RURAL COMMUNITIES AUSTRALIA

SUBMISSION TO THE PARLIAMENTARY INQUIRY ON UNCONVENTIONAL GAS (FRACKING), NATURAL RESOURCES COMMITTEE, PARLIAMENT OF SOUTH AUSTRALIA

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SUMMARY OF SUBMISSION:

1. **International research documents adverse impacts of hydraulic fracturing for shale gas.**
2. **This evidence presents clear risks of this technology for the health and well-being of human populations and for the integrity of environmental systems.**
3. **On the basis of the evidence, the Precautionary Principle must apply in the making of policy.**
4. **The State regulations governing the approval of proposals for hydraulic fracturing require a full, quantitative accounting of the impacts and risks associated with these operations, including uncertainties. This is in alignment with the Precautionary Principle.**
5. **Existing hydraulic fracturing Environmental Impact Reports, even when approved, have not met these regulatory requirements.**
6. **International best-practice in environmental assessment centres on *Integrated Life Cycle and Risk Assessment*. Without the detailed data and technical information provided by this Assessment regulatory requirements cannot be effectively met.**

RECOMMENDATION:

Implementation of *Integrated Life Cycle and Risk Assessment*, as described in this Submission, should be mandatory for all proposers of hydraulic fracturing in this State in meeting the requirements of Regulation 10 of the Petroleum and Geothermal Energy Regulations 2000 for the Environmental Impact Report.

CONTENTS

A. THE INTERNATIONAL EVIDENCE BASE

1. **The impacts of hydraulic fracturing (fracking) for shale gas and coal seam gas have now been researched in many countries, including North America, Europe and China. This large body of published scientific work has raised clear concerns about a number, size and scope of environmental and social impacts associated with the fracking technology.**

   These impacts have been summarised recently by the Stockholm International Water Institute's 2014 report (Hoffman et al. 2014) . Issues reported by the SIWI review of this research included:

   Water availability: Substantial amounts of water are needed for hydraulic fracturing and the drilling operation—up to half a million cubic metres per well.

   Groundwater contamination: There are demonstrated threats to aquifer water quality from faulty well casing and concrete. This can connect deeper gas with shallow aquifers under differential pressure. Drilling can connect shallow gas with aquifers. There are demonstrated problems of leakage with abandoned wells and deterioration of casing.

   Quality of surface waters: There has been frequent spillage of fracking fluids or contaminated wastewater from routine operations or storms. There have been regular problems handling highly saline or chemically contaminated waste water around the drilling site (impacting safety of workers) and in transport (some massive spills). There have been significant problems with waste ponds leaching into soils, and overspills. There are typically high levels of Total Dissolved Solids in waste water that cannot be handled by treatment plants.

   Air quality: Emissions from hydraulic fracturing include ozone precursors NOx, and methane from flares, valves, and compressor blowdowns; particulate emissions; silica dust from proponent handling during fracking; and Volatile Organic Compounds (such as benzene, toluene, ethyl benzene and xylenes) from condensate or tanks.

   GSG emissions: Leakage of methane from natural fractures typically occurs around the bore, from well casings and concrete, and from pipelines and infrastructure. This can offset any CO_2 saving of natural gas over coal.

   Health: There are substantial US studies indicating increased incidence of disease near wells from groundwater and air contamination. A recent rural Colorado study of 125,000 live births indicated a statistically greater likelihood of birth defects within 10 miles of wells.

Triggering of seismic events: The US Geological Survey identified up to a 6-fold increase in seismic events in well areas. Regulations in some areas now require indefinite suspension of any drilling with a 1.0 or higher event. Seismic events associated with hydraulic fracturing have been measured up to 4.8 on the Richter scale. A 2015 study of earthquakes in Ohio has directly linked earthquake activity to fracking operations, and that state as suspended drilling in all the wells in question.

Social and community disruption: Demonstrated impacts of gas field development include unplanned industrialisation, noise pollution from operations and truck traffic, decline in property values; and the loss of ecosystem services. There is a need for comprehensive economic and social valuation of these large landscape-scale impacts.

The Stockholm report bibliography references many international sources of data and evidence supporting these findings.

2. **Recent, credible international assessments emphasise the ongoing risks of fracking.**

For example:

a. The UK Government Chief Scientific Advisor released this month a report on the technology, emphasising that the risks across the hydraulic fracturing life-cycle were largely not identified or measured (Bennett et al. 2014). In terms of the lack of understanding and measurement of the risks associated with the innovation trajectory of the technology the Chief Scientist grouped hydraulic fracturing at this stage of its development with other products that subsequently proved to be very damaging, including asbestos and tobacco. Commenting on a group of new scientific initiatives, one of which is fracking, the report remarks:

> "What characterizes. . .these typical but not exhaustive innovation-risk examples is the science-led initial development; the connection to a profitmaking commercial sector; an unbalanced distribution between those who gain and those who are exposed to the perceived risks; an inconsistency over the seemingly wide ranging general benefit of the technology and the localized or targeted exposure to any residual risks; complicated time frames of immediate gain and prolonged uncertain disadvantages, especially for future generations; and a deeply felt resentment amongst vociferous antagonists that their preciously held underlying values are being excluded from the final policy decision."

b. The US Environmental Protection Agency is undertaking a five-year project to identify and quantify all the impacts and risks to drinking water quality associated with hydraulic fracturing across its life-cycle: site preparation, drilling operations, site operations, wastewater, transport, and so on. Technical papers are being published as they are completed (EPA 2012).

c. Recently fracking in New York State was banned, following a review by the New York Department of Health of health risks associated with the technology (Zucker 2014). The study presented the following major findings:

"Summarized below are some of the environmental impacts and health outcomes potentially associated with HVHF (High Volume Hydraulic Fracturing) activities:

- Air impacts that could affect respiratory health due to increased levels of particulate matter, diesel exhaust, or volatile organic chemicals.
- Climate change impacts due to methane and other volatile organic chemical releases to the atmosphere.
- Drinking water impacts from underground migration of methane and/or fracking chemicals associated with faulty well construction.
- Surface spills potentially resulting in soil and water contamination. Surface-water contamination resulting from inadequate wastewater treatment.
- Earthquakes induced during fracturing.
- Community impacts associated with boom-town economic effects such as increased vehicle traffic, road damage, noise, odor complaints, increased demand for housing and medical care, and stress."

These findings duplicate those of the Stockholm International Water Institute Report cited above.

d. Many countries have banned fracking on the basis of the research evidence, including Germany, France, Bulgaria, Romania, the Czech Republic, Northern Ireland, and Luxembourg. Regions in Spain and Switzerland have bans in place. The New York State ban follows an earlier ban by the state of Vermont. Counties or cities that have banned fracking, or placed a moratorium on it, occur in 25 US States, including New Jersey, California, and Texas.

B. THE PRECAUTIONARY PRINCIPLE

1. It is clear from the international research evidence and policy that serious concern about the environmental impacts of fracking is both reasonable and appropriate. As noted, the technology is still in the early phases of its development; the full range of risks is still unknown and unmapped; and evidence of damaging environmental and social impacts is continuing to emerge in the international research literature.

2. In this situation international best-practice is to apply the **Precautionary Principle**. An authoritative definition of the Principle is provided by UNESCO (World Commission on the Ethics of Scientific Knowledge and Technology (COMEST) 2005):

> "When human activities may lead to morally unacceptable harm that is scientifically plausible but uncertain, actions shall be taken to avoid or diminish that harm.
>
> Morally unacceptable harm refers to harm to humans or the environment that is threatening to human life or health, or serious and effectively irreversible, or inequitable to present or future generations, or imposed without adequate consideration of the human rights of those affected.
>
> The judgement of plausibility should be grounded in scientific analysis. Analysis should be ongoing so that chosen actions are subject to review. Uncertainty may apply to, but need not be limited to, causality or the bounds of the possible harm. Actions are interventions that are undertaken before harm occurs that seek to avoid or diminish the harm. Actions should be chosen that are proportional to the seriousness of the potential harm, with consideration of their positive and negative consequences, and with an assessment of the moral implications of both action and inaction. The choice of action should be the result of a participatory process."

3. This submission argues that the international scientific research on fracking has established a scientifically plausible ground for believing that fracking is associated with unacceptable environmental and social harms. **In that situation the Precautionary Principle mandates that actions must be taken to avoid or diminish those harms**.

C. THE SOUTH AUSTRALIAN REGULATORY ENVIRONMENT

1. Legislation and regulation governing the Environmental Impact Report (EIR)

Any proposer of hydraulic fracturing in South Australia must be prepare an Environmental Impact Report (EIR) under the Petroleum and Geothermal Energy Act 2000, in particular Section 97 of the Act and Regulation 10 of the Petroleum and Geothermal Energy Regulations 2000.

With respect to Environmental Protection, Regulation 10, sub-regulation (1) requires licensees to prepare and Environmental Impact Report (EIR). The EIR must provide information or material on the following (emphases added):

(c) A description of the reasonably foreseeable **events** associated with the activities that could pose a threat to the relevant environment, including—
- (i) information on the following:
  - (A) events during the *construction stage (if any), the operational stage and the abandonment stage*; and
  - (B) events due to atypical circumstances (including *human error, equipment failure or emissions, or discharges above normal operating levels*); and
- (ii) information on the *estimated frequency* of these events; and
- (iii) an explanation of the *basis on which these events and frequencies have been predicted*; and

(d) an assessment of the potential **consequences** of these events on the environment, including—
- (i) information on the following:
  - (A) the extent to which these consequences can be managed or addressed; and
  - (B) the action proposed to be taken to manage or address these consequences; and
  - (C) the anticipated *duration* of these consequences; and
  - (D) *the size and scope* of these consequences; and
  - (E) the *cumulative effects* (if any) of these consequences when considered in conjunction with the consequences of *other events* that may occur on the relevant land (insofar as this is reasonably practicable); and
- (ii) an explanation of the *basis on which these consequences have been predicted*;

Further, Regulation 10, sub-regulation (3) states that Information and material provided under sub-regulation (1) must—

(a) be balanced, objective and concise; and
(b) state any limitations that apply, or should apply, to the use of the information and material; and

(c) identify any matter in relation to which there is *a significant lack of relevant information or a significant degree of uncertainty*; and
(d) so far as is relevant, identify the *sensitivity* to change of any assumption that has been made and any significant risks that may arise if an assumption is later found to be incorrect.

In summary, the Regulation relevant to hydraulic fracturing proposals requires:

- Identification of risks across the entire life cycle of the operation.
- The quantification of these risks in frequencies.
- An account of the method by which these frequencies have been estimated.
- Full identification of all the impacts of these events on the environment.
- Quantification of the potential duration, size, scope and cumulative impact of these events.
- An account of the potential risks posed by the interaction of these events with other activities on the land occupied by the project.
- An account of the technical methods by which these quantitative estimates have been made.
- A quantitative analysis of the uncertainty associated with these data.
- A sensitivity analysis on variations of these data.

2. Evidence of inadequate practice in hydraulic fracturing proposal EIRs

This submission argues that recent EIRs included in current hydraulic fracturing projects in the State have not met the requirements of Regulation 10. A survey of recent proposals has shown:

- The EIRs typically give no more than a qualitative description of potential events which place the environment at risk across some stages of the project, together with a description of risk mitigation strategies. Moreover, some stages, such as site preparation and site abandonment (the latter specifically required by the Regulation) are often omitted
- Risks are typically described in crude terms, such as ‘possible’, ‘unlikely’, or ‘remote’. This is presented as a subjective judgement, with no information provided on how these descriptive assessments were arrived at. No quantitative estimates are provided of the predicted frequencies of these risks, nor of the basis on which those quantitative estimates should be made, as required by the Regulation.
- Typically no data is provided on the durations, size, scope or cumulative effects of these impacts on the environment. No consideration is given to the risk posed by interactions of these events with other activity on the land occupied. No data on uncertainty is provided.

No sensitivity analysis data is carried out. All are required by the Regulation—all are usually missing.

- There are typically no references to the Australian and international technical literature on these risks provided in the Reference list, or cited in support of the risk description. As a result the risk description is presented simply a subjective judgement of the proposer, unsupported by credible data. This submission argues that this does not meet the requirements of the Regulation.

Reference to inadequate proposals of this kind can be provided to the Parliamentary Committee if required.

D. INTEGRATED LIFE CYCLE AND RISK ASSESSMENT

How should the requirements of the Regulation be properly met?

In my opinion, Regulation 10 does embody the principles of best international practice in the assessments of the risks of such projects to the environment. Its requirements should therefore be taken seriously: they must be met.

International best-practice in this area is represented by *Integrated Life Cycle and Risk Assessment.* This Assessment is at the level of technical sophistication that is required to meet the quantitative requirements of the Regulation. In addition, it is a critical part of implementing the Precautionary Principle for hydraulic fracturing. **Without the detailed data and technical analysis provided by the Assessment the requirements of the Precautionary Principle and Regulation 10 cannot be properly met.**

1. Phases of the methodology

There is a wide technical professional literature on Integrated Life Cycle and Risk Assessment. It is standard professional best-practice throughout the world. The elements of the methodology can be briefly outlined as follows (Sonnemann et al. 2004):

Phase 1: Life Cycle Analysis

The specific steps of the hydraulic fracturing operation—such as site preparation, drilling preparations, drilling operations, site operations, waste water treatment, transport of materials and waste, drilling completion, site abandonment—are identified. The Life Cycle Inventory (LCI*) identifies and quantifies* all the input and output flows of the processes relating to each step identified in the LCA.

Phase 2: Impact Assessment

The impacts of the input and output flows of the processes identified in the LCI on human health and on the environment are *identified, described and quantified*. Impact categories may include human toxicity; eco-toxicity; potential degradation of environmental systems, such as water quality in aquifers; and ecological quality of wetlands or native vegetation communities. The Environmental Risk Assessment (ERA) framework includes:

- **Hazard identification**: identification of the adverse effect that a substance has the capacity to cause.
- **Exposure assessment**: quantitative estimates of the concentrations of substances or processes to which human populations or environmental systems may be exposed.
- **Exposure-response assessment**: quantitative estimates of the relationship between the level of exposure and the incidence and severity of an effect.
- **Risk characterisation**: quantitative estimates of the frequencies and severity of the adverse effects likely to occur in a human population or environmental system due to actual or predicted exposure to a substance.

Phase 3: Uncertainty Assessment

Both Phase 1 and Phase 2 require a wide range of quantitative estimates to be made, based on comprehensive evaluations of the relevant technical literatures. All quantitative estimates are associated with uncertainty. These uncertainties are captured quantitatively in the analysis, as follows:

- All factors identified as material in the LCI and ERA are systematically associated with specific probability distributions, based on an in-depth analysis of the technical literature.
- Monte Carlo Simulation is then carried out.
- A Sensitivity Analysis is then carried out, using the analytic tool developed.
- The results of the analysis are described and discussed.

2. The Submission

It will be noted that the Integrated Life Cycle and Risk Assessment methodology described here meets *point by point* the requirements of Regulation 10. Existing EIRs do not provide this level of analysis. It is therefore submitted that:

> **Implementation of *Integrated Life Cycle and Risk Assessment*, as described in this Submission, should be mandatory for all proposers of hydraulic fracturing in this State in meeting the requirements of Regulation 10 of the Petroleum and Geothermal Energy Regulations 2000 for the Environmental Impact Report.**

3. Department responsibilities

Government agencies tasked with the assessment of the EIR for hydraulic fracturing should be fully informed and qualified on the methodology of Integrated Life Cycle and Risk Assessment. These agencies should be asked to formulate for proposers precise requirements for the application of this Assessment to EIRs in their proposals. These agencies should then be asked to apply the standards of this Assessment to the evaluation of all hydraulic fracturing proposals.

4. International review

Many international jurisdictions now have extensive experience in applying Integrated Life Cycle and Risk Assessment to proposals for hydraulic fracturing. Agencies should be required to submit their methodology frameworks of the Assessment to qualified international review before it is adopted as policy.

About the author: Dr. Geoffrey Wells is an internationally experienced academic leader and consultant. He is a former Dean in the Business School at the University of South Australia. He has developed, and currently teaches, graduate courses in sustainable business and natural resource management, and has published articles and books in these academic arenas. He has recently been a member of the research team on two major Australian government research grants in modelling local management responses to climate change, and has carried out funded research in economic valuation methods in natural resource management. Dr Wells is the Director, Rural Communities Australia, a not-for-profit organisation which supports the environmental integrity and social health of rural communities.

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