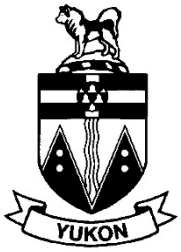


# Yukon Legislative Assembly

33rd Yukon Legislative Assembly

# Final Report of the Select Committee Regarding the Risks and Benefits of Hydraulic Fracturing

January 2015

January 19, 2015

The Honourable David Laxton, MLA
Speaker of the Yukon Legislative Assembly

Dear Mr. Speaker:

The Select Committee Regarding the Risks and Benefits of Hydraulic Fracturing, appointed by Order of the Assembly on May 6, 2013, as amended by Order of the House on November 18, 2013, May 1, 2014, and December 16, 2014, has the honour to present its Final Report, and commends it to the House.

I wish to take this time to thank all members of the Committee for their dedication to this process and their hard work, through many hours of travel, meetings and discussions.

Patti McLeod
Chair of the Committee
(MLA – Watson Lake)

# Select Committee on Risks and Benefits of Hydraulic Fracturing

## Members of the Committee:

Patti McLeod, Chair of the Committee, MLA (Watson Lake)

Lois Moorcroft, Vice-Chair of the Committee, MLA (Copperbelt South)

Hon. Currie Dixon, MLA (Copperbelt North)

Darius Elias, MLA (Vuntut Gwitchin)

Sandy Silver, MLA (Klondike)

Jim Tredger, MLA (Mayo-Tatchun)

### Clerk to the Committee:

Allison Lloyd, Clerk of Committees, Yukon Legislative Assembly

### Acting Clerk to the Committee:

Linda Kolody, Deputy Clerk, Yukon Legislative Assembly

### Researcher:

John Cole

## Acknowledgements

The Select Committee Regarding the Risks and Benefits of Hydraulic Fracturing would like to thank the many individuals and organizations who expressed their views to the Committee through written submissions, oral presentations and the Committee's public hearings. The Committee would also like to thank the staff of the Legislative Assembly Office for administrative, logistical, and procedural assistance.

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# Introduction

On May 6, 2013, the Yukon Legislative Assembly unanimously carried Motion No. 433, thereby establishing the Select Committee Regarding the Risks and Benefits of Hydraulic Fracturing (the Committee). The Committee's mandate, or purpose, is set out in the motion, and specifies that the Committee is to report its recommendations to the Legislative Assembly regarding a policy approach to hydraulic fracturing in Yukon that is in the public interest, including its findings and recommendations. The all-party Committee's mandate is broad and includes a number of interconnected responsibilities. The Committee decided upon a three-phased approach to fulfilling its mandate. Firstly, the Committee endeavoured to gain a science-based understanding of the technical, environmental, economic, and regulatory aspects of hydraulic fracturing, as well as Yukon's current legislation and regulations relevant to the oil and gas industry. Secondly, the Committee undertook to facilitate an informed public dialogue for the purpose of sharing information on the potential risks and potential benefits of hydraulic fracturing. The third stage of the Committee's work was gathering input from the Yukon public, First Nations, stakeholders, and stakeholder groups. Having completed this work, this report represents the Committee's report to the Legislative Assembly, and is consistent with the mandate given to the Committee by the Legislative Assembly.

# Gaining an Understanding of Hydraulic Fracturing

The Committee was tasked with gaining a science-based understanding of the various aspects of the process of hydraulic fracturing, as well as the current legislation and regulations relevant to the oil and gas industry. To achieve this, the Committee spent over 70 hours in meetings with and briefings from various government departments, agencies, and regulatory bodies as well as groups with specific interests and information. Where possible, these presentations are available online through the Legislative Assembly's website. In the course of this work, the Committee met with the following:

- the Government of Yukon's Department of Environment,
- the Government of Yukon's Department of Justice,
- the Government of Yukon's Department of Energy, Mines and Resources,
- representatives and staff from the Yukon Environmental and Socio-economic Assessment Board,
- representatives and staff from the Yukon Water Board,
- representatives from the Yukon Chamber of Commerce Energy Committee,
- representatives from Yukoners Concerned About Oil and Gas Exploration and Development,
- representatives from the Yukon Conservation Society, and,
- Dr. Brendan Hanley, Chief Medical Officer of Health, Yukon.

## The Government of Yukon's Department of Environment

The Government of Yukon's Department of Environment provided a presentation to the Committee which addressed the department's role in the oil and gas process, the status of current environmental legislation and processes, a draft water strategy, environmental risks and benefits, environmental challenges, Yukon readiness, and, a proposed path to achieve readiness. The department spoke about its work to support the development of regulatory capacity to properly regulate and monitor shale gas extraction, tools to gather scientific baseline information, regulate waste water management, develop the expertise to deal with northern complexities such as permafrost, cold, short summer season and remote locations, and regulate and monitor fugitive emissions.

## The Government of Yukon's Department of Justice

The Department of Justice noted in its presentation to the Committee that hydraulic fracturing would likely require at least one, if not multiple authorizations from different agencies as well as requiring a *Yukon Environmental and Socio-economic Assessment Act* (YESAA) assessment. Yukon's *Oil and Gas Drilling and Production Regulations*, the *Waters Act,* the *Environment Act*, the *Lands Acts* and the *Occupational Health and Safety Act* would affect the operations and procedures of any future hydraulic fracturing projects in Yukon.

The department pointed out to the Committee that most key statutes with the exception of the *Environment Act* are a result of Devolution or Land Claims and that this may constrain future legislative options. The department informed the Committee that key statutes have never been interpreted or applied to a hydraulic fracturing operation in Yukon; consequently, it is unable to provide assurances as to whether or not there are any regulatory shortcomings.

## The Government of Yukon's Department of Energy, Mines and Resources

The Department of Energy, Mines and Resources presented the Committee with current information on unconventional oil and gas resources in Yukon. They also provided an overview of Yukon's *Oil and Gas Act*, current legislation regulating hydraulic fracturing, current exploration and production in Yukon, a concise description of the hydraulic fracturing process, and serious issues that need to be addressed resulting from the process.

The key messages for the Committee from the Department Energy, Mines, and Resources were that developing unconventional oil and gas resources by using the technique of hydraulic fracturing is the trend throughout North America, and is of interest to industry for potential development in Yukon. Yukon's *Oil and Gas Drilling and Production Regulations* could regulate hydraulic fracturing, however, work is currently underway reviewing the regulations and working with other oil and gas regulators to ensure lessons learned are incorporated into a modern regulation.

## The Yukon Environmental and Socio-economic Assessment Board

The Yukon Environmental and Socio-economic Assessment Board's (YESAB) presentation to the Committee outlined the current oil and gas projects, noting that of the 10 assessed to date, none have involved modern hydraulic fracturing, but that should this occur, modern hydraulic fracturing is an activity that would be subject to the assessment process under YESAA. The purpose of YESAB is: to provide a neutral process done at arms-length from governments, to protect environmental quality and heritage resources, to ensure socio-economic as well as environmental factors are considered, and to guarantee opportunities for public and First Nation participation.

## The Yukon Water Board

The Yukon Water Board's presentation to the Committee outlined its objective "to provide for the conservation, development, and utilization of waters in a manner that will provide the optimum benefit from them for all Canadians and residents of the Yukon in particular."[1] It has published interim guidelines for oil and gas projects that provide clarity to prospective proponents applying for oil and gas related projects.

## The Yukon Chamber of Commerce Energy Committee

The Yukon Chamber of Commerce Energy Committee (the Energy Committee) presented before the Committee and submitted a statement of its position with respect to the role of shale oil and gas extraction in Yukon's economy. The Energy Committee recognized that its Chamber members include various types of Yukon businesses with different interests. The Energy Committee said low cost natural gas could benefit businesses and the oil and gas industry, and requested that the Government of Yukon educate and show the public how oil and gas can be produced in Yukon.

## Yukoners Concerned about Oil and Gas Exploration and Development (Yukoners Concerned)

Yukoners Concerned about Oil and Gas Exploration and Development (Yukoners Concerned) presented their support for a ban on hydraulic fracturing in Yukon. They noted the lack of data and scientific understanding on the risks of hydraulic fracturing by highlighting the testimonies of several of the experts that presented before the Committee. They focused primarily on their concerns about the risks to Yukon's water. They also noted the difficulties faced by other jurisdictions in regulating hydraulic fracturing.

## The Yukon Conservation Society

The Yukon Conservation Society (YCS) highlighted a number of their concerns about the risks posed by hydraulic fracturing. YCS concluded the costs to Yukon could outweigh the benefits of permitting hydraulic fracturing. They said that hydraulic fracturing could have harmful impacts on Yukon's aquifers, surface waters and landscapes. They presented that the assertion that hydraulic fracturing could be done safely and is the best way towards energy security was a myth and that there could be negative economic impacts associated with pursuing hydraulic fracturing. YCS also noted several other potential risks including: potential negative effects on First Nations communities and culture, increased frequency of earthquakes, impacts to human health and an increased contribution to global climate change.

## Dr. Brendan Hanley, Chief Medical Officer of Health, Yukon

Dr. Brendan Hanley, Chief Medical Officer of Health, Yukon presented the Committee with an overview of public health impacts. Dr. Hanley highlighted the following concerns: complex health considerations include a lack of studies, public health is not often at the table, it is difficult to assess certain risks due to lack of data, rapidly evolving industry technologies make forecasting difficult; shale gas and oil development is best considered in context as an alternative fossil fuel industry, and shale gas and oil development and other oil and gas projects deserve health impact assessments (HIAs), which along with implementation plans, need to be integrated into government approval processes.

[1] Yukon Water Board presentation to the Committee, September 30, 2013 , *Water Management for Oil and Gas projects; Roles and Responsibilities of the Yukon Water Board & Secretariat*, page 4

## Fact-finding Mission to Alberta

To achieve a first-hand understanding of the various aspects of the process of hydraulic fracturing, the Committee conducted a fact-finding mission to Alberta in January, 2014. This trip allowed the Committee to visit a site where the process of hydraulic fracturing was actually used and allowed the Committee to meet with and hear from various government departments, regulators and agencies as well as groups with specific interests and information.

During the Alberta trip, the Committee heard it was in a fortunate position to consider risks and benefits prior to shale gas and oil development, and was advised to ensure that comprehensive baseline data collection, an effective framework for managing risks, and a monitoring regime for shale gas development were in place prior to development.

Some government agencies indicated it was a challenge for regulations to keep pace with the rapidly evolving industry. Some residents and land owners reported complaints about degradation of health and the environment and the health authority's ability to report data and respond. While in Red Deer and Calgary, the Committee met with representatives from a number of organizations, including:

- the Alberta Energy Regulator,
- the Sundre Petroleum Operators Group,
- the Petroleum Services Association of Canada's *Working Energy Commitment* members,
- Alberta Health Services,
- Alberta Environment and Sustainable Resources Development,
- the Canadian Association of Petroleum Producers, and,
- the Cochrane Area Under Siege Coalition.

# Facilitating an Informed Public Dialogue

The Committee was tasked with facilitating an informed public dialogue for the purpose of sharing information on the potential risks and benefits of hydraulic fracturing. To achieve this, the Committee invited a number of experts from various fields and backgrounds to provide public presentations to the Committee. These presentations allowed members of the public to hear from experts and provided the opportunity for the public to ask questions. The presentations, questions and answers were all open to the public, filmed and recorded, and remain accessible online through the Yukon Legislative Assembly's website.

Over the course of four days in 2014 — January 31, February 1, May 27 and May 28 — the Committee and public heard 15 presentations. They were, in order of appearance:

## Gilles Wendling, Hydrogeologist

Mr. Wendling's presentation focused on the potential and observed impacts of hydraulic fracturing on ground water. He noted that multiple pathways exist for gas to escape a well and well leaks can be immediate or occur after a number of years. Mr. Wendling also referenced statistics that indicated 30% of oil and gas wells leaked after 10 years and that percentage increased over time. He noted connections between ground and surface waters were complex and that Yukon is still developing its understanding of its own water resources and how they behave. He also said more study was required of existing wells, on the interaction of ground water and permafrost, and that more Yukon baseline data was needed before any activity should proceed.

## B.C. Oil and Gas Commission

The presentation by the B.C. Oil and Gas Commission focused on how the industry is safely regulated in British Columbia. It noted how environmental, social, technical, and geological issues are managed through a comprehensive regulatory system. The presenters also explained the importance of monitoring, compliance and transparency. The B.C. Oil and Gas Commission said it does not assess cumulative greenhouse gas (GHG) emissions or monitor health effects directly.

## The Pembina Institute

Adam Goehner presented on behalf of the Pembina Institute and focused on the challenges in developing robust regulations due to rapid technological changes. Gaps in knowledge include naturally-occurring radioactive materials (NORMs) disposal, and GHG emissions. Overlapping infrastructure fragments the landscape, increasing footprint and cumulative effects. Regional and land use strategies should be in place prior to development. Mr. Goehner noted that regulations need to be adaptable to the changing understanding and evolving pace and scale of development, as well as the need to measure long-term cumulative effects. He also noted that more work was needed regarding the flaring or venting of gas, transparency of data reporting to enable benchmarking, and performance monitoring.

## Industry representatives from EFLO Energy, Inc. (EFLO), Northern Cross (Yukon) Limited (Northern Cross), and the Canadian Association of Petroleum Producers (CAPP)

EFLO presented that there were significant economic benefits that could come from the development of the Kotaneelee field through the creation of jobs, taxes, royalties and spinoff benefits, and local production and use of natural gas. The presenters also said that environmental impacts could be managed through the existing effective regulations. EFLO said small scale hydraulic fracturing to meet only local needs is not feasible. Northern Cross presented information about its Eagle Plains program, concluding that hydraulic fracturing could be done safely if well regulated, that it had no immediate plans for hydraulic fracturing but would prefer if the option was left open, and that the significant economic benefits of an oil and gas industry would outweigh the potential negative impacts. CAPP's presentation provided an overview of the technology and the process of hydraulic fracturing and its use in North America.

## Bernhard Mayer, Professor, Geoscience

Professor Mayer's presentation focused on the impacts that hydraulic fracturing could have on groundwater. He noted a general lack of scientific information about these impacts remains, due in part to scientists' lack of access to sites or reliable industry data. Professor Mayer provided examples of how a system of monitoring might be established to generate scientifically defendable data for the testing of impacts, or lack thereof, of shale gas and oil development on the quality of shallow groundwater aquifers. He concluded that it was feasible to develop such a groundwater monitoring program if there was willingness amongst stakeholders, collaboration, adequate funding, and a long-term commitment to design and maintain programs.

## Rick Chalaturnyk, Professor, Geotechnical Engineering

Professor Chalaturnyk provided an overview of the risks and benefits of hydraulic fracturing and some parameters on how to weigh the competing risks and benefits. He provided information on the geology of shale gas plays, on how well casings are constructed and tested, and how monitoring of well casings can be done at a technical level.

Professor Chalaturnyk noted some possible benefits such as affordable energy, direct and indirect employment, less dependence on imported energy, and backup to the renewable energy sources of solar and wind.

Some of the risks he identified were the degradation of local air quality and water resources, the consumption of potentially scarce water supplies, habitat fragmentation and ecosystem damage, community stress and instability, induced seismic events, and exacerbation of climate change. Professor Chalaturnyk stated that "Risk itself can be managed; it can be minimized. You can share the risk, you can transfer the risk and you can accept a particular level of risk in a project. One of the things you cannot do is ignore the risk."[2]

## Fort Nelson First Nation

Chief Sharleen Gale and Director of Lands Lana Lowe presented on behalf of the Fort Nelson First Nation. Chief Gale and Ms. Lowe's presentation focused on the experience the Fort Nelson First Nation has had with the oil and gas industry. They noted that there have been significant environmental impacts on their land as well as impacts on their treaty rights. They indicated that working with the Government of British Columbia on land use planning and cumulative effects assessment was essential and that the British Columbia regulatory regime does not adequately protect their lands in the treaty. They said First Nation impact benefit agreements with industry were inadequate, and advised Yukon should be very careful about proceeding with hydraulic fracturing, which could have severe and far reaching consequences.

## National Energy Board

The presentation by the National Energy Board (NEB) gave an overview of hydraulic fracturing and the safety and environmental risks that exist. It provided an overview of how its regulations address these risks and how hydraulic fracturing is regulated in their jurisdiction. NEB said it expects proponents to describe what they are going to do about minimizing greenhouse gas (GHG) emissions, and that the presenters did not come prepared to talk about the impact of the industry on GHG emissions.

## Mark Jaccard, Professor, Resource and Environmental Management

Professor Jaccard's presentation discussed some of the macro-economic issues of natural gas and fossil fuel markets. He noted that effective regulation could likely reduce the local impacts but that accurate data comparisons were necessary to assess the impact of natural gas from a global climate change perspective. He noted the likelihood of the natural gas price gap between Asia and North America diminishing, advised against public funding of large infrastructure projects, and suggested avoiding reliance on the tax revenue from natural gas projects due to the likelihood of a boom-and-bust scenario. He noted a small jurisdiction like Yukon should be exploring renewable or zero-emission options as part of its energy system.

## Lalita Bharadwaj, Associate Professor, Toxicologist

Professor Bharadwaj gave an overview of hydraulic fracturing and its use in natural gas development, noting the intensity and scale of unconventional resource development and a number of direct and indirect impacts that this development could have on human health. She explained there are significant gaps in the knowledge needed to assess the risks to human health, due to a lack of air, water and soil baseline data and information about the chemicals and chemical mixtures used. Professor Bharadwaj noted that hydraulic fracturing is one of seven stages within shale gas development, each of which could pose a potential environmental risk, that different

[2] Transcript of public proceedings, February 1, 2014, pages 2-14 — 2-15

hydraulic fracturing fluid is used depending on the geochemistry and geomechanics of the shale, and that it is the concentration of particular agents that are used in the fracturing fluid and the unknown chemical reactions that is significant.

## Dr. Brendan Hanley, Chief Medical Officer of Health, Yukon

In his public presentation, Dr. Hanley raised many of the same issues that he had previously shared with the Committee. Dr. Hanley's presentation focused on the human health impacts of hydraulic fracturing. Dr. Hanley also shared some perspectives about how oil and gas development can have human health impacts. His presentation noted the need to optimize the socio-economic impacts of development, the need to reduce GHGs, and the need to anticipate and mitigate the physical impacts of development. He noted the need to optimize mental health and wellness through various planning initiatives, and the need to conduct health impact assessments and develop implementation and oversight mechanisms for them.

## Dr. Eilish Cleary, Chief Medical Officer of Heath, New Brunswick

Dr. Cleary's presentation focused on New Brunswick's experience with hydraulic fracturing and identified some common hazards to public health as well as significant gaps in knowledge that limit the ability to assess the risks to public health.

She noted that public health officials should be more involved in the assessment process and that while there are economic benefits that could occur there are also potential socio-economic risks to community wellbeing from hydraulic fracturing. She was not aware of any place that does a good job of measuring health impacts as a result of shale gas and oil development.

## Dr. Charl J. Badenhorst, Regional Medical Health Officer, Northeast Health Service District of British Columbia

Dr. Badenhorst's presentation focused on the experience of northern British Columbia with hydraulic fracturing and the commensurate boom-and-bust style economy its use created. He noted that socio-economic impact assessments were done either too late or poorly, and that socio-economic impact assessments are an essential step to identifying and evaluating the potential direct or indirect impacts of proposed economic projects.

Unplanned community development will cost governments more, as increased housing costs and crime rates outweigh the positive impacts. Dr. Badenhorst noted Yukon should consider whether the boom-and-bust economic model, which he described as "rapid industrial development, operational stability and then over-production, competition with world markets, industrial decline," is truly viable and desirable to Yukon people who live in the region where activity may take place.[3]

## Donald Reid, Associate Conservation Zoologist, Wildlife Conservation Society Canada

Mr. Reid's presentation focused on the potential impacts of hydraulic fracturing on wildlife in Yukon. He noted that the use and potential contamination of water, air pollution, and infrastructure development and the noise produced are some of the impacts that could negatively affect wildlife habitat. He said that lack of knowledge of water systems makes it difficult to quantify, regulate or monitor risks to wildlife, especially in mountainous terrain where the interconnection between surface and subsurface waters are more precarious. In light of climate change, he questioned the ethics of contemplating new hydrocarbon developments.

[3] Transcript of public proceedings, May 28, 2014, page 4-13

## John Hogg, Vice-president, MGM Energy Corp.

Mr. Hogg's presentation provided an overview of the work done to date in the Northwest Territories with regards to hydraulic fracturing. He presented that a strong, effective regulatory regime is in place there to limit negative environmental impacts as well as significant economic benefits that have accrued to the people who live in the region. He presented that Yukon shale gas will be some of the most expensive gas in North America to find and produce and that significant economic benefits may occur if shale gas and oil were developed in Yukon. He suggested limiting the pace and scale of development, requiring transparency and accessibility of data, strong regulations and ongoing monitoring to ensure that negative impacts are limited.

# Public Hearings and Input

The Committee was tasked with holding public hearings in the two communities most likely to be affected by oil and gas development, Watson Lake and Old Crow, and in other Yukon communities as deemed appropriate by the Committee. 290 requests for hearings were received in response to the Committee's call for expressions of interest to determine in which other communities public hearings would be held. Additional communities were selected based on the requests submitted and the Committee held a total of 13 public hearings throughout Yukon. Residents of some communities noted that the timing of the public hearings was inconvenient and participation may have been limited due to other events taking place. The community, the date the hearing was held, the number of attendees, and the number of witnesses were as follows:

| | | |
|---|---|---|
| • Watson Lake, Monday, June 23, 2014 | Public attendance: 27 | Witnesses: 7 |
| • Teslin, Tuesday, June 24, 2014 | Public attendance: 23 | Witnesses: 8 |
| • Old Crow, Wednesday, June 25, 2014 | Public attendance: 19 | Witnesses: 12 |
| • Dawson City, Thursday, June 26, 2014 | Public attendance: 55 | Witnesses: 30 |
| • Faro, Monday, July 7, 2014 | Public attendance: 17 | Witnesses: 10 |
| • Ross River, Monday, July 7, 20114 | Public attendance: 23 | Witnesses: 11 |
| • Carmacks, Tuesday, July 8, 2014 | Public attendance: 22 | Witnesses: 5 |
| • Pelly Crossing, Tuesday, July 8 | Public attendance: 57 | Witnesses: 16 |
| • Mayo, Wednesday, July 9, 2014 | Public attendance: 11 | Witnesses: 6 |
| • Haines Junction, September 23, 2014 | Public attendance: 55 | Witnesses: 20 |
| • Carcross and Tagish, September 24, 2014 | Public attendance: 148 | Witnesses: 57 |
| • Whitehorse, September 25, 2014 | Public attendance: 185 | Witnesses: 35 |
| • Whitehorse, September 27, 2014 | Public attendance: 86 | Witnesses: 36 |

In addition to hearing oral presentations at the public hearings, the Committee accepted written submissions from the day the Committee was established, until September 30, 2014. The Committee received a total of 435 written submissions from 383 individuals and organizations. 24 submissions were received from Canadian citizens outside Yukon and 39 were from outside Canada. A number of petitions were also submitted to the Committee.

All written submissions and all transcripts of the public hearings and public proceedings are available online through the Legislative Assembly's website. Hard copies of the Committee's materials will also be archived following the end of the current session of the Legislature.

It is difficult to summarize each and every submission, however, the following represents a general overview of the concerns that were heard through the various opportunities for public input.

- Water contamination – rivers and lakes, and groundwater being contaminated by chemicals used in the shale gas extraction process, compromising the security of the fresh water supply and causing health issues for fish, animals and humans
- Large volumes of water being removed from the fresh water supply, turned into contaminated water and injected into deep wells for permanent storage
- Health problems from hydraulic fracturing chemicals, flowback water and produced water
- Well integrity – fugitive gas emissions harming animals, people and the atmosphere
- Increased seismic activity caused by the hydraulic fracturing process and the injection of wastewater into deep wells
- Access roads disrupting wildlife and causing an increase in non-First Nation hunting
- Inadequate waste management
- Inadequate site remediation
- Inadequate monitoring of well sites during and after production
- Air quality deterioration causing health issues
- GHG emissions from fugitive gas escaping into the atmosphere
- Compromising of First Nations' rights and the consequent legal disputes
- Competition with other land uses such as tourism and agriculture
- Increased traffic with an increased risk of accidents
- Noise pollution during site development and production
- Spills of toxic chemicals
- Increased health and social problems
- Concerns with the integrity of the government decision-making processes for hydraulic fracturing

The Committee heard Yukoners express the belief that fresh uncontaminated water is connected to all aspects of a healthy environment and population. The Committee heard that clean, uncontaminated water and a pristine environment are important assets and they require the utmost protection.

The Committee heard that some Yukoners are concerned about the ability and capacity of the Government of Yukon's regulatory regime to address issues related to hydraulic fracturing.

The majority of Yukoners that the Committee heard from do not want to see hydraulic fracturing used to extract shale oil and gas resources in Yukon. Many indicated a preference for the Government of Yukon to devote scientific research funding to finding sustainable renewable energy resources to meet Yukon's future energy needs.

The Committee also heard from a minority of Yukoners that they may consider hydraulic fracturing as an option at a future date, after adequate studies have been done in the environmental and health impact areas where there are currently many knowledge gaps. Some would welcome a moratorium on hydraulic fracturing until the technology, methodology, regulation, monitoring, compliance, enforcement and remediation regimes have matured to the point where the risks have been minimized and a high level of reliability and sophistication capable of restoring the health of the habitat to its pre-development state is achieved and scientifically proven.

The Committee also heard from a few Yukoners who would support shale oil and gas extraction industry as a means of fostering economic growth and believe that the Government of Yukon could keep pace with strong regulations, compliance, and enforcement regimes to protect the environment and public health.

# Input from First Nations

Motion No. 433 establishing the Select Committee Regarding the Risks and Benefits of Hydraulic Fracturing mandated the Committee with gathering input from First Nations. To this end, the Committee sent a letter on October 17, 2013 to the leadership of each of Yukon's fourteen First Nations, to the Council of Yukon First Nations' Grand Chief, and the Gwich'in Tribal Council, which has a Yukon trans-boundary agreement, inviting them to present their perspectives to the Committee.

Letters to First Nations governments noted that dealings with the Committee are not considered government-to-government consultations. Following the release of a progress report summarizing the Committee's activities, the Committee mailed a second letter to all First Nations on February 28, 2014, inviting submissions.

The Committee welcomed First Nations participation in a variety of ways: at an in camera meeting, at a Committee public proceeding, or in writing. At its public hearings, the Committee offered translation services where requested. First Nation elders were invited to give an opening prayer in a number of communities.

## Liard First Nation

At the Committee's first public hearing in Watson Lake, Liard First Nation elders and citizens spoke of their opposition to hydraulic fracturing and the need to protect fish, wildlife, people and the water for future generations.

## Daylu Dena Council

The Daylu Dena Council in Lower Post, British Columbia, part of Liard First Nation and the Kaska Nation which do not recognize the British Columbia/Yukon border dividing their traditional territory, provided a detailed submission to the Committee. The council described their experiences interacting with the oil and gas industry and the B.C. Oil and Gas Commission and noted concerns about industry practices and shortcomings with the B.C. Oil and Gas Commission. These concerns include timber use, sump sites, multiple access roads and a lack of planning and baseline data. The submission highlighted hydraulic fracturing's potential negative impacts on water and wildlife. "Based on the many uncertainties that still exist, Daylu Dena Council is not supportive of Hydraulic Fracturing in Yukon."[4]

## Vuntut Gwitchin First Nation

At the Committee public hearing in the community of Old Crow, Vuntut Gwitchin First Nation (VGFN) Deputy Chief Bonnee Bingham, Councillor Brandon Kyikavichik, Councillor Paul Josie, elders, youth, and citizens spoke about their deep connection to the land and the water, concern for the wellbeing of the animals, and their opposition to hydraulic fracturing. An elder called for a 25 to 30 year moratorium on hydraulic fracturing to save the environment.

The First Nation provided the Committee with their August 2013 resolution, passed by consensus, "That the VGFN oppose hydraulic fracturing in VGFN traditional territory until [the VGFN] accept[s] it is 100% safe."[5]

[4] Letter to the Committee from the Daylu Dena Council, dated September 29, 2014

[5] Vuntut Gwitchin First Nation Resolution No. 2013-01, submitted to the Committee August 31, 2014

## Teslin Tlingit Council

The Teslin Tlingit Council's (TTC) submission to the Committee communicated strong opposition to hydraulic fracturing as a method of fossil fuel extraction in its traditional territory and Yukon as a whole. The TTC passed a resolution opposing hydraulic fracturing in TTC traditional territory in July 2014 at its Annual General Assembly. The submission noted the TTC's "responsibility to protect Teslin Tlingit lands, water, and cultural way of life."[6] The TTC mentioned Chapter 14 of its final agreement makes the Government of Yukon responsible for the protection of water supplies. The submission also expressed concern about "uncertainties plaguing all facets of the hydraulic fracturing process, including regulation and management" and the Government of Yukon's ability "to reconcile First Nation interests through the exercise of consultation in ways that are in keeping with the honor of the Crown."[7] Finally, noting recent aboriginal rights and title legal decisions, the TTC cautioned that the Government of Yukon could risk inviting further legal challenge.

## Tr'ondëk Hwëch'in First Nation

At the public hearing in Dawson City, Chief Eddie Taylor and Deputy Chief Jay Farr voiced their opposition to hydraulic fracturing, noting the Tr'ondëk Hwëch'in First Nation passed a resolution to ban the practice in their traditional territory. They noted that fresh water is the most valuable resource for their ecosystems, animals and homelands and should not be exposed to industry without their consent. They told the Committee the right thing to do in its report to the Legislative Assembly was to recommend a ban on hydraulic fracturing. They also referred to the Tr'ondëk Hwëch'in court challenge of the Government of Yukon's Peel Watershed Regional Land Use Plan and the risk of inviting further legal challenges should the Government of Yukon proceed with hydraulic fracturing when Yukon First Nations oppose it.

## Ross River Dena Council

At the Ross River public hearing, Chief Brian Ladue and Councillor James Dick noted the Kaska Nation have pristine land, and the Government of Yukon should look at economic alternatives such as adventure and cultural tourism instead of "really harmful ways of making money that's through extraction of minerals and gas and trees."[8] Chief Ladue emphasized that the Ross River Dena Council Chief and Council "are opposed to hydraulic fracturing."[9]

## Little Salmon Carmacks First Nation

Chief Eric Fairclough reported at the Carmacks public hearing that the Little Salmon Carmacks First Nation (LSCFN) passed a resolution at a General Assembly in June 2014 to communicate to the Committee and the Government of Yukon LSCFN's "opposition to hydraulic fracturing in its Traditional Territory and in Yukon."[10] The resolution said water is at the heart of a healthy environment and spoke to the risk of toxic chemicals harming groundwater and waterways important to the ecology.

## Selkirk First Nation

At the public hearing in Pelly Crossing, Chief Kevin McGinty said the method of hydraulic fracturing to extract oil and gas was too controversial and supported waiting another 40 years to

[6] Letter to the Committee from the Teslin Tlingit Council Executive Office, dated September 3, 2014

[7] Letter to the Committee from the Teslin Tlingit Council Executive Office, dated September 3, 2014

[8] Transcript of public hearing, July 7, 2014, page 9-9

[9] Transcript of public hearing, July 7, 2014, page 9-6

[10] Little Salmon Carmacks First Nation GA Resolution #10-2014, submitted to the Committee at the public hearing July 8, 2014

"let technology catch up" and for it to be proven that hydraulic fracturing is completely safe.[11] He thanked the Committee for allowing Selkirk First Nation citizens to voice their opinions and hoped the community's voice against hydraulic fracturing would be heard. Elders spoke about the need to have clean water now and for future generations.

## First Nation of Na Cho Nyäk Dun

The First Nation of Na Cho Nyäk Dun's (NND) Annual General Assembly resolution of July 2013 calls on the Government of Yukon "to prohibit any fracking in the NND Traditional Territory" and "Declares [the NND's] Traditional Territory to be a frack-free zone."[12] The NND recognizes its "responsibility to maintain the integrity and wellness of the lands and resources within [its] traditional territory and [its citizens'] way of life for future generations,[ …] the 'special relationship' between NND Citizens and the natural environment" and its deep concern about the potential harm hydraulic fracturing could cause to drinking water and the natural environment. [13]

An NND Youth Councillor submitted a petition to the Committee urging the Government of Yukon to ban hydraulic fracturing in Yukon, citing opposition because of harm to traditional ways of life including fishing, hunting and harvesting, threats to water, land and air resources, few and short-lived jobs and economic benefits, and the negative impacts for the next seven generations to come.

## Carcross-Tagish First Nation

Prior to the public hearing in Carcross, the Committee held an in camera meeting with Carcross-Tagish First Nation (CTFN) leadership and elders. The CTFN's submission to the Committee noted that the First Nation opposes hydraulic fracturing in its traditional territory. At the Committee's public hearing in Carcross, "Aboriginal drumming and a folk protest song enlivened the public against fracking" and "C/TFN leadership, elders, members and staff made 29 witness statements."[14]; The statements "reflected an indigenous perspective respectful of the sacred obligations that C/TFN carries for Mother Earth, the lands, waters, air, animals, birds, all the resources and the next generations yet to come."[15] Concerns over water and air pollution were raised along with concerns about past and future contamination from industrial development. The CTFN observed that "Climate change was also a theme with a call for renewable and green technologies in place of hydraulic fracturing."[16]

## Council of Yukon First Nations

Several First Nations governments and citizens referenced the June 2013 Council of Yukon First Nations (CYFN) General Assembly resolution calling on the Government of Yukon to prohibit hydraulic fracturing in Yukon and declaring the traditional territories of its member nations to be "frack-free". CYFN member nations are Carcross-Tagish First Nation, Champagne and Aishihik

[11] Transcript of public hearing, July 8, 2014, page 12-8

[12] First Nation of Na Cho Nyäk Dun Annual General Assembly Resolution #006-2013, submitted to the Committee at the public hearing July 9, 2014

[13] Ibid.

[14] *Carcross/Tagish First Nation Submission for a Frack-Free Traditional Territory to the Yukon Legislative Assembly Select Committee Regarding the Risks & Benefits of Hydraulic Fracturing*, submitted to the Committee October 10, 2014, pages 4 - 5

[15] *Carcross/Tagish First Nation Submission for a Frack-Free Traditional Territory to the Yukon Legislative Assembly Select Committee Regarding the Risks & Benefits of Hydraulic Fracturing*, submitted to the Committee October 10, 2014, page 5

[16] Ibid.

First Nations, First Nation of Na Cho Nyäk Dun, Kluane First Nation, Little Salmon Carmacks First Nation, Selkirk First Nation, Ta'an Kwäch'än Council, Teslin Tlingit Council and Tr'ondëk Hwëch'in.

## Gwich'in Tribal Council

Referencing the Vuntut Gwitchin First Nation resolution of August 2013 to oppose hydraulic fracturing, Gwich'in Tribal Council resolved at its 2014 Annual General Assembly to declare "the Gwich'in Settlement Region to be a frack-free zone" and further resolved "that the Gwich'in Tribal Council 2014 Annual General Assembly call on the Governments of the Yukon and Northwest Territories to prohibit any fracking in the Yukon and Northwest Territories."[17]

# Consideration of Risks and Benefits

The Committee was tasked with considering the risks and benefits of hydraulic fracturing if it were used in Yukon. The Committee wishes to note that it is comprised of legislators with limited scientific backgrounds and, as such, it is difficult to qualify and quantify these risks from a scientific standpoint. Therefore the following discussion should not be considered a scientific overview of the risks and benefits of hydraulic fracturing, but rather the Committee's best attempt at summarizing what was learned and heard from the various sources outlined above. While there are many scientific studies of hydraulic fracturing from Canada and beyond, the Committee suggests readers seeking more scientific information refer to the 2014 report commissioned by Canada's Minister of Environment, entitled *Environmental Impacts of Shale Gas Extraction in Canada* by the Council of Canadian Academies' Expert Panel on Harnessing Science and Technology to Understand the Environmental Impacts of Shale Gas Extraction.

## Summary of the Gaps in Knowledge and Scientific Understanding

The Council of Canadian Academies' expert panel's report notes a number of gaps in the scientific understanding of issues surrounding hydraulic fracturing. The Committee wishes to highlight below some of these limits in knowledge.

### Shale Gas Technology and Well Integrity

- There are deficiencies in the methods used to determine well integrity as the current geophysical logging method and gas leakage measurement do not yield satisfactory data about the nature of leakage pathways and gas leakage rates.
- The maximum height of induced fractures is not well known.
- High-quality data collection and interpretation is not generated and placed in the public domain.

### Water

- Impacts on groundwater quality are generally not predictable using established scientific analyses because such impacts would likely be gradual, over decades or longer.
- The baseline hydrogeological and hydro geochemical conditions of groundwater flow systems in areas of Canada where there is, or may be, shale gas development are poorly understood.
- The behaviour of chemical additives used in hydraulic fracturing in groundwater and their reactions in situ fluids and rock are not well understood. The attenuation of produced fluids released into fresh ground water and surface water is similarly not well understood.

[17] Gwich'in Tribal Council Annual General Assembly Resolution #006:2014 AGA Anti-Fracking, submitted to the Committee September 30, 2014

- The assimilation capacities of the groundwater zone for shale gas extraction contaminants are generally unknown and probably vary depending on hydrogeological environments.
- The linkages between groundwater and surface water resources are not well understood, and historical surface water records for all the areas under development are seldom good.
- Calculating minimum stream flows in rivers draining shale gas plays will require a consensus among stakeholders on limits of abstractions during low-flow periods.

**Greenhouse Gases (GHGs) and Other Air Emissions**

- The rates and volumes of fugitive methane emissions are unknown.
- Better measurements of well leakage, including measurements to assess gas leakage outside the well casing, and field-proven estimates of the number of leaking wells, are necessary.
- Scientific opinions differ regarding the appropriate values to use in evaluating the warming potential of methane, the impact of atmosphere aerosols produced by burning coal, and the type of combustion technology applied.
- Information is needed on the location of future wells, the planned infrastructure and the anticipated scale of development to assess the impact of air emissions. In parts of Canada, this information is not available.
- Baseline observations of air quality are lacking in several regions where development has taken place or may take place.

**Land and Seismic Impacts**

- There is an absence of geological and environmental baseline information in shale gas regions.
- While the science of how fluid injections can cause events is well understood, and the risks can be minimized by being proactive, whether wastewater injection can be safely carried out in all regions of Canada is unknown.
- More information on the potential for geological formations to receive large volumes of injected fluids without over-pressurizing reservoirs is needed to determine whether this waste disposal option is possible. If not, shale gas developers who use slick water technology will need to find alternative water disposal methods prior to development.

**Human Health Impacts**

- There is a lack of studies on the risks of human and animal exposure to industry-related chemical substances.
- The mixtures of chemicals associated with shale gas activities are generally unknown and untested, making it difficult to predict and assess risk from direct/indirect exposures
- Concentrations of additives will change due to reactions with chemicals in shale-producing formations and dilution with brine. These reactions may produce new chemicals of potential health concern.
- The pathways of hydraulic fracturing chemicals in the environment, including the routes through which individuals may be exposed, are unclear.
- Typical exposure duration times and concentrations of different contaminants have not been fully established and specific health impacts are therefore difficult to predict or identify.
- Calculations of additive risk for specific compounds through different routes of exposure, or of cumulative risks from several compounds, are not available.
- Public health surveillance, leading to epidemiological studies or rigorous health impact assessments, has not been conducted.

- The lack of baseline monitoring has made it difficult to distinguish between ambient pollution and incremental pollution from shale gas activities.
- There is sparse data on the cumulative effects of development on communities and the land.

# Potential Risks and Benefits

The following represents the Committee's consideration of the potential risks and benefits of hydraulic fracturing if it were used in Yukon, based on what the Committee read and heard from presenters and submissions.

## Water

Issues related to water were among the most commonly identified risks noted by expert presenters as well as by many Yukoners. In general these concerns relate to water contamination for Yukon streams, rivers, and lakes, and the significant volumes of water needed for the process of hydraulic fracturing. All Yukoners have a deep connection to water and land, and value clean water as a resource with intrinsic value. Yukon First Nations have resolved to keep their waters clean for future generations.

There are multiple sources and pathways for potential surface water and groundwater contamination in the hydraulic fracturing process. There is the potential of chemicals or other contaminants being spilled at the surface of a hydraulic fracturing site and contaminating the surrounding water. Accidents, human or mechanical errors, or poor practices related to the handling of chemicals or flowback water could cause these spills. The majority of contamination issues that have been identified to date have been a result of these types of surface contaminations.

Some of the sources and pathways for potential groundwater contamination relate to leaky or improperly sealed well casings. Any leak or fissure between any of the wellbore, the steel casing, the concrete seal, or the surrounding rock provides contamination pathways. Flowback water, natural gas, or saline water from great depths could migrate upwards and potentially contaminate subsurface aquifers. The Committee has heard that while there are methods for monitoring whether or not this contamination is occurring, they are not widely employed at this time and that even the existing best practices cannot assure long-term prevention of leakage. Furthermore, the Committee heard that lack of documented monitoring has resulted in a general lack of scientific information about groundwater quality in areas where hydraulic fracturing has occurred or is occurring.

Another area of concern heard by the Committee is the potential for gas or fluids to travel upwards towards groundwater through natural fractures or faults. Upwards migration of gas and fluids varies greatly depending on the subsurface geology of any given region. While the potential for the upward migration of gas and fluids can exist naturally due to an area's subsurface geology, it can be greatly exacerbated by further fractures or faults caused by hydraulic fracturing. These concerns are compounded by a general lack of scientific information about the precise nature of the subsurface geology.

The precise fate of hydraulic fracturing fluid after it is pumped into the shale rock remains unknown. While some is recovered and can be re-used or recycled, a large amount remains below ground. The Committee heard there is no known case of hydraulic fracturing fluids migrating from the deep shale zone to the groundwater level directly through the overburden rock. However, sufficient research has not been done on migration pathways and the risk of hydraulic fracturing

fluids migrating over time. There has not been enough monitoring around shale gas well sites to understand the behaviour of chemical additives used in hydraulic fracturing or the long-term impacts on groundwater quality.

There is also concern about the limited understanding of the results of the interaction of hydraulic fracturing fluid with NORMs for which radioactive properties present unknown long-term risks.

Flowback water is typically transported off-site for storage and treatment at an approved site or disposed of by injecting it into purpose-built or previously existing deep disposal wells. In addition to obvious risks associated with transport and spills, disposal of flowback water in deep wells poses a risk of groundwater contamination due to long-term well integrity issues as well as risk of induced seismicity. The Committee heard that not enough is known about the fate of the chemicals in the flowback water to understand potential impacts to human health, the environment, or to develop appropriate remediation.

There are risks of degradation of permafrost at project locations. The interaction between groundwater and surface water, and the potential for permafrost to provide pathways for contaminant migration is not well understood. It is important to take into consideration regional and local pathway assessments and the role of permafrost aquifers when considering the potential risks of hydraulic fracturing.

There is insufficient data to understand the groundwater flow systems in areas where there is or may be shale gas. These risks are dependent on local geology and can only be assessed over extended time, duration and distances.

Finally, the overall quantity of water used in the process of hydraulic fracturing is a concern. The Committee heard a number of differing figures about the volume of water needed for hydraulic fracturing, depending on the basin and technique used. Due to rapid technological change and industry innovation, the volume of water needed for the process of hydraulic fracturing is changing constantly. Factors such as the depth of the shale gas reservoir, and the geological characteristics of the shale itself will determine how much water is needed. In some cases alternatives to water, such as propane gel, are being used. Nonetheless, in some areas where extensive use of hydraulic fracturing has been allowed the volumes of water used have exceeded the capacities of the watersheds or water sources.

Yukon First Nations have a unique role in regards to water. Chapter 14 of the *Umbrella Final Agreement* guarantees the protection of quality, quantity and rate of flow of water in Yukon and the Committee has been made aware that there is a risk the Government of Yukon could face legal challenges should this provision be disregarded or inadequately met.

## Greenhouse Gases (GHGs) and Climate Change

The issue of GHGs and the more general issue of global climate change have been raised by both expert presenters and many Yukoners. The Committee heard that the natural gas produced through the process of hydraulic fracturing has the potential to displace more GHG-intensive fossil fuels and may contribute to reducing overall GHG emissions. Some presenters said that natural gas could be viewed as a “bridge-fuel” that could lead to a more renewable future. The Committee has also heard, however, that in some cases these assertions fail to recognize life-cycle emissions. Fugitive methane emissions produced through the process of hydraulic fracturing and use of gas produced through this method may emit more GHGs than other fossil fuels.

With specific regards to the emissions of GHGs, the Committee heard that a primary concern related to hydraulic fracturing is the potential for fugitive emissions of methane, both at the well

and throughout the natural gas distribution system. Since it is recognized that methane is a more potent, though shorter-lived, GHG than the carbon dioxide resulting from the burning of fossil fuels, fugitive emissions of methane are concerning from a climate change perspective. The Committee heard a number of opinions as to how much methane escapes through fugitive emissions in the hydraulic fracturing process and at what point those fugitive emissions offset emission reductions that may occur as a result of switching from the burning of more GHG-intensive fossil fuels to natural gas. The Committee also heard that few, if any, jurisdictions effectively regulate or monitor fugitive emissions. Proven scientific methods for detecting and measuring leakage of GHGs to the atmosphere have not yet been developed.

The Committee heard that investment in the production of natural gas may divert resources and attention from needed investment in renewable energy options. A cost comparative analysis has not been conducted between developing renewable energy sources and fossil fuel energy sources. A significant number of Yukoners who participated in the public hearings indicated a strong preference for investment in renewable energy rather than using hydraulic fracturing to develop a fossil fuel industry.

## Land Impacts

The process of hydraulic fracturing and the associated activities will have impacts on the land. While aspects of hydraulic fracturing do reduce some of the surface impacts compared to conventional oil and gas development, fully developed shale gas regions that employ hydraulic fracturing require extensive infrastructure including well pads, pipelines, compressor stations, staging areas and roads.

The cumulative impact of the development of this infrastructure fragments the landscape and affects fish and wildlife and their habitat. The degree to which these impacts can be mitigated depends on the information and planning that occurs before the development is undertaken, and the nature of development. The Committee heard that land use planning and that the measurement and consideration of cumulative effects can help identify potential harms.

The extent to which these land areas are affected and whether or not they can be reclaimed after a site closes is not well understood. Environmental effects and the cumulative impacts on the land and communities may take decades to become apparent. It is not known how long a closed site would need to be monitored after reclamation and remediation of the site is thought to be completed.

In addition to impacts on the surface of the land, the Committee understands that the use of hydraulic fracturing may cause minor seismic events. The degree to which this occurs, either from the specific activity of hydraulic fracturing or the injection of waste fluids into disposal wells, is highly dependent on the geology of the area in question. While some research has been done on induced seismicity, its potential impact on existing infrastructure, especially disposal or abandoned wells, needs to be considered. Micro-seismic monitoring can provide information to help understand the general impacts of induced seismicity. Peer-reviewed scientific papers on this subject have recently been published and knowledge continues to grow.

## Human Health and Social Impacts

The Committee heard that the use of hydraulic fracturing can have impacts on human health as well as broader socio-economic impacts. Direct human health concerns relate to the exposure of proximal populations to any contamination or pollution that may occur in the process or resulting from hydraulic fracturing. Concerns have been raised by experts that many chemicals used during the drilling, fracturing, completion and production stages of gas operations may have negative

long-term health effects that are not immediately apparent. Furthermore, there are health risks associated with air quality, noise and light pollution that occurs with industrial development. Health experts who presented to the Committee emphasized there are significant data gaps that limit the ability to thoroughly assess the risks to public health.

Development can lead to an influx of employment and economic activity in communities where such activity did not previously occur. The Committee heard that the rapid development of shale gas through the use of hydraulic fracturing has led to social challenges, such as an increase in crime, prostitution and violence. The Committee also heard that a majority of the workforce would be fly-in, fly-out camps. These impacts are consistent with other boom-and-bust developments that relate generally to resource development, and are felt more acutely in smaller communities. Rapid development can lead to pressures on the health care system, education system and an increase in the cost of housing.

These considerations need to be weighed before development occurs, and health impact assessments can provide a tool to consider these aspects. In most jurisdictions where hydraulic fracturing has been used, human health impact assessments have not been conducted and specific health impacts cannot be predicted or quantified.

## Economic Impacts

A range of opinions about the potential economic costs and impacts of hydraulic fracturing in Yukon were presented to the Committee. The Committee heard that in order for Yukon to fully develop its natural gas resources, hydraulic fracturing would need to be used. Some presenters indicated that there are economic benefits that could arise from this type of development. These benefits may include the creation of new jobs that range in skill level but all tend to be relatively high paying. These jobs can lead to the development of new skills and trades that are not otherwise available in Yukon. However, the Committee heard from north-eastern British Columbia presenters that a majority of those employed in the oil and gas industry in their region were fly-in, fly-out workers living in camps.

Significant investment is required for companies to undertake these processes and the associated economic activity could provide spin-off benefits to local businesses in the service and supply sector. The Committee heard that economic activity from the development of natural gas through the process of hydraulic fracturing may also provide some diversification to Yukon's economy from the traditional mainstays of mining, tourism and government.

The Committee heard that the development of a local fuel supply for transportation, heat or electricity may be an added economic benefit, if that local supply could displace imported alternatives. Others noted that oil and gas is a global commodity and that its value is determined by the international marketplace, and is likely to vary or fluctuate over the long term. The Committee also heard that Yukon alone could not provide enough demand to justify the large-scale development of natural gas.

The development of natural gas through the process of hydraulic fracturing could lead to a boom-and-bust style economy where much of the revenue created would leave Yukon. The jobs created through this development could be temporary and the majority could go to workers from outside Yukon, unless adequate training was provided for the local labour force.

The Committee also heard that the development of natural gas through the process of hydraulic fracturing can create financial benefits for affected governments through taxes and royalties. The Committee heard that governments who relied on revenues from royalties or taxes were assuming considerable risks and that governments should avoid investment in large infrastructure projects

to support industrial development. Increased health care costs and inflation that affects the local economy are likely.

# Recommendations

The Select Committee Regarding the Risks and Benefits of Hydraulic Fracturing was mandated to report its findings and recommendations, if any, regarding a policy approach to hydraulic fracturing in Yukon that is in the public interest. At the outset, the Committee agreed to work towards reaching a consensus in fulfilling its mandate.

The Committee could not reach consensus to make recommendations on the following matters:

- whether or not hydraulic fracturing can be done safely,
- whether or not hydraulic fracturing should be allowed in Yukon,
- whether or not social license from the Yukon public is necessary before considering hydraulic fracturing in Yukon, and
- whether or not to proceed with specific regulatory development of hydraulic fracturing.

The Committee did agree that the following recommendations should be addressed before hydraulic fracturing is considered.

## Public Dialogue

The Committee was tasked with facilitating an informed public dialogue for the purpose of sharing information about the potential risks and benefits of hydraulic fracturing. A clear majority of First Nation governments and Yukoners who participated in the Committee's activities indicated their opposition to hydraulic fracturing.

**Recommendation 1:** THAT the Government of Yukon should have the support of the Yukon First Nations whose traditional territories are affected before allowing hydraulic fracturing.

**Recommendation 2:** THAT the Government of Yukon should consider options for continuing an informed public dialogue amongst Yukoners about the issue of hydraulic fracturing and the oil and gas industry more generally.

**Recommendation 3:** THAT the Government of Yukon should make all relevant environmental data open, transparent and available to the public.

**Recommendation 4:** THAT the Government of Yukon should respect First Nation final agreements and its ongoing obligations towards non-settled First Nations in addressing any issue related to hydraulic fracturing.

## Economic Impacts

The Committee did not receive comprehensive information and analysis on the positive and negative economic impacts of hydraulic fracturing.

**Recommendation 5:** THAT the Government of Yukon conduct a thorough study of the potential economic impacts of developing a hydraulic fracturing industry. The study should include an assessment of potential infrastructure, health and social services and environmental costs related to the industry. The thorough economic analysis should include but not be limited to:

- an estimation of marketable oil and gas reserves in each basin,
- an estimation of the necessary capital investment for production in each basin,
- an estimation of operating and regulatory costs,

- an estimation of tax revenue and disbursement,
- the effects on Yukon's gross domestic product (GDP),
- wage and employment analysis including the economic impact of a fly-in, fly-out industry, and
- a comparison of the impacts of a hydraulic fracturing industry in contrast to a renewable energy industry.

## Water

The Committee recommends:

**Recommendation 6:** THAT baseline ground and surface water data be collected for an appropriate period of time, in order to ensure that comprehensive data is available.

**Recommendation 7:** THAT a better understanding of the impacts and interactions of hydraulic fracturing fluids on groundwater be developed.

**Recommendation 8:** THAT requirements related to water intensive practices are adhered to even if non-water options for shale formation fracturing are to be considered.

**Recommendation 9:** THAT adequate seasonal thresholds are established to ensure the usage of fresh water does not exceed watershed capacity.

**Recommendation 10:** THAT companies be required to make public the chemicals and chemical compounds that would be used, including case numbers, volumes, percentages and concentrations prior to any hydraulic fracturing activity.

**Recommendation 11:** THAT research be conducted to demonstrate whether well integrity can prevent migration of liquids or gases in the long term.

## Greenhouse Gases (GHGs) and Other Air Emissions

Detailed peer-reviewed studies on fugitive emissions of GHGs throughout the complete life cycle of natural gas are not yet available in Canada.

Because the scientific data is still developing on fugitive emissions throughout the complete life cycle of natural gas, and methane emissions are potentially more damaging to our environment than carbon dioxide ($CO_2$), the Committee recommends the following:

**Recommendation 12:** THAT air quality baseline data be collected for an appropriate period of time, in order to ensure that comprehensive data is available.

**Recommendation 13:** THAT research be done to develop a method to effectively measure and monitor GHG emissions over the full life cycle of natural gas.

**Recommendation 14:** THAT research be conducted regarding fluid and gas leakage specific to the unique permafrost conditions in Yukon.

**Recommendation 15:** THAT steps be taken to ensure that volatile organic compounds are not released during development and production.

## Land and Seismic Impacts

The Committee recommends:

**Recommendation 16:** THAT baseline data on wildlife and wildlife habitat be collected for an appropriate period of time, in order to ensure that comprehensive data is available, and that the impacts of hydraulic fracturing on wildlife be studied.

**Recommendation 17:** THAT baseline data on seismic activity be collected for an appropriate period of time, in order to ensure that comprehensive data is available.

**Recommendation 18:** THAT the impacts of seismic activity in Yukon be studied to evaluate the seismic risks caused by hydraulic fracturing and to avoid the development of flow paths to fresh water.

**Recommendation 19:** THAT the impacts of hydraulic fracturing on Yukon's permafrost be thoroughly researched. This would include research on the interaction between groundwater and surface water, regional and local scale pathway assessments and evaluation of permafrost degradation at wellheads.

## Human Health and Social Impacts

Additional research is needed to gain a better understanding of the health and social impacts of hydraulic fracturing and the related costs.

**Recommendation 20:** THAT health related baseline data be collected for an appropriate period of time, in order to ensure that data is available.

**Recommendation 21:** THAT Yukon's Chief Medical Officer of Health be mandated to conduct a thorough human health risk assessment where hydraulic fracturing development is proposed in Yukon.

# APPENDIX I – List of Acronyms

| | |
|---|---|
| CAPP | Canadian Association of Petroleum Producers |
| $CO_2$ | carbon dioxide |
| CTFN | Carcross-Tagish First Nation |
| CYFN | Council of Yukon First Nations |
| GDP | gross domestic product |
| GHG | greenhouse gas |
| HIA | health impact assessment |
| LSCFN | Little Salmon Carmacks First Nation |
| NEB | National Energy Board |
| NND | The First Nation of Na Cho Nyäk Dun |
| NORMs | naturally-occurring radioactive materials |
| TTC | The Teslin Tlingit Council |
| VGFN | Vuntut Gwitchin First Nation |
| YCS | The Yukon Conservation Society |
| YESAA | *Yukon Environmental and Socio-economic Assessment Act* |
| YESAB | The Yukon Environmental and Socio-economic Assessment Board |

# APPENDIX II – Motions

## Order of the House Appointing the Committee

Motion No. 433, carried by the Yukon Legislative Assembly on May 6, 2013:

"THAT a Select Committee Regarding the Risks and Benefits of Hydraulic Fracturing be established,
THAT Patti McLeod be Chair of the Committee,
THAT the Chair of the Committee have a deliberative vote on all matters before the Committee,
THAT the honourable members Hon. Currie Dixon, Stacey Hassard, Jim Tredger, Sandy Silver, and Darius Elias be appointed to the Committee,
THAT the Committee be mandated to:

(1) gain a science-based understanding of the technical, environmental, economic, and regulatory aspects of hydraulic fracturing,
(2) gain an understanding of Yukon's current legislation and regulations relevant to the oil and gas industry,
(3) consider the potential risks and benefits of hydraulic fracturing if it were used in Yukon,
(4) facilitate an informed public dialogue for the purpose of sharing information on the potential risks and benefits of hydraulic fracturing, as well as gathering input from Yukon public, First Nations, stakeholders, and stakeholder groups including non-governmental organizations,
(5) hold public hearings in the two communities most likely to be affected by oil and gas development, Watson Lake and Old Crow, and in other Yukon communities as deemed appropriate by the Committee; and
(6) consider whether hydraulic fracturing can be done safely if properly regulated;

THAT the Committee have the power to call for persons, papers and records and to sit during inter-sessional periods,
THAT in exercising its power to call for persons, papers and records the Committee may invite:

(1) officials from the Government of Yukon to appear as witnesses on technical matters,
(2) officials from other North American jurisdictions with experience in the regulation of hydraulic fracturing to appear as witnesses on technical matters,
(3) experts in matters related to hydraulic fracturing to appear as witnesses,
(4) representatives of Yukon First Nation governments and Yukon municipalities to appear as witnesses; and
(5) stakeholders, and interested parties including non-governmental organizations and members of the public to appear as witnesses, or provide input through other methods to be determined by the Committee,

THAT the Committee report to the Legislative Assembly its recommendations regarding a policy approach to hydraulic fracturing in Yukon that is in the public interest, including:

(1) its findings, if any, regarding the potential risks and benefits of hydraulic fracturing and whether allowing use of this technique is in the public interest; and
(2) its recommendations, if any, regarding any steps that should be taken to responsibly regulate hydraulic fracturing should its use in Yukon be allowed,

THAT the Committee report to the House its findings and recommendations no later than the 2014 Spring Sitting of the Legislative Assembly,
THAT if the House is not sitting at such time as the Committee is prepared to present its report, the Committee Chair shall transmit the Committee's report to the Speaker, who shall transmit the report to all Members of the Legislative Assembly and then, not more than one day later, release the report to the public; and
THAT the Clerk of the Legislative Assembly be responsible for providing the necessary support services to the Committee."

## Order of the House Amending the Committee's Membership

Motion No. 518, carried by the Yukon Legislative Assembly on November 18, 2013:

"THAT the membership of the Select Committee Regarding the Risks and Benefits of Hydraulic Fracturing, as established by Motion #433 of the First Session of the 33rd Legislative Assembly, be amended by:

(1) rescinding the appointment of Stacey Hassard to the Committee, and

(2) appointing Lois Moorcroft to the Committee."

## Orders of the House Amending the Committee's Reporting Deadline

Motion No. 662, carried by the Yukon Legislative Assembly on May 1, 2014:

"THAT the terms of reference of the Select Committee Regarding the Risks and Benefits of Hydraulic Fracturing, as established by Motion No. 433 of the 1st Session of the 33rd Legislative Assembly, be amended by changing its reporting deadline to the House from the 2014 Spring Sitting of the Legislative Assembly to the 2014 Fall Sitting of the Legislative Assembly."

Motion No. 839, carried by the Yukon Legislative Assembly on December 16, 2014:

"THAT the reporting deadline for the Select Committee Regarding the Risks and Benefits of Hydraulic Fracturing, established in Motion No. 662 of the First Session of the 33rd Legislative Assembly, be amended by changing said deadline from the 2014 Fall Sitting to January 19, 2015."