

Hydraulic Fracturing and Water Governance  
Canadian Water Network (CWN) Workshop  
Victoria, BC (October 15–16, 2014)  
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## Regional Briefing Notes

### INTRODUCTION

These regional briefing notes were created to inform participants at the “Hydraulic Fracturing and Water Governance” workshop of the status of the shale gas industry and associated water governance challenges in regions in Canada that have been identified as potential sources of shale gas. The notes were mainly derived from conversations with research partners associated with the Canadian Water Network grant.<sup>1</sup>

The briefing notes introduce main governance issues related to hydraulic fracturing and water governance in Alberta, British Columbia, New Brunswick, Nova Scotia, the Northwest Territories, Ontario, and Quebec. The notes describe – in each of the seven regions – the state of the industry, governance framework, governance challenges, and any information gaps. Our description of these issues is preliminary, intended to support discussion rather than be conclusive or all encompassing. At the end of this document, a set of tables (Appendix 1) provides an overview and summary of these issues for quick reference and easy comparison. First, however, we describe elements of the national context that are relevant to all seven regions.

### Hydraulic Fracturing and Water Governance in Canada

Shale gas development – especially hydraulic fracturing of unconventional sources – has become a source of controversy across all scales of governance. Perceptions of the risks of hydraulic fracturing operations are polarized: supporters see the operations as a low-risk source of economic value, but opponents believe these developments pose significant threats to surface and groundwater and associated social and ecological systems. While some regions have experience with resource development, many are new to an “oil and gas” culture; communities’ responses to new projects are shaped by their respective histories of extractive industries (or lack thereof). In this context of polarized public discourse, many jurisdictions, facing the pressures of the fast-moving and powerful fossil fuel industry and – in many regions – lacking capacity and experience, have turned to one of two starkly contrasting approaches: (1) opting in, allowing rapid development in a governance environment full of regulatory gaps, or (2) opting out, erecting bans or temporary moratoriums to delay production (see Stephenson and Shaw, 2013).

In spite of these divergent responses, and in spite of different geophysical, hydrological, and social contexts, many jurisdictions share governance-related challenges. Our

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<sup>1</sup> These briefing notes were prepared by a team of researchers working in support of the CWN workshop, and therefore do not necessarily reflect the views of the research partners. The notes are intended to support discussion at the workshop and are not for broader circulation.

preliminary assessment of issues of water governance and hydraulic fracturing, presented here, show many similarities between provinces and regions. Questions of which groups currently hold decision-making authority and which other groups seek more influence are pervasive:

- First Nations seek more authority over resource decision-making in their territories.
- Many environmental and community groups have sought changes to planning processes that would allow greater chance for meaningful public participation.
- Municipalities, too, have sought to assert authority in decision-making around hydraulic fracturing.

Many jurisdictions, too, are challenged in their decision-making by a lack of information, particularly on baseline hydro-ecological conditions and the effects of hydraulic fracturing on water resources. Furthermore, many provinces lack information on how to monitor and assess cumulative effects of multiple projects over time.

### **Federal Responsibilities**

The federal government has responsibilities related to several aspects water governance and hydraulic fracturing.

- The federal government has a duty to consult with First Nations on any activity that would impact their aboriginal and treaty rights under Section 35 of the Constitution Act (1982). (In many cases, this responsibility is delegated to provincial governments.)
- A federal environmental assessment could be triggered for any hydraulic activities on federal lands such as national parks, Indian reserve land, or military bases.
- The federal government is responsible for assessing any impacts that fall under their responsibility, such as fish habitat.
- Under the Canadian Environmental Protection Act (1999), the federal government is also responsible for air quality and for assessing whether materials are toxic to human health and the environment and managing those materials. (See Nova Scotia 2014).

### **Key Resources on Canada**

Council of Canadian Academies (CCA). 2014. *Environmental Impacts of Shale Gas Extraction in Canada: The Expert Panel on Harnessing Science and Technology to Understand the Environmental Impacts of Shale Gas Extraction*. Ottawa: Council of Canadian Academies.

Accessed September 29, 2014.

[http://www.scienceadvice.ca/uploads/eng/assessments%20and%20publications%20and%20news%20releases/Shale%20gas/ShaleGas\\_fullreportEN.pdf](http://www.scienceadvice.ca/uploads/eng/assessments%20and%20publications%20and%20news%20releases/Shale%20gas/ShaleGas_fullreportEN.pdf).

Rivard, C., Lavoie, D., Lefebvre, R., Séjourné, S., Lamontagne, C., and Duchesne, M. (2014). "An Overview of Canadian Shale Gas Production and Environmental Concerns." *International Journal of Coal Geology*, 126, 64–76. doi:10.1016/j.coal.2013.12.004

### **Resources on Water Use and Risk in Hydraulic Fracturing**

Freyman, Monicka. 2014. *Hydraulic Fracturing & Water Stress: Water Demand by the Numbers*. (2014) Boston, MA: Ceres. Accessed September 29, 2014.

<http://www.ceres.org/resources/reports/hydraulic-fracturing-water-stress-water-demand-by-the-numbers/view>.

Liroff, R.A. 2011. *Extracting the Facts: Investors Guide to Exposing Risks from Hydraulic Fracturing Operations*. Falls Church, VA: Investor Environmental Health Network. Accessed September 30, 2014. <http://www.iehn.org/documents/frackguidance.pdf>.

## I. ALBERTA

### Overview

The province of Alberta is the most significant oil and gas producer in Canada. Because of the size and age of its industry, Alberta has developed regulatory frameworks to address energy-related water governance, but critics note that the industry's agency with responsibility in this area – the Alberta Energy Regulator (AER) – fails to adequately balance water-related issues (and other socio-environmental concerns) with development.

### Status of the Industry

Alberta shale deposits include the Duvernay formation and the Colorado Group along the border with Saskatchewan, and others like the Montney and Muskwa-Otter Park. In total, approximately 6,300 horizontal wells have been fractured in shale strata in the province since 2008 (Parks 2013). Hydraulic fracturing is used to extract Alberta's unconventional shale gas, and shale or "tight" oil resources.

Most hydraulic fracturing in Alberta has been for oil. However, while shale gas production in Alberta comprises only about 0.1 percent of the province's total gas production (Rivard et al. 2014, 75), analysts expect this proportion to increase with the growth of unconventional production in southern, central, and western Alberta. This increase will be encouraged by future development of greater pipeline capacity and west coast LNG processing facilities (CCA 2014, 25). The potential reserves are significant: a recent estimate for gas in place was greater than 3,000 trillion cubic feet (although typically only between 5–30 percent of in-place reserves are economically or technologically recoverable [CCA 2014, 125]). Fracturing is a key element of shale gas production; of the 190 shale gas wells drilled, 178 had been fractured (CCA 2014, 25; based on data to 2011).

### Overall Framework for Water Governance

The Alberta Energy Regulator is the agency responsible for all oil and gas development. Under Alberta's Water Act, the AER regulates all aspect of energy-related water management (CCA 2014, 25) and is responsible for the allocation of water permits and licenses for oil and gas activities like hydraulic fracturing. The AER regulations for fracturing include requirements that (a) companies must notify the AER prior to any fracturing so that the agency can increase its field presence, (b) wells must have dual casing systems, and (c) operators must provide risk-management and monitoring plans. An AER representative noted that the agency is researching place-based regulation, cumulative effects management, and other governance techniques (Parks 2013). Critics, however, have noted that the AER – as a "single window" regulator created in 2013 to streamline regulation in order to attract energy investment – is focused on developing resources, and, as such, protections for public safety and the environment become minor caveats (see Vlavianos 2012).

The Water Act (2000) is the key use legislation in Alberta (Alberta Water Portal 2014). As of March 29, 2014, the AER (like the OGC in BC; see next section) will be responsible for water allocations under the Water Act for short- and long-term withdrawals for energy resource practices (AER 2014a). The Water Act specifies conditions for monitoring and reporting water

use; public reporting is required under the Responsible Energy Development Act (2012) (AER 2014b). Further monitoring requirements are set out in the Environmental Protection and Enhancement Act (AER 2014a).

Alberta allocates water to oil and gas companies using a “first in time, first in right” (FITFIR) allocation system. Critics have challenged this system, within which the provincial collects no royalties when it allocates water rights (or when those water rights are later sold) (Christensen and Droitsch 2008, 15).

### **Identified Water Governance Challenges**

Scarcity: Critics have noted that fracturing demands massive quantities of freshwater while Alberta faces greater risks of water scarcity than other provinces (Christensen and Droitsch 2008). Shale gas development is proposed in areas where it will compete with other water uses (CCA 2014). The threat of scarcity led to the creation of the 2004 “Water for Life” strategy, but due to a lack of funding, implementation has been slow. The AER suggests that, in shale gas development, no “technical issues” related to quantity have been identified; AER is, as a result, concerned with quantity for “social reasons” (Parks 2013). Others have suggested that scarcity continues to be an issue in the province (see Christensen and Droitsch 2008; Schindler and Donahue 2006), and 2009 and 2010 were the driest back-to-back years since the 1800s (Wingrove and Walton 2010).

Contamination risks: Many Albertans – including those in the vicinity of actual or potential hydraulic fracturing – are very concerned about water contamination from hydraulic fracturing (Parks 2013). For example, when a Calgary-based company, Goldenkey Oil, applied to drill three wells within Lethbridge city limits, potential groundwater contamination was a key reason why homeowners and city council fought the application (Bennett 2014). A lack of information on contamination risks is a key information gap in the regulation of hydraulic fracturing. In 2007, a scientist and oil patch consultant named Jessica Ernst filed a \$33-million lawsuit against Calgary-based Encana Corporation, alleging that hydraulic fracturing had resulted in contamination of her local groundwater supply with toxic chemicals and methane (Nikiforuk 2013); the resulting case, which is still ongoing, has held the activities of provincial oil and gas regulators up for public scrutiny (Nikiforuk 2014).

Keeping pace with development: Critics regularly charge that Alberta is enabling oil and gas development at a scale and pace that overpower the ability of regulators (and the regulatory framework) to protect social and environmental values (see, for example, Nikiforuk 2014; Vlavianos 2012). Critics also identify the limited public participation as a key problem in oil-and-gas governance. Only those members of the public who can prove that they are “directly and adversely affected” by a proposed development can have standing for an appeal or opportunity for ongoing engagement with a project. As such, only a small group – mostly landowners adjacent to energy projects – has a say in the direction of provincial oil and gas development. Critics of Bill 2, the Responsible Development Energy Act, have noted that this legislation further shifts rights away from landowners and toward oil producers (see Brown 2012).

### **Information Gaps**

Participants in Alberta governance for hydraulic fracturing have identified key water quality– and quantity–related subjects on which information is needed:

- The risk of groundwater and well-water contamination from shale gas development. While large contamination events are well documented, smaller events – which recent studies (see Osborn et al. 2011; Nikiforuk 2011) have suggested are ubiquitous at shale gas developments – remain poorly understood. While industry is required to do groundwater/well-quality testing, tests for dissolved gases and isotopic analysis would give a “signature” that would enable researchers to identify the source of the gas (i.e. whether it is shallow and therefore natural in groundwater, or deep, and therefore provide evidence of seepage from hydraulic fracturing). Contamination is the biggest information gap that people are talking about on the ground; it is a primary driver of uncertainty and concern.
- The potential for scarcity. Water use is expanding rapidly; some scholars have raised questions about the risk of scarcity as a result of high industry use and agricultural demand, as well as population growth (see Schindler and Donahue 2006).

### Key Resources

Alberta Energy. 2012. “Regulating Unconventional Oil and Gas in Alberta.” Accessed, October 2, 2014.

[https://www.aer.ca/documents/projects/URF/URF\\_DiscussionPaper\\_20121217.pdf](https://www.aer.ca/documents/projects/URF/URF_DiscussionPaper_20121217.pdf)

Alberta Energy. 2014. “Shale Gas.” Government of Alberta. Accessed October 1, 2014.

<http://www.energy.alberta.ca/NaturalGas/944.asp>.

Brown, Russ. 2012. Bill 2: “The Critics Are Correct.” Faculty of Law, University of Alberta.

Accessed September 29, 2014. <http://ualbertalaw.typepad.com/faculty/2012/12/bill-2-the-critics-are-correct.html>.

Christensen, Randy, and Danielle Droitsch. 2008. *Fight to the Last Drop: A Glimpse into Alberta’s Water Future*. Ecojustice: Vancouver, BC. Accessed September 29, 2014.

<http://www.ecojustice.ca/publications/reports/fight-to-the-last-drop-a-glimpse-into-alberta2019s-water-future/attachment>.

Schindler, D.W. and Donahue, W.F. 2006. “An Impending Water Crisis in Canada’s Western Prairie Provinces.” *Proceedings of the National Academy of Sciences*, 103(19), 7210–7216.

Vlavianos, Nickie. 2012. “A Single Regulator for Oil and Gas Development in Alberta? A Critical Assessment of the Current Proposal.” *Resources* 113: 1–10.

## BRITISH COLUMBIA

### Overview

British Columbia is home to massive shale gas plays and the provincial government is committed to their development as a key tenet of its economic strategy. Water governance is changing, particularly under the new Water Sustainability Act and the development of new consultation agreements between First Nations and the provincial government; however, many actors continue to raise concerns over the impacts of fast-paced development, particularly in the province's northeast.

### Status of the Industry

British Columbia holds four primary gas plays – the Montney Basin, the Horn River Basin, the Liard River Basin, and the Cordova Embayment – all of which are in the province's northeast. The production potential is massive; in the Montney and Horn River basins there are estimates that range from 580 trillion cubic feet to 1,200 trillion cubic feet, although only 20 percent of that amount is thought to be recoverable (CCA, 2014). Between 2005 and 2009, producers aggressively pursued land tenures in the region (Adams 2012). In 2012, there were 1,100 active horizontal wells drilled post-2005 in the Montney (Oil and Gas Commission 2012), and in the Horn River Basin, 285 wells were drilled between 2008 and 2011 (Adams 2012). In the past few years, activity has decreased, limited extraction is occurring, markets are limited. The price of natural gas is currently low. Some companies have sold their assets or remain inactive; the industry has developed a “wait and see” attitude.

The provincial government is committed to the development export of natural gas and has sought through its “National Gas Strategy” to hasten the industry's development (BC Ministry of Energy and Mines 2012). Revenue from LNG projects has been earmarked to go toward reducing provincial debt (Coleman 2013). Completion of LNG-related infrastructure – including a pipeline and coastal processing facilities – are key elements in the province's plans for expansion. Further development thus hinges not only on natural gas prices, but also on whether proposed LNG facilities move forward.

### Overall Framework for Water Governance

The BC Oil and Gas Commission (OGC) was created in the late 1990s to support the development of petroleum resources in the province (Parfitt 2010). Critics have noted that while the OGC was supposed to be an independent agency, the provincial government has – through several legislative changes – been given more influence over the commission's operational activities (see Campbell and Horne 2011). Furthermore, other researchers and agencies have noted a conflict of interest: as a “single window” agency for energy governance, the OGC is responsible both for promoting oil and gas development and for managing its impacts (Parfitt 2010). The Office of the BC Auditor General (2011) expressed concern, too, that while the OGC is mandated to foster a healthy environment, no formal provincial program exists to manage environmental impacts from development.

Water resources for the purpose of hydraulic fracturing are governed under two provincial acts: the Oil and Gas Activities Act and the Water Act. While short-term water

permits for water use in oil and gas development (often called “Section Eights”) have long been under the authority of the OGC, in 2013, long-term licenses were also transferred to the OGC from the Ministry of Environment. In May 2014, the provincial government passed its Water Sustainability Act (to replace the Water Act). Analysts have suggested that the Act may result in certain environmental protections, such as through the regulation of groundwater, but have also expressed concern about how the Act made more short-term water authorizations available for hydraulic fracturing (see West Coast Environmental Law 2014). (See Curran [2014] for the UVic Environmental Law Centre’s response to the new Act.)

### **Identified Governance Challenges**

First Nations’ inclusion: BC First Nations have demanded inclusion in decision-making processes surrounding oil and gas referrals and governance of resources on their land. Consultation processes have been deemed inadequate at addressing impacts to treaty rights, and, in some cases, such that of the Fort Nelson First Nation, consultation processes are being renegotiated to give the nation more authority (Lana Lowe, personal communication; see also Garvie and Shaw forthcoming). However, many people involved in consultation processes and ongoing negotiations over shale gas have noted that a culture of mistrust has built up between First Nations and government because of past conflicts and the two groups have different ideas about what effective water governance looks like.

Global market pressures: High natural gas prices globally resulted in development pressures in British Columbia, although have also slowed the pace of development more recently. Critics argue that the provincial government’s desire to compete for industry investments has resulted in a lack of robust regulation (e.g. Parfitt 2011).

Greenhouse gas emissions: Many consider natural gas a clean energy because of a relatively low release of carbon during burning; however, in order for natural gas to be usable, CO<sub>2</sub> has to be stripped away beforehand, releasing large amounts of greenhouse gas into the atmosphere (Jaccard and Griffin 2010). In British Columbia, certain shale gas plays such as the Horn River, are particularly high in carbon dioxide compared to other areas in Canada (CCA, 2013). Methods of accounting for provincial greenhouse gas targets do not currently include these production-related emissions (Ibid), thereby privileging shale gas as a “clean” energy source compared to other sources.

Fair distribution of costs and benefits: Critics have noted that the royalty structure for industry does not result in meaningful benefits for British Columbians (Parfitt 2011). The provincial government is currently redesigning the royalty structure.

### **Information Gaps**

Participants in BC water governance have identified several key subjects on which information is needed:

- **Baseline water conditions:** Data on the baseline conditions of water resources is lacking. Furthermore, monitoring on development impacts is ad hoc and performed by industry. Actual water use is not reported.

- Baseline wildlife data: The current wildlife populations and the impacts of ongoing LNG development in areas of habitat remain largely unknown (see Garvie, Shaw, and Lowe forthcoming).
- Impacts of hydraulic fracturing: Several scientific questions on the impacts of hydraulic fracturing – and, thus, on best practices for water quantity and quality – remain unanswered.
- Best practices for community engagement: Current regulatory frameworks have insufficiently engaged communities in water-related governance; more information is needed regarding what communities really want and how to involve them systematically in decision-making.
- Indigenous governance: clear procedures and governance structures that respect constitutional and/or Treaty rights of First Nations in British Columbia have not been designed and consistently are a source of conflict for First Nations, government, and industry.

### Key Resources

BC Ministry of Energy and Mines. 2012. *British Columbia's Natural Gas Strategy*. Victoria: BC Ministry of Energy and Mines. Accessed September 29, 2014. [http://www.gov.bc.ca/ener/popt/down/natural\\_gas\\_strategy.pdf](http://www.gov.bc.ca/ener/popt/down/natural_gas_strategy.pdf).

Campbell, Karen, and Matt Horne, M. 2011. *Shale Gas in British Columbia: Risks to B.C.'s Water Resources*. The Pembina Institute. Accessed September 29, 2014. <http://www.pembina.org/pub/2263>.

Stephenson, Eleanor, and Karena Shaw. 2013. "A Dilemma of Abundance: Governance Challenges of Reconciling Shale Gas Development and Climate Change Mitigation." *Sustainability* 5(5): 2210–2232.

Garvie, Kathryn H., and Karena Shaw. Forthcoming. "Oil and Gas Consultation and Shale Gas Development in British Columbia." *BC Studies* Vol. 184 (Winter 2014/15).

Prystupa, Mychaylo. 2014. "Defiant Northern Chief Galvanizes BC's First Nations against Premier's LNG Plans." *Vancouver Observer*. April 22, 2014. Accessed September 29, 2014. <http://www.vancouverobserver.com/news/bc-first-nations-slam-brakes-premier-s-lng-plans>.

## NEW BRUNSWICK

### Overview

New Brunswick's oil and gas industry has a long history but remains relatively small, in spite of large shale gas deposits. The province's recently restructured its environmental impact assessment process for oil and gas developments; however, a large number of social actors and community groups still want a more significant voice in decision-making, particularly around hydraulic fracturing. The new government looks set to proceed with a moratorium.

### Status of the Industry

New Brunswick's first well, drilled in 1859, was one of the first in North America (Office of the Chief Medical Officer for Health 2012). The long, slow development of the industry has resulted in the use of varying technologies, from conventional vertical wells to newer horizontal slick-water fracturing methods (Office of the Chief Medical Officer for Health 2012). In spite of growth in oil and gas production starting in the 1990s, the industry remains small, especially when compared nationally.

Nine companies have now begun work in the province – Corridor Resources and SWN Resources Canada are the two most active (Office of the Chief Medical Officer for Health 2012; Merrill 2014, personal communication). These companies are drawn by New Brunswick's large estimated shale gas deposits and pre-existing infrastructure; the province holds an estimated 80 trillion cubic feet of deep shale gas in a small and populated area and the Maritime and Northeast Pipeline could be used to transport gas from new shale deposits to New England (Leonard, 2012).

The provincial government promotes gas development as a significant economic opportunity, but investment has been low and development on the ground has been slow. Regional companies, lacking capacity and capital, look nationally and internationally for partnerships. Hydraulic fracturing, however, has been a source of great controversy in the province, and, in September 2014, newly elected premier Brian Gallant said that he intends to go ahead with his party's plan for a moratorium (CBC News 2014a).

### Overall Framework for Water Governance

The Department of Energy and Mines holds authority over the use of water and natural gas, while the Department of Environment governs all environmental impacts, including from natural gas and on water (Merrill personal communication). The Clean Environment Act (1973), the Oil and Natural Gas Act (1976), and the Clean Water Act (1989) are the acts governing water and natural gas. The Oil and Gas Act deals mainly, however, with the engineering-related aspects of the oil and gas industry (e.g. well-casing integrity).

All natural gas projects in New Brunswick must complete an environmental impact assessment (EIA) (see Environment and Local Government 2012). Specifically, under the Clean Environment Act's Environmental Impact Assessment Regulation, all proponents must first submit an application, including a project description that identifies potential impacts, which will undergo a "Determination Review," conducted by a technical committee of representatives with expertise on different aspects of the project. If committee members

determine that a project has significant potential impacts, they may recommend a “Comprehensive Review,” which includes an EIA study and an opportunity for public comment. To date, however, oil and gas registrations have not triggered Comprehensive Review (Merit, personal communication). In 2011, the province introduced a new “phased” EIA for oil and gas activities: review of work begins much earlier in the project planning, but exploration activities can now occur simultaneously with the EIA process (Environment and Local Government 2014).

A growing number of social actors have begun to demand increased involvement in and control over natural gas production–related activities. Although the provincial government has jurisdiction over mineral rights, municipalities have begun to pass bylaws and resolutions related to hydraulic fracturing (Patterson 2014; Sierra Club n.d.). The authority of these municipal initiatives is as yet untested. Meanwhile, a wide range of social groups – including First Nations, environmental and religious organizations, medical associations, and other industry groups (like those representing tourism companies) – seek a higher degree of involvement in the decision-making process. These groups request a variety of approaches to governance of hydraulic fracturing, including, for example, a moratorium, a ban, and formalized consultation processes. In May 2013, the Elsipogtog First Nation initiated a widely publicized protest at a proposed shale gas site (Schwartz and Gollom 2013).

### **Governance Challenges**

Limitations of environmental impact assessment: While the province has introduced its new “phased” EIA, it does not have a strategic cumulative impact phase that considers the impacts of the industry as a whole (Merit, personal communication). As with most EIA processes, proponents can amend a project until it meets certain standards; thus it is perceived that the opportunity to reject a project completely once it is undergoing the EIA process, is lacking.

Lack of legally binding rules for industry: The new phased EIA approach operates under the Clean Environment Act, but no changes have been made to the EIA Regulation Act; the conditions set out in “Rules for Industry” are therefore not legislated or legally binding.

Industry-run public consultation: During the thirty-day public consultation period, the public must find registration documents posted on the government website. Critics have noted that any public comment is sent to industry for consideration; industry runs its own consultation process and there is no investigation of how they are reporting comments from the public.

Lack of consultation with First Nations: First Nations demand that their rights be upheld, and that they be consulted regarding shale gas development (Assembly of First Nations Chiefs, New Brunswick 2013). A high degree of uncertainty exists regarding the processes through which consultation should occur.

Lack of capacity for monitoring and enforcement: Analysts suggest that the province lacks the capacity to monitor the shale gas industry; it has no formal systematic framework for data collection, reporting, and evaluation (Merrill, personal communication). Concern also exists regarding whether the province can challenge infractions to enforce regulations (Ibid).

## Information Gaps

Analysts of hydraulic fracturing in New Brunswick have identified several key subjects on which information is needed:

- Baseline conditions of watersheds and hydraulic systems
- Risks to water quality (including toxicity risks, the chemicals used, and the effectiveness of wastewater treatment)
- Current baseline health conditions and potential health effects
- The scope and scale of future shale gas development
- Methods for preventing or mitigating social impacts.

## Key Resources

Al, Tom, Karl Butler, Rick Cunjack, and Kerry MacQuarrie. 2012. "Opinion: Potential Impact of Shale Gas Exploitation on Water Resources." University of New Brunswick. Accessed September 30, 2014. <http://www.unb.ca/initiatives/shalegas/shalegas.pdf>.

Conservation Council New Brunswick. 2010. *Fracking for shale gas in New Brunswick: what you need to know*. To access the primer, contact the Conservation Council NB.

Department of Environment. 2011. *Phased Environmental Impact Assessment (EIA) Process for Oil & Gas Development in New Brunswick*. Presentation Accessed October 8, 2014. <https://upriverenvironmentwatch.files.wordpress.com/2014/07/phased-eia-oil-gas-stakeholder-meeting-jan-27-2011-1.pptx>

New Brunswick. 2011. *The New Brunswick Energy Blueprint*. New Brunswick Department of Energy. October 2011. Accessed September 30, 2014. <http://www2.gnb.ca/content/dam/gnb/Departments/en/pdf/Publications/201110NBEnergyBlueprint.pdf>.

New Brunswick. 2013. *Responsible Environmental Management of Oil and Gas Activities in New Brunswick: Rules for Industry*. Accessed September 30, 2014. <http://www2.gnb.ca/content/dam/gnb/Corporate/pdf/ShaleGas/en/RulesforIndustry.pdf>

Office of the Chief Medical Officer of Health. 2012. *Chief Medical Officer of Health's Recommendations Concerning Shale Gas Development in New Brunswick*. New Brunswick Department of Health. Accessed September 30, 2014. [http://www2.gnb.ca/content/dam/gnb/Departments/h-s/pdf/en/HealthyEnvironments/Recommendations\\_ShaleGasDevelopment.pdf](http://www2.gnb.ca/content/dam/gnb/Departments/h-s/pdf/en/HealthyEnvironments/Recommendations_ShaleGasDevelopment.pdf)

## NOVA SCOTIA

### Overview

Development of shale gas was part of the Nova Scotia government's plan to diversify its energy sources. Public opposition to hydraulic fracturing, however, was fierce, and in 2009, the government (under the NDP) announced that it would issue no new licenses without a rigorous policy review. In September of this year, Nova Scotia's Liberal government introduced a bill to ban high volume hydraulic fracturing, except for use in testing or research (Gorman 2014).

### Status of the Industry

Nova Scotia has a forty-year history of oil and gas exploration and development, and offshore production began in earnest in the 1990s (NSDE n.d.). The province's shale gas resources are far less substantial compared to offshore petroleum. (The Horton Bluff Shale, which fronts the Bay of Fundy, is Nova Scotia's most significant source of shale gas, holding an estimated 3.4 trillion cubic feet. [USDE 2013].) Nevertheless, in 2005, when offshore drilling results began to disappoint, the province began to explore options for developing shale gas resources. In 2006, Triangle Resources began exploring some leases; however, public concern over Triangle's storage of wastewater led to broader concerns about the sustainability of the industry as a whole (Council of Canadians, n.d.).

With the 2007 Environmental Goals and Sustainable Prosperity Act (ESPGA), policymakers sought to integrate environmental health with economic prosperity. In seeking to diversify its energy sources, the province has suggested that shale gas could become part of a new energy plan (Nova Scotia Environment 2014a). However, when the NDP came into power in 2009, the government announced that it would issue no licenses for shale gas development until a regulatory regime was in place. During public consultation for this regime, there were 238 public submissions put forward, 92 percent of which were in support of a moratorium or ban on hydraulic fracturing (CBC 2014b). The Liberal government, elected in October 2013, continued the policy review, expanding it to include a more extensive public inquiry. (The panel was chaired by David Wheeler and became known as the "Wheeler Review.") In the summer of 2014, the government released ten draft papers (Nova Scotia Environment 2014) and provided a two-month period for public comment. The papers appeared to support lifting the moratorium, but the panel chair's tone began to shift; he now suggests that more time is needed (Heather Castledon, personal communication). In September 2014, by introducing amendments to the Petroleum Resources Act, Liberal energy minister Andrew Younger officially legislated a ban on hydraulic fracturing (Gorman 2014).

### Overall Framework for Water Governance

Under the Petroleum Resources Act (1989), the Department of Energy holds authority for shale gas. The department puts out calls for exploration proposals; successful proponents are invited to sign a lease agreement. Hydraulic fracturing on the lease must be approved through a separate application through the Department of Energy (Nova Scotia 2011). Proponents of an exploration project must hold a public meeting and reach a lease agreement with the private landowner before submitting an application to the Department of Environment. The application

includes information about proximity to watercourses and wells, the location and quantity of water to be withdrawn for the project, and other issues of drilling technology, waste disposal, and monitoring. Proponents require a permit for the use of groundwater or surface water in any amount exceeding 15,000 litres per day.

Under the Water Act (1919) and the Environment Act (1990, part 10), the Department of Environment's Drinking Water, Water Resources & Industrial Management Branch and the Compliance Branch hold authority for water.

### **Governance Challenges**

Poor public perception of the provincial government: Many members of the public perceive that shale gas development – in its early days in Nova Scotia – went ahead without an adequate regulatory framework. As a result, the provincial government needs to rebuild public trust in its capacity to regulate. Many analysts now argue that government and industry lack the social license to proceed with shale gas development and therefore must build a regulatory regime that considers all stages of the industry.

Widespread opposition to hydraulic fracturing: The freshwater policy community, including NGOs like Ecology Action Centre and No Frack Nova Scotia, is very vocal on the subject of hydraulic fracturing. Furthermore, the Native Council of Nova Scotia (which represents Mi'kmaq living off reserves) recently released a statement opposing all hydraulic fracturing in the province (Ross 2014). The Assembly of Nova Scotia Mi'kmaq Chiefs created its own working group to develop a summary of the organization's concerns to submit to the 2013–2014 review process and supported the recent ban (Assembly of Nova Scotia Mi'kmaq Chiefs 2014).

Lack of comprehensive provincial water monitoring: While community monitoring programs exist, and government and academic researchers have begun to map water resources (e.g. Water Canada 2014), the province lacks an official government water quality monitoring program. Monitoring has been done primarily by industry, as areas have been mapped out for exploration permits. Furthermore, little data on baseline quality and quantity exists. Drinking water is a primary concern for Nova Scotians, as many rely on groundwater, and, without baseline data, the impacts of hydraulic fracturing on water quality will be difficult to ascertain (and prove legally, if necessary). Cuts to environmental departments and programs, however, have reduced capacity for water monitoring and other important regulatory processes.

### **Information Gaps**

Analysts of shale gas, water resources, and hydraulic fracturing in Nova Scotia have identified several key subjects on which information is needed:

- Ecological effects of hydraulic fracturing and, in particular, its effects on groundwater
- Current baseline health conditions and potential health effects
- The size of the shale gas resource in the province.

### **Key Resources**

Harris, Barb. 2013. "Out of Control: Nova Scotia's Experience with Fracking for Shale Gas." Nova Scotia Fracking Resource and Action Coalition. Accessed October 3, 2014. <https://nofrac.files.wordpress.com/2013/04/out-of-control-full-report.pdf>.

NSMikmaqRights. 2014. Hydraulic Fracturing Meeting – Opening Chief Prosper. Meeting with Dr. Wheeler during public consultation of Hydraulic Fracturing Review. Accessed October 3, 2014. [https://www.youtube.com/watch?v=\\_bvSAJs4v7g&list=PLj1bHh2Jj4DJ7ysYQHfgbd7kgncBpX1p-&index=1](https://www.youtube.com/watch?v=_bvSAJs4v7g&list=PLj1bHh2Jj4DJ7ysYQHfgbd7kgncBpX1p-&index=1).

Nova Scotia. 2014b. *Independent Hydraulic Fracturing Review*. (Also called the "Wheeler Review.") Released August 28, 2014. Government of Nova Scotia. Accessed September 30, 2014. <http://www.novascotia.ca/nse/pollutionprevention/consultation.hydraulic.fracturing.asp>

Shingler, Benjamin. 2013. "Emails Show Federal Officials Worried about Second Idle No More Movement." August 17, 2014. Canadian Press. Accessed October 3, 2014 <http://www.ctvnews.ca/politics/emails-show-federal-officials-worried-about-second-idle-no-more-movement-1.1963194>.

## NORTHWEST TERRITORIES

### Overview

Companies have begun to explore in the Canol shale play, but development (and associated hydraulic fracturing activities) has been slow moving. Large restructurings of the balance of regional, territorial, and federal power under Bill C-15 will have significant – but as yet undetermined – effects on water governance in the context of oil and gas development.

### Status of the Industry

Oil and gas companies are exploring the potential of the Canol shale play in the Sahtu Settlement Region in the Central Mackenzie Valley. Currently, while fourteen exploration licenses have been granted encompassing 1.2 million hectares in the Norman Wells area (Aboriginal Affairs and Northern Development Canada 2013), no production licenses have been issued. Lease-holding companies have organized into the Central Mackenzie Valley Producer's Group, which includes ConocoPhillips Canada, MGM (recently bought out by Paramount), Husky, Imperial Oil, and Shell Canada. Companies have taken small steps toward hydraulic fracturing:

- MGM (now Paramount) applied for permission to undertake hydraulic fracturing but withdrew the application when the Sahtu Land and Water Board (SLWB) decided the application demanded further review through the Mackenzie Valley Environmental Impact Review Board (MVEIRB).
- ConocoPhillips Canada, the most active company currently operating in the NWT, was approved for horizontal drilling and fracturing on two wells, which they carried out in over the 2013–14 winter and plans more exploratory hydraulic fracturing on ten new wells over the next five years but has committed no funds toward the project for the 2014–15 winter (Wohlberg 2014a).

ConocoPhillips's decision to stall drilling is reflective of recent industry behaviour in the NWT, where companies appear to be putting development on hold. For example, in a recent "growth portfolio" created for their shareholders, Husky listed their NWT holdings as a long-term (2020 or later) project and recently withdrew an application to fracture four wells in the Sahtu. The profitability of NWT projects (perhaps in comparison to companies' other multinational holdings) is a likely factor behind companies' hesitations, perhaps because of high production costs and lack of existing transport and distribution infrastructure in the region (Shauna Morgan, personal communication, July 2014).

### Overall Water Governance Framework

The framework for water governance is changing with the current devolution, under Bill C-15, of authority over lands and resources from the federal government to the Government of the Northwest Territories (GNWT). Prior to devolution, the federal government retained exclusive control of water rights except in areas where this authority had been transferred through land claim agreements. In land claims settlement regions like the Sahtu, where shale oil development is concentrated, authority over land and water management lies with co-management resource boards, where First Nations and non-First Nations governments share

equal membership. The Sahtu Land and Water Board (SLWB) receives applications for all projects including water permits and licenses for hydraulic fracturing. The SLWB will generally consult community organizations and its strategic land use plan, and has forty-two days to issue or deny a license/permit or to refer the project to the MVEIRB for further environmental assessment. In areas not covered by land claims, currently the regional land and water boards govern water use for oil and gas activity in the NWT.

The water governance framework appears to be changing with devolution, though the extent and timing of changes is somewhat uncertain. As of April 2014, onshore water resources are the jurisdiction of the GNWT, but regional governance structures across the NWT including the Sahtu appear to be changing. The establishment of an eleven-person territorial board in Yellowknife is a key part of this restructuring; some analysts have noted that this centralization will reduce the proportional representation of each Aboriginal government (Morgan 2014). Some Aboriginal leaders and governments have expressed frustration with the changes, noting that land claim settlements took years of negotiations and the bill will void key pieces of these agreements (see Alexie 2014; Morgan 2014; Wohlberg 2014b). Greater power for the federal government is another key element in Bill C-15 and a point of concern for some local residents and critics of the restructuring, who perceive that the changes are intended to enable more intensive, less regulated resource development in the North (Morgan 2014).

Territorial water management is guided by the GNWT Water Strategy – *Northern Waters, Northern Voices* (GNWT 2010) – which is currently in its implementation phase. The strategy has progressive elements, like a greater focus on public engagement and on building collaborative relationships and monitoring programs, but critics argue that it lacks regulatory teeth and defined standards for water management (personal communication, Shauna Morgan, July 2014).

## **Governance Challenges**

Lack of monitoring and local water-related expertise: The sub-surface effects of hydraulic fracturing in the Sahtu are unmonitored due to the lack of local hydrological expertise. Dr. Erin Kelly with the GNWT is conducting some community-based water monitoring, but these local programs are not specifically designed to be an oil and gas industry monitoring program, but rather to gather baseline information. In 2013, the GNWT allocated funds through the Environmental Studies Research Fund (ESRF) for regional monitoring, water baseline studies, and wildlife and wildlife habitat studies (GNWT 2013), but these projects are behind schedule due to devolution (personal communication, Shauna Morgan, July 2014).<sup>2</sup>

Balancing development pressures with protection of social and ecological values: Significant internal and external pressure exists to develop oil and gas resources in the NWT, and the federal government has made northern development a priority. The challenge for decision-makers is to balance these pressures with environmental protections and the protection of the interests of local people who value healthy ecosystems and still rely on land based practices like hunting and trapping for their economic and cultural survival. (Many First Nations and

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<sup>2</sup> The ESRF was created through federal oil and gas legislation that requires companies operating on “frontier land” to pay into a fund for baseline research and monitoring. The GNWT decides how the money is spent; industry also sits on the fund’s governance committee.

others with an interest in environmental protection are also employed in the industry.)

### **Information Gaps:**

Analysts of the relationship between oil and gas development and hydraulic fracturing in the Northwest Territories have identified several key subjects on which information is needed:

- Surface and groundwater baseline conditions, particularly on monitoring for oil and gas and fracking indicators. Water quality is the primary concern at this time. Several groups – including government and industry – are discussing monitoring but have not developed a comprehensive strategy or made their separate data available for regional decision-makers.
- Impact of disturbance on permafrost. In particular, research have suggested that wells could create columns of melted and potentially permeable ground, and would act as pathways for groundwater movement between aquifers, with possible implications for groundwater contamination.
- The effect of linear disturbance on boreal caribou (identified as a Species-At-Risk and part of Environment Canada’s boreal caribou recovery strategy) and how negative impacts will be managed as development grows.

### **Key Resources**

Bevington, Dennis. 2013. “A Northern Consensus on Completing (Not Dismantling) the NWT Regulatory Regime.” Office of the MP for the Western Arctic. Accessed September 30, 2014. [http://www.dennisbevington.ca/pdfs/en/2013/NWT\\_Consensus\\_on\\_Regulatory\\_Regimes.pdf](http://www.dennisbevington.ca/pdfs/en/2013/NWT_Consensus_on_Regulatory_Regimes.pdf).

Government of the Northwest Territories (GNWT). 2010. *Northern Voices, Northern Water: NWT Water Stewardship Strategy*. Accessed September 30, 2014. [http://www.enr.gov.nt.ca/sites/default/files/strategies/nwt\\_water\\_stewardship\\_strategy.pdf](http://www.enr.gov.nt.ca/sites/default/files/strategies/nwt_water_stewardship_strategy.pdf).

Morgan, Shauna. 2014. “Despite the Fanfare, Devolution Means Less Say for Northerners over Land and Resources.” Yellowknife: Pembina Institute. Accessed September 30, 2014. <http://www.pembina.org/op-ed/2533>.

## ONTARIO

### Overview

Ontario holds a relatively small volume of oil and gas in shale plays; however, since 2010, geological researchers have begun to identify potentially productive reserves. A large proportion of these shale-based resources is located near densely populated regions in the province's south. Two successive premiers have opposed hydraulic fracturing in the region; opposition is also strong and widespread among First Nations. Ontario currently has no framework for the regulation of hydraulic fracturing.

### Status of the Industry

Energy researchers believe that the volume of potential shale gas and shale oil reserves in Ontario is less significant than that found in other regions. In 2010, however, a drilling program by the Ontario Geological Survey (OGS) discovered shale gas resources with "recoverable potential" (Béland Otis 2012). In 2011, a second drilling program at sites in the Lake Huron, Georgian Bay, and Manitoulin Island regions (Lui 2012). In 2012, two companies, Mooncor Oil and Gas and Dundee Energy, were acquiring exploration and oil and gas rights on Lake Huron in the Kettle Point play (Canadian Press 2012). At the time, however, then-premier Dalton McGuinty stated that Ontario was not prepared to allow hydraulic fracturing until the process and its implications for water were better understood (Canadian Press 2012).

Opposition came from First Nations has been clear and widespread. In 2012, the Chiefs of Ontario (a political organization representing 133 First Nations in Ontario and which is committed to self-determination efforts), notified Premier Kathleen Wynne that they would fight hydraulic fracturing across Ontario (Manitoulin Expositor 2013). The Aamjiwnaang First Nation in the Sarnia area reported that when industry representatives visited to discuss hydraulic fracturing in the region, the First Nation said that it would stand up against any deployment of that technology (Graf 2014).

### Overall Framework for Water Governance

Ontario does not have a "single-window" regulator agency with authority over water allocations for oil and gas development. If the province does in future allow hydraulic fracturing, multiple government agencies could be involved: the Ministry of Natural Resources regulates the permitting, construction, and inspection of natural gas wells; the Ontario Energy Board oversees production and price setting (Shroeck and Karisny 2013). The Ministry of Environment (MOE), meanwhile, holds authority over water use and waste; the MOE implements the Ontario Water Resources Act (OWRA) and the Environmental Protection Act (1990).

Ontario has legislation that could provide some enhanced protection for water resources:

- Since the passage of the Safe Water Drinking Act (2002), decision-makers can require permit holders to develop water conservation plans or other measures to promote

efficient water use to minimize water losses through consumptive use (and water takings for hydraulic fracturing would be categorized as “consumptive”).

- The Ontario Water Resources Act and the Water Taking Regulation also include some groundwater regulation that applies to water takings.
- Ontario’s Clean Water Act (2006) established source water protection committees to represent municipalities, industries, and individuals at the watershed scale (Ontario Water Works Association 2014). The committees assess risks to source water quality and quantity and write plans for mitigating drinking water impacts, either through existing regulatory requirements or the creation of voluntary initiatives.
- Municipalities, through control of bylaws and land use planning, have some authority over managing a significant water threat, though their ultimate authority in relation to the province over issues of oil and gas development remains untested.

### **Governance Challenges**

**Lack of a regulatory framework for hydraulic fracturing:** The existing regulations that could apply to Ontario’s shale gas industry are untested. However, Schroeck and Karisny (2013) assessed the regulatory frameworks in the Great Lakes region of Canada and the US and found that governments in both countries lack comprehensive hydraulic fracturing regulation, and regulation at the state/provincial scale is fragmented.

**Location of shale deposits and population density:** The province’s potentially recoverable shale gas resources in the Greater Toronto Area and southeast Ontario underlie densely populated regions. We anticipate that achieving a social license would be a significant challenge.

**Location of shale deposits and ecologically important areas:** Another challenge is the location of shale deposits in relation to ecologically and socially important areas. Some potential target regions underlie key wildlife habitat and popular vacation/recreation areas like Georgian Bay and Manitoulin Island. Threats to water and land from hydraulic fracturing and the linear disturbance of infrastructure development could have negative implications for tourism, recreation, and wildlife, and spur organized local resistance.

### **Information Gaps**

Analysts of future potential shale oil or shale gas developments in Ontario have identified several key subjects on which information is needed:

- A cost-benefit analysis of the development of the industry in the regions
- The hydrological characteristics of potentially gas-producing regions
- The necessary new regulations (and integration of diverse and complex existing regulations) to manage the industry and ensure protection of water resources.

### **Key Resources**

Krueger, R. 2011. “The Public Policy Implications of Shale Gas Extraction in Canada.” Student publication. Faculty of Engineering. McMaster University. Accessed September 30,

2014. <http://msep.eng.mcmaster.ca/epp/publications/student/Ralph%20Krueger.pdf>.  
Ontario Petroleum Institute. n.d. *Safely Harvesting Energy: An Overview of Hydraulic Fracturing in Ontario*. Accessed October 3, 2014.  
[http://www.dundeedrilling.ca/docs/ONTARIO\\_SAFELY\\_HARVESTING\\_ENERGY.pdf](http://www.dundeedrilling.ca/docs/ONTARIO_SAFELY_HARVESTING_ENERGY.pdf).

Schroeck, Nicholas, and Stephanie and Karisny. 2013. "Hydraulic Fracturing and Water Management in the Great Lakes." *Case Western Reserve Law Review* 63(4):1166–1186.

## QUEBEC

### Overview

Many publications list Quebec alongside British Columbia, Alberta, and New Brunswick as one of Canada's high potential shale gas landscapes (CCA 2014; Rivard et al. 2014). In 2011, the Quebec provincial government established a moratorium on hydraulic fracturing. Overall, analysts have characterized Quebec's approach to shale gas development as precautionary: the government appears committed to public consultation and research while considering future development.

### Status of the Industry

Since 2006, proponents have demonstrated considerable interest in the shale gas potential of the Utica Shale in the St. Lawrence lowlands. The area extends from Montreal to Quebec City and also encompasses Trois-Rivieres. The majority of the play lies beneath the south shore of the St. Lawrence River, but a narrower belt lies on the north shore as well.

During a 2007–10 exploration period (see Rivard et al. 2014), twenty-nine wells were drilled, eighteen of which were hydraulically fractured; no wells, however, have so far reached production stages (CCA 2014). By 2008, the apex of the exploration rush in the Utica Shale (Rivard et al., 2014), the entire St. Lawrence sedimentary platform – an area of roughly 20,000 square kilometres – was licensed to oil and gas companies. While industry has yet to confirm the full potential of the play or the economic viability of production, early test wells showed fairly good returns and Quebec's environmental assessment agency, le bureau d'audiences publique sur l'environnement (BAPE), published partial estimates of technologically recoverable gas between 22 to 47 trillion cubic feet (Quebec 2014: 31). The BAPE has estimated that full production of the Utica Shale could mean roughly 20,000 wells drilled (BAPE 2011; cited in CCA 2014: 119).

Still, at present, there is no production of shale gas in Quebec. Exploration in 2008–09 sparked significant community resistance; nearly one hundred anti-shale gas protest groups have formed (Rivard et al., 2014). In March 2011, the Quebec government placed a temporary moratorium on shale gas development in the St. Lawrence lowlands in order to conduct environmental studies, research hydraulic fracturing, and consult the public. One independent oil and gas exploration company, Lone Pine Resources Inc., successfully sued the Canadian federal government (under NAFTA's Chapter 11) for \$250 million in investment damages caused by the moratorium. Nevertheless, the newly elected provincial Liberal government appears to plan to sustain the moratorium in the Utica Shale. The new government did, however, recently announce that it is committed to investing public funds in exploring the shale oil potential of Anticosti Island (potentially 30–50 billion barrels in place), a mostly unpopulated island northeast of the Gaspé Peninsula.

According to the 2014 Council of Canadian Academies report, Utica wells require between 12,000 and 20,000 cubic metres of water for hydraulic fracturing, an amount high relative other plays in Canada – second only to the Horn River Basin in BC (although water use in the Horn River is still significantly higher).

### Overall Framework for Water Governance

That Quebec has no framework to regulate water use for shale gas development was part of the justification for the moratorium in the Utica Shale (Rivard et al. 2014). Quebec's Ministry of Environment, which governs surface and groundwater withdrawals, is guided by the Environmental Quality Act and the Water Policy legislation (2002). In 2013, the government published a draft Water Withdrawal and Protection Regulation intended, in part, to strengthen the regulatory rigour for water withdrawal authorizations; the regulation, however, is not yet finalized. The environment minister has stated that before companies begin operations, measures to regulate and control development must be in place.

Quebec is undertaking two key initiatives to acquire governance knowledge to inform a regulatory approach for shale gas development and hydraulic fracturing, including the creation of (1) the program for groundwater knowledge acquisition (PACES), and (2) a strategic environmental assessment (SEA) committee on shale gas. The PACES program – which is being carried out by the MOE and a coalition of local watershed groups, universities, students, and experts – seeks to understand risks to aquifers, on which Quebecers rely for drinking water. The SEA committee has undertaken a program of knowledge acquisition regarding the Utica Shale; an SEA on Anticosti's oil potential should begin in 2015. The SEA currently argues for a “single window” regulatory agency for oil and gas permitting (BAPE 2014).

The Utica Shale lies within the traditional territories of three First Nations: the Mohawk community of Kahnawake to the west, and the Abenaki communities of Odanak and Wolinak in the heart of the zone (BAPE 2014). The Kahnawake Mohawk protested in solidarity with the Mi'kmaq in New Brunswick; Kahnawake is a member nation of the Haudenosaunee Six Nations who condemn hydraulic fracturing. The Abenaki Nations, meanwhile, in 2011, gave comments to the BAPE. They did not condemn hydraulic fracturing outright but stated that a decision should not be made until a full environmental assessment is conducted.

Municipalities in Quebec might have some authority to enact in relation to oil and gas operations, under two pieces of legislation: (1) the Municipal Powers Act, which covers environmental issues, traffic and nuisance control, and public health; and (2) the Act to Affirm the Collective Nature of Water Resources and Provide for Increased Water Resource Protection. In opposition to shale gas, some municipalities have passed resolutions on the transport of hazardous materials and the protection of water within their boundaries (BAPE 2014).

## **Governance Challenges**

Conflicting uses: the area above the Utica Shale supports 2.1 million people and almost all of the land targeted for shale gas development is currently zoned for agriculture.

A high degree of public resistance: The BAPE (2014a) found that the prospect of shale gas development in the Utica Shale does not have “social acceptability” for several reasons that relate to governance; citizens were skeptical that decision-making processes could reflect their interests.

Need for a new regulatory model: The SEA analyzed a range of governance scenarios and argued that a mix of centralization and decentralization would be necessary. However, there is

currently no legislation that could enable the delegation of authority within the Sustainable Development Act.

Need for better mechanisms for public participation and engagement: The SEA found that Quebec needs new mechanisms for consultation; in particular, consultation prior to development is needed to identify and mitigate potential conflicts.

### **Information Gaps**

The BAPE, the SEA, and other analysts of potential shale gas developments in Quebec have identified several key subjects on which information is needed:

- Risks to groundwater and surface water, including the possibility of methane leakage
- Effective methods to deal with wastewater, since Quebec does not have strata that would permit deep saline injection for frack fluid disposal
- Baseline conditions and the assimilation capacity of groundwater systems.

### **Key Resources**

Quebec. 2014. *Strategic Environmental Assessment on Shale Gas: Knowledge Gained and Principal Findings*. Quebec: Strategic Environmental Assessment Committee on Shale Gas. Accessed September 30, 2014. [http://ees-gazdeschiste.gouv.qc.ca/wordpress/wp-content/uploads/2014/03/SEA-knowledge-gained-and-principal-findings\\_jan-2014.pdf](http://ees-gazdeschiste.gouv.qc.ca/wordpress/wp-content/uploads/2014/03/SEA-knowledge-gained-and-principal-findings_jan-2014.pdf).

Rivard, Christine, Denis Lavoie, René Lefebvre, Stephan Séjourné, Charles Lamontagne, and Mathieu Duchesne. 2014. “An Overview of Canadian Shale Gas Production and Environmental Concerns.” *International Journal of Coal Geology* 126:64–76. doi:10.1016/j.coal.2013.12.004.

Canadian Energy Research Institute (CERI). 2013. “Potential Economic Impacts of Developing Quebec’s Shale Gas.” Canadian Energy Research Institute Study No. 132. March 2013. Accessed September 30, 2014. [http://www.ceri.ca/images/stories/2013-03-08\\_CERI\\_Study\\_132\\_-\\_Quebec\\_Shale.pdf](http://www.ceri.ca/images/stories/2013-03-08_CERI_Study_132_-_Quebec_Shale.pdf).

## APPENDIX I: SUMMARY TABLES

### Status of the Industry

Alberta	Large and well-established oil and gas industry; 6,300 wells fracked since 2008
British Columbia	Fast-moving (especially between 2005 and 2009) industry; a key part of provincial economic strategy
New Brunswick	Long history of oil and gas development but shale gas industry is small; newly elected premier intends to move ahead with his party's plan for a moratorium
Nova Scotia	Fierce public opposition; in September 2014, the government introduced a bill to ban high volume hydraulic fracturing (except for testing and research)
Northwest Territories	Companies exploring in the Canol shale play (Central Mackenzie Valley), but development is slow moving
Ontario	Starting in 2010, geological researchers identified potentially productive reserves; province currently lacks regulatory framework to govern hydraulic fracturing
Quebec	Quebec has a high potential shale gas landscape; the provincial government instituted a moratorium in 2011

### Overall Framework for Water Governance

Alberta	Alberta Energy Regulator (AER) is responsible for all oil and gas development.
British Columbia	BC Oil and Gas Commission (OGC) is responsible for the development of petroleum resources and the management of its impact. The OGC is authorized for Section 8 (temporary) water withdrawals, but now has authority for full licenses (although the Ministry of Environment also holds authority and delegates it for the water use purpose of oil and gas). Key legislation is the Oil and Gas Activity Act and the Water Act.
New Brunswick	Department of Energy and Mines has authority over the use of water and natural gas; Ministry of Environment regulates impacts on water. Key legislation is the Clean Environment Act (1973), the Oil and Natural Gas Act (1976), and the Clean Water Act (1979). All gas projects must complete and Environmental Impact Assessment.
Nova Scotia	Department of Energy holds authority for shale gas; Department of Environment receives application on potential impacts. Key legislation is the Water Act (1919), the Petroleum Resources Act (1989), the Environment Act (1990, part 10), and the Environmental Goals and Sustainable Prosperity Act (2007).
Northwest Territories	Regional governance boards currently hold authority, but governance is changing with current process of devolution under Bill C-15, including the creation of a new eleven-person territorial board in Yellowknife; all water management is guided by the GNWT's Water Strategy – <i>Northern Water, Northern Voices</i> .
Ontario	Multiple agencies could be involved in regulation of shale gas

	development and water governance: the Ministry of Natural Resources, the Ontario Energy Board, and the Ministry of Environment. Key legislation includes the Ontario Water Resources Act and the Water Taking Regulation, the Ontario Clean Water Act, the Environmental Protection Act, and numerous municipal bylaws.
Quebec	Ministry of Environment governs surface and groundwater withdrawals. Key legislation includes the Environmental Quality Act and Water Policy legislation (2002). Two processes to acquire governance knowledge regarding shale gas development: (1) the program for groundwater knowledge acquisition (PACES) and (2) a strategic environmental assessment (SEA) of shale gas.

### Governance Challenges

Alberta	Scarcity; contamination risks; keeping pace with development
British Columbia	Inclusion of First Nations (protection of treaty and non-treaty rights); global market pressures; greenhouse gas emissions; distribution of costs and benefits; lack of cumulative impacts assessment
New Brunswick	Lack of cumulative impact assessment; approval-based EIA process; lack of legally binding rules for industry; industry-run public consultation; lack of consultation with First Nations; lack of capacity for monitoring and enforcement
Nova Scotia	Poor public perception of the provincial government; widespread opposition to hydraulic fracturing; lack of comprehensive provincial water monitoring.
Northwest Territories	Lack of monitoring and local water-related expertise; balancing development pressures with protection of social and ecological values
Ontario	Lack of a regulatory framework for hydraulic fracturing; location of shale deposits in densely populated and ecologically important regions
Quebec	Conflicting uses (high density populations, agricultural zoning); a high degree of public resistance; need for a new regulatory model; need for better mechanisms for public participation and engagement

### Information Gaps

Alberta	Risks to groundwater and well-water; water scarcity concerns in drought-prone regions
British Columbia	Baseline water conditions; impacts of hydraulic fracturing on water safety; best practices for community engagement
New Brunswick	Baseline conditions of watersheds and hydraulic systems; risks to water quality; current baseline health conditions and potential health effects; the scope and scale of future gas development; methods for preventing or mitigating social impacts
Nova Scotia	Ecological effects, especially on groundwater; current baseline health conditions and potential health effects; the size of the shale gas resource in the province
Northwest Territories	Surface and groundwater baseline conditions; impact of disturbance on permafrost; the effect of linear disturbance on boreal caribou
Ontario	Cost-benefit information on the industry's development; the

	hydrological characteristics of potentially gas-producing regions; the new regulations (and integration of diverse and complex existing regulations) to manage the industry and protect water resources
Quebec	Risks to groundwater and surface water; effective methods to deal with wastewater; baseline conditions and assimilation capacity of groundwater systems; best practices for public engagement

### Key References

Alberta	Alberta Energy 2014; Brown 2012; Christensen and Droitsch 2008; Vlavianos 2012.
British Columbia	BC Ministry of Energy and Mines 2012; Campbell and Horne 2011; Glave and Moorehouse 2013; Stephenson and Shaw 2013; Garvie and Shaw forthcoming; Prystrupa 2014.
New Brunswick	Al, Butler, and MacQuarrie 2012; New Brunswick 2011, 2013; Office of the Chief Medical Officer of Health 2012
Nova Scotia	Nova Scotia 2014b (also called the “Wheeler Review”)
Northwest Territories	Bevington 2014; GNWT 2010; Morgan 2014
Ontario	Krueger 2011; Shroeck and Karisny 2014
Quebec	Canadian Energy Research Institute 2013; Quebec 2014; Rivard 2014

## REFERENCES

- Aboriginal Affairs and Northern Development Canada. 2013. *Northern Oil and Gas Annual Report*. Accessed September 30, 2014. [http://www.aadnc-aandc.gc.ca/DAM/DAM-INTER-HQ-NOG/STAGING/texte-text/pubs\\_ann\\_ann2013\\_1400849527813\\_eng.pdf](http://www.aadnc-aandc.gc.ca/DAM/DAM-INTER-HQ-NOG/STAGING/texte-text/pubs_ann_ann2013_1400849527813_eng.pdf).
- Adams, C. 2012. *Summary of Shale Gas Activity in Northeast British Columbia 2011*. Ministry of Energy and Mines, Geoscience and Strategic Initiatives Branch. Accessed October 3, 2014. from [http://www2.gov.bc.ca/assets/gov/topic/5AA72D624ACD3D710DDF7BEB863BDB58/stats\\_act/summary\\_of\\_shale\\_gas\\_activity\\_in\\_nebc\\_2011.pdf](http://www2.gov.bc.ca/assets/gov/topic/5AA72D624ACD3D710DDF7BEB863BDB58/stats_act/summary_of_shale_gas_activity_in_nebc_2011.pdf).
- Alberta Energy Regulator (AER). 2014a. “Water Act.” Government of Alberta. Accessed October 4, 2014. <http://www.aer.ca/applications-and-notice/application-process/water-act>.
- Alberta Energy Regulator (AER). 2014b. “Water Act: Fact Sheet.” Government of Alberta. Accessed October 4, 2014.
- Alberta Environment and Sustainable Resource Development. 2014a. “Compulsory Industry Monitoring and Alberta’s Environmental Regulatory Program.” Accessed October 4, 2014. <http://www.environment.alberta.ca/01528.html>.
- Alberta Water Portal. 2014. “Work: Alberta Water Legislation, Regulations and Guidelines.” Accessed October 4, 2014. <http://albertawater.com/alberta-water-legislation-regulations-guidelines>.
- Alexie, Robert. 2014. Untitled Speech. Mr. Robert Alexie (President, Gwich’in Tribal Council) at the Aboriginal Affairs and Northern Development Committee. July 27, 2014. Open Parliament. Accessed October 4, 2014. <http://openparliament.ca/committees/aboriginal-affairs/41-2/10/robert-alexie-1/only/>.
- Assembly of First Nations Chiefs in New Brunswick. 2013. “First Nations, Consultation, and Fracking.” October 26, 2013. *Telegraph Journal*. Accessed September 30, 2014. [http://www.chiefsnb.ca/index.php/news/item/first\\_nations\\_consultation\\_and\\_fracking](http://www.chiefsnb.ca/index.php/news/item/first_nations_consultation_and_fracking).
- Assembly of Nova Scotia Mi’kmaq Chiefs. 2014a. “Chiefs Strongly Support Nova Scotia’s Decision on Hydraulic Fracturing.” Press Release. September 3, 2014. Accessed September 30, 2014. [http://mikmaqrights.com/wp-content/uploads/2014/01/Press-Release\\_Fracking-Decision\\_03Sept14\\_FINAL.pdf](http://mikmaqrights.com/wp-content/uploads/2014/01/Press-Release_Fracking-Decision_03Sept14_FINAL.pdf).
- BC Ministry of Energy and Mines. 2009. *BC Energy Plan Report on Progress*. Accessed September 29, 2014. [http://www.energyplan.gov.bc.ca/report/BCEP\\_ReportOnProgress\\_web.pdf](http://www.energyplan.gov.bc.ca/report/BCEP_ReportOnProgress_web.pdf).
- Béland Otis, C. 2012. *Project Unit 09-024. Preliminary Results: Potential Ordovician Shale Gas Units in Southern Ontario*. Toronto: Ontario Ministry of Northern Development and Mines.
- Bennett, Dean. 2014. “Fracking ‘Almost Completely Unregulated’ in Alberta, NDP Charges.” *Globe and Mail*. February 14, 2014. Accessed September 30, 2014. <http://www.theglobeandmail.com/report-on-business/industry-news/energy-and-resources/fracking-almost-completely-unregulated-in-alberta-ndp-charges/article16694749/>.
- Brown, Russ. 2012. Bill 2: “The Critics Are Correct.” Faculty of Law, University of Alberta. Accessed September 29, 2014. <http://ualbertalaw.typepad.com/faculty/2012/12/bill-2-the-critics-are-correct.html>.

Campbell, K. and M. Horne 2011. "Shale Gas in British Columbia: Risks to B.C.'s Water Resources." The Pembina Institute. Accessed September 29, 2014. <http://www.pembina.org/pub/2263>

Canadian Press. 2012. "Ontario Not Ready To Allow Fracking." CBC News Toronto. November 20, 2012. Accessed September 30, 2014. <http://www.cbc.ca/news/canada/toronto/ontario-not-ready-to-allow-fracking-1.1140920>.

CBC News. 2014a. "Bryan Gallant's Hydro-Fracking Promise Concerns Oil Industry." September 24, 2014. CBC News. Accessed September 30, 2014. <http://www.cbc.ca/news/canada/new-brunswick/brian-gallant-s-hydro-fracking-promise-concerns-oil-industry-1.2777118>

CBC News. 2014b. "Fracking Public Responses 'Well Informed,' Report Finds." July 2, 2014. CBC News. Accessed October 3, 2014. <http://www.cbc.ca/news/canada/nova-scotia/fracking-public-responses-well-informed-report-finds-1.2694558>.

Christensen, R. and D. Droitsch. 2008. *Fight to the Last Drop: A Glimpse into Alberta's Water Future*. Ecojustice: Vancouver, BC. Accessed September 29, 2014. <http://www.ecojustice.ca/publications/reports/fight-to-the-last-drop-a-glimpse-into-alberta2019s-water-future/attachment>.

Coleman, Rich. 2013. *Revised Service Plan 2013/14 – 2015/2016*. Ministry of Natural Gas Development and Minister Responsible for Housing. Accessed September 29, 2014. [http://www.bcbudget.gov.bc.ca/2013\\_june\\_update/sp/pdf/ministry/mngd.pdf](http://www.bcbudget.gov.bc.ca/2013_june_update/sp/pdf/ministry/mngd.pdf).

Council of Canadians. n.d. *Nova Scotia – Fracking Across Canada: A Fractivist's Toolkit*. Accessed October 3, 2014. <http://www.canadians.org/sites/default/files/publications/nova-scotia.pdf>

Curran, Deborah. 2014. "British Columbia's New Water Sustainability Act: Waiting for the Details." Environmental Law Centre, University of Victoria. May 13, 2014. Accessed September 29, 2014. <http://poliswaterproject.org/sites/default/files/Bill%2018%202014%20Summary%20May%2013%202014.pdf>

Environment and Local Government. 2014. "Environmental Impact Assessment." New Brunswick Department of Environment and Local Government. Accessed September 30, 2014. [http://www2.gnb.ca/content/gnb/en/departments/elg/environment/content/environmental\\_impactassessment.html](http://www2.gnb.ca/content/gnb/en/departments/elg/environment/content/environmental_impactassessment.html).

Garvie, Kathryn H., Lana Lowe, and Karena Shaw. Forthcoming. "Shale Gas Development in Fort Nelson First Nation Territory: Potential Regional Impacts of the LNG Boom." *BC Studies* Vol. 184 (Winter 2014/15).

Garvie, Kathryn H., and Karena Shaw. Forthcoming. "Oil and Gas Consultation and Shale Gas Development in British Columbia." *BC Studies* 184 (Winter 2014/15).

Glave, James, and Jeremy Moorhouse. 2013. *The Cleanest LNG in the World? How to Slash Carbon Pollution from Wellhead to Waterline in British Columbia's Proposed Liquefied Natural Gas Industry*. Clean Energy Canada. Accessed September 29, 2014. [http://cleanenergycanada.org/wp-content/uploads/2013/09/CEC\\_Cleanest\\_LNG\\_World.pdf](http://cleanenergycanada.org/wp-content/uploads/2013/09/CEC_Cleanest_LNG_World.pdf).

Gorman, Michael. 2014. "Nova Scotia Fracking Ban Bill Allows Testing and Research." *Herald News*. September 30, 2014. Accessed September 30, 2014. <http://thechronicleherald.ca/novascotia/1240152-nova-scotia-fracking-ban-bill-allows-testing-and-research>.

Government of the Northwest Territories (GNWT). 2013. *Government of the Northwest Territories Response to Committee Report 6-17(3): Report on Hydraulic Fracturing Tour: Toward a Policy Framework for Hydraulic Fracturing in the Northwest Territories*. March 6, 2013. Accessed September 30, 2014. <http://www.assembly.gov.nt.ca/sites/default/files/13-03-06td40-174.pdf>.

Government of the Northwest Territories (GNWT). 2010. *Northern Voices, Northern Water: NWT Water Stewardship Strategy*. Accessed September 30, 2014. [http://www.enr.gov.nt.ca/sites/default/files/strategies/nwt\\_water\\_stewardship\\_strategy.pdf](http://www.enr.gov.nt.ca/sites/default/files/strategies/nwt_water_stewardship_strategy.pdf).

Graf, C. 2014. "The First Nations People in Sarnia Are Pushing Back Against Fracking." *Vice*. January 7, 2014. Accessed September 30, 2014. [http://www.vice.com/en\\_ca/read/the-first-nation-people-in-sarnia-are-pushing-back-against-fracking](http://www.vice.com/en_ca/read/the-first-nation-people-in-sarnia-are-pushing-back-against-fracking).

Harris, Barb. 2013. "Out of Control: Nova Scotia's Experience with Fracking for Shale Gas." Nova Scotia Fracking Resource and Action Coalition. Accessed October 3, 2014. <http://nofrac.files.wordpress.com/2013/04/out-of-control-full-report.pdf>.

Jaccard, Mark, and Brad Griffin. 2010. "Shale Gas and Climate Targets: Can They Be Reconciled?" Pacific Institute for Climate Solutions. School of Resources and Environmental Management, University of Victoria. Accessed September 29, 2014. [http://pics.uvic.ca/sites/default/files/uploads/publications/WP\\_Shale\\_Gas\\_and\\_Climate\\_Targets\\_August2010.pdf](http://pics.uvic.ca/sites/default/files/uploads/publications/WP_Shale_Gas_and_Climate_Targets_August2010.pdf).

Leonard, Craig. 2012. "Future of Oil and Gas Industry." Government of New Brunswick, Department of Energy of Mines. Accessed October 3, 2014. <http://www2.gnb.ca/content/gnb/en/news/statement/renderer.2012.11.2012-11-28a.html>.

Lui, E. 2012. "Ontario Government Quietly Drills Shale Gas Formations in the Province." *rabble.ca*. November 7, 2012. Accessed September 30, 2014. <http://rabble.ca/blogs/bloggers/making-waves/2012/11/ontario-government-quietly-drills-shale-gas-formations-province>.

Manitoulin Expositor. 2013. "Chiefs of Ontario Say No to Fracking." *Manitoulin Expositor*. December 6, 2013. Accessed September 30, 2014. <http://www.manitoulin.ca/chiefs-ontario-say-fracking/#prettyPhoto>.

NSMikmaqRights. 2014. Hydraulic Fracturing Meeting – Opening Chief Prosper. Meeting with Dr. Wheeler during public consultation of Hydraulic Fracturing Review. Accessed October 3, 2014. [https://www.youtube.com/watch?v=\\_bvSAJs4v7g&list=PLj1bHh2Jj4DJ7ysYQHfgbd7kgncBpX1p-&index=1](https://www.youtube.com/watch?v=_bvSAJs4v7g&list=PLj1bHh2Jj4DJ7ysYQHfgbd7kgncBpX1p-&index=1).

Ministry of Energy and Mines 2012. *British Columbia's Natural Gas Strategy*. Victoria: Ministry of Energy and Mines. Accessed September 29, 2014. [http://www.gov.bc.ca/ener/natural\\_gas\\_strategy.html](http://www.gov.bc.ca/ener/natural_gas_strategy.html).

- Nikiforuk, Andrew. 2011. "Fracking Contamination 'Will Get Worse': Alberta Expert." *The Tyee*. December 19, 2011. Accessed October 4, 2014. <http://thetyee.ca/News/2011/12/19/Fracking-Contamination/>.
- Nikiforuk, Andrew. 2013. "Alberta's Top Judge to Hear High Profile Fracking Case." *The Tyee*. March 29, 2013. Accessed October 4, 2014. <http://thetyee.ca/News/2013/03/29/Alberta-Fracking-Case/>.
- Nikiforuk, Andrew. 2014. "Alberta Moves to Strike Down Ernst's Fracking Lawsuit." *The Tyee*. April 18, 2014. Accessed September 30, 2014. <http://thetyee.ca/News/2014/04/18/Anti-Fracking-Suit>.
- Nova Scotia. 2011. *Review of Hydraulic Fracturing in Nova Scotia*. Government of Nova Scotia. June 11, 2011. Accessed September 30, 2014. <http://www.novascotia.ca/nse/pollutionprevention/docs/Consultation.Hydraulic.Fracturing-What.We.Heard.pdf>.
- Nova Scotia Environment. 2014. "Government Action on Climate Change." Climate Change Nova Scotia, Nova Scotia Environment. Accessed September 30, 2014. <http://climatechange.gov.ns.ca/content/WhatNSIsDoing>.
- Nova Scotia Department of Energy (NSDE). (n.d.) "Nova Scotia Onshore History Timeline – Full." Accessed Oct 3, 2014. [http://energy.novascotia.ca/sites/default/files/Nova%20Scotia%20Onshore%20History%20Timeline%20-%20FULL\\_0.pdf](http://energy.novascotia.ca/sites/default/files/Nova%20Scotia%20Onshore%20History%20Timeline%20-%20FULL_0.pdf).
- Nova Scotia. 2014. *Independent Hydraulic Fracturing Review*. (Also called the "Wheeler Review.") Released August 28, 2014. Government of Nova Scotia. Accessed September 30, 2014. <http://www.novascotia.ca/nse/pollutionprevention/consultation.hydraulic.fracturing.asp>.
- Office of the Auditor General of BC. (2010). *An Audit of the Management of Groundwater Resources in British Columbia*. Report 8: December 2010. Accessed September 29, 2014. <http://www.bcauditor.com/pubs/2010/report8/audit-management-groundwater-resources-british-columbia>.
- Office of the Chief Medical Officer of Health. 2012. *Chief Medical Officer of Health's Recommendations Concerning Shale Gas Development in New Brunswick*. New Brunswick Department of Health. Accessed September 30, 2014. [http://www2.gnb.ca/content/dam/gnb/Departments/h-s/pdf/en/HealthyEnvironments/Recommendations\\_ShaleGasDevelopment.pdf](http://www2.gnb.ca/content/dam/gnb/Departments/h-s/pdf/en/HealthyEnvironments/Recommendations_ShaleGasDevelopment.pdf).
- Oil and Gas Commission (OGC). 2012. "Montney Formation Play Atlas NEBC." BC Oil and Gas Commission. Accessed September 29, 2014. <https://www.bcogc.ca/node/8131/download>.
- Ontario Water Works Association. 2014. "Source Water Protection Committee." Accessed September 30, 2014. <http://www.owwa.ca/committees/source-water-protection-committee/>.
- Osborn, S. G., Vengosh, A., Warner, N. R., & Jackson, R. B. 2011. Methane Contamination of Drinking Water Accompanying Gas-Well Drilling and Hydraulic Fracturing. *Proceedings of the National Academy of Sciences* 108(20), 8172–76.

- Parfitt, Ben. 2010. *Fracture Lines: Will Canada's Water be Protected in the Rush to Develop Shale Gas?* University of Toronto Monk School of International Affairs, Toronto, Canada. Accessed September 29, 2014. <http://powi.ca/wp-content/uploads/2012/12/Fracture-Lines-Will-Canadas-Water-Be-Protected-in-The-Rush-to-Develop-Shale-Gas-20101.pdf>.
- Parfitt, Ben. 2011. *Fracking Up Our Water, Hydro Power and Climate: B.C.'s Reckless Pursuit of Shale Gas*. Vancouver: Canadian Centre for Policy Alternatives, BC Office. Accessed September 29, 2014. [https://www.policyalternatives.ca/sites/default/files/uploads/publications/BC%20Office/2011/11/CCPA-BC\\_Fracking\\_Up.pdf](https://www.policyalternatives.ca/sites/default/files/uploads/publications/BC%20Office/2011/11/CCPA-BC_Fracking_Up.pdf).
- Parks, Kevin. 2013. *Shale-Gas Development, Hydraulic Fracturing, and Water in Alberta: AER's Regulatory Program*. Alberta Energy Regulator. October 29, 2013. Accessed September 29, 2014. <http://www.synergyalbertaregistration.ca/conference/2013/downloads/presentations/WaterPanelKParks.pdf>.
- Patterson, Brent. 2014. "Colorado Campaign on Community's Right to Ban Fracking." Vancouver Island Water Watch Coalition. Accessed September 30, 2014. [http://www.vancouverislandwaterwatchcoalition.ca/go1763a/Right\\_to\\_Ban\\_Fracking](http://www.vancouverislandwaterwatchcoalition.ca/go1763a/Right_to_Ban_Fracking).
- Ross, S. 2014. "Mi'kmaq Unanimous in Opposition to Fracking." *Herald News*. August 12, 2014. Accessed September 30, 2014. <http://thechronicleherald.ca/novascotia/1228780-mi-kmaq-unanimous-in-opposition-to-fracking>.
- Schindler, D.W., and W.F. Donahue. 2006. "An Impending Water Crisis in Canada's Western Prairie Provinces." *Proceedings of the National Academy of Sciences* 103(19): 7210–7216.
- Schroeck, Nicholas, and Stephanie Karisny. 2013. Hydraulic Fracturing and Water Management in the Great Lakes. *Case Western Reserve Law Review* 63(4): 1166–1186.
- Schwartz, Daniel, and Mark Gollom. 2013. N.B. Fracking Protests and the Fight for Aboriginal Rights. October 19, 2014. CBC News. Accessed September 30, 2014. <http://www.cbc.ca/news/canada/n-b-fracking-protests-and-the-fight-for-aboriginal-rights-1.2126515>.
- Shingler, Benjamin. 2013. "Emails Show Federal Officials Worried about Second Idle No More Movement." August 17, 2014. Canadian Press. Accessed on October 3, 2014 <http://www.ctvnews.ca/politics/emails-show-federal-officials-worried-about-second-idle-no-more-movement-1.1963194>.
- Sierra Club Canada. n.d. "Sierra Club Congratulates Inverness County, Nova Scotia, for Passing Historic Fracking Ban." Sierra Club Canada. Accessed September 30, 2014. <http://www.sierraclub.ca/en/node/5957>.
- U.S. Department of Energy (USDE). 2013. *Technically Recoverable Shale Oil and Shale Gas Resources: An Assessment of 137 Shale Formations in 41 Countries Outside the United States*. U.S. Energy Information Administration Accessed October 3, 2014. <http://www.eia.gov/analysis/studies/worldshalegas/pdf/fullreport.pdf>
- Vlavianos, Nickie. 2012. "A Single Regulator for Oil and Gas Development in Alberta? A Critical Assessment of the Current Proposal." *Resources* 113: 1–10.

Water Canada. 2014. "First Nova Scotia Watershed Assessment, Geodatabase, and Atlas Released." March 28, 2014. Water Canada. Accessed September 30, 2014. <http://watercanada.net/2014/first-nova-scotia-watershed-assessment-geodatabase-and-atlas-released>.

West Coast Environmental Law. 2014. "The Strengths and Weaknesses of the New Water Sustainability Act." March 14, 2014. Accessed September 29, 2014. <http://wcel.org/resources/environmental-law-alert/strengths-and-weaknesses-new-water-sustainability-act>.

Wingrove, Josh, and Dawn Walton. 2010. "Once-in-a-Generation Drought Creates Water Crisis in Alberta." *Globe and Mail*. April 12, 2010. Accessed October 4, 2014. <http://www.theglobeandmail.com/news/national/once-in-a-generation-drought-creates-water-crisis-in-alberta/article4352684/>.

Wohlberg, Meagan. 2014a. "ConocoPhillips Won't Fund Sahtu Winter Drill Program." *Northern Journal*. April 14, 2014. Accessed September 30, 2014. <http://norj.ca/2014/04/conocophillips-pulls-funds-for-sahtu-winter-drill-program/>.

Wohlberg, M. 2014b. "Tlicho Lawsuit Won't Stop Devolution Bill: Ottawa." *Northern Journal*. February 17, 2014. Accessed October 4, 2014. <http://norj.ca/2014/02/tlicho-lawsuit-wont-stop-devolution-bill-ottawa/>.