SUBMISSION TO THE SCIENTIFIC INQUIRY INTO HYDRAULIC FRACTURING IN THE NORTHERN TERRITORY

Geralyn McCarron
MB BCh BAO FRACGP
23rd March 2017

INTRODUCTION

Thank you for the opportunity to make a submission to the Scientific Inquiry into Hydraulic Fracturing in the Northern Territory.

My name is Geralyn McCarron. I am a general practitioner living and working in Brisbane, Queensland. I hope my personal insights into the reality of the unconventional gas industry in Queensland may be of value in your decision-making. I am also a member of the National Toxics Network and for your consideration I attach as part of my submission the NTN paper[1] *"Unconventional Gas Exploration and Production: Human Health Impacts and Environmental Legacy"* written by Dr Mariann Lloyd-Smith, dated April 2016.

The issue of unconventional gas development was first brought to my notice in 2011 in the context of Tamboran's plans to use hydraulic fracturing for shale gas in the Lough Allen Basin, the area of North West Ireland where I was born and raised. As I researched the implications of their proposal I became aware that in their "information sessions" in Ireland the picture Tamboran was presenting to the community bore little relationship to reality[2]. I also became aware that the unconventional gas industry was already developing in Queensland particularly in the Tara/ Chinchilla /Kogan area of the Darling Downs. In June 2012 I had to opportunity to visit the Western Darling Downs on a bus trip organized by Bridging the Divide, a Brisbane based, nonprofit, community organization. The lived experiences related by the people I met were confronting. On that and on several return visits I met many people who were extremely concerned about the noticeable deterioration in the health of their families since the advent of the gas industry.

THE QUEENSLAND EXPERIENCE OF UNCONVENTIONAL GAS

In June 2012 the Queensland Government had committed to investigate the growing health complaints of residents. The months passed and by February 2013 no health report had been published, yet both the industry and politicians repeatedly stated that Queensland Health had investigated and no health problem had been found. In a letter[3] printed in The Sydney Morning Herald (19th January 2013), Rick Wilkinson, Chief Operating Officer Eastern Region, Australian Petroleum Production & Exploration Association Ltd (APPEA) claimed that Queensland Health had *"reported no pattern of illness consistent with effects from natural gas extraction."*
It was in those circumstances that in February 2013 I surveyed and documented[4] the reported health impacts of 113 individuals from 38 families living an the area of the Darling Downs heavily impacted by the gas industry. Overall 58 % of people surveyed reported adverse health impacts which they attributed to the industry.

Of the 96 individuals aged between 6 and 82 years, 72% complained of skin irritation, whereas only 17% had previously had problems with their skin. People reported symptoms of discomfort, sensitivity, itch and inflammation of their skin which, particularly in adults, was often in the absence of a visible rash. 32 % of respondents reported spontaneous nose-bleeds, while only 7% had a history of nose bleeds prior to CSG. Eye irritation was a major issue,

---

[1] http://www.ntn.org.au/wp/wp-content/uploads/2016/05/NTN-Unconventional-Gas-Report-April-2016.pdf

[2] Please see Appendix 2 regarding Tamboran in Ireland.

[3] Letter, Rick Wilkinson, Sydney Morning Herald http://www.smh.com.au/national/letters/churches-fail- to-put-reasoned-argument-20130118-2cz9s.html

[4] 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

occurring in 60% of respondents. Headaches, tingling, paraesthesia, numbness, difficulty concentrating and extreme fatigue were frequently reported.

People reported their symptoms improved or disappeared when they were away from the area.

The reported health impacts in the children were of particular concern to me.

There were 31 children in the age group 6-18 years.
19 (61%) reported spontaneous nose bleeds. Skin irritation affected 24 of the 31 children. Almost all the children (28 out of 31) reported mild headaches and in over half (17 out of 31) the headaches were severe. Over 30% of the children (10/31) experienced paraesthesia. Cough, chest tightness, chest pain, difficulty sleeping, nausea, rashes, difficulty concentrating and muscles pains and spasms were frequent concerns.

There were 17 children in the 0-5year age group.
Parental concerns included rashes (11), eye irritation (11), and cough (5).
Very significant symptoms reported in this age group were:

- twitching and unusual movements (6);
- poor colour/blueness of mouth or limbs (6);
- blood from the nose (9);
- headaches (8);
- tingling/numbness/ pins and needles (5).

Of the 13 children who were walking, 5 were reported to have demonstrated unusual clumsiness or unsteadiness.

Parents particularly noted their children who had been playing outside coming in with nose-bleeds. Often they had linked increased frequency of these occurrences with wind direction and some had stopped their children playing outside at these times. Some adolescents had had daily nose-bleeds for three months at a time. These rural children now deliberately avoided going outdoors when possible. Adults who had lived in the bush all their life now found their lives restricted to indoors. Children were noted to be constantly rubbing their fingers. Children complained of "*ants in their hands*" and one infant reportedly screamed and dipped his fingers in water in the middle of the night. Children were reported to be waking at night in distress wanting their mums to rub their limbs. Children were reported to be waking out of their sleep with headaches.

In several cases children were the younger children in large families. Parents who were very experienced noted that older siblings who had already left home, who were born and raised in the same environment prior to the advent of the gas industry had been healthy.

Extreme fatigue, difficulty focusing and difficulty concentrating were new and debilitating symptoms for many residents. Some people could identify distinct individual odours at different times, variously described as:" rotten eggs, sickly sweet, like pine tarsal, acetone, creosote, after burn from cigarette lighter." Many people noted the association between their symptoms, wind direction and the location of the CSG waste water/evaporation ponds. Symptoms were worse when odours came through. Some people commented on the link between road spraying and their symptoms.

For adults and children alike, eye irritation and skin irritation, particularly when outside, were said to be constant background complaints, with severe exacerbations linked to odour events. For some the discomfort was severe and their skin peeled in the shower.

Infants, children and adults alike suffered from headaches. Some had been so intense that they had been investigated with CT scans and lumbar puncture.

Children and adults alike complained recurrently of a metallic taste which made them nauseous and anorexic. Undiagnosed cough, repeated diagnosis of 'flu', pneumonia, pleurisy and exacerbation of asthma were recurrent themes. Children were missing a lot of school. Sleep disturbance was endemic within the families surveyed. Many people related this directly to the noise associated with CSG activities: trucks moving, reversing, beeping, the noise and vibration from drilling, fracking and seismic testing. Some people were very clear that their sleep was disturbed by noise and vibration from the compressor station, at distances up to 15km away. Many other people's sleep was disturbed by the constant strain of living with, and dealing with, the impact of CSG on their daily lives. Many expressed helplessness and hopelessness in the face of their children's ill health and their inability to help and protect them. Some had the capacity to move away and did. Most found themselves trapped.

Eventually in March 2013 the long anticipated Queensland Government report[5] into the health impacts in the Tara region was released. It states:

"In summary the most that can be drawn from the DDPHU[6] 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."

This finding was important as the Government report involved minimal non-systematic environmental sampling, and relied mainly on inadequate industry commissioned data. The investigation of patient symptoms was grossly underfunded and understaffed, with no medical staff actually visiting the site. Only 15 people were examined clinically. Positive findings of volatile chemicals were dismissed, despite the fact they are potentially capable of causing health impacts, especially over long periods of time. Rather than evidence of safety, the absence of evidence reflected absence of investigation.

The salient and critical recommendation from this government report was that an air-monitoring program *"be established by DEHP[7] to monitor overall CSG emissions and the exposure of local communities to those emissions."*

Despite assurances from the then deputy health minister and the head of Queensland health that there was a *'whole of government'* plan to enact the recommendations of the report, four years later there is still no information on overall gasfield emissions and the exposures of local communities to those emissions. In fact FOI information and direct communication with Dr Bristow from Darling Downs Health and Hospital Services indicates that this critical recommendation for the health of the community was actively blocked by DEHP. In a remarkable catch-22 DEHP determined that (based on the same minimal environmental industry commissioned data from 2012) the gas companies were in compliance and therefore did not support expanding the programme. It is irrelevant whether the companies were in compliance[8] with their environmental authority. The issue was never whether they were compliant. The issue underlying the genesis of the government report and its recommendations was the health of the community and the community's exposure to gasfield emissions.

---

[5] Coal seam gas in the Tara region: Summary risk assessment of health complaints and environmental monitoring data

[6] Darling Downs Public Health Unit

[7] Department of the Environment and Heritage Protection

[8] What does compliance mean? Emission limits are not prescribed for each gas well or the broader reticulation system but rather, emission from this infrastructure must not cause nuisance or environmental harm. Queensland has no limit on flaring or venting of gas. Each gas well can vent/flare 3 million cubic metres of gas before they have to pay royalties.

'Natural' gas must reach export standards, but it is the contaminated waste that is vented, flared, sprayed, evaporated and buried at source in the Darling Downs that is the source of the problems for the region and its residents. The industry has been involved in a series of overtly dangerous and damaging activities in order to dispose of the massive volumes of contaminated waste generated. These activities, with the blessing of the authorities, include flaring, venting of raw gas, use of massive waste evaporation ponds and lined and unlined waste pits, road spraying of CSG waste water, and spraying of drilling muds and untreated human waste onto agricultural land which is in the middle of a flood plain.

One of the very serious issues impacting the health of people in Queensland's gas field is water contamination. For years residents have been reporting what they termed *"toxic rain*[9]", debris which was sometimes white, sometimes black falling onto themselves and their property. It takes the paint off cars. It has been falling onto residents' roofs and into their rainwater tanks, the collecting system for their domestic and drinking water supply.

Limited testing by DEHP, local council, the TV programme "today tonight" and tests organized by the residents themselves has repeatedly shown similar results. Rainwater tanks in the gasfields have been contaminated with heavy metals particularly lead, at levels 10 times above safe drinking water levels. This is in tanks with no lead in the collecting system. Other heavy metals repeatedly implicated are barium, chromium, arsenic, and nickel. Water in the rainwater tanks has been found to be extremely acidic with pH's of the order of 4.36, 4.37. Hydrocarbons have been found. Contamination with radioactive materials including lead 210 and Caesium 137 has been found in the sediment at the bottom of the rainwater tanks. The rainwater collecting systems have been seriously polluted with airborne contaminants. Residents who cannot afford to buy bottled water even for drinking let alone have access to the large amounts of water necessary daily for safe bathing, washing dishes, clothes and cleaning household surfaces have been left in a severely compromised situation. The appropriate authorities are fully aware of the situation. No assistance to secure safe water has been given by them.

Other water sources in this rural community have been seriously contaminated and compromised. Previously reliable water bores bubbled gas and became flammable. Bores which were productive of water of sufficient quality and quantity for domestic use and to sustain 145 head of cattle through Queensland's longest drought began blowing gas, and eventually failed. The children who were bathed in the bore water screamed from the rashes which developed where their skin had been submerged. These impacts have been repeatedly reported to the appropriate authorities. Nothing has been done.

In this flood plain another traditional method of harvesting water has been overland flow into domestic and stock dams. In an attempt to get rid of its contaminated waste the industry sprayed raw CSG produce water onto rural roads. This ran off the road into domestic and stock dams with subsequent skin eruptions in people who came in contact with the dam water and with death of stock, and native wildlife including yabbies in the dams. These impacts have been repeatedly reported to the appropriate authorities, yet they did nothing to assist the residents.

Multiple constraints limited the resident's efforts to organize their own biological testing. There was no facility to test for potential gas field contaminants at local pathology providers, so specimens of urine were sent to an occupational health and safety laboratory for analysis of gasfield/industrial contaminants. Cost was a major issue, as expensive tests (tax deductible for the gas companies) were full price for gasfield residents with limited resources. There were limitations on what could be tested for. Some chemicals could not be tested for directly, only their metabolites or breakdown products in the urine. Reference ranges apply only to adult workers exposed for the equivalent of an 8 hour day to a single agent. No reference levels exist

[9] See appendix 1, extracts of submissions to the Federal Senate Inquiry into unconventional gas.

for children or adults exposed to multiple contaminants 24 hours a day/ 7 days a week.[10]

Out of 16 urine samples, 13 people had evidence of mixtures of 2 or more toxic chemicals in their urine including phenol, cresol, PAH, metabolites of toluene, metabolites of xylene, acetone and methylethylketone.

Directly as a result of a peak in severe symptoms the urine of a three year old child was tested. Testing revealed extremely high levels of hippuric acid, the major metabolite of toluene, in his urine. As soon as she was aware of the result, the mother of this child immediately contacted her local Queensland Health doctor with the contents of the report.

Toluene metabolites found at high levels in a child in a non-occupational context is worrying, taking into account the short half-life i.e. toluene is quickly metabolised. This should have prompted investigation by the health department as a matter of urgency. Toluene is a known neurotoxin, an irritant and a suspected reproductive toxin that can be absorbed via inhalation. It is known to be associated with coal seam gas and has been found repeatedly in air samples in the residential estates.

The families received no assistance from the health department.

Since I first visited the Darling Downs in 2012 I have returned on many occasions. I have witnessed the extreme distress of many families and I have personal knowledge of many families who have had no choice but to leave their homes and everything they knew and loved because of the impact on their health. I also have personal knowledge of many families who, despite the impact on their health, are effectively trapped in the gasfields as no one is willing to buy their home. In desperation[11], families have in fact just walked off the land with nothing to show for a lifetime of work, resulting in the local council auctioning their properties for unpaid rates.

Two years after I first surveyed the health of 113 residents, to my knowledge 45 people had left the area. One had died and there were several more I could not account for. To my knowledge six families had been bought out by the gas industry with gag orders attached to the contract.

Reports of headaches, sore eyes and nose-bleeds continue as before. In addition there have been increasing community anxieties about apparently increased incidences of unusual cancers, cancers in young people and what appears to be clusters of cancers in small

---

[10] Occupational health standards cannot be applied to children. Children are not just little adults, and in children the risks of exposure to low level toxins is not well understood. The level of risk which is considered acceptable for exposure of an adult 80kg worker to a single toxin over an 8 hour working day cannot be extrapolated to an unborn baby or infant exposed 24hours a day to a mixture of toxins, many of which are unidentified. Some chemicals can affect the endocrine system at extremely low levels. Children and unborn babies are most vulnerable. In pregnancy and early infancy chemicals can cause permanent brain damage at levels of exposure that would have little or no adverse effect in an adult. The cause of human health impacts may not be simple, that is a single chemical culprit, but be the cumulative impact over time of several related or unrelated chemicals. It is the interactions of a mixture of chemicals both outside and inside the body which warrant investigation. If one compound prevents the breakdown or excretion of other compounds from the body then unforeseen toxicity can result. If solvents are part of the mix, then the blood brain barrier may be compromised, with serious and unpredictable consequences

[11] One example involves a couple who were expecting their first grandchild at the property. 5 years previously they had sank a new bore. At some time since then QGC drilled a well 500-600 metres from their bore. The water commenced bubbling, with an awful smell of H2S. Over 2 months their pigs wasted, the chickens were dying. The landowner was afraid to have his family eat the eggs or vegetables. He shot all his pigs, pulled out all his vegetables, and the family walked off their land.

communities including pancreatic cancers, sarcomas, lymphomas and leukaemias amongst others.

Concerns include, for example, three cases of pancreatic cancer within a 10km radius in a community of approximately 50 people when the incidence of pancreatic cancer is usually of the order of 11/100,000 people.

There are just 3 families living immediately beside a gas hub, and for years there has been an unlined CSG waste-water pond on one property. Cancer in the forms of leukaemia and a rare type of sarcoma have been diagnosed in two young adult siblings in one family and the child next door has also been diagnosed with leukaemia.

On the other side of the gas hub, in a lane where 6 families live, cancer has been diagnosed in 5 of the houses.

At the local school (of approximately 500 students) 2 were being treated for sarcoma.

These serious community concerns regarding unusual patterns of cancer have not been investigated.

The often asked and unanswered question for many people living in the gas fields of the Darling Downs is, *"Is it safe to live here?"*

In Queensland there were no baseline studies and no adequate investigation of the health complaints has yet occurred. Indisputable facts are hard to come by, but information I have acquired from the Darling Downs Hospital and Health System is extremely concerning.

According to Queensland Government statistics[12], between June 2007 and June 2012, the population of the Darling Downs increased by 7% (from 235.193 to 251,893).

According to statistics compiled by the Darling Downs Hospital and Health Services[13],[14] (Figs 3, 2 , 12 and 20) while the population increased by 7% between 2007 and 2012:

Acute hospital admissions for respiratory conditions increased by **124%**;
Acute hospital admissions for circulatory conditions increased by **114%**;
Invasive cancer incidence increased by **14%**; and
Attempted suicides increased by **50%.**

[12] http://www.queenslandplan.qld.gov.au/resources/assets/regional-fact-sheets-darlingdowns.pdf

[13] Statistics requested by Dr Geralyn McCarron regarding potential health impacts associated with the coal steam gas industry.

[14] Note- data was accessed in September 2015, so statistics for 2015 are incomplete

Figure 3: Acute hospital admissions - respiratory conditions by residence and year

Residence	Year										Grand Total
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	
Chinchilla	15	24	27	41	38	112	206	195	194	134	986
Dalby	32	46	61	64	55	211	308	316	291	211	1595
Elsewhere		1	1	1	2	1	5	3	3	0	17
Goondiwindi	6	12	8	14	12	101	142	131	134	95	655
Inglewood	1	1	1	6	4	29	53	50	28	24	197
Kingaroy	22	46	49	61	55	156	213	237	243	190	1272
Miles	8	9	13	12	12	47	75	78	70	50	374
Millmerran	3	5	11	7	13	23	50	42	32	19	205
Southwest	8	56	52	27	44	53	88	214	187	49	778
Stanthorpe	12	17	25	33	36	122	147	145	174	106	817
Texas	2	3	7	10	5	12	31	22	26	10	128
Toowoomba	491	922	1035	1032	1152	1224	1317	1278	1513	984	10948
Warwick	26	172	312	284	315	373	321	287	346	259	2695
Grand Total	626	1314	1602	1592	1743	2464	2956	2998	3241	2131	20667

Figure 2: Acute hospital admissions - circulatory conditions by residence and year

Residence	Year										Grand Total
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	
Chinchilla	32	65	53	63	57	167	289	372	331	189	1618
Dalby	38	89	97	82	88	262	516	531	503	316	2522
Elsewhere		1		3	1	2	3	12	2	3	27
Goondiwindi	5	33	23	32	27	102	216	164	164	110	876
Inglewood	1	7	16	6	11	21	33	56	49	37	237
Kingaroy	36	86	109	93	102	194	374	342	419	221	1976
Miles	9	18	35	28	22	76	123	112	94	55	572
Millmerran	5	20	20	17	25	41	64	75	58	26	351
Southwest	37	88	67	71	80	74	137	243	286	82	1165
Stanthorpe	28	50	63	61	69	203	318	336	315	221	1664
Texas	9	11	12	16	11	28	40	43	36	25	231
Toowoomba	702	1485	1736	1691	1834	2023	2159	2391	2606	1637	18264
Warwick	51	334	536	533	571	629	641	614	566	374	4849
Grand Total	953	2287	2767	2696	2898	3822	4913	5291	5429	3296	34352

Figure 12: Queensland Invasive Cancer Incidence and Mortality for Year and Residence

Year	Incidence			Mortality		
	Darling Downs	South West	**Total**	Darling Downs	South West	**Total**
2005	1366	137	1503	476	52	528
2006	1500	124	1624	497	42	539
2007	1479	128	1607	483	61	544
2008	1599	173	1772	502	52	554
2009	1681	133	1814	528	58	586
2010	1571	135	1706	521	51	572
2011	1622	138	1760	509	45	554
2012	1693	150	1843	550	60	610

Figure 20: All attempted suicides by year – Darling Downs and South West

Year	Total
2006	112
2007	230
2008	244
2009	247
2010	282
2011	275
2012	346
2013	403
2014	471
2015	208
Grand Total	2818

These statistics give significant credence to the resident's ongoing health concerns.

For years the people forced to live with unconventional gas have been reporting to the relevant authorities in Queensland the impacts on their health and the evidence of environmental harm- death of native wildlife, birds and domestic animals, the foul odours, cracks in the earth, bubbling from the soil, gas in the water bores- even the Condamine River is flammable[15].

https://www.facebook.com/jeremybuckingham/videos/1367696236582894/

RIVER ON FIRE! Gas explodes from Australian river near frackin...

Still from a video posted by Senator Jeremy Buckingham demonstrating the extreme flammability of the bubbling river.

[15] In mid 2012 a local resident alerted the public to the fact that several kilometres of the Condamine River was bubbling. In true *'Yes Minister'* style, within hours of the evidence being posted on social media, the authorities and the gas companies denied it could be related to gasfield activities... then they announced an *'investigation'*. The bubbles proved to test strongly positive for methane. The people living along the river for more than 60 years had never seen anything like it before; in their environmental impact statements the gas companies had never once documented such a dramatic scenario as a bubbling, burning river; despite all evidence to the contrary, the industry still tries to push the theory that it is naturally occurring and that the river was always bubbling.

The level of environmental harm is now so undeniable that the Queensland Environment Department is prosecuting Linc, an underground coal gasification company, for reckless environmental harm at the plants between 2007 and 2013 and allege groundwater and hundreds of square kilometres of prime agricultural land have been put at risk. The soil is contaminated with high levels of hydrogen sulphide, carbon monoxide and hydrogen and over an area of 320 square kilometers around Hopeland farmers have been forbidden to dig a hole deeper than 2 metres due to leakage of these gases from the soil. Government testing has also confirmed soil contaminated with high levels of benzene. Recently the "area of caution" where soil contamination has been confirmed has been doubled. Inexplicably, despite the government having enough evidence of serious environmental harm over an extensive area to actually prosecute the offending company, they have left the families living in the middle of known areas of contamination without appropriate information despite repeated and ongoing requests. This is despite the fact that stock and domestic water bores in the area are "kicking' with explosive levels of gas. Water bores have dropped more than 60 metres and are unusable. Volatile organic compounds at 5% per volume have been measured on resident's verandahs and stock animals have been dropping dead[16]. Chemicals of serious concern such as benzene, toluene, naphthalene, cresol xylene and phenol were identified in an investigation into the "Linc Stink" as far back as 2012. Inexplicably also, although the government has postulated that the mechanism of harm was Linc energy caused fracturing of the overburden, allowing escape of gases from the under ground fire and leakage along underground river beds, they have given Origin energy permission to drill more than 100 coal seam gas wells in the same area of Hopeland, fracturing the overburden with each well and providing multiple conduits for seepage of gas to the surface. This is in the same area where a farmer is not permitted to dig a hole deeper than 2 meters.

The level of environmental harm from air pollution is plainly visible. In scenes reminiscent of 'Apocalypse Now' the night sky glows orange from the flares [17] and the resident population continues to breathe the toxic fumes.

The night sky. ORANA FLARE from 20km away. Courtesy of Rev G. Slaughter. March 2017

[16] See appendix 1, extracts from residents submissions to the Federal Inquiry into Unconventional Gas
[17] https://www.chinchillanews.com.au/news/orange-light-in-the-sky-over-chinchilla-explained/3154351/

AUSTRALIAN RESEARCH INTO THE IMPACTS OF UNCONVENTIONAL GAS

Remarkably, or perhaps not since the main coal seam gas research body at the University of Queensland is funded by gas companies Santos, Arrow, QGC and Origin, minimal academic research into the health impacts of the unconventional gas industry has come out of Queensland.

Werner[18], Vinks et al wrote:
"More importantly, while evidence of the environmental cause of adverse health impact was lacking, several scholars and experts voiced concerns about the potential for adverse health outcomes. These concerns were based on credible evidence of detrimental environmental impact and strongly suggest that the lack of evidence of health impact does not dismiss claims of health impact. The available evidence, or lack thereof, is not sufficient cause to rule in or rule out significant or specific, future, or cumulative health impacts of UNGD activities.

It is probable that the lack of evidence on direct causal links between environmental hazards and health outcomes is a result of the rapid expansion of this industry in a short period of time — leaving evidence-based research activities with very little time to respond. Additionally, there is the potential for environmental health outcomes with longer latencies for which effects may not yet be seen."

In an exploratory study of all-age hospitalization[19] for three study areas in Queensland Werner et al also found that certain hospital admission rates increased more quickly in the CSG study area than in the other study areas.
The CSG area showed increases in hospitalization rates compared to the rural areas for neoplasms (RR: 1.09, 95 % CI: 1.02–1.16) and blood/immune diseases (RR: 1.14, 95 % CI: 1.02–1.27).

In 2014 Santos and Maher from Southern Cross University reported[20] wide-spread enrichment of both Methane (up to 6.89ppm) and Carbon dioxide (up to 541ppm) within the production gas field in the Tara region, compared to outside.

In 2015 a survey by Australia's Commonwealth Scientific and Industrial Research Organisation[21] of 390 residents in the Chinchilla region of Queensland found that 48.5% felt their community was *'only just coping', 'not coping'* or *'resisting'* the industry. While 51.5% felt their community was adapting, just 11.4% of this group saw the change as *'into something different but better'*

---

[18] Werner AK, Vink S, Watt K, Jagals P. Environmental health impacts of unconventional natural gas development: a review of the current strength of evidence. *Science of the Total Environment* 2015; **505:** 1127-1141. **https://doi.org/10.1016/j.scitotenv.2014.10.084**

[19] Werner AK, Watt K, Cameron CM, Vink S, Page A, Paul Jagals P, All-age hospitalization rates in coal seam gas areas in Queensland, Australia, 1995–2011
BMC Public Health (2016) 16:125 DOI 10.1186/s12889-016-2787-5
http://bmcpublichealth.biomedcentral.com/articles/10.1186/s12889-016-2787-5

[20] Maher DT, Santos IR, Tait DR, Mapping Methane and Carbon Dioxide Concentrations and δ13C Values in the Atmosphere of Two Australian Coal Seam Gas Fields Water Air Soil Pollut (2014) 225:2216 DOI 10.1007/s11270-014-2216-2

[21] https://industry.gov.au/Office-of-the-Chief-Economist/Publications/Documents/coal-seam-gas/Socioeconomic-impacts-of-coal-seam-gas-in-Queensland.pdf

Dr Meuthen Morgan from the University of New England investigated the mental health impacts of unconventional gas[22].
Dr Morgan wrote:
"Farmers are exposed to a unique range of vocational stressors, and while mental health morbidity is similar to their non-rural counterparts, suicide rates in the farming community are higher."
"Farmers in the CSG- Stressed and Globally-Stressed profiles exhibited clinically significant levels of psychological morbidity."
"stress associated with CSG impacts both on-farm (operations, profitability, and personal privacy) and off-farm (health, community and environmental) were assessed as severe"

Professor Melissa Haswell who has recently been appointed Professor of Health, Safety and Environment at the School of Public Health and Social Work at QUT in her recent paper[23] "Health concerns associated with unconventional gas mining in Western Australia: A critical review." Technical Report · March 2017 Professor Haswell wrote:

"Since 2013, there has been an increasing focus on the likely vulnerability of developing fetuses and children to environmental hazards as compared to adults. The complex developmental processes that occur during gestation are exquisitely sensitive to chemicals and signals in the uterine environment. There is a growing understanding of the negative impacts of various exposures to the mother during pregnancy on birth outcomes, for example air pollution (PM2.5) and tobacco smoking on birth weight and preterm births, as well as alcohol and other drugs on brain development. Many of the chemicals involved in unconventional gas mining have reproductive and developmental toxicity.

Infants and children continue to face higher risks from toxic exposures due to their higher metabolic and respiration rates, their smaller body size and smaller and immature organs, including the liver, lungs and kidneys that deal with or store many toxins that enter the body. Children also experience greater exposure to toxins in the environment through outdoor play activities, compared to adults.

It is also very important to recognise that infant and child well-being is highly sensitive to psychosocial and community stressors, including noise, negative emotions expressed by others and witnessing aggression and conflict."

In the Australian context it is disturbing to me what has not been done. I approached the NHMRC asking them to actively promote and fund high quality scientific research into the health impacts of unconventional gas. In reply I got a letter ignoring my request and assuring me that that considerable work is being undertaken by the Australian Government in relation to coal seam gas (CSG) including the National Chemicals Notification and Assessment Scheme (NICNAS), Commonwealth Scientific and Industrial Research Organisation (CSIRO), Department of Environment, Australian Research Council (ARC), and other government agencies.

I am aware of the published work of some of these agencies with regard to unconventional gas and it simply reinforces my view that funding must be found for unbiased scientific research that is rigorously planned, implemented and actually addresses the questions that need to be answered. The unbiased scientific contribution by these agencies with regard to unconventional gas is, in my opinion, pitifully lacking.

---

[22] Morgan M, "Fracked: Coal seam gas extraction and farmers' mental health" Journal of Environmental Psychology April 2016. http://www.sciencedirect.com/science/article/pii/S0272494416300317
[23] Haswell M,
https://www.researchgate.net/publication/314230557_Health_concerns_associated_with_unconventional_gas_mining_in_Western_Australia_A_critical_review

As an example of my concern, I would point you to the previously mentioned report from the office of the Chief Economist entitled *"Review of the socioeconomic impacts of coal seam gas in Queensland 2015"*[24].
The remarkable and shocking admission in this Government Report, considering that this was in theory a report that was meant to review the socioeconomic impacts of CSG in Queensland was: **"We made a conscious decision not to meet with local landholders and community groups."** This fundamental omission demonstrates a lack of understanding of both the issues at stake and the context of socioeconomic impact assessment.

With regard to the work of CSIRO, I think it would be fair to say that in the years before CSIRO was subjected to massive personnel and funding cuts and political interference, it was an organisation whose research was recognised and highly respected both nationally and internationally. Nevertheless, their published research so far as it relates to the CSG industry does not, I believe, meet the exacting standards the public would expect from the CSIRO. In 2014 CSIRO published a report[25] into CSG fugitive emissions. It is true they labelled it a 'pilot' study, but since CSIRO is our national scientific agency, and since CSG had, at that time already been a serious issue in Queensland for 8 years one might have expected more diligence in the design of the project. Minimal wells were tested (43 out of more than 5,000 wells) and even the selection of those wells was biased, influenced by the participation of the companies. Of the 43 non-randomised wells examined, only three showed no emissions. These were two plugged and abandoned wells and one suspended well that had been disconnected from the gas gathering system. But of real significance CSIRO noted a larger source of methane that they were not monitoring for, a source which was interfering with their study, that was found on a gas relief vent on a water gathering installation close to one of the wells examined. They noted that an indicative estimate of the emission rate from this vent suggested that the source was at least three times higher than the largest well pad emission rate. Similar installations are widespread through the Queensland gas regions.

I am aware of NICNAS and its study of CSG chemicals. Naively I would have assumed that prior to 2006, that is, prior to the commencement of intense CSG exploration, the chemicals to be used for this purpose, in the massive quantities necessary would have been vetted for safety by the national industrial chemicals regulatory body. That obviously did not happen. My understanding is that of the 23 chemicals commonly used for fracking in Australia, only 2 of them have been assessed by NICNAS in any context, (unrelated to CSG) and nothing to date has been published by NICNAS regarding assessment of chemicals associated with CSG extraction. This is despite NICNAS commencing a project in 2012 to address this issue.[26] The exclusions for this project are rather important.

---

[24] Stakeholders involved in formulation of this report included:
• social science and other researchers, including from the Gas Industry Social and Environmental Research Alliance (GISERA), and the University of Queensland's Centre for Coal Seam Gas (UQ-CCSG); Queensland Government representatives, including the Office of Groundwater Impact Assessment (OGIA) and the Department of Natural Resources and Mines (DNRM)
• representatives from the GasFields Commission Queensland (GFCQ); industry associations, including the Queensland Resources Council (QRC) and the Australian Petroleum Production and Exploration Association (APPEA); representatives from coal seam gas companies and joint ventures operating in Queensland.
Remember that GISERA is a partnership between CSIRO, Australia Pacific LNG (APLNG) and QGC; and the Centre for Coal Seam Gas at the University of Queensland (UQ-CCSG), which has funding from Santos, Arrow Energy, QGC and APLNG all gas companies with a vested interest in the outcome of any study.

[25] http://www.environment.gov.au/system/files/resources/57e4a9fd-56ea-428b-b995-f27c25822643/files/csg-fugitive-emissions-2014.pdf

[26] http://www.nicnas.gov.au/communications/issues/fracking-hydraulic-fracturing-coal- seam-gas-extraction/information-sheet

"In particular, the National CSG Chemicals Assessment project does not examine impacts of drilling and hydraulic fracturing chemicals on deeper groundwater systems such as confined aquifers. Also, the assessment does not examine fugitive emissions of geogenic gases such as methane. The assessment of human health and environmental impacts associated with geogenic chemicals and other chemicals used at CSG sites, such as diesel fuels and machinery lubricants, is also outside the current project scope; as is an examination of the risks associated with the chemicals used in the extraction of shale and conventional oil and gas extraction in Australia."
We are informed by NICNAS that the 'mixtures' of drilling or fracking chemicals will not be assessed in this study, only individual active ingredients, despite the call by the WHO and other researchers to assess the cumulative load of chemicals used. NICNAS has acknowledged there is a lack of human or environmental toxicological data for many of the products in use but will not be in the position to address these data gaps. The project by NICNAS will not initiate new health studies and there is no 'health and medical research' mandate. Five years after commencement of the project, thousands of wells have been already been drilled, thousands of wells have been fracked and refracked in the shallows and there is not even the most basic information yet available from our national industrial chemicals regulatory regarding the safety of the chemicals being used. Dr Mariann Lloyd-Smith[27], senior advisor to IPEN and a member of the UN Expert Group on Climate Change and Chemicals has labelled the government's assessment of Coal Seam Gas chemicals "a total farce".

On 22nd July 2014 in private communication with ARPANSA[28] I was informed that:
"ARPANSA is not aware of any comprehensive radiological risk assessments conducted in Australia dealing specifically with the impact of TENORM emitted by coal seam gas exploration, extraction and processing."

At this late stage in the unconventional gas industry's development, the dearth of independent, high quality scientific research into the human health impacts of the unconventional gas industry in this country is a very significant problem.

INTERNATIONAL RESEARCH INTO UNCONVENTIONAL GAS

Conversely, internationally there is an extensive and rapidly increasing peer-reviewed body of literature regarding the documented impacts of the unconventional gas industry, yet many data gaps remain.

Despite industry's repeated outright denial of harm caused to water resources, the December 2016 update of the American EPA report[29] finally confirms contamination of drinking water resources and the multiple industry activities resulting in more frequent or more severe impacts. I quote:

"People rely on clean and plentiful water resources to meet their basic needs, including drinking, bathing, and cooking. In the early 2000s, members of the public began to raise concerns about potential impacts on their drinking water from hydraulic fracturing at nearby oil and gas production wells."
"The hydraulic fracturing water cycle describes the use of water in hydraulic fracturing, from water withdrawals to make hydraulic fracturing fluids, through the mixing and injection of

[27] http://www.sunshinecoastdaily.com.au/news/csg-assessment-total-farce-says-advisor/2911067/

[28] Australian Radiation Protection and Nuclear Safety Agency (ARPANSA)
[29] https://cfpub.epa.gov/ncea/hfstudy/recordisplay.cfm?deid=332990

hydraulic fracturing fluids in oil and gas production wells, to the collection and disposal or reuse of produced water. These activities can impact drinking water resources under some circumstances. Impacts can range in frequency and severity, depending on the combination of hydraulic fracturing water cycle activities and local- or regional-scale factors. The following combinations of activities and factors are more likely than others to result in more frequent or more severe impacts:

- *Water withdrawals for hydraulic fracturing in times or areas of low water availability, particularly in areas with limited or declining groundwater resources;*
- *Spills during the management of hydraulic fracturing fluids and chemicals or produced water that result in large volumes or high concentrations of chemicals reaching groundwater resources;*
- *Injection of hydraulic fracturing fluids into wells with inadequate mechanical integrity, allowing gases or liquids to move to groundwater resources;*
- *Injection of hydraulic fracturing fluids directly into groundwater resources;*
- *Discharge of inadequately treated hydraulic fracturing wastewater to surface water resources; and*
- *Disposal or storage of hydraulic fracturing wastewater in unlined pits, resulting in contamination of groundwater resources.*

"Cases of impacts were identified for all stages of the hydraulic fracturing water cycle. Identified impacts generally occurred near hydraulically fractured oil and gas production wells and ranged in severity, from temporary changes in water quality to contamination that made private drinking water wells unusable.

"...significant data gaps and uncertainties in the available data prevented us from calculating or estimating the national frequency of impacts on drinking water resources from activities in the hydraulic fracturing water cycle."

The Physicians for Social Responsibility and Concerned Health Professionals of New York have compiled and regularly updated the "*Compendium*[30] *of scientific, medical and media findings demonstrating risks and harms of fracking*" (Unconventional oil and gas extraction) in the United States. The fourth edition was published in November 2016.
They note:
"...more than 80 percent of all of the peer-reviewed literature that is relevant to assessing the environmental, socioeconomic, and public health impacts of shale and tight gas development has been published since January 2013. Indeed, nearly one-quarter of the now more than 900 available studies were published in the first nine months of 2016 alone. The vast majority of the literature reveals both potential and actual problems. Specifically, as demonstrated by PSE's statistical analysis of the body of scientific literature available from 2009-2015—which, at the date of publication included 685 peer- reviewed papers—

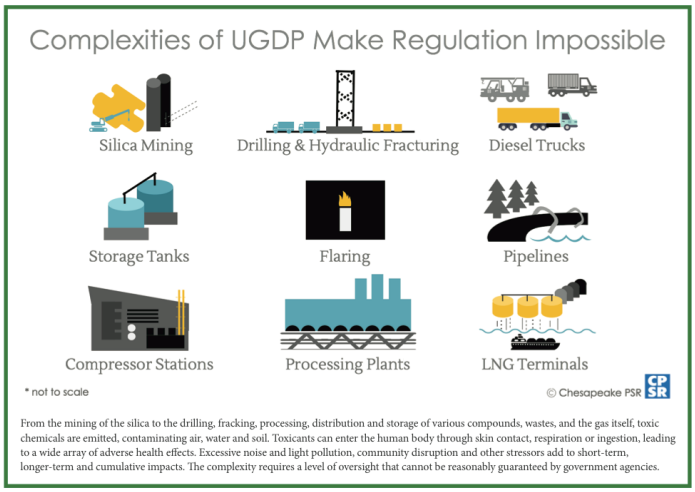
69 percent of original research studies on water quality found potential for, or actual evidence of, water contamination;
87 percent of original research studies on air quality found elevated air pollutant emissions; and
84 percent of original research studies on human health risks found signs of harm or indication of potential harm."

Significantly the growing evidence indicates that regulations are simply not capable of preventing harm. On analysis of the 900 available studies the Physicians for Social Responsibility and Concerned Health Professionals of New York conclude that: *"regulations have not prevented significant harms; and that some harms are not preventable through regulatory opportunities".*

[30] http://www.psr.org/resources/fracking-compendium.html?referrer=https://www.google.com.au/

The Chesapeake Physicians for Social Responsibility argue that the complexities of Unconventional gas exploration and production make regulation impossible[31].

"From the mining of the silica to the drilling, fracking, processing, distribution and storage of various compounds, waste and the gas itself, toxic chemicals are emitted, contaminating air, water and soil. Toxicants can enter the human body through skin contact, respiration or ingestion, leading to a wide array of adverse health effects. Excessive noise and light pollution, community disruption and other stressors add to short-term, longer-term and cumulative impacts. The complexity requires a level of oversight that cannot be reasonably guaranteed by government agencies."



Professor Haswell, in her paper "Health concerns associated with unconventional gas mining in Western Australia: A critical review" notes:
"In December 2016, a comprehensive systematic review of 156 peer-reviewed publications was published, examining the evidence of human exposures to harmful air and water pollutants, health impacts, seismic activity and climate impacts of unconventional gas mining. This review found multiple potential hazards to human health associated with mining and substantial gaps in understanding that prevented confirmation of the safety of the industry, and recommended no new developments in the United Kingdom until research demonstrated its safety."

EXAMPLES OF STUDIES OF IMMENSE SIGNIFICANCE TO PUBLIC HEALTH ARE:

- Pregnant women who live near active unconventional natural gas development operations (UNGD) in Pennsylvania were at a 40 percent increased risk of giving birth prematurely and at a 30 percent risk of having a high risk pregnancy (eg hypertension and asthma).[32] (study of 9,384 pregnant women and their 10,496 newborns January 2009 to January 2013);

---

31 https://static1.squarespace.com/static/54949381e4b05fcc6a96c5c6/t/58754debe6f2e1e518ac8a15/1484082670803/FrackingRegulationsCannotProtectMarylandChesapeakePSRJan2017DontFrackMDFrackingBan.pdf

32 Casey JA[1], Savitz DA, Rasmussen SG, et al Unconventional natural gas development and birth outcomes in Pennsylvania, USA Epidemiology. 2016 Mar;27(2):163-72. doi: 10.1097/EDE.0000000000000387. https://www.ncbi.nlm.nih.gov/pubmed/26426945

- The more exposure a pregnant woman had to gas wells, the higher her risk for a smaller than normal baby. Mothers whose homes were nearest to a high density of wells were 34% more likely to have babies who were 'small for gestational age'[33];
- Children born in areas with the highest number of gas wells had a 30% increased rate of congenital heart defects (CHD) compared to children born in areas with no gas wells within 10km. (25,000 births from 1996 to 2009)[34];
- A Yale University research team reports[35] that carcinogens involved in UNG operations have the potential to contaminate both air and water in nearby communities in ways that may increase the risk of childhood leukemia. The team identified 55 known or possible carcinogens that may be released into air and water from UNG operations. Of these, 20 are linked to leukemia or lymphoma.
- Pennsylvania residents with the highest exposure to active unconventional gas wells were nearly twice as likely to experience a combination of migraine headaches, chronic nasal and sinus symptoms, and severe fatigue[36];
- Health symptoms reported by residents increased as distance between household and gas wells decreased. Among persons living less than one km from drilling and fracking operations, rashes and respiratory problems were more prevalent[37];
- Those who live near a higher number of, or larger active gas wells were 1.5 to 4 times more likely to suffer from asthma attacks than those who live further away, with the closest group having the highest risk. Increased risk at all stages of well development, pad preparation, drilling, stimulation/fracking and production.[38] (Study of 35,000 medical records between 2005 and 2012);
- Cardiology hospitalisation was 27 percent higher than in control communities with no wells. Neurology inpatient prevalence rates were significantly associated with density of wells. Hospitalisations also rose significantly for cancer, skin conditions, and urological problems. No such increase in health problems was observed in a control Pennsylvania county without any drilling and fracking activity.[39] (Hospitalisation 2007-2011, study of 93,000 inpatient records.);

---

[33] Shaina L, Stacey LA et al, Perinatal Outcomes and Unconventional Natural Gas Operations in Southwest Pennsylvania. 2015 http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0126425

[34] McKenzie L, Guo R et al, Birth Outcomes and Maternal Residential Proximity to Natural Gas Development in Rural Colorado. Environmental Health Perspectives, April 2014 https://ehp.niehs.nih.gov/1306722/

[35] Elliott EG, Trinh P, et al. Unconventional oil and gas development and risk of childhood leukemia: Assessing the evidence. Science of The Total Environment Volume 576, 15 January 2017, Pages 138–147 http://www.sciencedirect.com/science/article/pii/S0048969716322392

[36] Tustin AW, Hirsch AG, Rasmussen SG, et al Associations between unconventional natural gas development and nasal and sinus, migraine headache, and fatigue symptoms in Pennsylvania. Environ Health Perspect. 2017 Feb;125(2):189-197. doi: 10.1289/EHP281. Epub 2016 Aug 25. https://www.ncbi.nlm.nih.gov/pubmed/27561132

[37] Rabinowitz PM, Slizovskiy IB, et al Proximity to natural gas wells and reported health status: results of a household survey in Washington County, Pennsylvania. *Environ Health Perspect*; DOI:10.1289/ehp.1307732 https://ehp.niehs.nih.gov/1307732/

[38] Rasmussen SG Ogburn EL, et al Association between unconventional natural gas development in the Marcellus Shale and asthma exacerbations. JAMA Intern Med. 2016 Sep 1;176(9):1334-43. doi: 10.1001/jamainternmed.2016.2436. https://www.ncbi.nlm.nih.gov/pubmed/27428612

[39] Jemielita T, Gerton G, et al. Unconventional gas and oil drilling is associated with increased hospital utilization rates. 2015 http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0131093

It should be noted that the health impacts of air pollution potentially impacts a wide area, and those who rely on locally produced food whether from their own production or bought at market, risk contamination. The flares contain widely-recognized toxins, such as benzene, which pollute the air. Local people complain of respiratory problems such as asthma and bronchitis. There have been over 250 identified toxins released from flaring[40] including carcinogens such as benzopyrene, benzene, carbon disulphide (CS2), carbonyl sulphide (COS) and toluene; metals such as mercury, arsenic and chromium; sour gas with H2S and SO2; Nitrogen oxides (NOx); Carbon dioxide (CO2); and methane (CH4) which contributes to the greenhouse gases

It is important also to note that In 2013 the World Health Organisation[41] defined outdoor air pollution as a class I carcinogen. Diesel fumes, benzene, particulate matter all cause cancer. The health danger of particulate matter[42] is well understood. Particles, if small enough, can be absorbed from the lungs directly into the bloodstream causing damage to multiple organs. This includes lung damage, strokes, heart attacks, kidney damage, diabetes, and hypertension. With particulate matter, as with benzene, there is no safe level of exposure or a threshold below which no adverse health effects occur. Air pollutants react to form other harmful compounds. Ozone is formed when the oxides of nitrogen and volatile organic compounds combine in the presence of sunlight. Ozone can permanently damage children's lungs. A study by the University of Southern California[43] of fourth grade school children found that each increase of 20 parts per billion in ozone was associated with a 63% school absence rate increase for illness.

HEALTH IMPACTS OF CLIMATE CHANGE

In its early days of unconventional gas development, it was mistakenly promoted as being a viable transition fuel towards renewables. There is increasing evidence that the fugitive and deliberate emissions from gas operations in the form of methane have not been adequately measured, calculated or accounted for[44]. Since methane is a powerful greenhouse gas, up to 80 times more powerful than carbon dioxide the level of methane released into the atmosphere is critical. To have any benefit over dirty coal in terms of climate change, fugitive emissions of methane must be less than 3% but emissions from unconventional gas developments have been measured at between 4 and 30%. Recent research[45] also indicates that natural gas power plants emit up to 120 times more methane than facility-reported estimates.

---

[40] Ismail OS, Umukoro GE, Global Impact of Gas Flaring, Energy and Power Engineering, Vol. 4 No. 4 (2012) , Article ID: 20231 , 13 pagesDOI:10.4236/epe.2012.44039

[41] International Agency for Research on Cancer, press release no 221 17 Oct 2013 http://www.iarc.fr/en/media-centre/iarcnews/pdf/pr221_E.pdf -

[42] Review of evidence on health impacts of air pollution REVIHAAP project, WHO 2013, http://www.iarc.fr/en/media-centre/iarcnews/pdf/pr221_E.pdf

[43] The Ozone We Breathe, http://earthobservatory.nasa.gov/Features/OzoneWeBreathe/ozone_we_breathe2.php

[44] http://www.abc.net.au/news/2017-02-28/the-clean-green-image-of-coal-seam-gas-is-under/8312466?pfmredir=sm

[45] Lavoie TN, Shepson PB et al. Assessing the Methane Emissions from Natural Gas-Fired Power Plants and Oil Refineries. Environmental Science and Technology. http://pubs.acs.org/doi/abs/10.1021/acs.est.6b05531

An accurate assessment of methane emissions' contribution to climate change is critical as climate change poses major risks to health. As documented[46] by the Doctors for the Environment Australia: *"Climate change is widely regarded as the biggest threat to health in the 21st century (Costello et al. 2009; WHO 2015). Climate change affects health in many ways: directly through extreme events* such *as heatwaves, floods, bushfires, and indirectly via worsening air quality, changes in the patterns of infectious diseases, threats to food and water supplies, and effects on mental health."*

COMPOUNDED DIFFICULTIES FACED BY COMMUNITIES FORCED TO LIVE WITH THE GAS INDUSTRY

Significant compounded difficulties are likely to be experienced by rural and low socio-economic communities dealing with pre-existing stressors who already have limited access to health care and who are forced to live with unconventional gas.

Unconventional gas projects are often promoted as "development" but their introduction has not brought better quality of life or additional services to the local people in Queensland. In the rural residential estates the residents live on rural blocks ranging in size typically from 30 to 250 acres. They are surrounded by the infrastructure of the gas industry. But there are no shops, petrol stations, schools or other basic facilities. Despite massive gas infrastructure now surrounding them basic facilities have not improved. The nearest doctor is in Tara which is an approximately 70km round trip. Residents habitually travel to medical facilities in Chinchilla, Dalby and Toowoomba where the regional base hospital is located. An added burden of ill health in such a rural situation adds significant challenges that would be unthought-of in an urban area. This includes the extended time involved in travel to and from a health care facility, the sometimes impossible ability to access reliable transport and needing to have available the significant amount of money required for petrol or diesel, money which may not exist or be earmarked for other vital purposes. In a person who is already incapacitated these challenges may be insurmountable.
In rural families who were previously semi–self sufficient, having had access to their own safe drinking water, vegetables, chickens etc. the financial burden created by contamination of these basic requirements has been a major stressor. The complete devaluation of their home and property making them unsaleable has left many people trapped in an untenable situation and at the mercy of the gas company as the only possible buyer.

In the rural towns such as Chinchilla and Miles, the impact of the initial (short lived) boom associated with the construction phase of the gas industry and the inevitable bust on the resident population was different but also devastating.
I quote the words of Karen Auty, resident of Chinchilla, from her submission[47] to the Federal Senate Select Committee on Unconventional Gas Mining[48], which was initiated and chaired by Senator Glenn Lazarus.

" KAREN AUTY RESIDENT OF CHINCHILLA, SUBMISSION 285
"Sky rocketing rents (during the construction phase) forced out many permanent, long term residents. Pensioners, retirees, sole parents, single income families and non-industry workers left

[46] https://www.dea.org.au/wp-content/uploads/DEA_Climate_Change__Health_Fact_Sheet_final.pdf
[47] http://www.aph.gov.au/Parliamentary_Business/Committees/Senate/Gasmining/Gasmining/Submissions

[48] Please see Appendix 1 for extracts from further submissions to the Senate Inquiry of gasfield residents, all of whom are personally known to me.

the town in droves. They will not return. Young children, (were) living in tents at the showground in the midst of a very chilly winter was something previously unseen in this town. Lack of Public Housing contributed to this situation.
Those of us fortunate enough to own our own homes have been subject to crippling increases in our Western Downs Regional Council rates. In just five years my rates have risen from $1083 to $2011. Unimproved land valuation increased from $58,000 to $182,500[49]. This is despite no expenditure by Council in the form of kerbing and channelling or improvements of any kind. The demand for new and investment housing resulted in 'pop-up' housing estates, constructed before adequate infrastructure, such as storm water drains, were in place. This directly resulted in flooding of long established properties where flooding had never been an issue. Many of the new houses developed slab cracks and structural damage within two years of construction, putting into question the quality control and signing off on building regulations. "
TRAFFIC A huge increase in the regions' traffic, especially by heavy vehicles, impacted our local roads, not just in wear and tear, but also in the road toll and road trauma rate. I believe the statistical rise is unmatched anywhere in Australia. With the traffic increase came a phenomenal rise in roadside litter. Council and/or Main Roads seem unable to restore this eyesore to a pre-industry standard.
CRIME RATE The population of the town, including surrounding 'worker camps' more than tripled, yet policing numbers did not reflect this. The rise in assaults, alcohol and drug related incidents, thefts, vandalism, break and enters and traffic incidents have had a negative impact. Our police station throughout the significant 'boom' period remained opened only part-time hours. Their very recent upgrade, along with staffing resources, came years too late.
Other government services have proved to be under-resourced and inadequate to service the population. This includes the court house, hospital and mental health facilities." I can only add to this, that since the construction bubble has burst, the town has been left reeling with high unemployment, inadequate infrastructure and services, still rising Council rate costs, plummeting land valuations, a glut of vacant rental properties, spiking crime rates and struggling local businesses.
The abrupt change of demographic is mostly due to the real estate crash and the large number of rental vacancies, with recommendations from Centrelink and other such agencies in coastal and interstate cities that Chinchilla is now attractive for welfare recipients and parolees. This influx has seen our Police and Court services stretched as the issues of domestic violence, drug use/ offences and property thefts have reached levels previously unheard of in our once quiet and safe town.
Families that are heavily impacted by their misfortune to live in proximity to gas infrastructure find their physical and mental health worsening with each passing week. The response from Government has been nothing short of token and indeed appalling."

In areas of socio-economic disadvantage typically targeted by the unconventional gas industry a percentage of the population inevitably suffer the added disadvantage of inadequate literacy levels. Regardless, they are expected to wade through industry and government documents including EISs which may be of the order of 7000 pages and write formal submissions in reply without any assistance to do so. They may or may not have the time, resources, skills or knowledge to navigate their way around government websites and complaint systems. Even if they have the knowledge and skills they may not have the physical ability to access information in a timely manner, or at all, due to inadequate internet and mobile connection.
In meetings with industry representatives to negotiate access or other legal agreements, the industry inevitably has a team of trained negotiators, possible including those who are legally trained, whereas residents in rural areas are often unaware of their rights. In rural areas of Queensland where traditionally a man's word was his bond, landholders found to their cost that their concepts of honour and honesty did not apply to the gas companies[50].

[49] Update 2017 rates, unimproved value has fallen to $35,000 but rates remain over $2,000 per year and council has its biggest ever deficit.
[50] Gas companies are regularly referred to by rural landholders as "liars, cheats, and thieves."

According to Australian Petroleum Production and Exploration Association chief executive David Byers:
"Experience in Queensland[51] shows that gas companies have been able to successfully negotiate thousands of land access agreements and compensation arrangements with farmers so this is an issue that can be successfully managed."

In Queensland, one of the factors which put already vulnerable people at risk has been the perception that they are required to cooperate, negotiate and enter into legally binding agreements with the gas companies. This is particularly so when such an agreement is subject to a gag clause which has the effect of isolating the individual from their community. Invariably confidentiality clauses are insisted on by the gas companies and it is unusual for 3rd parties to have any insight into the constraints enforced on landholders by the gas companies. However I have access to a document[52] which a landholder refused to sign.
The circumstances were that the family were surrounded by gas infrastructure and one of the major problems they endured was the unbearable noise day and night. Complaints to the government agencies resulted in no action, and they were told to negotiate an alternative access agreement with the gas company. The landowner entered negotiations with the aim of finding a solution to the noise so that the family could enjoy peaceful sleep, study and leisure and reverse the serious adverse impacts of noise on their health and wellbeing.
For the purposes of noise regulation the deemed background noise in rural areas is 25dB, (the actual background noise may be as low as 15-20dB). It is recognized that noise levels "greater than 5 dB above the background noise levels are likely to cause annoyance."
The AAA drawn up by the gas company for signature did nothing to address the aim of noise reduction at the household. They did not suggest sound-proofing, or a night time noise curfew. Instead, for the next 50 years (or longer if defined by the company) for the princely sum of $70,000 in full and final payment the gas company expected the landowner to sign a document accepting noise levels of 55dB during the day and night-time noise levels of 62dB.
The landowner was expected to sign a document permanently indemnifying the gas company and its agents against all harm caused by them by way of not only noise but also dust, odour, light and vibration, and not only to his family, but also to visitors and subsequent owners of the land. He was prohibited from raising objections with government agencies and disclosing the contents of the agreement.
In the meantime throughout the months and years he was being given the runaround by the gas company's legal team, the government agencies charged with protecting his interests refused to engage with him as he was *"in negotiations for an alternative access arrangement."*

The adverse impact on mental health in communities forced to live with the intrusion of the gas industry has been in some cases extreme. The pre-existing traditional stressors of life on the land are already significant – the need to cope with the cycles of drought and flood, inadequate prices, physical isolation, a tendency towards stoicism, reluctance to seek help and inadequate services available to name a few. When individuals are then submersed for years in a struggle to keep gas companies off their land, or dealing with the harm caused by gas company's presence the pressure mounts. When they are spending significant amounts of time which would be better dedicated to their work, rest, family or even sleep reading documents, writing submissions, attending unpaid meetings with gas employees and lawyers and endlessly worrying the mental health toll is high. When the land is their life, the loss of intergenerational equity can be devastating. When in addition the community is divided and secrecy is imposed, the social relationships and support structures usually protective of mental health may be absent.

[51] http://www.theaustralian.com.au/business/mining-energy/farmers-fight-for-rights-to-royalties/news-story/105c4e00b71630588c088b7e037cf752
[52] See Appendix 4

The adverse impacts on the mental health, as well as the social and economic well being of the community can be compounded by the direct actions of the gas companies. Allegations[53] over allegedly unpaid work have been made against Santos at the down turn of the industry in Queensland, with liquidators for Lean Field Development claiming that *"Santos owes Lean Field an estimated $6.3million."*

RECOMMENDATIONS

In 2013 in my report on the health impacts in Queensland I made the following recommendations.

1) A fully funded comprehensive medical assessment of residents currently living in proximity to unconventional gas development should be carried out as a matter of urgency.
2) The planning and urgent implementation of fully funded, long term epidemiological studies is essential 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.
3) Health impact assessments must be 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.
4) Comprehensive air and water monitoring (an open, ongoing and unlimited information loop) is essential. If we are looking at possible non beneficial human health impacts we need to look at all the gases and volatiles both natural and derived emitted via well drilling, gas and pipeline valves, leaking wellheads, flaring, and other processes involved in gas collection/purification/refining to export specifications. This monitoring is urgently required. It must be independent, unbiased, fully funded and available for public scrutiny preferably in real time and in electronic form.
5) Gas companies must be required to fully and openly disclose in a timely manner, all chemicals, and all quantities of chemicals, used or planned to be used for drilling, fracking, cleaning, dehydration, and other processes at every gas facility. All historical results they have of analyses of air, soil and water should be available for public scrutiny.
6) The federal government must develop legislation, a unified standard, to protect public health across Australia from the impacts of unconventional gas development and other extractive industries.
7) There must be open, fully informed, public debate on the future of the unconventional gas industry in Australia.

These recommendations were made with reference to the industry in Queensland where baseline monitoring of health and the environment had never been done. It is apparent that comprehensive baseline monitoring should be an absolute requirement prior to any proposed development. No company should be allowed to go on site and drill an exploratory well in any region of Australia until adequate data had been collected on the baseline status of air, soil, surface and ground water in that area and the baseline data was freely, easily, permanently, and publically available. Baseline environmental data collection should occur over a prolonged

[53] See appendix 3 Courier Mail article. http://www.couriermail.com.au/business/pipeline-company-collapses-claiming-late-payments-by-gas-giant-santos/news-story/22ae992bfc7140193f41be1590ce34c8

time period, preferably of the order of 2 years to cover seasonal changes, extremes of temperature including temperature inversions, humidity, wind direction, rainfall or lack of it, water levels etc.

A reliable method of understanding and recording the baseline health of the community with systematic long term follow up including mechanisms for identifying adverse health impacts at an early stage should be in place before any exploratory work is permitted.

Should the industry be permitted, it is essential to ensure that all data that should be collected is collected. Enforcement of collection of comprehensive, real time air and water monitoring giving accurate, reliable and timely information on the actual exposure of individuals to the full range of environmental toxins including mixtures is critical. **Built into any permit should be criteria under which permission would be withdrawn.**

HOWEVER FOUR YEARS AFTER I DOCUMENTED THE HEALTH OF RESIDENTS IN QUEENSLAND'S GASFIELDS, MY CONCLUSION AND RECOMMENDATIONS ARE THAT THE UNCONVENTIONAL GAS INDUSTRY SHOULD NOT BE PERMITTED ANYWHERE IN AUSTRALIA.

It is my opinion that the risks to human health, the environment and intergenerational equity are too high.

Published outcomes from some of the peer reviewed medical research into the health impacts of unconventional gas are so significant and have such serious potential implications for public health that in my opinion it is necessary to invoke the precautionary principle in consideration of the future of the unconventional gas industry.

The Wingspread Declaration on the Precautionary Principle counsels that 'When an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not established scientifically. In this context the proponent of the activity, rather than the public, should bear the burden of proof' (Science and Environmental Health Network 2016).

Decisions made as a result of the current Scientific Inquiry into Hydraulic Fracturing in The Northern Territory will have profound consequences far into the future. The burden of responsibility placed on those making decisions regarding the future of the unconventional gas industry is significant and unenviable. However in light of the evidence already freely available including knowledge of the impacts of the unconventional gas industry both in Queensland and in the USA, ultimately decisions regarding sanctioning, promoting or permitting the activities of the unconventional industry come down to decisions regarding duty of care.

I would suggest that:

- If you value the health of our citizens including children who are not yet born, please do not permit unconventional gas developments.
- If you value the air we all breathe, the water we drink, the safe nutritious food we grow in Australia, do not permit unconventional gas developments
- If you value Country, if you understand that we are all merely the temporary custodians of this ancient land do not allow it to be destroyed and contaminated on your watch.
- If you value this remarkable landform with its surface and underground water, its wildlife and extraordinary cultural heritage, please do everything you can to protect it.

Dr Geralyn McCarron