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Submission to the Inquiry into the Implications for Western Australia of Hydraulic Fracturing for Unconventional Gas

Submission from
Doctors for the Environment Australia Inc.
David Shearman, Hon Secretary
College Park House, 67 Payneham Road
COLLEGE PARK SA 5069
Phone: 0422 974 857
Email: admin@dea.org.au
www.dea.org.au

DEA

Doctors for the Environment Australia (DEA) is an independent, self-funded, non-government organisation of medical doctors in all Australian States and Territories. Our members work across all specialties in community, hospital and private practice. We work to minimise public health impacts and address the diseases – local, national and global –caused by damage to our natural environment.

This submission will be focused on the potential health implications of hydraulic fracturing and the processes that implicitly accompany it.

It is important to firstly emphasize that hydraulic fracturing is just one process of a group of recent innovations and new technologies that have enabled the development of previously inaccessible petrochemical reserves. The other integral innovations and technologies include "slickwater", high volumes of fluid, horizontally or directional drilling and multi-well pads and cluster drilling.

The combined process, that is often just referred to as hydraulic fracturing, has really only emerged over the last decade[1]. Consequently there is very limited evidence regarding its health or environmental impacts in the short to medium term and no long-term data.

It must also be differentiated from the previous use of hydraulic fracturing in vertical wells and conventional reserves, due to the different chemicals employed and the very different nature, scale and density of activity.

The combined technologies used result in new and increased risks during each phase as well as the technical hydraulic fracturing stage, ie.;

- Exploration, site identification and preparation
- Drilling, casing and cementing
- Well completion
- Production
- Abandonment

It is clearly misleading to limit risk assessment only to the single stage of hydraulic fracturing without considering the stages that preceded and follow it.

a) how hydraulic fracturing may impact on current and future uses of land

Water Resources

DMP now acknowledges that extraction using hydraulic fracturing (HF) is highly water intensive, each "frack" can use 10 -20 million litres of water. As the process involves multiple installations and multiple fracks at each well site, the cumulative impacts must be assessed. Over time these may affect regional water security through depletion and through changes to the quality of aquifers both chemical and biological. Locally there is also the potential for adverse effects on aquatic habitats and ecosystems. Lowering of the water table through extraction may become relevant to agriculture. In the US there are now examples of water licenses being withdrawn. This is particularly relevant in the Perth basin where a growing population and drying from climate change are threatening the availability surface water.

[1] Shale gas: a provisional assessment of climate change and environmental impacts. Wood, Ruth; Gilbert, Paul; et al, 2011. Tyndall Centre Technical Reports

Biodiversity Impacts

Biodiversity may be affected as a secondary function of water extraction and availability, or from surface or subsurface contamination. Chemical additives used, or chemicals formed or liberated, can be directly toxic to plants and animals in the same way that they can impact on human health. There are compounds widely used in fracking, which may have limited toxicity in humans but are highly toxic to aquatic organisms.

There is generally a far greater potential for higher exposures in wildlife and farm animals than humans. The adverse impacts on domestic and farm animals have been highlighted by a study by Bamberger and Oswald in the US[2]. The paper reports multiple accounts of adverse health effects in herd and domestic animals that live in proximity to unconventional gas installations.

Invasive and novel species can be introduced through multiple vehicle and personal movements, with drilling rigs and trucks being taken from one location to another. In the West Australian context already problematic infections such as dieback are of particular concern.

The density and nature of the new roads and pipelines increases fragmentation of habitats and light, noise and vehicle movements can also impact biodiversity.

Biodiversity loss or impacts can affect human health and well being in numerous ways. For example; through the social and economic effects of crop damage that can result from ozone air pollution or the reduction in natural services such as pollinators.

Traffic

Each well pad can result in the 7,000 to 11,000 truck movements for a single 10 well pad and up to 250 vehicles movement on one day.[1] The nature of unconventional gas developments means there will be a great many wells. The regional and rural road network is already struggling with current heavy vehicle traffic and would require enormous investment to upgrade to manage the demands of unconventional gas development. Who would pay for these new roads and upgrades? And any investment in this will result in fewer resources to invest in important human services such as health and education, which would have impacts on health and well-being.

It is likely that this expansion of traffic will increase road trauma, not just involving those working at the mine site. As well as these effects, the large increase in diesel traffic would also add to the air pollution in regional centres and towns, together with the large quantities of diesel used on well sites.

Diesel combustion produces fine particulate matter, oxides of nitrogen and volatile organic compounds, all of which are harmful to human health. Diesel exhaust is classified as a class 1 carcinogen meaning it causes cancer in humans.

Urban centres are also likely to be impacted upon, vehicles may well begin and end their journeys there.

[2] Impacts of Gas Drilling on Human and Animal Health. Bamberger, Michelle; Oswald, Robert E. **New Solutions: A Journal of Environmental and Occupational Health Policy** 22.1 (2012): 51-77

Visual Impacts

Operating rigs work around the clock, with lights and noise 24 hours a day. Excess and continuous noise can increase stress, disturb sleep and have a variety of adverse physiological effects. These effects are well documented and include hypertension in adults and poor school performance amongst children.

Solastalgia, the phenomenon of psychological distress arising from loss of familiar and cherished landscape and sense of place, has also been described in the context of extractive industries such as unconventional gas. While this may be dismissed as just a psychological impact, the effects are real and the health impacts include physical as well as psychological symptoms.

Other Cumulative and Long-term Impacts

Because of their density, distributed nature and associated road, pipeline and other infrastructure, unconventional gas drilling and associated activities result in significant cumulative changes to land use. Many of these will result in long-term agricultural and social consequences for regional communities. The social and economic costs of rehabilitation may exceed the resources of small and medium sized companies and in the case of delayed or very long lasting impacts, such as water contamination from well failure and subsurface migration may eventually fall to the communities and tax payer to remediate.

Local air pollution from ozone produced as a result of emissions of volatile organic compounds and oxides of nitrogen from both wells and diesel pumps has been observed in other shale gas fields and reduces agricultural yields.

Gas drilling in agricultural areas also raises the prospect of chemical contaminants entering the food chain through air pollution or through wild and domestic animals drinking from storage ponds or resulting from surface and ground water contamination.

Long lasting agricultural impacts may also arise from chemical contamination, through spillage, leakage and illegal dumping, or biological impacts from invasive weeds, plant diseases and loss of biodiversity.

b) the regulation of chemicals used in the hydraulic fracturing process

The nature of hydraulic fracturing requires or is facilitated by the use of a wide variety of chemical additives. Whilst according to their concentration in the fracking fluid, these may appear to be small but they are not inconsequential due the very large volumes of fluid used. So a single "frack" uses around 180-580 cubic meters (*or tonnes at a relative density of one*) of chemical additives.[3]

Historically, wide varieties of chemicals have been used or are in use. For example, a US Representative Committee[4] estimated that between 2005 and 2009, 2,500 hydraulic fracturing products were used containing 750 chemicals and other components. Of these, 29 chemicals were classified as very toxic and were components of 652 different products. The 29 included: human carcinogens; substances listed under the Safe Drinking Water Act; and hazardous air pollutants listed under the Clean Air Act.

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[3] Shale gas: a provisional assessment of climate change and environmental impacts. Wood, Ruth; Gilbert, Paul; et al, 2011. Tyndall Centre Technical Reports

[4] US House of Representatives Committee on Energy and Commerce Minority Staff, April 2011

This is consistent with other studies and reviews. Many of the chemicals used have not been identified with "CAS" numbers and nearly all have not been assessed for safety in this or similar context. Colburn[5], reported that of 353 chemicals identified by CAS numbers used in natural gas operations in the US, 75% could produce acute symptoms - eye/skin irritation, nausea and vomiting, asthma, cough, sore throat, flu like illness', dizziness, headaches, weakness, fainting, numbness and convulsions. Forty five percent can affect brain, immune and cardiovascular, renal systems and 37% could affect the endocrine system while 25% were carcinogenic or mutagenic. These impacts may not be evident at the time of exposure, and can have unpredictable delayed effects on individuals and their offspring

Short-term toxicity is far easier to link to a source or exposure and often requires a relatively large dose exposure, whereas long-term low level exposure may not be immediately evident and may occur at far lower dose levels.

As with exposure to asbestos or cigarette smoke, many of these effects may not present for years, or in the case of cancer, decades. So an absence of observational evidence at this time does not provide reassurance of safety.

In the case of endocrine disruption and some carcinogens the dose can be very small and even affect the offspring of those exposed.

We welcome the WA government's decision to publish the chemicals used in hydraulic fracturing and drilling. However, to ensure that human health is protected it will be necessary for all of the proposed chemicals to be adequately assessed by the appropriate authority, in this case NICNAS.

It is already apparent that NICNAS has barely commenced this task, at the 2011 Senate Enquiry into Coal Seam Gas, it was noted that of 50-60[6] fracking related chemicals in known usage in Australia, only 4 had been assessed and these had not been assessed in the context of fracking.

There are risks to human health and to the health of flora and fauna from chemicals used at each stage of the process; transportation to the site on rural roads, handing at the site, injection into wells, recovery as waste (or produced) water, storage and disposal. There is evidence of this occurring in the US where the vast majority of hydraulic fracturing has occurred.

Chemicals may enter ground or surface water through spills, due to well failure, subsurface migration and incorrect disposal. Similarly many of the chemicals in use are volatile and enter the local air shed. This can occur through venting or flaring and also via evaporation from storage or wastewater ponds. NSW has banned the use of open evaporation ponds.

As with other petrochemical deposits many toxic compounds (Hydrocarbons, including BTEX and other polyaromatic compounds, heavy metals and radioactive elements - NORMs) exist in the shale seams, these are liberated through extraction and so can pose a threat in much the same way as additive chemicals.

Complicating matters further it is likely that the process itself may result in the formation of novel chemicals, such as degradation products or due to chemical reactions between multiple ingredients. There is virtually no published information regarding this and a precautionary approach should be taken to protect human health until this has been adequately assessed.

[5] **Natural Gas Operations from a Public Health Perspective** Theo Colborn, Carol Kwiatkowski, Kim Schultz & Mary Bachran, Human and Ecological Risk Assessment: an International Journal, 2011, 17, pp 1039-1056

[6] http://www.youtube.com/watch?v=DBnOBgJPuYE

Climate change has been identified as the biggest threat to human health this century[7] and the largest contributor to anthropogenic emissions is fossil fuel combustion.

Whilst methane produces less greenhouse gas emissions at the point of combustion, there is potential for unplanned leakage and deliberate venting.

Several researchers[8] have assessed this and found that even small fugitive emissions rates in the order of 2% negate the advantage of gas. Clearly for there to be any net reduction, gas would have to displace dirtier fossil fuels such as coal, meaning they must stay in the ground. There is little evidence that there are plans to achieve this and therefore new gas developments will represent additional greenhouse gas emissions.

Recommendations

Due to the multiple significant and cumulative risks to human health we recommend a moratorium on development of the shale gas industry in WA until long-term safety has been established.

Prior to any further development and included in the Health Impact Assessment

- All proposed chemicals should be identified by an international CAS number and should not be used until they have been assessed for safety in the context of hydraulic fracturing by Australia's regulatory authority NICNAS.

- Produced wastewater containing volatile and toxic compounds should not be stored in uncovered or open ponds.

- Baseline water and air quality should be assessed prior to commencement of drilling, monitored throughout, and after completion of, drilling and well completion.

- Hydraulic fracturing and other unconventional gas extraction techniques should not be allowed near groundwater sources for human consumption or agriculture, nor near waterways. A full assessment of water consumption by the process and its impact on water availability for other uses should also be undertaken and made publicly available prior to any decision being made as to whether or not to approve the project.

- "Green completion" should be mandatory and will require monitoring and enforcement to minimise fugitive emissions.

- Important landscapes, habitats and corridors should be evaluated, scientifically characterised and considered in planning and reclamation. Effective field monitoring should be established and enforced to inform on-going assessment of cumulative community and land use effects. Development in areas of high ecological and heritage value or sensitivity should be highly restricted or prevented.

- A whole of life cycle analysis should be performed for greenhouse gas emissions, environmental and social impacts.

[7] Costello et al Managing the Health Effects of Climate Change. Lancet 2009

[8] Wigley T. Switching from coal to natural gas would do little for global climate. Climate Change Letters. Sept 2011