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Dear Commissioner,

I wish to make a submission concerning the Northern Territory Governments inquiry into hydraulic fracturing and the exploration of shale and tight gas. I call on you to make recommendations to amend the laws of the Northern Territory (NT) in response to the following concerns:

1. **We don't currently fully understand the impact of hydraulic fracturing and horizontal gas exploration or the wide range of implications on the environment, native fauna, flora and most importantly the implications for human health. Therefore the law must:**

- Require drilling competency standards to protect safety, health and resource management.
- Ensure sustainable resource management through the collection of baseline scientific data in order to identify the environmental impact of such activities, these should be published and easily accessible to members of the public.
- Reflect the precautionary principle in environmental assessment and regulatory control.

2. **Current NT laws do not allow for community consultation or public participation, therefore the law must:**

- Provide sufficient public consultation through adequate notice of proposed exploration ventures. Simply advertising once in a local newspaper is unjust and does not allow the public an opportunity to voice their concerns.
- Facilitate the landowner and provide the opportunity for the affected parties to exercise the right to object or refuse gas exploration on their land.
- Require the publication of the Ministers reasons for decision and all associated documentation considered by the Minister in the decision making process, including Environmental Impact Statements and Assessments (EIS & EIA).
- Allow, support and facilitate an independent third party to carry out external reviews of any decision made by the Minister.
- Provide an opportunity for the appeal of a decision made by the Minister to an independent organisation or tribunal.
- Allow the regulation of access to land by explorers and operators and allow the land owner to specify terms of access.

3. **Environmental Impact Assessment (EIA) is not adequate, therefore the law must:**

- Be amended to ensure each project with the potential for environmental degradation is properly assessed not just economically but also environmentally in order to achieve the central goal of the EIA process sustainable development.

- Allow the EIA process and all decisions made to be transparent and readily available for public submission.
- Require EIA & EIS for exploration activity. It would be considered highly detrimental to propose one EIA document may suffice for all hydraulic fracturing ventures throughout the Territory due to the vastly heterogeneous nature of the underlying stratigraphy.
- Require the operator to integrate the waste water management planning and rehabilitation into the exploration and production as a requirement for licencing.
- Require the consideration of all alternatives and provide for land use reservations.

4. **Regulatory oversight is not effective, therefore the law should be changed to:**

- An independent body such as the Environmental Protection Agency (EPA) should be appointed to regulate all environmental impacts of the hydraulic fracturing of shale and tight gas in the Northern Territory. This should include sub-surface and groundwater contamination as well as impact on biodiversity on site.
- Require frequent on site visits by environmental and regulatory officers.
- Remove intent and knowledge as elements of environmental offences.
- Substantially increase penalties and extend statute of limitations for prosecutions.
- Apply the *Water Act* to all mining activity in the Northern Territory including the exploration for hydraulic fracturing of shale and tight gas. This will allow for the excessive water use these operations require to be closely monitored and regulated.
- Apply the *Waste Management and Pollution Control Act* to all mining activity, regardless of where it takes place across Australia.
- Implement suitable structural co-ordination between the relevant Government agencies.

5. **The real cost of Hydraulic Fracturing should be known and recovered from Operators, including:**

- Wear and tear on existing infrastructure including public roads.
- Water usage and pollution.
- Cost for the rehabilitation of the decommissioned gas wells and fields.
- Reduction in value of land to landholders as a result of Hydraulic fracturing of shale and tight gas.
- Loss of ecology and biodiversity.
- Impact on human health.

Additional to these concerns I have a number of other concerns regarding the operational logistics of shale and tight gas exploration these are as follows:

- **Water Use** Excessive use of local resources with between 50,000 to 350,000 gallons of water required to fracture one well in a coal bed formation while 2 to 5 million gallons of water may be necessary to fracture one horizontal well in a shale formation. The water used for the hydraulic fracturing process is acquired from surface water or groundwater in the local area (U.S, EPA, 2010). Wells are often fractured multiple times and in some cases a single well maybe refracted up to 10 times significantly multiplying water and chemical use exponentially.

- **Human Health:** Communities living near gas fields in the US have reported serious health effects following the commencement of shale and tight gas operations. Additional to this

residents of Tara in Queensland have also reported a wide range of health effects following the exploration of shale and tight gas in their local areas. The reported health implications are as follows:

- respiratory and neurological effects
- severe headaches
- nausea, vomiting
- nose bleeds, rashes, eye and throat irritations
- severe skin irritations
- higher risks for cancer

- **<u>Impacts on human health and the environment.</u>**
  - Excessively high water usage.
  - Excessively high use of harmful chemicals of which up to 70% remain underground.
  - Loss of traditional land, sacred sites, highly fertile farm land and national parks.
  - High risk of groundwater contamination, this is of great concern as both rural and remote communities in the Northern Territory depend upon these resources.
  - Migration of gas, methane and other toxic substances into groundwater or aquifers through fracturing of tight and shale gas induced pathways.
  - Soil and sub-surface water contamination due to chemical laden waste water and retention ponds.
  - Air pollution from hazardous air pollutants released from wells and infrastructure before, during and after operation.
  - Major threat to human and environmental health.
- **<u>Chemical Usage</u>**

  A typical 15 million litre fracturing operation uses anywhere between 80 to 330 tons of chemicals. Chemicals used include carcinogens, neurotoxins, irritants, reproductive toxins and endocrine disruptors. I have listed a number of these harmful chemicals commonly used in the fracturing process below and at the rear of this document.

  <u>Hydraulic fracturing fluids commonly include:</u>

- **Gelling agents** to hold the proppant in suspension (e.g. mixtures of industrial guar gum, diesel, alkanes/alkenes);
- **Gel stabilisers** (e.g. sodium thiosulphate) and gel breakers (e.g. Ammonium persulphates, sodium persulphate);
- **Friction reducers** to ease pumping and evacuation of fluid (e.g. polyacrylamide, mixtures of methanol, ethylene glycol, surfactants /fluorocarbon surfactants);
- **Diluted acid** to dissolve minerals (e.g. hydrochloric acid, muriatic acid);
- **Biocides** to prevent bacterial action underground (e.g. glutaraldehyde, Tetrakis);
- **Hydoxymethyl phosphonium sulphate** / THPS, 2-Bromo-2-nitro-1,3-propanediol (Bronopol), 2, 2-Dibromo-3-nitrilopropionamide (DBNPA);
- **Clay stabilisers** to prevent clay expanding on contact with water and plugging the reservoir (e.g. tetramethyl ammonium chloride); and
- **Buffer fluids** and crosslinking agents.

Hydraulic fracturing may also use:

- **Corrosion inhibitors** (e.g. formamide, methanol, naphthalene, naptha, nonyl phenols, acetaldhyde);
- **Scale inhibitors** (e.g. ethylene glycols);
- **Iron control** (e.g. citric acid, thioglycolic acid);
- **pH adjusting agents** (sodium or potassium carbonate); and
- **Various surfactants** to affect fluid viscosity (e.g. isopropanol, 2-Butoxyethanol /2-BE.)

Drilling fluid components include:

- **Viscosifiers** to increase viscosity of mud to suspend cuttings (e.g. bentonite, polyacrylamide)
- **Weighting agent** (e.g. barium sulphate)
- **Bactericides/biocides** to prevent biodegradation of organic additives (e.g. glutaraldehyde)
- **Corrosion inhibitors** to prevent corrosion of drill string by acids and acid gases (e.g. zinc carbonate, sodium polyacrylate, ammonium bisulphate)
- **Defoamers** to reduce mud foaming (e.g. glycol blends, light aromatic and aliphatic oil, naptha)
- **Emulsifiers and deemulsifiers** to help the formation of stable dispersion of insoluble liquids in water phase of mud.
- **Lubricants** to reduce torque and drag on the drill string (e.g. chlorinated paraffins)
- **Shale control inhibitors** to control hydration of shales that causes swelling and dispersion of shale, collapsing the wellbore wall (e.g. anionic polyacrylamide, acrylamide copolymer, petroleum distillates)
- **Polymer stabilisers** to prevent degradation of polymers to maintain fluid properties (e.g. Sodium sulphite).
- **Breakers** to reduce the viscosity of the drilling mud by breaking down long chain emulsifier molecules into shorter molecules;
- **Salts** (e.g. potassium chloride, sodium chloride, calcium chloride)

Examples of UG Chemicals and the Health and Environmental Effects

Ethylene Glycol, a known human respiratory toxicant and associated with increased risks of spontaneous abortion and sub-fertility in female workers;

2-Butoxyethanol, a highly mobile and persistent contaminant of groundwater, which can cause reproductive problems and birth defects in animals, and destruction of red blood cells;

Ethoxylated 4-nonylphenol, a persistent, bio accumulative, endocrine disruptor, very toxic to aquatic organisms and causing sexual deformities in exposed oyster larvae, found to increase the incidence of breast cancer in lab animals;

Methanol, a volatile organic compound, highly toxic to humans (most commonly used chemical) 31;

Isopropanol, central nervous system depressant capable of causing degenerative changes in the brains of lab animals;

Formamide, a teratogen with the potential to affect the unborn child, which can be absorbed into the body by inhalation and through the skin;

Naphthalene, causes nasal and lung tumours and is listed by International Agency for Research into Cancer (IARC) as possible human carcinogen'. The US Department of Health and Humans Service found it to be 'reasonably anticipated to be a human carcinogen'. (Source: NTN, 2012).

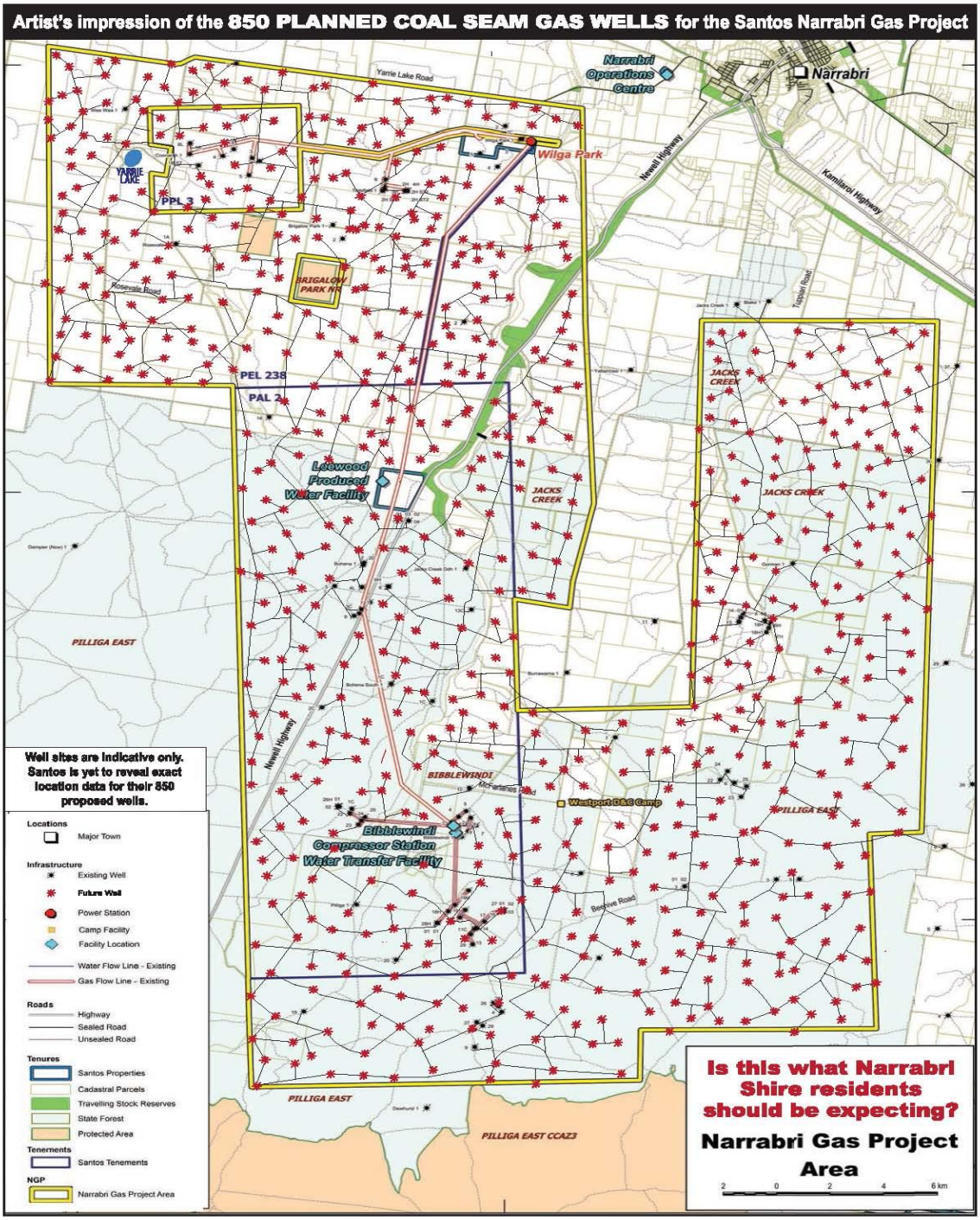
I have provided a substantial list of chemicals and their compositions and also common uses for these chemicals at the rear of this document for your reference.

- **Spatial Intensity**

  The spatial intensity of shale & tight gas exploration is extremely invasive and highly destructive to the environment. The gas companies cannot extract all the shale and tight gas with one gas well therefore they need hundreds in any given area. This then transforms the landscape into an uninhabitable gas land as seen in the picture below (Tara, Queensland). This land often becomes contaminated making it essentially wasteland which cannot be utilised for agricultural purposes.

(Source: Gas field Free Northern Rivers, 2013)

- The map below illustrates the threat of shale and tight gas exploration and the spatial intensity of such operations. This map is an artist's impression of the 850 proposed coal seam gas (CSG) wells Santos plans to put over the Pilliga Forest and Yarrie Lake areas in the Narrabri Shire New South Wales. This type of gas exploration clearly poses a threat to the environment and the health of surrounding communities nearby to the gas fields.



(Source: KateSonWeb 2013)

- **<u>Water Contamination</u>**
  - US studies indicate shale and tight gas exploration may be responsible for the contamination of groundwater with a number of chemicals, heavy metals, salts and gases identified. Research has also found increased levels of methane concentrations in water bores closer to shale gas wells, creating an explosion hazard and significant implications for human health (Source: Osborn, Vengosh, Warner, Jackson, 2011).

- **Threat to Aquifers**
  - Ground water contamination can occur if gas and toxic flow back fluids migrate from gas wells into aquifers through natural underground faults or fractures created during the hydraulic fracturing of shale and tight gas (Source: Fotenot, Hunt, Hildenbrand, Carlton, et. al, 2013). I have attached a diagram on the next page illustrating the hydraulic fracturing process and how it may contaminate drinking water resources. This is highly probable if shale and tight gas is located nearby to aquifers.

I would like to thank you for your time on this matter and I would like to call on you to make the correct and necessary changes to the current laws. I would also like to call on you to take action against the current Northern Territory Government and their plans to destroy large parcels of land across the Northern Territory. I thoroughly look forward to the pleasure of speaking with you in the near future concerning this matter. Should you need to contact me my mobile number is 0410070233 or I can be contacted via email at ruck0006@flinders.edu.au.

Regards,

Simon J Ruckenstuhl

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