

LOCK THE GATE ALLIANCE

AUSTRALIANS WORKING TOGETHER TO PROTECT OUR LAND, WATER, AND FUTURE

Submission to the Senate Select Committee Inquiry on Unconventional Gas Mining in Australia: March 2016

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Introduction

Lock the Gate Alliance is a national grassroots organisation made up of thousands of individuals and over 240 local groups who are concerned about unsafe or inappropriate mining. The mission of the Lock the Gate Alliance is to protect Australia's agricultural, environmental, and cultural resources from inappropriate mining and to educate and empower all Australians to demand sustainable solutions to food and energy production. Lock the Gate Alliance is committed to advocating that environmental and community health, as well as the productivity of local economies, should take priority over the development of an unconventional gas industry in Australia.

Lock the Gate Alliance wholeheartedly welcomes this Senate Inquiry and its mandate to thoroughly examine 'the adequacy of Australia's legislative, regulatory and policy framework for unconventional gas mining including coal seam gas (CSG) and shale gas mining'. The Alliance appreciates the opportunity to make a submission on the existing and potential impacts of the unconventional gas industry on Australian communities and the local environments, land and water resources on which they depend.

Following two and a half decades of rapid development that has seen a massive expansion in the unconventional gas (UG) industry across twenty one states¹ of the USA, there is now a significant body of literature detailing many negative impacts of unconventional gas extraction, including, though by no means limited to, hydraulic fracturing (fracking) processes. The growing evidence of actual harm, and the potential environmental and health risks from UG development, has now resulted in decisive action from governments across the globe to halt the expansion of this industry. Internationally, jurisdictions with some form of ban or moratorium in place include Scotland, Wales, Germany, Bulgaria, Romania, the Netherlands, Northern Ireland, Wales, the Czech Republic, Luxembourg and France as well as the US States of New York, Maryland, and Vermont and the Canadian Provinces of New Brunswick, Newfoundland, Nova Scotia and Quebec.

Experiences of the UG industry overseas have been mirrored in Australia over the past few years with the rapid development of a coal seam gas (CSG) industry in Queensland following the approval of three large CSG to LNG export projects in 2010-11. This unprecedented expansion of gasfield industrialization in rural Queensland has already done lasting damage to the natural environment, water resources and local communities of the impacted areas. With the unconventional gas industry looking to expand across most states and territories of Australia, the potential risks to the nation's limited food growing lands, scarce water resources and vital rural communities cannot be underestimated.

¹ <http://www.citizensforethics.org/pages/map-states-where-the-fracking-industry-is-active>

Summary of Recommendations to Senate Inquiry

Given the mounting evidence of the risks and impacts of UG extraction in both Australia and internationally (as documented in our 'Response to Inquiry Terms of Reference' section below), the Lock the Gate Alliance calls on this Senate Inquiry to recommend the following:

1. A moratorium on any new unconventional gas mining or exploration until further important research has been completed and proper baselines put in place.
2. Exclusion zones to protect agricultural land, significant water resources, national landscapes and tourism icons, and residential dwellings from unconventional gas exploration and mining impacts.
3. The creation of new legislation to implement the goals of the National Food Plan and to give statutory weight to the Australian Council on Food.
4. Improved Federal environment laws that properly protect water sources, cultural heritage and significant environmental areas.
5. Identification of best practice methods for baseline monitoring of health impacts, water resources, air quality, soil quality, and fugitive emissions.
6. The creation of a Clean Air and Water Act that sets national standards on pollution from unconventional gas mining to protect human health and the establishment of a national Environment Protection Authority.
7. Proper measurement and accounting of greenhouse gas emissions from unconventional gas operations.
8. Federal legislation to ensure that cumulative impacts from gas mining on nationally significant water resources, natural areas and cultural heritage sites are assessed, prevented and mitigated.
9. Expansion of the EPBC Act 'water trigger' so that all forms of unconventional gas extraction ie. shale and tight gas, are covered by it, as well as all coal and unconventional coal developments.
10. Banning of "flaring", associated with fracking, which releases noxious air pollution and which has been banned in some overseas jurisdictions.
11. Requirement for full hazard assessments and compulsory disclosure of all chemicals used in unconventional gas mining, and prohibition of the use or production of chemicals or chemical mixtures that are harmful to human health or the environment.
12. Use of existing federal powers to create national legislation to give landholders, Traditional Owners and communities the right to say "NO" to unconventional gas operations.

Lock the Gate Alliance notes that in most jurisdictions in Australia the unconventional gas industry is still in exploration or early production stages. The Alliance commends the actions of State Governments in Victoria and Tasmania who have responded to community concerns by implementing moratoriums on UG development in those states, and welcomes actions by some other State Governments that have attempted to address the many issues surrounding this industry.

In Queensland, a radically different scenario exists, with approximately 4,500² CSG wells producing gas in that state as at June 2015, and an additional 20,000 wells already approved. The rush to exploit CSG in Queensland and convert it to LNG, never previously attempted, has done lasting damage to the water resources and communities of the affected areas, and has had drastic negative economic consequences, rapidly driving up the price of gas for domestic consumers and industry, and throwing regional economies into turmoil. In Queensland, the approvals for large scale CSG projects were done in haste and implemented before communities knew of the potential impacts and without any opportunity for them to object to the industry being imposed upon them.

In light of the harm currently being experienced on a daily basis by farming families in CSG production regions in Queensland, the Alliance urges this Inquiry to recommend that the Federal Government use whatever mechanisms are available, including the COAG framework, to encourage the Queensland government to undertake the following 8 point plan to urgently address the impacts of the existing CSG industry on impacted communities:

1. Amend the laws to prevent CSG companies using the threat of the Land Court to intimidate and coerce farmers, and instead provide landholders with a right to say no so that CSG companies are required to deal fairly if they want to obtain access.
2. Place an immediate halt on Origin Energy plans to drill CSG wells in the Hopeland area and create a permanent no-go zone to protect this important floodplain area from CSG drilling in the future.
3. Urgently broker buy-outs between gas companies and at least 5 families who are now at crisis point around Chinchilla, with the goal of having them moved to their satisfaction by the end of the year.
4. Establish a CSG Family Crisis Panel which has a statutory role to broker exits for families who can no longer live with the stress of CSG mining, and which has a wide remit to intervene at a high level to resolve protracted difficulties for families.
5. Establish and fund a Resources Ombudsman under statute, with all relevant powers granted to such office generally, to adjudicate in a formal manner on CSG related disputes, complaints and issues.
6. Establish a dedicated counselling and support service for CSG Affected Communities, which is managed under the CSG Family Crisis Panel.
7. Immediately commence a study into the health impacts of CSG, funded to the tune of at least \$500k, with an emphasis on mental health impacts and amelioration measures and which also includes ambient air quality monitoring program as recommended previously.
8. Establish a CSG Health Roundtable, comprised of independent public health professionals

² https://www.dnrm.qld.gov.au/__data/assets/pdf_file/0020/238124/petroleum.pdf

with experience in environmental health, mental health and social impacts, to advise it on CSG impacts and to design and oversee the study referred to above.

Further to this, the Alliance urges the Inquiry to recommend that the Australian Government refuse to approve any further CSG developments in Queensland that require Federal approval, until such time as the above recommendations have been implemented.

Response to Senate Inquiry Terms of Reference (TOR):

The Senate Select Committee review of unconventional gas mining Terms of Reference focus on *'The adequacy of Australia's legislative, regulatory and policy framework for unconventional gas mining including coal seam gas (CSG) and shale gas mining with reference to:*

- a. a national approach to the conduct of unconventional gas mining in Australia;*
- b. the health, social, business, agricultural, environmental, landholder and economic impacts of unconventional gas mining;*
- c. government and non-Government services and assistance for those affected;*
- d. compensation and insurance arrangements;*
- e. compliance and penalty arrangements;*
- f. harmonisation of federal and state/territory government legislation, regulations and policies;*
- g. legislative and regulatory frameworks for unconventional gas mining in comparable overseas jurisdictions;*
- h. the unconventional gas industry in Australia as an energy provider;*
- i. the current royalty and taxation arrangements associated with unconventional gas mining; and*
- j. any related matter.'*

Lock the Gate's responses to some of the Terms of Reference are detailed in the following paragraphs.

1. TOR a: A national approach to the conduct of unconventional gas mining in Australia

As unconventional gas is found in less permeable deposits or spread more diffusely throughout rock substrates than conventional (or so-called "natural") gas, rather than in discrete pockets or reservoirs, it is more difficult to extract and therefore requires more specialized (i.e. 'unconventional') extraction techniques and processes. The methods required for the extraction of unconventional gas include hydraulic fracturing (fracking), horizontal drilling, multiple drilling, and acidation. In addition to these extra processes, unconventional gasfields involve the industrialisation of entire landscapes with hundreds if not thousands of wells and ancillary infrastructure. This infrastructure includes vast networks of roads and pipelines, gas

compressor stations and processing plants, and wastewater holding dams and treatment facilities. The number of wells required and area of land impacted is exponentially larger than for conventional gasfields. In summary, the technologies of scale and spatial intensity of unconventional gas development, both at the surface and underground, makes it an entirely different proposition to conventional gas extraction. (For a detailed explanation of scale and intensity see Professor Tony Ingraffea's testimony to the South Australian Fracking Inquiry³).

Currently, unconventional gas exploration and production operations in Australia are largely managed and controlled under State Government onshore petroleum legislation, with some (usually large-scale) projects also requiring Australian Government approval if Federal environment laws are triggered by a proposed UG development. These onshore petroleum statutes were typically developed to manage historical conventional gas operations, which, as outlined above, are very different in their scale and intensity than conventional operations, with correspondingly far greater potential for impacts on land, water and air. Consequently, the roll out of the unconventional gas industry across Australia has taken place within a regulatory environment that is grossly inadequate to the task of managing this geographically dispersed and spatially intensive industry and the new and often experimental processes and methods it employs.

Across the country, the current State legislation under which the UG gas industry is operating often fails to address a whole range of factors and governments are playing policy catch up as this industry is rolled out without proper consideration of the possible or likely impacts. Some of the issues that current legislation fails to adequately address include: impacts that occur during the exploration phase of development; cumulative impacts across multiple projects; use of untested chemicals and chemical cocktails in fracking processes; cumulative water demand of unconventional gas mining, and the intersection of that with existing water demand; treatment, storage and disposal of unprecedented volumes of saline wastewater (that also contains fracking chemicals and other toxic substances present in the rock substrates such as heavy metals and radionuclides); fugitive emissions and air pollution impacts and resultant human health risks; and satisfactory monitoring and compliance regimes. In addition to the failure to properly address the risks, there is also an absence, across all jurisdictions, of legislated mechanisms to ensure that adequate baseline data relating to air, water and soil systems is gathered prior to commencement of UG activities. Without proper baseline data, there is no way to measure and quantify impacts that do occur, let alone manage or mitigate those impacts.

Whilst there have been some attempts by State Governments, in response to sustained pressure from their constituents, to address the policy deficits, those attempts have largely

³ Ingraffea, Professor Tony, Presentation to South Australian Parliamentary Inquiry into Fracking. Available here: <https://www.parliament.sa.gov.au/Committees/Pages/Committees.aspx?CTId=5&CId=295>

fallen short of properly addressing the legislative inadequacies. Similarly, the States have largely failed to enact proper protections for important water resources, productive agricultural lands, sensitive environmental areas, existing rural industries and human health to ensure that they are not negatively impacted by UG operations. For example, Lock the Gate's [detailed report](#) (see Appendix One) analysing the NSW Government policy framework on CSG shows that it is "falling short on the four big issues of concern to communities: water, health, protection of farmland, and landholder and community rights" and highlights the fact that one year on from the Final Report into coal seam gas by the NSW Chief Scientist, the New South Wales Government "has still not implemented her most important recommendations." The analysis also noted that the NSW regulatory framework remains "fragmented, inadequate and poorly understood," and that the "Government has failed to deliver on 8 of the 15 recommendations by the Chief Scientist, and only delivered partially on the remaining 7 recommendations". Pointedly, the report concludes, "the failings exposed by this report card are particularly damning, because it was the Chief Scientist's recommendations which formed the basis for the NSW Government to push ahead with the industry. Poor implementation of those recommendations is affecting lives and impacting on communities."

In testimony⁴ to the South Australian Parliamentary Inquiry into fracking, US academic Tony Ingraffea highlights the inability of the current SA regulatory to manage the impacts of UG development in that state. Being familiar with the regulations across most state and provinces of the US and Canada, Ingraffea is well placed to comment on the adequacy or otherwise of Australian regulatory frameworks. He notes that the SA regulations fail on a number of levels: importantly they fail to address the particularity of shale gas extraction; they fail to refer to 'green completions'; nothing in them regarding surface containment or underground containment or tank containment or lake containment of flowback; nothing regarding the different types of compressor stations that can be installed; nothing about when the flaring has to start, when the flaring has to stop and they are not explicit with respect to important elements regarding wellbore integrity. In summary, he notes: "...your current regulations are vague, laissez-faire, written such that the industry is given all the responsibility to interpret things the way they want and the state in this case is left, in my opinion, holding the bag," and further, "I think your regs are wholly insufficient in their current state. They do not address the problems and the issues that have occurred in other provinces and other states that have been addressed and revised in much tougher regulations."

The policy failings of State Governments around unconventional gas reflect a lack of political will and occur in an environment where the States are increasingly addicted to projected royalty revenues, and seemingly unashamedly beholden to the vested interests of the resource

⁴ Ingraffea, Professor Tony, Presentation to South Australian Parliamentary Inquiry into Fracking. Available here: <https://www.parliament.sa.gov.au/Committees/Pages/Committees.aspx?CTId=5&CId=295>

extraction industries and their paid lobbyists. This widespread policy failure on the part of State Governments, and the negative consequences of these failings on impacted communities, highlights the need for the Federal Government to use its powers to step in and protect the well-being of these communities, the land and water resources they rely upon for their livelihoods and the natural and rural landscapes they value and cherish. The Lock the Gate Alliance therefore calls upon the Federal Government to use the powers it has to implement a national approach to the conduct of Unconventional Gas mining that includes:

- A moratorium on any new unconventional gas mining or exploration until further important research has been completed and proper baselines put in place.
- Exclusion zones to protect agricultural land, significant water resources, national landscapes and tourism icons, and residential dwellings from unconventional gas exploration and mining impacts.
- The creation of new legislation to implement the goals of the National Food Plan and to give statutory weight to the Australian Council on Food.
- Improved Federal environment laws that properly protect water sources, cultural heritage and significant environmental areas.
- Identification of best practice methods for baseline monitoring of health impacts, water resources, air quality, soil quality, and fugitive emissions.
- The creation of a Clean Air and Water Act that sets national standards on pollution from unconventional gas mining to protect human health and the establishment of a national Environment Protection Authority.
- Proper measurement and accounting of greenhouse gas emissions from unconventional gas operations.

A [2012 Report](#) (see Appendix Two) by the Australian Network of Environmental Defender's Offices, clearly details the legislative powers under which the Australian Government could reasonably enact such a national policy framework.

2. TOR b: The health, social, business, agricultural, environmental, landholder and economic impacts of unconventional gas mining:

In the last few years, the state of knowledge about the risks and harms of unconventional gas mining has grown exponentially. When the New York State (NYS) Department of Health released its final Public Health Review⁵ of fracking in December 2014, the number of studies in the peer-reviewed scientific literature exceeded 400, up from the 60 studies that existed two years previously in a similar review by the NYS Department of Conservation. The environmental impacts outlined in the NYS Health Department review and their potential adverse effects on

⁵ A Public Health Review of High Volume Hydraulic Fracturing for Shale Gas Development: http://www.health.ny.gov/press/reports/docs/high_volume_hydraulic_fracturing.pdf

public health led the Department to recommend to the state government that fracking should not proceed in the State of New York. (The NYS legislature subsequently announced plans to impose a ban on fracking in the state).

The New York based health organization, the *Concerned Health Professionals of New York*, have compiled the *Compendium of Scientific, Medical, and Media Findings Demonstrating Risks and Harms of Fracking*⁶ (*The Compendium*) - “a fully-referenced compilation of the evidence for the risks and harms of fracking that brings together findings from the scientific and medical literature, government and industry reports, and journalistic investigation.” (It is worth noting here that in referring to impacts of fracking, *The Compendium* is referring to the entire life cycle and range of activities of unconventional gas operations, not just the fracking process itself.)

The second Edition of *The Compendium*, released in December 2014, noted that the “number of peer-reviewed publications [on the impacts of fracking] doubled between 2011 and 2012 and then doubled again between 2012 and 2013,” with 154 peer-reviewed studies on the impacts of fracking and unconventional gas released in the year prior to publication, almost all of which revealed problems. A further 100 new studies on the impacts of fracking and UG appeared in the peer-reviewed literature in the nine month period between the release of the 2nd edition and 3rd edition’s release in October 2015.

Clearly illustrating the rate at which the moving stream of data on unconventional gas extraction is accumulating, and the extent of the problems this data reveals, the 3rd Edition of the Compendium notes:

‘Our knowledge base is very young. The study citation database maintained by PSE Healthy Energy shows that over half of the available studies on the adverse impacts of shale and tight gas development have been published since January 2014. In 2014, 192 peer-reviewed studies on these impacts were published. In the first six months of 2015, 103 studies appeared.⁷ The vast majority of these studies reveal problems. Specifically, as demonstrated by PSE’s statistical analysis, 69 percent of original research studies on water quality found potential for, or actual evidence of, water contamination; 88 percent of original research studies on air quality found elevated air pollutant emissions; and 84 percent of original research studies on human health risks found signs of harm or indication of potential harm.’

Lock the Gate Alliance recommends that the Senate Inquiry take the time to read in full the detailed summaries of peer reviewed research covered in the NYS Department of Health

⁶ Concerned Health Professionals of New York & Physicians for Social Responsibility. (2015, October 14). Compendium of scientific, medical, and media findings demonstrating risks and harms of fracking (unconventional gas and oil extraction) (3rd ed.). <http://concernedhealthny.org/compendium/>

⁷ PSE Healthy Energy. <http://www.psehealthyenergy.org/site/view/1180>

Public Health Review⁸ and the latest edition⁹ (October 2015) of the Compendium of Fracking Risks.

Summarized below is a list from the NYS Public Health Review outlining some of the environmental impacts and health outcomes that have been associated with UG operations:

- Air impacts that could affect respiratory health due to increased levels of particulate matter, diesel exhaust, or volatile organic chemicals.
- 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.
- A range of health complaints and impaired health outcomes among residents living near HVHF [fracking] activities.
- 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.
- Climate change impacts due to methane and other volatile organic chemical releases to the atmosphere.

Additionally, the NYS Health Department review notes that an evaluation of the available research on fracking and UG impacts reveals critical information gaps. They state: “These need to be filled to more fully understand the connections between risk factors, such as air and water pollution, and public health outcomes among populations living in proximity to HVHF [high volume hydro-fracking] shale gas operations.”

The following paragraphs provide more detail on some of the health, social, business, agricultural, environmental, landholder and economic impacts of unconventional gas mining.

i. Health Impacts

There are a number of very significant impacts on the mental, emotional and physical well-being of communities facing and experiencing the rapid industrialization of their local area for UG development. These impacts are outlined in the following paragraphs.

Health Impacts Associated with Air and Water Pollution

⁸ A Public Health Review of High Volume Hydraulic Fracturing for Shale Gas Development: http://www.health.ny.gov/press/reports/docs/high_volume_hydraulic_fracturing.pdf

⁹ 3rd Edition of the Compendium can be found at <http://www.psr.org/assets/pdfs/fracking-compendium.pdf>

Studies increasingly show that air pollution associated with UG development is a grave concern with a range of impacts, with researchers documenting dozens of air pollutants from drilling and fracking operations that pose serious health hazards¹⁰. Hazardous air pollutants are released from a range of processes in UG operations. These include: the burning of diesel in machinery, generators, construction equipment and chemical, water, and waste transport vehicles; off-gassing from wastewater holding ponds; flaring and venting at wellheads; and emissions and leaks from wells, pipelines, processing plants and compressor stations.¹¹

Importantly, *The Compendium* notes that the risks of exposure to harmful substances occur not only as a result of drilling and fracking stages of gas operations but throughout the life time of UG operations, including emissions from infrastructure compressor stations, pipelines and wastewater holding ponds and other processes such as silica and sand mining activities,. Exposure to harmful substances can also occur through direct skin contact with fracking chemicals and wastes; drinking or bathing in contaminated water and through contaminated dust particulates¹².

A 2012 study detected 44 hazardous air pollutants at unconventional gas well sites¹³, whilst other recent US studies¹⁴ show that drilling and fracking emissions often contain strikingly high levels of benzene. The NYS Dept. of Health Public Health Review (the NYS Review) noted that “studies provide evidence of uncontrolled methane leakage, emissions of other volatile organic chemicals, and particulate matter from well pads and natural-gas infrastructure [as well as]... intermittently high dust and benzene concentrations.” *The Compendium* notes that benzene is a potent human carcinogen that has “been detected in the urine of well pad workers (at levels known to raise risks for leukemia), in private drinking water wells contaminated by fracking operations, and in ambient air at nearby residences.” It concludes that such exposures represent significant public health risks.¹⁵

Exposure to a range of harmful substances associated with unconventional gas operations constitutes a serious health hazard to those working on and living adjacent to or surrounded by UG development. The NYS Review¹⁶ states that emissions from UG operations have the potential to contribute to community odour problems and respiratory health impacts such as

¹⁰ Concerned Health Professionals of New York & Physicians for Social Responsibility. (2015, October 14). Compendium of scientific, medical, and media findings demonstrating risks and harms of fracking (unconventional gas and oil extraction) (3rd ed.). <http://concernedhealthny.org/compendium/>

¹¹ NTN: Toxic Chemicals in the Exploration and Production of Gas from Unconventional Sources

¹² NTN: Toxic Chemicals in the Exploration and Production of Gas from Unconventional Sources

¹³ NTN: Toxic Chemicals in the Exploration and Production of Gas from Unconventional Sources

¹⁴ See footnotes 3–8, 12, 57, 174 in Fracking Compendium, Vol. 2

¹⁵ <http://concernedhealthny.org/wp-content/uploads/2014/07/CHPNY-Fracking-Compendium.pdf>;

¹⁶ A Public Health Review of High Volume Hydraulic Fracturing for Shale Gas Development: http://www.health.ny.gov/press/reports/docs/high_volume_hydraulic_fracturing.pdf

asthma exacerbations whilst *The Compendium* reports that “drilling and fracking emissions contribute to toxic air pollution and smog (ground-level ozone) at levels known to have health impacts,” and further that “public health problems associated with drilling and fracking, including occupational health and safety problems, are increasingly well documented.”

The Compendium notes that “among residents living near drilling and fracking operations, documented indicators variously include increased rates of hospitalization, self-reported respiratory problems and rashes, motor vehicle fatalities, trauma, drug abuse, and low birth weight among infants,” whilst among oil and gas industry workers “risks include both toxic exposures and accidents.” Some of the public health effects of UG development that researchers have documented, as outlined in *The Compendium of Fracking Risks*, include:

- increased rates of hospitalization for cardiological complaints, cancer, skin conditions, and urological problems;
- increase in frequency of health symptoms reported by residents as distance between households and gas wells decreased; with rashes and upper respiratory problems more prevalent among persons living less than one kilometre from drilling and fracking operations;
- increases in commercial vehicle accidents;
- a sharp rise in ambulance calls and emergency room visits for drug related cases and oilfield related injuries and accidents;
- increase in infant deaths to six times the normal rate over three years;
- congenital heart defects, and possibly neural tube defects in newborns, associated with the density and proximity of natural gas wells within a 10-mile radius of mothers’ residences;
- elevated rates of low birthweight among infants born to mothers living near drilling and fracking operations during their pregnancies;
- reductions in average birthweight and length of pregnancy as well as increased risk for low birthweight and premature birth associated with proximity to fracking operations.

Noise pollution, light pollution, and stress

The Compendium of Fracking Risks states that “drilling and fracking operations and ancillary infrastructure expose workers and nearby residents to continuous noise and light pollution that is sustained for periods lasting many months,” with sources of fracking-related noise pollution including blasting, drilling, flaring, generators, compressor stations, and truck traffic. Cornell University’s Professor Tony Ingraffea notes¹⁷ that: “Noise pollution and gaseous emissions from compressor stations are common and are common complaints. If you have wet gas, you're

¹⁷ Ingraffea, Professor Tony, Presentation to South Australian Parliamentary Inquiry into Fracking. Available here: <https://www.parliament.sa.gov.au/Committees/Pages/Committees.aspx?CTId=5&CId=295>

going to need processing plants. Think of them as mini-refineries—again, lots of noise, lots of flares, lots of noxious emissions.”

The Compendium of Fracking Risks summarises the health impacts of noise and light pollution that is now being documented in scientific research:

‘Exposure to environmental noise pollution is linked to cardiovascular disease, cognitive impairment, and sleep disturbance. Workers and residents whose homes, schools, and workplaces are in close proximity to well sites are at risk from these exposures as well as from related stressors. A UK Health Impact Assessment (HIA) identified stress and anxiety resulting from drilling-related noise—as well as from a sense of uncertainty about the future and eroded public trust—as key public health risks related to fracking operations.....chronic exposure to light at night is linked to adverse health effects, including breast cancer.’

A recent CSIRO study¹⁸ examining farmers’ perceptions of coexistence between agriculture and large-scale coal seam gas development in Queensland found that “issues regarding atmospheric pollution (dust, light, noise) has a significant impact on many aspects of farmers’ lives.” The impact of significantly increased traffic, both on and off the farm, was also a significant concern to farmers.

Health Impacts in Australian Coal Seam Gasfields

In the Australian context, Doctors for the Environment Australia (DEA) has written extensively on the issues surrounding unconventional gas and health in publically available submissions to various State Government Parliamentary Inquiries. DEA’s policy statement in relation to unconventional gas extraction can be found [here](#).

The DEA policy statement notes:

‘Production, transport and combustion of CSG in Australia all have health impacts. DEA has presented evidence to parliamentary committees that it considers the current level of assessment, monitoring and regulation of CSG exploration and mining activities to be inadequate to protect the health of current and future generations of Australians. There is the potential for public health to be affected directly and indirectly through CSG operations.’

DEA supports moratoriums on UG development in Australia “until the health and environmental consequences are adequately understood, and appropriate monitoring and regulations are in place to protect human health.”

¹⁸ Huth N.I., Cocks B., Dalglish N., Poulton, P., Marinoni O., Navarro J. (2014) Farmers’ perceptions of coexistence between agriculture and a large scale coal seam gas development: working paper, June 2014, CSIRO, Australia.

The Australian Medical Association¹⁹ and the Public Health Association²⁰ of Australia likewise support a precautionary approach to the expansion of the unconventional gas industry in Australia. The AMA policy calls for the following policy actions:

- “all existing coal seam gas extraction projects should be regularly monitored for any health effects and the presence of air and ground water pollutants in their local environment;
- all future proposals for coal seam gas mining should be subject to rigorous and independent health risk assessments, which take into account the potential for exposure to pollutants through air and ground water and any likely associated health risks;
- in circumstances where there is insufficient evidence to ensure safety, the precautionary principle should apply; and
- these initiatives should apply to all unconventional gas extraction, including shale gas²¹.”

Health Impacts around Tara, Queensland

A survey of 113 people in the Tara estates in the Western Downs observed that 58% of those surveyed reported that their health had definitely been adversely affected by CSG. These results are provided in the report 'Symptomatology of a gas field'²² by Dr GERALYN McCARRON. Whilst this small survey is not a comprehensive epidemiological study it does refute the assertion that “*just a handful of people are complaining that their health is affected by CSG.*” Furthermore, the character and frequency of specific health complaints, particularly relating to potential neurotoxicity in both children and adults are concerning. The Specific Symptoms Recorded in this study include:

- Almost all the 31 children aged 6-18 were reported to suffer from headaches to some degree, but in 17 of these children the headaches were severe and for four children constant (i.e. occurring at least twice a week).
- Approximately a third of the all the 48 children to age 18 (15/48) were reported to experience paraesthesia.
- Regardless of any potential recall bias of their pre-existing health status these numbers and the significance of these symptoms stand out as a matter of serious concern.
- Add to that reports of spontaneous nose bleeds (31 out of 96 people age 6-82 (32%)) severe fatigue (61 out of 96 people (64%)), difficulty concentrating (59 out of 96 people (61%)), eye irritation 20 out of 31 children (64%) and skin irritation 69 out of 96 people (72%) and a pattern

¹⁹ <https://ama.com.au/media/ama-calls-coal-seam-gas-health-checks>

²⁰ PHAA Submission to the Independent Review of Coal Seam Gas Activities in NSW:
<https://www.phaa.net.au/documents/item/400>

²¹ <https://ama.com.au/article/better-environmental-health-0>

²² <http://www.ntn.org.au/wp/wp-content/uploads/2013/05/Symptomatology-of-a-gas-field-An-independent-health-survey-in-the-Tara-rural-residential-estates-and-environs-April-2013.pdf>

of ill health emerges which is undoubtedly abnormal in comparison to my suburban general practice.

- Parents of 6 of the 17 children, aged 5 and under, were concerned about twitching or unusual movements, and parents of 5 of the 13 children who were walking were concerned about their clumsiness or unsteadiness on their feet.

Considering that the rural residential estates near Tara is the most densely settled area in Australia to have seen intensive CSG development, Lock the Gate maintains that the effect of any health impacts there should be taken seriously and investigated comprehensively.

Nine months after Dr McCarron's report, in March 2013, the Queensland Government released a report titled "Coal Seam Gas in the Tara region: Summary risk assessment of health complaints and environmental monitoring data". The report was based on minimal industry sampling and very limited clinical investigation. Despite that, it did still conclude that *"In summary the most that can be drawn from the DDPHU report is that it provides some limited clinical evidence that might associate an unknown proportion of some of the residents' symptoms to transient exposures to airborne contaminants arising from CSG activities."*

Limitations of the report and the methodology used are as follows:

1. It was based on minimal non-systematic environmental sampling, and relied mainly on inadequate industry commissioned data.
2. The investigation of patient symptoms was grossly underfunded and understaffed, with no medical staff actually visiting the site. Only 15 people were examined clinically.
3. Positive findings of volatile chemicals were dismissed, despite the fact they are potentially capable of causing health impacts, especially over long periods of time.
4. The total clinical input was minimal:
 - Only 15 people were seen in person by Dr Adams;
 - Only 56 people, in total, were surveyed during the 9 months of the investigation;
 - No doctor from Queensland Health came within 20km of the gasfields or visited any of the residents in their homes;
 - No tests for gasfield chemicals were carried out on any of the residents; *and*
 - The clinical diagnosis was not defined for the people presenting.

There were also serious limitations in the air quality testing carried out for the Queensland Government report, as follows:

- The environmental air testing programme carried out by QGC (the gas company implicated in the health impacts) for the Qld. Government report was extremely limited and inadequate in every aspect with only 13 air samples being collected.

- Over the 9-month duration of the Qld. Government investigation, QGC only organized one-off testing at 9 residences, all within a 9 day time period.
- Despite this, many volatile organic compounds were detected.
- However, for 26 chemicals the detection level used was significantly higher than the health standard.
- Although benzene, a known human carcinogen was detected at a level which demonstrably exceeded its reference criteria, its significance was dismissed.
- There was no baseline data collected prior to CSG development against which to test the current results.
- Despite the extraordinary limitations of the testing, some of the volatile compounds detected were: Acetone, acrolein, alpha-pinene, benzene, benzothiazole, chloromemethane, cyclohexane, dichlorofluoromethane, ethanol, ethyl acetate, ethylbenzene, 2-ethyl-1-hexanol, heptane, hexane, heptadecane, hexadecane, 2- methylbutane, methylcyclohexane, methylene chloride, methyl ethyl ketone, 3- methylhexane, 3 methylpentane, naphthalene, pentane, phenol, propene, tetradecane, tetrachlorethylene, 1,2,4,- trimethylbenzene, toluene, vinyl acetate, xylene.

The Queensland Government report itself recognised the limitations of the testing on which it relied:

“the air monitoring programme had important limitations. The total limiting period was 9 days, the methodology resulted in limits of reporting for some analytes that were substantially higher than reference air quality criteria and the monitoring was not designed to identify short term peaks or troughs in air concentrations. It is considered a more strategic air quality monitoring programme could be implemented to provide more useful information....”

In addition to the range of limitations surrounding the testing parameters and conduct of the actual report, the failings extended even further, with an ongoing failure to implement the recommendations that *were* made in the report. The two most vital recommendations were:

- *“That a strategic ambient air monitoring program be established by DEHP to monitor overall CSG emissions and the exposure of local communities to those emissions.....The Department of Health would provide health-based guidance on the design of the program and participate with other agencies in the review and reporting of results. Key elements to include are:
-Identification of analytes that are known or reasonably likely to be associated with CSG activities
-Identification of relevant health-based reference criteria for each analyte prior to determining sampling and analysis methods, these should include short-term and long-term criteria....as appropriate for each specific analyte*

-Use of sampling and analysis methods that will achieve limits of reporting that do not exceed the health-based reference criteria for each analyte”

- *“Future health clinics related to CSG concerns may be indicated for residents in the Tara region and elsewhere. Community input should be sought into the nature, location, frequency and timing of such clinics. Given the identification of mental health concerns relating to the impacts of the CSG industry on some residents in the Tara region, future clinics should include specific expertise on mental health impacts. Relevant Hospital and Health services in CSG areas should be involved in the planning and resourcing of such clinics within their areas”*

In relation to the first recommendation above, a letter to Dr Geralyn McCarron on 27th October 2014, Dr Bristow (of DDHHS) confirmed that an active decision had been taken NOT to implement the recommendations of the health investigation wrote, stating that:

- *“In relation to Dr Neville’s recommendation proposing a strategic ambient air monitoring program to monitor overall CSG emissions and exposure of the local communities to those emissions, this recommendation was apparently initially considered by the Department of Environment and Heritage Protection (DEHP) who determined the air quality data from Tara indicated compliance and thus did not support in expanding the program.”*

Queensland Regulation of Air Emissions from CSG

Environmental Authorities are drastically inadequate to control direct air emissions from CSG gasfields. The Environmental Authority for the Kenya gasfield (EPPG00878413) has a single condition which states that *'The release of odour, dust or any other airborne contaminant(s), or light from the petroleum activities, must not cause an environmental nuisance at any sensitive place'* (Schedule F). It is only in relation to the products of fuel burning and combustion facilities that the EA mandates any ambient air quality standards (see Schedule G). The only three substances covered by that are NOX, SOX and Carbon Monoxide.

Notably, data from the National Pollutant Inventory for Qld CSG facilities reveals very large volumes of pollutants being emitted. For example, [QGC reports for the Kenya Processing Facility](#) for the year 2013-2014 record emissions of 89,000kg of volatile organic compounds, 35,000kg of formaldehyde, 330,000kg of PM10, 12,000kg of PM2.5, and 0.32kg of polycyclic aromatic hydrocarbons, amongst other things.

Actions Sought to Respond to Tara Health Impacts

There is a very significant and growing body of evidence from the USA relating to the negative health impacts of unconventional gas development. A number of US studies published in the last year (detailed in the section on US health impacts above), provide new and startling

evidence about the impacts of unconventional gas mining on human health that should trigger urgent action in Australia. This research needs to be urgently reviewed, and action taken to prevent any further dangerous health impacts in Qld. In light of that, and the information provided above, Lock the Gate recommends that:

1. The promised comprehensive ambient air monitoring program and health clinics are implemented as soon as possible, including an initial highly ‘targeted’ air monitoring program to specifically identify the analytes that are being emitted from sources.
2. Additional precautionary measures are put in place as a matter of urgency to limit gasfield activities and air emissions in proximity to homes.
3. A fully funded comprehensive medical assessment of residents currently living in proximity to unconventional gas development is carried out as a matter of urgency.
4. A fully funded, long term epidemiological study is commenced to track the health of people exposed to CSG over the next several decades. This must include workers in the industry as well as people who may already have left the area because of health concerns.
5. Health impact assessments must be required as an integral part of any and every unconventional gas development. No new permit should be issued without one, and health impact assessments should be carried out for every development already in place.
6. Comprehensive air and water monitoring (an open, ongoing and unlimited information loop) is a mandatory requirement for CSG companies.

Mental Health Impacts

The social stressors associated with the large-scale heavy industrial activities that accompany UG development take a heavy toll on the mental and emotional health of rural families and communities impacted by UG development. Doctors for the Environment Australia note that “water and air pollution, water shortages, permanent degradation of productive agricultural land and loss of livelihood and landscape.....all have mental health consequences for communities living in a gas field.”²³

A 2013 study²⁴ investigating the impacts of mining and CSG operations on the mental health of landholders in south west Queensland established that these operations placed rural communities “under sustained stress”. The study conducted twelve workshops within the region, asking community members, among other things, about the issues which were affecting their mental health. Study participants reported that mining and CSG operations “significantly

²³ Doctors for the Environment Australia, Submission to the NSW Parliamentary Inquiry into Coal Seam Gas, 16/09/2011

²⁴ Hossain D. et al. Impact of the mining industry on the mental health of landholders and rural communities in southwest Queensland (2013). *Psychiatry*, 21:32-37.

impacted or exacerbated issues such as the health, social fabric and economy of the community”, and the authors noted that local health services faced “unsustainable pressure”. A 2014 article in the Medical Journal of Australia²⁵ notes that “gas developments can have numerous and considerable social and psychological effects, which may exacerbate more direct health risks.”

A 2014 CSIRO study²⁶ noted that local farmers perceived the nature of CSG development in South West Queensland to date as an “invasion” or “occupation”, whilst a previous study²⁷ in Chinchilla found residents describing a ‘tsunami of change’. The CSIRO Study states: “[Among famers] there was a real sense of the farm being their “country” and therefore the unrequested intrusion of CSG development was seen as an occupying force. The use of common high visibility uniforms by all CSG and contractor staff further supported the analogy, though interestingly one participant adapted the wording to an agricultural metaphor in describing the large workforce as an invasion by an “orange fungus”.”

Interacting and engaging with CSG companies has also been reported²⁸ as having a significant negative impact on farmer’s well-being. The interactions between farmers and CSG companies resulting in issues of stress, conflict and disconnection.

ii. Social Impacts

The Queensland and NSW experience with the expansion of coal seam gas operations has shown that when this industry is forced upon communities against their wishes, there is potential for significant conflict and social upheaval and disruption as a result- even at the exploration phase of the industry. Lock the Gate members and local community groups report a range of impacts on their mental and emotional wellbeing from proposed and actual UG development. These impacts include:

- A sense of injustice that they do not have the right to refuse access to companies for UG activities and that this industry is being forced on an unwilling population.
- Fear and anxiety about the impacts of the UG industry on their family’s health and the quality of the air and water they rely upon.

²⁵ Coram, A., Moss, J., Blashki, G., *Harms unknown: health uncertainties cast doubt on the role of unconventional gas in Australia’s energy future*, MJA 200 (4) : 3 March 2014.

²⁶ Huth N.I., Cocks B., Dalglish N., Poulton, P., Marinoni O., Navarro J. (2014) Farmers’ perceptions of coexistence between agriculture and a large scale coal seam gas development: working paper, June 2014, CSIRO, Australia.

²⁷ Walton, A.M., McCrea, R., Leonard, R., Williams, R., 2013. Resilience in a changing community landscape of coal seam gas: Chinchilla in Southern Queensland. *Journal of Economic and Social Policy* 15, Article 2

²⁸ Huth N.I., Cocks B., Dalglish N., Poulton, P., Marinoni O., Navarro J. (2014) Farmers’ perceptions of coexistence between agriculture and a large scale coal seam gas development: working paper, June 2014, CSIRO, Australia.

- Concern about the impact of UG development on the economic viability of their farms and property values.
- A sense of anger and betrayal that governments are supporting industry rather than communities in the development of the UG industry.
- A sense of anger that the industry is being pushed ahead rapidly without proper consideration of the impacts and before proper scientific studies have been done and baseline data collected.

In discussing the broader social impacts of UG development, Doctors for the Environment Australia (DEA) note: “Informed consent of landholders is often lacking in the contract process when mining companies first approach landholders about unconventional gas extraction.... The injustice and powerlessness that this engenders contributes to solastalgia and poorer mental health outcomes.” Overall, DEA maintain that UG development can “divide previously close-knit rural communities, increasing tension and disharmony.”

The lack of a veto right for landholders in relation to UG development, the stress involved in dealing with UG companies (often against their will), the lack of full information and disclosure on the realities of UG development, and the often underhanded tactics employed by companies contributes to a sense of powerlessness, betrayal and frustration amongst landholders and affected communities. According to DEA, in eastern Australia, “the stress and disruption caused to farmers has already been shown to force some of them to leave a CSG drilling area, allowing once productive lands to lapse into disuse,” whilst in the US “longtime residents are moving, unable to bear the changes the gas industry has wrought on their landscape and community.”

In their submission to the 2015 Victorian Parliamentary Inquiry²⁹ DEA note:

‘The migratory, boom and bust nature of UG developments can carry significant social and psychological effects for those who live in communities near operations and on those who may travel to work at these developments. A study³⁰ of impacts of mining and unconventional gas operations on landholders in Queensland found that these operations placed rural communities “under sustained stress”, with study participants describing significant impacts on the health, social fabric and economy of local communities.’

The health and social impacts of UG development will necessarily have a flow on negative impact on the overall wellbeing of rural communities, as well as the functionality of other industries in which rural residents are engaged. This impact will be magnified due to the fact

²⁹ http://www.parliament.vic.gov.au/images/stories/committees/EPC/Submission_416_-_Doctors_for_Environment_Australia_.pdf

³⁰ Hossain D. et al. Impact of the mining industry on the mental health of landholders and rural communities in southwest Queensland (2013). *Psychiatry*, 21:32-37.

that farming and rural communities are the very same communities who are already at most risk from the adverse health effects of drought, climate change and the degradation and depletion of Australia's river systems and groundwater resources.³¹

The impacts of the use of fly-in, fly-out and drive-in, drive-out workforces, used extensively in existing unconventional gas developments in Australia, also has a range of negative social impacts which were comprehensively documented in a recent Parliamentary Inquiry³². The use of FIFO and DIDO workforces have come under scrutiny for their negative influence on community cohesion, increased rents and other living expenses, and their association with elevated levels of alcohol and drug use, as well as mental health issues and violence.

iii. Agricultural and Landholder Impacts

US Context

The US experience of UG development is now showing that drilling and fracking can take agricultural land out of production and pose risks to the agricultural sector. *The Compendium of Fracking Risks* notes: "Studies and case reports from across the country have highlighted instances of deaths, neurological disorders, aborted pregnancies, and stillbirths in cattle and goats associated with livestock coming into contact with wastewater. Potential water and air contamination put soil quality as well as livestock health at risk. Additionally, farmers have expressed concern that nearby fracking operations can hurt the perception of agricultural quality and nullify value-added organic certification."

Research summarised in *The Compendium* outlines threats to agricultural production that include:

- damage to soils and crops from gas leaks;
- cattle deaths following ingestion of fracking fluids;
- a 16% decline in the number of dairy cows in areas where fracking was prevalent,
- still born calves following exposure of cows to drilling wastewater;
- dramatic negative effects on vegetation caused by the drilling and fracking of a natural gas well in an experimental forest;
- dead and sick animals in several states that had been exposed to drilling or hydraulic fracturing fluids, wastewater, or contaminated ground or surface water;
- failure of contaminated fields to produce crops following fracking wastewater spills;

³¹ DEA, Submission to the Inquiry into Coal Seam Gas, 16/09/2011

³² House of Representatives Standing Committee on Regional Australia. *Cancer of the bush or salvation for our cities? Fly-in, fly-out and drive-in, drive-out workforce practices in regional Australia*. Canberra: Commonwealth of Australia, 2013.

http://www.aph.gov.au/parliamentary_business/committees/house_of_representatives_committees?url=ra/fifodido/report.htm

- contamination of aquifers that supply drinking water and farming irrigation as a result of illegal dumping of fracking wastewater.

Queensland Context

The expansion of CSG production in Queensland has demonstrated the potential for UG developments to severely disrupt virtually every aspect of agricultural production and potentially even remove the land from production. In the course of its work supporting landholders and communities facing the impacts of unconventional gas developments, Lock the Gate Alliance hears firsthand about the myriad effects these development are having on the livelihoods, health and well-being of Australian farming families living adjacent to and surrounded by gas activities. These harmful impacts include: intimidation, coercion and bullying by CSG companies; intolerable noise and light pollution from flaring, traffic and CSG infrastructure; contamination and depletion of water in farm bores; rivers bubbling with methane; bores running dry; stock losses associated with pipeline construction and water contamination; costly and time consuming interruptions to farming operations; huge trucks and heavy machinery on small local roads affecting lifestyle, safety and road infrastructure; dust impacts on pasture; increases in weed infestation; industry workers leaving mess from pipeline construction in farm paddocks; workers destroying fences and leaving gates open; properties not able to be sold; mental health impacts resulting from dealing with companies and the impacts of industry development; and physical health symptoms including respiratory ailments, headaches, rashes, nausea and vomiting, and nose, throat and eye irritations. For many affected landholders, these impacts affect all facets of life and are making their living situation untenable. Personal testimonies of a number of affected landholders can be viewed in a series of [short films](#) on the Lock the Gate Alliance website.

A recent CSIRO study³³ documents the many issues that farmers are facing as the CSG industry expands across the Surat Basin in south west Queensland. The study examined farmers' perceptions of coexistence between agriculture and large-scale coal seam gas development in Queensland and involved a series of workshops with a cross-section of the farming community involved in a diversity of agricultural pursuits (grazing, cropping and mixed farming systems) across the Surat Basin. Whilst some participants of the study currently had no CSG infrastructure on their farms, all participants were currently involved in negotiations or operations with CSG companies, with approximately one third of participants interacting with more than one CSG company. (In an indication of the additional burden CSG operations place on farmers, the study notes that "many participants mentioned that they also had to deal with a significant number of large non-CSG companies on a regular basis. These included companies

³³ Huth N.I., Cocks B., Dalgliesh N., Poulton, P., Marinoni O., Navarro J. (2014) Farmers' perceptions of coexistence between agriculture and a large scale coal seam gas development: working paper, June 2014, CSIRO, Australia.

seeking to construct pipelines or electrical power transmission lines through their properties, and a wide range of contractors for the CSG companies.”)

The CSIRO Study outlines six areas of significant concern to farmers in relation to the impacts of CSG development on their farms and/or in their local area:

1. High levels of CSG-related traffic (e.g. trucks, rigs, cars) on farms was clearly shown as the cause of many issues and that these issues impact on nearly all aspects of the farming family’s lives. Increased traffic during the rapid growth in CSG development in the Surat Basin region is having similar impacts to those seen in UG development in the US, including concerns around safety and security for families; impacts on the local way of life; roads being damaged faster than they could be repaired; large concerns for the volumes of traffic and the threat to other drivers.
2. The impact of CSG infrastructure on the landscape’s aesthetic value was a significant concern for farmers and had impinged on the positive feedback that they had been receiving about their farms. This concern was so great that some farmers were thinking of moving even though they had planned to retire onto their property.
3. Great potential for friction to occur between neighbours and a sense that the increased conflict seen overseas could eventuate in their local area. Possible causes of conflict included inequity in access to water produced by the CSG extraction process, differences in acceptance of the CSG industry, or impacts of CSG development that may reach across property boundaries (e.g. pollution). It was generally acknowledged by the farmers that it may still be too early for some of the relationship impacts of rapid CSG development to be observed given that the CSG industry is still in the early phases of its development.
4. Great uncertainty about the nature and likelihood of developing a joint CSG-farm enterprise that met their expectations. Farmers who participated in the study expressed uncertainty with respect to impacts on property values, long term negotiations, changes in company ownership, duration of CSG extraction and impacts on the farm business operations. The current compensation model was not seen as attractive as a partnership model, as participants currently saw CSG companies aiming to make large profits and felt that a system that allowed them to gain a reasonable share in this for their support was only fair.
5. Engagement with CSG companies was seen to impact on wellbeing in ways that affect personal lives, families, and ultimately on health.
6. The impact of CSG development on farm viability, in particular, the risk of loss of ground water, impacts on farm operations and lowered property values. The addition of CSG infrastructure into the farm landscape has raised concerns with many landholders due to perceived risks to the environment, family and business. The study outlines the concerns raised by farmers in five broad categories as follows (with some concerns featured in more than one category):

- **Environment:** Visual Impact, Water Quality, Water Loss, Salt Disposal, Noise, Dust, Light, Risks to flora and fauna, Soil degradation, Weeds/Biosecurity;
- **Personal:** Loss of connection, Leaving the farm, Relationships, Impact on social life, Mental health/Stress, Hopelessness, Conflict, Complexity, Workload/Time, Finance, Security;
- **Home:** Security, Safety, Amenity, Privacy, Conflict, Mental health/Stress, Dust, Light, Noise, Workload/Time;
- **Farm Business:** Loss of control/Uncertainty, Lifestyle, Water supply, Animal welfare, Labour, Weeds/Biosecurity, Farm logistics, Property value, Road congestion, Compensation, Workplace safety/ Security, Taxation, Workload/Time;
- **Health:** Mental Health/Stress, Water quality, Dust, Noise, Light, Fugitive emissions, Pressure on health systems, Traffic safety, Workload/Time, Power lines/Radiation.

A point of interest in this CSIRO study that again highlights the huge impact of CSG operations on farmers' lives and livelihoods was the fact that many farmers who were approached to participate in the study declined for reasons sometimes referred to as "workshop fatigue". The Study notes: "Others were preoccupied with legal proceedings. Many farmers had already found themselves heavily involved in negotiations with CSG companies or information sessions to help them in these proceedings. As a result, many could not provide the time required to be involved."

In a submission to the NSW Parliamentary Inquiry onto CSG, Rabobank [also noted](#) the risks from unconventional gas mining, including reductions in farm productivity, efficiency, land values and credit availability.

iv. *Economic, Business and Employment Impacts*

The gas industry and State Governments are claiming that unconventional gas development will be an economic elixir for the Australia's regional economies. However, the most advanced unconventional gas development in Australia, in Queensland's Darling Downs region, shows that gas development negatively impacts all sectors of local industry other than the gas industry itself. While the industry employs some people, and some businesses profit by servicing the mining industry, overall it is a small, short term employer that drives up costs for local businesses and negatively impacts the community.

Detailed research by the mining industry funded Sustainable Minerals Institute³⁴ found that while those working in the coal seam gas industry in the Darling Downs region had a positive view of the impact of the industries, people working in local businesses, agriculture,

³⁴ Everingham, J., Collins, N., Rodriguez, D. Cavaye, J., Vink, S., Rifkin, W. & Baumgartl, T. (2013) *Energy resources from The food bowl: an uneasy co---existence. Identifying and managing cumulative impacts of mining and agriculture. Project report.* CSRM, The University of Queensland: Brisbane.

government and the community sector consistently believed CSG development and mining had led to a deterioration of:

- **Financial capital**- revenue streams and economic resources.
- **Built capital**- local infrastructure including buildings, transport, equipment and communications.
- **Human capital**- skills, knowledge, abilities and good health.
- **Social capital**- organisations, networks and relationships, based on shared values, mutual trust and reciprocity.

The main reasons for these social and financial impacts are the loss of skilled staff to the gas industry and the increased cost of labour, rent, transport and goods and services for local businesses.

While gas companies continually spruik the promise of more jobs for local communities as a justification for unconventional gas development, in actual fact the oil and gas industry is one of the smallest employers in Australia, employing less than 0.2% of the Australian workforce. The majority of gas industry jobs are required for the short construction phase only, they are not ongoing, as modern gas fields are highly mechanized and need very few people to operate them. Local employment opportunities are minimal with the majority of skilled workers being brought in from elsewhere with fly-in-fly-out workforces. Those employed locally are usually skilled workers poached from local industries that have spent years training them, leaving these industries short of labour and unable to compete with gas industry wage rates.

Overall, the gas industry fails to provide the *long term, sustainable, locally sourced* employment opportunities and pathways that are needed to properly address rural and remote unemployment. In the US, experiences in various states and accompanying studies have shown that the oil and gas industry's promises for job creation from drilling for natural gas have been greatly exaggerated. Likewise, in Queensland, with the 4 year construction phase of the CSG production gasfields in the Surat Basin now coming to an end, the gas 'boom-towns' of Dalby, Roma and Chinchilla are experiencing a crippling economic down turn with associated job losses and loss of revenue for local businesses³⁵.

The Australia Institute has produced a detailed analysis, *Be Careful What you Wish For*³⁶, based mostly on gas industry funded research into Queensland CSG development, which outlines

³⁵ - <http://www.businessinsider.com.au/bhp-shuts-shale-operations-2015-1>
<http://www.couriermail.com.au/business/gas-companies-to-sack-staff-in-surat-basin-towns/story-fnihsp3-1227239152115>

³⁶ <http://www.tai.org.au/content/be-careful-what-you-wish>

some of the of the economic implications of unconventional gas development in regional Australia.

v. *Environmental Impacts*

There is a rapidly growing literature detailing the large range of environmental impacts associated with unconventional gas development, including impacts on farmland, rangelands and natural areas and contamination and depletion of water resources. These impacts are discussed in more detail in the following sections.

a. *Impacts on water resources:*

Unconventional gas development has the potential to negatively impact on Australia's limited water resources- which in many instances are already under pressure from over allocation, changing rainfall patterns and a warming climate. Any impacts on the water resources currently relied upon by existing rural industries and populations will obviously have flow on effects on the viability of those industries and communities. Water resources can be impacted by both contamination and depletion as a result of UG development, as outlined in the following paragraphs.

Water Contamination

The latest volume of *The Compendium of Fracking Risks* highlights growing evidence of the reality that drilling and fracking and other aspects of unconventional gas development inherently threaten groundwater and have contaminated drinking water sources in the United States.

During fracking processes, contamination of underground water resources with flowback fluids can occur via a number of pathways. These include: migration of fluids via natural pathways in underground geologies; via pathways created by the fracking process; or as a result of well blow outs and well casing failure (see section 6 below for more on this topic).³⁷ Flowback fluids contain hazardous fracking chemicals as well as naturally occurring toxic substances released from target geological zones such as methane, BTEX (benzene, toluene, ethylbenzene, xylene), polycyclic aromatic hydrocarbons (PAHs), naturally occurring radioactive materials (NORMs), heavy metals and other volatile organic compounds (VOCs)³⁸. Surface and ground water supplies can also be impacted as a result of migration of gases through natural faults and fracking induced pathways. Contamination of shallow aquifers may also occur from surface

³⁷ NTN: Toxic Chemicals in the Exploration and Production of Gas from Unconventional Sources

³⁸ NTN: Toxic Chemicals in the Exploration and Production of Gas from Unconventional Sources

leaching of polluted water and chemical spills. (Contamination resulting from wastewater disposal will be dealt with separately in a later section of this submission.)

Examples of water contamination from unconventional gas operations in the US

Despite the gas industry's repeated claims that unconventional gas extraction does not threaten water supplies, a range of studies from across the United States presents irrefutable evidence that groundwater contamination occurs and is more likely to occur close to drilling and fracking sites.³⁹ According to *The Compendium of Fracking Risks*, "in Pennsylvania alone, more than 240 private drinking water wells have been contaminated or have dried up as the result of drilling and fracking operations over a seven-year period." In just the last 18 months, published research reveals a growing breadth of impacts on water resources resulting from UG operations, as well as deficits in the baseline knowledge required to properly assess impacts. For example:

- A first-ever assessment of the range of depths at which fracking occurs across the United States found that many wells are shallower than widely presumed. The authors of this study noted that vertical fractures are able to propagate 2,000 feet upward, and hence, "shallow hydraulic fracturing often has greater potential risks of contamination than deeper hydraulic fracturing does."⁴⁰
- Widespread drinking water contamination throughout the heavily drilled Barnett Shale region in northern Texas, where 550 water samples from public and private water wells were analysed, found elevated levels of 19 different hydrocarbon compounds associated with fracking (including the carcinogen, benzene, and the reproductive toxicant, toluene), detections of methanol and ethanol, and strikingly high levels of 10 different metals.⁴¹
- In the first fully documented case of a commonly used fracking chemical entering a drinking water source, researchers found the presence of a fracking-related solvent in private drinking water wells near drilling and fracking operations. Study authors propose that "the most likely explanation of the incident is that stray natural gas and drilling or [hydrofracking] compounds were driven ~1-3 km along shallow to intermediate depth fractures to the aquifer used as a potable water source."⁴²

³⁹ Concerned Health Professionals of New York & Physicians for Social Responsibility. (2015, October 14). Compendium of scientific, medical, and media findings demonstrating risks and harms of fracking (unconventional gas and oil extraction) (3rd ed.). <http://concernedhealthny.org/compendium/>

⁴⁰ Jordon, R. (2015, July 21). Shallow fracking raises questions for water, new Stanford research shows, Stanford University press release. Retrieved from http://news.stanford.edu/news/2015/july/fracking_water-jackson-072115.html

⁴¹ Hildenbrand, Z. L., Carlton, D. D., Fontenot, B. E., Meik, J. M., Walton, J.L., Taylor, J. T., . . . Schug, K.A. (2015) A comprehensive analysis of groundwater quality in the Barnett Shale region. *Environmental Science & Technology*, 49(13), 8254-62. doi: 10.1021/acs.est.5b01526

⁴² Llewellyn G. T., Dorman, F., Westland, J. L., Yoxthimer, D., Grieve, P. Sowers, T., . . . Brantley, S. L. (2015). Evaluating a groundwater supply contamination incident attributed to Marcellus Shale gas development.

- Elevated levels of methane were found in groundwater discharging into a stream near drilling and fracking operations in Pennsylvania along with high levels of methane in nearby private water wells as a result of gas migration near a gas well with a defective casing. The monitoring technique used in this study allowed researchers to demonstrate that the source of the methane was shale gas from the Middle Devonian period, which is the kind of gas found in the Marcellus Shale.⁴³
- Comparison of pre-drill and post-drill data on water quality found changes in water chemistry that coincided with the advent of drilling and fracking activities. Elevated levels of chloride, iron, barium, strontium, and manganese were found with concentrations exceeding health-based maximum contaminant levels in some cases. Methane was also detected in most houses tested in this study.⁴⁴
- An investigation of the chemical make-up of hydrocarbon-based fracking fluid chemical mixtures (including solvents, gels, biocides, scale inhibitors, friction reducers, & surfactants) found that the compositions of these mixtures vary widely according to region and company, making the process of identifying individual compounds difficult. The lead author of this study noted that “[b]efore we can assess the environmental impact of the fluid, we have to know what to look for.”⁴⁵
- A review of US national water quality databases found that insufficient data exist to understand the impact of fracking on drinking water and to properly assess the potential effects of oil and gas development over larger geographic areas.⁴⁶
- A team of researchers established that petroleum-based hydrocarbons can break down underground in ways that promote the leaching of naturally occurring arsenic, a known human carcinogen that causes bladder, lung, and skin cancer, into groundwater.⁴⁷

Proceedings of the National Academies of Science, 112, 6325-30. doi: 10.1073/pnas.1420279112/-
/DCSupplemental

⁴³ U.S. Geological Survey. (2015, April 1). New stream monitoring method locates elevated groundwater methane in shale-gas development area. Retrieved from http://www.usgs.gov/newsroom/article.asp?ID=4176&from=rss&utm_source=dlvr.it&utm_medium=facebookhttp://www.readcube.com/articles/10.1002%2F2014WR016382?r3_referer=wol&tracking_action=preview_click&show_checkout=1&purchase_site_license=LICENSE_DENIED_NO_CUSTOMER#.VaPKNYsqdyA

⁴⁴ Alawattegama, S. K., Kondratyuk, T., Krynock, R., Bricker, M., Rutter, J. K., Bain, D. J., & Stolz, J. F. (2015). Well water contamination in a rural community in southwestern Pennsylvania near unconventional shale gas extraction. *Journal of Environmental Science and Health, Part A: Toxic/Hazardous Substances and Environmental Engineering*, 50, 516-528. doi: 10.1080/10934529.2015.992684

⁴⁵ Elsevier. (2015 April 8). Fracking fluids contain potentially harmful compounds if leaked into groundwater. *ScienceDaily*. Retrieved from http://www.sciencedaily.com/releases/2015/04/150408090323.htm?utm_source=feedburner&utm_medium=email&utm_campaign=Feed%3A+sciencedaily%2Fearth_climate%2Frecycling_and_waste+%28Recycling+and+Waste+News+--

⁴⁶ Phillips, S. (2015, March 3). USGS: fracking water quality data “scarce.” *StateImpact Pennsylvania*. Retrieved from <https://stateimpact.npr.org/pennsylvania/2015/03/03/usgs-fracking-water-quality-data-scarce/>

⁴⁷ U.S. Geological Survey (2015, January. 26). Natural breakdown of petroleum underground can lace arsenic into groundwater. Retrieved from http://www.usgs.gov/newsroom/article.asp?ID=4110&from=rss&utm_source=dlvr.it&utm_medium=facebook#.VaVGXIsqdyA

- Researchers found high levels of iodide, bromide, and ammonium in samples of wastewater from fracking operations in two US shale formations, with the same chemicals found to be present when fracking wastewater was discharged into rivers and streams at three treatment sites in Pennsylvania and during an accidental spill in West Virginia.⁴⁸
- A research team found methane contamination in drinking water wells located in eight areas above the Marcellus Shale in Pennsylvania and the Barnett Shale in Texas, with evidence of declining water quality in the Barnett Shale area. The investigators were able to isolate the origin of the fugitive methane found in the drinking water. These results implicated leaks through cement well casings as well as via naturally occurring cracks and fissures in the surrounding rock as the source of the methane contamination.⁴⁹
- A critical review of biocides in fracking fluid found that the fate of these chemicals underground is not known and their toxicity not well understood. The study noted that while many biocides are short-lived, some may transform into more toxic or persistent compounds and that oxidizing biocides that are chlorine- or bromine-based can react with other fracking chemicals and may produce toxic halogenated by-products.⁵⁰

The U.S. Environmental Protection Agency's (EPA) 2015 draft report⁵¹ on the potential impacts of fracking on drinking water resources confirmed specific instances of drinking water contamination linked to drilling and fracking activities. The EPA report identified potential mechanisms, both above and below ground, by which drinking water resources can be contaminated by fracking and confirmed a number of specific instances where these potential mechanisms did indeed lead to drinking water contamination. "The EPA investigators documented 457 fracking-related spills over six years but acknowledged that they do not know how many more may have occurred. Of the total known spills, 300 reached an environmental receptor such as surface water or groundwater."⁵² In some cases, drinking water was contaminated by spills of fracking fluid and wastewater, whilst in others, below ground movement of fluids, including gas, resulted in contaminated drinking water resources.

⁴⁸ Harkness, J. S., Dwyer, G. S., Warner, N. R., Parker, K. M., Mitch, W. A., & Vengosh, A. (2015). Iodide, bromide, and ammonium in hydraulic fracturing and oil and gas wastewaters: environmental implications. *Environmental Science & Technology*, 49, 1955-63. doi: 10.1021/es504654n

⁴⁹ Darrah, T. H., Vengosh, A., Jackson, R. B., Warner, N. R., & Poreda, R. J. (2014). Noble gases identify the mechanisms of fugitive gas contamination in drinking-water wells overlying the Marcellus and Barnett Shales. *Proceedings of the National Academy of Sciences*, 111 (39), 14076-14081. doi: 10.1073/pnas.1322107111

⁵⁰ Kahrilas, G. A., Blotvogel, J., Stewart, P. S., & Borch T. (2015). Biocides in hydraulic fracturing fluids: a critical review of their usage, mobility, degradation, and toxicity. *Environmental Science & Technology*, 49, 16-32. doi: 10.1021/es503724k

⁵¹ U.S. EPA. (2015). *Assessment of the potential impacts of hydraulic fracturing for oil and gas on drinking water resources* (External review draft). U.S. Environmental Protection Agency, Washington, DC, EPA/600/R-15/047, 2015. Retrieved from <http://cfpub.epa.gov/ncea/hfstudy/recordisplay.cfm?deid=244651> .

⁵² The Compendium: <http://www.psr.org/assets/pdfs/fracking-compendium.pdf>

The Compendium⁵³ authors note that despite gas industry claims that the EPA report proved fracking is safe, on the contrary, it confirmed that drilling and fracking activities have contaminated drinking water in some cases and acknowledged that it cannot ascertain how widespread the problem was due to insufficient data. The EPA conceded that insufficient baseline drinking water data and a lack of long-term systematic studies limited the power of its findings. Following misinterpretation of the report findings, EPA Science Advisor Thomas A. Burke later clarified that the report does not show that fracking is safe, stating: “That is not the message of this report. The message of this report is that we have identified vulnerabilities in the water system that are really important to know about and address to keep risks as low as possible.”⁵⁴

Issues with Fracking and Drilling Waste Disposal

After fracking at each well, the large volumes (tens of thousands of litres per well) of hazardous flow back fluid (the 15 - 80% of the fracking fluid mixture that returns to the surface),⁵⁵ must be stored and disposed of. Contamination of surface water may occur from release of insufficiently treated or untreated wastewater onto land surfaces or directly into waterways and as a result of leakage from waste storage facilities. Soil and surface water contamination may also occur from accidental spills or leakage of fracking fluids at the surface and via surface well blow outs.^{56 57} Water, soil and crop contamination may also occur from reuse of improperly treated or untreated wastewater onto farmland.

The issue of how to deal with produced water from UG operations is a significant one for the industry. This water is produced for the lifetime of the well and typically contains ‘heavy metals, NORMs, fracking or drilling chemicals, volatile and semi volatile organic compounds and high concentrations of salts’⁵⁸. The commonly used methods of wastewater management include: reinjection into aquifer formations, spraying onto roads for dust suppression, reuse for brick making, holding in large open storages to allow evaporation, temporary storage in holding ponds or tanks followed by treatment or partial treatment and release into waterways or reuse in agricultural operations.⁵⁹

⁵³ Concerned Health Professionals of New York & Physicians for Social Responsibility. (2015, October 14). Compendium of scientific, medical, and media findings demonstrating risks and harms of fracking (unconventional gas and oil extraction) (3rd ed.). <http://concernedhealthny.org/compendium/>

⁵⁴ Ward Jr., K. (2015, June 7). EPA says new study doesn’t show fracking is safe. *Charleston Gazette*. Retrieved from: <http://www.wvgazette.com/article/20150607/GZ01/150609432>

⁵⁵ http://www.karoolplaces.com/wp-content/uploads/2011/06/coop_shale_gas_report_final_200111.pdf

⁵⁶ NTN: Toxic Chemicals in the Exploration and Production of Gas from Unconventional Sources; http://www.karoolplaces.com/wp-content/uploads/2011/06/coop_shale_gas_report_final_200111.pdf

⁵⁷ Fracking: a serious concern for surface water as well as groundwater: <http://ec.europa.eu/environment/integration/research/newsalert/pdf/275na3.pdf>

⁵⁸ NTN: Toxic Chemicals in the Exploration and Production of Gas from Unconventional Sources

⁵⁹ NTN: Toxic Chemicals in the Exploration and Production of Gas from Unconventional Sources

The National Toxics Network notes that the ‘treatments to remove contaminants from produced water are limited by the chemicals they can remove, the energy needed and their economic costs,’ and also, that ‘reverse osmosis filtration has significant limitations and cannot remove many of the organic chemicals used in UG activities.’ In particular, ‘low molecular weight, non-polar, water-soluble solutes such as the methanol and ethylene glycol are poorly rejected.’ The Compendium of Fracking Risks also highlights the issues around waste disposal, stating: “the disposal of fracking wastewater remains a problem without a safe, viable solution,” and further, that: “injection wells for disposal of fracking waste pose demonstrable threats to drinking water aquifers; municipal sewage treatment plants are not capable of treating fracking waste [with] disposal of fracking waste through them [] encourage[ing] the formation of carcinogenic by-products during chlorination.” In light of these findings the use of municipal sewage treatment plants for disposal of CSG waste, as has been the case in past CSG exploration activities across NSW^{60, 61, 62}, is of considerable concern.

In Queensland the state government has developed a beneficial use approval system for coal seam gas water which details the requirements for using CSG water for aquaculture, coal washing, dust suppression, industrial and manufacturing operations, irrigation and livestock watering.⁶³ However, Lock the Gate has significant concerns about the use of this water when it ends up making its way into soils and natural waterways due to the potential for substances that have not been wholly removed from the water to accumulate in, and negatively impact, natural and agricultural systems. Environmental Engineer Stuart Khan of the University of NSW has expressed serious reservations about the disposal and use of produced water⁶⁴, claiming that: “Disposing of CSG waters directly to surface waters will significantly impact the quality of those surface waters. Attempts to beneficially reuse CSG water without treatment for application’s such as irrigation, poses risks to soil quality and shallow groundwater quality.” And further: “poorly managed discharge of reverse osmosis waters to the environment may also pose a risk to some surface water systems by disrupting (diluting) natural mineral and nutrient compositions, essential for many aquatic ecosystems. Uncontrolled discharges to ephemeral streams will disrupt natural flow regimes with potentially significant ecological implications.”

NSW irrigators have expressed concern about the impacts of using produced water on cropping land following a trip to areas of the US where produced water is being released onto farming land⁶⁵. “Some US farmers are finding after 10 years of irrigating with water mixed with the CSG produced water that the sodium composition of their soils has changed, altering its fertility, clay content and friability and making it more prone to deep cracking.” Notably, a recent trial

⁶⁰ <http://www.smh.com.au/environment/water-issues/agls-irrigation-trial-using-csg-waste-water-found-to-be-unsustainable-20150416-1mmf82.html>

⁶¹ http://www.lockthegate.org.au/metgasco_guilty_of_dumping_csg_wastewater_at_council_sewage_plant

⁶² <http://www.theherald.com.au/story/2798557/veil-on-coal-seam-gas-waste-disposal/>

⁶³ <http://www.ehp.qld.gov.au/management/non-mining/csg-water.html>

⁶⁴ Submission to the NSW Parliamentary Inquiry into Coal Seam Gas

⁶⁵ http://www.weeklytimesnow.com.au/article/2013/08/27/580901_national-news.html

program in Gloucester, NSW where CSG wastewater was used for crop irrigation was discontinued after regulators found it left behind unacceptably high levels of salt and heavy metals in the soil.⁶⁶ AGL's irrigation trial involved the use of a mixture of CSG produced water and fresh water to irrigate crops, including lucerne, triticale and forage sorghum, and an area of improved pasture. The NSW EPA was concerned about the levels of salt and some heavy metals found in this 'beneficial re-use' irrigation trial and found that "the presence of these [substances] made the long-term viability of the program unsustainable." A recent US Study suggests that "treatment of fracking wastewater must include aeration, precipitation, disinfection, a biological treatment to remove dissolved organic matter, and reverse osmosis desalination in order for it to be appropriate for non-fracking uses, such as crop irrigation."⁶⁷

In the US water may also be filtered and reused in fracking operations, but the viability of this depends on a number of factors, including the quantity, quality and duration of the water production⁶⁸. A US Report⁶⁹ from 2013 notes that whilst the oil and gas industry continues to talk about water recycling technologies, "data on actual use of recycling are hard to come by, and it appears that these technologies are not yet widely used."

Recent research from the US highlights the following issues with current waste disposal methods in the US unconventional gas industry:

- Alterations of local hydrology caused by the injection of large volumes of hydraulic fracturing fluids that may have mobilized contaminants left over from legacy oil, gas, and mining operations as well as opened pathways for the migration of fracking fluids themselves.⁷⁰
- Identified risks in disposal practices such as: use of wastewater for crop irrigation, in which case contaminants may seep from the surface of agricultural areas into groundwater; use of unlined pits for waste storage and reinjection into potable aquifers.⁷¹
- Analysis of the organic chemicals found in liquid waste that flowed out of gas wells in Colorado after they had been fracked revealed the presence of many fracking fluid

⁶⁶ <http://www.smh.com.au/environment/water-issues/agls-irrigation-trial-using-csg-waste-water-found-to-be-unsustainable-20150416-1mmf82.html>

⁶⁷ Lester, Y., Ferrer, I., Thurman, E. M., Sitterley, K. A., Korak, J. A., Aiken, G., & Linden, K. G. (2015). Characterization of hydraulic fracturing flowback water in Colorado: Implications for water treatment. *Science of the Total Environment*, 512–513, 637-44. doi: 10.1016/j.scitotenv.2015.01.043

⁶⁸ Chesapeake Energy presentation: EPA Hydraulic Fracturing Study Technical Workshop #4 Water Resources Management

⁶⁹ Western Organization of Resource Councils: *Watered Down: Oil & gas production & oversight in the west*.

⁷⁰ Alawattegama, S. K., Kondratyuk, T., Krynock, R., Bricker, M., Rutter, J. K., Bain, D. J., & Stolz, J. F. (2015). Well water contamination in a rural community in southwestern Pennsylvania near unconventional shale gas extraction. *Journal of Environmental Science and Health, Part A: Toxic/Hazardous Substances and Environmental Engineering*, 50, 516-528. doi: 10.1080/10934529.2015.992684

⁷¹ Long, J. C. S, Birkholzer, J. T., & Feinstein, L. C. (2015, July 9). Summary report. In: *An Independent Scientific Assessment of Well Stimulation in California*. California Council on Science and Technology, Sacramento, CA. Retrieved from: <http://ccst.us/publications/2015/2015SB4summary.pdf>

additives, including biocides, which are potentially harmful if they leak into groundwater.

- Researchers have shown that liquid waste from shale gas fracking operations is chemically different than waste flowing out of conventional wells and hypothesize that the hydraulic fracturing process itself liberates elements from clay minerals in the shale formations, including boron and lithium, which then enter the liquid waste.⁷²
- Inadequate regulations governing waste disposal via injection wells including no testing of what the waste contains; inadequate monitoring and failure to protect drinking water sources from waste disposal.⁷³
- A review⁷⁴ of disposal well files and more than 2,090 mechanical integrity tests revealed that North Dakota frack waste injection wells were often leaky and that state regulators continued to allow fluid injection into wells with documented structural problems even though the wells did not meet EPA guidelines for well bore integrity.

Water contamination from CSG operations in Australia

In late May 2012, the Condamine River was found bubbling⁷⁵ 'like a spa bath' near the Queensland country town of Chinchilla. A gas metre registered high levels of methane coming from the river. The bubbling was occurring in an area where coal seam gas wells are located⁷⁶ in close proximity to the River. Whilst the gas company concerned, Origin Energy, blithely described the bubbling as a 'natural' phenomenon⁷⁷, landholders in the area have never heard of or encountered gas leakages on this scale previously, and Dr Gavin Mudd⁷⁸ from Monash University School of Engineering stated that it was feasible that de-watering of the coal seam had enabled methane gas to escape to the surface. Whilst initial government investigations^{79,80} were inconclusive as to the cause, government documents obtained by the media⁸¹ in 2013 say

⁷² Warner, N. R., Darrah, T. H., Jackson, R. B., Millot, R., Kloppmann, W., & Vengosh, A. (2014). New tracers identify hydraulic fracturing fluids and accidental releases from oil and gas operations. *Environ. Sci. Technol.*, 48(21), 12552–12560. doi: 10.1021/es5032135

⁷³ Sadasivam N. (2014, July 29). Report criticizes EPA oversight of injection wells, *ProPublica* Retrieved from <http://www.propublica.org/article/report-criticizes-epa-oversight-of-injection-wells>
116 U.S. Government Accountability Office. (June 27, 2014). EPA program to protect underground sources from injection of fluids associated with oil and gas production needs improvement. GAO-14-555. Retrieved from <http://www.gao.gov/products/GAO-14-555>

⁷⁴ Brown, A. (2015, February 14). Lacking integrity? State regulatory officials don't follow EPA guidance on saltwater disposal wells. *The Dickinson Press*. Retrieved from <http://www.thedickinsonpress.com/energy/bakken/3679507-lacking-integrity-state-regulatory-officials-dont-follow-epa-guidance>

⁷⁵ <http://www.youtube.com/watch?v=Di8cCrlyW6k&feature=related>

⁷⁶ <http://mines.industry.qld.gov.au/geoscience/interactive-resource-tenure-maps.htm>

⁷⁷ <http://www.queenslandcountrylife.com.au/news/state/agribusiness/general-news/searching-for-origin-of-condamine-bubbles/2629517.aspx>

⁷⁸ <http://www.abc.net.au/local/stories/2012/11/08/3628589.htm>

⁷⁹ https://www.dnrm.qld.gov.au/__data/assets/pdf_file/0005/119669/condamine-river-gas-seep.pdf

⁸⁰ <http://www.couriermail.com.au/news/queensland/mystery-over-methane-gas-in-condamine-river/story-e6freoof-1226559590621>

⁸¹ <http://www.couriermail.com.au/news/queensland/government-report-points-the-finger-at-csg-as-cause-for-bubbles-in-the-condamine-river/story-fnihsrf2-1226689683452>

that the gas creating the bubbles was "consistent with published values of coal seam gas". As of early 2016⁸², the methane seeps have been seen to be intensifying and whilst being monitored, a definitive cause for seeps is yet to be established.

There have also been a number of reported cases of methane migration into farm bores following coal seam gas development in the Western Downs region of Queensland. These cases include:

- Evidence of methane migration as a result of coal seam gas mining was been provided by a local landholder⁸³ who has been able to set his water bore on fire after drilling took place nearby.
- An old coal exploration drillhole⁸⁴ at Daandine, near Dalby, catching fire after coal seam gas mining in the vicinity.
- Explosions/blow outs of water bores at a number of used and disused water bores in the vicinity of CSG operations near Hopeland in 2014 and 2015, with gas and water sometimes spewing metres into the air^{85, 86, 87}.

During the exploration phase of coal seam gas development in NSW, there have been a number of recorded contamination events around the state. Santos' CSG operations in the Pilliga Forest region of NW NSW have been plagued with issues, with at least 20 toxic coal seam gas waste water spills and continuing leaks from evaporation ponds. The spills that Santos has recorded shows leaks from all parts of the operations, from evaporation ponds, pipelines, the waste-water treatment facilities and at well sites. In 2013, Santos was found guilty of poisoning an aquifer in the Pilliga Forest in north-west NSW with radioactive uranium 20 times safe levels as well as toxic heavy metals. This was the first official case of aquifer contamination from coal seam gas operations in Australia. This is of considerable concern given that the Pilliga is a major recharge zone for the Great Artesian Basin, which is a critical water source for farmers and inland Australia. The NSW Environment Protection Authority (EPA) fined Santos just \$1500 on February 11 2014 for this contamination when the maximum fine is \$1 million.

A spill in June 2011 in the Pilliga resulted in 10,000 litres of untreated toxic coal seam gas waste water containing a dangerous cocktail of heavy metals (including arsenic, lead and chromium), salts and petrochemicals that killed vegetation and wildlife. Santos was found guilty in the NSW Land and Environment Court and fined a paltry \$52,000 when the maximum penalty for one offence is \$1 million. In 2010 toxic coal seam gas waste water was discharged on two occasions

⁸² <http://www.abc.net.au/news/2016-02-14/condamine-river-mysterious-bubbling-intensifying-landholders-say/7139676>

⁸³ <http://www.youtube.com/watch?v=SMe59e9Lcco>

⁸⁴ <http://www.youtube.com/watch?v=OZ1PoMreM0Y>

⁸⁵ http://www.lockthegate.org.au/why_the_earth_rumbles_at_hopeland_coal_seam_gas

⁸⁶ <http://www.themorningbulletin.com.au/news/making-good-on-legislation-bender-no-time-to-waste/2868253/>

⁸⁷ <http://www.beefcentral.com/news/92413/>

into Bohena Creek, part of the Murray-Darling Basin. The EPA fined Santos a paltry \$3000 in July 2012 even though the maximum penalty is \$1 million per offence.

A 2015 routine monitoring at AGL's (now abandoned) Waukivory CSG Project at Gloucester detected elevated levels of toxic BTEX (Benzene, Toluene, Ethylene, Glycene) chemicals in flowback water from wells following hydraulic fracturing. Given that the fracking chemicals and raw water used both tested negative for these chemicals, it was assessed that the likely source of BTEX was the coal seams and that the chemicals were mobilized as a result of the fracking process⁸⁸. Whilst this contaminated flowback water was not released to the environment, but taken to a licensed facility for treatment and disposal, this incident highlights the contamination risks associated with wastewater treatment and raises questions about the methods of treatment and disposal that are being used or proposed for this industry and whether or not they are adequate.

Impacts on water availability from UG water use

Fracking for unconventional gas is an extremely water-intensive practice, with shale and tight gas fracking requiring significantly larger volumes of water than coal seam gas fracking operations. The Australian gas industry provides a figure of 11 million litres to frack a shale gas well,⁸⁹ however a range of other sources suggest that water use is often much higher.⁹⁰ According to a 2015 water study from the United States, horizontal shale gas fracking uses the most water, requiring up to 36.6 million litres of water per well⁹¹, or around 1200 truckloads of water for just one fracked well. Wells are often fracked on multiple occasions, sometimes up to ten times⁹², thereby multiplying water use. Significant amounts of water are also used in drilling processes (around 1 million litres per well)⁹³. Whilst industry suggests overall water use could be minimised by reuse of fracking wastewater in new fracking operations, a recent US water report⁹⁴ notes that few operators in the US are using recycled fracking water in fracking operations, with the total reported use of recycled water equalling the water used at just 125 to 250 shale oil wells. The study states: "with few exceptions, the rest of the water used for fracking is gone for good from the hydrological cycle."

⁸⁸ <http://www.epa.nsw.gov.au/resources/licensing/150311-agl-gloucester.pdf>

⁸⁹ APPEA: The Natural Gas Revolution - Natural gas from shale and tight rocks.

⁹⁰ Kargbo D, William R & Campbell D, (2010) Natural Gas Plays in the Marcellus Shale: Challenges and Potential Opportunities, Vol. 44, No. 15 *Environmental Science & Technology*; CIWEM UK, 2012 Policy Position Statement 'Hydraulic Fracturing (Fracking) of Shale in the UK';

⁹¹ Gallegos et al, 2015, Hydraulic fracturing water use variability in the United States and potential environmental implications, *Water Resources Research Journal*.

⁹² European Parliament, 2011, Economic & Scientific Policy Dept, Impacts of shale gas and shale oil extraction on the environment and on human health.

⁹³ WA Govt, 2015, *Natural gas from shale & gas fact sheet: water use & management*.

⁹⁴ *Gone for Good: Fracking and Water Loss in the West*: http://www.worc.org/media/Gone_for_Good1.pdf

In relation to water use, the European Commission report⁹⁵ on fracking notes:

“The hydraulic fracturing process is water-intensive and therefore the risk of significant effects due to water abstraction could be high where there are multiple installations. A proportion of the water used is not recovered. If water usage is excessive, this can result in a decrease in the availability of public water supply; adverse effects on aquatic habitats and ecosystems from water degradation, reduced water quantity and quality; changes to water temperature; and erosion. Areas already experiencing water scarcity may be affected especially if the longer term climate change impacts of water supply and demand are taken into account. Reduced water levels may also lead to chemical changes in the water aquifer resulting in bacterial growth causing taste and odour problems with drinking water. The underlying geology may also become destabilized due to upwelling of lower quality water or other substances.”

Whilst the potential for negative impacts on water supplies due to extraction of water for fracking operations is down played by industry, who often cite comparatively higher figures for irrigated agricultural production in their own defense, depletion of ground and surface water resources from fracking operations can have significant impacts once the industry is in full production in a region. The large number of wells needed to develop unconventional resources and the requirement for multiple fracturing of wells multiplies the overall take of water by the industry. The threat to water resources is greater in lower rainfall regions, and on a regional and local scale where water resources are already under serious pressure, in particular where they are relied upon by a range of existing industries and may already be subject to over-allocation.

The extraction of water from underground aquifers for fracking has the potential to place significant stress on groundwater systems, particularly if they are already utilized by existing rural industries. This demand on groundwater for supplying fracking operations will be critical in semi-arid regions, where underground aquifers are often the sole or principal source of water, and more broadly, during extended drought periods and during periods of reduced rainfall which are likely to be more frequent as a result of climate change. The water needed for the development of an UG industry in arid and semi-arid regions of Australia such as the Northern Territory, South West Queensland, and Mid-West WA, is of particular concern, particularly in light of existing concerns about over-allocation, changing rainfall patterns, and groundwater depletion in these regions.

In the US there is growing awareness of the cumulative impacts of fracking water use on available water resources in the drier regions of the country. A 2013 report, *Gone for Good*:

⁹⁵ Support to the identification of potential risks for the environment and human health arising from hydrocarbons operations involving hydraulic fracturing in Europe, *European Commission: DG Environment (August 2012)*

*Fracking and Water Loss in the West*⁹⁶ details how the semi-arid states of Colorado, Montana, North Dakota, and Wyoming let the oil and gas industry drain irreplaceable groundwater resources and remove these resources from the hydrological cycle [and how] this water loss threatens the future of other industries, agriculture, and the families who live near oil and gas development." Alarming, this report states: "From the research undertaken to compile this report, it seems clear that water use for fracking is reaching a crisis point in the region. There is mounting evidence that the current level of water use for oil and gas production simply cannot be sustained, and that projected increases in use may lead to a crisis."

Another recent report⁹⁷ highlights the impacts of fracking on water availability in semi-arid and drought prone regions of the US, noting that, "of the nearly 40,000 oil and gas wells drilled since 2011, three-quarters were located in areas where water is scarce, and 55% were in areas experiencing drought." In a lesson that governments in Australia looking to expand the unconventional industry in our semi-arid regions could well learn from, the Ceres Report notes: "Hydraulic fracturing is increasing competitive pressures for water in some of the country's most water-stressed and drought-ridden regions" and without new tougher regulations on water use the industry could be on a "collision course"⁹⁸ with other water users. In Texas, extraction of water for fracking has contributed to serious problems of ground and surface water depletion during drought conditions where towns and pastoral properties must compete with fracking operators for scarce water supplies⁹⁹, whilst in California, fracking also threatens groundwater resources through water consumption. According to one Californian study¹⁰⁰, while the volume of water used in fracking represents a small percentage of overall annual water consumption in California, fracking-related water use is disproportionately concentrated in areas of the state already suffering from water shortages, and further drawdowns of these aquifers may interfere with agricultural and municipal water needs.

Groundwater Depletion associated with Queensland CSG Operations

A 2012 Queensland Government report (Surat Underground Water Impact Report- UWIR)¹⁰¹ on the impacts of coal seam gas development on water resources in the Surat Basin found that

⁹⁶ http://www.worc.org/media/Gone_for_Good1.pdf

⁹⁷ <http://www.ceres.org/issues/water/shale-energy/shale-and-water-maps/hydraulic-fracturing-water-stress-water-demand-by-the-numbers>

⁹⁸ http://www.theguardian.com/environment/2014/feb/05/fracking-water-america-drought-oil-gas?CMP=share_btn_fb

⁹⁹ *Frackers guzzle water as Texas goes thirsty*: <http://nation.time.com/2013/09/29/frackers-guzzle-water-as-texas-goes-thirsty/>; Western Organization of Resource Councils: *Watered Down: Oil & gas production & oversight in the west*.

¹⁰⁰ Long, J. C. S, Birkholzer, J. T., & Feinstein, L. C. (2015, July 9). Summary report. In: *An Independent Scientific Assessment of Well Stimulation in California*. California Council on Science and Technology, Sacramento, CA. Retrieved from: <http://ccst.us/publications/2015/2015SB4summary.pdf>

¹⁰¹ https://www.dnrm.qld.gov.au/__data/assets/pdf_file/0017/31328/ogia-surat-uwir-summary.pdf

“petroleum tenure holders are predicted to extract approximately 95,000 megalitres of water per year over the life of the industry and this extraction will impact on water levels” in the region. The UWIR found that of the 21,000 water bores (used for grazing, irrigation, industry and urban consumption) within the Surat Cumulative Management Area some 528 bores are expected to experience a decline in water level of more than the trigger threshold as a result of CSG water extraction. (n.b. The trigger threshold is five metres for consolidated aquifers (such as sandstone) and two metres for unconsolidated aquifers (such as sands)).

Media reports show that there are also landholders outside the Cumulative Management Area (CMA) identified in the UWIR whose bores are being impacted by CSG operations. In October 2013, Chinchilla farmers Col and Marcia Davis told Queensland Country Life¹⁰² that they were “running out of water on their Wamba property after gas drilling affected their bore supplies.” The Davises, who run 1500 cattle and a piggery on a farm that sits 600 metres outside the Surat CMA and 5 kilometres from the nearest gas well, have seen water levels drop and gas levels rise in a number of bores relied upon for watering stock.

b. Industrialisation of Rural and Natural Landscapes

In general fracking and UG development in rural regions leads to:

- Industrialization of rural regions with roads, pipelines, and infrastructure.
- Destruction of the visual amenity of rural areas.
- Reduced quality of life for rural residents and impacts on farm animals and wildlife populations due to massive increases in truck movements; the impacts of continual noise and lights during drilling and fracking activities; and toxic emissions from gas infrastructure at all stages of the extraction process.

The more particular impacts of these developments vary according to the type of land on which the activities are being carried out, and the existing land use as follows:

Farmland: When gas development takes place on agricultural lands there are a variety of impacts including:

- Loss of productive farming land due to the large surface area required for UG development.
- Reduced viability of farming operations due to UG industry operations and infrastructure and negative impacts on water resources relied upon by existing industries (as detailed above).

¹⁰² <http://coalseamgasnews.org/qld/qld-farmers-lose-bore-water-following-csg-extraction/>

- Competition for scarce water resources between UG operators and existing land users due to the large water use in hydraulic fracturing processes (Approximately 7.7 -38 megalitres per fracture with multiple fractures often needed for each well¹⁰³).

Natural areas: When UG development takes place in natural vegetated areas there are likely to be very significant impacts on native vegetation, wildlife habitat and biodiversity. These impacts include^{104 105}:

- Destruction and fragmentation of critical wildlife habitat and food resources for construction of roads, pipelines and well pads.
- Wildlife deaths from large numbers of heavy traffic movements and exposure to wastewater via leaks spills or in holding ponds.
- Depletion and contamination of ground and water supplies represent a major threat to the vegetation, natural ecosystems, wildlife, groundwater dependent organisms, and wetland areas that rely on those water resources.
- Invasion by noxious weeds as well as feral pests and predators due to increased fragmentation.
- Increased bushfire risk due to increases in ignition sources and flammable fuel for fires.
- Fouling of natural waterways from vegetation clearing and sediment run off from pads, pipelines and roads as well as wastewater releases into waterways.
- Disruption to wildlife by machinery, traffic and drilling noise and emissions.

The Compendium of Fracking Risks highlights the scale of the impacts of unconventional gas development in the US- impacts that could be mirrored in Australia if the industry moves to full production in all the areas currently targeted for exploration. *The Compendium* notes that:

“Unconventional technologies in gas and oil extraction facilitated the drilling of an average of 50,000 new fractured wells per year in North America over the past 15 years. An interdisciplinary study published in *Science* demonstrated that the accumulating land degradation has resulted in continent-wide impacts, as measured by the reduced amount of carbon absorbed by plants and accumulated as biomass. This is a robust metric of essential ecosystem services, such as food production, biodiversity, and wildlife habitat, and its loss “is likely long-lasting and potentially permanent.” The land area occupied by well pads, roads, and storage facilities built during this period is approximately three million hectares, roughly the land area of three Yellowstone National Parks. The authors concluded that new approaches to land use planning and

¹⁰³ NTN: Toxic Chemicals in the Exploration and Production of Gas from Unconventional Sources

¹⁰⁴ Engineering Energy: Unconventional Gas Production, ACOLA

¹⁰⁵ *Support to the identification of potential risks for the environment and human health arising from hydrocarbons operations involving hydraulic fracturing in Europe, European Commission: DG Environment (August 2012)*

policy are “necessary to achieve energy policies that minimize ecosystem service losses.”¹⁰⁶

Recent studies detail some of the impacts of UG operation on wild lands and waterways in the US as follows:

- A survey of streams in Arkansas, led by the University of Central Arkansas, found alterations in macroinvertebrate communities to be related to drilling and fracking operations in the Fayetteville Shale. Fracking activity near streams was associated with greater sediment and more chlorophyll. “This study suggests that land disturbance from gas development affected stream communities.”¹⁰⁷
- A study In Wyoming showed that the arrival of drilling and fracking activities coincided with an increase in salinity in a creek that drains public land in a semi-arid region of the state. The study found that the dissolved minerals associated with the rise in salinity matched those found in native soil salts, suggesting that disturbance of naturally salt-rich soils by ongoing oil and gas activities, including pipeline, road, and well pad construction, was the culprit. “As [shale gas and oil] development continues to expand in semiarid lands worldwide, the potential for soil disturbance to increase stream salinity should be considered, particularly where soils host substantial quantities of native salts.”¹⁰⁸
- Officials with the North Dakota Division of Oil and Gas said they had primary enforcement responsibilities and that EPA guidance did not apply to these wells. The investigation noted, “... a review of state and federal documents, as well as interviews with geologists, engineers, environmental policy experts and lawyers who have litigated under the Safe Drinking Water Act, suggests the agency is loosely interpreting guidance and protocols that are meant to maintain the multiple layers of protection that separate aquifers from the toxic saltwater.”

c. Rehabilitation of land

In assessing the rehabilitation of land that has been hydraulically fractured, the European Commission report¹⁰⁹ on fracking notes: “The evidence suggests that it may not be possible fully to restore sites in sensitive areas following well completion or abandonment, particularly in areas of high agricultural, natural or cultural value. Over a wider area, with multiple

¹⁰⁶ Allred, B. W., Kolby Smith, W., Tridwell, D., Haggerty, J. H., Running, S. W., Naugle, D. E., & Fuhlendorf, S. D. (2015). Ecosystem services lost to oil and gas in North America. *Science*, 348 (6233), 401-402.

¹⁰⁷ Johnson, E., Austin, B. J., Inlander, E., Gallipeau, C., Evans-White, M. A., & Entekin, S. (2015). Stream macroinvertebrate communities across a gradient of natural gas development in the Fayetteville Shale. *Science of the Total Environment*, 530-531, 323-32. doi: 10.1016/j.scitotenv.2015.05.027

¹⁰⁸ Bern, C. R., Clark, M. L., Schmidt, T. S., Nolloway, J. M., & McDougal, R. R. (2015). Soil disturbance as a driver of increased stream salinity in a semiarid watershed undergoing energy development. *Journal of Hydrology*, 524, 123-136. doi: doi.org/10.1016/j.jhydrol.2015.02.020

¹⁰⁹ *Support to the identification of potential risks for the environment and human health arising from hydrocarbons operations involving hydraulic fracturing in Europe, European Commission: DG Environment (August 2012)*

installations, this could result in a significant loss or fragmentation of amenities or recreational facilities, valuable farmland or natural habitats.” A recent US study¹¹⁰ documents the failure of plant and soil systems disturbed by drilling and fracking activities to return to pre-drilling conditions following rehabilitation- even after 20 to 50 years.

Given the spatial intensity of UG fields and the number of large multi well pads and road and pipeline corridors required, there is likely to be a very significant total land area that is rendered unusable for other purposes as a result of fracking operations. The scars on the landscape from UG developments are likely to remain indefinitely, particularly in arid regions, and will permanently destroy the visual amenity of these regions. This is of significant concern in the many natural areas that are currently being targeted for UG development across Australia, in particular, outstanding tourist and natural icons that are renowned for their visual grandeur and biodiversity values such as the Kimberley in Western Australia, the Top End and Central Australia in the Northern Territory and Queensland’s Channel Country.

3. TOR c: Government and non-Government services and assistance for those affected:

The sections above on health, landholder, environmental and agricultural impacts outline some of the issues currently facing rural residents who have live in areas where rapid development of the unconventional gas industry, particularly coal seam gas operations, have taken place. It is apparent from the experiences of local communities impacted by coal seam gas development in Queensland that the existing government and non-government services are woefully inadequate to deal with these issues. In light of this deficit, and in response to the harm currently being experienced on a daily basis by farming families in CSG production regions in Queensland, the Alliance recommends that a comprehensive range of interventions, along the lines of the national reform agenda outlined in earlier sections of this submission, be implemented in Queensland. In addition the Alliance urges this Inquiry to recommend that the Federal Government use whatever mechanisms are available to it, including the COAG framework, to encourage the Queensland government to undertake the following 8 point plan to urgently address some of the most significant impacts of the existing CSG industry on impacted communities:

1. Amend the laws to prevent CSG companies using the threat of the Land Court to intimidate and coerce farmers, and instead provide landholders with a right to say no so that CSG companies are required to deal fairly if they want to obtain access.
2. Place an immediate halt on Origin Energy plans to drill CSG wells in the Hopeland area and create a permanent no-go zone to protect this important floodplain area from CSG drilling in the future.
3. Urgently broker buy-outs between gas companies and at least 5 families who are now at

¹¹⁰ Minnick, T. J. & Alward, R. D. (2015). Plant–soil feedbacks and the partial recovery of soil spatial patterns on abandoned well pads in a sagebrush shrubland. *Ecological Applications* 25(1), 3-10.

crisis point around Chinchilla, with the goal of having them moved to their satisfaction by the end of the year.

4. Establish a CSG Family Crisis Panel which has a statutory role to broker exits for families who can no longer live with the stress of CSG mining, and which has a wide remit to intervene at a high level to resolve protracted difficulties for families.

5. Establish and fund a Resources Ombudsman under statute, with all relevant powers granted to such office generally, to adjudicate in a formal manner on CSG related disputes, complaints and issues.

6. Establish a dedicated counselling and support service for CSG Affected Communities, which is managed under the CSG Family Crisis Panel.

7. Immediately commence a study into the health impacts of CSG, funded to the tune of at least \$500,000, with an emphasis on mental health impacts and amelioration measures and which also includes ambient air quality monitoring program as recommended previously.

8. Establish a CSG Health Roundtable, comprised of independent public health professionals with experience in environmental health, mental health and social impacts, to advise it on CSG impacts and to design and oversee the study referred to above.

4. TOR d: Compensation and insurance arrangements:

Farmers and other landholders have raised major concerns about the likelihood that they may ultimately be liable for any negative impacts caused by hydraulic fracturing. The NSW Chief Scientist recently released a report which concluded that the CSG industry was markedly under-insured and that landholders were likely to bear a substantial risk as a result. The risks of contamination raise major concerns for food producers who have signed National Vendor Declarations.

This is a particular concern because there are numerous potential contamination pathways for livestock from UG activities. These include:

1. Discharge of treated UG wastewater into creeks and rivers
2. Direct contamination of groundwater from spills, leaks or well failure
3. Direct access to chemicals left discarded on site ie in drums etc
4. Irrigation and animal production utilising UG wastewater
5. Airborne contamination from a range of chemical substances
6. Discharge of drilling mud onto land for 're-use'
7. Waste management practices such as spraying roads
8. Accidents, overflows and flood events

Notably, the Rural Industries Research and Development Corporation [cite](#) a case study in Qld where a landowner was advised by their supply chain partners that they would be liable for any contamination caused by CSG activities. Neither the CSG company nor the insurer would agree to indemnify the landholder against that risk.

Legal advice received by the landholder was that the Conduct and Compensation Agreement on offer from the CSG company only provided indemnity to a shelf company and that the agreement waived future compensation rights. Any compensation for a contamination event would need to be pursued through the Courts.

The major implications for landholders and livestock producers in particular, are that:

1. The onus of proof in any contamination event is almost certain to reside with the landholder.
2. The inadequacies of baseline monitoring by companies and the prohibitive costs of monitoring for landholders, means that proving contamination is likely to be extremely difficult.
3. Farmers who sign National Vendor Declarations for livestock that may have been contaminated by contact with CSG waste are likely to be liable for any harm incurred.
4. CSG companies are refusing to include provisions in access agreements to accept liability for any contamination that may occur.
5. CSG companies in Australia are under-insured and do not have adequate insurance to cover the types of risks that CSG activities bring.
6. Some graziers have reported that insurers have examined the risk to them of CSG contamination and found it too high to offer insurance.

Any unforeseen contamination of agricultural and horticultural production from the expansion of unconventional gas and fracking operations in regions that support sheep and cattle, grain and other crops, vineyard and orchard products could have significant negative economic impacts on these industries. Across Australia there are many regions that currently support important agricultural and horticultural operations that are now being targeted for unconventional gas extraction. These regions include, among others, Queensland's Darling Downs and Golden Triangle regions, the Liverpool Plains and North West regions of NSW, South East South Australia, Gippsland and Western Victoria and the Mid-West and Gascoyne regions of Western Australia.

5. TOR f: Harmonisation of federal and state/territory government legislation, regulations and policies:

Across all Australian states the government response to community concerns about unconventional gas extraction and fracking impacts has been to insist that any adverse impacts can be managed and mitigated through adequate regulation. The NSW Chief Scientist's Review of Coal Seam Gas Activities in NSW¹¹¹ is an example of this approach. This Review concluded that, while there were inherent technical challenges and risks in coal seam gas extraction, these could in general be managed. After listing a number of recommendations the Report noted that

¹¹¹ <http://www.chiefscientist.nsw.gov.au/coal-seam-gas-review/final-report-september-2014>

“all of this needs to take place within a clear, revised, legislative framework which is supported by an effective and transparent reporting and compliance regime and by drawing on appropriate expert advice.”

However, the most recent findings from the US show that regulations are simply not capable of preventing harm¹¹² and relying on regulatory frameworks alone to manage the risks associated with fracking is not a viable solution for governments. Regulation is ineffective both because the number of wells and attendant infrastructure in unconventional gas operations is so large and keeps increasing and, more importantly, because some of fracking’s many component parts, which include the subterranean geological landscape itself, are simply not controllable. For instance, a new study on fracking-related air pollution in northeastern Colorado shows that even though the volume of toxic emissions per well might be decreasing, overall air quality in the shale field continues to deteriorate as the rapid, continuing increase in the number of wells cancels out improvements to air quality brought about by more stringent regulations. Similarly, the *Compendium of Fracking Risks* details the results of a new study from Texas which raises the possibility that methane can migrate into aquifers through *unseen* cracks and fissures in the rock surrounding the wellbore in ways that no cementing and casing protocols, however strictly applied, can prevent. Additionally, new findings from West Virginia show how unmapped, long-abandoned wells—including those drilled generations ago—can become re-pressurized during nearby fracking operations and serve as conduits for the contamination of drinking water. The *Compendium* notes that “no set of regulations can obviate these problems”.

In addition to the regulatory issues outlined from the US, the scale of unconventional gas operations make regulatory enforcement and monitoring a difficult and expensive undertaking which is not economically feasible for governments within existing funding priorities and frameworks. In existing UG operations such as those in NSW and Queensland the role of monitoring has largely been left to the industry, if it is done at all, and enforcement agencies are under resourced and under staffed. The fact that there has been little baseline monitoring of existing water, air and soil parameters prior to the roll out of the UG industry in Australia also means that impacts will not be measurable, if and when they occur.

Given the above issues surrounding the failure of even “world’s best practice”, comprehensive regulatory regimes to adequately manage and mitigate the impacts of the unconventional gas industry, Lock the Gate Alliance, reiterates the need for permanent “no go” zones to protect Australia’s most important natural, agricultural, cultural and water resources and assets from damage and destruction from unconventional gas development. The Alliance repeats the call for this Inquiry to recommend the implementation of:

¹¹² <http://concernedhealthny.org/wp-content/uploads/2014/07/CHPNY-Fracking-Compendium.pdf>

- Exclusion zones to protect agricultural land, significant water resources, national landscapes and tourism icons, and residential dwellings from unconventional gas exploration and mining impacts.
- Federal legislation to ensure that cumulative impacts from gas mining on nationally significant water resources, natural areas and cultural heritage sites are assessed, prevented and mitigated.

6. Any related matter:

i. Chemical use in Unconventional Gas Development

The unconventional gas industry often claims that most of the chemicals used in fracking can be found in household products, thereby inferring that they are safe. While it is true that some of the chemicals can be found in products you might use in your home, this statement overlooks the fact that they may not be safe for humans and the environment if they make their way into air, water and soil during or after fracking operations. This issue is of particular concern given the large quantities used in fracking fluids and the various untested combinations with numerous other chemicals.

This industry claims that fracking chemicals are largely composed of ‘household products’ also deliberately glosses over the fact that many fracking chemicals are known to be toxic and many others have not been assessed for their long-term impacts on the environment and human health. For instance, fracking compounds used in Australia have been shown to include many hazardous substances, including carcinogens, neurotoxins, reproductive toxins, irritants/sensitisers, and endocrine disruptors. It is also worth noting that some of these chemicals are toxic even in extremely small concentrations¹¹³.

In addition to claiming that the chemicals used in unconventional gas extraction are safe, the industry also claims that chemicals only make up a small percentage of overall fracking fluid volume so there is nothing to worry about. Whilst it is true that chemical additives only make up between 0.5 - 2%¹¹⁴ of fracking fluids, and this is only a small proportion relative to the large volumes of water used, it translates to very large *actual* quantities of chemical additives. For example, a typical 15 million litre fracturing operation would use from 80 to 330 tons of chemicals¹¹⁵.

The National Toxics Network¹¹⁶ has published a number of papers on chemical use in the unconventional gas industry which identify a range of issues in relation to the chemicals used in fracking and their regulation. These include:

¹¹³ Caram, Moss & Blashki, 2014 “Harms UnKnown: health uncertainties cast doubt on the role of unconventional gas in Australia’s Energy Future”, Medical Journal of Australia.

¹¹⁴ Hazen and Sawyer, December 22, 2009. Impact Assessment of Natural Gas Production in the New York City Water Supply Watershed.

¹¹⁵ Ibid

¹¹⁶ NTN: Toxic Chemicals in the Exploration and Production of Gas from Unconventional Sources

- Many chemicals used in fracking operations in Australia have not been assessed for their toxicity to the environment and humans. “The mixtures used in drilling and fracking fluids are also not assessed for toxicity or persistence and can form new compounds when exposed to sunlight, water, air, radioactive elements or other natural chemical catalysts.”¹¹⁷
- Large numbers of hazardous products were identified in US fracking operations.
- There is a reliance on industry reporting of fracking chemicals in the US, with many potentially toxic chemicals not being reported as they are classed as ‘trade secrets’.

Doctors for the Environment (DEA)¹¹⁸ note that it is “not possible to undertake adequate health risk assessments of [fracking] operations as insufficient information has been gathered on the nature and doses of chemicals entering water and air and the exposures of people to these chemicals.” DEA are concerned that many of the chemicals used in fracking are known to be hazardous to health through release into water and/or air and include endocrine-disrupting and cancer causing agents. They maintain that disclosure of the chemicals used in fracking and assessment of their impacts over time are inadequate.

A US study, *Natural Gas Operations from a Public Health Perspective*,¹¹⁹ notes that fracking “relies on undisclosed types and amounts of toxic chemicals” and that “many chemicals used during the fracturing and drilling stages of gas operations may have long-term health effects that are not immediately expressed”. The authors recommend that full disclosure of the contents of all products, extensive air and water monitoring, coordinated environmental/human health studies, and regulation of fracturing under drinking water legislation is vital to protecting human health from harm from the chemicals used in fracking.

ii. Well Bore Integrity in Unconventional Gas Development

State Governments and the unconventional gas industry claim that fracking can be done safely if it is regulated appropriately and ‘best practice’ well construction guidelines are followed. However there is growing evidence to show that even strict regulations are simply not capable of preventing harm¹²⁰ and that ‘world’s best practice’ well construction just isn’t enough to stop wells leaking. Industry studies and independent analyses indicate inherent engineering problems including uncontrolled and unpredictable fracturing, induced seismicity leading to an

¹¹⁷ NTN: Toxic Chemicals in the Exploration and Production of Gas from Unconventional Sources

¹¹⁸ DEA, Submission to the Inquiry into Coal Seam Gas, 16/09/2011

¹¹⁹

<http://cce.cornell.edu/EnergyClimateChange/NaturalGasDev/Documents/PDFs/fracking%20chemicals%20from%20a%20public%20health%20perspective.pdf>

¹²⁰ Compendium of Fracking Risks, 2014

increase in earth tremors, plus well casing problems, infrastructure integrity issues and leaks that cannot be prevented despite apparent ‘best practice’ regulations.¹²¹

*The Compendium of Fracking Risks*¹²² notes:

“Studies consistently show that oil and gas wells routinely leak, allowing for the migration of natural gas and potentially other substances into groundwater and/or the atmosphere. Recent research suggests that the act of fracking itself may induce pathways for leaks. Leakage from faulty wells is an issue that the industry has identified and for which it has no solution. According to Schlumberger, one of the world’s largest companies specializing in fracking, about five percent of wells leak immediately, 50 percent leak after 15 years, and 60 percent leak after 30 years. Data from Pennsylvania’s Department of Environmental Protection (DEP) for 2000-2012 show over nine percent of shale gas wells drilled in the state’s northeastern counties leaking within the first five years. Leaks pose serious risks including potential loss of life or property from explosions and the migration of gas or other chemicals into drinking water supplies.”

Alarming, the Compendium notes that “industry has no solution for rectifying the chronic problem of well casing/cement leakage,” and further: “there is no evidence to suggest that the problem of cement and well casing impairment is abating.... Indeed, a 2014 analysis of more than 75,000 compliance reports for more than 41,000 wells in Pennsylvania found that newer wells have higher leakage rates and that unconventional shale gas wells leak more than conventional wells drilled within the same time period.”

APPENDICES:

Appendix One: NSW CSG Report Card

Appendix Two: ANEDO Report on National Reform Agenda for Unconventional Gas

¹²¹ Ibid

¹²² Compendium of Fracking Risks, October 2015.