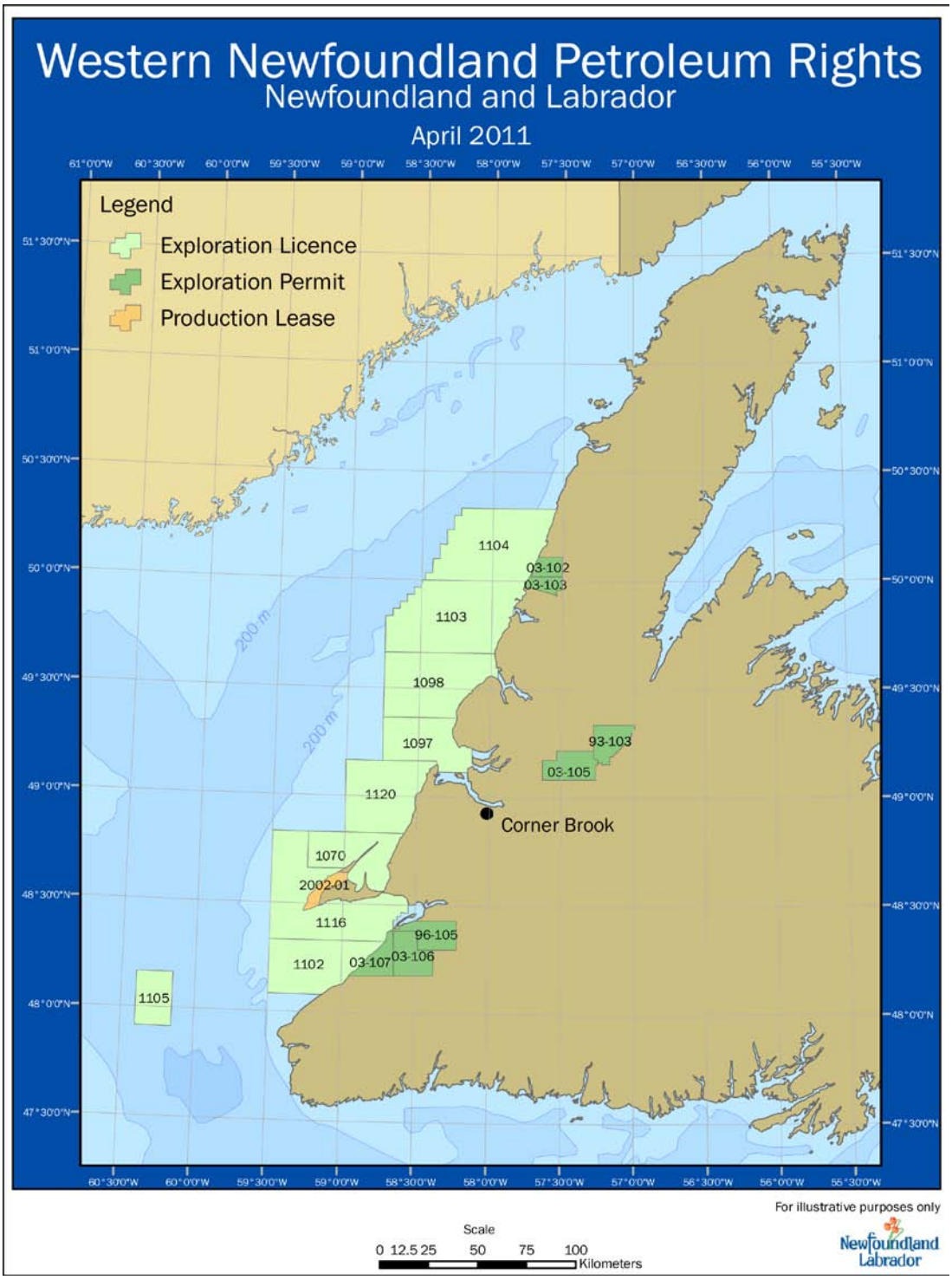

Figure 8: Western Newfoundland Petroleum Rights[51]

Sites onshore in George's Bay have been fractured to produce oil and there are two wells that are awaiting equipment for fracturing to assess potential for natural gas.[52] Near Deer Lake, there is also one well waiting hydraulic fracturing to assess natural gas potential.[53] It is also unclear what regulatory requirements or processes that industry will have to meet to proceed with hydraulic fracturing operations. In mid-August 2011 Shoal Point on the Avalon Peninsula is expected to be hydraulic fractured for natural gas.[54,55] This technology is subject to regulatory approval, but the mechanisms for hydraulic fracturing remain unclear and the public is unsure if these projects will be properly regulated and the public will be properly informed.

Our Recommendation

Sierra Club Canada - Atlantic Canada Chapter recommends a legislated ban on hydraulic fracturing operations in all four of the Atlantic Provinces.

This recommendation is based on scientific evidence that indicates hydraulic fracturing operations for natural gas pose serious and long term negative impacts to our water resources, to our air, and the potential to damage to our local and regional economies. To date there has been no verifiable independent proof that these operations can be conducted safely and with minimal environmental impact.

Furthermore, using natural gas to meet energy demands delays the much needed transition from fossil fuel energy sources to renewable energy sources that represents a more sustainable future.

Who We Are

Sierra Club Atlantic is a vibrant grassroots organization that empowers people to protect, restore, and enjoy a healthy safe planet. We are your chapter of Canada's only national grassroots environmental organization, working to bring your community's concerns to the attention of regional and national leaders. Together, we are a credible, influential voice working to make a better world a reality.

We are involved in a broad range of activities from advocacy to education. Our major efforts are in the areas of energy and climate change, community health, sustainable economies, the protection of wild spaces, and environmental education.

We accept donations from individuals and members, foundations, and corporations who have passed our corporate screening policy. This policy is designed to keep us independent and able to speak freely. We do a lot with very little.

End Notes

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