FRACCING ONSHORE AUSTRALIA

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SUMMARY

Recent history has seen major inquiries in the Senate and under the control of several State and Territory Governments where one aspect involved the oil exploration technique of fraccing.

Each and every inquiry has concluded that the technique is safe for the purposes of petroleum extraction, subject to appropriate scientific and technical regulation over the activity.

The paper covers the more significant negative submissions made to those inquiries by a range of providers and then explains why those submissions lack scientific and technical support. Our conclusion can only be that it is time for political intervention with science to be abandoned for the long term benefit of Australia and its energy requirements, not only on the east coast. Each of these inquiries has focused its attention to onshore petroleum activities, but the technique is also commonly used offshore in tight sands and shales.

The paper will include a brief section to define what fraccing is and how the activity has been applied onshore Australia, rather than as applied to the massive fraccs in the major shale basins in the USA.

Submissions have been made by groups such as Lock the Gate, elements of the green movement in Australia, doctors and farmers. Few of these submissions have been founded on sound scientific principles, but that does not make them any less interesting or politically powerful.

INTRODUCTION

Fraccing as an exploration or production technique continues to receive a high level of unfair criticism from those persons lacking scientific training and who have received somewhat biased education on the potential impacts of drilling and at times fraccing as part of that drilling process. In any drilling activity, as with any modern technology or scientific progress in general, there are risks and it is how the drilling industry deals with these risks that is the point. Because of the geology of the remaining undrilled structures in onshore Australia, if we cannot fracc shales and tight sands formations there will be no or negligible onshore production of gas or oil within 5 - 10 years.

While the most recent Inquiry in the Norther Territory has seen some maturity in the debate to cover wider aspects of project development, the Inquiry did continue with a questioning attitude to fraccing per se. That Inquiry has produced an Interim Report, with some very interesting reading for those involved in the debate.

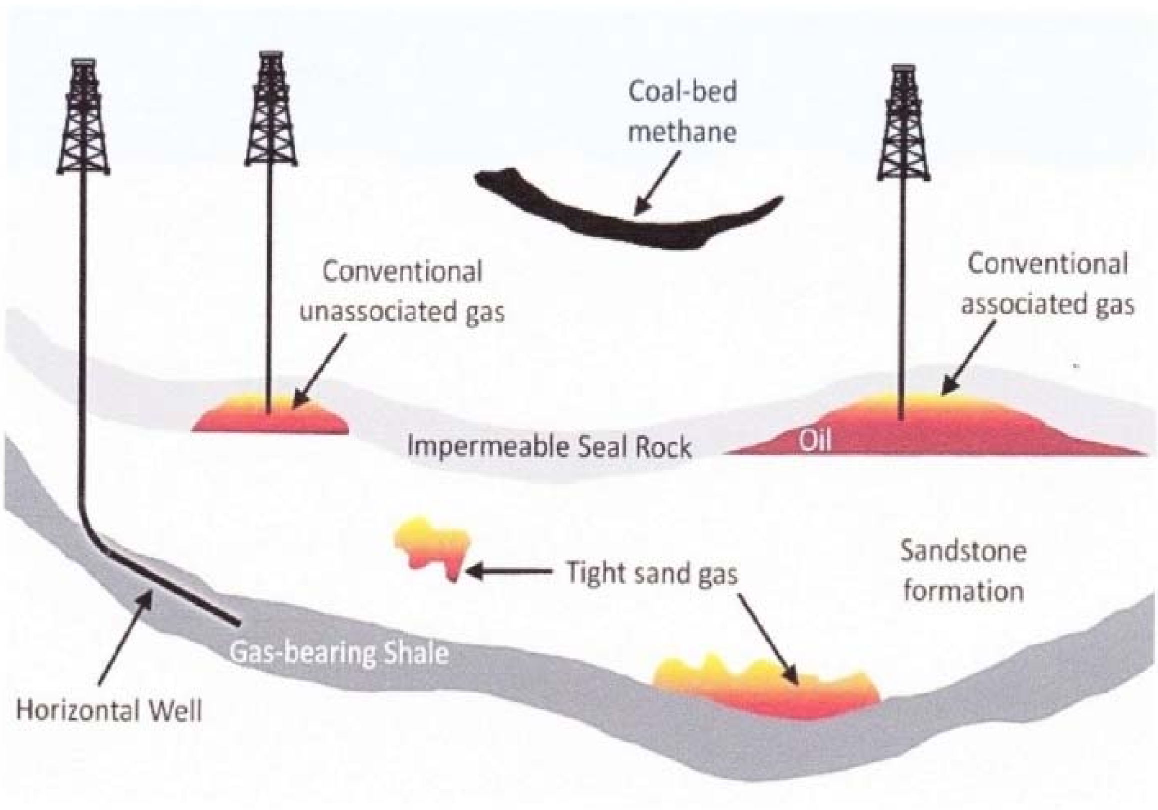
This Extended Abstract will look at:

- the history of fraccing;
- the most recent Inquiries; and
- scientific updates from the USA,

to give readers a better background on the issues involved while not shirking from any issue the industry must address. One example of real issues are those identified in the December 2016 EPA report to Congress (see later). It would be very foolish if we here in Australia did not learn from whatever lessons are available from the USA.

Because of the need for brevity the author has adopted a deliberate approach by quoting sources of information from respected providers as a method of eliminating areas for dispute, accepting anything in the public environment will be exposed to persons who have problems with the accuracy of their statements.

The following graphic will assist in understanding the differing plays.



Source: 12.wp.com/www.pmfias.com/wp-content/uploads/2016/01

STATUS QUO

The debate around fraccing confuses the real issue of the supply of onshore gas to the east coast markets. Every Inquiry to date has said fraccing is safe so long as properly Regulated.

After 16 major Inquiries in the States, Territories and in the Senate where one aspect was fraccing, any reasonable person would have expected the Regulation of fraccing in Australia would have advanced to the stage where the majority of stakeholders would be able to support the package. While it is never possible to get 100% of stakeholders to agree on all aspects of onshore gas supply, our Governments should by now have got their combined acts together. This is a substantial weakness of our inadequately trained and educated politicians.

The fact is that while the US Environment Protection Agency (EPA)in their Report has indicated a range of USA failures by exploration/production companies that have generated some damage to aquifers, drinking water supplies, in South Australia there have been ZERO such incidents reported to the SA Department of Development. This suggests that fraccing at the scale used in Australia which uses a lower level of downhole pressure and a limit of around 20 perforations per well, has reduced the risks of fraccing and enhances our case throughout Australia. Does this reduced scale and pressure reductions in Australia below those assessed in the USA mean we in Australia are entitled to be comfortable with our present policies?

The Relevant Major Inquiries of Recent History

These included:

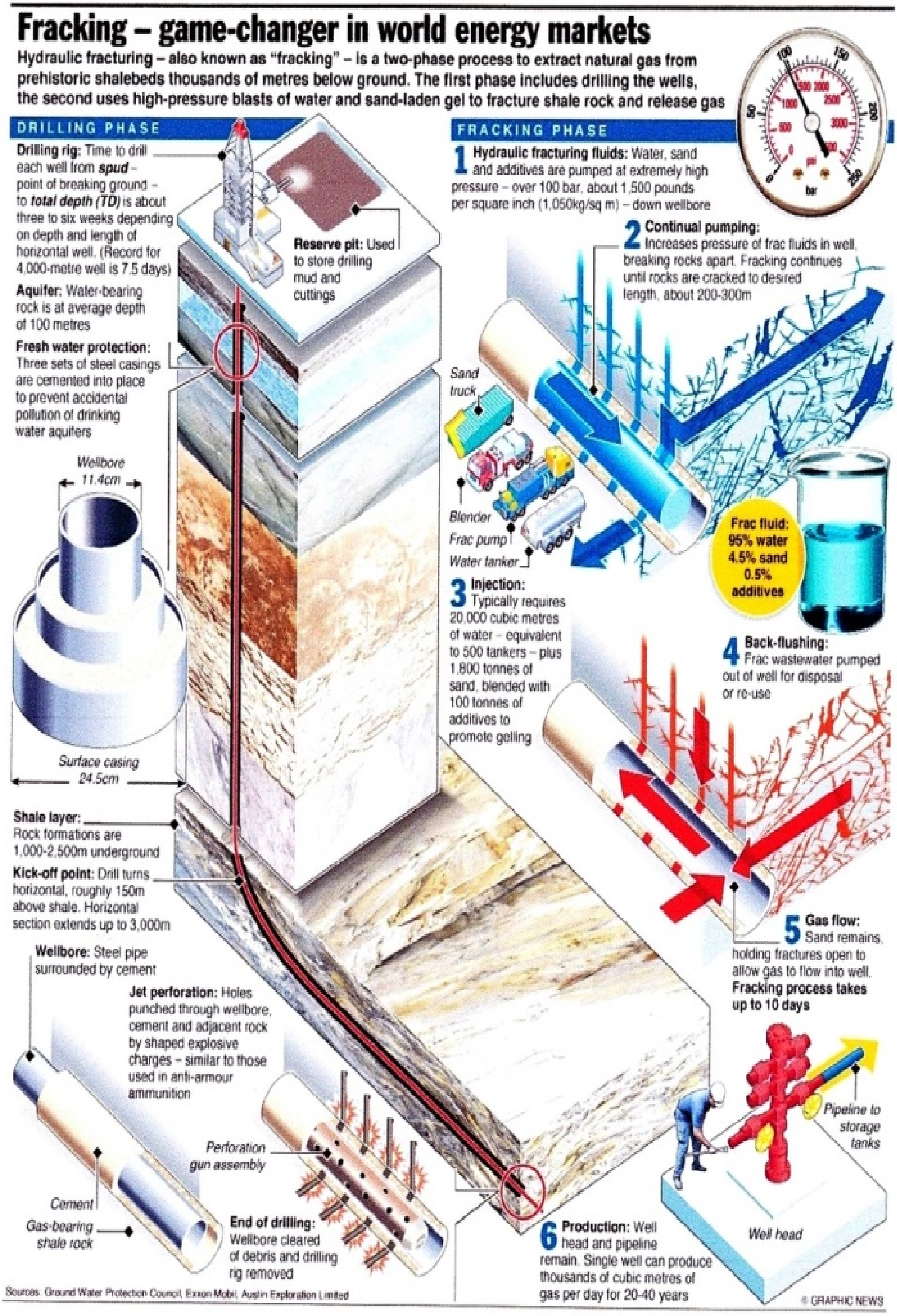
- Aug 2013 to Nov 2015 WA Standing Committee on Environment and Public Affairs
- 2015 NT Hydraulic Fracturing Inquiry (Chair Dr Hawke AC)
- 2016 Senate Inquiry Select Committee on Environment (Chair Glen Lazarus)
- December 2016 EPA USA into Impact of Hydraulic Fracking on Drinking Water
- 2017 NT Scientific Inquiry Hydraulic Fracturing in the Northern Territory (Justice Pepper)

Through space limitations this paper will focus on the last two, with some comments on the Senate Inquiry. An extensive paper has been written by your author in 2016 for the APPEA Conference in Perth dealing with the historical and other issues of the Inquiries pre 2016.

Commonly Accepted Coverage of What is Fraccing.

The following is a direct quote from Wikipedia.

Hydraulic fracturing (also fracking, fraccing, frac'ing, hydrofracturing or hydrofracking) is a well stimulation technique in which rock is fractured by a pressurised liquid. The process involves the high pressure injection of fraccing fluid (primarily water, containing sand or other proppants suspended with the aid of thickening agents) into a well bore to create cracks in the deep-rock formations through which natural gas, petroleum and brine will flow more freely. When the hydraulic pressure is removed from the well, small grains of hydraulic fracturing proppants (either sand or aluminium oxide) hold the fractures open.



Source: engtechmag.files.wordpress.com/2011/11/shale-gas.jpg

The Risks of Fraccing

The following is a graphic representation generated by the US EPA.

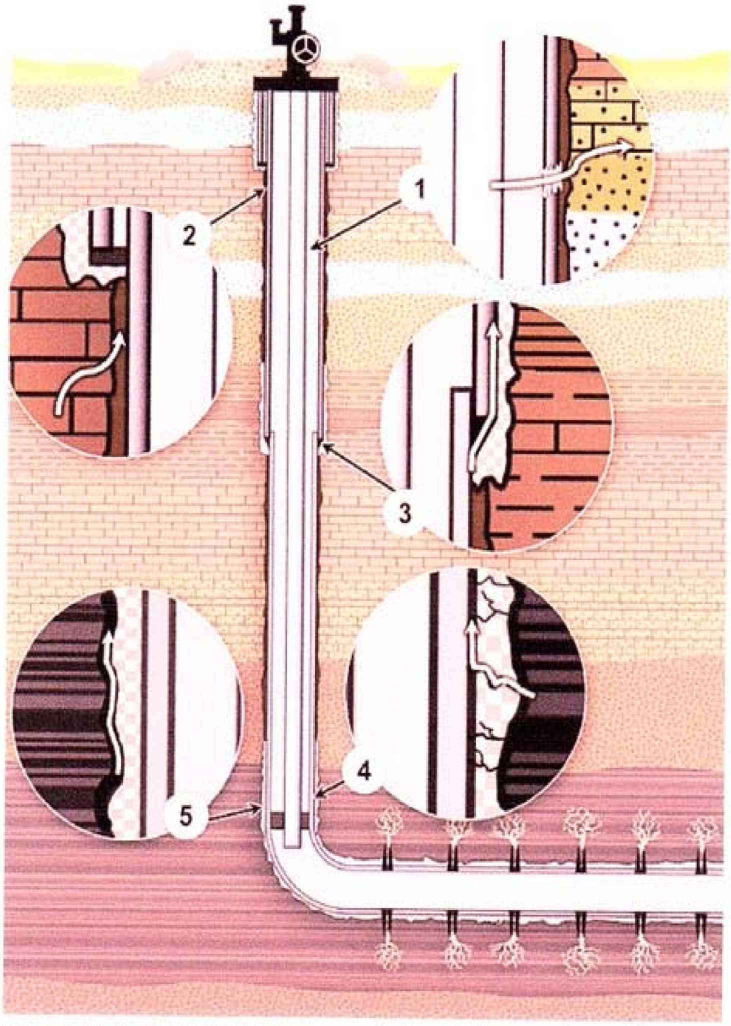


Figure ES-6. Potential pathways for fluid movement in a cemented well. These pathways (represented by the white arrows) include: (1) a casing and tubing leak into the surrounding rock, (2) an uncemented annulus (i.e., the space behind the casing), (3) microannuli between the casing and cement, (4) gaps in cement due to poor cement quality, and (5) microannuli between the cement and the surrounding rock. This figure is intended to provide a conceptual illustration of pathways that can be present in a well and is not to scale.

Source: EPA Report over Impact of Fraccing on Drinking Water - Executive Summary

The EPA has established that there has been a range of ways that both groundwater and sub-surface aquifers have in the USA been deleteriously impacted by processes associated with a fraccing activity. For the avoidance of doubt, waters have been impacted as follows (not exclusive):

- While not fraccing exclusively oriented, during the drilling process wells pass through subterranean reservoirs on their way down to the target zone which contain gases and some fluids. Those gases and fluids then travel up the outside of the well casing and potentially have some pollution impact on higher level aquifers and through venting at the surface;
- Either man oriented mistakes or equipment failures at surface cause spills of chemicals to the surface or become part of frac fluids or spills of frac fluids at surface before those fluids are injected down the well stem;

- Spills of process water at surface or leakages of process waters from unlined or inadequately lined surface storage dams;
- Spills of diesel and other petroleum products at surface, where the petroleum product is used to power any of the surface equipment;
- Gas leakages from pipelines (usually have more issues with exposure to air), when the gas becomes in suspension in sub-surface waters;
- Leakages of methane gas and/or process waters outside the perforations, where the leakages are not recovered through the drill stem and the leakages then follow the outside of the drill casings through to higher level aquifers and the surface; and
- Whether caused by multiple fraccing activities or the inadequate design of well casings and the placement of cement around the casings, gases and frac fluids and/or process waters escape and flow into areas surrounding the casings and then through natural pressures migrate upwards into aquifers and the surface.

History of Fraccing around the World

The following is a direct quote from Wikipedia.

Fracturing as a method to stimulate shallow, hard rock oil wells dated back to the 1860s. Dynamite or nitroglycerin detonations were used to increase oil and gas production from petroleum bearing formations. On 25 April 1865, US Civil War veteran Col Edward A L Roberts received a patent for an "exploding torpedo". It was employed in Pennsylvania, New York, Kentucky and West Virginia using liquid and also, later, solidified nitroglycerin.

The relationship between well performance and treatment pressures was studied by Floyd Farris of Stanolind Oil and Gas Corporation. This study was the basis of the first hydraulic fracturing experiment, conducted in 1947 at the Hugoton Gas Field in Grant County of South Western Kansas by Stanolind. A paper on this process was issued in 1949 and exclusive licence was granted to the Halliburton Oil Well Cementing Company. On 17 March 1949 Halliburton performed the first two commercial hydraulic fracturing treatments in Stephens County, Oklahoma and Archer County, Texas.

Massive hydraulic fracturing (also known as high-volume hydraulic fracturing) is a technique first applied by Pan American Petroleum in Stephens County, Oklahoma in USA in 1968. The definition of massive hydraulic fracturing varies but generally refers to treatments injecting over 150 short tons, or approximately 300,000 pounds (136 metric tonnes) of proppant.

Massive hydraulic fracturing quickly spread in the late 1970s to Western Canada, Rotliegend and Carboniferous gas-bearing sandstones in Germany, Netherlands (onshore and offshore gas fields) and the United Kingdom in the North Sea. Horizontal oil or gas wells were unusual until the late 1980s. Then, operators in Texas began completing thousands of oil wells by drilling horizontally in the Austin Chalk, and giving massive slick water hydraulic fracturing treatments to the well bores.

Ignoring CSG, most of the gas wells that have been fracced in Australia over recent years have been done in South Australia in the Cooper-Eromanga Basins. Since 1969, 700 plus wells have been fracced in the sandstone reservoirs for oil and gas. Others have been fracced for water and for geothermal purposes. According to the SA Department of State Development brochure of 2015 "THE FACTS about natural gas and fracture stimulation in South Australia", there have been ZERO negative impacts identified to:

- water resources;
- soil;
- native vegetation and fauna;
- landscape and heritage;

- air quality: and
- health and wellbeing of people and enterprise.

In the context of CSG, drilling techniques have evolved that require minimal if any fraccing of a CSG horizontal well. By drilling at 90 degrees to the natural cleating (splits) in the coal, the coals naturally create their own fissures sufficient to allow extraction of the formation water in coal seams and subsequently gas production up the well.

What today is called a massive hydraulic fracturing (aka high-volume hydraulic fraccing or HVHF) in the USA is probably better described as a monster fracc to allow a proper comparison between the fraccs referred to in Wikipedia and those occasionally done by groups such as Chesapeake. The comparison will be dealt with later. The important point to note is that massive fraccs, much less monster fraccs, are not carried out in Australia because of a range of factors including the geology and the inability of getting large volumes of fraccing fluids, proppants and required equipment to the well sites in Australia to achieve the massive fraccs.

The following is a direct quote from the EPA Report on Drinking Water in the USA more comprehensively reported upon later.

"Approximately one million wells have been hydraulically fractured since the technique was first developed in the late 1940s. Roughly one third of those wells were hydraulically fractured between 2000 and approximately 2014. Wells hydraulically fractured between 2000 and 2013 were located in pockets of activity across the United States. Based on several different data compilations, we estimate that 25,000 to 30,000 new wells were drilled and hydraulically fractured in the United States each year between 2011 and 2014, in addition to existing wells that were hydraulically fractured to increase production. Following the decline in oil prices, the number of new wells and hydraulically fractured appears to have decreased, with about 20,000 new wells drilled and hydraulically fractured in 2015.

Technical background

In this Extended Abstract we do not have the space to properly explain many of the technical terms and aspects of fraccing. It has been necessary to assume background knowledge and build on the issues identified by the independent Inquiries over terms like:

- fraccing, multiple fraccs, stimulations and perforations;
- horizontal drilling, well bores, laterals, casings, cement mixtures and fracc heights;
- fracc fluids, gels, viscosity, ground water, surface water, produced water, recycled waters and processed waters;
- fracc chemical additives, slurries and proppants;
- BTEX (benzene, toluene, ethyl benzene, xylenes) and banned chemicals due to toxicity; and
- downhole pressures and temperature changes.

There is considerable high quality information of an independent nature available on Wikipedia and the US Environment Protection Authority Website. Your author provided a very comprehensive paper on Fraccing Forum for the APPEA Conference in May 2016 presented at their annual conference in Perth that deals in more detail with these terms.

When and Why Is It Necessary to Fracc

The reason to fracc always comes down to the central question of whether the petroleum product is contained within a reservoir/source layer that will allow natural underground pressures to release the petroleum products at rates of flow that will justify commercial production. If the layer is tight sands for example or in rock or shales that will not allow adequate flow rates, then the exploration company will look at fraccing the well at the source layers to increase that production flow. The fraccing will operate to split the layers in such a fashion as the petroleum product will flow to the point of least resistance, meaning the say oil or gas will be attracted to the splits (perforations caused by gun tools) in the well pipes specifically created in the pay zones section of the pipes and then flow up the pipe to the surface for collection and separation.

December 2016 Report of Environment Protection Agency to Congress

This Report was released worldwide on 14 December 2016. It contains an Executive Summary of 50 pages, 666 pages of Report and 599 pages of Appendices. These are all available at www.epa.gov/hfstudy. It would be short-sighted to ignore this Report in Australia on the basis that the two countries approach to Regulation, ownership of sub-surface minerals and petroleum products is so different, or that the Australian geological settings and plays cannot be compared to the enormous scale of operations as are possible in the USA.
The following summarise the key elements of that Report:

- the Report was commissioned by Congress;
- it was and remains a definitive study that there definitely have been some instances of damage to drinking water supplies at various points in the USA caused by fraccing or unconventional drilling;
- the severity of the instances was impossible to gauge because the lack of pre-data did not allow a proper comparison of elevation levels directly related to fraccing or unconventional drilling; and
- some areas (eg Powder River region) that have been drilled and fracced have virtually no protection zones between the bottom of aquifers and the likely top of the frac zone, implying a very high contamination risk for the aquifers from fraccing.

There are undoubtedly places in the US (and Australia) where there are naturally occurring BTEXs already present in the sub-surface area around the collection points. This type of information is extremely scarce and it is relevant because even when BTEXs are not used by the drilling contractor, the naturally occurring BTEXs can still be recovered in the process water and raised to the surface. Is it adequate to dilute the BTEX content by adding fresh water so that these compounds can be returned to their prior resting place without consequence?

It is also important to take into account the quantity of sub-surface water that may exist in any given place. In the Pennsylvania basins like the Marcellus there are copious sources of high quality water that may be accessed by the drillers. In the some of the Texas basins, this is not the case and those particular regions are comparatively dry putting pressure on water qualities that may be available and what is available in quantity terms.

The EPA Report is not about identifying specific locations or parties in particular, but it is relevant to consider the impact of “monster” fraccs in those conclusions. Logic would suggest the larger the fracc, the larger the possibility that the pressures generated will create issues such as leakages around the stem or changes in the sub-surface away from the wellsite. This would increase the risks of leakages of process waters away from the controls of the wells.

With the dropping oil to below US$40 WTI and gas prices below US$2 per gigajoule, US drilling and exploration companies had to get their costs down seriously quickly. With economic pressures on contractor margins being one factor and the availability of drill rigs (caused by the poor oil price), previous cost norms were totally renovated. So the massive fraccs and now the monster fraccs are a function or response. The industry in the USA is so much more dynamic and responsive to product values, but the questions remains from the EPA Report have there been corners cut and risks taken that may have justified some of the conclusions in the Report. Back in Australia there has been a revolution in costs, but that has not seen as dramatic upsurge in drilling/fraccing. The reasons for this local situation are more obvious when one considers the geological structures in Australia do not warrant this wholesale drilling at all costs approach and the cost to get large volumes of fracc fluids and equipment to any site compared to the likely rewards would not justify such a massive fracc.

With good reasons, it is tempting to consider the EPA Report as USA focused and not relevant here. However in each and every major Inquiry in Australia there are large volumes of submissions that use every last bit of negative information gleaned from the USA news releases to argue against fraccing in Australia.

Without looking at the details, examples in recent Inquiry submissions have included:

Examples - Senate Select Committee on Unconventional Gas Mining

There were 316 submissions to the Inquiry chaired by Senator Lazarus. The Senate Interim Report and the submissions are available at:

www.aph.gov.au/Parliamentary_Business/Committees/Senate/Gasmining/Gasmining.

One of the more technically oriented provided by National Toxic Network (submission 15) contained the comments on the following:

- volumes of fracc fluids injected;
- non disclosure of chemical additives, particularly those known carcinogens;
- chemical additives contain chemicals that have been shown to cause permanent changes in the brain and affect behaviour, obesity, fertility, cancer and result in other adverse health outcomes in laboratory animals;
- impact of dispersal sprays on wide paddock areas;
- reverse osmosis filtration has limitations for disposal and re-injection of process waters;
- evidence of fugitive emissions can be seen in the bubbling methane gas reported along a five km stretch of the Condamine River in Queensland. *(Note: The Queensland Government's initial investigation that four CSG wells were within five kms radius of the gas seep, but there was no evidence of fracking within 40 kms); and*
- Australian guidelines and standards do not take into account low level, chronic exposure to environmental contaminants even those that demonstrate potential endocrine and epigenetic impacts.

Examples - NT Inquiry into Hydraulic Fracturing- Interim report

Reports from some shale gas fields of the US (e.g. the Marcellus Basin in Pennsylvania) indicate a six-fold higher incidence of cement and/or casing issues for shale gas wells compared with conventional gas wells 6.2% compared with 1% for oil wells. However, according to APPEA the average fracture rate of casing or cement failure in the US is as low as 0.1% to 0.3%. For wells constructed to modern standards, this rate has been reported to be only 0.004% compared with 0.2% for older wells and is most commonly attributed to slow leakage of methane around the external casing, which, once identified, can be remediated by additional cementing and pressure testing. Faulty well integrity and non-hydraulic fracturing is considered to be the primary cause of the aquifer contamination that has occurred in Pennsylvania and Texas in their respective shale gas basins. The improvements of the past few decades in well design and well testing are considered to have substantially reduced well integrity risks for contemporary installations.

To date in SA there have been no reported impacts on aquifers noting that while the conventional oil and gas industry is mature in that State, the unconventional gas industry is still in a very early stage in its development following Santos' first successful tight gas well drilled in 2012.

There has been one instance of a well blow out in the Northern Territory. This occurred for a vertical fracturing operation being conducted in September 2012 Petrofrontier's Baldwin-1 Well.

There is now considerable evidence that low magnitude earthquakes recorded in the US and the UK may occur during hydraulic fracturing and certainly larger scale (Richter Scale magnitude greater than 2.0) earthquakes have occurred during the reinjection of waste water.

Overseas findings to date suggest that the hydraulic fracturing stimulation of earthquakes of sufficient scale (Richter Scale magnitude 2.0 or greater) as to be felt locally and to cause slight damage to buildings is extremely rare.

In its submission DPIR states that there is no evidence to suggest that the hydraulic fracturing process can produce measurable earthquakes in non-faulted geological areas.

The Panel has not located any scientific information to date about the potential for the development of sink holes or diminished well integrity as the result of drilling in karstic terrain. However, the Panel notes that sink holes normally occur at shallow depths (tens of metres) in either limestone or evaporate (salt) rock that has been subject to long term solution by groundwater. Further, the Panel considers that sink holes are unlikely to occur as a result of hydraulic fracturing because of the large vertical distance between the hydraulic fracturing zone and the surface (several thousand metres), a distance over which the intervening rocks for any cavities produced by hydraulic fracturing in this context. This contrasts with CSG operations where a substantial proportion of the original void volume is removed as produced water, and there is a real possibility of subsidence given the closer proximity to the surface.

The Interim Report of the Most Recent Northern Territory Inquiry

This Report was released in July 2017, with a desire to complete hearings and their final Report by Christmas 2017. The report and the submissions are available using google on

www.frackinginquiry.nt.gov.au

There are 10 members of the Panel that apart from Justice Pepper are scientists. There are no Panel members trained in economics or economic modelling.

The interim report makes it clear that the role of the Panel is not to provide recommendations to the politicians enabling them to make the decisions to remove any moratorium or to specifically define specific regulations that would apply to the future management of any possible oil and gas project on shore in the Northern Territory.

The Panel has clearly been influenced by the EPA Report to Congress on the Impact of Fracking on Drinking Water. The Report even includes some graphics which have been extracted from the EPA Report.
There are a number of aspects which are seen by the members of the Panel to be significant negatives on any decision making process to allow further oil and gas extraction onshore Northern Territory. Obviously some of the issues referred to in the EPA Report are included in that list of negatives. To be fair to the Panel, they have made a number of positive comments impartially dealing with the negatives. The most significant negatives on a net basis come out of the social, environment and health aspects of petroleum operations onshore.

The Panel has contracted two independent parties to conduct further research and provide feedback on:

- Economic modelling on the financial impact of petroleum operations on the Northern Territory, regions in the Northern Territory and communities within those regions; and
- Social studies modelling over the impact of petroleum operations on local communities.

The work of Professor Allan Hawke during the prior Inquiry was seen as useful but not conclusive. That work was principally scientifically and technically oriented and as a result has limitations. The submission by Deloittes to the prior NT Inquiry was considered to be overly ambitious in the financial benefits capable of being achieved.

The Panel is presently holding meetings with a range of communities through the Northern Territory and will be conducting more meetings with bodies such as the South Australian Department of Development and the Alberta (Canada) department dealing with the extraction of petroleum products within the province of Alberta in Canada.

The Health (Mental and Physical) Issues of Unconventional Drilling

Without going into details, some of the issues identified in the submissions to the various Inquiries have included:

- Doctors in regions covering CSG exploration and production identifying an increase in respiratory illnesses, headaches and general sickness, with increased worries over carcinogens and ECDs.
- The culture and backgrounds of many of the construction and production operators were very foreign to the locals causing tension in the communities.
- Previously quiet conservative environments were suddenly thrust into a new challenging world of oil the and gas industry and many could not deal with this intrusion.
- There were releases of gasses and liquids that worried the locals over pollution to their environments and water sources.
- Some pressures were evident with companies seeking to lock down property access agreements with locals and some people felt under pressure to sign documents they did not understand.
- The boom/bust scenarios that frequently flowed from mining and oil and gas projects once the recoverable products were exhausted did not encourage community participation.
- The NT as one example had examples of inadequately restored sites post operations that then impacted on healthy environments elsewhere.

While many of these have nothing to do with the techniques of fraccing, they are side issues from projects that need fraccing to generate sufficient revenue to be viable.

The current NT Scientific Inquiry has announced that it will be extensively consulting with local communities to consider many of these issues.

Is Fracking Safe? The 10 Most Controversial Claims About Natural Gas Drilling.

Popular Mechanics wrote an article and posted it to their website in 2016 at www.popularmechanics.com/science/energy/g161.

Their comments are worth repeating on some of those claims.

3. Natural Gas is Cleaner, Cheaper, Domestic and it's Viable Now (T. Boone Pickens, Sept 2009)

Burning natural gas is cleaner than oil or gasoline, and it emits half as much carbon dioxide, less than 1/3 the nitrogen oxides and 1% as much sulphur oxides as coal combustion. But not all shale gas makes it to the fuel tank or power plant. The methane that escapes during the drilling process, and later as the fuel is shipped via pipelines, is a significant greenhouse gas. At least one scientist, Robert Howarth at Cornell University, has calculated that methane losses could be as high as 8%. Industry officials concede that they could be losing anywhere between 1% and 3%. Some of those leaks can be prevented by aggressively sealing condensers, pipelines and wellheads. But there's another upstream factor to consider. Drilling is an energy intensive business. It relies on diesel engines and generators running around the clock to power rigs, and heavy trucks making hundreds of trips to drill sites before a well is completed. Those in the industry say there's a solution at hand to lower emissions – using natural gas itself to power the process.

4. There’s Never Been One Documented Case of Groundwater Contamination (Sen James Inhofe April 2011)

The Senator is incorrect. In the past two years alone, a series of surface spills, including two blow outs at wells operated by Chesapeake Energy and EOG Resources and a spill of 8,000 gallons of fraccing fluid at a site in Dimock Pennsylvania have contaminated groundwater in the Marcellus shale region. But the idea stressed by fracking critics that deep-injected fluids will migrate into groundwater is mostly false. Basic geology prevents such contamination from starting below ground. A fracture caused by the drilling process would have to extend through the several thousand feet of rock that separate deep shale gas deposits from freshwater aquifers.
The fracking fluid itself thickened with additives, is too dense to ascend upward through such a channel
.
7. Do Not Drink this Water (Hand written sign in the documentary “GasLand 2010”)

Its an iconic image, captured in the 2010 Academy Award-nominated documentary “GasLand “. A Colorado man holds a flame to his kitchen faucet and turns on the water. The pipes rattle and hiss, and suddenly a ball of fire erupts. It appears a damning indictment of the gas drilling nearby. But Colorado officials determined the gas wells weren’t to blame; instead, the home owners own water well had been drilled into a naturally occurring pocket of methane. Nonetheless, up to fifty layers of natural gas can occur between the surface and deep shale formations, and methane from these shallow deposits has intruded on groundwater near fracking sites. In May, Pennsylvania officials fined Chesapeake Energy $1 million for contaminating the water supplies of 16 families in Bradford County. Because the company had not properly cemented its boreholes, gas migrated up along the outside of the well, between the rock and steel casing, into aquifers. The problem can be corrected by using stronger cement and processing casings to create a better bond, ensuring an impermeable seal.

8. Radio Active Contents in Wastewater (ProPublica Nov 2009)

Shale has a radioactive signature – from uranium isotopes such as radium-226 and radium-228 – that geologists and drillers often measure to chart the vast underground formations. The higher the radiation levels, the greater the likelihood those deposits will yield significant amounts of gas. Tests conducted earlier this year in Pennsylvania waterways that had received treated water – both produced water (the fracking fluid that returns to the surface) and brine (naturally occurring water that contains radioactive elements, as well as other toxins and heavy metals from the shale) – found no evidence of elevated radiation levels.

FINAL COMMENTS

The more obvious useful points are:

- the activities of contractors need to be very carefully supervised to ensure they meet the specs of their contracts and comply with all Regulations in place at the time of fraccing. This contract may need to include penalty clauses to meet compensation claims outside the purview of the exploration company;
- all cementation work and casing done downhole must be at the highest standards and appropriately located to ensure absolute minimal leakage up and around the casings;
- spills of fracc fluids and chemicals pre-mix must be cleaned up immediately and not allowed to seep into the sub-soils, with remedial action taken to collect into waste and dispose securely;
- the statistics on what causes so many of the spills and leaks indicates that people management and equipment monitoring are of the utmost importance to prevent site accidents;
- process water and mixed water pre-fracc will need to be kept in quality appropriately lined dams and tanks awaiting re-injection or injection as the case may be;
- regular reporting of all leaks and spills will become standard expectations; and
- the need for base line data to be collected before any operations start.

What does come out of the EPA Report to Congress are a number of intelligent questions our Australian Regulators and our drilling/tenement owners must address. These include:

- how large is any fraccing activity that is going to be allowed onshore Australia and how that will be related to particular regions and geological scenarios?
- what chemicals and agents will be excluded from acceptable additive lists in the fracc fluids?
- how close it will be possible to fracc a well, to any other existing well subterranean network, particularly any plugged and abandoned wells?
- what monitoring responsibilities will any exploration/production company have over plugged and abandoned wells if those wells are part of a subterranean fissure network that may inter-relate via geological structures, faults and sheer zones?
- what separation distance and geological safe-harbours will be required between the bottom layers of water aquifers and the top layers of the zones of interest that will be horizontally drilled and fracced?
- in environmentally sensitive regions, what additional spill controls and clean up obligations will be imposed and issues over compensation to the landowners involved?
- what base-line datasets will be required before, during and after fraccing activities?
- what ongoing daily, monthly and annual reporting will be required over any field that has received Regulatory Authority approval to fracc?
- how many perforations will be allowed down a horizontal drill pipe in the pay zones and what additional controls around casing and production head leakages?
- will there be environmental trust funds established to deal with any potential environmental damage caused by explorer/producers onshore Australia and what is likely to be the level of contributions and how they will be administered for the protection of all stakeholders?