Policy Considerations of the NB Salmon Council on Unconventional Shale Gas Extraction (Fracking) in New Brunswick

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1.0 Background

The New Brunswick Salmon Council (the Council or the NBSC) is concerned with of the health of wild Atlantic salmon, salmon populations and the habitat that they require for survival. Therefore the Council is concerned about the proposed development of an industry that proposes to extract gas using unconventional means (commonly referred to as "fracking") from shale deposits that underlie several world-class salmon rivers that are located in NB. These shale deposits cover approximately 10,000 km^2 (1,000,000 ha) in NB, with much of this area lying in the Southwest Miramichi River drainage.

While there are many other issues being raised and investigated in New Brunswick about human health and other environmental issues, the focus of this effort by the NB Salmon Council is specifically on wild Atlantic salmon and the ecosystems they depend upon to survive. Recreational fisheries for wild Atlantic salmon bring millions of dollars and hundreds of jobs to rural areas in New Brunswick annually. Salmon angling is a sustainable industry based upon a renewable resource.

In Dec of 2012 the Board of the NBSC struck a subcommittee to identify issues concerning the interaction of these activities with the health and well-being of wild Atlantic salmon and the ecosystems upon which they depend.

Our current basic understanding of the proposed fracking industry is summarized below:

1. The potential extent of the shale that contains commercially extractable gas is estimated using seismic testing methods.
2. These estimates are confirmed with test drilling.
3. Access to the extraction sites is gained on existing corridors where possible, however, new roads will be required to access some areas.
4. Concrete well pads are constructed and multiple holes are drilled first vertically and then horizontally into the shale deposits. The horizontal well sections can be up to three kilometres long. The direction of the horizontal portion of the drill hole is based on maximizing the number of natural shale fractures encountered along its path.
5. Well casings are installed along the length of the hole during the vertical drilling and a concrete grout is injected into the well and back up the outside of the casing to seal the vertical portion of the casing to the bedrock.
6. The horizontal leg has slits in the pipe. A large volume of water containing approximately 2% chemical lubricants, oxidation inhibitors and a "proppant" (i.e. sand) is injected at very high pressure down the well. This mixture expands the existing cracks in the shale. The sand props open the cracks allowing the natural gas to be released into the well casing for capture at the surface.

7. When the pressure is released, the newly released methane and the fracking fluid travel back to the surface via the the casing. This mixture is maintained within the vertical well-casing by the concrete grout seal discussed previously.
8. The fluid is captured and re-used or hauled away for treatment.
9. The gas is initially flared and the well is capped with a well-head.
10. A gathering line is constructed to the well pad and individual wells are connected to this line.
11. The gas is piped to a conditioning plant where the impurities are removed.
12. It is re-pressurized for export in a lateral pipeline that brings it to the main line for transport to consumers.

2.0 Overview and Assessment of Concerns

2.1. Gas and fracking fluid escape from the horizontal leg of the well

In New Brunswick, it is expected that the horizontal portion of the wells will be 2 to 3 kilometres underground, below a dense “cap-rock”, below typical water table depths. The NB Regulation “Rules for Industry” require a minimum fracking depth of 600m. According to UNB geologist, Dr. Tom Al, it is highly unlikely that waste fluid and gas will contaminate the water table given the immense pressure imposed by the cap-rock. However, the migration of natural gas and fracking fluid has been documented to travel toward the surface through abandoned wells and natural geological faults that connect the shale to the surface. These connections between the horizontal leg of the wells and surface need to be well understood and mapped out so they can be avoided. Stringent requirements for locating geological faults and abandoned wells are required for appropriate placement of the horizontal leg.

Potential Impact: At the depths proposed, very little migration to the water table or surface water is anticipated.

Mitigation: As indicated by geotechnical experts from UNB, the likelihood of these events is low. This is of minor concern to the NBSC, provided the faults and abandoned wells can be avoided.

Priority: Low

2.2. Well casing integrity - Gas and fluid escape in the vertical leg and at the wellhead

Methane is a powerful greenhouse gas and fracking fluid can contaminate surface water. Wellhead leakage has been documented within the industry and the Province acknowledges that all wells leak to some extent. Maintaining well-casing integrity is critical to preventing contamination of the water table and surface waters and is entirely dependent upon procedures and processes by the contractors and materials limitations. The Province has not provided information that quantifies the anticipated failure rate nor what the potential outcomes of those failures might be. Not all failures would necessarily result in loss of gas/fluid into surface or groundwater.

Potential Impact: There will always be some level of risk of integrity loss in the vertical leg and/or at the well-head. The impact of methane contamination in surface waters to wild Atlantic salmon and aquatic health is not well understood. The escape of fracking fluid/waste-water could have acute and significant impact on juvenile and adult Atlantic salmon and water/habitat quality.

Proposed Mitigation: There should be zero tolerance of this type of leakage. Require systems to be in place to detect these events and repair the problem. Require ISO Certification of all companies involved in the installation and maintenance of the wellheads. Require mandatory full time inspection during all phases by independent third party inspectors. The Energy Minister mentions a "6-cow" tolerance level for the amount of methane that would be allowed before action is to be taken. Require mandatory public reporting of the failure rate of wells and what the outcomes of those failures are determined to be.

Priority: Very High

2.3. Siting of well pads

The NBSC is concerned that proposed setbacks of 30m laid out in the NB "Rules for Industry" may be insufficient to protect springs, brooks, rivers and aquatic health from the potential effects of well-head integrity loss and/or surface spills of waste fluids. Horizontal directional drilling provides the ability to access shale deposits that are kilometres away so there is no need to locate well pads directly adjacent to streams.

Potential Impact: If well-pads are too close to watercourses, then there is increased concern about impact of loss of well-head integrity, site spills (during waste handling) and siltation. Any combination of these occurrences could serve to contaminate spawning, rearing and holding areas for wild Atlantic salmon if well-pads are allowed to be placed as close as 30m to a watercourse.

Proposed Mitigation: The NBSC recommends a minimum 200m setback requirement from watercourses, whereas the NB Rules for Industry state 30m.

Priority: Moderate

2.4. Water sourcing for the fracking process

The hydraulic fracturing process requires vast quantities of water. Each well can require in excess of 10 million Litres of water to complete the process. During certain high flow times of the year (e.g. spring) there is generally enough excess water from floods that these amounts would have only a minor an impact. However, in some areas, the removal of water from natural watercourses may have an effect on the quantity required to support Atlantic salmon life processes, particularly during low flow periods (e.g. mid-late summer, early fall and winter). Note, often the lowest flow rates are in winter when the eggs are in the gravel.

Potential Impact: Water draw-downs in spawning/rearing areas for wild Atlantic salmon during low flow periods can result in increased water temperatures, less habitat availability and greater competition among juvenile salmon, therefore reducing freshwater survivals rates.

Proposed Mitigation: Apply prohibitions to water sources (e.g. lakes, watercourses potable groundwater). Water should not be withdrawn from sources that serve the purpose of providing for natural processes – i.e. rearing water for salmon. Priority must go to protecting aquatic health. Potential sources of water considered to be acceptable include wastewater from treatment plants, freshwater sourced below the head-of-tide or seawater.

Priority: High

2.5. Waste fluid management and disposal

To date, waste fluids from hydro-fracturing processes in NB have been trucked to a treatment facility in Debert, Nova Scotia. However, the Debert treatment facility no longer accepts waste fracking fluid from NB. Disposal options are limited for financial reasons (reverse osmosis and water evaporation are very expensive). Deep well injection, a disposal method used in some US jurisdictions, is not an option in New Brunswick due to geological constraints according to DNR. New treatment facilities will be required in New Brunswick as well as appropriate means of treated water re-use and disposal. We understand this will be addressed in EIA's of the proponents prior to production drilling. As of now, as part of the permitting process, the province requires the proponents to submit plans for approval by the NB Department of Environment (NBDENV) for their waste fluid disposal. These plans must be accepted by NBDENV) prior to the permitting of development.

Potential Impact: The over-arching concern is the potential loss of contaminated fluids and substances into our ground/surface waters either slowly over time (seepage from storage lagoons) or acute due to transportation/handling failures/accidents. Ultimately, the treated waste-water must be deposited back to the salt water environment so there must be strict standards and regulations governing where and how this disposal is to be done.

Proposed Mitigation**:**

- Waste fluid recapture and storage: There should be no open storage and no dumping of brine into inland waters and estuaries. Lagoons can and will leak over time and will ultimately discharge to surface waters. Lagoons cannot de-salinate waste-water meaning that leakage and surface water discharge from lagoons could result in saline/brine solutions escaping into watercourses.

- Waste fluid transportation: There is a high potential for spills, particularly along new, unpaved service roads. Waste fluid should be assumed to be equivalent to gasoline. It should be handled with similar and appropriate procedures and care.

- Fully/properly treated/decontaminated waste water must meet appropriate post-treatment standards/regulations and is a saline brine that we feel can only be safely deposited to the ocean

- There must be strict adherence to the planning requirement prior to development including a shut-down of the operation if the plan is not successfully implemented.

Priority: Very High

2.6. Water and Aquatic Health Monitoring

Aquatic health monitoring/enforcement (baseline and ongoing) is not covered in the Rules for Industry. This is a principle concern of the NB Salmon Council. Monitoring water chemistry is only one component of monitoring aquatic conditions. Benthic invertebrate monitoring is required to provide indications about how aquatic life is responding to changes in water chemistry that can occur naturally or from anthropogenic causes such as drilling, mining, etc.

Potential Impact: If baseline aquatic health conditions are not determined prior to development, taking into account natural variation, and ongoing testing is not conducted, it will be unlikely that any changes to the aquatic health from operations would be detected and appropriately mitigated. This would also include difficulty in determining cause and assigning accountability.

Proposed Mitigation:

- Mandatory third-party baseline testing of surface water quality and benthics, including determination of natural variation, paid for by industry. (Note: the Rules for Industry make no mention of benthic monitoring – only water quality. The committee feels that this is a major shortfall with respect to protecting wild Atlantic salmon).
- The benthic testing should begin before commencement of seismic exploration.
- There should be ongoing mandatory third party testing during development, operation, post shut-down.
- Testing should be started immediately to determine baseline data and natural variability. Without knowing natural variability of water quality and aquatic health over a series of years, then problems caused by the industry may not be "provable".

Priority: High

2.7. General Industry Activities

There are many processes and many operators carrying out different functions during exploration, drilling, fracturing, extraction, transportation, treatment, etc. There are many opportunities for poor practice to result in harmful alteration, disruption or destruction of salmon and their habitat.

Proposed Mitigation:

- All companies involved at all stages of the process must be ISO certified.
- All monitoring must be done by independent certified third parties, paid for by industry.

Priority: High

2.8. Cumulative Effects of Extensive Development (i.e. density within watersheds)

It is uncertain how big the industry will become. Simple extrapolation of the area of shale and rules-of-thumb for the density of wells and pads leads to an estimate of 30,000 wells and 5,000 to 6,000 well pads. This would involve extensive linear corridor development that would act cumulatively with forest and paved surface roads to have a significant and measurable impact on salmon habitat because of erosion, sedimentation, forest removal, resultant geomorphic changes and access provision for salmon resource over-exploitation. This magnitude of development cannot be properly mitigated and is not acceptable to the NBSC. The Province indicated in a recent meeting that this extrapolation was not valid. The Province foresees the development of only 50 wells per year (~10 pads /year) for 20 years. This magnitude of development might be absorbed by the assimilative capacity of the environment if mitigated properly.

Proposed Mitigation: Follow best mitigation practices for linear corridor development. Plan and pay for the decommissioning of an equivalent length of unused forest road to compensate for the development of new linear corridors. Place a mandatory cap on the extent of development to a level indicated by the Province during our recent meeting – i.e. no more than 50 wells per year. Disallow carry-over of development capacity from year to year (i.e. if 40 wells are completed one year, do not allow 60 the next). There should be no well development allowed after a 20-year period.

Priority: Very High

2.9. Environmental Impact Assessments (EIA)

The NBSC suggests a requirement that after 500 wells have been drilled an additional EIA must be completed that will review progress to date, challenges encountered, assess cumulative development impacts and how the industry is going to adapt to the shortcomings encountered.

Priority: Very High

2.10. Additional Concerns

The use of unconventional, multi-directional, horizontal hydraulic fracturing technology and practices (fracking) are less than a decade old (about 6-7 yrs). Many water-related issues have surfaced where the industry has developed too quickly, particularly in parts of the US. Much is unknown about the short, medium and long-term risks and impacts of this industry on the health of our freshwater resources.

Unanticipated problems can also arise as witnessed in the well-intended rush to develop marine-based salmon aquaculture that resulted in large-scale impacts on wild Atlantic salmon and their ecosystems.

Many questions and unknowns remain. There is still much study required to have any understanding as to the real risks and threats to springs, brooks, rivers, lakes, etc, and to native fish species, wild Atlantic salmon in particular.

The key issues surrounding a new shale gas industry in NB that are rated as high or very high priority by the NBSC in summary are:

- Well casing integrity - Gas and fracking fluid escape at the wellhead;
- Water sourcing for the fracking process;
- Waste fluid management and disposal;
- Water and Aquatic Health Monitoring;
- General Industry Activities; and
- The Cumulative Effects of Extensive Development.

3.0 Proposed Policy Consideration

Because of its status as a proponent of policies and actions that conserve and benefit wild Atlantic salmon, their habitat and the fisheries for them, the NB Salmon Council is opposed to the development of a shale gas industry in New Brunswick unless and until:

1. the mitigative measures for the potential effects that are listed in this document are implemented, particularly for any of the potential impacts that have been identified as Moderate to Very High priority.

2. the industry is kept to a manageable size (for example the government's understanding of 50 wells per year for 20 years).

4.0 References

4.1. Papers/Journals/Studies

1) *Government Document – "Responsible Environmental Management of Oil and Natural Gas Activities in New Brunswick - Rules for Industry" - http://www2.gnb.ca/content/dam/gnb/Corporate/pdf/ShaleGas/en/RulesforIndustry.pdf*

2) *UNB Opinion Paper – "Potential Impact of Shale Gas Exploitation on Water Resources" (Al, Butler, Cunjak and MacQuarrie, April 2012) - http://www.unb.ca/initiatives/shalegas/shalegas.pdf*

3) *Journal Article – "Shale Gas Extraction Faces Growing Public and Regulatory Challenges". (Physics Today, July 2011)*

4) *Study – "Methane Contamination of Drinking Water Accompanying Gas-Well Drilling and Hydraulic Fracturing". (Osborn, Vengosh et al, January 2011)*

5) *Journal Article – "Water Management Challenges Associated with the Production of Shale Gas by Hydraulic Fracturing". (Gregory et al, 2011 – Elements, Vol.7, p.181-186)*

6) *Paper – "Shale-Gas Experience as an Analog for Potential Wellbore Integrity Issues on CO2 Sequestration". (Williams et al, 2010; submission to US National Energy Technology Laboratory)*

4.2. Video Presentations:

1) *Dr. Anthony Ingraffea (Cornell) presentation on technical issues, constraints and risks of unconventional shale gas exploitation – Dec. 2011 – Hampton High School. Youtube video:*
   - *Part 1: https://www.youtube.com/watch?v=SjdhiZJCyzU&feature=related,*
   - *Part 2: https://www.youtube.com/watch?v=oPVWY96tIxg*

2) *Dr. Adrian Park (UNB) presentation to NB Community College – perspectives on shale gas exploration and exploitation. (Nov. 2011)*