My name is Neil MacLean. I'm a retired professional engineer who has worked in the electronics industry, the utility business and in the nuclear industry as well as in consulting. I am retired. I have degrees from UNB, Sussex and Cornell. My investments are diversified and I have no particular financial interest in the mining business.

I'm an engineer, so I do not oppose new technology on principle.

I came to shale gas with an open mind, but after quite a bit of digging into it, I'd far far rather live next to a nuclear power plant than in an area undergoing shale gas development.

I am greatly alarmed that shale gas industry green house gas emissions are at least as bad or worse than the coal industry when the total of all consequent emissions are considered including those arising from stray mining emissions.

Meanwhile, the gas industry likes to promote itself as a climate friendly fuel selectively ignoring their considerable stray methane emissions.

To me, climate change is the world's number 1 problem. I don't want New Brunswick to exacerbate this problem by engaging in shale gas development which will cause abundant ongoing stray emissions of greenhouse gases much worse than carbon dioxide. And stopping such emissions, once started, presents much difficulty because of unidentified leakage paths.

My second greatest concern with shale gas development is that it is a threat to water supplies, both long term and short term.

I was previously at a presentation on fracking put on by the government's shale gas group before the Saint John Branch of the Association of Professional Engineers and Geologists of NB. At that presentation I raised concerns about the potential for frack fluid migration through ground faults. One of the people who answered me was Annie Daigle who is here today. She reassured me there could be no problem, and stunned me by quoting Dr. Tony Ingraffea of Cornell as backing up her assurance. I subsequently spoke directly to Dr. Ingraffea, one of the world's foremost experts on fracking. Dr. Ingraffea shared my concerns and could not recall saying anything which would suggest that frack fluid migration through ground faults could not occur.

Common sense tells you that when you have a fluid under a huge pressure over 10 MegaPascals, it will seek the path of least resistance, and a fault that is not tightly sealed offers such a path which can facilitate many kilometers of fluid migration driven by the extremely high source pressures used in fracking.

One huge problem with fracking is the unreliability of cement casings whose failure rate from day 1 is over 5%, and only increases over time. I laughed when I read about fixing

broken cement casings in the NB government recommendations.. To me that sounds like an industry fairy tale if you talking about failures at any appreciable depth.

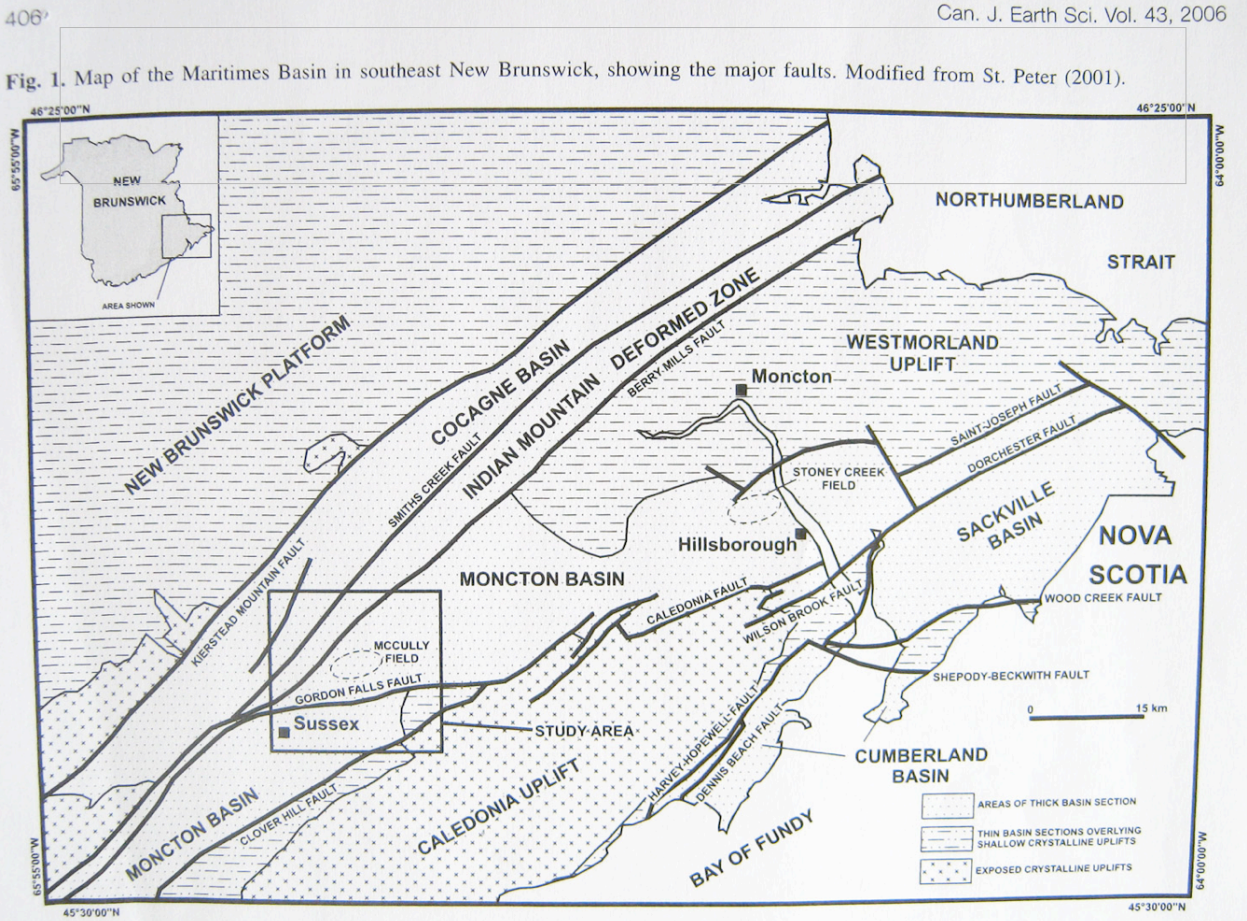
I suggest you refer to Dr. Ingraffea's lecture that he gave in Hampton not long ago. Google Ingraffea Hampton in which he explains why the problem of cement casing integrity is essentially intractable - starting toward the end of the Part 1 video, and continuing into the part 2 video. part 1 (www.youtube.com/watch?v=SjdhiZJCyzU) and at part 2 (www.youtube.com/watch?v=oPVWY96tIxg) . Industry has been wrestling with this problem for decades, and will continue to do so - making modest progress, but with no really excellent solution anticipated.

When an objective, qualified source of expertise suggests that the problem of well casing integrity is essentially intractable,, I believe him. He's paid to be accurate, not to try to promote the dreams of the Premier of New Brunswick.

Every well that is drilled is its own potential pathway to aquifer contamination because of the unreliability of well casing cement.

I consulted a retired geoscientist about my concerns. This fellow still does some consulting on the side and most recently was hired by the large North American engineering consulting firm EXP to assess aquifer vulnerability within the Royal District Planning Commission area in which Norton is located.

There are abundant potential naturally occurring pathways in the ground. Southern New Brunswick has been the point of collision between continents in the geological past. This diagram from the Canadian Journal of Earth Sciences shows the major faults in the so-called Moncton basin which takes in Sussex and the Kennebecasis valley.



A series of major faults run in parallel and they haven't been thoroughly investigated but they are believed to run to varying depths over 30 kilometers deep in places. And there are a much larger number of smaller lateral faults off of the major faults, and indeed sub-laterals. Because of the way the major faults were formed they tend to be in compression, and in many cases would obstruct fluid flow. But the laterals and sub-laterals are much less apt to be in compression, and therefore offer abundant potentially good fluid flow paths.

What this means is that when we lay out many thousands of kilometers of underground laterally drilled fracking lines intended only to penetrate neighboring shale, you are bound to intersect small unexpected faults which have the potential to allow the injected fracking fluid to migrate much further than intended.

A rough calculation shows that a pressure of 8MPa is sufficient to pump water up a column about half a mile high - near a kilometer. But regardless of pumping pressures, underground conditions can see fluids more gradually migrate upwards over time, driven by forces derived from differentials in density. That seems to me to make vast quantities of frac fluid left in the ground rather a serious potential risk over time - and hardly practical to clean up.

The Royal District Planning Commission area, which takes in Norton, was the subject of New Brunswick's only aquifer vulnerability assessment study. That study is available on the Internet. Just go to the Royal Planning Commission website and look under the News tab, and click on a link on that page to get complete details.(www.royaldpc.com/node/49) .

Although the study was impaired by a lack of the best kinds of data, it suggests big sections of the Kennebecasis valley are vulnerable to aquifer damage. It is a mark of how little we know that there is only one such study and that it was based on far from the best data. The consultant did as best could be done with limited data.

So it seems to me to be common sense to be less than fully assured that pumping vast tonnages of toxins into the ground is advisable, in view of the threat it poses to our aquifers, and the relative impracticality of cleaning up any such problem once it arises. And given the potential slowness of in ground action due to slight density differences, you would not want to get cocky if there appeared to be apparent early avoidance of difficulty.

I ask you to think about the care that is normally exercised in the construction of a sanitary landfill. It is sited on relatively impermeable ground to start with, but then there are multiple layers of containment membrane with leakage detection in between the layers. A similar approach is taken in storage of nuclear waste - multiple layers of protection with leakage detection between the layers. If there is a leak, you go and fix the problem before the last layer of protection is violated.

The contrast is that in fracking, the fracking lines are specifically laid out to leak **everywhere** there might be gas entrapped in the shale which extends all over the place. And that leaking fluid contains and releases lots of toxins in the ground. There can be no containment membrane. and there can be no reliable detection of unwanted fluid migration through a great number of possible paths.

From my point of view, we don't have a more important resource than fresh water. It makes no sense to me to be putting that at risk for a short term industry demonstrated to be anything but straightforward, that will make a mess of our roads, make a mess of the countryside, pollute our air, threaten our health, threaten other industries that rely on a good environment , and accelerate climate change.

If we think administrative regulations alone can make inherently unacceptable risks okay, then instead of inviting the shale gas industry into New Brunswick, I think we should do our safety-by-regulation magic for the outer space industry: it offers better jobs; much more is known about outer space than we have yet to map and study of underground New Brunswick; and it wouldn't threaten so many other things we love.

Submitted

Neil MacLean, P. Eng. (retired)