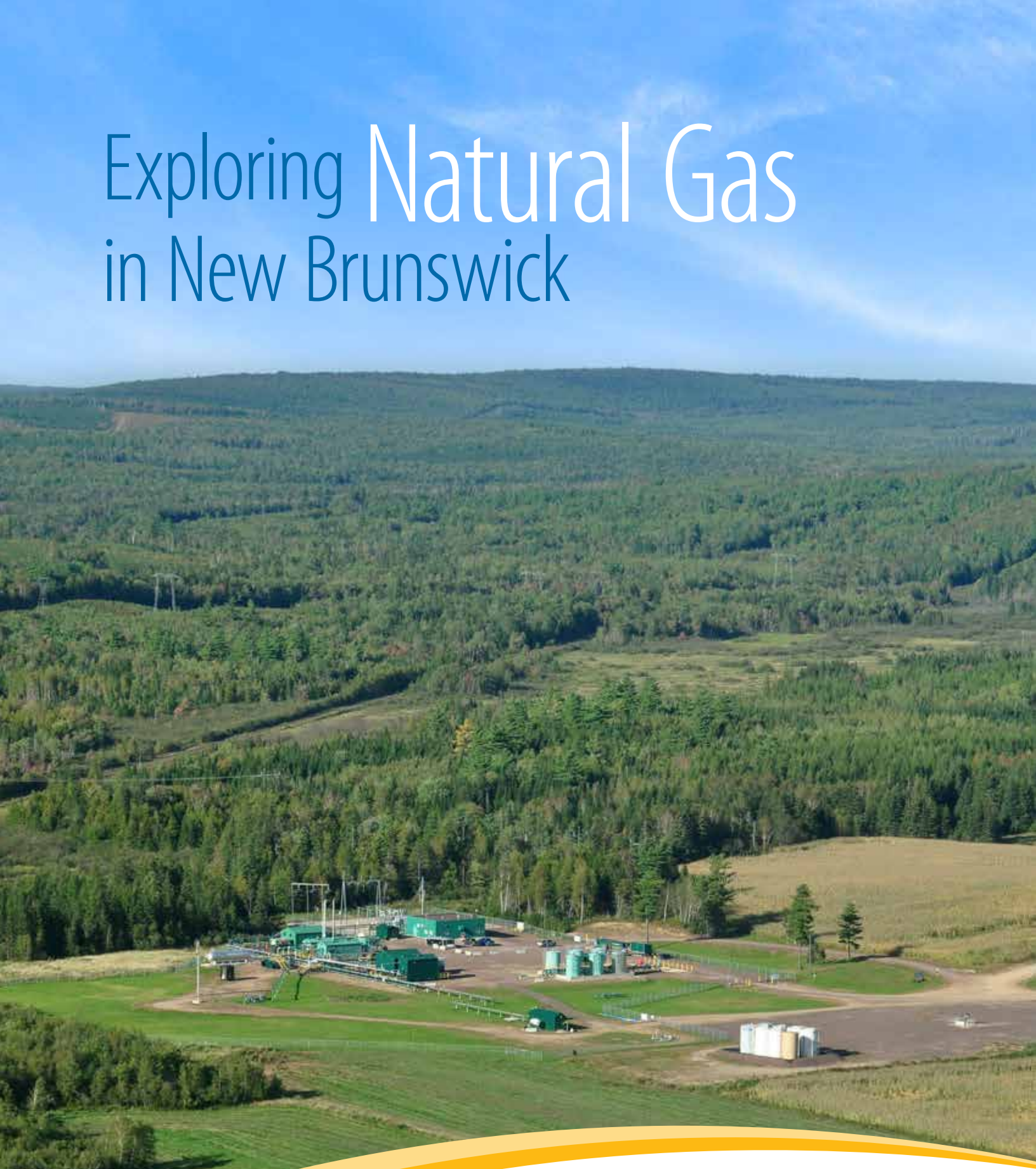
Exploring Natural Gas in New Brunswick



New Nouveau Brunswick
CANADA

Exploring Natural Gas in New Brunswick

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Cover photo: Corridor Resources natural gas compression station near Sussex, N.B.
Credit: Lori Byers

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Introduction

New Brunswick's potential in the oil and gas sector is immense. Studies performed on deposits in the southern areas of the province have shown that our potential rivals that of major oil and gas producing jurisdictions.

Sable Island has been the main source of natural gas for the Maritimes over the past decade and demand has grown over that time. In 2012, total gas consumption in the Maritimes represented 90% of the regional supply and, as a result, when there are production disruptions, demand exceeds supply.

There will be substantial costs to our province, primarily in the form of increasing energy prices, if we do not take advantage of our natural gas resources. Conversely, there will be substantial benefits to our province if we do.

New Brunswick needs a long-term and stable source of natural gas. Current industry activity in the province proves that we have a resource that can be developed safely and economically.

The development of natural gas in New Brunswick will create jobs. It will create revenues for services we require such as education, health care and infrastructure. It will stimulate economic development. Most importantly, it will be done in a manner that will be safe and sustainable for the environment.

There has been a great deal of regulatory progress in New Brunswick with the development of new *Rules for Industry* in the oil and gas sector, as well as a new *Oil and Natural Gas Blueprint* that will help provide policy guidance for the province in the years to come.

The following pages present the most current information about this sector as part of the province's ongoing dialogue with New Brunswickers.

More information about the natural gas industry is also available at: www.gnb.ca/energy

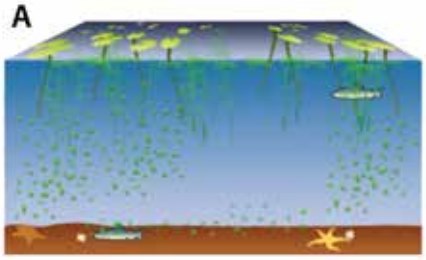
The creation of natural gas in New Brunswick

About 350 million years ago, the landmass we know today as New Brunswick had a tropical climate. As the continents pulled apart over millions of years, parts of the Earth's crust settled and this led to the creation of lakes in what is now southern New Brunswick.

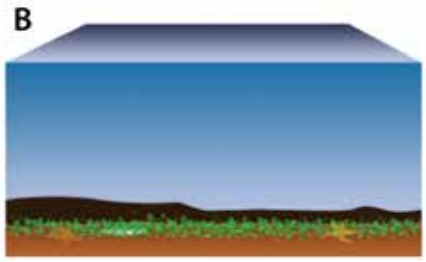
Organic matter and sediment were deposited in these ancient lakes, and over millions of years the organic matter and sediment layers were buried, resulting in higher temperatures and pressures with increasing depth. This increase in pressure and temperature converted the layers of sediment and organic matter into oil and natural gas within the organic shale deposits. In New Brunswick, these shale deposits are generally found two kilometres or more below the ground.

Organic shale formations, while rich in oil and gas, are difficult to develop because the oil and gas are trapped within the rock and do not easily flow. As a result, shale formations require hydraulic fracturing to allow oil and gas to flow.

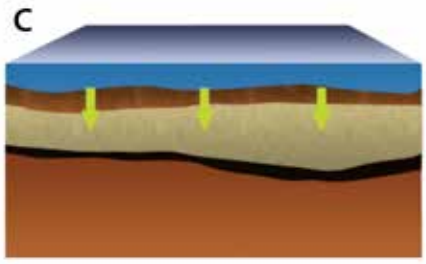
Technological advancements, including the use of horizontal drilling with hydraulic fracturing (individual technologies that have existed for decades and have been used together for the past 15 years), have paved the way for the safe and economical development of shale gas.



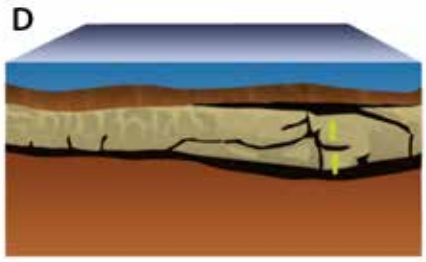
Organic matter and sediment in the water column



Accumulation of sediment and organic matter on lake bottom



Burial under increasing layers of sediment, increased heat and pressure



Shale rock created

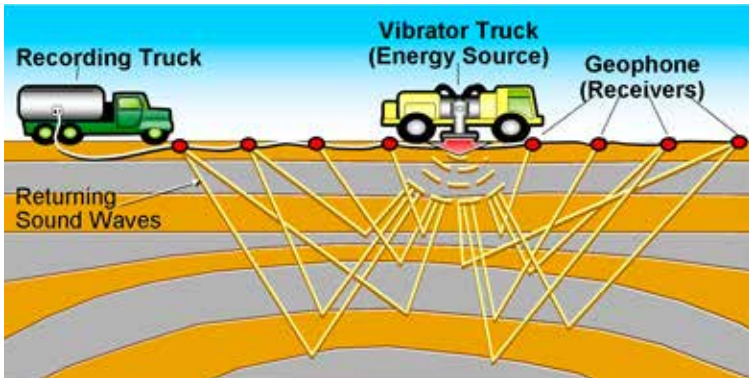
Natural gas exploration and development in New Brunswick

While it is known that there is natural gas in New Brunswick, we must determine if it can be extracted in an economical manner. There are a number of steps that must be followed to determine if an expanded natural gas industry is viable in our province.

1) Geophysical exploration

Exploration for natural gas begins with the review of maps and reports about the geology of an area's underground rock formations. Once exploration sites are identified, companies must obtain the proper licences and permits required as well as acquire access to land in order to conduct geophysical exploration.

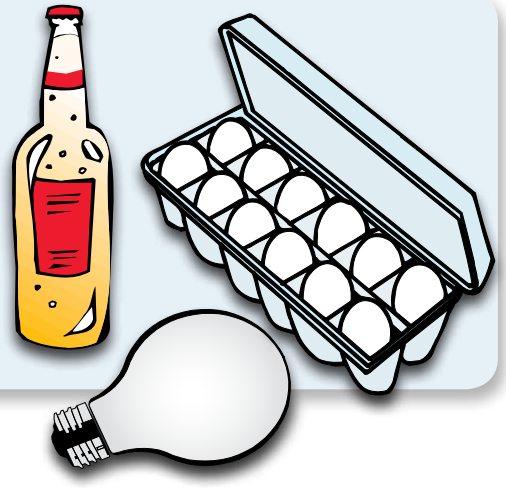
Seismic testing



Seismic testing uses energy waves to map rock layers below the earth's surface. This helps to identify geological formations that could contain natural gas. Seismic testing is conducted by using an energy source to generate energy waves that are sent into the earth. As the waves reflect from different rock types back to surface, they are measured to determine the depth of the various formations. The energy source can be created by vibrating the ground using specially designed trucks (i.e. vibroseis), or by using small explosive charges placed in the ground.

Does seismic testing have any environmental impact?

In an experiment held at Vauxhall, Alberta, eggs, light bulbs and beer bottles were buried at close range to standard seismic shot holes containing one kilogram of explosive (similar to the charges used in New Brunswick oil and gas exploration). Packed in the wet earth, the eggs, light bulbs and beer bottles were unharmed in six explosions ranging from 12.2 metres to 26.6 metres from the charge.



The rules for oil and gas companies in New Brunswick stipulate the setbacks required for seismic testing based on how far the energy waves can travel given the size and type of energy source. For example, a seismic charge of one kilogram would have no impact on anything outside a radius of five metres from the charge while a 10 kilogram charge can be detonated safely 24 metres from a fragile structure. Under New Brunswick's rules, seismic charges can only be detonated 180 metres or further from any residential structure or building.

Is seismic testing allowed to take place in provincially significant wetlands?

Seismic testing is not allowed to occur in wetlands having provincial, national or international importance. Outside of provincially significant wetlands, activity is allowed, but only under conditions prescribed by a Watercourse and Wetlands Alteration Permit (WAWA). Over 1,200 WAWA permits were issued in New Brunswick last year to allow for activities such as forestry, road building and subdivision development while minimizing the impact on the environment.

2) Drilling

Following seismic testing, companies often drill exploratory or stratigraphic wells. These types of wells are drilled vertically and allow for a better understanding of the geology of the exploration area. The rock cores collected from the wells provide samples of the various rock layers and give additional insight into the area's potential resources.

Following analysis, if it is confirmed that the area has natural gas and it can be extracted in an economically-viable way, companies will, upon receiving the necessary permits, begin drilling production wells.

Much confusion surrounding shale gas has been due to the term "hydraulic fracturing" being mistakenly applied to the entire well development process. In fact, long before hydraulic fracturing takes place, the site must be prepared and the well must be drilled.

Preparing a site can include the construction of roads to the well pad and the grading of the area where the equipment will be placed. Well pads and roads must be built in a manner that will prevent erosion and sedimentation and maintain drainage.

From the start of drilling, the primary focus is on the protection of fresh groundwater. As the drill bit moves through these water-bearing zones, fresh water is pumped down the drill pipe and back up the outside of it to lift and remove rock fragments from the wellbore. By doing this, a thin layer of mud is left along the wellbore walls to help isolate the wellbore from fresh-water-bearing zones, ensuring any disturbance of groundwater is minimized until a permanent barrier is installed.

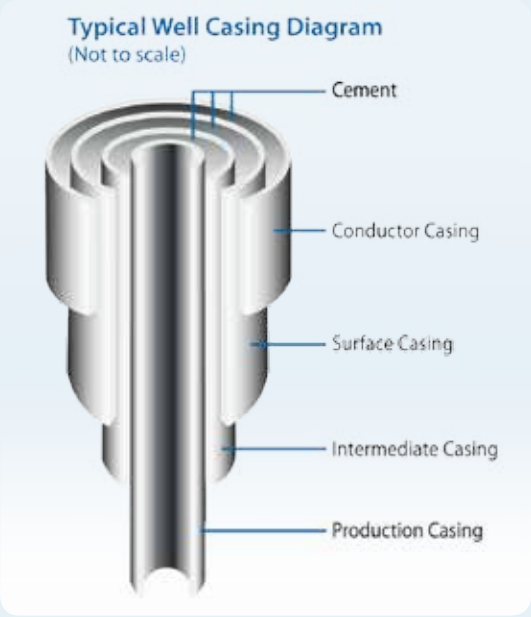
Once the well depth is below the deepest fresh water-bearing zone, a steel casing is installed and cemented into place by pumping cement down the centre of the wellbore and back up the outside of the casing, isolating the well from the surrounding rock and groundwater. Steel casings of diminishing diameter are installed inside the initial casing as the well is drilled to deeper depths and a protective layer of cement is placed between each casing.

Once hardened, each casing's protective layer of cement is evaluated for properties such as quality, alignment and integrity. Drilling only resumes once the cement has hardened and the surface casing and subsequent casings have passed a pressure test. Each of these layers also provides an additional level of groundwater protection.

Natural gas wells can be drilled vertically or horizontally depending on the area's geological formation. Vertical wells are drilled to the shale formation and a final casing is cemented in place. Horizontal wells are drilled to a specific depth above the targeted area of the shale formation. The drill then continues to move horizontally for hundreds of metres, after which the final casing is cemented in place and run to the end of the wellbore. It takes between 15 to 30 days of continuous drilling to complete a horizontal well.

How safe are gas wells over the long term?

Wells are constructed with multiple barriers of steel and cement to ensure their integrity. In addition, they are vented to allow any leaks to move vertically through the space between outer casings, rather than into groundwater. The venting is monitored to detect leaks, which can be repaired by measures such as remedial cementing.



3) Hydraulic fracturing

Hydraulic fracturing has been used by the oil and gas industry since 1949 and has modernized to become a key element of oil and natural gas development worldwide. In fact, this process is used in nearly all oil and natural gas wells drilled in North America today. Properly conducted, hydraulic fracturing is a safe, sophisticated, highly engineered and controlled procedure.

Once the well has been drilled to the required depth and the casing is cemented in place, the casing within the part of the well that passes through the shale formation far below the surface is perforated, creating small openings between the shale formation and the wellbore.

Next, a mixture of fluid, sand and additives are injected into the well under high pressure to fracture the shale, which releases the natural gas from the rock and allows it to flow to the well bore under its own pressure.

Hydraulic fracturing is monitored to protect human health and safety. Once completed and tested, a well will then be capped temporarily while pipelines and other production equipment are put into place.

4) Production and development

Drilling and hydraulic fracturing of the well typically takes up to a couple of months depending on the well depth. Once this is complete, the majority of the surface equipment is removed from the well pad and the site is prepared for production.

Completed gas well and processing station in Pennsylvania (photo courtesy Chesapeake Energy)

One misconception about shale gas wells is that they have a short life. This is not the case. While the gas produced by a new well is certainly at its peak soon after production begins, wells typically continue to produce an economically viable quantity of gas for anywhere from 10 to 20 years after production begins. When the well's production has ceased or has declined below economic levels of recovery, it will be abandoned. Abandonment activities require regulatory review and approval and require the operator to ensure the well is properly plugged and capped in order to eliminate any flow.

Following well abandonment, the well pad is reclaimed and restored. The site will be restored to its original elevation and the original vegetation (grass, trees, crops, etc.) will be planted.

Production from shale gas wells will provide provincial revenue from royalties that will help ensure services such as health and social programming are available to New Brunswickers when they need them.

A June 2013 study by the accounting firm Deloitte confirmed the significant positive impact that gas production could have for New Brunswick. It identified the direct investment for one well to be $13 million along with indirect and induced spending of $8 million. This spending represents supply opportunities for local businesses and also provides the opportunity for new businesses to be created, generating more jobs for New Brunswickers.

How much might the natural gas industry be worth to New Brunswick?

The value of the industry will be dependent on the number of wells developed, but under a moderate activity level of 50 wells per year, there would be approximately $600 million in direct investment annually. Over a 20-year period, the industry at this moderate level would result in $13 billion of direct investment with an additional $8 billion in indirect and induced investment.

Royalties paid to the province are dependent on market prices, but based on price forecasts, 50 wells per year would provide approximately $1 billion in royalty payments over a 20-year period. In addition, corporate, income and sales taxes from the industry would provide further revenues to the province.

How much land would a shale gas industry use?

The average well pad is four acres in size (approximately two soccer fields). A well pad can host multiple wells with an average-sized multi-well pad containing six to eight. A moderate drilling program of 50 wells per year would require approximately 30 acres of land for well pads. A 20-year program developed at the same rate would require 600 acres for well pads. As a comparison, this is equal to two average-sized farms in New Brunswick. Once production ceases, the land occupied by well pads will be returned to its original state.

A Corridor Resources well pad in New Brunswick during the production phase. Outlines of soccer fields shown for size comparison.

And just how many jobs will the shale gas industry bring to New Brunswick?

The Deloitte study found that each well would require approximately 160 workers for varying periods of time, equating to 21 full-time equivalent (FTE) jobs. With a moderate drilling program of 50 wells per year, over 1,000 FTE positions could be created annually as a direct result of the development.

5) Health and environment

Any industrial process in New Brunswick is required to follow strict environmental requirements and the oil and gas industry is no different. The provincial government believes the most effective way of protecting the environment and the health of New Brunswickers is through effective and stringent requirements, and, as such, introduced in 2013 new rules for the oil and gas industry. They include measures such as additional well protection, improved water management and increased environmental monitoring.

Natural gas is a cleaner burning fuel than heating oil or coal, and by increasing our supply and usage, our province will be better able to reduce our overall greenhouse gas emissions. A domestic source of natural gas could lead to increased use of natural gas in vehicles and home heating, as well as in industrial activities, which could further stimulate the establishment of large industries in New Brunswick. Electricity generation with gas could reduce the use of coal and heating oil in the region and pave the way for renewable generation.

The increased use of natural gas in the United States has actually contributed to a reduction in that country's overall greenhouse gas emissions over the past five years.

Human and environmental health are priorities for New Brunswickers, which is why the province has taken measures to protect our water, land and air in order to gain the many benefits that a natural gas industry could provide to our province.

What about shale gas emissions?

Methane, the primary component of natural gas, is 21 times more potent as a greenhouse gas (GHG) than carbon dioxide, the most common GHG, if released into the atmosphere. However, when burned, methane produces half the GHG emissions of coal, which is why it is cleaner than other fossil fuels. Ensuring methane is captured in the production process is important to ensure that the GHG benefits of this cleaner fuel are realized. Multiple studies have shown that GHG emissions from shale gas development are only half of what they are from coal. The displacement of coal by natural gas in energy production has led to a significant decrease in emissions in the United States over the past five years.

6) Rules, regulations and legislation

The regulation of the oil and gas industry in New Brunswick is enabled by legislation that includes the *Clean Water Act*, the *Clean Air Act*, the *Occupational Health and Safety Act*, the *Pipeline Act* and the *Oil and Natural Gas Act*. New Brunswick's *Rules for Industry*, which were introduced in 2013, set out the operational requirements for companies within the industry. These are enforced by a team of inspectors that work in the Department of Energy and Mines, the Department of Environment and Local Government, the Department of Public Safety, WorkSafeNB and the Energy and Utilities Board.

Lists of the various permits and acts that pertain to each stage of the natural gas exploration and development process are included as an appendix.

The provincial government has also created the New Brunswick Energy Institute, an independent organization drawing on expertise in fields such as hydrogeology, groundwater management, public health, geology, engineering and traditional knowledge. The institute will review and assess the environmental, social, economic and health issues relating to the development of energy within New Brunswick, with the aim of providing scientific information to the public on these topics. This information will allow government to ensure the rules and regulations keep pace with technological advances in the industry and will help inform future policy decisions.

Photo credit: Brian Atkinson

Hydraulic fracturing questions and answers

1) Why do companies use this process?

Natural gas will not readily flow to a wellbore drilled through shale because it is trapped in small pores in the rock. Shale is much less permeable than other types of rock (the more permeable a type of rock is, the easier the natural gas will flow to the wellbore). Hydraulically fracturing the shale creates a higher permeability, which allows the gas to flow more easily.

2) Will hydraulic fracturing use a lot of water and deplete our water resources?

Based on current activity in the province, each New Brunswick shale gas well could require up to 20 million litres of water for water-based hydraulic fracturing. While that may sound like a lot, it is only 0.00025% of the 80 trillion litres of rain that falls on New Brunswick each year. New Brunswick has and will continue to have an ample water supply for people, ecosystems and industry, including natural gas development.

Will industry always be using fresh water for hydraulic fracturing?

No. In fact, some wells already use alternative fluids such as propane for the hydraulic fracturing process. If water is used, proponents will be required to demonstrate why they are unable to use treated/recycled wastewater from municipal or industrial sources (including flowback and produced water from oil or gas wells), ocean water, or non-potable groundwater water in their process before they are allowed to use freshwater resources. Additionally, industry will be required to follow a water management plan, which will include an assessment of the impact the water withdrawal will have on the source. Water quality monitoring is also required.

3) What about the additives that are used? Isn't fluid migration a risk to our water?

No. With thousands of shale gas wells completed with hydraulic fracturing, there has never been a documented case of the additives used in the process migrating naturally from the shale formation to the groundwater. In New Brunswick the shale formation is approximately two kilometres below the surface, providing ample protection for groundwater. The two kilometres between the shale formation and the surface contains multiple layers of rock formations, which would make the upward migration of additives from the shale formation to groundwater all but impossible.

What additives are used and will we know what they are?

The graphic below breaks down a typical composition of fracture fluids. Additives used in the hydraulic fracturing process are commonly found in many household products used on a daily basis. More importantly, New Brunswick has made the full disclosure of all additives used in the hydraulic fracturing process mandatory for all oil and gas development.

Other <2%

Acid
Used in swimming pools

Anti-bacterial Agent
Used in disinfectants

Breaker
Used in hair colour

Clay Stabilizer
Used in intravenous (IV) fluids

Corrosion Inhibitor
Used in plastics

Crosslinker
Used in laundry detergents

Friction Reducer
Used in cosmetics

Gelling Agent
Used in toothpastes

Iron Control
Used in food additives

pH Adjusting Agent
Used in many bar soaps

Scale Inhibitor
Used in household cleaners

Surfactant
Used in deodorant

4) Where does all of that water go? Where do the additives and sand go?

Following the hydraulic fracturing process, the proppant (a solid material, typically sand, designed to keep an induced hydraulic fracture open once the pressure is released), some of the water and additives are absorbed into the shale. To what extent this occurs depends on the shale's characteristics. For example, certain clay minerals found in shale can absorb water, which causes the clay to expand, closing off the fractures that the hydraulic fracturing fluid created. This has led to the use of non-water-based fluids such as liquid propane.

The remaining fluid returns to the surface and is captured and directed to storage tanks. The fluid is then recycled and reused in future hydraulic fracturing processes. Water-based fluids may be treated at a licensed water treatment facility to meet provincial and federal water quality standards and released.

Where will flowback water be treated?

Treatment facilities exist in neighbouring provinces, but if exploration determines the potential for the industry is significant, it is likely that industry investment would occur to develop the necessary capacity here at home. New Brunswick's *Rules for Industry* require that a waste water management plan be approved prior to any hydraulic fracturing being permitted. This means that an acceptable solution must be in place before any waste water is produced.

The facts about shale gas

Much misinformation about shale gas continues to circulate in the public domain. Below are some of the often repeated claims that, upon further review and research, are found to be out of context or unable to withstand scientific scrutiny.

While there are clearly differing opinions about shale gas, even within the academic world, it is important that New Brunswickers have a balanced view of the industry and let facts and science guide their decision-making.

Claim – *Oil and gas wells have failure rates of 5% in their first year and up to 50% within 20 years.*

Fact – The above numbers are contained in a 2003 magazine article about offshore wells in the Gulf of Mexico[1]. The study discussed "sustained casing pressure (SCP)", which occurs when pressure builds in the open space between two casings. The use of the term "failure" in this situation is misleading, as SCP does not necessarily mean that there is a leak outside of the well.

Studies performed on wells drilled and completed in Ohio and Texas by the Groundwater Protection Council[2] in 2011 found the percentage of wells that experienced failures over a 15 year period were 0.03% and 0.01% respectively. Detection and monitoring is the most important aspect of well integrity because once SCP is detected, it can be corrected.

Claim – *Natural gas from shale emits more greenhouse gas (GHG) than coal.*

Fact – This claim originated from a study[3] that stated that large amounts of gas from wells were simply vented into the atmosphere. This study has been refuted by numerous institutions, including the Massachusetts Institute of Technology (MIT)[4], Carnegie Mellon University[5], the U.S. Department of Energy[6] and Cornell University[7]. In fact, the United States has become a world leader in reducing GHG emissions – the International Energy Agency has stated that "In the United States, a switch from coal to gas in power generation helped reduce emissions by 200 million tonnes (Mt), bringing them back to the level of the mid-1990s."[8]

1 Schlumberger , September 2003: http://www2.gnb.ca/content/dam/gnb/Departments/en/pdf/Publications/MudCement2003.pdf

2 Ground Water Protection Council, August 2011: http://www.gwpc.org/sites/default/files/State%20Oil%20%26%20Gas%20Agency%20Groundwater% 20Investigations.pdf

3 Cornell University, June 2011: http://thehill.com/images/stories/blogs/energy/howarth.pdf

4 MIT, November 2012: http://iopscience.iop.org/1748-9326/7/4/044030/pdf/1748-9326_7_4_044030.pdf

5 Carnegie Mellon University, August 2011: http://iopscience.iop.org/1748-9326/6/3/034014/fulltext/

6 U.S. Department of Energy, October 2011: http://www.netl.doe.gov/energy-analyses/pubs/NG-GHG-LCI.pdf

7 Cornell University, October 2011: http://download.springer.com/static/pdf/112/art%253A10.1007%252Fs10584-011-0333-0.pdf? auth66=1390761766_14cf8a0d016848a2ed99f4d8c3aeb646&ext=.pdf

8 International Energy Agency, 2013: http://www.iea.org/media/freepublications/executivesummary/WEO2013_Climate_Excerpt_ES_WEB.pdf

Claim – *Shale gas wells cause air quality problems.*

Fact – Various studies and reports have been used to make the claim that shale gas wells can cause air quality issues in the areas surrounding them. However, most of the studies cited for this claim are based on very small samples taken over short periods of time and therefore make assumptions regarding the long term outcomes. In other cases, claims of poor air quality have been disproved once they have been systematically investigated. This has been the case with numerous studies[9, 10] from the Barnett Shale formation in Texas in which researchers concluded that the air quality in the development area was the same as the rest of the state, despite claims by some residents.

With an issue as important as air quality, it is essential to ensure that we are using correct and pertinent data. The required monitoring of development sites and the work of the New Brunswick Energy Institute will both provide New Brunswickers with data to ensure that air quality standards are met.

Claim – *Shale gas wells contaminate water wells.*

Fact – This statement is often used while making two different claims.

The first is that additives from the hydraulic fracturing process can find their way naturally into the water table. This is simply not true. Study[11] after study[12] has found that additives from fracturing fluids do not migrate from the shale formation into groundwater sources. The U.S. Department of Energy has stated that "In fact, based on over sixty years of practical application and a lack of evidence to the contrary, there is nothing to indicate that when coupled with appropriate well construction; the practice of hydraulic fracturing in deep formations endangers ground water."[13]

The second claim is that natural gas itself will migrate into groundwater sources. Recently, a Duke University study[14] found that water wells near gas wells had a greater chance of elevated methane levels than water wells not in the proximity of gas development. However, no baseline study was performed to determine if there was methane in the water prior to drilling. This is an important omission, since two recent studies from the U.S. Geological Survey (USGS)[15] and the American Association of Petroleum Geologists[16] also found methane in water wells, but in areas where gas drilling had not taken place, indicating that methane is often naturally present in water. In addition, studies from Pennsylvania[17] and Arkansas[18] found no methane present in water wells or groundwater due to shale gas development. New Brunswick rules require water testing in order to create a pre-activity water quality baseline.

9 Texas Department of State Health Services, May 2010: http://www.dshs.state.tx.us/epitox/consults/dish_ei_2010.pdf

10 Texas Commission on Environmental Quality, 2010: http://www.tceq.state.tx.us/publications/pd/020/10-04/a-commitment-to-air-quality-in-the-barnett-shale

11 Ground Water Protection Council, August 2011: http://www.gwpc.org/sites/default/files/State%200il%20%26%20Gas%20Agency%20Groundwater% 20Investigations.pdf

12 Duke University, University of Rochester, and California State Polytechnic University, June 2013: http://www.pnas.org/content/early/2013/06/19/1221635110.full.pdf

13 U.S. Department of Energy, May 2009: http://www.gwpc.org/sites/default/files/state_oil_and_gas_regulations_designed_to_protect_water_resources_0.pdf

14 Duke University, University of Rochester, and California State Polytechnic University, June 2013: http://www.pnas.org/content/early/2013/06/19/1221635110.full.pdf

15 U.S Geological Survey, June 2013: http://pubs.usgs.gov/sir/2013/5085/

16 Bulletin of the American Association of Petroleum Geologists, February 2014: http://archives.datapages.com/data/bulletns/2014/02feb/BLTN12178/BLTN12178.htm

17 Pennsylvania State University/ The Center for Rural Pennsylvania, March 2012: http://www.rural.palegislature.us/documents/reports/ Marcellus_and_drinking_water_2012.pdf

18 U.S. Geological Survey, January 2013: http://pubs.usgs.gov/sir/2012/5273/

Claim – *Public health risks related to shale gas development are unknown.*

Fact - Many reports and studies, including one from Public Health England[19], have found that the risks to public health from exposure to emissions from shale gas extraction are low, as long as operations are properly run and regulated. New Brunswick's rules are very stringent and cover all key aspects of public health including air emissions, water quality and noise levels.

Claim – *Shale gas development will cause damage to our roads.*

Fact – It is true that increased truck traffic as a result of natural gas development could put more stress on our road system. That is why New Brunswick's *Rules for Industry* require that a traffic analysis of the development area must be performed and submitted to the Department of Transportation and Infrastructure (DTI) prior to any activity. Proponents will fund the analysis and review the results with DTI to determine the appropriate contribution to any repair costs that may be required. This approach is consistent with other jurisdictions where there has been natural gas development. For example, in Pennsylvania[20], industry has invested over $300 million repairing and improving roads since 2010.

Claim – *We don't know what additives are being used in the hydraulic fracturing process in New Brunswick.*

Fact – The *Rules for Industry* require full disclosure of all additives to the Department of Environment and Local Government.

Claim - *New Brunswick does not have enough inspectors to enforce the rules and regulations.*

Fact – New Brunswick currently has approximately 45 producing oil and natural gas wells. There are currently three individuals within the Department of Energy and Mines with the expertise to monitor and inspect oil and gas wells. The Department of Environment and Local Government has 40 staff members who perform a number of enforcement and inspection-related duties for oil and gas operations, such as: water protection officers, engineers, compliance and enforcement investigators and regional inspectors who are equipped to perform air and water inspections in support of New Brunswick's *Rules for Industry.* There are also over 10 inspectors in the Department of Public Safety for specialized equipment (welding, boilers, natural gas equipment) and over 30 inspectors at WorkSafeNB for worker safety.

New Brunswick's current ratio of wells to inspectors is approximately 1:2. This compares favourably to recent ratios in other jurisdictions such as Ohio (1300:1 in 2013), Colorado (5000:1 in 2011) and North Dakota (500:1 in 2011). These numbers make it clear that New Brunswick is well positioned for strong inspection and enforcement of our oil and gas rules and regulations.

19 Public Health England, October 2013: http://www.hpa.org.uk/webc/HPAwebFile/HPAweb_C/1317140158707

20 The Daily Review, June 2012: http://thedailyreview.com/news/chesapeake-energy-announces-upcoming-roadwork-in-northern-pa-1.1331625

New Brunswick's rules – how do they compare?

In February 2013, New Brunswick released a document entitled *Responsible Environmental Management of Oil and Natural Gas Activities in New Brunswick – Rules for Industry*.

The chart below compares New Brunswick's *Rules for Industry* as they relate to often cited areas of concern with two other Canadian jurisdictions that have an active oil and gas industry: British Columbia and Alberta. This chart is up-to-date as of July 2014.

Requirement	**British Columbia**	**Alberta**	**New Brunswick**
Well construction requirements - double walled barriers	Not specified	Any new wells can be either doubled walled or may be single walled with increased monitoring and reporting requirements	Initial well in a new setting must have double walled steel barriers (two layers of steel) throughout the well
Setbacks for oil and gas wells	Dwellings –100 m Schools –100 m Hospitals –100 m	Dwellings –100 m Schools –100 m Hospitals –100 m	Dwellings – 250 m Schools – 500 m Hospitals – 500 m
Well water monitoring and testing near oil and gas activities	All well water must be tested before and after: Seismic testing – no requirements Drilling – no requirements Hydraulic fracturing – within a 200 m radius only if fracturing within 600 m of surface	Not specified	All well water must be tested before and after: Seismic testing – within a 200 m radius Drilling and hydraulic fracturing – within a 500 m radius from the well pad
Geological assessment prior to hydraulic fracturing	A Risk Assessment is required if fracturing operations are shallower than 600 m from the surface	A Risk Assessment is required if fracturing operations are within 100 m of groundwater	Companies must prepare an assessment to evaluate the geological formation's ability to prevent fluid migration and protect groundwater
Shallow hydraulic fracturing	Allowed with Risk Assessment	Allowed with Risk Assessment	Hydraulic fracturing is not allowed shallower than 600 m
Water use in hydraulic fracturing – preferred water sources	Options for water sources are provided, but preference of water source is not stated	Preference of water source is not stated	1) recycled wastewater (most preferred); 2) ocean water; 3) non-potable groundwater; 4) captured run-off water or rainwater; 5) lakes or watercourses; 6) potable groundwater (least preferred)
Fracture fluid disclosure to the regulator	All fracture fluid contents must be disclosed, but descriptive information can be limited for proprietary reasons	All fracture fluid contents must be disclosed, but descriptive information can be limited for proprietary reasons	All fracture fluid contents must be disclosed
Air quality monitoring	Companies must follow provincial emission reduction legislation	Companies must follow provincial emission reduction legislation	Companies must prepare, adopt and follow emissions management and greenhouse gas reduction plans
Noise level limits	Measured at the external wall of the nearest dwelling: Daytime – n/a Nighttime – 40 decibels	Measured at the external wall of the nearest dwelling: Daytime – n/a Nighttime – 40 decibels	Measured at the external wall of the nearest dwelling: Daytime – 50 decibels Nighttime – 40 decibels
Security and emergency planning	Companies are required to submit an emergency response plan	Companies are required to submit an emergency response plan	Companies are required to submit an emergency management program

Where New Brunswick's rules are more stringent than other jurisdictions

Where New Brunswick's rules are similar to other jurisdictions

Appendix

Geophysical exploration

Prior to any work by oil and gas companies, there is a thorough permitting process. Below are the permits, rules and regulations which govern exploration and development in the oil and gas industry in New Brunswick.

Legislation / Best practices

Department of Energy and Mines (DEM)
- *Oil and Natural Gas Act*

Department of Environment and Local Government (DELG)
- *Clean Environment Act*
- *Clean Water Act*

Department of Natural Resources (DNR)
- *Crown Lands and Forests Act*

Department of Transportation and Infrastructure (DTI)
- *Highway Act*

WorkSafeNB
- *Occupational Health and Safety Act*

Best Practices - Canadian Association of Geophysical Contractors (CAGC)

Key administrative requirements

DEM – Geophysical Exploration Licence
DEM – Geophysical Exploration Permit
DTI – District transportation engineer consent (work within any highway right of way)
DELG – Watercourse and Wetland Alteration Permit (WAWA)
WorkSafeNB – Blasting certification
WorkSafeNB – Register as an employer as required by the *Workers' Compensation Act*
DNR – Crown Land Licence of Occupation
DNR – Cutting permits and work permits
Public – Private land surface access agreements

Key operational requirements

Notification to occupants
Setbacks from structures
Pre- and post-activity water well testing
Shothole location identification
Shothole abandonment procedures
Progress reports
Final report and plan

Drilling

Legislation / Best practices

Department of Energy and Mines (DEM)
- *Oil and Natural Gas Act*

Department of Environment and Local Government (DELG)
- *Clean Environment Act*
  - Phased Environmental Impact Assessment
- *Clean Water Act*
- *Clean Air Act*
- *Community Planning Act*

Department of Natural Resources (DNR)
- *Crown Lands and Forests Act*

Department of Transportation and Infrastructure (DTI)
- *Highway Act*

Department of Public Safety
- *Boiler and Pressure Vessel Act*

WorkSafeNB
- *Occupational Health and Safety Act*

Responsible Environment Management of Oil and Natural Gas Activities in New Brunswick – Rules for Industry
- The *Rules for Industry* will be implemented as conditions to Approvals, Licences and Certificates of Determination issued under existing legislation including the *Oil and Natural Gas Act*, *Clean Environment Act*, *Clean Air Act* and the *Clean Water Act*.

Alberta Energy Regulator Directives as they relate to oil and gas drilling and completion

Best practices:
Drilling and Completions Committee: recommended technical operating practices
Enform Safety Council: Industry Recommended Practices
Canadian Association of Oilwell Drilling Contractors

Key administrative requirements

DEM – Licence to Search or Lease
DEM – Well Licence
DELG – Environmental Impact Assessment
DELG – Approvals to construct and operate, with conditions
DELG – Wetland and Watercourse Alteration Permit (WAWA)
DELG – Zoning Requirements
DNR – Crown Land Licence of Occupation
DNR – Cutting permits and work permits
DTI – Highway access and use permits
DTI – Special move permits
Public – Private land surface access agreements
DPS – Registration of designs of pressurized equipment
DPS – Inspection and issuance of certificates of inspection for operation of boiler and pressure vessel items

Key operational requirements

Public information sessions
Pre- and post-activity water well testing
Drilling setbacks
Blowout Prevention Systems (BOP)
Drilling fluids (water-based fluids on surface hole)
Surface casing setting depth requirements
Casing cementing
Casing pressure tests
Drilling commencement notification
Daily progress reports
Final operational reports

Hydraulic fracturing

Legislation / Best practices

Department of Energy and Mines (DEM) / Energy and Utilities Board (EUB)
- *Oil and Natural Gas Act*
- *Pipeline Act*

Department of Environment and Local Government (DELG)
- *Clean Environment Act*
  - Phased Environmental Impact Assessment
- *Clean Water Act*
- *Clean Air Act*
- *Community Planning Act*

Department of Natural Resources (DNR)
- *Crown Lands and Forests Act*

Department of Transportation and Infrastructure (DTI)
- *Highway Act*

Department of Public Safety
- *Boiler and Pressure Vessel Act*

WorkSafeNB
- *Occupational Health and Safety Act*

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Alberta Energy Regulator Directives as they relate to oil and gas drilling and completion

Best practices:
Drilling and Completions Committee: recommended technical operating practices
Enform Safety Council: Industry Recommended Practices
Canadian Association of Oilwell Drilling Contractors

Key administrative requirements

DEM – Licence to Search or Lease
DEM – Well Licence
DELG – Environmental Impact Assessment
DELG – Approvals to construct and operate, with conditions
DELG – Containment system plan approvals
DELG – Waste management plan approvals
DELG – Site rehabilitation plan approvals
DELG – Watercourse and Wetland Alteration Permit (WAWA)
DELG – Zoning requirements
DNR – Crown Land Licence of Occupation
DNR – Cutting permits and work permits
DTI – Highway access and use permits
DTI – Special move permits
DPS – Installation permits for boiler and pressure vessel items
DPS – Certificate of inspection for boiler and pressure vessel items
EUB – Permit to Construct Pipeline
EUB – Licence to Operate a Pipeline
Public – Private land surface access agreements

Key operational requirements

Public information sessions
Frac fluid disclosure
Blowout Prevention Systems (BOP)
Daily progress reports
Final operational reports

Production

Legislation / Best practices

Department of Energy and Mines (DEM) / Energy and Utilities Board (EUB)
- *Oil and Natural Gas Act*
- *Pipeline Act*

Department of Environment and Local Government (DELG)
- *Clean Environment Act*
  - Phased Environmental Impact Assessment
- *Clean Water Act*
- *Clean Air Act*
- *Community Planning Act*

Department of Natural Resources (DNR)
- *Crown Lands and Forests Act*

Department of Transportation and Infrastructure (DTI)
- *Highway Act*

Department of Public Safety
- *Boiler and Pressure Vessel Act*

WorkSafeNB
- *Occupational Health and Safety Act*

Responsible Environment Management of Oil and Natural Gas Activities in New Brunswick – Rules for Industry
- The *Rules for Industry* will be implemented as conditions to Approvals, Licences and Certificates of Determination issued under existing legislation including the *Oil and Natural Gas Act, Clean Environment Act, Clean Air Act* and the *Clean Water Act*.

Alberta Energy Regulator Directives as they relate to oil and gas drilling and completion

Best practices:
Enform Safety Council: Industry Recommended Practices
Canadian Association of Petroleum Producers: Best Management Practices
National Energy Board: Best Practices

Key administrative requirements

DEM – Licence to Search or Lease
DEM – Discovery well designation
DEM – Allowable production
DELG – Environmental Impact Assessment
DELG – Approvals to construct and operate, with conditions
DELG – Watercourse and Wetland Alteration Permit (WAWA)
DELG – Zoning requirements
DNR – Crown Land Licence of Occupation
DNR – Cutting permits and work permits
DTI – Highway access and use permits
DTI – Special move permits
EUB – Permit to Construct Pipeline
EUB – Licence to Operate a Pipeline
Public – Private land surface access agreements

Key operational requirements

Design Registration
Plan approval for gas fired equipment
Installation permits for gas fired equipment
Installation permits for boiler and pressure vessel items
Quality control manuals for installers
Inspections during installation
Production allowable
Production commencement notification
Monthly production volume reports
Monthly royalty statements
Blowout Prevention Systems (BOP)
Daily progress reports
Final operational reports

Reclamation

Legislation / Best practices

Department of Energy and Mines (DEM) / Energy and Utilities Board (EUB)
- *Oil and Natural Gas Act*
- *Pipeline Act*

Department of Environment and Local Government (DELG)
- *Clean Environment Act*
  - Phased Environmental Impact Assessment
- *Clean Water Act*
- *Clean Air Act*
- *Community Planning Act*

Department of Natural Resources (DNR)
- *Crown Lands and Forests Act*

Department of Transportation and Infrastructure (DTI)
- *Highway Act*

WorkSafeNB
- *Occupational Health and Safety Act*

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- The *Rules for Industry* will be implemented as conditions to Approvals, Licences and Certificates of Determination issued under existing legislation including the *Oil and Natural Gas Act*, *Clean Environment Act*, *Clean Air Act* and the *Clean Water Act*.

Alberta Energy Regulator Directives as they relate to oil and gas drilling and completion

Best practices:
Drilling and Completions Committee: recommended technical operating practices
Enform Safety Council
Canadian Association of Oilwell Drilling Contractors

Key administrative requirements

DEM – Licence to Search or Lease
DEM – Well abandonment
DEM – Suspend production
DELG – Environmental Impact Assessment
DELG – Approvals to construct and operate, with conditions
DELG – Site rehabilitation plan approvals
DELG – Zoning requirements
DNR – Crown Land Licence of Occupation
DTI – Highway access and use permits
DTI – Special move permits
EUB – Pipeline Abandonment
Public – Private land surface access agreements

Key operational requirements

Downhole abandonment
Surface abandonment (cut & cap)
Surface reclamation
Daily progress reports
Final operational reports