Scientific Inquiry into Hydraulic Fracture Stimulation in WA
Dongara Public meeting – 1 March 2018

1. INTERESTS REPRESENTED

- Community (round table meetings)
- Local business
- Local residents
- Agriculture/farming
- Industry
- Midwest Chamber of Commerce and industry
- Shire

2. SCOPE OF DISCUSSION / ISSUES TO ADDRESS

a) Scientific analysis of risks: environmental, health, agricultural, heritage and community.
b) Describe regulatory mechanisms that may be employed to mitigate or minimise risks to an appropriate level.

3. CONCERNS / RISKS

5.1 Water

- Water paramount – aquifers supply community; cannot put value on water
- Aquifer north where Geraldton/Dongara get water
- Aquifers must be protected
- Water is a special concern for horticulture; takes water from aquifer for irrigation and drinking water, which may be compromised by fracking industry; 1km from fracked well
- World Water Day – climate change – water is most important natural resource in the world
- Water is a finite resource; dry climate threatening the land

Water quantity

- Hydraulic fracturing uses large quantities of water – amount used per well – 70% remains underground
- Limited potable water in world context
- A petroleum company's water licence was 32,000kL from superficial aquifer; only used 5,000kL

Water quality

- Health of River Irwin
- Waste water from fracking is toxic, also above ground ponds, treatment plants, liners are not sufficient; what is happening underground

- Groundwater contamination from lost integrity of wells
- Surface water contamination
- Contamination with flood events, other metals released
- Aquifer contamination – well failure, all water, area has lots of limestone/caverns, cross-contamination
- Concern about water contamination and effects on farming business
- Water contaminated in other areas, moving to Midwest; surface water and groundwater
- No monitoring, so you don't know where contamination goes in long term
- Microbes in groundwater being affected
- Water supply from bores and rainwater (not reticulated); concerned about contamination of groundwater, and contamination of rainwater, which comes after wind blows across gasfields
- Groundwater is currently high in salt and calcium; rainwater so far tested to be safe, although not near gas field flaring
- Groundwater quality also impacted by the agricultural industry
- Concern that water used in fracking remains trapped below ground and any surface flow back is radioactive and contaminated forever; not necessarily from the chemicals used in fracking, but from gases released by fracking

Water experiences

- Surface contamination at Gingin
- Mine: water was good quality; wanted to sell; water table dropped from mining and no longer able to access water; now bottled water needed
- Department of Water wanted a 1.5km buffer around water catchments, but rejected by governments (about 3 years ago); there is no buffer around water catchments, so spills and flow back potentially compromise the catchment
- Statement refuted by local government, who protects water catchment areas

3.2 Air quality

- Air pollution – petroleum company has monitors around fracking site
- Odour
- Concern about greenhouse gas from whole industry, from multiple wells
- Risk of fugitive emissions from wells
- Concerned about fugitive emissions/leaks from well; methane from old wells; and fluids
- Wells not monitored or locations known over long time; issues over time after well has been rehabilitated
- No mechanism to monitor air quality in regional areas

Air quality experiences

- Greenhouse gas emissions from flaring, generators, etc – petroleum company ensures well is maintained

- Flaring at Irwin – wind was South West, blew over town, see/hear/smell, even in the infancy of the industry

3.3 Human health

- Health likely to be impacted by air quality
- Mental health issues
- Health effects people living close/near gas fields
- No baseline health known; no health assessment done – Health Impact Assessment?
- Experience of negative reactions because of the wells, including physical and mental health issues
- Feel regular noise and vibration, impacting on mental health
- Distressing physical and mental health impacts - Experience of eye irritation at home near to gas wells; dissipates when in Dongara/Geraldton and/or Perth; Experience of blurry vision, even on still days, and blood noses
- Worry about vehicles full of chemicals driving along local roads

3.4 Environmental health

- No benchmark on environment – already degraded
- Concern for people, wildlife, aquifers, waterways
- Consequences of fracking unknown, just like asbestos, smoking, organochlorides
- Fracking leads to degradation, erosion, networks of roads
- Biodiversity hotspot under threat; fracking has potential to decimate biodiversity
- Still haven't reached hydrology balance; acidity, waterlogging, salinity, all have impacts on agriculture
- Ground and soil monitoring shows that farmers have greater impact than a well.

Cumulative impacts

- Cumulative risk – multiple wells; inevitable accidents; how will this be addressed
- Change from exploration to extraction becomes an issue of scale, of impacts, infrastructure, disruption to farming activity
- Concerned about the impacts of intensive fracking development
- Large scale impacts on broad landscape

Visual impacts

- Multiple wells – visual impacts, industrialisation

Reserves

- Honeysuckle Reserve – birds gone, no one visits/stays long, contamination concerns
- Nature reserve declared after Woodada Deep 1 approved; therefore very strict management and protocols for entry

Clearing
- Fracking involves more land clearing
- Petroleum company in area aims for minimal clearing

Invasive species
- Vehicle movements introduce weeds, spread dieback

Terrestrial flora and fauna
- Habitat fragmentation and destruction
- Toxicity of ponds to animals
- Surface water impacts and effects on local and migrating birds

Fire/safety
- Flares – safety risk issues; evacuation/explosion

Seismic activity
- Induced seismicity
- Earthquake risk due to high pressure used in fracking
- Increased earthquake risk; Meckering earthquake – water bodies disappeared – we don't know enough about impacts

3.5 Fracking process

- Perth Basin is in tight sandstone (not shale)
- Nothing more shallow than 2.8km
- Technology – both conventional and unconventional
- Failure of Macondo in United States because was not cemented to rock
- Industry disputes 'all wells leak'; need to be specific to Western Australian wells
- Predecessors fracked in vertical wells; horizontal wells are a concern in relation to terrestrial stability

Well integrity
- Construction/leaking; steel/corrosion
- Industry - 325 wells (all wells) in Perth Basin; no failure; all are multiple casing; 6-7% failure stats come from single casings wells; multiple casings reduce stats to <1%; Department of Mines, Industry Regulation and Safety has statistics; failure rate not on web site
- Failure 4.6%-8.9% rate (from publication)
- Locals have information on abandoned wells leaking

- Leakages in Kimberley
- Casing corrosion of bore in Northern Territory from 1960s
- Longevity of well construction

Materials/chemicals used and managed

- Chemicals involved in process – risks; tonnes per well, stay down wells – move underground
- Chemicals put on crops has greater damage than fracking

Regulation experience

- No monitoring, no regulation
- Monitoring ceases after 2 years
- Regulations were tightened in 2012 and 2015; likely to be tightened again
- Mine department inspects each well (thinks this occurs), inspects cement, etc.
- Monitoring in remote locations unlikely, due to remoteness
- Rehabilitation of the wells is poorly done; many of the redundant wells are not decommissioned or properly managed; risk of ongoing escape of methane, and some of the casings are corroded
- The life of the wells is relatively short, so government (Department of Mines, Industry Regulation and Safety) is supposed to be monitoring, but people are not confident that the government is doing the job properly
- Community concerns about who is monitoring – Company, Water Corporation and government (Department of Mines, Industry Regulation and Safety) have expressed confidence that the oversight and auditing is acceptable
- Well leaking in 2012 – took 8-10 weeks to do anything
- Environmental regulation framework is rigorous in Western Australia
- Groundwater monitoring program at every local petroleum company operation activity and reported to government

Risk assessment

- Risks cannot be fully mitigated; cannot regulate people
- Cannot be done safely
- Industry undertakes risk mitigation
- Drilling through aquifers; Wells will leak, so risk is catastrophic
- Need good risk management

3.6 Country/community

- Risk to economic, social and spiritual values
- Number of benefits brought by local petroleum company to Dongara region; employment at Greenough (also Dongara)

- Benefit to landholder through use of roads put on property and realignment of fences and addition of cattle grids.

Sense of place/community

- Survey of community opinion indicated industry has no social licence to operate

Economics/jobs

- Disruption of farming activities and methods, due to roads, etc.
- Livelihood – jobs don't usually happen; short term jobs; not good economics when all factors considered
- People and water are more important than industry
- Damage to private property/area outweighs benefits; economics not there; has asked a petroleum industry to do economics; economics need to offset damage
- Looking for opportunities for existing businesses to interface with oil and gas industry, but only if activities are good for local business and people
- Hopes Dongara can embrace a new industry but understands the importance of it being safe and good for the community
- Irwin keen to have jobs and economic development, but not at any cost
- Concern about future viability of the region; gas offers some hope; companies are operating under licences and so the state must be vigilant for everyone's future but also for future energy supply
- Jobs and the future of Dongara are important – if companies come to town, they need to employ and buy locally; the companies need to provide opportunities for local people to be upskilled and employed; where are the scholarships, traineeships, apprenticeships, ranger programs
- Local petroleum company is reported to be a good company; they have helped small business operators get geared up to work for them, employed local caterers, cleaners and maintenance teams

3.7 Philosophy/ethics/natural justice/policy concerns

Ethics

- Lack of trust between community and industry, e.g. Social licence to operate is easy to say, claiming inclusion, collaboration, but companies often do not do anything once they have the licence to operate from government; flaring from the local gas wells was not communicated and yet the company claimed they would regularly communicate with interested community members; no telephone numbers provided and no local contact person; it was a very scary time for local people; some thought it was a fire; Shire did not know what was happening either
- A mine licence to operate is not the same as a social licence to operate
- Elderly residents concerned that complaints of noise and vibration not taken seriously by the company, who could not be contacted direct

- Government and Department of Mines, Industry Regulation and Safety can't be trusted to protect water catchments
- Do not trust the companies or the current compliance; government doesn't care about country people

Natural justice

- Industry imposed on farmers, who cannot say no; landowners should have veto rights
- Direct negative impact on property values with mining; refused bank loans; landholders believe value of land is impacted, affecting credit worthiness
- Access to and understanding of government department decisions, processes and policies are not easy and if you ask government for clarification, you have to pay for a solicitor for a determination; big money talks and the little guys get overlooked; government doesn't care about small communities or individuals who don't have deep pockets

Policy

- Hard to understand ban in Swan Valley but not in agricultural areas in Midwest – why?
- Conflicting land uses
- Competition for high value water resources
- Conflicts with horticultural industry, which will stay longer than oil/gas industry
- Detracts from developing renewable energy sources
- Not conducive to tourism development
- Play with people's livelihoods
- Western Australia exports gas; need to justify development of onshore and unconventional gas
- Community does not have anything to gain by getting into risky energy technologies; would be socially and morally irresponsible not to pursue solar and wind technologies
- Threat to area's reputation for clean/green agriculture
- How compatible is gas production with clean and green horticultural and agricultural industries

3.8 Information/communication matters

- Companies are required to engage with the community, but they have no guidelines on how to engage and with whom; companies do not have any social sophistication – no investment in communicating with the community; it has to be more than a website or the odd email; they have to live in the community and actively engage
- Surface contamination at Gingin; lack of information to community; failure of system/transparency
- Mixed messages/information around

- Communication of issues is important
- Department communication to community about decommissioning is not diligent enough about what is happening, who is responsible for what and when
- Little community understanding of the extent of the liability associated with the wells and the entire extraction process;
- Who is responsible for gas leaks, over flows, destruction of roads, natural habitats, interruption to farming activities, and for how long
- Not convinced that government is particularly good or consistent in their monitoring and reporting publicly
- A petroleum company has addressed stakeholder concerns through round table discussions over the last 3 years; company has learnt from the experience and people in Irwin are more comfortable because of the history of involvement; may not be the same in the other Shire
- Relationships with industry has now improved.
- Involvement of community led to chemical disclosure; now publicly available
- Siting well in consultation with landholder and they got a new access track
- Senecia 2 flare test – complaints on noise; company learnt from this and stakeholder engagement

Knowledge gaps

- Independent assessment by geologists of the geological make-up underlying the Irwin Valley, gas fields surrounding Dongara, etc, to be made available to the community
- Don't know what is going on underground when fracking
- Need to know where every well was located – community needs to know, e.g. gold mining and caving in from old operations
- What is extent of footprint
- Irwin – aimed for tight gas; found conventional gas; shows how little is known when drilling

4. Regulatory considerations; What regulatory mechanisms may be employed to mitigate or minimise risks to an acceptable level?

4.1 Regulation framework

- Avoid conflicts of interest at all levels
- Provide opportunities for local people to be upskilled and employed; require scholarships, traineeships, apprenticeships, ranger programs
- Want full environmental impact assessment of all fracking proposals
- Want mechanisms for stakeholders to have input into regulations
- Want rehabilitation of wells and vegetation

'Safe' option

- Fracking is an insidious, dangerous and invasive practice that should never be allowed
- Fracking can't be safely regulated
- Too many unknowns to give guarantee of no harm

Responsibility

- Companies change names and ownership percentages and responsibility is abrogated; government/regulator should be diligent in tracking and keeping people and companies honest and meeting their responsibilities
- Government is too financially constrained and there is too much movement of personnel, resulting in lost knowledge and inconsistent regulation;
- Need a strong and independent regulator, not government, or the issuer of the licence, or the producer or monitor
- Who is responsible for monitoring and rehabilitation?

4.2 Modelling, baseline studies, monitoring, analysis and public reporting

- Need high level baseline data on air quality, water, human health and soil before any fracking activity; subject area should be the whole community and measuring should be consistent
- Regular and transparent water, air quality and noise monitoring
- Monitoring undertaken by an independent body
- Public reporting of monitoring results that puts results in perspective and explains situation in every-day language – the science community continually fails to communicate effectively
- Develop a transparent plan for water allocation, monitoring, and usage for all purposes (agriculture, fracking, community, etc), with regular reporting
- Monitoring of quantum of water used in fracking and quantum of safe/recovered water
- Accurate scientific measurement of cumulative impacts in the community and region; too much silo measuring/reporting when there should be whole of process measurement
- Whole of life cycle monitoring must be mandatory and regulated
- Monitor greenhouse gases
- Public disclosure of chemicals used

4.3 Insurance/penalties/compensation

- If fracking goes pear-shaped, will there be anyone who stands up and says they will compensate the community members affected?
- Revenue from gas into community – compensate for loss of value
- Liability for things going wrong?

4.4 Land access

- Land access a concern for farmers, who have no right of veto
- Land access agreement has no right of veto; landholder should have right of veto; signed agreement should be renegotiated when company ownership changes
- Horizontal wells are a concern in relation to property rights

5 REFERENCES, INFORMATION SOURCES CITED/REFERRED TO

- Reports of Qld/US pollution of water/air

6 ATTACHMENTS

6.1 Documents provided at the public meeting

Date	Subject
	Document – 'Information on unconventional gas development for WA scientific inquiry', prepared by Bryan Whan for Lock the Gate Alliance, includes substantial reference list
March 2011	Rockwater Pty Ltd, Woodada Deep-01 Well, Aquifer Connectivity Report, prepared for AWE limited
12 June 2015	Aurora Environmental, letter to AWE Limited on investigation of noise and odour complaint from Senecio-03 Well intervention and production testing
23 July 2015	AWE presentation on AWE Perth Basin Operations – Drover 1: Groundwater monitoring - to Coorow Community Reference Group
2016	Joint submission by Drover-1 Shire of Coorow Community Reference Group and AWE Limited Pty Ltd as a nomination for the DMP Community Partnership Awards
27 October 2016	Email from Rod Copeland on contribution to Shire of Irwin Community Roundtable
1 December 2017	Shire of Irwin Community Roundtable workshops, Q&A Tracking Table
8 December 2017	Snapshot: Shire of Irwin Onshore Energy Industry (2017)
Undated	Government of WA, Departments of Primary Industries and Regional Development, Water and Environmental Regulation, Planning, Lands and Heritage; Water for Food project, Midlands: Groundwater and Land Assessment
October 2015	Farming Land Access Agreement template, for petroleum exploration activities under the *Petroleum and Geothermal Energy Resources Act 1967*

Please accept these as my concerns and evidence. 1 MARCH – DONGARA – public inquiry meeting.

INFORMATION ON UNCONVENTIONAL GAS DEVELOPMENT FOR WA SCIENTIFIC INQUIRY

Prepared by Bryan Whan for Lock the Gate Alliance

[redacted]

1-3-18

[redacted]

This document is designed to assist people wishing to prepare a submission to the WA fracking inquiry. It contains a summary of information that can be used in preparing a submission, including numerous references, a list of which is provided in the last pages.

Please also see citations AT THE END OF THIS DOC.

1. GENERAL BACKGROUND

References (1.1, 1.2, 1.3, 1.4)

1.1 Unconventional Gas

Unconventional gas exploration and/or production is now taking place across Australia. Coal seam gas, shale gas and tight gas differ from conventional gas because they are more difficult to extract and cannot be developed with conventional processes. The gas is the same, the difference is how it is extracted from the ground.

The three main types of unconventional gas are:
- Coal seam gas (CSG), found in coal seams.
- Shale gas found in shale rocks.
- Tight gas found in low permeability sandstone or limestone rocks.

1.2 Difference between conventional and unconventional gas

Different extraction techniques are required due to the different geology of the reservoirs from which they are extracted.

Conventional gas
- Found in relatively large permeable rock reservoirs.
- The gas can usually be extracted relatively easily via vertical wells.
- Has been extracted in Australia for many decades.

Unconventional natural gas
- Found in less permeable deposits or spread more diffusely throughout the rock substrates.
- This gas is more difficult to extract and therefore requires more specialized (i.e. 'unconventional') extraction techniques and processes.
- The methods required for the extraction of unconventional gas include hydraulic fracturing (fracking), horizontal drilling, multiple drilling, and acidation.

1.3 Impacts on area

- Unconventional gas production is highly invasive. While conventional gas production generally requires single wells, shale and tight gasfields involve the industrialisation of entire landscapes as hundreds or even thousands of closely spaced gas wells are required to extract commercially viable quantities of gas. Gasfields also require vast networks of access roads, gas pipelines, processing plants, compressor stations, and wastewater holding dams and treatment plants.
- Valuable agricultural and horticultural land is lost. Native forests and wild life are impacted.
- The presence of mining in the area will reduce surrounding land values. Experience elsewhere in Australia has shown that land owners have been refused bank finance due to uncertainty of the asset caused by the presence of wells on the property *(10.11, 10.12, 10.13)*.

1.4 Unconventional gas techniques

- Involve using invasive 'unconventional' methods to crack rocks that hold methane gas deep underground.
- Techniques such as horizontal drilling and hydraulic fracturing (fracking) are used to extract methane from the shale and sandstone rocks.

- Fracking involves pumping large volumes of water, chemicals, radioactive tracers and sand into the ground at high pressure to release gas.
- Tight gas may also require acidation, which involves pumping acids into the well to dissolve the cements between rock grains.

Modern fracking techniques used for unconventional gas extraction are vastly different to older fracking methods used in WA's conventional oil and gas industries. These newer, more damaging fracking processes have only been in use since the 1990's and require vast quantities of water and chemicals, much higher pressures, and riskier horizontal drilling techniques. Modern fracking technology has never been deployed on a commercial scale in Western Australia.

1.5 Water use *(1.4)*

Fracking is an extremely water-intensive practice.
- A single shale gas frack uses 11-34 million litres of water in the fracking fluids.
- Wells are often fracked on multiple occasions, sometimes up to ten times, multiplying overall water use.
- Some of this fluid returns to the surface as flowback, but most stays underground and is never recovered - estimates suggest 70% or more remains underground.

1.6 Wastewater *(1.11)*

- Wastewater from gas operations includes flowback from fracking and 'produced' water that is present in the source rock. This produced water is brought to the surface during gas production. The wastewater may contain heavy metals, salts, radioactive materials and volatile organic compounds.
- The massive volumes of wastewater produced may be stored in large ponds, partially 'treated' and released into waterways or re-injected back underground - a process that can lead to earth tremors and earthquakes.

1.7 Shale and tight gas in Western Australia *(1.12, 1.13, 1.14)*

- WA could contain 280 trillion cubic feet of potential shale and tight gas resources.
- Gas companies are actively exploring for gas across the state, with the Kimberley, Mid West and South West regions currently being targeted for exploration and pilot production.
- Fracking for unconventional gas is already underway in WA, with around 12 exploration wells fracked in the past 11 years.
- The Department of Mines and Petroleum (DMP) has handed out exploration licences to gas companies that could end up fracking through our precious groundwater sources, including the Yarragadee North and South aquifers that supply Perth and the Southwest with drinking water.
- There are currently four gas exploration licences granted in the South West region that could open the door to widespread drilling through the Yarragadee aquifer. Currently there is a fracking ban covering the south west, peel and metro regions, but this ban is not protected by an act of Parliament and could be overturned without having to go back to the Parliament.
- Conservative estimates suggest that the Kimberley could see 41,720 gas wells and the Perth Basin more than 14,000 *(1.14)*

1.8 What is at risk?

A large swathe of Australia is covered in coal and gas leases & applications. Families and communities are suffering as a result. In parts of Queensland, the unconventional gas industry has impacted on the health of families living close to mines and gasfields. These impacts are only just beginning to be recognised, although people have been providing anecdotal evidence of the impacts for many years *(1.15, 1.16)*.

In Queensland, the rate of change has seen prime agricultural regions transformed into industrial areas through coal seam gas *(1.3)*. 18,000 wells have been approved, and tens of thousands more are planned.

Invasive gas mining impacts include:
- Industrialization of whole regions with wells, roads, pipelines, and infrastructure.
- Contamination of ground and surface waters with toxic chemicals and methane.
- Loss of agricultural land and reductions in property values.
- Release of hazardous air pollutants from venting, flaring and wastewater evaporation.
- Depletion of water resources from well dewatering and use in fracking.
- Substantial greenhouse emissions from methane leakage.
- Serious health effects experienced in communities living near gasfields in the USA & Queensland.
- Fragmentation and destruction of native forests and critical wildlife habitat.

- Reduced quality of life for rural residents from industrialization of rural areas.
- Increased threat of seismic activity from fracking and wastewater re-injection.

1.9 Quick Facts on coal & gas *(1.17, 1.18, 1.19)*

- Australia gets little benefit from coal and gas production because 83% of the mining industry is foreign-owned.
- Mining is one of the smallest employers in Australia, employing only 2% of the population which is less than the arts and recreation services industry.
- Australia has plentiful supplies of 'conventional' or 'natural' gas and some of the best solar and wind resources in the world.
- Most gas is shipped overseas - Australia plans to become the biggest exporter of gas by 2020.
- On the east coast, exports of coal seam gas are driving up the cost of gas for consumers in Australia, because companies are increasing domestic prices to match overseas prices.

1.10 Successful actions *(1.20, 1.21, 1.23)*

- The Government of Victoria has introduced legislation to ban fracking and unconventional gas exploration.
- Tasmania has instigated a moratorium on fracking, with a possible ban ahead.
- The Northern Territory has a temporary fracking ban in place while it holds its own fracking inquiry, which is also looking into unconventional gasfields more broadly.
- The Queensland Parliament passed a bill to restore the rights of landholders and communities to object to major mining projects.
- Parts of NSW are protected from unconventional gas development following legislation that prohibits all unconventional gas activities within 2km of residential areas, and the Upper Hunter equine and viticulture critical industry clusters *(1.23).*
- The South Australian Liberal Party has promised to ban fracking in the state's South East if it wins the state election in March 2018
- Numerous national, state and regional governments overseas have enacted bans or moratoriums.
- Many local councils across Australia have passed motions opposing unconventional gas development and calling for a moratorium.

The growing evidence of actual harm, and the potential environmental and health risks from shale gas development, has now resulted in decisive action from governments across the globe to halt the expansion of this industry. Internationally, jurisdictions with some form of ban or moratorium in place include Scotland, Wales, Germany, Bulgaria, Romania, the Netherlands, Northern Ireland, Wales, the Czech Republic, Luxembourg and France as well as the US States of New York, Maryland, Florida and Vermont and the Canadian Provinces of New Brunswick, Newfoundland, Nova Scotia and Quebec *(1.6, 1.7, 1.20)*

1.11 A warning from Queensland

The impact on the land and the industrialisation unconventional gas production creates is neatly demonstrated in a series of 'Before and After' photos of various forest and agricultural areas in Queensland. *http://www.csgfreenorthwest.org.au/qlds_story (1.8).*

1.12 The community does not want unconventional gas *(1.22)*

Across Australia there have been more than 450 communities who have declared themselves coal or gasfield free. In WA, we have close to 20 communities who have said they want to remain Gasfield Free. These communities include Brunswick, Stratham, Dandaragan, Greenough, Cervantes, North Boyanup, Moora, The Vines, Forest Grove, Stirling Estate, Quedjinup, Caversham East, Leeman, Greenhead, Exmouth, Irwin, Jurien, Carnamah and Chittering.

Gasfield Free communities follow an extensive survey of residents who are asked house by house, street by street, whether they want to declare their communities Gasfield Free. When a community declares itself Gasfield Free it is making a powerful statement to the gas industry that the industry does not have a social licence to operate in the community

Representing a large sector of the rural community, the Country Women's Association of WA passed a motion at its 2017 Annual Conference calling for an end to fracking and unconventional gasfields in WA. This follows a similar ban passed by the NSW branch of the CWA earlier in the year. *(1.10)*

1.13 Exhaustive information from scientific papers and peer-reviewed journal articles *(1.7, 1.24)*

Contrary to industry claims that there is no evidence of risks from unconventional gas, there are extensive databases providing scientific evidence of the risks and harms.

PSE database – 1400 papers *(1.24)*

The Physicians Scientists and Engineers for Healthy Energy maintains a citation database on shale and tight gas development which provides an exhaustive and evolving list of bibliographic information, abstracts and links to vetted scientific papers and peer-reviewed journal articles *(1.24)*. Currently containing about **1400** citations, it is divided into 12 different categories, including air quality, water quality, climate, public health and regulations. http://www.psehealthyenergy.org/site/view/1180

Compendium of Scientific, Medical, and Media Findings Demonstrating Risks and Harms of Fracking – 900 papers *(1.7)*

The New York based health organization, the *Concerned Health Professionals of New York,* has compiled the *Compendium of Scientific, Medical, and Media Findings Demonstrating Risks and Harms of Fracking* - a fully-referenced compilation of the evidence for the risks and harms of fracking that brings together findings from the scientific and medical literature, government and industry reports, and journalistic investigation.

The latest edition of this compendium highlighted the following emerging trends:

- Growing evidence shows that regulations are simply not capable of preventing harm.
- Fracking threatens drinking water.
- Drilling and fracking emissions contribute to toxic air pollution and smog (ground-level ozone) at levels known to have health impacts.
- Public health problems associated with drilling and fracking, including reproductive impacts and occupational health and safety problems, are increasingly well documented.
- Natural gas is a bigger threat to the climate than previously believed.
- Earthquakes are a consequence of drilling and fracking-related activities in many locations.
- Fracking infrastructure poses serious potential exposure risks to those living near it.
- Drilling and fracking activities can bring naturally occurring radioactive materials to the surface.
- The economic instabilities of fracking further exacerbate public health risks.
- Fracking raises issues of environmental justice.
- Health care professionals are increasingly calling for bans or moratoria until the full range of potential health hazards from fracking are understood.

Many studies (numbers in brackets) were documented in the following categories:

- Air pollution (55)
- Water contamination (108)
- Inherent engineering problems that worsen with time (13)
- Radioactive releases (16)
- Occupational health and safety hazards (44)
- Public health effects, measured directly (23)
- Noise pollution, light pollution, and stress (12)
- Earthquakes and seismic activity (60)
- Abandoned and active oil and natural gas wells as pathways for gas and fluid migration (22)
- Flood risks (9)
- Threats to agriculture and soil quality (20)
- Threats to the climate system (56)
- Threats from fracking infrastructure (71)
- Inaccurate job claims, increased crime rates, threats to property value and mortgages, and local government burden (64)
- Inflated estimates of oil and gas reserves and profitability (23)
- Disclosure of serious risks to investors (Information from industry returns to Government)
- Medical and scientific calls for more study and more transparency (36)

Based on this scientific evidence, the Concerned Health Professionals of NY and Physicians for Social Responsibility concluded:
'Findings to date from scientific, medical, and journalistic investigations combine to demonstrate that fracking poses significant threats to air, water, health, public safety, climate stability, seismic stability, community cohesion, and long-term economic vitality. Emerging data from a rapidly expanding body of evidence continue to

reveal a plethora of recurring problems and harms that cannot be averted or cannot be sufficiently averted through regulatory frameworks. There is no evidence that fracking can operate without threatening public health directly or without imperilling climate stability upon which public health depends. Industry swore that its cracking rock technology was safe and proven, but science now tells a different story. And in the words of a new commentary about fracking in the American Journal of Public Health: Mounting empirical evidence shows harm to the environment and to human health ... and we have no idea what the long-term effects might be.... Ignoring the body of evidence, to us, is not a viable option anymore.'

2. WHAT THE INDUSTRY CLAIMS – INDUSTRY CREDIBILITY

References (2.1, 2.2, 2.3, 2.4)

2.1 Claims made by the industry

The gas companies, the Australian Petroleum Production and Exploration Association (APPEA), and the WA Department of Mines, Industry Regulation and Safety claim that:

- Mining for unconventional gas is safe, and the risks are known and can be managed.
- The gas industry has a good track record of safe operations in SA, Qld, WA, NSW, and Victoria.
- The industry is transparent, consultative, and honest, and is committed to relationships built on trust and mutual respect.
- Gas mining will provide jobs and investment to boost the economy.

A thorough analysis of peer-reviewed evidence, as reviewed in this paper, clearly demonstrates these claims cannot be justified, and the industry lacks credibility in promoting these views.

Typical claims made by industry follow:

Jobs and economic benefits

- Development of Northern Territory's onshore natural gas resources will deliver 6300 new long-term jobs and generate up to $1b revenue over next 20 years.
- Using more natural gas would enhance Australia's ability to meet increasing energy needs while at the same time reduce greenhouse gas emissions.
- SANTOS has invested $15.4b throughout Australia - $8b in Qld with $1b in regional areas. More than 10,000 people have worked on the construction operation and many more suppliers and businesses have benefited.

Risks

- The risks are well known and can be managed.
- Numerous Australian and international reviews have found that the risks associated with hydraulic fracturing can be managed effectively with a robust regulatory regime.
- The most common well integrity risk is slow leakage of methane around the external casing, but the consequences of such leaks, although negative from a climate change perspective, do not threaten health because natural gas is not toxic, the frequency of substantial leaks is low, and the leakage rates are low as well.
- Origin Energy: Studies and decades of practical experience show the risk of groundwater and surface water contamination is very low.
- Santos: Numerous reputable independent reports and inquiries have found that the technical process of hydraulic fracturing to be safe and sustainable when accompanied by operational capability, good management processes, and a robust regulatory framework.
- The gas industry has a demonstrated track record of safe, sustainable operations in SA, Qld, NT, WA, NSW and Vic.
- Around Australia, thousands of wells have been drilled – and more than 1000 have been fracked – with no significant impact on the environment or groundwater resources. Some minor surface incidents have occurred, but none that have caused the type of environmental harm some people claim is inevitable. As with any industry, there are risks involved that must be managed and minimised.
- Today, companies can drill multiple horizontal well paths from a single surface location. Clustering wells onto a single surface location dramatically reduces the overall amount of surface land required for wells and related infrastructure.

Credibility of industry

- The industry is committed to ensuring the equitable treatment of all stakeholders, and it focuses on building relationships based on trust and mutual respect.
- Origin Energy: One of our overriding principles is to be open and transparent at all times. We always engage respectfully based on a dialogue of facts.
- Santos: We acknowledge that we must have a social licence to operate. Relationships are built on respect and openness.

Impacts on other industries
- Independent evidence from Queensland and South Australia shows the established industries have not been disadvantaged by the development of the natural gas industry.

Health complaints in Queensland
- Queensland Health found no clear link could be drawn between the health complaints of some residents and the local CSG industry. The Queensland Health report found that the nature of complaints meant there were multiple possible causes and explanations including faecal contamination in the water supply, the use of wood- fired heaters or open fires, and rainwater contaminated with bacteria, viruses or other organisms. These causes are not related to gas operations. The report noted the most prevalent reported symptoms are headache, transient (reversible) eye irritation, nosebleeds and skin rashes. These are common medical complaints,

2.2 Industry credibility? Personal stories and case studies *(2.21)*

While industry claims it is transparent, respects and consults with the landowners, and its operations are safe without any impacts, there is abundant evidence that suggests a very different story. This review provides abundant scientific evidence that refutes these claims. The following examples of personal stories also questions the industry's credibility of claiming a policy of consultation, honesty and public interest.

Landowners on the Darling Downs, Queensland *(1.3 A fractured country, An unconventional invasion. http://www.lockthegate.org.au/our_films)*

- Families on the Darling Downs in Queensland have health problems through living close to the gas mining. They are no longer able to drink the water, with instances where gas was emitted from their water supplies. The presence of gas mining on their properties and the transformation of their prime agricultural land to an industrial zone which operates 24 hour a day has devastated their lives, and it has affected their mental as well as physical health. Their properties and livelihoods are ruined. The value of their properties has reduced drastically, preventing them from selling and moving on.
- Contrary to what the industry claims, these land owners recounted experiences on how they were treated with contempt by the gas companies.
- Personal stories from:
    - Brian Monk, Landowner, Kogan, Darling Downs, Qld
    - Ruth Armstrong, Mixed cropping farmer, Cecil Plains, Darling Downs Qld
    - Mabel Quakawoot, Bailai Elder, Gladstone, North Qld
    - Graham Gibson, Vigneron, Broke, Hunter Valley, NSW
    - Joe Hill, Angus cattle breeder, Miles, Darling Downs, Qld
    - Lee McNicholl, Beef producer, Dulacca, South West Qld
    - Ian Moore, Farmer, Jerry's Plains, Hunter Valley, NSW
    - Scott Lloyd, Farmer, Chinchilla, Qld
    - Marion Palmer, Landholder, Tara, Darling Downs, Qld
    - Debbi Orr, Landowner, Tara, Darling Downs, Qld
    - Geoff and Barbara Brown, Vigneron, Hunter Valley, NSW
    - David Quince, Farmer and Grazier, Tambar Springs, Liverpool Plains, NSW
    - Don Durrant, Farmer, Doubtful Creek, Northern NSW
    - Ben Marrjarr, Traditional Owner, Arnhem Land, NT
    - Megan Kuhn, Farmer, Bundella, North West NSW
    - Lesley MacQueen, Dairy Farmer, Lynchs Creek, Northern NSW
    - Wal Buckman, Farmer, Lynchs Creek, Northern NSW
    - Paul Hobbs, Landholder, Lynchs Creek, Northern NSW

Megan Baker, Wilkie Creek Qld *(2.3)*

Megan's family suffered 5 years of negotiations and a legal battle with Arrow Energy, taking a huge toll on her family. The gas company dozed fences and introduced weeds, and vehicles would come and go all hours of the

day and night. Stock were running everywhere because they could not be contained to one paddock due to the damage. They were forced out of production so eventually decided to sell the sheep flock.

Wayne Waker – Chinchilla, Queensland *(2.4)*

Wayne signed an access agreement for unconventional gas extraction by Origin Energy, but was given misleading information during negotiations. He was advised that coal seam gas would provide extra money and would have no impact. The company would 'just come in the front gate, conduct activities for a while, and then move on'. They cut about 10 holes in the boundary fences, drove over a 6 feet high fence and went where they liked – all without consultation. He has pipelines running through his property, and 10 high vents pumping out methane gas. The company had no principles, morals or scruples, and treated the landowner with contempt. Wayne gets headaches and sore eyes and is worried about long term health. His lifestyle and agricultural production have been ruined. His property is now not worth the original unimproved value.

Nood and Narelle Nothdurft – living in the heart of a gas field *(2.5)*

Their 860 acre farm was transformed into an industrialised gas field, with 4 processing plants and 7 gas wells. Within a 2.5km radius of their home there are 30 wells, 37 high point vents which vent methane 24/7/365, and hundreds of km of water and gas pipelines. There are 4 vents within 80m of their home with signs indicating the gas is flammable, explosive and dangerous. Gas company said it was only venting air, but FLIR camera images showed it was methane and VOCs. There is an unbearable noise generated from the gas infrastructure, with dust and methane emisions.

Their children suffer from incredible health problems – severs headaches, vomiting, metal taste in their mouths, sore limbs, nasal problems.

Neil Stanley's story – Kogan Qld *(2.6)*

In late 2009, QGC drilled a gas well on an important cultural heritage site near Kogan in western Queensland. The site, a Bora Ring used in initiation ceremonies, was well documented and well known. QGC has never been made accountable for desecrating the site.

Greg and Joanne Vines' story – Wallumbilla, Qld *(2.7)*

Greg and Joanne Vines battled gas giant Santos for nearly two years over the company's push to lay a second pipeline through the Vines' property in south-west Queensland for coal seam gas (CSG). The couple were worried about the weeds a trencher and vehicles would bring to their property as the machinery would have been in areas of parthenium infestation, a toxic plant that impacts heavily on pastoral production. Despite repeated requests the company was unable to provide the Vines with adequate documentation to prove the trencher was weed free. The Vines locked their gates in an attempt to keep the trencher off their land and protect their pasture business, but they were threatened with arrest on their own property and had their locked gates cut. Their fight with Santos has taken a heavy toll. Fracking and unconventional gas has changed their lives, for the worse. 'Blatant disregard for people'

USA experience

There is extensive experience from USA of farmers living in areas subject to fracking. Farmers can't use the water, which catches on fire, and it is possible to have explosions in the house if it is not kept open. There are immense health issues, and children are most susceptible. Some farmers have been bought out by the gas companies, but they must sign confidentiality agreements, so they can't talk openly. A clear conclusion is that agriculture and gas production cannot co-exist.

Negotiations with Kimberley traditional owners
(1.5 and 1.9 A fractured State, and an Excerpt from A Fractured State.
https://www.dontfrackwa.com.au/2017/12/18/afracturedstate/
https://www.facebook.com/frackfreewa/videos/1038894279581650/)

A traditional landowner, Mitch Torres, recounted her experience at a negotiation meeting with a gas company, where the company representatives mislead the indigenous people by saying the chemicals used in fracking were similar to those used in jelly beans. The indigenous participants had quite a different view about fracking when it was later explained correctly.

Misrepresenting tight gas as conventional

Gas companies have been known to misrepresent tight gas as 'conventional' in the past.

- Metgasco misrepresented the drilling planned at Bentley in NSW, obtaining an approval for conventional drilling, when it was in fact unconventional tight sands gas that is being sought.
- In South West WA, companies claim they are targetting conventional gas, when it is tight sandstone and limestone in the area. The company which originally applied for the gas licence over Capel, Boyanup and Dardanup was called 'Unconventional Resources Pty Ltd'. After community protest, they changed their name to Bunbury Energy.
- In the Mid West, the Waitsia field is being heralded as the biggest conventional gas find in about 40 years. But the company has admitted they would start with 20 wells in 50 square kilometres. There is also tight Gas in exactly the same spot, so it is possible they will develop that eventually too. They will have the land access by then.

Views of some people who work, or have worked, in the unconventional gas industry

While the leaders of the gas industry claim that fracking is safe, and the industry has credibility, it is significant the number of people who work or have worked in the industry who have different views. Unfortunately, many are unable to speak publicly for fear of losing their jobs. Concerns from those involved reinforces doubts about the credibility of the industry.

Some examples of people that we can name, who are experienced in the mining industry but are now critics of unconventional gas production, include:

- Jessica Shaw: Current State MP for Swan Hills, previously worked in resources and energy
- Peter Lindsay: Former CSG industry regulator, Qld Government (DERM) (1.26)
- Prof Anthony Ingraffea: Currently Cornell University, ex consultant and researcher with oil and gas industry

2.3 Industry credibility? Documentaries

A number of documentaries have been produced by reputable TV networks and production companies outlining the truth about unconventional gas production and its impacts.

- Lock The Gate: A fractured State *(1.5)*
- Australia's NOW Government – Fracking destroying our country *(2.8)*
- The Gas Rush: ABC's 4 Corners Feb 2010 *(2.9)*
- Undermined: Nine's 60 Minutes 14 May 2010 *(2.10)*
- Voices from Gasfields – it started with just one well *(2.11)*
- Food Security and Australia's Regional Way of Life: Coal Seam Gas: Alan Jones - National Press Club Address 19 October 2011 *(2.12)*
- Coal Seam Gas: Channel 10 'The Project' 21 Feb 2013 *(2.13)*
- Fracking an inconvenient truth 17 Aug 2013 *(2.14)*
- Exposing the real price of the US fracking industry *(2.15)*
- Water on fire – Marcellus shale reality *(2.16)*

3. BUSTING INDUSTRY MYTHS

References (1.2, 1.3, 3.1, 3.2, 3.3)

3.1 Myth: "We've been fracking for years without adverse consequences"

Response

- Fracking techniques, and the associated risks, have changed over time.
- In WA, hydraulic fracturing has mainly been applied to enhance production in *conventional* oil and gas reservoirs with vertical wells.
- Fracking for *unconventional* gas in WA only commenced in the last 15 years and only a handful of wells have been fracked in that time.
- Fracking for unconventional gas is vastly different to the techniques used in conventional gas extraction
    - it involves high volume "slickwater" hydraulic fracturing with horizontal drilling, rather than vertical drilling for conventional gas..
    - it uses significant quantities of a large variety of chemicals
    - it requires massive volumes of water and produces large volumes of toxic wastewater
    - much higher pressures must be applied to the well to undertake a frack

- The entire shale gas production process requires industrialisation of vast areas of land with ever-expanding networks of multi-well pads, gas and water pipelines, access roads, treatment plants, compressor stations, and toxic wastewater ponds.

3.2 Myth: "Fracking for shale gas is safer than for CSG"

The industry claims that the depth of shale gas deposits (typically 3-5km under the ground) means there is less risk to groundwater from fracking than when fracking for CSG, which is extracted from shallower coal seams which are closer to underground aquifers.

Response

- Shale gas wells are, if anything, more likely to fail than coal seam gas wells due to the greater pressures required to fracture shale (which is extremely hard) compared to fracturing coal seams.
- The greater pressure required places the well infrastructure under greater strain and therefore increases the chance of failure of well casing and integrity.
- As shale gas wells must pass through potable underground aquifers, well failure can lead to contamination of these water sources and upward migration of fracking fluids and gas.
- Because shale wells are generally deeper and longer, they are more difficult to construct, and with added complexity comes greater chance of failure.
- Fracking for shale gas also uses much larger quantities of water and chemicals than fracking for CSG, increasing the potential for depletion of water resources and chemical contamination.
- Whilst only a proportion of CSG wells need to be fracked (10-40%), *all* shale gas wells require fracking to extract commercial quantities of gas.

3.3 Myth: "Fracking can be done safely, if it is regulated appropriately"

Response

- There is growing evidence to show that even strict regulations are simply not capable of preventing harm.
- Industry studies and independent analyses indicate inherent engineering problems including uncontrolled and unpredictable fracturing, induced seismicity leading to an increase in earth tremors, plus well casing problems, infrastructure integrity issues and leaks that cannot be prevented despite apparent 'best practice' regulations.
- If a shale gas industry is established in the Kimberley and Mid-West regions, appropriate monitoring and compliance is unlikely due to resource constraints in Government Departments, the large number of production wells required and the remote locations of many of these wells.

3.4 Myth: "There's no real risk of wells leaking, as well casings are thick and made of concrete and steel"

Response *(3.4, 3.5, 3.6, 3.7)*

- 'World's best practice' well construction just isn't enough to stop wells leaking.
- A detailed study in Pennsylvania found that more than 6% of gas wells leaked in the first year of operation and up to 75 per cent of existing wells could have some form of integrity failure.

3.5 Myth: "The chemicals used can be found in household products"

Response *(3.8)*

- While some chemicals can be found in home products, they may not be safe for humans and the environment if they make their way into water supplies, particularly in the large quantities used in fracking fluids and in various untested combinations with numerous other chemicals.
- Many fracking chemicals are known to be toxic and many others have not been assessed for their long-term impacts on the environment and human health. Fracking compounds used in Australia have been shown to include many hazardous substances, including carcinogens, neurotoxins, reproductive toxins, irritants/sensitisers, and endocrine disruptors. It is also worth noting that some of these chemicals are toxic even in extremely small concentrations.

3.6 Myth: "Only a small amount of chemicals is used in fracking"

Response

- While chemical additives make up only 0.5 - 2% of fracking fluids, it translates to very large *actual* quantities of chemical additives.
- A typical 15 million litre fracturing operation would use from 80 to 330 tons of chemicals.

3.7 Myth: "The gas industry will create local jobs"

Response *(3.9, 3.10)*

- The oil and gas industry is one of the smallest employers in Australia, employing less than 0.2% of the Australian workforce. (Just 22,000 out of a total workforce of around 12.5million. Bunnings employs 40,000 workers across its stores in Australia and NZ.)
- The majority of gas industry jobs are required for the short construction phase only.
- Local employment opportunities are minimal with the majority of skilled workers being fly-in-fly-out workers. Those employed locally are usually skilled workers poached from local industries that have spent years training them, leaving these industries short of labour and unable to compete with gas industry wage rates.
- In Queensland, with the 4 year construction phase of the CSG production gasfields in the Surat Basin now coming to an end, the gas 'boom-towns' of Dalby, Roma and Chinchilla are experiencing a crippling economic down turn with associated job losses and loss of revenue for local businesses.

3.8 Myth: "The gas industry will revive ailing rural economies"

Response *(3.11)*

The most advanced unconventional gas development in Australia, in Queensland's Darling Downs region, shows that gas development negatively impacts all sectors of local industry other than the gas industry itself. While the industry employs some people, and some businesses profit by servicing the mining industry, overall it is a small, short term employer that drives up costs for local businesses and negatively impacts the community. People working in local businesses, agriculture, government and the community sector consistently believed CSG development and mining had led to a deterioration of the economy of the region.

3.9 Myth: "Unconventional gas will provide tremendous economic benefits"

Response

The gas industry has been prolific in putting out exaggerated claims about CSG's economic benefits while at the same time staying almost completely silent on the health and environmental risks. The economic benefits are likely to be relatively small, and a lot more work needs to be done to assess the health and environmental risks. There is little for Australia to gain by rushing into an expansion of unconventional gas operations.

3.10 Myth: "Unconventional gas will reduce greenhouse emissions"

Response

- Researchers have measured elevated levels of methane and other gases in Queensland gas fields.
- Methane is about 34 times as potent as a climate change-fueling greenhouse gas than carbon dioxide over a span of 100 years. Over 20 years, it's 86 times more potent. Of all the greenhouse gases emitted by humans worldwide, methane contributes more than 40 percent of all radiative forcing, a measure of trapped heat in the atmosphere and a measuring stick of a changing climate. *(3.4)*

4. CHEMICALS USED IN HYDRAULIC FRACKING

4.1 Information from Inquiry background paper *(1.25)*

Hydraulic fracture stimulation fluid is generally composed of around 90 per cent water, with 9.5% sand or ceramic beads, and 0.5% chemicals. Chemicals are added to improve the transportation of the proppant, prevent the growth of bacteria, reduce mineral clogging and prevent well corrosion over time. In Western Australia, all chemicals to be used need government approval.

Type of chemicals	Purpose	Examples
Proppants	Proppant or tiny solids (e.g. sand) are used to physically hold open tiny rock fractures or cracks and to allow fluids and gas to move around them	Crystalline silica (quartz), crystalline silica (cristobalite), ceramic
Biocides	Limits the growth of bacteria in fluids which may reduce flow rates and contribute to well corrosion	Glutaraldehyde, sodium hypochlorite, quaternary ammonium chlorides
Oxygen scavengers and	Removes or deactivates oxygen and other corrosive material in fluids which contribute to well corrosion	Zinc carbonate, isopropanol, methanol, formic acid, gelatine, sodium sulfite

corrosion inhibitors		
pH control, buffers, salts, stabilisers, solvents	Adjusts the chemical and physical properties of the fluid to achieve optimal flow rates	Potassium carbonate, sodium acetate, sodium carbonate (soda ash), hydrochloric acid, acetic acid, ethylene glycol, magnesium silicate hydrate (talc), magnesium oxide
Friction reducer	Reduces the friction forces of fluids being pumped into the well to increase flow rates	Polyacrylamide, hydrotreated light petroleum distillate, methanol, ethylene glycol, sodium lignosulphate, glycerine
Clay inhibition, stabiliser	Counters clay swelling in the well when drilling and in the rocks being fractured to optimise drilling and flow rates	Sodium chloride, isopropanol, tetramethyl ammonium chloride, potassium chloride, magnesium nitrate, silica gel
Gelling agents, binders, cross linker	Increases the thickness of fluids which allows more proppant to be carried into rock fractures	Bentonite, boric acid, triethanolamine, sodium chloride, hydrogen peroxide, sodium sulphate, guar gum, xanthan gum
Breakers	Breaks down the gelling agents and releases the proppant into rock fractures	Sodium persulfate, hemicellulose enzyme, ammonium persulphate, magnesium oxide
Surfactants	Reduces the stickiness of fluids to improve flow rates	2-Butoxyethanol, ethanol, lauryl sulphate

4.2 Risks of chemicals *(4.3, 4.2, 4.1, 1.6)*

Fracturing fluids can move through the environment and come into contact with humans in a number of ways, including surface leaks, spills, releases from holding tanks, poor well construction, leaks and accidents during transportation of fluids, flowback and produced water to and from the well pad, and run-off during blowouts, storms, and flooding events.

Western Australia requires companies to disclose the list of chemicals used in fracking. However, hardly any of the chemicals used in fracking operations have been assessed by chemical safety regulator the National Industrial Chemicals Notification and Assessment Scheme (NICNAS). And little is known about the 'synergistic' effects of these chemicals – how they behave when mixed with other natural and introduced chemicals in a high pressure, high temperature environment. Many chemicals have not been assessed for their long-term impacts on the environment and human health. In Australia, of the 23 identified as commonly used 'fracking' chemicals, only 2 had been assessed by the national regulator, National Industrial Chemicals Notification and Assessment Scheme (NICNAS) and neither for their use in coal seam gas *(4.5)*.

Flowback refers to the 15 - 80% of the hydraulic fluid mixture that returns to the surface. It contains some of the chemicals injected, plus contaminants from the coal seam like BTEX, (benzene, toluene, ethylbenzene, xylene), polycyclic aromatic hydrocarbons (PAHs), naturally occurring radioactive materials (NORMs), heavy metals and other volatile organic compounds (VOCs). Samples taken from the top of the well-head, a day after the well had been 'fracked', detected VOCs (bromodichloromethane, bromoform, chloroform and dibromochloromethane), as well as benzene and chromium, copper, nickel, zinc *(4.6)*.

Produced water, waste water produced along with the gas, is contaminated with heavy metals, NORMs, fracking or drilling chemicals, volatile and semi volatile organic compounds and high concentrations of salts. For a typical shale gas well, daily produced water volumes range from 300 – 4,500 litres *(4.7)*. The amount of produced water from a coal seam gas well varies between 0.1 - 0.8 megalitres (ML) per day *(4.8)*.

Benzene, Toluene, Ethylbenzene, Xylene or BTEX are volatile organic compounds (VOCs) found naturally in crude oil, coal and gas deposits and associated groundwater *(4.9)*. While they are prohibited from use in WA, they can be released from the coal seam via drill holes or fractures *(4.10)*. The short term health effects of BTEX include skin, eye / nose irritation, dizziness, headache, loss of coordination and impacts to respiratory system. Chronic exposure can result in damage to kidneys, liver and blood system. Benzene is strongly linked with leukemia *(4.11)* and diseases such non-Hodgkin's lymphoma (NHL).

Other VOCs can also be toxic. Some are known to cause cancer in animals (e.g. methylene chloride), or in humans (e.g. formaldehyde) or are suspected human carcinogens (e.g. chloroform, bromodichloromethane). VOCs are also key ingredients in forming ozone (smog), which is linked to asthma attacks, and other serious health effects. VOC exposure may result in eye, nose, and throat irritation; headaches, visual disorders, memory impairment, loss of coordination, nausea, damage to liver, kidney, and central nervous system *(4.12)*.

Naturally occurring radioactive materials (NORMs) are found in coal seams and shale, e.g. uranium, thorium, radium-228 and radium-226 *(4.13)*. The radioactive material can be released through the drilling process in drill cuttings/muds and flowback water. Radium is a known carcinogen and exposure can result in increased incidence of bone, liver and breast cancer. Radon, a decay product of radium can cause lung cancer. The level

of reported radioactivity varies significantly, depending on the radioactivity of the reservoir rock and the salinity of the water co-produced from the well. The higher the salinity the more NORM is likely to be mobilized. Since salinity often increase with the age of a well, old wells tend to exhibit higher NORM levels than younger ones *(4.14)*.

In Australia, BTEX chemicals have been found in 5 out of 14 monitoring wells at Arrow Energy's gas fields, near Dalby, Queensland. Benzene was detected at levels 6 and 15 times the Australian drinking water standard (0.001 milligram per litre /1ppb) *(4.15)*. Toluene and methane have been detected in a private drinking water bore in Queensland *(4.16)*.

No health impact assessment is required for gas fracking under WA legislation, and no baseline health studies are required in communities before fracking is approved. This makes it is very difficult to explore connections between fracking and any future health impacts, should such impacts occur. Many of the chemical compounds used in the fracturing process lack scientifically based maximum contaminant levels, making it more difficult to quantify their public health risks.

4.3 Misleading information from gas industry

The industry and supporters of fracking argue that only a small amount of chemicals is used in fracking *(1.25, 4.17, 4.18, 4.19)*, and the chemicals used can be found in household products *(4.21, 4.19, 4.18)*.

While chemical additives make up less than 2% of the fracking fluid, this still translates to large quantities. A typical 15 million litre fracturing operation would use from 80 to 330 tons of chemicals *(4.20)*. A well may be 'fracked' a number of times. An estimated 18,500 kilograms were used in a coal seam gas fracking in Australia with up to 40% not recovered *(4.4)*.

Claiming that fracking fluids are safe because some are used in household products is a misleading and devious argument. While some chemicals may be harmless when used appropriately in the home at low concentrations, it does not follow that they are safe in the amount and processes used in fracking. Even common salt can be harmful used in the wrong way. These arguments also ignore the use of other toxic and dangerous chemicals.

5. WELL INTEGRITY AND FAILURE

References (1.3, 5.1, 5.2, 5.3, 5.4)

5.1 Do modern gas wells leak?

- There is growing evidence to show that even strict regulations are simply not capable of preventing harm and that 'world's best practice' well construction just isn't enough to stop wells leaking.
- Studies consistently show that oil and gas wells routinely leak, allowing for the migration of natural gas and potentially other substances into groundwater and/or the atmosphere. Recent research suggests that the act of fracking itself may induce pathways for leaks.
- According to Schlumberger, one of the world's largest companies specializing in fracking, about 5 per cent of wells leak immediately, 50 per cent leak after 15 years, and 60 percent leak after 30 years *(5.5)*.
- Some incidents (as well as breaches of approval processes and conditions) have come to light only because of whistle-blowers within government departments and gas companies.

5.2 Well integrity failure risks

An industry paper in Oilfield Review 2003, published by Schlumberger *(5.5)*, admits:

- 'Techniques for locating, exploiting and transporting natural gas to our homes and industries have had huge advances since the early days. Despite these advances, many of today's wells are at risk. Failure to isolate sources of hydrocarbon either early in the well construction process or long after production begins has resulted in abnormally pressured casing strings and leaks of gas into zones that would otherwise not be gas-bearing'.
- 'Since the earliest gas wells, uncontrolled migration of hydrocarbons to the surface has challenged the oil and gas industry. Gas migration, also called annular flow, can lead to sustained casing pressure (SCP). The presence of SCP indicates that there is communication to the annulus from a sustainable pressure source because of inadequate zonal isolation. Annular flow and SCP are significant problems affecting wells in many hydrocarbon-producing regions of the world. By the time a well is 15 years old, there is a 50% probability that it will have measurable SCP in one or more of its casing annuli. However, SCP may be present in wells of any age'.

A 2014 study published in the Proceedings of the National Academy of Sciences of the United States of America provides a useful and more recent overview of the industry and scientific data produced to that date, specifically considering unconventional extraction.

The International Association of Hydrogeologists in 2015 noted in its submission to the Hawke Inquiry *(5.6)*:

- Deterioration and failure of improperly decommissioned wells will, over time, result in long term release of oil and/or gas into the environment. Pathways in the annulus may develop that would allow oil, gas, and brine to move vertically across geologic formations and contaminate groundwater. Substances dissolved in the brine may include those that occur naturally in the shale formations and others injected during the hydraulic fracturing process.
- Upwardly migrating gas, known as stray gas, represents an explosion hazard if not properly vented away from buildings and drinking water wells.
- The risk that annular pathways will develop increases over time as chemical, mechanical, and thermal stresses causes deterioration of well structures and components.
- Failure modes of improperly abandoned wells include the formation of cracks in the cement casing or packers, corrosion of steel production casing, faulty valves, and leaking temporary plugs or surface caps.

5.3 Frequency of well failure

- Estimates of well failure rates vary although the more conservative well failure rates found in the literature are between 4.6% and 8.9%. *(5.7)*
- Davies *et al.* (2014) *(5.7)* reviewed reliable databases of well integrity from around the world and found that failure rates were highly variable from 1.9 to 75 per cent, with the Marcellus Shale well failure rate at 6.3 per cent, for example. They found a greater proportion of failure in injection wells (such as those required for hydraulic stimulation) when compared to production only wells (such as in traditional oil/gas fields). They concluded it is not possible to have zero per cent well integrity failure. They also noted that the amount of information retained by oil and gas companies and regulators was not sufficient for an exhaustive study, and were not released even if available.
- A 2009 study from Alberta, Canada of more than 315,000 oil, gas and injection wells of various ages, showed that 'injection wells' into which liquids or gases are pumped are 2-3 times more likely to leak than conventional 'production wells'. The same study found that horizontal or inclined wells are observed to have significantly higher failure rates than vertical wells. It is universally acknowledged that problems with casing centralisation and cement slumping in horizontal or inclined wells may contribute to the increased incidence of leakage.
- Data from Pennsylvania's Department of Environmental Protection (DEP) for 2000-2012 show over nine percent of shale gas wells drilled in the state's north eastern counties leaking within the first five years.
- According to state inspections of all 6,000 wells drilled in Pennsylvania's Marcellus Shale before 2013, six to ten per cent of them leaked natural gas, with the rate of leakage increasing over time. The rate was six per cent in 2010 (97 well failures out of 1,609 wells drilled); 7.1 per cent in 2011 (140 well failures out of 1,972 wells drilled); and 8.9 percent in 2012 (120 well failures out of 1,346 wells drilled) *(5.13)*. Wells with horizontal underground arms were four times more likely to fail than vertical wells in the same area.
- A 2011 report from Pennsylvania, USA, showed about 75% of groundwater wells sampled within 1 kilometre of gas drilling in the Marcellus shale were contaminated with methane from the deep shale formations. Isotopic fingerprinting of the methane indicated that the deep shale was the source of contaminations, rather than biologically derived methane.
- In 2016, an interdisciplinary team led by University of Colorado researchers found methane in 42 water wells in the intensely drilled Denver-Julesburg Basin where high volume, horizontal fracking operations began in 2010. Of the 42 affected wells, 11 had already been identified by state regulators as suffering from 'barrier failures' *(5.8)*.
- In 2014, University of Waterloo researchers warned that natural gas seeping from 500,000 wellbores in Canada represented 'a threat to environment and public safety' due to groundwater contamination, greenhouse gas emissions, and explosion risks. Ten percent of all active and suspended gas wells in British Columbia now leak methane, and some hydraulically fractured shale gas wells in that province have become 'super methane emitters', spewing as much as 2,000 kilograms of methane a year *(5.9, 5.10)*.
- In 2014, the Council of Canadian Academies identified inherent problems with well integrity as one of its top concerns about unconventional drilling and fracking. According to one expert panel, 'the greatest threat to groundwater is gas leakage from wells from which even existing best practices cannot assure long-term prevention.' Cement may crack, shrink, or become deformed over time, thereby reducing the tightness of the seal around the well and allowing the fluids and gases to escape into the annulus between casing and rock and thus to the surface *(5.11)*.

- In 2015, the New York State Department of Environmental Conservation stated 'there is a risk that well integrity can fail, especially over time, and questions have arisen about whether high-volume hydraulic fracturing can cause seismic changes which could potentially result in fracturing fluid migration through abandoned wells or existing fissures and faults. Thus, high-volume hydraulic fracturing could result in significant adverse impacts to water resources from well construction and fracturing fluid migration' (5.12).
- Professor Anthony Ingraffea (Cornell State University, and previously a consultant and researcher in the oil and gas industry) showed leaking gas wells in a video *(5.4)*.
  An analysis of industry literature showed:
  - In 340,000 oil and gas well in Canada, 15-16% of conventional wells leak and 65% of modern deviated wells leak.
  - 35% of 1.8million global wells leak – 5% in young wells and 35% in old wells.

  An analysis of public 75,000 inspection reports in Pennsylvania between 2000-2013 showed:
  - Leakage in old wells pre 2009 of 13% for unconventional wells and 20% for conventional wells.
  - Leakage in modern wells post 2009 were better, but still 12% in unconventional wells.

5.4 Incidents in Australia

- Peter Lindsay, a former CSG industry regulator in the Queensland Government (DERM) claimed that some of the infrastructure in Queensland is already failing *(1.3)*.

- An example of the effect of corrosive water on cementing and casing is provided by deep oil exploration wells drilled in the Perdika/Great Artesian Basin in NT in the 1960s. Now, some fifty years later, the steel casing has almost entirely corroded away, resulting in inter-aquifer contamination. This well required expensive rehabilitation works to stem artesian flow. This single bore cost the Northern Territory and Commonwealth Governments $500,000 to plug as the company responsible for the well was insolvent. This example highlights the issue of operator insolvency due to the boom and bust cycles of oil and gas development which complicate efforts to hold liable parties responsible and provide for timely environmental reclamation.
- Spills have occurred in Australian CSG operations. A scalded area in NSW's Pilliga Forest has not recovered almost 10 years after a wastewater spill by Eastern Star Gas. Wastewater leaking from a pond in the Pilliga (on tenements that Santos bought from Eastern Star Gas) resulted in the contamination of groundwater with uranium and arsenic.
- There have been numerous reports of water contamination and health impacts by people living close to Australian CSG fields in Camden, NSW and on the Western Darling Downs in Queensland. They are similar in nature to reports in the United States.
- In Western Australia a well in the Whicher Range, east of Margaret River was fracked in 2004 using diesel as the fracking fluid as other fluids caused the clay soils to swell. The experimental technique failed and more than half of the 1.2M litres of diesel remains trapped down the well.

5.5 Long-Term Well Integrity and well abandonment

- Once production ceases wells are closed using cementing and capping.
- It is not possible to have a zero per cent well failure rate during production let alone post abandonment.
- Wells deteriorate with age, and they remain after they go out of production.
- If Regulations only apply to the title holder during production, the rest of the community, who do not get any financial benefit, will have to bear the costs of maintaining the wells forever.

5.6 Industry reports of risks *(1.7)*

The US Securities and Exchange Commission's website reviews annual forms filed by unconventional gas industry that identify the risks associated with their operations. It is a requirement for companies to disclose 'the most significant factors that make the offering speculative or risky'.

- Oil and natural gas companies have routinely warned of drilling's serious risks. Such hazards and risks include leaks, spills, release of pollutants, flooding which could affect operations in low-lying areas, explosions, blowouts, environmental damage, property damage, injury, and death.
- Chesapeake Energy Corporation has stated that 'horizontal and deep drilling activities involve greater risk of mechanical problems than vertical and shallow drilling operations.'
- The companies also routinely warn of inadequate insurance to cover drilling harms.

The risks identified by these oil and gas companies are consistent with those identified in the exhaustive scientific studies undertaken.

6. IMPACTS ON WATER - Ground water and Surface water

6.1 Contamination of aquifers and surface water

Water and chemical use and wastewater production from unconventional gas mining places WA's vital water resources at risk from contamination and depletion.

There are numerous examples of peer-reviewed literature showing serious unconventional gas impacts on groundwater in the USA, regardless of the industry's insistence that there are no impacts. This should provide a warning to Western Australia that impacts do occur and are usually found by third parties *(5.2).*

The gas industry claims that because shale and tight gas extraction involves deeper rock layers, they are safer than gas extraction from shallow coal seams. But according to a European Commission Report *(6.1)* there is an overall high risk of ground and surface water contamination resulting from fracking.

Aquifers can be contaminated by fracking:
- through water seeping from leaking wells
- from faults induced by fracking
- from surface spills of produced water involved in the fracking process
- contaminated water from the gas source per se. *(1.6, 6.2, 6.3, 6.4).*

After fracking at each well, the large volumes of hazardous flow back fluid must be stored and disposed of. Surface water pollution can occur:
- when there are accidental spills of fluids or solids at the surface
- when well blow outs occur
- through discharge of insufficiently treated waste water onto land surfaces or into waterways *(1.6, 6.2, 6.3, 6.4).*

Flowback fluids contain hazardous fracking chemicals as well as naturally occurring toxic substances released from target geological zones such as:
- methane
- BTEX (benzene, toluene, ethylbenzene, xylene)
- polycyclic aromatic hydrocarbons (PAHs)
- naturally occurring radioactive materials (NORMs)
- heavy metals and other volatile organic compounds (VOCs) *(6.5, 6.6, 6.7, 6.8).*

6.2 Contamination of ground water and drinking water in USA – Results of studies

- In the US state of Pennsylvania alone, more than 240 private drinking water wells have been contaminated or have dried up as the result of drilling and fracking operations over a seven-year period. There has been widespread drinking water contamination in 550 water samples throughout the heavily drilled Barnett Shale region in northern Texas *(6.9).*
- In March 2016 a USA federal jury awarded two Dimock, Pennsylvania couples $4.24 million after finding an oil and gas company responsible for contaminating their well water during drilling and fracking activities *(6.31).*
- The presence of a fracking-related solvent in private drinking water wells near drilling and fracking operations *(6.10).*
- Elevated levels of methane have been found in groundwater discharging into a stream near fracking operations in Pennsylvania along with high levels of methane in nearby private water wells due to a defective casing *(6.11).*
- Comparison of pre-drill and post-drill data on water quality found changes in water chemistry that coincided with the advent of drilling and fracking activities. Methane was also detected in most houses tested in this study *(6.12).*
- 56 of the 143 well owners surveyed in south-western Pennsylvania in 2015 indicated changes in water quality or quantity. Chloride, sulphate, nitrate, sodium, calcium, magnesium, iron, manganese and strontium were commonly found, with 25 households exceeding the secondary maximum contaminate level for manganese. Methane was detected in 14 of the 18 houses tested. Since 2009, 65 horizontal wells were drilled within a 4 km radius of the community and each well was stimulated on average with 3.5 million gallons of fluids *(6.13).*
- A 2016 study by Stanford University scientists determined that fracking and related oil and gas operations have contaminated drinking water in the town of Pavillion, Wyoming where residents have long complained about foul-tasting water *(6.14, 6.15).*

- Analysis, in the journal *Environmental Science & Technology, 2017*, revealed 6,648 spills from the fracking industry from just four states - Colorado, New Mexico, North Dakota and Pennsylvania, in 10 years *(6.16)*. The researchers determined that up to 16 percent of fracked oil and gas wells spill hydrocarbons, chemically laden water, fracking fluids and other substances.
- Analysis of published data (Vengosh *et al.* 2014, *6.4*) showed evidence of stray gas contamination, surface water impacts in areas of intensive shale gas development, and the accumulation of radium isotopes and other contaminants in some disposal and spill sites.
- Recent research from the USA found higher levels of arsenic and other heavy metals, plus higher salinity, in water bores which were less than 3km from shale gas wells *(6.17)*. Other research has found increased methane concentrations in water bores closer to shale gas wells, creating an explosion hazard *(6.18)*.
- Studies from Duke University in the US have found high levels of radioactivity in a creek used for disposal of wastewater *(6.19)*.
- Using geochemical and isotopic tracers to identify the unique chemical fingerprint of Bakken region brines, a 2016 Duke University study found that accidental spills of fracking wastewater have contaminated surface water and soils throughout North Dakota where more than 9,700 wells have been drilled in the past decade. Contaminants included salts as well as lead, selenium, and vanadium. In the polluted streams, levels of contaminants often exceeded federal drinking water guidelines. Soils at spill sites showed elevated levels of radium *(6.20)*. Contaminants were observed in spill sites up to 4 years following the spill events, and it was concluded there is clear evidence of direct water contamination from fracking *(6.21)*.
- High levels of iodide, bromide, and ammonium were found in samples of wastewater from fracking operations in two US shale formations. The same chemicals were found when fracking wastewater was discharged into rivers and streams at three treatment sites in Pennsylvania and during an accidental spill in West Virginia *(6.22)*.

6.3 Experiences in Australia

- A review by Klohn Crippen Berger Free *(6.23)* for the Queensland Department of Natural Resources and Mines concluded that gas from CSG development can even occur in water bores that do not experience a water level decline from CSG development. These impacts have also been reported by numerous landholders who suffered bore impairment from excess gas.
- There have been numerous reports of water contamination and health impacts by people living close to Australian CSG fields in Camden, NSW and on the Western Darling Downs in Queensland. They are similar in nature to reports in the United States *(6.24)*.
- In Australia, Gavin Mudd from Monash University showed gas bubbling from the Condamine river. The industry claims this was not due to Coal Seam Gas (1.3)!
- Spills have also occurred in Australian CSG operations. A scalded area in NSW's Pilliga Forest has not recovered almost 10 years after a wastewater spill by Eastern Star Gas. Wastewater leaking from a pond in the Pilliga (on tenements that Santos bought from Eastern Star Gas) resulted in the contamination of groundwater with uranium and arsenic *(6.24)*.
- In May 2013 some 240,000 litres of oil were spilled at a conventional well in Santos's Zeus field west of Thargomindah. Despite clear evidence, the Queensland environment department chose not to prosecute Santos for this breach of conditions *(6.24)*.
- In the Northern Territory, Origin Energy has used unlined pits for the storage of waste water, and then has failed to responsibly remove all contaminants, leaving polluted water in areas that then flooded. Photos are available showing the state that a shale gas pad was left in after gas fracking activities stopped in 2015 *(1.6)*.
- In Australia, during the exploration phase of coal seam gas development in NSW, there have been a number of recorded contamination events around the state. Santos' CSG operations in the Forest region of NW NSW recorded at least 20 coal seam gas waste water spills and continuing leaks from evaporation ponds. Santos' records show spills and leaks from all parts of the operations, from evaporation ponds, pipelines, the wastewater treatment facilities and at well sites *(6.25)*.
- Eastern Star Gas was responsible for pollution offences in NSW. The EPA issued two penalty notices with fines of $1,500 each to Eastern Star Gas for discharging polluted water containing high levels of salt into Bohena Creek in March and November 2010 *(6.26)*.
- In 2014, Santos was found guilty of polluting an aquifer in the Pilliga Forest *(6.27)* with radioactive uranium 20 times safe levels as well as toxic heavy metals *(6.28)*.
- A spill in June 2011 in the Pilliga resulted in 10,000 litres of untreated toxic coal seam gas wastewater containing a mix of heavy metals (including arsenic, lead and chromium), salts and petrochemicals that killed vegetation and wildlife. Santos was found guilty in the NSW Land and Environment Court and fined $52,000 *(6.29)*.

7. IMPACTS ON AIR

Unconventional gas mining and fracking will lead to large deliberate and fugitive emissions of methane, adding to climate change *(1.6)*.

7.1 Gas emissions associated with fracking

- Damien Maher, a Senior Research Scientist with Southern Cross University, showed that methane levels surrounding gas mines were consistently higher – up to 3 times background values *(1.2)*. It was previously shown that in the Condamine River area considerable atmospheric methane levels were associated with the CSG development in the Surat Basin area where fracking had occurred, evidenced by bubbling of methane in the Condamine River *(7.1)*.
- It is increasingly being recognised that volatile chemicals used in the fracking process and the gases released pose health risks to workers and people living nearby. Volatile organic compounds and hydrocarbons (including the carcinogen benzene) are released during unconventional gas operations, from venting, holding tanks, ponds, compressors and other infrastructure. Some of these mix with nitrous oxides from diesel-fuelled machinery, creating ground level ozone – a significant respiratory irritant. (*Doctors for the Environment Australia, (7.2)*.
- Emissions measured near gas wells include the BTEX compounds - benzene, toluene, ethylbenzene, and xylene – of which benzene is a contributor to lifetime excess cancer risk *(7.3)*. Emissions of formaldehyde, hydrogen sulphide, acrylonitrile, methylene chloride, sulphuric oxide, and volatile organic compounds (VOCs) are recorded near gas drilling, and all have potential adverse health effects. Trimethyl-benzenes, aliphatic hydrocarbons, and xylenes may cause neurological effects, and can irritate the respiratory system and mucous membranes *(7.4)*.
- A 2012 study detected 44 hazardous air pollutants at unconventional gas well sites *(7.5)*, whilst other recent USA studies *(7.6)* show that drilling and fracking emissions often contain strikingly high levels of benzene. The NYS Department of Health Public Health Review (the NYS Review) noted that 'studies provide evidence of uncontrolled methane leakage, emissions of other volatile organic chemicals, and particulate matter from well pads and natural-gas infrastructure as well as intermittently high dust and benzene concentrations'.
- Exposure to a range of harmful substances associated with unconventional gas operations constitutes a serious health hazard to those working on and living adjacent to or surrounded by unconventional gas development *(7.7)*. Emissions can contribute to community odour problems and respiratory health impacts such as asthma.
- The Bakken shale emits 250,000 tons of ethane per year *(7.8)*. Emissions observed in this single region are 10 to 100 times larger than reported in inventories. Ethane is a gas that affects climate and decreases air quality.

7.2 Recorded Methane Venting in Australia (7.9, 7.10)

- An independent energy advisor, Tim Forcey, used an FLIR GF-320 infrared camera in the Queensland coal seam gasfields in 2017 to demonstrate substantial gas emissions from vents:
    - Continuous releases of methane from "high-point vents" on water-gathering pipelines
    - Intermittent releases of methane from other gas field equipment
    - Methane bubbling from the Condamine River and Wambo Creek.
- This report includes videos that amply demonstrate these emissions.
- Given the very large number of high point vents and other gas field equipment vents which are located throughout the Queensland CSG fields, if the scale of venting detected by the FLIR camera was replicated, it would represent a potentially vast, unmeasured contribution to global warming.

Arcadia Valley, Qld, in 2015, where flare stacks from wells looked to be just hundreds of metres apart.

7.3 Industry concerns

Industry reports illustrate the level of concern:

- The industry publication GasTips, World Oil Oilfield Review stated that between 7% and 19% of more than 1000 wells drilled from 2005 to 2007 in western Canada had gas migration along the casing annulus, and 9% to 28% of them had gas leakage through surface casing vents *(7.11).*
- Unintended natural gas migration along production wellbores, even for conventional gas, has been a chronic problem for the oil and gas industry as a result of poor primary cement jobs, particularly in gas wells *(7.12).*
- Brufatto et al (2003)cite USA Mineral Management Service data from the Gulf of Mexico indicating, 'By the time a well is 15 years old, there is a 50% probability that it will have measurable gas build up in one or more of its casing annuli *(7.13).*
- Schlumberger, one of the world's largest companies specialising in fracking, published in its magazine as long ago as 1994: 'Older fields will continue to benefit from the expertise of the corrosion engineer and the constant monitoring required to prevent disaster *(7.14).*

7.4 Climate change:

As climate change is widely considered the major global health threat of this century, fugitive emissions produced from the gas industry are an unacceptable health risk *(7.15).*

Methane is a more powerful greenhouse gas than carbon dioxide – 86 times more powerful when considered over a 20-year timeframe and 34 times more over a 100-year timeframe. large amounts of methane leak into the atmosphere throughout the lifecycle of gas development and production, so unconventional gas is likely as bad or worse for climate change than coal or oil *(7.24).*

A recent review by the Melbourne Energy Institute on methane fugitive emissions from unconventional gasfields in the USA *(7.16)* concluded:

- Actual measurements above USA gasfields have recorded fugitive emissions of up to 17% of production. For comparison, the unconventional gas industry in Australia claims that its fugitive emissions amount to only 0.1% of production *(7.17).*
- 'Top down' methods of measuring fugitive emissions, such as satellite imagery and aerial borne surveys, have revealed methane emissions that are many orders of magnitude greater than emissions recorded from 'bottom up' surveys using ground measurements'.
- It is widely recognized that at more than about 3% leakage, gas is actually more polluting than coal when used to generate electricity *(7.18).*

The Australia Institute showed that emissions from unconventional gas have been severely underestimated in Australia *(7.19).* The current methodology for measuring greenhouse gas emissions from unconventional gas extraction is based on assumed and outdated methane emissions factors, rather than direct measurement of wells, pipelines and other gasfield infrastructure. The estimate used by the Australian Government is 0.058 tonnes of methane leaked per kilotonne of methane produced, or 0.0058%. This estimate is based on a historic USA emissions factor designed for measuring conventional gas emissions and is no longer used in the USA. Actual measurements by 16 peer reviewed research projects, using improved technology to take direct measurements from gas fields in the US, have ranged from 2-17% of production *(7.20).*

The impact of these unaccounted-for methane emissions is seen in recent research showing that USA methane emissions have risen 30% in the last decade. The study used evidence from atmospheric observations to trace the largest rise of these emissions to the central part of the USA, where oil and gas extraction has expanded dramatically over the same time period (7.21).

The Melbourne Energy Institute reported that methane gas migrating to the surface due to coal seam dewatering and depressurisation for coal seam gas production was a potentially significant source of greenhouse gas *(7.22).* It found that migration of methane along existing natural faults and fractures is possible and may increase with continued depressurization by unconventional gas mining. It noted that presence of free methane in water bores can be the direct consequence of depressurisation of the coal seams. The Melbourne Energy Institute also concluded that Australia may be dramatically under-estimating the fugitive methane emissions from unconventional gas.

Bista (2017) from Murdoch University *(7.23)* concluded that greenhouse gas emissions resulting from the development of Western Australia's five onshore gas basins would be equivalent to all other Australian emissions sources combined at 2014 levels each year for 20 years which is the general lifetime of a well. This paper concludes that onshore gas fracking without any control mechanism could not be considered as a transition fuel

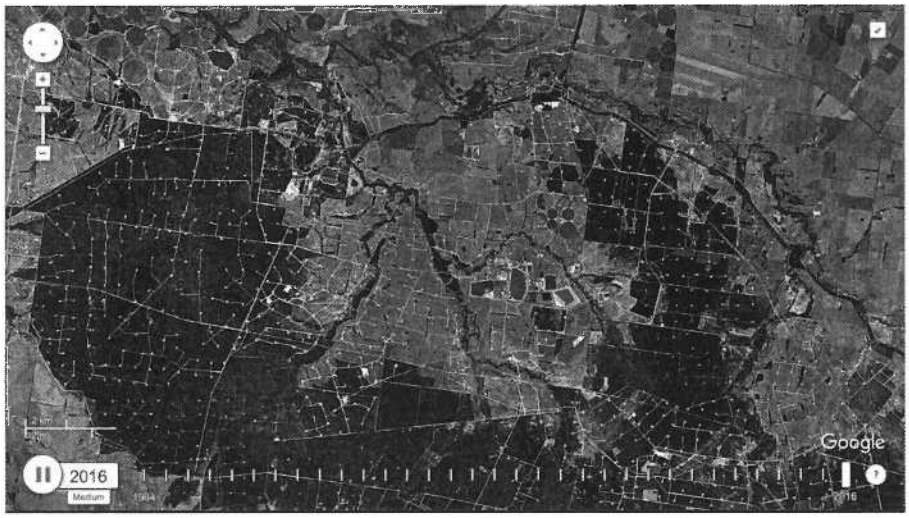
for climate change mitigation in Australia. Fracking emissions could be a highly significant source of greenhouse gas emissions nationally as well as globally.

8. IMPACTS ON LAND

8.1 Transformation of productive land into industrial landscape

The biggest impact on land is the transformation of entire regions of beautiful productive land into an industrial landscape. **It could be argued that this alone is reason to not allow unconventional gas mining.** While the industry claims that the footprint is relatively small, it does not take too much research to realise this is not correct. Much evidence is provided in this paper to support this. The industry will claim that new technologies involving multiple lateral drillings will reduce this footprint, but this is yet to be determined.

The background paper for the WA Inquiry claims that the footprint for unconventional gas will have a smaller footprint than coal seam gas *(8.1)*. It is not appropriate to assume that yet. Australia's former and present Chief Scientists, Professor Chubb and Dr Finkel, have both admitted that Australia's unconventional shale gas industry will have a larger footprint and require considerably more water than CSG. They have highlighted the absolute necessity to undertake detailed studies in an effort to understand the complications that could arise from this industry *(8.2, 8.3)*.



Gas wells on Condamine State Forest and farmland in Queensland, 2016.

8.2 Well Density

The high density of gas wells associated with unconventional gas mining and the impacts on the landscape have been summarised previously in this review – see sections 1.3, 1.8, 1.11, 1.12, 2.2

- In a few years, prime agricultural regions have been transformed into industrial areas through coal seam gas *(1.3)*. In Queensland, 18,000 wells have been approved, and tens of thousands more are planned.
- Estimates suggest that the Kimberley might soon be home to over 100,000 shale gas wells and the Mid West to over 25,000 shale wells *(1.12)*.
- The impact on the land and the industrialisation unconventional gas production creates is neatly demonstrated in a series of 'Before and After' photos of various forest and agricultural areas in Queensland. *A warning from Queensland: http://www.csgfreenorthwest.org.au/qlds_story (1.8)*

It is important to note that although conventional oil and gas production can have many of the same types of water resource and environmental impacts (spills, well integrity failure etc.), the well density in an unconventional oil/gas field, when compared to a conventional oil/gas field, is hundreds to thousands of times higher *(5.2)*.

Early in the development of the tight gas industry, hydraulic stimulation was done on vertical wells so a higher well density was required. However, since the development and reduced cost of horizontal drilling techniques, lower well densities are more typical with multiple wells starting from the same drilling site or pad. Although this reduces pad and well density in the landscape, it potentially puts greater pressure on the sites in terms of likelihood of impact due to the increased failure potential in the vertical portion of the well hole. Regardless, there are large increases in well density when compared to conventional oil and gas *(5.2)*.

8.3 Rehabilitation

It may not be possible to fully restore sites in sensitive areas following well completion or abandonment, particularly in areas of high agricultural, natural or cultural value (European Commission report, *8.4, 1.6*). Over a wider area, with multiple installations, this could result in a significant loss or fragmentation of amenities or recreational facilities, valuable farmland or natural habitats.

A recent USA study documents the failure of plant and soil systems disturbed by drilling and fracking activities to return to pre-drilling conditions following rehabilitation- even after 20 to 50 years *(8.5)*.

An interdisciplinary study published in *Science* 2015 demonstrated that the accumulating land degradation has resulted in continent-wide impacts of the unconventional gas industry in the United States, as measured by the reduced amount of carbon absorbed by plants and accumulated as biomass. This is a robust metric of essential ecosystem services, such as food production, biodiversity, and wildlife habitat, and its loss "is likely long-lasting and potentially permanent. The land area occupied by well pads, roads, and storage facilities built during this period is approximately three million hectares, roughly the land area of three Yellowstone National Parks *(8.6)*.

8.4 Fragmentation and Biosecurity

Ecological experts in Australia have identified that the considerable surface footprint of CSG infrastructure represents a serious threat to biodiversity fragmentation through direct clearing of bushland, loss of native vegetation, fragmentation of important remnant vegetation, spread of invasive species and increased fire risk *(8.7)*.

The sheer scale of gas wells and associated infrastructure, presents genuine risks for unique natural landscapes. In Queensland, farmers have reported serious invasions of weeds following CSG development. One cattle farmer has initiated legal action against a CSG company after he had to destock his property at Dalby after a sudden infestation of the noxious African lovegrass weed following CSG activities *(8.8)*.

Lawyers in Queensland representing farmers dealing with the CSG industry consider that weeds may ultimately be one of the biggest legacies of the CSG industry *(8.9)*, and have highlighted the weaknesses of biosecurity measures.

8.5 Seismic Activity

Evidence arising in the past 18 months has demonstrated links between fracking and waste fluid reinjection with increased seismicity and earthquakes.

- International researchers in 2016 concluded that the underground injection of waste water from oil drilling had contributed to earthquakes in California in 2005 by changing pressures along an active fault *(8.10)*.
- An article in the Texas Journal of Oil, Gas, and Energy Law in 2016 exhaustively reviewed the literature on earthquake activity in areas of six states (Arkansas, Colorado, Kansas, Ohio, Oklahoma, and Texas) concluded that courts should impose strict liability for earthquake damage caused either by fracking itself or by the underground injection of fracking fluids *(8.11)*.
- Emerging data summarised in Scientific American in 2016 suggests that pressure changes caused by fracking wastewater injection can migrate for years before encountering a geological fault and altering stresses in ways that allow for slippage *(8.12)*. In spite of increasing scientific clarity about these mechanisms, regulators have been slow to respond.
- May 2016: In a study that has "far-reaching implications for assessment of induced seismicity hazards," a Canadian team of researchers determined in 2016 that hydraulic fracturing itself is linked to earthquake swarms in western Canada, in contrast to the central United States where disposal of fracking waste is the cause of most induced seismicity. Furthermore, lowering the volume of injected fluid may not be sufficient to prevent quakes *(8.13)*.

The evidence is strong enough that the Oklahoma Supreme Court ruled unanimously that homeowners can sue the oil and gas industry for injuries or property damage resulting from earthquakes. The number of earthquakes of magnitude 3.0 or higher has skyrocketed in Oklahoma since the advent of the fracking boom, with fewer than two per year before 2009 and more than 1,100 predicted to occur in 2015 (8.14).

The Dutch government plans to compensate people whose homes and buildings were damaged in a 3.4 magnitude quake, blamed on extraction at Europe's biggest gas field. More than 900 homes and buildings were damaged, according to an association which collates reports from residents. Groningen, which houses the European Union's largest gas field, has been plagued by tremors which increased as gas production rose in the region through the 1990s. *(8.15)*

9. HEALTH IMPACTS

9.1 Claims made by industry and Governments have no credibility

The gas industry and Governments maintain that unconventional gas extraction is safe and 'clean'. There is a rapidly growing body of research that demonstrates this is far from the truth and that unconventional gas operations can have serious consequences for human and animal health.

Adgate, Goldstein and McKenzie (2014) *(9.1)* present a clear argument that unconventional gas mining poses risks to health, both directly and indirectly, and at the local, regional and global level. Thus, decisions on unconventional gas mining made by all Australian states and territories, and by other nations, affect us all.

There are numerous independent reviews involving many hundreds of peer-reviewed papers demonstrating the impacts of unconventional gas on human health.

9.2 Impacts shown from 700 peer-reviewed papers *(9.4, 9.4a)*

Peer-reviewed scientific literature to 2016 involving more than 700 studies on the impacts of unconventional gas development show:
84% of public health studies indicate risks to public health
69% of water studies show actual or potential water contamination
87% of air quality studies indicate elevated air pollution.

Also referenced in Other Sources :
Public Health Association of Aust: Submission to Inquiry into Hydraulic Fracturing in NT 2017 (9.2)
Doctors for Environment Australia: Submission to Inquiry into Hydraulic Fracturing in NT April 2017 (7.2, 9.3)
Chesapeake PSR (2016) The health effects of fracking. Fracking harms human health. Chesapeake PSR
Physicians for social responsibility. Health and Energy Brief. Author – Gina Angiola, MD (9.6)

9.3 Saunders – 156 papers

A comprehensive review of 156 peer-reviewed publications (Saunders et al., 2016) (9.8) found multiple potential hazards to human health from exposures to harmful air and water pollutants associated with unconventional gas mining (9.7).

The major concerns identified were (9.9):

- There are direct local health concerns associated with living and working in close proximity to all steps of the unconventional gas mining process, not just the hydraulic fracturing ('fracking') component. These include potential exposures to air pollutants released during the whole process, including volatile organic compounds, fine silica, oxides of nitrogen, hydrogen sulphide, formaldehyde, ground level ozone and diesel fumes.
- Local communities may also face stress from an array of changes, including exposure to noise, lights, odours, and dust, as well as worries and fears about health, accidents, declining property values, increased traffic, industrialised landscapes, loss of community cohesion, post-construction job losses, local business loss, and changes to community character.
- Findings from various research studies have suggested associations between living close to unconventional gas operations and higher frequencies of negative health indicators, such as lower birth weights, more birth complications, more self-reported symptoms such as migraines, nasal and sinus problems and fatigue, and more hospitalisations due to heart, nerve and asthma conditions.
- At a local and regional level, unconventional gas activities near drinking water sources carry the potential for impacts on water quality.
- Dealing with wastewater from hydraulic fracturing safely remains a major challenge – each method and proposed new solution carries with it potential problems and complications.
- At a global level, there are grave concerns about the unconventional gas industry's contribution to climate change.

9.6 Review by Concerned Health Professionals of New York & Physicians for Social Responsibility.

Sources:

- *Concerned Health Professionals of New York & Physicians for Social Responsibility Compendium of scientific, medical, and media findings demonstrating risks and harms of fracking (unconventional gas and oil extraction). (2016, 2015) (1.7, 9.14).*

- *Chesapeake PSR (2016) The health effects of fracking. Fracking harms human health. Chesapeake PSR Physicians for social responsibility. Health and Energy Brief. (9.6)* Author – Gina Angiola, MD
- *Doctors for the Environment Australia: Submission to Inquiry into Hydraulic Fracturing in NT April 2017 (7.2)*

Some of the public health effects of unconventional gas development outlined in the Compendium of Fracking Risks compiled by the Concerned Health Professionals of New York *(1.7),* include:

- increased rates of hospitalization for cardiological complaints, cancer, skin conditions, and urological problems;
- increase in frequency of health symptoms reported by residents as distance between households and gas wells decreased; with rashes and upper respiratory problems more prevalent among persons living less than one kilometre from drilling and fracking operations;
- increases in commercial vehicle accidents;
- a sharp rise in ambulance calls and emergency room visits for drug related cases and oilfield related injuries and accidents;
- increase in infant deaths to six times the normal rate over three years;
- congenital heart defects, and possibly neural tube defects in newborns, associated with the density and proximity of natural gas wells within a 10-mile radius of mothers' residences;
- elevated rates of low birthweight among infants born to mothers living near drilling and fracking operations during their pregnancies;
- reductions in average birthweight and length of pregnancy as well as increased risk for low birthweight and premature birth associated with proximity to fracking operations *(9.16).*

Health impacts have been identified from exposure due to proximity to active wells.

- In October 2015, researchers at the Johns Hopkins Bloomberg School of Public Health and collaborating institutions analysed data from roughly 10,000 birth records in Pennsylvania and found a statistically significant association between maternal proximity to active fracking operations and premature births and high-risk pregnancies *(9.10, 9.11).*
- In July 2016, researchers at the Johns Hopkins Bloomberg School of Public Health and collaborating institutions analysed medical records of more than 35,000 asthma patients, ages five to 90 years old, and found a statistically significant association between proximity to active fracking operations and mild to severe asthma exacerbations *(9.12).*
- In August 2016, researchers at the Johns Hopkins Bloomberg School of Public Health and collaborating institutions analysed responses to questionnaires received from more than 7,000 adult primary care patients in central and northern Pennsylvania, and found statistically significant associations between proximity to active fracking operations and various combinations of migraine headaches, chronic rhinosinusitis and fatigue symptoms *(9.39).*
- In a further study from Pennsylvania, published in 2015, researchers examined health care use with fracking activity. They looked at well numbers and density and examined over 95,000 inpatient hospital records. They found that hydraulic fracturing as determined by well number or density had a significant association with cardiology hospital inpatient rates, and well density had a significant association with neurology hospital inpatient rates *(9.13).*

Exposures that may take years to become clinically apparent were identified.

- In 2015, researchers at the University of Pennsylvania and Columbia University reported an increase in cardiac and neurologic hospitalizations in two Pennsylvania counties with active fracking operations, compared with a neighbouring county where such operations had been banned *(9.34).*
- In 2016, researchers working collaboratively with local residents near oil and gas operations in Wyoming reported combined results from environmental sampling and biomonitoring in one of the first studies of its kind. Toxicants and their metabolites, including BTEX6 chemicals known to damage multiple organ systems, were detected in air samples and in the urine of residents *(9.35).* Although most of the wells in this region are conventional vertical wells, the human health hazards from volatile organic compounds are present in all types of oil and gas development and production.
- In 2016, researchers documented endocrine-disrupting chemicals in surface waters near fracking wastewater disposal sites in West Virginia. Such chemicals can have potent effects on human development at exceedingly low concentrations during critical developmental windows *(9.36).* As part of their ongoing work, researchers now also have documented adverse effects on development and reproductive capacities of both male and female mice at concentrations that are relevant to real-life human environmental exposures *(9.37, 9.38).*

Drilling and fracking emissions contribute to toxic air pollution and smog (ground-level ozone) at levels known to have health impacts *(9.14).*

- The New York State Department of Environmental Conservation determined that fracking could increase ozone levels in downwind areas of the state, potentially impacting the ability to maintain air quality that meets ozone standards.
- Air near gas wells in rural Ohio had levels of polycyclic aromatic hydrocarbons that surpassed those in downtown Chicago. They were also ten times higher than the levels found in rural areas without fracking operations, raising the lifetime risk of cancer for residents living near the well pads by 45 percent.
- Increased air pollution and smog formation poses a serious risk to all those already suffering from respiratory issues, such as children with asthma.

Public health problems associated with drilling and fracking, including occupational health and safety problems, are increasingly well documented *(9.14).*

- Health impacts among residents living near drilling and fracking operations include increased rates of hospitalization, self-reported respiratory problems and rashes, motor vehicle fatalities, trauma, drug abuse, and low birth weight among infants.
- Benzene has been detected in the urine of wellpad workers in Colorado and Wyoming.
- The National Institute for Occupational Safety and Health named oil and gas extraction industry workers among those at risk for silicosis, an incurable lung disease caused by exposure to silica dust, from the silica sand that is used extensively in fracking operations.
- Fatality rates among workers in the oil and gas extraction sector in North Dakota were seven times the national fatality rates in this industry, which itself has more deaths from fires and explosions than any other private industry. An increase in workplace deaths has accompanied the fracking boom in West Virginia.

Drilling and fracking activities can bring naturally occurring radioactive materials to the surface *(9.14).*

- Exposure to increased radiation levels from these materials is a risk both for workers and for residents.
- In Pennsylvania, radon levels in homes have been rising since the advent of the fracking boom, and buildings in heavily drilled areas have significantly higher radon readings than areas without well pads—a difference that did not exist before 2004.
- University of Iowa researchers documented a variety of radioactive substances including radium, thorium, and uranium in fracking wastewater and determined that their radioactivity increased over time; they warned that radioactive decay products can potentially contaminate recreational, agricultural, and residential areas.
- The New York State DEC's Findings Statement noted that naturally occurring radioactive materials (NORM) are brought to the surface in the cuttings, flowback water and production brine. The build-up of NORM in pipes and equipment has the potential to cause a significant adverse impact because it could expose workers handling pipes, for cleaning or maintenance, to increased radiation levels.

Unconventional gas development affects human health and well-being not only through direct exposures to toxic chemicals in air, water and soil, but also through many stressors introduced into communities. These include excessive noise and light pollution, increases in traffic accidents and fatalities, increases in domestic violence, alcohol and drug use, crime and disruptions of family and community relationships.

Importantly, in order to make any meaningful decisions about the risk to public health from UGD, baseline studies need to be undertaken as well as comprehensive epidemiological studies of population health, with support for research on potential health effects of unconventional gas development, independent of industry funding, including long term prospective health studies. Also, health surveillance of persons living and working near major unconventional gas developments needs to be carried out, with full and transparent disclosure.

The Physicians for Social Responsibility concluded that the science is increasingly clear. The health risks posed by fracking are real, significant and unacceptable. No regulatory framework has been shown to adequately protect public health or the environment *(9.6).*

9.7 Medical health survey in the Tara region Queensland

Source: McCarron (2013). Symptomatology of a gas field. An independent health survey in the Tara rural residential estates and environs. geralynmcc@iinet.net.au (9.15)

This report documents an investigation during February and March 2013 by a concerned General Practitioner, in relation to health complaints by people living close to coal seam gas development in SW Queensland.

- Thirty -five households in the Tara residential estates and the Kogan/Montrose region were surveyed in person and telephone interviews were conducted with three families who had left the area. Information was collected on 113 people from the 38 households. Of these, 17 were children 5 years of age or less, 31 were children aged between 6 and 18, and 65 were adults aged between 19 and 82.

- 58% of residents surveyed reported that their health was definitely adversely affected by Coal Seam Gas, whilst a further 19% were uncertain. The pattern reported was outside the scope of what would be expected for a small rural community.
- In all age groups there were reported increases in cough, chest tightness, rashes, difficulty sleeping, joint pains, muscle pains and spasms, nausea and vomiting. Approximately one third of the people over 6 years of age were reported to have spontaneous nose bleeds, and almost three quarters were reported to have skin irritation. Over half of children were reported to have eye irritation.
- A range of symptoms were reported which can sometimes be related to neurotoxicity (damage to the nervous system), including severe fatigue, weakness, headaches, numbness and paraesthesia (abnormal sensations such as pins and needles, burning or tingling). Approximately one third of the all the 48 children to age 18 (15/48) were reported to experience paraesthesia. Almost all the 31 children aged 6-18 were reported to suffer from headaches and for over half of these the headaches were severe. Of people aged 6 years and over, severe fatigue and difficulty concentrating was reported for over half. Parents of a number of young children reported twitching or unusual movements, and clumsiness or unsteadiness.

No baseline air or water monitoring or baseline health studies were done prior to the Queensland Government permitting the widespread development of the CSG industry in close proximity to family homes. No ongoing health study or surveillance and no ongoing testing to monitor chronic exposure levels is in place. This is clearly unacceptable.

The rural residential estates near Tara are the most densely settled area in Australia to have seen intensive CSG development. Since 2008, the people of these estates have informed successive Queensland Governments of their health problems. Their reports of ill health have been trivialised and ignored.

The recent report released by the Queensland Government following their investigation into the health impacts near Tara was so inadequate and flawed that it has done little to alleviate concerns.
- The Queensland government undertook 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.

A 2018 paper by Dr. McCarron *(9.32)* suggests a link between the escalating rise in hospital admissions for circulatory and respiratory conditions and a massive increase in air pollutants from the unconventional gas industry in south east Queensland. While recognising limitations on the data, partly due to anomalies in the data reported by industry and inadequate Government monitoring, it was concluded there was sufficient evidence to warrant full investigation.

9.8 Health Impacts Associated with Air and Water Pollution *(9.7)*

An array of chemicals capable of causing significant health impacts may be released during unconventional gas operations *(9.7, 9.17)* including:
- Volatile organic compounds, including BTEX (Benzene, Toluene, Ethylene and Xylene), that occur naturally in the shale, and evaporate from the flowback wastewater after fracking and from flaring excess gas
- Polyaromatic hydrocarbons (PAHs), heavy metals, naturally-occurring radioactive materials (NORMs)
- Endocrine-disrupting chemicals
- Nitrogen oxides
- Hydrogen sulphide from gas processing
- Formaldehyde (from the breakdown of escaping methane)
- Diesel fumes from extensive truck movements
- Ground level ozone, that forms from mixtures of pollutants and which is known to travel large distances.

Workers, and possibly people living very close to hydraulic fracturing operations, may also be exposed to unsafe levels of fine silica due to the large volumes of sand used, increasing the risk of silicosis *(9.7)*.

The following are some health studies that have emphasized the health risks posed by potential exposure to chemicals that may be released during unconventional gas operations via water and air.
- USA experience has indicated that health risks associated with air pollution are at least as serious to the health of people living nearby as the risks mediated through water contamination (Finkel & Hays, 2013; Brown et al., 2014) *(9.7)*.

- While significant concern has been raised about the large number and potential toxicity of the chemicals used in hydraulic fracturing and drilling muds, many researchers emphasise that the highly saline flowback waters containing naturally occurring chemicals are of substantially greater concern from an environmental and public health aspect (Colborn et al., 2011; Elliot et al., 2017; Vidic et al., 2013). The combination of chemicals and their resulting by-products can accumulate and persistent indefinitely in the environment or be taken up by plants and animals and may enter the food chain *(9.7)*.
- A study by Elliott et al. (2017) examined the carcinogenicity data on 1177 chemicals in fracking fluids and wastewater (US EPA) and 143 chemicals identified in scientific papers reporting air pollutants that were published before 2016. Over 80% of these chemicals were not evaluated for carcinogenicity. Among 119 chemicals that were evaluated, 49 water and 20 air pollutants were possible, probable or known carcinogens and 20 were associated with leukemia/lymphoma, including benzene, butadiene, cadmium, diesel exhaust and PAHs *(9.7)*.
- A second study by Elliott et al. (2017b) examined the reproductive and developmental toxicity of 1021 chemicals identified in fracturing fluid and wastewater, and found that toxicity information was lacking for 781 (76%). Among the 240 that had been evaluated, 103 were known to have the potential for reproductive toxicity and 95 for developmental toxicity *(9.7)*.
- Toxins of greatest concern linked to gas extraction include volatile organic compounds (like benzene), poly-aromatic hydrocarbons, heavy metals and radioactive materials. These can affect the respiratory, endocrine, nervous and cardiovascular systems and some, notably benzene, can cause cancer (Colborn et al., 2011; ATSDR 2013) *(9.7)*.
- Diesel engines emit particulate matter, nitrogen oxides and volatile organic compounds and was recently classified as a Group 1 carcinogen by the International Agency for Research on Cancer (IARC 2014) *(9.7)*.
- Silica, handled in very large quantities in the drilling and hydraulic fracturing processes, has the potential to pose serious risks to the respiratory health of exposed workers, causing silicosis decades later. There is also evidence of potent endocrine disrupting chemicals associated with the industry (Lloyd- Smith & Senjen 2013). Ground level ozone, that forms from mixtures of pollutants emitted during unconventional gas mining is also of significant concern, and can travel large distances, acting at a regional level *(9.7)*.
- Anecdotal reports and findings of a community study found significantly higher reports of respiratory (39% vs 18%) and skin (19% vs 3%) conditions among people living within 1 km compared to those living more than 2 km from shale gas wells in Pennsylvania (Rabinowitz et al., 2015) *(9.7)*.
- People living near unconventional gas wells throughout the world, including near coal seam gas gas wells in Tara, Queensland, have anecdotally reported similar distressing symptoms, as well as headaches, nosebleeds, numbness and tingling sensations (McCarron 2013; McCarron & King 2014) *(9.7)*.
- A study conducted by Macey et al (2014) identified levels of air-borne toxins above Federal guidelines in four USA States where substantial oil and gas production activities had occurred.
- Negative health outcomes have been found to occur more often in groups of residents with greater exposure to shale gas mining, compared with groups with lower exposure *(9.7)*:
    - Developmental problems during pregnancy and infancy – lower birth weight, small for gestational age, higher frequency of serious birth complications, specific birth defects (Casey et al., 2016; McKenzie et al., 2014; Stacy et al., 2015).
    - Hospitalisations – for cardiovascular and neurological disorders and for those with existing asthma conditions (Rasmussen et al., 2016; Jemielita et al., 2015).
    - Symptoms – migraine headaches, chronic nasal and sinus irritation, fatigue, nausea, skin rashes, eye irritation, nosebleeds, and asthma worsening requiring medication changes (McCarron, 2013; Rabinowicz et al.,2015, Rasmussen et al., 2016).
- Petroleum-based hydocarbons can break down underground in ways that promote the leaching of naturally occurring arsenic, a known human carcinogen that causes bladder, lung, and skin cancer, into groundwater *(9.19)*.
- Elevated levels of toxic BTEX (Benzene, Toluene, Ethylene, Glycene) chemicals in flowback water from fracked wells were detected at AGL's Waukivory CSG Project at Gloucester, NSW *(9.20)*. It is likely the chemicals were mobilized due to the fracking process. This well is now abandoned.
- In a 2013 US study, surface and groundwater near areas experiencing high levels of unconventional gas activity in Colorado were shown to contain endocrine-disrupting chemicals in concentrations high enough to interfere with the response of human cells to male sex hormones and estrogen. Exposure to endocrine-disrupting chemicals can increase the risk of reproductive, metabolic, neurological, and other diseases, especially in children and young organisms. *(9.33)*

9.9 Impacts on mental health, psychosocial wellbeing and community cohesion

There are many avenues through which the unconventional gas industry can harm mental health and individual and community wellbeing *(9.9)*.

- The initial phase impacts include distress and anxiety due to disagreements that split the community into those who support the industry and those who oppose it.
- In the 'boom' phase tight-knit communities can feel inundated with strangers coming in, swamping unprepared health and mental health services. Crime may also increase. Such impacts are detrimental to the social cohesion and for some, the moral character, of the community.
- In the post-construction phase, jobs decline dramatically and housing demand drops. Production ramps up with drilling and fracking, with its 24-hour lights, noise, odours, tree clearing and truck movements - causing some people to feel a deep sense of loss of control, loss of place and loss of peace and a feeling of being trapped and unable to escape.
- All of these phases present risks of depression, anxiety and increased use of alcohol and other drugs for coping.

Doctors for the Environment Australia note that 'water and air pollution, water shortages, permanent degradation of productive agricultural land and loss of livelihood and landscape all have mental health consequences for communities living in a gas field *(9.21)*.

A 2013 study involving 12 workshops established that CSG operations in south west Queensland placed rural communities 'under sustained stress' *(9.22)*. Study participants reported that mining and CSG operations 'significantly impacted or exacerbated issues such as the health, social fabric and economy of the community', and the authors noted that local health services faced 'unsustainable pressure'.

A 2014 article in the Medical Journal of Australia noted that 'gas developments can have numerous and considerable social and psychological effects, which may exacerbate more direct health risks' *(9.23)*.

A 2014 CSIRO study *(9.24)* noted that local farmers perceived the nature of CSG development in South West Queensland as an 'invasion' or 'occupation', whilst a previous study in Chinchilla found residents describing a 'tsunami of change' *(9.25)*.

Interacting and engaging with CSG companies has also been reported as having a significant negative impact on farmer's wellbeing *(9.26)*. The interactions between farmers and CSG companies resulted in issues of stress, conflict and disconnection.

A survey of 378 Australian farmers, predominantly from Queensland and NSW, published in Journal of Environmental Psychology *(9.27)* in 2016, found that farmers concerned about the impacts of coal seam gas on their health, community and the environment, were more likely to report symptoms of depression and decreased levels of wellbeing.

Schlumberger Oilfield Australia Pty Ltd was fined $162,500 after a worker at a Queensland drilling site was burned when exposed to unsafe levels of radiation *(9.33)*.

9.10 Livestock health risks (9.28, 9.6)

There is considerable evidence from the USA that gas mining is detrimental to livestock and domestic animals. Twenty-four case studies have been compiled of apparent harm to animals, mainly resulting from contamination of water wells, springs, ponds or creeks, some due to accidents or negligence, and others a consequence of normal operations. On seven cattle farms studied in the most detail, half the herd, on average, was affected by death or failure to breed.

In one case, of 60 cattle with access to a creek allegedly contaminated with fracking wastewater, 21 died and 16 failed to reproduce, while 36 cattle without access to the tainted water remained healthy *(9.40)*.

In another case, of 140 cattle exposed to fracking waste, about half died and many others bore stunted or stillborn calves while 60 others in another pasture had no problems.

The Concerned Health Professionals of New York has compiled several other cases of affected livestock. For example, in Pennsylvania, one farmer whose cows were exposed to drilling wastewater in 2010 lost 8 out of 11 newborn calves.

A 2012 case study in the USA also found serious evidence of harm to domestic stock from shale gas drilling waste contamination, including cattle deaths, stillbirths and reproductive problems (9.29).

9.11 Involvement of health experts (9.7)

Far too frequently, public health, psychological/mental health and medical expertise are 'missing from the table' in assessing the impacts of unconventional gas on health (Goldstein et al., 2012). Experts in engineering, safety

science, environmental management and toxicology, while extremely important, should not be assumed to also have a comprehensive, in depth understanding of the impacts of unconventional gas on the health and wellbeing on people's lives. Direct public and psychological health expertise is required.

9.12 Precautionary principle

Many people assume that the precautionary principle is being applied by government *(9.7)*, i.e. that,

- preventive action would be taken in the face of uncertainty
- the proponents of a proposed activity would be required to demonstrate its safety, not the community
- governments would explore a wide range of alternatives to possibly harmful actions
- government would encourage public participation in decision making.

In submissions to the NSW Chief Scientist and Engineer's examination of the public health and safety of coal seam gas mining in 2013, many public health organisations and the Australian Medical Association, called for application of the Precautionary Principle. The Australian Medical Association stated simply, 'If in doubt, turn CSG off' *(9.30).*

The British Medical Journal recently published a joint letter with similar sentiments signed by 18 leading medical scientists, stating: 'The arguments against fracking on public health and ecological grounds are overwhelming. There are clear grounds for adopting the precautionary principle and prohibiting fracking' *(9.31).*

Many public health and medical organisations in Australia are calling on governments to apply the Precautionary Principle in this situation, and refrain from allowing unconventional gas mining to occur in Australia until there is sufficient evident demonstrating that it is safe for people and the environment. Among these organisations are:

- Doctors for the Environment Australia
- Public Health Association of Australia
- Australian Medical Association
- National Toxics Network
- Climate and Health Alliance, which includes 28 professional health bodies, e.g. Australian Psychological Association, Australian Council for Social Services, Australian College of Nursing, Australian Research Alliance of Children and Youth.

10. COMMUNITY

10.1 Impacts on the community

In the course of its work supporting landholders and communities facing the impacts of unconventional gas developments, Lock the Gate Alliance hears firsthand about the impact unconventional gas development is having on the livelihoods, health and well-being of Australian farming families living adjacent to and surrounded by gas activities. These harmful impacts include: intimidation, coercion and bullying by UG companies; intolerable noise and light pollution from flaring, traffic and UG infrastructure; contamination and depletion of water in farm bores; rivers bubbling with methane; bores running dry; stock losses associated with pipeline construction and water contamination; costly and time consuming interruptions to farming operations; huge trucks and heavy machinery on small local roads affecting lifestyle, safety and road infrastructure; dust impacts on pasture; increases in weed infestation; industry workers leaving mess from pipeline construction in farm paddocks; workers destroying fences and leaving gates open; properties not able to be sold; credit being denied; mental health impacts resulting from dealing with companies and the impacts of industry development; and physical health symptoms including respiratory ailments, headaches, rashes, nausea and vomiting, and nose, throat and eye irritations.

For many affected landholders, these impacts affect all facets of life and are making their living situation untenable. Personal testimonies of a number of affected landholders can be viewed in a series of short films compiled by the Lock the Gate Alliance talking about the impacts on them:
https://www.youtube.com/watch?v=4OG9JkzB_3M *(10.1)*

While the gas companies move on once the commercially viable gas has been extracted, the communities suffer long term *(1.3).* The unconventional gas mining leaves massive damage, and the community must foot the bill. Yet the community did not want it.

Queensland's experience shows that reality does not match the unconventional gas industry's claims. Few benefits are realised outside the gas industry, and there are serious social and economic effects on local communities and existing businesses *(10.2).*

10.2 Unconventional gas led to a degradation of public resources in QLD

A study conducted in the Darling Downs of Queensland between 2008 and 2013 by the industry-funded Sustainable Minerals Institute at the University of Queensland surveyed stakeholders from different sectors in the local community including the local business community, agriculture, local government, advocacy groups and environmental consultants, as well as the mining and unconventional gas industries *(10.3)*.

Far from mining and unconventional gas providing economic benefits, local businesses felt that it had reduced financial capital, human capital, infrastructure, social capital and natural capital. Local businesses had to compete with inflated gas industry wages in order to recruit and retain staff, and they experience increased rent and competition for services. There were disruptions to farmers from the rollout of access roads, pipelines, water treatment plants and other infrastructure.

10.3 Community cohesion and wellbeing:

The Queensland and NSW experience has shown that when an unconventional gas industry is forced upon communities against their wishes, there is potential for significant conflict and social upheaval and disruption as a result *(1.6)*. Lock the Gate members and local community groups report a range of impacts on their mental and emotional wellbeing, including:

- A sense of injustice that they do not have the right to refuse access to companies for UG activities and that this industry is being forced on an unwilling population.
- Fear and anxiety about the impacts of the unconventional gas industry on their family's health and the quality of the air and water they rely upon.
- Concern about the impact of unconventional gas development on the economic viability of their farms and property values.
- A sense of anger and betrayal that governments are supporting industry rather than communities in the development of the unconventional industry.
- A sense of anger that the industry is being pushed ahead rapidly without proper consideration of the impacts and before proper scientific studies have been done and baseline data collected.

Doctors for the Environment Australia note that the lack of a veto right for landholders in relation to unconventional gas development, the stress involved in dealing with companies (often against their will), the lack of full information and disclosure on the realities of unconventional gas development, and the often underhanded tactics employed by companies contributes to a sense of powerlessness, betrayal and frustration amongst landholders and affected communities. The injustice and powerlessness contribute to distress and poorer mental health outcomes. Unconventional gas development can 'divide previously close-knit rural communities, increasing tension and disharmony'.

According to DEA, in eastern Australia, the stress and disruption caused to farmers has already been shown to force some of them to leave a CSG drilling area, allowing once productive lands to lapse into disuse. In the USA long-time residents are moving, unable to bear the changes the gas industry has wrought on their landscape and community.

A study on landholders in Queensland found that unconventional gas operations placed rural communities under sustained stress, with study participants describing significant impacts on the health, social fabric and economy of local communities (10.4).

10.4 Boom Bust impact

The scale of the 'bust' after the short unconventional gas construction period ends is severe, and long-term job opportunities are extremely limited. Queensland Treasury figures reveal that more than 10,000 fly-in-fly-out jobs have been lost in the Surat Basin since the CSG construction boom peaked in 2014. In June 2014 there were 14,490 non-resident jobs in the region, and by June 2016 that had reduced to just 3,820 jobs (10.5), similar to pre-CSG levels.

The gas industry frequently makes claims about delivering substantial flow-on jobs in regional communities, particularly in the services industry, and job multipliers are frequently used to derive large job estimates. However, research undertaken by CSIRO's Gas Industry Social and Environmental Research Alliance found that job spill-overs into non-mining employment in the Surat Basin were negligible (10.6).

10.5 Employment impacts (*The Australian Institute, 2017 7.19*)

- While gas companies continually spruik the promise of more jobs for local communities as a justification for unconventional gas development, the simple fact is that it is a relatively small employer in the long term.

- The majority of gas industry jobs are required for the short construction phase only, they are not ongoing, as modern gas fields are highly mechanized and need very few people to operate them. Local employment opportunities are minimal with the majority of skilled workers being brought in from elsewhere with fly-in-fly-out workforces.
- The industry has made some incredible claims about its capacity to employ. In 2012 it claimed it created 100,000 jobs whereas the Australian Bureau of Statistics showed there were only 9,372 additional jobs. A 2011 report prepared for Santos by Allen Consulting Group found that a potential coal seam gas development in Northwest NSW would increase employment opportunities in NSW by 'around 2,900 ongoing full time positions', even though the project would only create about 30 gas industry jobs. Over 500 jobs would apparently be created in the public sector, at taxpayer expense *(10.7)*.
- Far from creating many additional jobs, the coal seam gas industry has been found to reduce employment in certain sectors. The Office of the Chief Economist's 2015 Review into the Socioeconomic Impacts of Coal Seam Gas in Queensland reported that 1.8 agricultural jobs are lost for every CSG job created *(10.8)*. Similarly, a study of Queensland's unconventional gas expansion by CSIRO's Gas Industry Social and Environmental Research Alliance found that for every 10 additional people employed in coal seam gas, 18 agricultural jobs were lost *(10.9, 10.10)*.
- The Chair of the NT Fracking Inquiry claimed there could be 32,000 jobs created by fracking in the NT, yet the Australian Institute states from the Inquiry's own research, there is a very high probability that no long term jobs will be created in the Northern Territory. Even the best case would be for only 500, but this was a very low probability. The Research Director of the Australian Institute criticised the inquiry chair, saying its own commissioned research had been ignored. The Chair later admitted she had quoted the wrong figure. *(10.19, 10.20)*

10.6 Property values and credit Availability

Rabobank, the world's leading specialist in food and agribusiness banking, stated risks from unconventional gas mining included reductions in farm productivity, efficiency, land values and credit availability. It also indicated that concurrent CSG mining and agricultural activities on agricultural land could result in problem loans or defaults (10.11).

In 2016 it was revealed that a Queensland family was unable to obtain a bridging loan using their property for equity, because the property had four coal seam gas wells on it. The Commonwealth bank stated that coal seam gas wells on the land make the security unacceptable for residential lending purposes *(10.12, 10.13)*.

10.7 Insurance

Insurance companies have refused to insure against risks associated with unconventional gas extraction, both in Australia and in the USA. In the USA, homeowners can be confronted with uninsurable property damage for activities that they cannot control *(10.14)*.

In the north west of NSW, farmers have been refused insurance cover for risks and contamination associated with unconventional gas extraction *(10.15)*.

Landholders are concerned they may be liable for any negative impacts caused by hydraulic fracturing. In 2014, the NSW Chief Scientist released a report, which concluded that the CSG industry was markedly under-insured and that landholders were likely to bear a substantial risk as a result *(10.16)*.

Meat and Livestock Australia has advised there is a genuine risk that landholders may ultimately be responsible for liabilities arising from unconventional gas activities if they lead to personal injury, property damage, or contamination *(10.17)*.

The Rural Industries Research and Development Corporation cite a case study in Queensland where a landowner was advised by their supply chain partners that they would be liable for any contamination caused by coal seam gas activities. Neither the CSG company nor the insurer would agree to indemnify the landholder against that risk *(10.18)*. Legal advice indicated:

- Gas companies are refusing to include provisions in access agreements to accept liability for any contamination that may occur.
- Gas companies in Australia are under-insured and do not have adequate insurance to cover the types of risks that CSG activities bring.
- Some graziers have reported that insurers have examined the risk to them of unconventional gas contamination and found it too high to offer insurance.

One must ask the obvious question: **Why don't the companies cover the liabilities if the process is so safe and free of risks?**

10.8 USA experience

The impacts on the community in Australia are a repeat of the experience in USA. Sixty-four studies showed industry claims of job creation and economic benefits were exaggerated, and economic analyses found that property values, tax revenues and tourism diminished *(1.7)*.

11. IMPACTS ON AGRICULTURE

11.1 Threat to agriculture in WA

Across Western Australia large areas of highly productive farmland are under threat from Unconventional Gas mining. This activity has the potential to severely disrupt virtually every aspect of agricultural production and potentially even remove the land from production.

11.2 Landholders will lose millions every year by hosting unconventional onshore gasfields

A 2016 CSIRO report found the alienation of productive farmland for CSG infrastructure in Queensland resulted in losses in gross economic returns of up to 10.9% *(11.1)*. The total losses to gross revenues varied between $1.32m and $3.29m per property and averaged $2.17 million.

The Lock the Gate Alliance notes that the methodology was estimating economic losses based solely on reduction in land area and did not attempt to quantify losses resulting from disruption to operations, dust generation, spills and leaks of wastewater or the spread of weeds. Therefore, total losses to landholders will undoubtedly be far higher.

11.3 Threats to agriculture and soil quality *(1.7)*

The compendium of scientific, medical, and media findings *(1.7)* cited 20 studies and concluded:

- Drilling and fracking take agricultural land out of production and pose risks to the agricultural sector.
- In California, fracking wastewater illegally injected into aquifers has threatened crucial irrigation supplies to farmers in a time of severe drought.
- The reuse of fracking wastewater for irrigation in California's San Joaquin Valley raises questions about contamination of food crops via bioabsorption through roots.
- Studies and case reports from across the country have highlighted instances of deaths, neurological disorders, aborted pregnancies, and stillbirths in farm animals that have come into contact with wastewater.
- Potential water and air contamination put soil quality as well as livestock health at risk.
- Farmers have expressed concern that nearby fracking operations can hurt the perception of agricultural quality and nullify value-added organic certification.
- Fracking chemicals in agricultural soils can interact with each other in ways that slow down their biodegradation.

12. LAND ACCESS

12.1 Land owners have no rights to prevent access by the mining company.

Landowners have no rights to veto gas development on their land. Petroleum leases are issued by the Department of Mines and Petroleum with no consultation or rights to object. The affected landowners, businesses or the community do not have to be notified, as has been the case with the current leases. If a landowner initially refuses access, the matter will be referred to a Magistrates court after three months to decide on appropriate compensation.

Leases are often issued first in national forests, and then expanded from there.

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Further information	
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	www.lockthegate.org.au

SCIENTIFIC FRACKING INQUIRY

DONGARA CONSULTATION

1 MARCH 2018

DOCUMENTS PROVIDED

Page	Date	Subject
2	March 2011	Rockwater Pty Ltd, Woodada Deep-01 Well, Aquifer Connectivity Report, prepared for AWE limited
24	12 June 2015	Aurora Environmental, letter to AWE Limited on investigation of noise and odour complaint from Senecio-03 Well intervention and production testing
44	23 July 2015	AWE presentation on AWE Perth Basin Operations – Drover 1: Groundwater monitoring - to Coorow Community Reference Group
66	2016	Joint submission by Drover-1 Shire of Coorow Community Reference Group and AWE Limited Pty Ltd as a nomination for the DMP Community Partnership Awards
78	27 October 2016	Email from Rod Copeland on contribution to Shire of Irwin Community Roundtable
80	1 December 2017	Shire of Irwin Community Roundtable workshops, Q&A Tracking Table
106	8 December 2017	Snapshot: Shire of Irwin Onshore Energy Industry (2017)
108	Undated	Government of WA, Departments of Primary Industries and Regional Development, Water and Environmental Regulation, Planning, Lands and Heritage; Water for Food project, Midlands: Groundwater and Land Assessment
112	October 2015	Farming Land Access Agreement template, for petroleum exploration activities under the *Petroleum and Geothermal Energy Resources Act 1967*

Rockwater
PROPRIETARY LIMITED

WOODADA DEEP-01 WELL

AQUIFER CONNECTIVITY REPORT

MARCH 2011

REPORT FOR
AWE LIMITED

(Report No. 387.0/11/01)

[redacted]

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1 INTRODUCTION

AWE Limited is proposing to undertake hydraulic fracturing ('hydrofracturing') in the Carynginia Shale in the Woodada Deep-01 well to test the capacity of the technique for enhancing hydrocarbon recovery from the Woodada gasfield. As part of the Western Australian State Government assessment for environmental approval of the proposal, the Department of Environment and Conservation (DEC) has requested AWE to provide additional information:

- groundwater information, namely the hydrogeology and connectivity of the aquifers; and
- information on the risk of contamination of aquifers from hydraulic fracturing, namely the use of chemicals.

AWE requested Rockwater to prepare a report to address the first bullet point above. AWE is to prepare a response addressing the second bullet point.

Rockwater proposed the following scope of work for the desktop study:

- Determine the hydrostratigraphy and aquifers in the area.
- Discuss the aquifer connectivity in the area.
- Identify groundwater users, locations of production bores and their aquifers.
- Identify potential risks to the groundwater resources in the area from hydrofracturing.
- Recommend suitable hydrogeological monitoring to be undertaken within the project.

Woodada Deep-01 is located about 12 km west-southwest of Eneabba townsite just north of Lake Logue (Fig. 1). The well was originally drilled and completed in 1981 as Woodada 04 to a depth of 2271 m brt (below rotary table) i.e. 2,266 m bgl (below ground level). More recently, the well was deepened to 2,552 m brt (2,547 m bgl) into the Irwin River Coal Measures.

Locations of most of the known oil exploration and production wells, and groundwater bores, in the project vicinity are shown in Figures 1 and 2. The Perth Basin regional surface geology is presented in Figures 3 and 3A, and the subcrop geological map is presented in Figure 4, based on mapping by Geological Survey of WA (Playford et al, 1976; Morey and Iasky, 1996).

2 GEOLOGY

The stratigraphic sequence at Woodada is summarised in Table 1, incorporating interpretations by AWE (Fig. 5) and from the Well Completion Report (Menzel, 1981) of the strata that were intersected in Woodada 04/Deep-01.

Table 1: Strata Recognised in Woodada Deep-01 Well

Depth (m brt [a])	Labelled Unit Fig. 5 (AWE)	Formation	Age	Main Lithologies Described in WD04 [b]	Regional Lithology
0 – 20	Undifferentiated	Superficial Deposits	Quaternary	Sand and clay	Sand, limestone, clay
20 – 286	Yarragadee [d]	Yarragadee Formation [d]	Middle to Late Jurassic	Continental siltstone and sandstone	Sandstone with siltstone and claystone beds; up to 2000 – 4000 m thick
286 – 320	Cadda	Cadda Formation	Middle Jurassic	Shallow marine siltstone and sandstone	Shale, siltstone, and sandstone, locally limestone
320 – 619	CCM	Cattamarra Coal Measures	Early to Middle Jurassic	Siltstone and sandstone with minor clay stone	Sandstone, carbonaceous siltstone; minor coal
619 – 1186	Eneabba	Eneabba Formation	Early Jurassic	Multi coloured claystone and sandstone	Sandstone, multicoloured siltstone and claystone; minor coal
1186 – 1435	Lesueur	Lesueur Sandstone	Middle to Late Triassic	Continental sandstone siltstone and minor claystone	Sandstone, coarse-grained, pebbly; minor siltstone and conglomerate
1435 – 1572	Woodada	Woodada Formation	Early to Middle Triassic	Paralic siltstone and sandstone, carbonaceous	Sandstone, fine-grained, and carbonaceous siltstone
1572 – 2133	Kockatea	Kockatea Shale	Early Triassic	Siltstone, shale and minor sandstone	Shale, dark, siltstone, and minor sandstone and limestone
2133 – 2232	Carynginia Limestone	Carynginia Formation	Late Permian	Limestone and sandstone	[e] Probably equivalent to the Beekeeper Formation (Hall and Kneale 1992) – sandstone, skeletal limestone, and shale
2232 – 2521	Carynginia Shale	Carynginia Formation	Early Permian	Siltstone and shale	Siltstone, micaceous and carbonaceous, lesser sandstone and conglomerate
2521 – unknown [f]	IRCM	Irwin River Coal Measures	Early Permian	Not intersected	Alternating sandstone, siltstone, carbonaceous shale, and coal.

Notes:
a m brt = metres below rotary table. Rotary table is 5.0 m above ground.
b WD04 = Woodada 4 well
c Depths from well completion report (Menzel, 1981).
d Interpreted as Cattamarra Coal Measures by Commander (1978), Kern (1997) and DoW (2010).
e Other formations not identified in Woodada Deep-01 but occurring locally between the Carynginia Formation and Kockatea Shale are: Dongara Sandstone, Wagina Sandstone & Mingenew Formation.
f Total drilled depth was only 2552m brt, the IRCM will extend below 2552m.

The well intersected sedimentary rocks of Permian to Quaternary age over a total depth of 2,552 m, as illustrated in Fig. 5. Geophysical logs of the Woodada 3 well are presented in Figure 6, taken from Mory and Iasky (1996). The sequence is described below, from oldest (Permian) to youngest (Quaternary).

2.1 STRATIGRAPHY

2.1.1 Permian

The Permian section consists of the Irwin River Coal Measures and the Carynginia Formation. The Irwin River Coal Measures, comprising coal and carbonaceous shale interbedded with sandstone and siltstone, was intersected over the lowermost 31 m of Woodada Deep-01 well and was not fully penetrated. The overlying Carynginia Formation is informally divided by AWE and Menzel (1981) into a lower shale member and an upper limestone member (Fig. 5). The lower Carynginia Shale is the target of the hydraulic fracturing investigation. However, Mory and Iasky (1996, and Fig. 6 herein) interpret the limestone in this part of the stratigraphic section to correlate with the Beekeeper Formation, which they indicate sits unconformably on the Carynginia Formation. The Carynginia shale member, capping the Irwin River Coal Measures, is 289 m thick in Woodada Deep-01.

2.1.2 Triassic

Three formations comprise the Triassic-age strata in the Woodada oil wells: Kockatea Shale, Woodada Formation and Lesueur Sandstone. Based on the AWE correlations (Fig. 5), their base is at 2133 m brt and their top at 1186 m brt.

The lowest unit, Kockatea Shale, is 561 m thick in Woodada Deep-01. In Woodada 3, the Kockatea Shale is interpreted to be about 420 m thick (Fig. 6). Here, the geophysical logs indicate consistently shaley strata in the upper 240 m and shale with sandy interbeds in the lower 180 m.

The Woodada Formation, predominantly sandstone and siltstone, is 137 m thick in Woodada Deep-01. Geophysical logs from Woodada 03 suggest that this is a thinly-bedded, fine-grained unit (Fig. 6).

The Lesueur Sandstone is coarse-grained sandstone with minor siltstone beds and in Woodada Deep-01 it is 249 m thick. The unit is designated to be about 200 m thick in Woodada 3 (Fig. 6).

2.1.3 Jurassic

Four Jurassic-age formations are recognised in the Woodada oil wells: Eneabba Formation, Cattamarra Coal Measures, Cadda Formation and Yarragadee Formation. Based on the AWE correlations (Fig. 5) the base of these strata in Woodada Deep-01 is at 1186 m brt. Their top is 15 m below ground level or at 20 m brt.

The lowest unit, Eneabba Formation, is characterised by multicoloured siltstone and claystone with sandstone interbeds. The geophysical logs of Woodada 03, notably the gamma-ray log, indicate that siltstone/claystone beds predominate in the lower half and sandstone in the upper half of the unit. For Woodada Deep-01, the Eneabba Formation is 567 m thick (Table 1). A thickness of 850 m is assigned in Woodada 03 (Fig. 6).

The overlying strata include all three formations up to the Yarragadee Formation at Woodada 03 (Fig. 6). But, further to the south the uppermost strata (beneath the superficial deposits) are predominantly Cattamarra Coal Measures, because of the geological structure including northerly dip of the strata. Figure 4 shows the subcrop geology as illustrated in Mory and Iasky (1996). By this interpretation, all the strata above 336 m brt at Woodada Deep-01 would be assigned to the Cattamarra Coal Measures.

2.1.4 Quaternary

Superficial deposits of Quaternary age form a thin layer, about 15 m thick, at Woodada Deep-01 vicinity. They are mapped as Tamala Limestone, and comprise mainly limestone and sand of eolian origin.

2.2 GEOLOGICAL STRUCTURE

The Perth Basin strata in the Woodada environs dip at very low angles, downwards to the east and north. They are cut by faults that trend mainly northerly: the Beagle and Coomallo Faults, that delineate the Cadda Terrace (on which the borefield is located), and several lesser faults that produce negligible displacement. The strata are essentially continuous over the Cadda Terrace, which is about 25 km wide (E-W) and more than 100 km long (N-S). The main faults near Woodada are shown in Figure 3.

3 HYDROGEOLOGY

3.1 AQUIFERS

Several of the strata above the Carynginia Shale Member are permeable aquifers, constituting the aquifer system of the Perth Basin. At some locations in the Woodada-Eneabba area the aquifers have the capacity to yield moderate to large quantities of fresh water to bores. Locally, and particularly at depths greater than 2,000 m, the groundwater may be saline.

Woodada Deep-01 is in the Arrowsmith Groundwater Area (Eneabba Plain subarea) for Department of Water (DoW) groundwater management purposes (DoW, 2010). The aquifers that are recognised in the subarea are listed in Table 2 (in order from shallowest to deepest).

Table 2: Aquifers in the Eneabba Plains Subarea

Aquifer	Formation	Typical Bore Yield (kL/day)	Groundwater Quality*	Comments
Superficial	Bassendean Sand Tamala Limestone	small to moderate	marginal to brackish	Very thin in the Woodada Deep-01 area
Yarragadee	Yarragadee Formation	large >1000	fresh to brackish	Recognised east of the Warradarge Fault (Fig. 3)
Cattamarra	Cattamarra Coal Measures	moderate >500	brackish	Recognised west of the Warradarge Fault (Fig. 3)
Eneabba	Eneabba Formation	moderate 500-1000	fresh to brackish	
Lesueur	Lesueur Sandstone	Large up to 2000	fresh to marginal	

Modified after DoW (2010)
*Fresh = <500 mg/L TDS; Marginal = 501-1500 mg/L TDS; Brackish = 1501-5000 mg/L TDS; Saline = 5001-50000 mg/L TDS: Hypersaline = >50,000 mg/L TDS.
*TDS= Total dissolved solids

3.2 CONFINING LAYERS

The stratigraphic succession includes shale, siltstone and carbonaceous strata both within formations (Cattamarra Coal Measures, Eneabba Formation and Woodada Formation), and those that are separate formations in their own right (Kockatea Shale). These form hydraulic confining layers which impede or restrict vertical groundwater movement between the major aquifers or between permeable layers within the major aquifers themselves.

The major regional confining layer between the Carynginia Shale and the overlying aquifers is the Kockatea Shale. The formation is 561 m thick, and comprises mainly shale and siltstone

with minor sandstone and limestone in Woodada Deep-01. Elsewhere in the area the Kockatea Shale may be more than 1,100 m thick (in Eneabba 1 oil well; Mory 1994). The Kockatea Shale is recognised as a primary regional seal for hydrocarbon plays in the northern Perth Basin (D'Ercole 2003) and as such would also form a major hydraulic confining layer.

The overlying Carynginia limestone member (Beekeeper Formation) is the reservoir for hydrocarbons in the Woodada gasfield and is interpreted as being permeable, providing little hydraulic confining properties. However, it is likely that within the unit there are layers with low permeability which would contribute some hydraulic confining properties.

With respect to the Lesueur Sandstone aquifer, the main confining units below it (between it and the Carynginia Shale) are the Kockatea Shale and the Carynginia Limestone Member, as discussed above. Also, within the Woodada Formation (immediately beneath the Lesueur Sandstone) there are siltstone beds that would impede vertical movement of fluids.

With respect to the aquifers at higher elevations, i.e. the Cattamarra Coal Measures and the Yarragadee Formation, there are the additional confining beds within the Eneabba Formation and the Cadda Formation.

3.3 FAULTS

The hydraulic properties along faults in the area are difficult to assess without specific investigations which have not been undertaken. Where permeable strata are juxtaposed across a fault there could be groundwater flow between adjacent aquifers. There is no information on the potential smearing of lower permeability lithologies along faults which could form low permeability barriers along the faults themselves. Commander (1978) indicates that there could be some leakage westwards from the Yarragadee aquifer to the Cattamarra aquifer across the Warradarge Fault, based on data from the Eneabba line of investigation bores. No other information is available on the hydraulic behaviour of the faults in the area. The Peron Fault, which separates the Yarragadee Formation from the Cattamarra Coal Measures to the west (Fig. 4), is interpreted to pass about 850 m to the east of Woodada Deep-01.

Faults cutting the strata are potential locations for upwards and downwards movement of fluids. This could be significant if faults (presently unidentified) occurred in the vicinity of the hydrofracturing operation. AWE has advised that 'Local faults are considered to be sealing based on moveable hydrocarbon accumulations being trapped below the Kockatea Shale throughout the Woodada Field. A regional pressure depletion within the Carynginia Limestone Member will limit any fracture growth or fluid movement from lower formations growing upwards'.

3.4 GROUNDWATER DEVELOPMENT – DOW LICENCES AND USERS

Groundwater extraction in the Arrowsmith Groundwater Area is licensed by the DoW. Only shallow domestic and stock watering bores are exempt from licensing. Such bores provide only small supplies (generally from the Superficial aquifer) and are the most numerous water-supply bores in the area. Current DoW licences to extract groundwater in the area of Woodada Deep-01 are shown in Figure 7 and are summarised in Table 3; and one licence in the adjacent Twin Hills subarea is included in the table. Licences authorising extraction from the Superficial, Yarragadee, Cattamarra, Eneabba and Lesueur aquifers are current.

Table 3: Licences to Take Water in the Region near Woodada Deep-01

Licence Number	Groundwater Area	Groundwater Subarea	Aquifer	Licence Allocation	Allocation Limit (DoW 2010)
Perth - Cattamarra Coal Measures North					
158358	Arrowsmith	Twin Hills	Cattamarra	50,000 kL	500,000
Perth - Eneabba					
60517	Arrowsmith	Eneabba Plains	Eneabba	1,400,000 kL	2,000,000
Perth - Lesueur Sandstone North					
65700	Arrowsmith	Eneabba Plains	Lesueur	470,000 kL	1,330,000
Perth - Superficial Swan					
155753	Arrowsmith	Eneabba Plains	Superficial	32,000 kL	14,600,000
Perth - Yarragadee North					
104700	Arrowsmith	Eneabba Plains	Yarragadee	12,000,000 kL	22,500,000
73006	Arrowsmith	Eneabba Plains	Yarragadee	200,000 kL	
169367	Arrowsmith	Eneabba Plains	Yarragadee	9,000 kL	

From the licence information (Table 3), the stratigraphically deepest aquifer that has a licence issued is the Lesueur aquifer at a location about 15 km east from Green Head and 25 km south from Woodada Deep 01 (Fig. 7). No details of the bores constructed under this licence have been obtained. The location is on the western side of the Beagle Ridge, and the Lesueur Sandstone aquifer here is isolated from aquifers in the vicinity of Woodada. While the Lesueur Sandstone might provide useful groundwater supplies to the west of the Beagle Ridge, its greater depth near Woodada probably gives rise to high groundwater salinities.

Production bores for the Yarragadee aquifer licence are located to the east of the Peron Fault which may provide only some leakage to the adjacent Cattamarra aquifer on the western side of the fault.

4 DISCUSSION OF HYDROGEOLOGICAL ASPECTS OF HYDRAULIC FRACTURING

The proposed hydraulic fracturing is to target the Carynginia Shale which lies at 2,232 to 2,521 m brt depth in Woodada Deep-01. Table 1 shows the depths of the stratigraphic horizons. Currently, the well contains several strings of steel casing shown in Figure 5. Annuli between the casings and the hole walls or the next-largest overlapping casing are partially or wholly cement-grouted.

The Lesueur Sandstone is the lowest stratigraphic unit that is known to produce useful supples of low-salinity groundwater in this region of the Perth Basin and, therefore, in need of protection from contamination. Formations deeper than the Lesueur Sandstone are believed to contain high salinity groundwater in the Woodada region. There is only one licensee: Water Corporation with the licence number 67500 which allows water to be taken from the Lesueur Sandstone at a rate of 470,000 kL/a. The Water Corporation licence location is some 25 km south of the Woodada Deep-01 well. However, the well completion report on Woodada-3 well states that the salinity of water in the Lesueur Sandstone at the well is calculated from geophysical logs to be 40,000 ppm NaCl equivalent. This suggests that the Lesueur Sandstone at Woodada is hydrogeologically separated from the Water Corporation licence area. The Woodada gasfield is on the eastern side of the Beagle Ridge, whereas the WC licence area is on the western side of the ridge.

Assuming the integrity of the well casings and cement grouts are maintained, a major factor with respect to the aquifers overlying the Carynginia Shale will be the maintenance of the hydraulic confming-bed properties of the intervening aquicludes, especially the Kockatea Shale, Carynginia Limestone member and Woodada Formation. These units have a combined thickness of 797 m. The majority of the strata apparently have low or very low permeability, based on lithological descriptions and geophysical logs. Given the probable high salinity of water reported in the Lesueur Sandstone at Woodada-3 well, the deepest formation likely to contain fresh to brackish water is the Eneabba Formation, with its base at 1,186 m brt i.e. 1,061 m above the shallowest hydrofracturing interval (2247 to 2263 m brt) in Woodada Deep -01. Within this section of the sedimentary pile, it is likely that the Carynginia limestone member (Beekeeper Formation) will prove to be competent and resistant to fracturing. It is 99 m thick in Woodada Deep-01.

Rockwater has been informally advised that the hydrofracturing from the planned tests may extend as much as 600 m laterally from Woodada Deep-01 within the Carynginia Shale (AWE pers comm. March 2011). The nearest known major fault (Peron Fault, Fig. 3) which could provide some pathway for vertical propagation of effects in the groundwater from the hydrofracturing, is about 850 m east of Woodada Deep-01.

5 SUMMARY AND CONCLUSIONS

Hydrofracturing of the Carynginia Shale is proposed to be undertaken over three depth intervals, between 2247 m and 2424 m brt within the Carynginia Shale in Woodada Deep-01 well. Rockwater was requested by AWE Limited to investigate potential aquifer interconnectivity following a query from DEC regarding the hydrofracturing test-works. It is necessary that the integrity of the well casings and annular cement grout intervals in Woodada Deep-01 is not compromised by the operations.

The top of the shallowest interval that is proposed for hydrofracturing is at 2247m brt. The base of the deepest recognised potential low salinity aquifer in Woodada Deep-01 well, i.e. the Eneabba Formation, is at 1,186 m brt, ie 1,061 m above the hydrofracturing. A considerable part of this 1,061m interval comprises low permeability strata which would behave hydraulically as confining layers for the fracture treatment fluid (these include the Carynginia Limestone Member, Kockatea Shale and Woodada Formation).

In the vicinity of Woodada Deep-01 well, the Lesueur Sandstone and deeper formations are indicated to contain water that is too saline for normal use. Some of the overlying formations such as the Eneabba Formation and the Cattamarra Coal Measures have been described as having potential to yield useful supplies of fresh to brackish groundwater. They have not been tested in the close vicinity of Woodada Deep-01 well.

In the Arrowsmith Groundwater Area there is one Department of Water licence for the Lesueur Sandstone: Licence No. 67500 which allows the Water Corporation to take water at a rate of 470,000 kL/a. The Water Corporation licence area is some 25 km south of the Woodada Deep-01 well. However, for the Woodada area, the well completion report for Woodada-3 well indicates a salinity of 40,000 ppm NaCl equivalent. This suggests that the Lesueur Sandstone aquifer at Woodada is not continuous to the Water Corporation licence area.

AWE Limited has advised that fracturing of strata should not extend up into aquifers that might contain fresh to brackish groundwater i.e. the Eneabba Formation and Cattamarra Coal Measures which are more than 1,000 m above the depth of the hydrofracturing operation. It is unlikely that effects from the hydrofracturing would be propagated vertically into these aquifers via local minor faults, although this cannot be confirmed from existing data. The nearest known major fault (the Peron Fault) is interpreted to lie about 850 m east from Woodada Deep-01, beyond the expected perimeter of hydrofracturing

Monitoring

AWE Limited advised that geophone sound detectors will be run into hole at a depth of approximately 2,000 m brt in a nearby monitoring well Woodada 14. This monitoring well is located 300 m east of the Woodada Deep-01 fracture treatment well. This real-time monitoring tool is widely used and accepted by the oil and gas industry as the tool of choice to monitor fracture growth vertically and propagation laterally. Details of this real-time monitoring tool will be discussed separately by AWE Limited.

Nearby bores constructed into the Tamala Limestone or other Quaternary-age superficial deposits should be monitored with respect to water level and chemical composition, to establish whether or not the operations have any effect on water levels or water quality in the shallow aquifer.

Dated: **17 March 2011** **Rockwater Pty Ltd**

J S Moncrieff
Principal Hydrogeologist

J R Passmore
Principal

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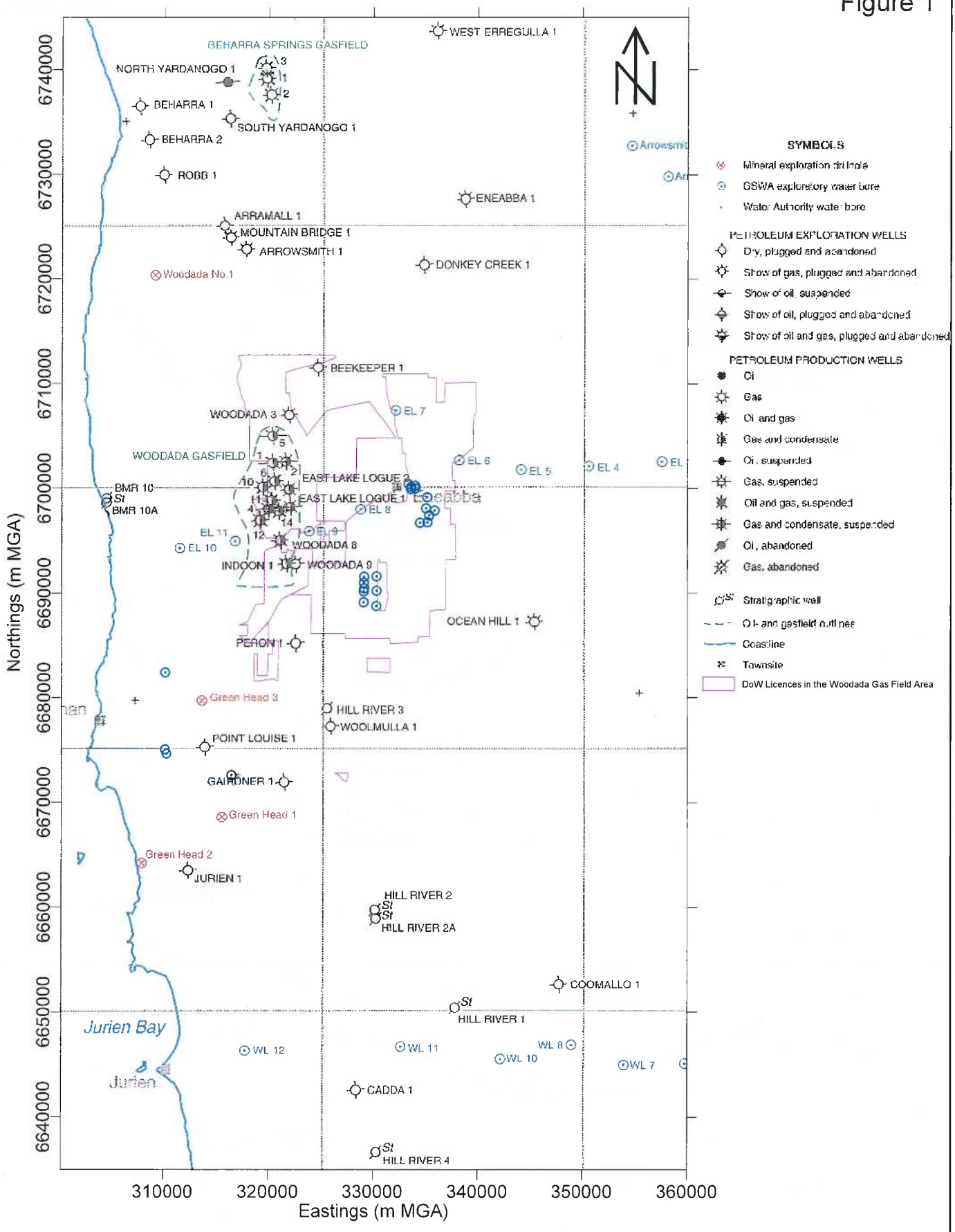
FIGURES

Figure 1



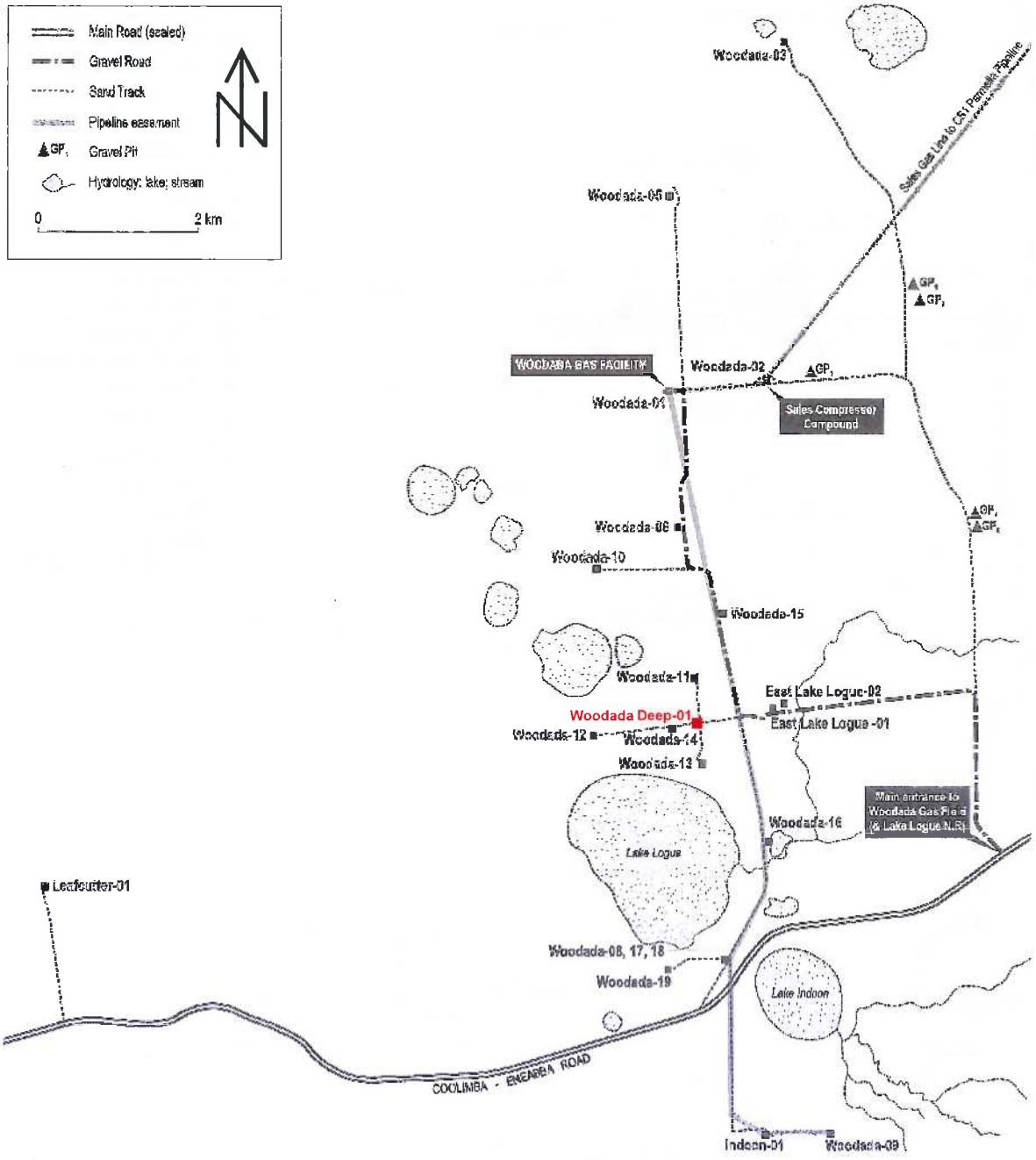
387-0/Surfer/11-01/Oil Well Locality.srf

CLIENT:	AWE Limited
PROJECT:	Woodada Deep-01 Hydrofracturing
DATE:	March 2011
Dwg. No:	387-0/11/1-1

REGIONAL LOCATION AND DEEP BORES

Rockwater

Figure 2

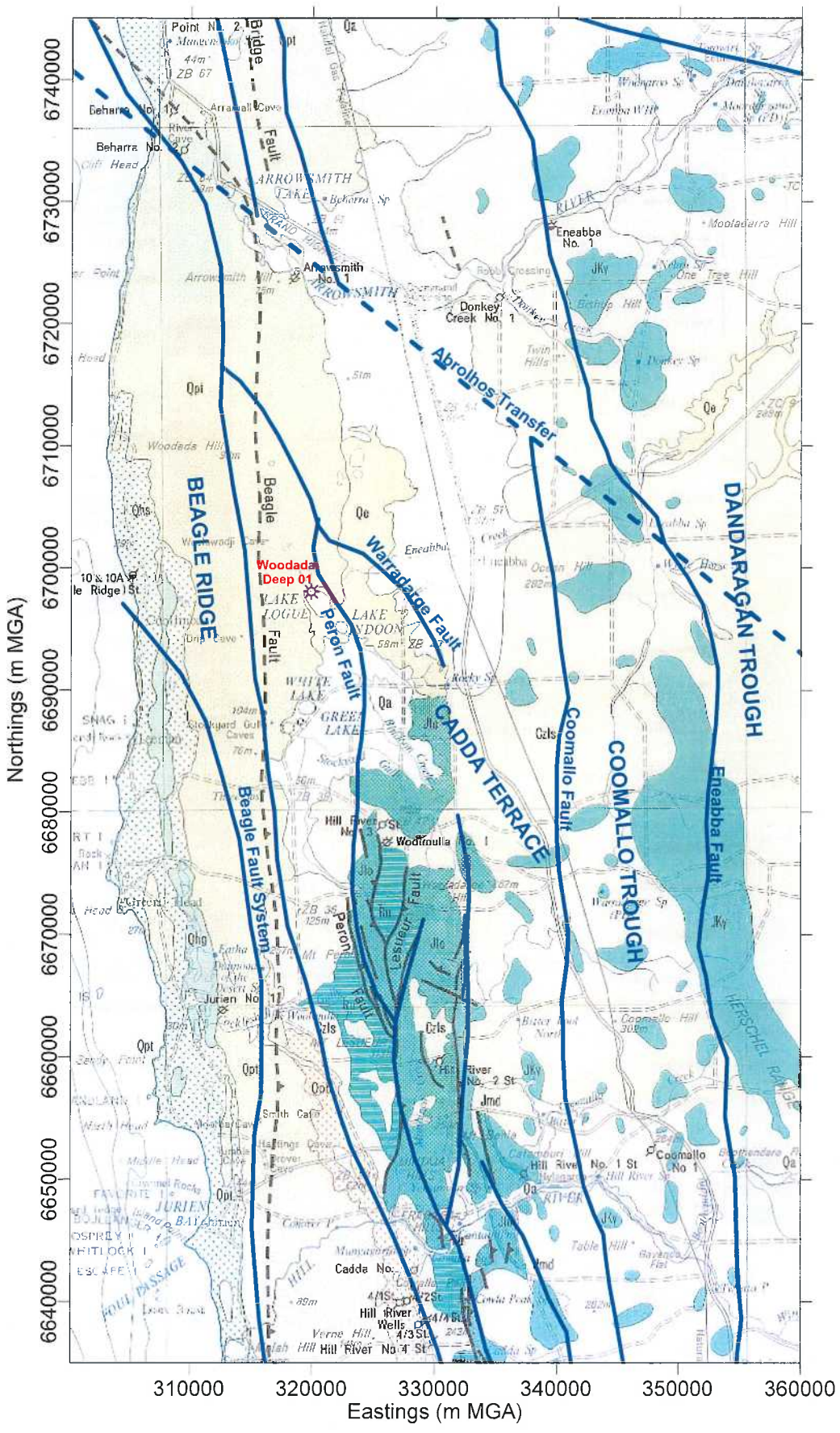


387-0/Surfer/11-01/Woodada Well Field.srf

CLIENT: AWE Limited	LOCATION OF WOODADA DEEP-01
PROJECT: Woodada Deep-01 Hydrofracturing	
DATE: March 2011	
Dwg. No: 387-0/11/1-2	

Rockwater

Figure 3



Geology from Geological Survey of WA.

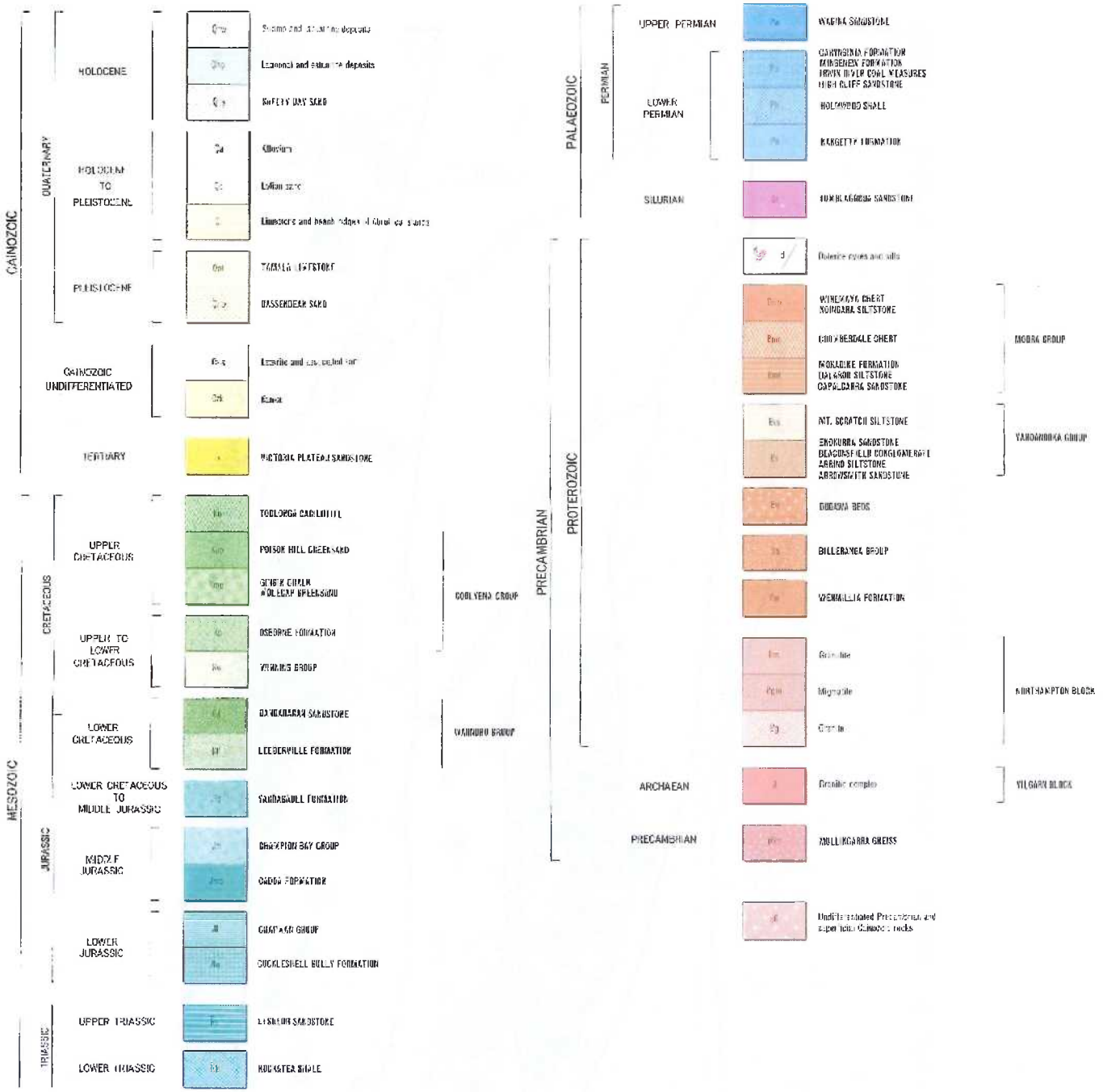
387-0/Surfer/11-01/Geology Locality.srf

CLIENT:	AWE Limited
PROJECT:	Woodada Deep-01 Hydrofracturing
DATE:	March 2011
Dwg. No:	387-0/11/1-3

GEOLOGICAL STRUCTURE

Rockwater

Figure 3A



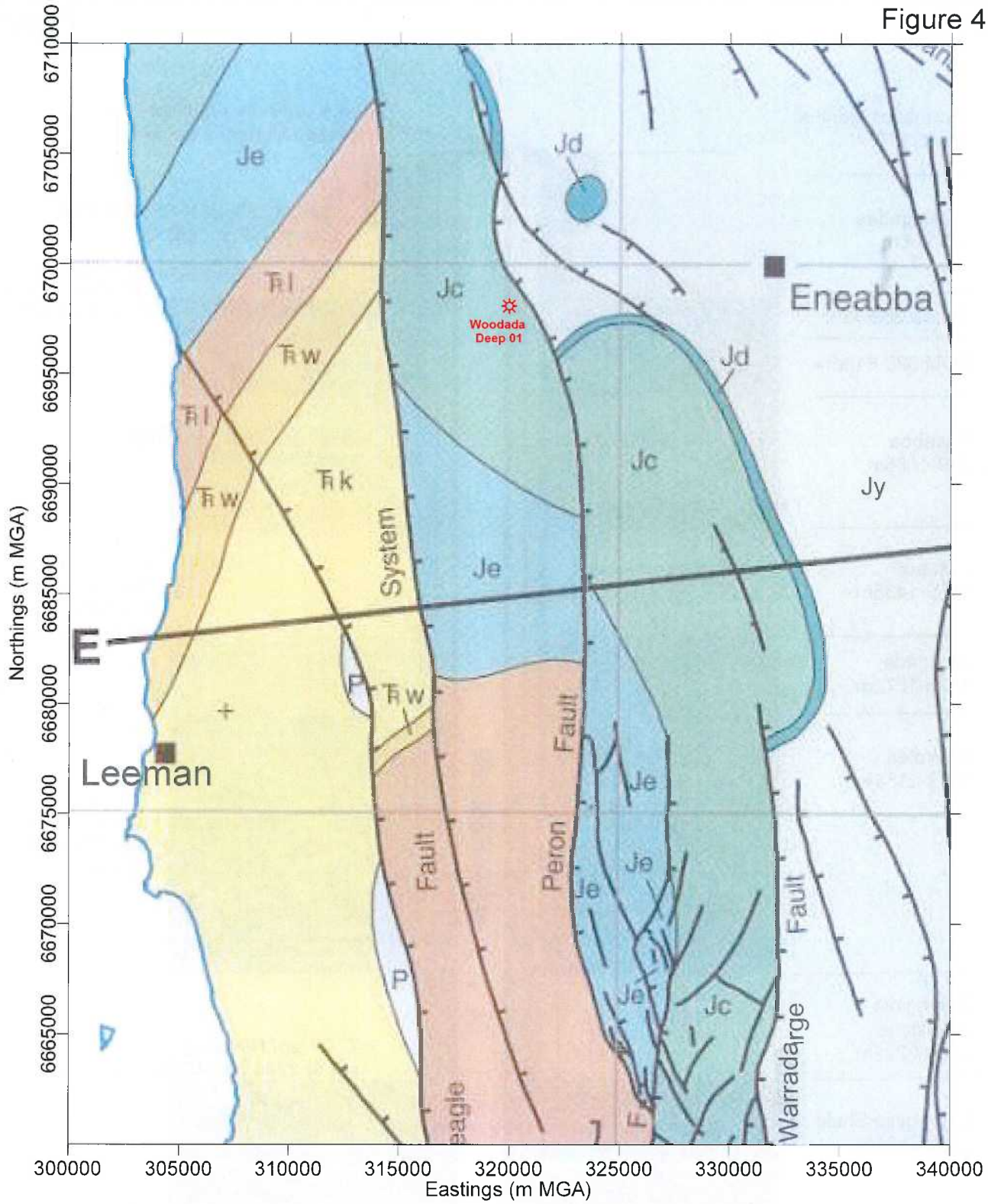
Geology from Geological Survey of WA.

387-0/Surfer/11-01/Geology Legend.srf

CLIENT: AWE Limited	GEOLOGICAL LEGEND
PROJECT: Woodada Deep-01 Hydrofracturing	
DATE: March 2011	
Dwg. No: 387-0/11/1-3A	

Rockwater

Figure 4



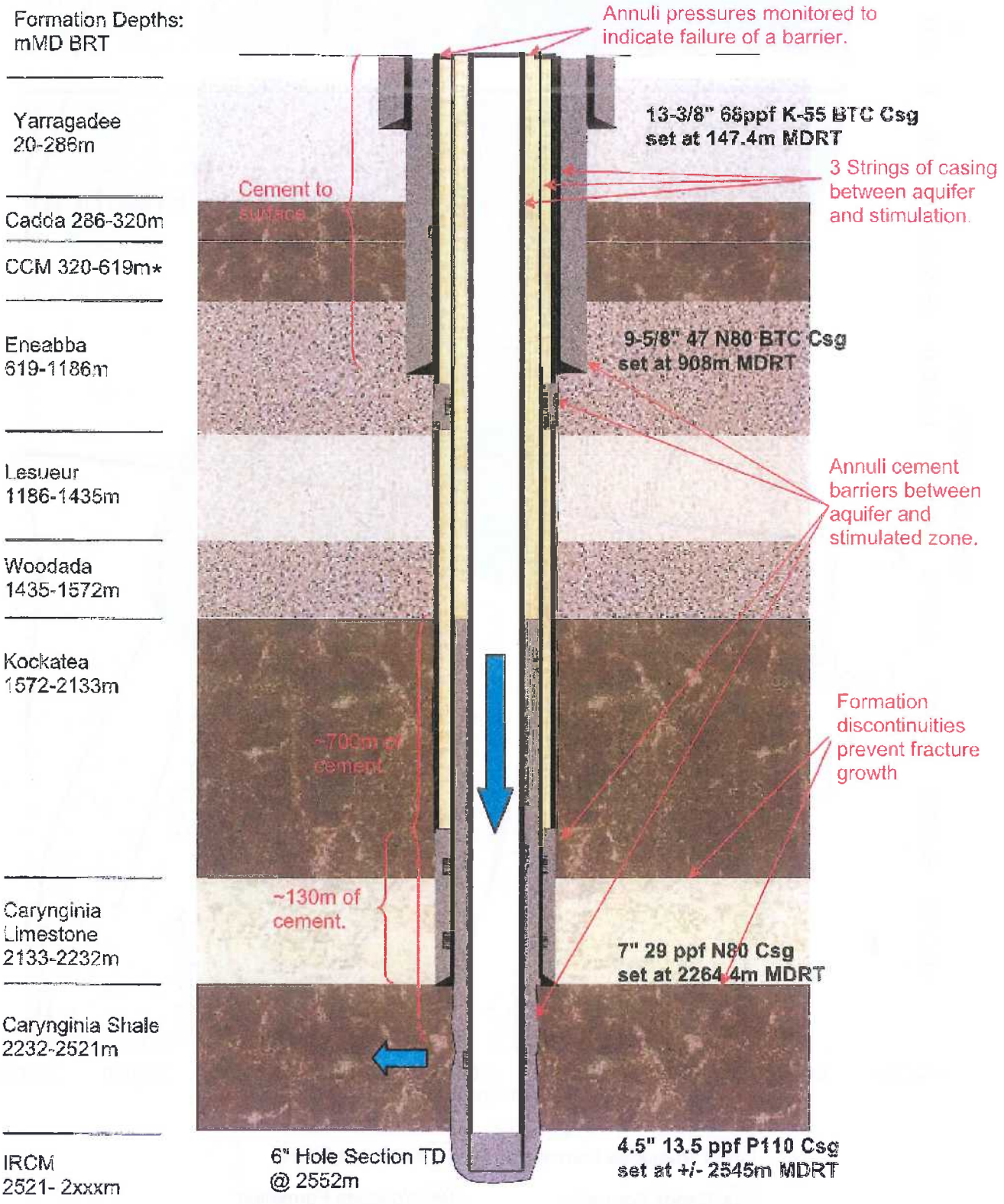
387-0/Surfer/11-01/Subcrop Geology.srf

CLIENT:	AWE Limited
PROJECT:	Woodada Deep-01 Hydrofracturing
DATE:	March 2011
Dwg. No:	387-0/11/1-4

SUBCROP GEOLOGY
(after Mory and Iasky, 1996)

Rockwater

Figure 5



Note: * Cattamarra Coal Measures is interpreted to lie beneath the superficial deposits in the area by Commander (1978).

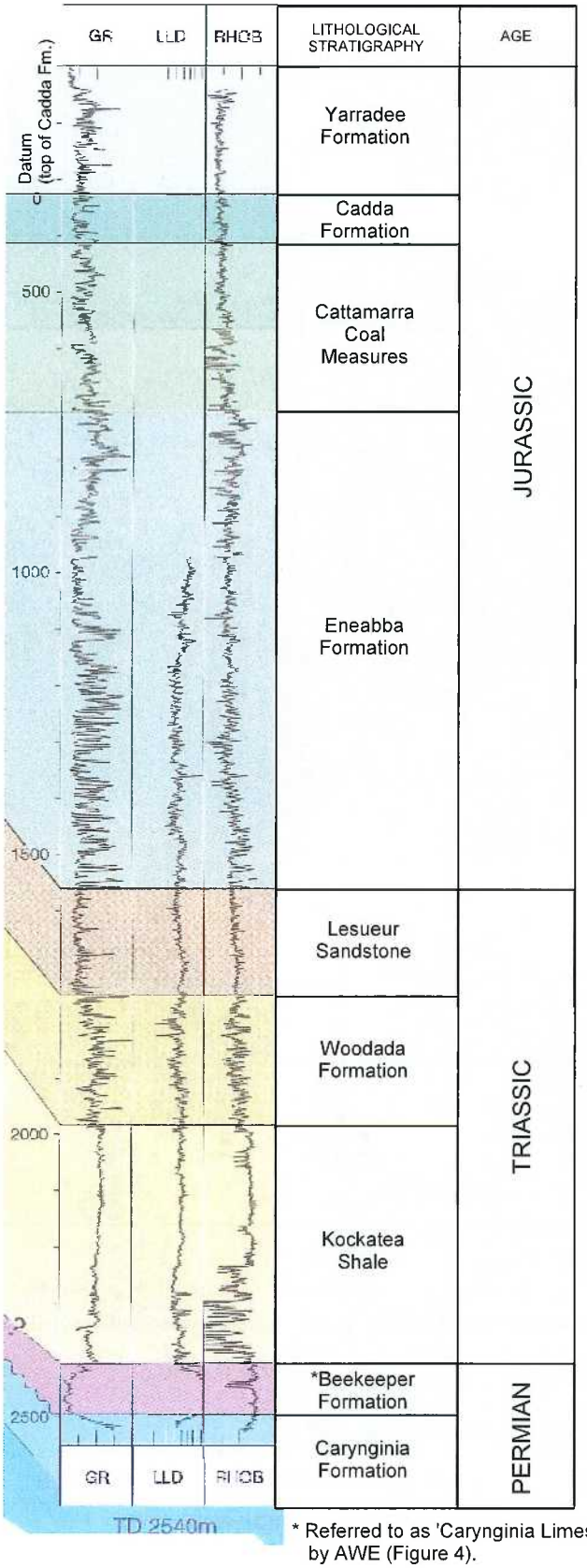
387-0/Surfer/11-01/Woodada Deep 01 Design.srf

Figure provided by AWE Ltd.

CLIENT: AWE Limited	WOODADA DEEP-01 BORE CONSTRUCTION, ANNULAR CEMENTING AND FORMATIONS
PROJECT: Woodada Deep-01 Hydrofracturing	
DATE: March 2011	
Dwg. No: 387-0/11/1/5	

Rockwater

Figure 6



* Referred to as 'Carynginia Limestone' by AWE (Figure 4).

387-0/Surfer/11-01/Woodada 3 Log.srf

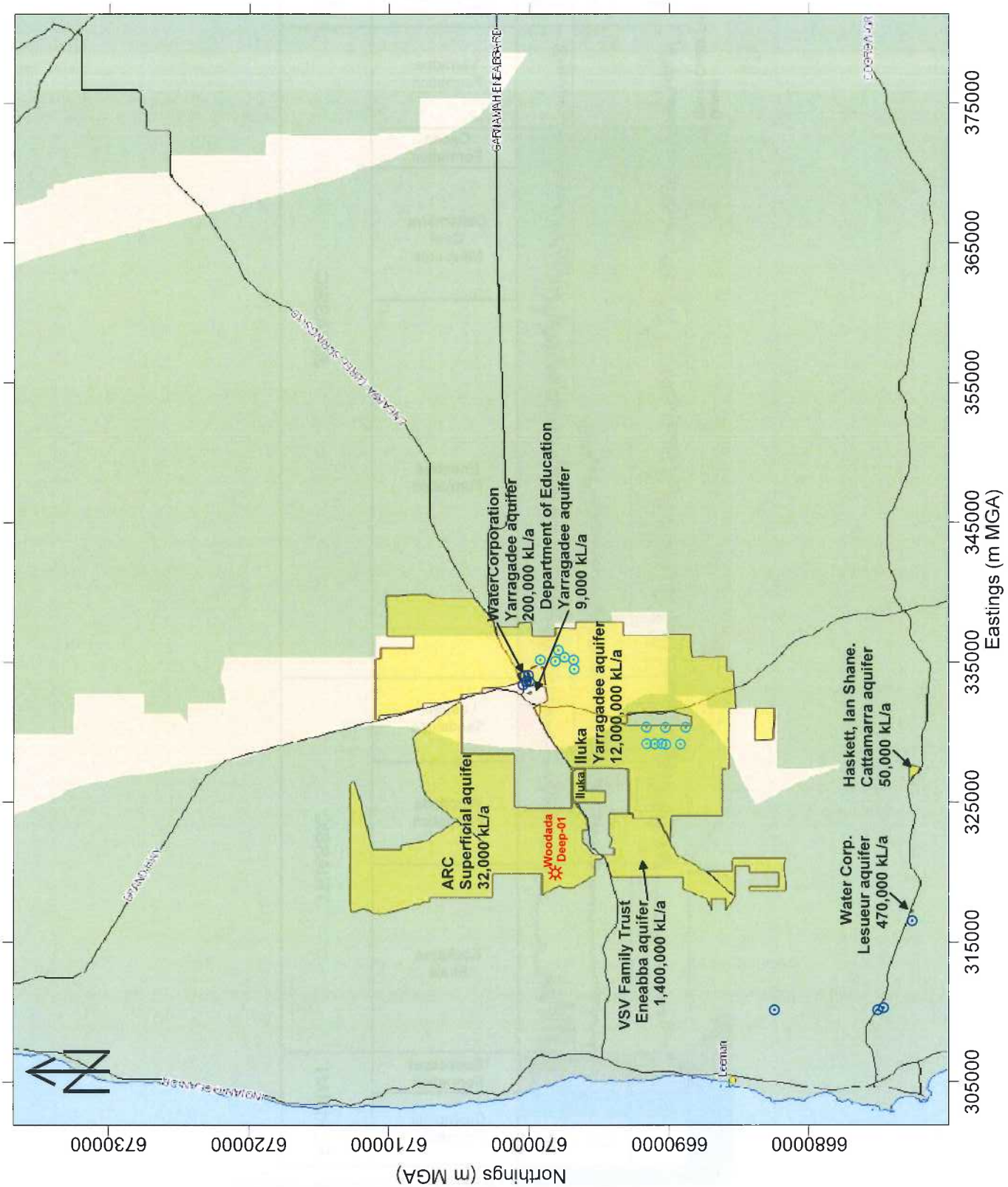
Mory, 1996

CLIENT:	AWE Limited
PROJECT:	Woodada Deep-01 Hydrofracturing
DATE:	March 2011
Dwg. No:	387-0/11/1-6

WOODADA 3
STRATIGRAPHY AND LOGS

Rockwater

Figure 7



387-0/Surfer/11-01/DoW Licences.srf

CLIENT:	AWE Limited
PROJECT:	Woodada Deep-01 Hydrofracturing
DATE:	March 2011
Dwg. No:	387-0/11/1-7

LICENCES TO TAKE GROUNDWATER
IN THE VICINITY OF WOODADA DEEP-01

Rockwater

Perth
[redacted]

12 June 2015

David Guise
Regional Manager – Western Australia
AWE Limited
Level 3, 1101 Hay Street
West Perth WA 6005

RE: Investigation of Noise and Odour Complaint from Senecio-03 Well Intervention and Production Testing

Dear David,

Aurora Environmental provide this letter of advice detailing the findings of the environmental investigation in response to a written complaint received by the Department of Environment Regulation (DER) regarding flaring associated with well testing of the Senecio-03 well.

BACKGROUND

The Senecio-3 well site is located within Permit L1, approximately 14.5 kilometres (km) east of Dongara and 367 km north of Perth, Western Australia. The Senecio-03 well in the Senecio Gas Field was spudded on 4 August 2014, and allows access to gas within the Dongara/Wagina formation located greater than 2,600m below ground level and additionally allowed for the exploration of deeper formations (Carynginia, Irwin River Coal Measures and High Cliff Formations). The exploration and testing of the deeper formations identified a significant gas discovery in the deeper sands, which has the potential to contain more gas that than the shallower Dongara/Wagina formation.

In order to accurately evaluate and test the two separate reservoirs AWE Limited (AWE) conducted well intervention and production testing on Senecio-03 between 18–21 February and 8-15 March 2015 which involved intermittent flaring of gas from the well over a total of 10 days.

In accordance with the requirements of the *Petroleum and Geothermal Energy Resources (Environment) Regulations 2012* (the 'Petroleum (Environment) Regulations'), the environmental risks and potential impacts of the activity (including noise from flaring) and management measures to mitigate the risks identified were presented in the *Senecio-03 Well Intervention and Production Testing Environment Plan Bridging Document* which was lodged with the Department of Mines and Petroleum on 7 November 2014 and subsequently approved.

A detailed stakeholder consultation program was undertaken by AWE during the preparation of the Environment Plan Bridging Document as required by Regulation 17(1)(b) of the Petroleum (Environment) Regulations). The consultation began in July 2014 and included a number of local residences (within 3 km of the well site) and the Shire of Irwin via various methods including mail outs, community information sessions, emails, phone calls and face-to-face meetings. AWE liaised closely with nearest residents to Senecio-3 and the Shire about the flaring plans and limited the consultation to those likely to be impacted based on previous experience with the Senecio-02 well.

No complaints regarding noise or odour were received during the four days of well testing of the Senecio-02 well in September 2012, located closer to the Irwin township, approximately 2.1km south of the town and 1.8 km northeast of Senecio-03 well. On this basis, noise mitigation measures implemented during flaring at the Senecio-02 well were considered successful.

As no noise or odour concerns were raised by stakeholders, and no complaints were received during flaring of the Senecio-02 well, AWE considered the enhanced noise management measures (diffuser and raised bund walls on the flare pit) to reduce noise emissions at Senecio-03 well site would be adequate. To confirm the adequacy of the management measures implemented, AWE also conducted noise monitoring at the well site during flaring.

Flaring at the Senecio-03 well commenced on 18 February 2015 and anecdotal information was received that the flare had initially been noticed by the nearest residents and their animals, and said they had not been unduly disturbed. On 10 March AWE personnel heard reports of local residents' concerns being made via social media and promptly followed this up with one of the neighbouring landowners asking them to help AWE contact the concerned resident. Based on this report via social media, AWE then decided to delay restarting the flare until daylight hours. AWE was able to contact the complainant, discuss their concerns and possible solutions including providing alternative temporary accommodation.

On 11 March, the AWE Regional Manager (Mr David Guise) met with Mr Rod Copeland to continue discussions regarding an unrelated matter on his property, and both Mr Guise and Mr Copeland observed the sound from the direction of the flaring. Aurora has been informed that Mr Guise and Mr Copeland have had previous conversations and both parties had contact phone numbers for each other.

On 15 March 2015 a complaint about noise emissions from the flare was received via phone from a local resident. In the hour following the complaint, AWE Limited (AWE) suspended the flow testing and shut-down the flare. AWE organised a meeting with concerned and available community members for the following evening (16 March 2015).

On 17 March 2015, Mr Copeland, resident at 26926 Midlands Road, Irwin WA, distributed a letter dated 13 March 2015 signed by 34 people from 20 residences in Irwin. The letter was distributed by email to; AWE, the Shire of Irwin and councillors, Hon Terry Redman MLA, Shane Love MLA, Hon Paul Brown MLC, Hon Mia Davies MLA, Hon Brendon Grylls MLA, Hon Martin Aldridge MLC, Vincent Catania MLA, Hon Dave Grills MLC, Hon Colin Holt MLC, Hon Jacqui Boydell MLC, Premier of WA, Minister for Mines and Petroleum, Mark McGowan MLA, Hon Gary Gray MP, Department of Mines and Petroleum (Phil Gorey, Mr Brad Jakowyna and Laura McCarthy), APPEA, CEO of WA Farmers, CEO of Shire of Carnamah, CEO of Shire of Three Springs, CEO of Shire of Coorow, CEO of Shire of Mingenew, CEO of City of Greater Geraldton, CEO of Shire of Northampton, Central Greenough Frack Free Zone, Conservation Council of WA, Peter Robertson, Jaime Yallup, Jo Franklin, Frack Free Geraldton, Claire Moodie, Geraldton ABC Radio Morning Show, Melissa Price Federal member for Durack, Jane Hammond Lock the Gate Media co-ordinator and Mr Ian Blayney MLA for Geraldton. The letter and email is provided in Attachment 1.

AWE (Jane Aberdeen, Regulatory and Community Affairs Manager) received a phone call from the Department of Environment Regulation (DER) (Mark Brand) on 18 March 2015 whom was investigating Mr Copeland's complaint. Ms Aberdeen explained the actions that had been taken and that the flare had been shut-down. Aurora has been informed that once he was aware of this, Mr

Brand requested additional information regarding the flaring schedule, the Environment Plan Bridging Document and the notification letters sent to stakeholders for his reporting requirements to the DER Executive.

AWE responded to Rod Copeland's email with a letter dated 20 March 2015. This letter is provided in Attachment 2. The letter was also sent to the concerned residents whom attended the meeting on 15 March, the Shire and local Irwin residents.

AWE has subsequently commissioned Aurora Environmental (Aurora) to assess the impacts from noise and odour emissions on the residences of Irwin during the flaring. Aurora provide this letter to respond to the DER's queries and outline the results of the investigation into the validity of the claims regarding noise and odour impacts from the flaring.

FLARING ACTIVITY

Flaring or burning of gas, was undertaken within the flare pit at the Senecio-03 well on the dates and times listed in Table A. The wind direction and speed data from the Bureau of Meteorology's (BoM) Geraldton Airport station (ID: 008315), which is the nearest weather station to the well site with available data, has been correlated with the flaring periods (Table A).

TABLE A: FLARING AT SENECIO-03 WELL

Date of Flaring	Time of Flaring	Duration of Flaring	Wind direction (degrees true)*	Average wind speed (range)* (km/h)
18 February 2015	11:00am to 5:15pm	6 hours 15 mins	SSE – S (160° – 190°)	36 (24 – 46)
20 February 2015	2:45pm to midnight	9 hours 45 mins	SSE – SSW (170° – 220°)	30 (22 – 37)
21 February 2015	Midnight to 1:45pm	13 hours 45 mins	SE – SSW (130° – 200°)	27 (17 – 41)
8 March 2015	10:45am to midnight	1 hour 45 mins	E – S (80° – 190°)	26.5 (11 – 42)
9 March 2015	Midnight to 8:30am	8 hours 30 mins	NNE – SSW (30° – 210°)	13 (5 – 21)
11 March 2015	6:00am to midnight	18 hours	N – SW (0° – 230°)	16 (0 – 28)
12 March 2015	Midnight to midnight	24 hours	N – W (0° – 270°)	12 (0 – 24)
13 March 2015	Midnight to midnight	24 hours	NNE – N (30° – 360°)	16 (5 – 35)
14 March 2015	Midnight to midnight	24 hours	N – NNW (0° – 340°)	28 (0 – 52)
15 March 2015	Midnight to 8:30pm	20 hours 30 mins	SSW – NW (210° – 320°)	17 (8 – 24)

*Data sourced from BoM at half–hourly intervals for the period 18 February 2015 to 15 March 2015.

INVESTIGATION OF NOISE EMISSIONS

Whilst the oil and gas activity of well evaluation and production testing is regulated under the Petroleum (Environment) Regulations, causing pollution (including noise pollution) is an offence under the *Environmental Protection Act 1986*. The key piece of legislation for setting noise limits and determining if noise is unreasonable is the *Environmental Protection (Noise) Regulations 1997* (the 'Noise Regulations').

The nearest residences to the well site are located approximately 3.3 km to the northwest (26825 Midlands Road) and 3.4 km to the north (40 Morgan Lane). The wind conditions under which impacts to the nearest residences may occur are under calm to light south-easterly to south winds.

Calm (0km/h) to light (< 19 km/h) (Beaufort Wind Scale 0-3) south to south-easterly wind conditions prevailed on:

- 21 February for 3 hrs;
- 8 March for 1.5 hrs;
- 9 March for 5.5 hrs;
- 11 March for 6.5 hrs;
- 12 March for 4.5 hrs;
- 13 March for 8.5 hrs; and
- 14 March for 1.5 hrs.

Based on the data recorded at the Geraldton Airport weather station (Table A). Under these conditions it is likely that sound from the flare could be heard at these residences during flaring.

To understand the intensity of the sound on the nearest residences, the maximum noise that could be produced from the source (i.e. flare pit) was established. The sound power level of the flare can be estimated to be 135 dB(A) based on monitored data. This can be used to accurately model noise levels during flare operation. Based on the outputs of this modelling it is estimated that noise levels at premises 3-4 km away from the flare pit could have been 45 dB(A). Based on this modelling, the level of noise is likely to have been audible to residences and could have exceeded the assigned noise levels allowable under the *Environmental Protection (Noise) Regulations 1997* (Table B) during evenings and night-time (1900 to 0700 hours). However as data on noise levels was not collected an exceedance of the assigned levels cannot be confirmed.

TABLE B: ASSIGNED NOISE LEVELS FOR NOISE SENSITIVE PREMISES

Type of premises receiving noise	Time of Day	Assigned Level (dB)		
		$L_{A\,10}$[1]	$L_{A\,1}$[2]	$L_{A\,max}$[3]
Noise sensitive premise: highly sensitive area[4]	0700 – 1900 hours Monday to Saturday (Day)	45	55	65
	0900 – 1900 hours Sunday and Public Holidays (Sunday / Public Holiday Day)	40	50	65
	1900 – 2200 hours all days (Evening)	40	50	55
	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and Public Holidays (Night)	35	45	55

AWE used qualitative data, previous experience and additional controls to ensure that the operation of the flare at Senecio-03 would not contravene the allowable noise levels specified in the Noise Regulations. This view was formed on the following basis:

- Flaring conducted at Senecio-02 well had not resulted in any complaints or exceedance of the Noise Regulations and this well site was located in a more sensitive location closer to residences;
- In view of the fact that gas production rates at Senecio-03 were expected to be higher than at Senecio-02, AWE adopted enhanced noise controls including fitting a diffuser to the flare and installing raised bund walls around the flare pit; and
- The design and control measures had been endorsed by the regulator.

However based on the meteorological data presented above, during the hours of which the prevailing winds were optimal for disturbing residents, it appears that noise levels may have exceeded the allowable criteria although no actual measurements exist to confirm this.

[1] $L_{A\,10}$ assigned level means an assigned level which, measured as an $L_{A\,Slow}$ value, is not to be exceeded for more than 10% of the representative assessment period.
[2] $L_{A\,1}$ assigned level means an assigned level which, measured as an $L_{A\,Slow}$ value, is not to be exceeded for more than 1% of the representative assessment period.
[3] $L_{A\,max}$ assigned level means an assigned level which, measured as an $L_{A\,Slow}$ value, is not to be exceeded at any time.
[4] Highly sensitive area means that area (if any) of noise sensitive premises comprising —
(a) a building, or a part of a building, on the premises that is used for a noise sensitive purpose; and
(b) any other part of the premises within 15 m of that building or that part of the building.

Aurora considers AWE's immediate responsive action to the initial complaint, including shutting down the flare within an hour of the noise complaint and organising a public meeting to openly discuss the issue were appropriate.

In order to prevent a recurrence of this situation, Aurora recommends that for future well evaluation and production testing, a **N**oise **M**anagement Plan is developed and approved by DER.

It is understood that some residents suggested that the noise emissions from the flare caused vibration which rattled windows. Advice from a recognised acoustical consultant (Herring **S**torer Acoustics, Tim Reynolds) indicated that such vibrations could typically only occur in very close proximity to a noise source such as a flare (i.e. within the boundaries of the well site).

ODOUR EMISSIONS

Impacts from odour emissions are regulated under the *Environmental Protection Act 1986* by the DER.

The assessment of odour impacts is a difficult process as it is highly subjective in nature with some individuals finding odours offensive that others consider part of their daily life. An example of this is that farmers who work day in day out with farm animals and experience the odour of animal manures and urine without being significantly offended while a person from an urban environment going to a farm is likely to find such odours offensive. In addition, the measurement of odours is difficult as there are currently no proven instruments for odour measurements (although some are being developed). This means that odour assessment is generally conducted using the human nose and that the odour assessor needs to be trained to characterise odours effectively and also needs to be present on site at the time an impact occurs.

In the case of the **S**enecio-03 well, the gas in question is a sweet, dry gas. This means the gas is primarily methane (measurements show the composition is in excess of 93% v/v methane) with minimal sulfur compounds (H_2**S** concentrations were measured to be typically in the range of 1-2 parts per million (ppm) and no measurement exceeded 3.8 ppm) and contains minimal condensate (liquid or long chain hydrocarbons). Accordingly, the gas would not be highly odourous in nature but as with all raw natural gases it will contain at least some trace levels of organic compounds other than methane that could give it a characteristic hydrocarbon odour. It should be noted that methane does not have a detectable odour which is why stenching agents such as mercaptans are added to reticulated natural gas supplies so gas leaks can be readily detected.

Aurora is familiar with gas production well sites and can only identify three potential odour sources that may contribute to odours at the time of the well commissioning:

1. Odours derived from any liquids that are separated from the gas after it exits the wellhead (usually a mixture of condensate and possibly some water);
2. Incomplete combustion of gas in the flare; and
3. Fugitive leakages of gas from flanges, valves and seals.

As gas is flammable/explosive and a valuable commodity, the oil and gas industry takes great care to minimise fugitive loss of hydrocarbons for commercial safety and environmental reasons. The design and maintenance of equipment is of the highest standard to minimise the release of flammable products to the maximum extent possible. In addition, flammable gas meters are placed

in the vicinity of the wellhead to provide early warning of any gas release that may represent a safety hazard in which case production would immediately be shut down.

Advice from AWE indicates there have been no gas alarms, from gas detection at the Senecio-03 well and in addition, measurements of ambient levels of hydrocarbon gases conducted by an independent consultant (Gemec) detected only very low trace levels of a hydrocarbons (See data in Attachment 3) which could not have contributed to off-site odour complaints outside the well site. Finally workers working in the vicinity of the well head did not detect any offensive odours.

As a result it is considered extremely unlikely that fugitive gas releases could have contributed to off-site odour impacts.

With regard to liquids, the well and flare system incorporated a closed condensate capture system to prevent the release of hydrocarbons to atmosphere. AWE has advised that only a few litres of hydrocarbon liquids were collected in this sealed system during the operation of the flare and as a result the condensate system is considered unlikely to be an odour source. This view is confirmed by the fact that AWE staff did not detect any significant hydrocarbon odours in the vicinity of the well site.

The final possible odour source is the flare. The flare is designed to ensure virtually complete combustion of any gas and liquids. The effective performance of the flare in this regard is shown by the fact that there was no dark smoke and extremely limited visible grey or white smoke emissions on an occasional basis during the flaring. This is confirmed by AWE workers including contractors and videos of the flare in operation viewed by Aurora staff.

The gas directed to the flare consisted of short chain organic compounds i.e. primarily C_1- C_4 compounds with the majority (>93%) being odourless methane and minimal long chain organic compounds with only trace levels of H_2S which would have been converted to SO_2 (which is not odourous at low concentrations like H_2S) in the combustion process. It is difficult to see how the flare could have represented a significant off-site odour source. It is however noted that the intense heat released during flaring, gives rise to a substantial thermal plume rise for burnt gas from the flare which means that it is conceivable that if odourous emissions were released from the flare, they may not be detected locally but could be detected a distance downwind when the plume re-intersected with the ground.

AWE staff indicated that they did not personally detect offensive odours either on or off-site during the operation of the flare.

RECOMMENDATIONS

Aurora understands no more flaring is expected at the Senecio-03 well.

AWE intends to continue exploration in the Perth Basin, within the Dongara region and will need to responsibly manage future flaring activities to reduce the potential impacts to the local community to as low as reasonably practicable (ALARP).

In order to achieve management to ALARP Aurora recommend implementing the following noise management strategies for future flaring:

1. Prior to future well evaluation and production testing, the Shire of Irwin, local residents and the DER is notified of the flaring schedule and provided with an opportunity and the details of the AWE contact person to liaise with during the flaring period.

2. Review the design of the flare pit for each new well site, and have the design verified in terms of noise emissions on nearest residences via noise modelling. Modify the flare pit design by either:
   a. Increasing the height and improving the design of noise bunds.
   b. Incorporating more diffusion area.
   c. Review selection and option of inline noise diffuser to assist in minimising noise from the flare.
3. If construction activities (including flaring) are carried out between 0700 and 1900 hours Monday to Saturday and noise emissions are controlled by using all reasonable measures then the noise emissions are exempted from meeting the Assigned Noise Levels in the Noise Regulations. If construction works are undertaken outside these hours and AWE believe it is possible that the relevant assigned noise levels at nearby premises may be exceeded, then a Noise Management Plan must be prepared and submitted to the CEO of the DER for approval prior to the commencement of flaring.
4. For future well sites, an allowable noise limit measured at set distance from the flare should be established by noise modelling studies that will ensure that noise levels at the nearest sensitive premises is in compliance with the relevant assigned noise levels. When flaring commences, AWE should perform check measurements at the set distance from the flare to verify that the flare is operating as designed and is unlikely result in exceedances of allowable noise limits.
5. Noise monitors should be set up at the nearest noise sensitive premise to log noise emissions during flaring, with an alarm system (via sms to mobile phones) that is triggered if noise exceeds allowable limits. The logged data should be compared with noise modelling predictions to assess which residences may have been impacted and implement adaptive management.
6. If necessary, cease flaring during light prevailing winds in the direction of noise sensitive premises.

For and on behalf of Aurora Environmental

Noel Davies
Principal

Attachments:

1. Rod Copeland Email dated 17 March 2015 with letter attached dated 13 March 2015
2. AWE letter dated 20 March 2015
3. Gemec Monitoring Data

ATTACHMENT 1

Rod Copeland Email dated 17 March 2015 with letter attached dated 13 March 2015

[redacted]

From: [redacted]
Sent: Wednesday, 27 May 2015 4:27 PM
To: [redacted]
Subject: FW: AWE - additional information - confidential
Attachments: Concerned Members of the Irwin Community 16-03-15.pdf

From: Rod & Annette Copeland [redacted]
Sent: Tuesday, 17 March 2015 1:11 AM
To: [redacted]
Cc: [redacted]
Subject: CONTINUOUS NOISE AND ACRID SMELL EMISSIONS FROM WAITSIA WELL @ IRWIN W.A.

To all of the individuals, government representatives or instrumentalities (Local, State and Federal), Action Groups, Farming Representative Bodies, and Oil and Gas Industry representatives, to which the attachment has been forwarded, this email is to inform you of the list of other entities that have also been sent this correspondence, and why.

THE SHIRE OF IRWIN and COUNCILLORS
It should be noted that the Shire, by its own declaration and we quote from ENVIRONMENTAL HEALTH section on the webpage that "Active involvement by local authorities in Environmental and Public health issues has achieved massive improvements in the quality of life and longevity of most Australians. However new health hazards have emerged in recent years—for example bird-flu, chemical sensitivity or noise exposure—that might have the potential to affect the health of residents."
It was with the references to chemical sensitivity and noise exposure that we as a community felt obliged to make this complaint.
We believe that the current noise and acrid smell emitting from Waitsia comes within these parameters.
We therefore insist that the Health representatives from the Shire are immediately reactive to our complaint and act on our behalf as ratepayers.

As this is a letter of complaint to our local government representatives, it is anticipated that it will be listed on the next meeting agenda and be discussed at the next meeting.

TO ALL OTHER LOCAL GOVERNMENT BODIES THAT WE HAVE CONTACTED,
Please be advised to what we, as a community, are now having to endure and this is only the beginning of what may happen within your own Shire.

THE HEALTH DEPARTMENT,
You are included because the problems that we are enduring are of vital importance to the current well-being of us and our children, and the long term health of the community and environment.

TO ALL POLITICIANS WHETHER STATE OR FEDERAL,

We, as voters in all levels of government, have contacted you so that you may be aware of what we are having to put up with, after some of your decision-making is foisted upon us,
You should be aware that some are your decisions are not made with the wishes of a majority of voters and those decisions have major impacts on peoples' lives during implementation of those ill-informed decisions and for a long time after.

FARMING REPRESENTATIVE BODIES,
You have been included on our list of contacts because you represent a large number of complainants that are now being currently impacted and in the future, your members will be more greatly affected, by what is happening right across the State of WA.

ACTION GROUPS,
You have been included because some of the problems inherent with O and G developments have already begun to surface in our region and we need your ongoing support to combat those problems.

THE OIL AND GAS INDUSTRY,
You have been included on our list simply because of your title.
You are the companies that want to make gross profits from the Oil and Gas underneath the land and the sea with little or no regard to adverse impacts on the citizens of that region.

One complainant received a phone call late on Friday 13 march 2015, from a representative of AWE, questioning whether they had any complaint about the flaring and its impact.
Unfortunately he was not at home and because of the timing of the call has not been able to respond, within working hours.
It would be advisable to call more residents of the area and we are quite sure that the message delivered would've been appropriate for what the true community thoughts are on the matter.

APPEA,
You have been included because you are the industry mouth-piece that continually pushes that the Oil and Gas industry is not a threat to the health and well-being of the community.

.
THE MEDIA OUTLETS
We are informing you of our concern of what is happening within our region so that more people are aware of what is going to happen in a vast number of regions in this State.

We are at the forefront of what is happening now, and want it known to EVERYONE in Government and industry that decisions made now, will have a detrimental effect on peoples' lives now and into the future, long after Oil and Gas has left our area, even after the burning of fossil fuels is a long lost memory.

The accompanying attachment is a true indication to our opposition to what is happening.

We are aware that by the time that this letter is received, testing may well have finished and AWE will probably say we have nothing more to worry about.

How far from the truth is that?

Please note that a hard copy will be forwarded to all listed entities and individuals

FROM
The concerned and united community of Irwin.

To all of the parties to which this letter has been forwarded to, please note, that we the undersigned,

Hereby notify each and every party that we are making a formal complaint about the continuous noise and burnt gases/condensate pollution that is currently being emitted from the Waitsia Gas-well on Irwin Park @ Irwin about 10km east of Dongara, by the Oil and Gas Company AWE Perth Pty Ltd (O and G)

We are the residents and/or frequent visitors of/to the immediate area within 5km radius of the Locality known as Irwin Town-site and immediate surrounds, and are in the direct line of impact for ANY pollution event that may occur from within the area of drilling for O and G

We are also ratepayers within the Shire of Irwin and with that, voting members of the public, for Local, State and Federal Governments.

We understand that the oil and gas company, AWE Perth Pty Ltd is undertaking a testing program of the new Waitsia well to prove its flows, volumes etc

We are all disgusted with the level of noise/roar/acrid smell being emitted from the flare, said to be set at "quarter choke". We'd all hate to hear the noise of full choke!

Perhaps some of you would like to be around for that?

Some of us have young children who are finding it impossible to sleep at night.

The adults are complaining that they can't sleep.

To drown out the noise, even the volume of the TV has to be increased substantially.

The constant "thump" of the concussion has given many residents a continuous headache.

Many are enduring the pain of sore eardrums.

Also many residents are experiencing an elevated increase in hay-fever like symptoms, sore and running eyes and nose and throat irritation.

We live with it by day, go to sleep (hopefully) at night, and wake to it (sometimes numerous times) in the morning.

Yesterday the smell of burnt diesel (perhaps condensate) was very heavy in the air(Thursday 12-03-15)

Currently we are enjoying (without the noise) what is considered to be the best living time of the year in this locality. It's a blight on the Oil and Gas Company, that after suffering through 35C plus days that we cannot have our windows open to enjoy the cooling night breezes.

WE SHOULD NOT HAVE TO PUT UP WITH THIS NOISE, ACRID SMELL AND DISRUPTION.

One can wake at night, and the incessant drone of the choked flare does not allow you to go back to sleep.

We all have developed small landholdings as a way of life in this area, because of the peacefulness and beauty of this part of the Shire, and did so without expecting to have our lives impacted in this manner.

Unfortunately with what was discussed on radio on Tuesday 10 March 2015 by the CEO of AWE Mr Bruce Clement, this is only the precursor of more to come.

To best describe the noise

(1) It is like standing within the Perth Airport, and listening to the roar of a plane on the tarmac at full revs and going nowhere
(2) It makes the houses vibrate from the concussion
(3) The constant vibration from the concussion makes one's ears hurt
(4) Even an AWE employee noted to an executive, that he could hear the noise at the Corybas well –site which is a further 1.5+ km away
(5) The same AWE executive stated that he was surprised how far the noise was carrying and how loud the noise was, when visiting one complainant's farm on Wednesday 11th March 2015.
(6) The impression given was that something was going to be done to lessen the impact on the local residents, hopefully curtailing the noise, but to now nothing has been done.
(7) On numerous occasions, dependent on wind direction, the acrid smell of the fumes being emitted, are that strong to be almost overcoming.

Everyone of you live kilometres away from this area and are not enduring the impost of this "noise/acrid smell invasion"

As citizens we are entitled to a peaceful night's sleep, especially as on the next day we have to perform our duties in a normal and fulfilling manner.

We acknowledge that a meter used for reading decibels of noise may show that the actual level of noise is not too extreme, but what it doesn't read is the continuity of the never changing sound and the annoying frequency of that noise.

What we cannot understand is, why after testing on the Sunday 8th March 2015 with the same extreme noise/roar/acrid smell from the site, and the subsequent joyous announcement to the ASX on Monday 9th March 2015 that the "find" was as big as previously announced and that contracts were being negotiated for the sale of the gas, THAT ANY MORE TESTING WAS NECESSARY?

To us, it appears a blatant waste of the gas, and a definitely unnecessary interruption to our lives, all in the name of profits.

THE UNDERSIGNED on 13th MARCH 2015

NAME	ADDRESS	PHONE/FAX/E-MAIL	SIGNATURE
[redacted]			

THE UNDERSIGNED

NAME	ADDRESS	PHONE/FAX/E-MAIL	SIGNATURE
[redacted]			

THE UNDERSIGNED

NAME	ADDRESS	PHONE/FAX/EMAIL	SIGNATURE
[redacted]			

ATTACHMENT 2

AWE Letter dated 20 March 2015

Ref: AWE1275LET

20 March 2015

Rod and Annette Copeland
[redacted]

Dear Rod and Annette

AWE Limited – Senecio-3 Flow Test

Thank you for raising your concerns about AWE's recent flow test operations at the Senecio-3 appraisal well site, located 14.5 kilometres east of Dongara. Following a complaint received on Sunday, 15 March, AWE immediately suspended the flow testing activity and organised a meeting with available community members for the following evening (Monday, 16 March) to discuss the issue.

This is an example of the value we place on having good relationships with the local community, especially in the areas we operate. We seek to continually improve our operations and use occasions like this to obtain feedback from the community to make operational or systems adjustments as required.

The extent to which noise carried, particularly in the evening, was unexpected, and we believe resulted from prevailing weather conditions at the time.

Prior to commencing the flow test program, and based on the risk assessment developed for the Senecio-3 Environmental Plan, AWE representatives spoke with a number of local residents living in close proximity to the Senecio-3 well site and the Shire of Irwin. The limited noise impact that occurred during the flow testing of the preceding Senecio-2 well, which was closer to Irwin residents, was used help to determine the level of likely concerns regarding Senecio-3.

AWE also used the risk assessment process to design and implement additional noise control measures developed specifically for the Senecio-3 flow test. These included a silencing control on the flare tip line and the installation of higher than normal bund walls around the flare pit.

Feedback from residents indicates that the noise was louder and more disruptive than we anticipated for some Irwin residents. Although the noise created by the flow test did not exceed anticipated levels on site, it has obviously resulted in a level of discomfort for some nearby residents.

AWE has acknowledged your feedback and has worked collaboratively with residents to rectify the immediate issue. On behalf of AWE, I apologise for any impact that our operations may have caused you, and assure you that we are already extending our level of engagement to a broader audience and will continue to engage at this level.

As part of our program to be a good neighbour, AWE is assessing whether additional noise control methods could be implemented on-site for any future flow testing. We will of course communicate these measures with you prior to any flow testing.

AWE will also review the factors that contributed to the recent concerns and will incorporate this work in any future programs.

If you have any questions, please don't hesitate to contact me via email at [redacted]

Yours sincerely

David Guise
Regional Manager – Western Australia

AWE PERTH PTY LTD [redacted]

ATTACHMENT 3

Gemec Monitoring Data

Table 1: Ambient Air Analytical Results - Volatile Organic Compounds

Sample ID	Date	Total Sampling Minutes	Acetate, 2-methoxyethyl-	Benzene	Benzene, 1,2,4-trimethyl-	Benzene, 1,4-dichloro-	Benzene, ethyl-	Butylacetate	Cyclohexane	Decane	Disulfide, dimethyl-	Ethane, 1,1,1-trichloro- (1,1,1-TCA)	Ethanol, 2-butoxy-	Ethanol, 2-ethoxy-	Ethene, tetrachloro- (PCE)	Ethyl tert-butylether	Ethylene, trichloro- (TCE)	Heptane
14B0578/001	10.03.15-20.03.15	14177	< 0.36	**0.24**	< 0.05	< 0.05	< 0.04	< 0.04	< 0.04	**0.28**	< 0.04	< 0.05	< 0.05	< 0.04	< 0.04	< 0.04	< 0.04	**0.06**
14B0578/002	10.03.15-20.03.15	14134	< 0.36	**0.22**	**0.65**	< 0.05	**0.93** [1]	< 0.04	**0.19**	**0.80**	< 0.04	< 0.05	< 0.05	< 0.04	< 0.04	< 0.04	< 0.04	**1.2** [1]
14B0578/003	10.03.15-20.03.15	14142	< 0.36	**0.06**	< 0.05	< 0.05	< 0.04	< 0.04	< 0.04	< 0.05	< 0.04	< 0.05	< 0.05	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
14B0578/004	10.03.15-20.03.15	14077	< 0.36	**0.34**	**0.07**	< 0.05	**0.08**	< 0.04	**0.25**	**0.16**	< 0.04	< 0.05	< 0.05	< 0.04	< 0.04	< 0.04	< 0.04	**0.09**
NOHSC Exposure Standard (TWA [2])			NE	16000	NE	451000 [3]	434000	713000	1030000	NE	NE	NE	12100	18000	NE	NE	270000	1640000
Laboratory Limit of Reporting			0.36	-	0.05	0.05	0.04	0.04	0.04	0.05	0.04	0.05	0.05	0.04	0.04	0.04	0.04	0.04

Notes: all concentrations reported in micrograms per cubic metre ($\mu g/m^3$)
'NE' denotes screening level not established or is under review
'-' denotes not obtained

1. sample response greater than highest standard (300 ng)
2.Time-Weighted Average (NOHSC 1995)
3. screening level for p - Dichlorobenzene

Table 1: Ambient Air Analytical Results - Volatile Organic Compounds

Sample ID	Date	Total Sampling Minutes	Hexan-1-ol, 2-ethyl-	Hexane	Isopropyl acetate	Limonene	Meth-1-oxy, 2-propanol-	Methyl tert-butylether	Nonane	Octane	Pinene, à-	Styrene	Toluene	Undecane	Xylene, m- & p-	Xylene, o-
14B0578/001	10.03.15-20.03.15	14177	< 0.07	**0.14**	< 0.04	< 0.08	< 0.04	< 0.04	0.07	0.05	< 0.17	**0.05**	**0.27**	**0.20**	**0.06**	**0.05**
14B0578/002	10.03.15-20.03.15	14134	< 0.07	**0.15**	< 0.04	**0.09**	< 0.04	< 0.04	**0.92**	**1.2** [1]	**0.19**	**0.10**	**3.6** [1]	**0.74**	**1.6** [1]	**1.3** [1]
14B0578/003	10.03.15-20.03.15	14142	< 0.07	< 0.04	< 0.04	< 0.08	< 0.04	< 0.04	< 0.05	< 0.04	< 0.17	< 0.04	**0.22**	< 0.09	< 0.04	< 0.04
14B0578/004	10.03.15-20.03.15	14077	< 0.07	**0.25**	< 0.04	**0.11**	< 0.04	< 0.04	**0.11**	**0.1**	< 0.17	**0.04**	**0.61**	**0.10**	**0.14**	**0.10**
NOHSC Exposure Standard (TWA [2])			NE	176000	1040000	NE	NE	NE	1050000	1400000	NE	231000	377000	NE	350000 [4]	
Laboratory Limit of Reporting			0.07	0.04	0.04	0.08	0.04	0.04	0.05	0.04	0.17	0.04	-	0.09	0.04	0.04

Notes: all concentrations reported in micrograms per cubic metre (µg/m^3)
'NE' denotes screening level not established or is under review
'-' denotes not obtained

1. sample response greater than highest standard (300 ng)
2.Time-Weighted Average (NOHSC 1995)
4. screening level for Xylene (o-, m-, p- isomers)

AWE Perth Basin Operations

Coorow Community Reference Group
Drover-01: Groundwater monitoring

23 July 2015

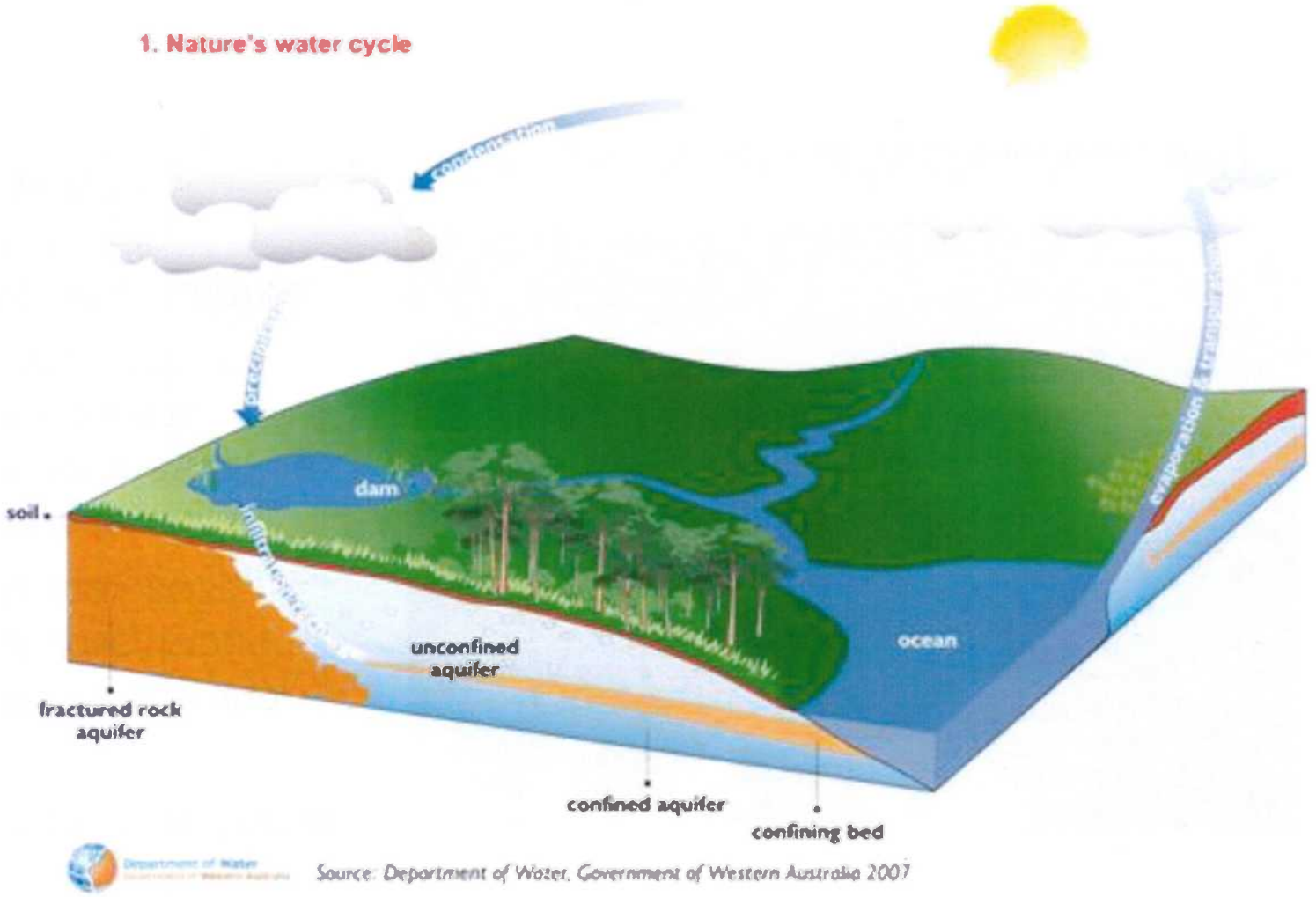
Overview

AWE

- Setting the scene - Groundwater monitoring basics
- Drover 01
  - Groundwater monitoring details
  - Recent monitoring results
- Next steps

Setting the scene - Groundwater monitoring basics

Groundwater is a reserve of water beneath the earth's surface in pores and crevices of rocks and soil.



Source: Department of Water, Government of Western Australia 2007

Groundwater monitoring program an important risk management tool

Setting the scene - Groundwater monitoring basics

AWE

Groundwater monitoring bores are used to:

- determine the nature and properties of soils through which liquids may seep;
- provide access to groundwater for measuring its level, physical and chemical properties; and
- allow groundwater samples to be withdrawn for laboratory analysis

Photo courtesy of DoW (not Drover-1)

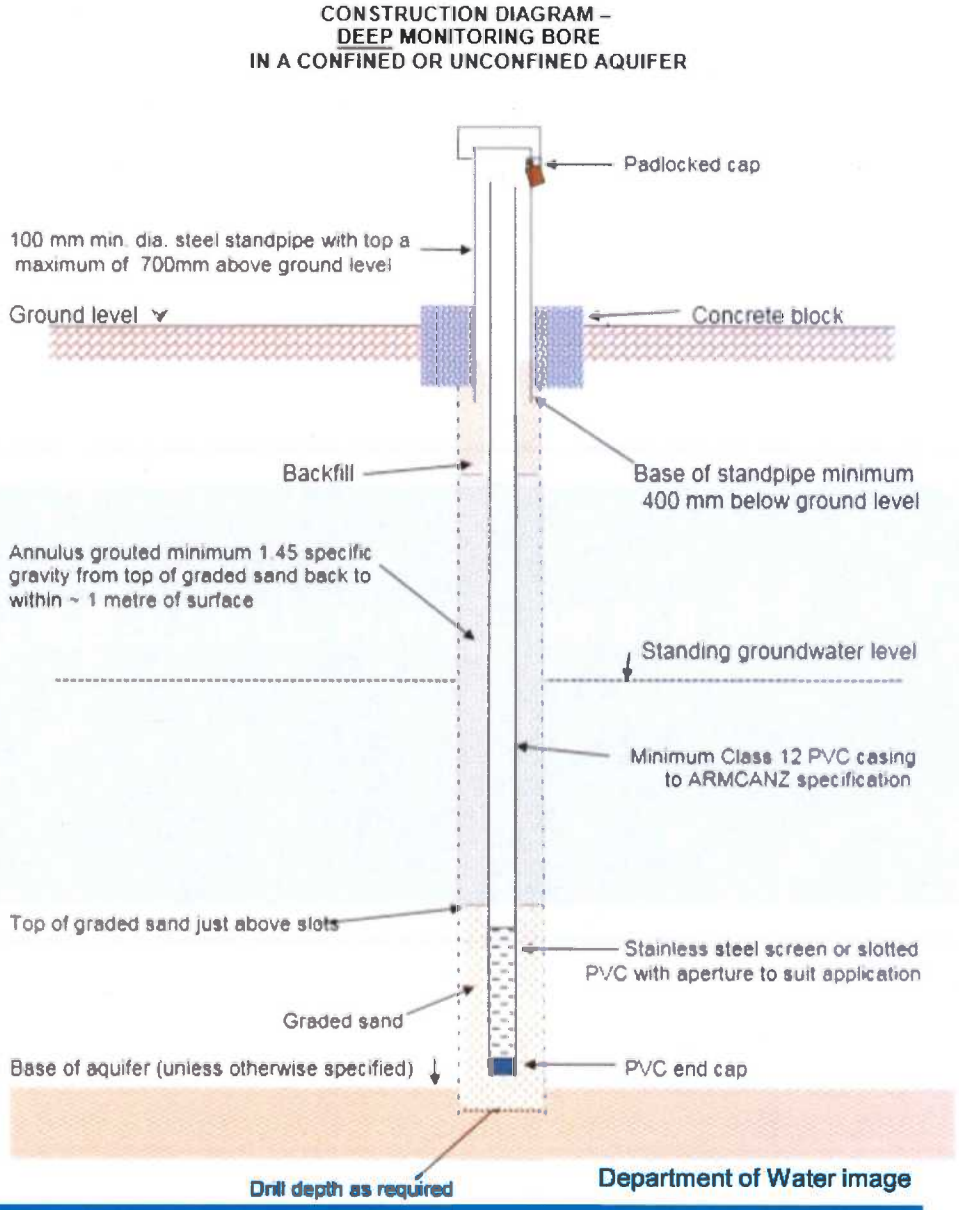
Monitoring bores are mainly needed to assess changes to water table levels and groundwater quality

Setting the scene - Groundwater monitoring basics

AWE

Factors considered

- Site of monitoring bores
- Bore construction and drilling technique (eg depth, diameter, main casing, completion)
- Water sampling techniques
- Equipment and site hygiene
- Bore drillers required to be qualified and licensed for the aquifer/s at the site



Groundwater monitoring program is tailored to each site and activity

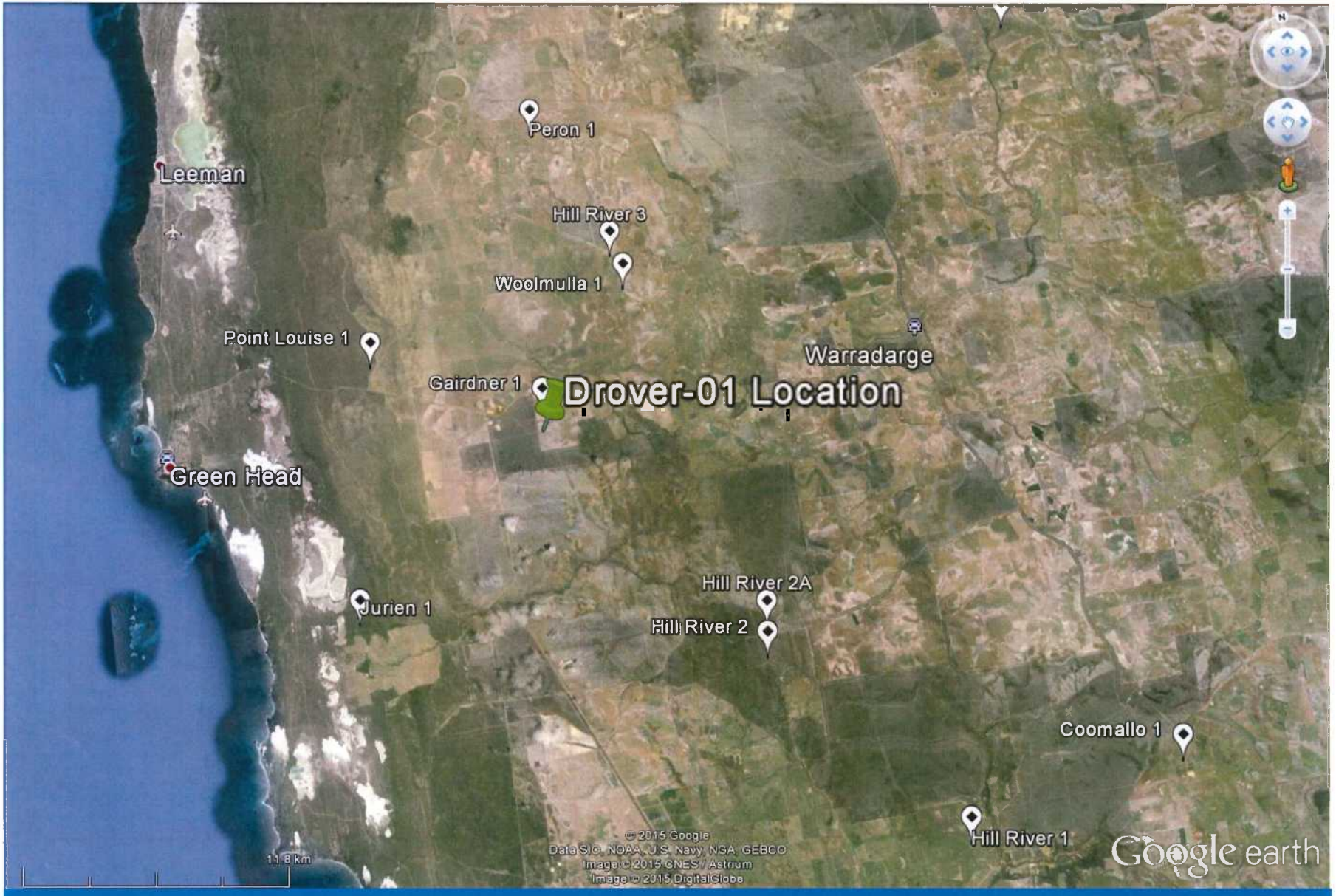
Drover-1

Groundwater Monitoring Assessment and Planning

AWE

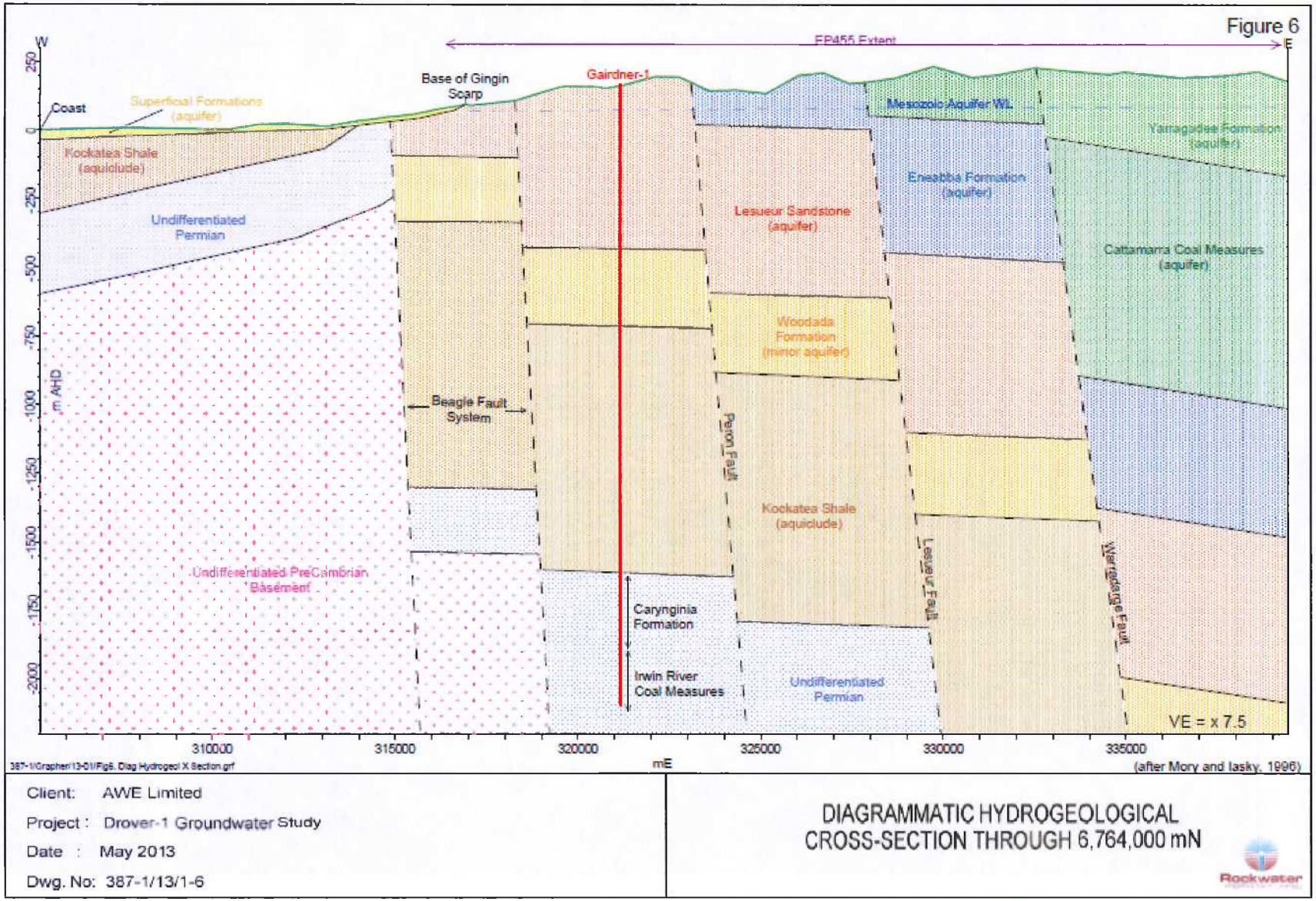
Exploration wells in the Drover-1 region

AWE



Exploration activity has been in the region since the 1960s

Drover-1 Cross Section from Ground Water Study



Hydrogeological assessment undertaken during Drover-1 planning phase drew on historic data

Drover -1 Regulatory assessment

AWE

Approvals process for the proposed Drover-1 well included review and assessment by:

- Department of Mines and Petroleum (DMP)
- Department of Water (DoW)
- Department of Parks and Wildlife (DPaW)
- Environmental Protection Authority (EPA)
- Appeals Convenor

Risk management controls

- DoW identified highest risk to water resources was from possible surface spillage of chemicals/diesel fuel
- DoW estimated that if any spill was not contained or remediated, it would take hundreds of (up to 800) years to travel the distance to Mt Peron borefield, which is approximately 4 km away.
- Depth to groundwater is 100 m. This gives ample time for containment and clean up of any surface spillage.
- If there was any surface spillage, AWE would promptly implement spill containment and clean up measures to prevent it from seeping offsite and into subsurface water.

In its response, the Department of Water recommended the adoption of a monitoring program and a contingency plan to the EPA to reduce this risk.

Groundwater monitoring program an important risk management tool

Drover-1 Groundwater Monitoring Advice

AWE

Independent consultants

- Designed the monitoring program (Rockwater) reviewed by DoW
- Monitoring bore installed by licensed water bore driller (?)
- Conduct monitoring on a six-monthly basis (Gemec)

DoW reviewed proposed monitoring program

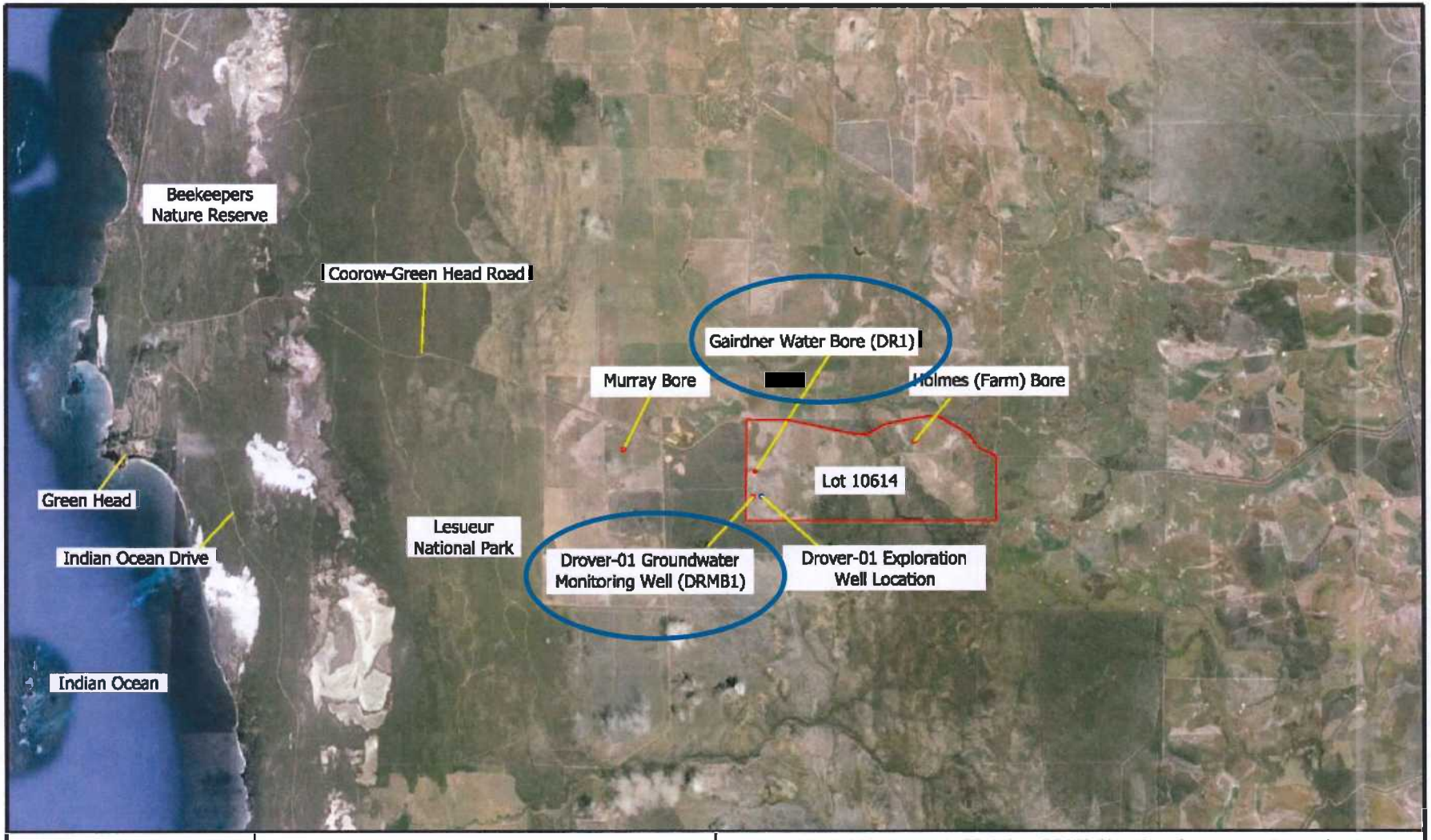
- Advised installation of a monitoring bore downstream
- Approved bore location and design based on site specific groundwater depth and flow
- Review monitoring results routinely

Drover-1

Groundwater Monitoring Details

AWE

Drover-01 bore locations



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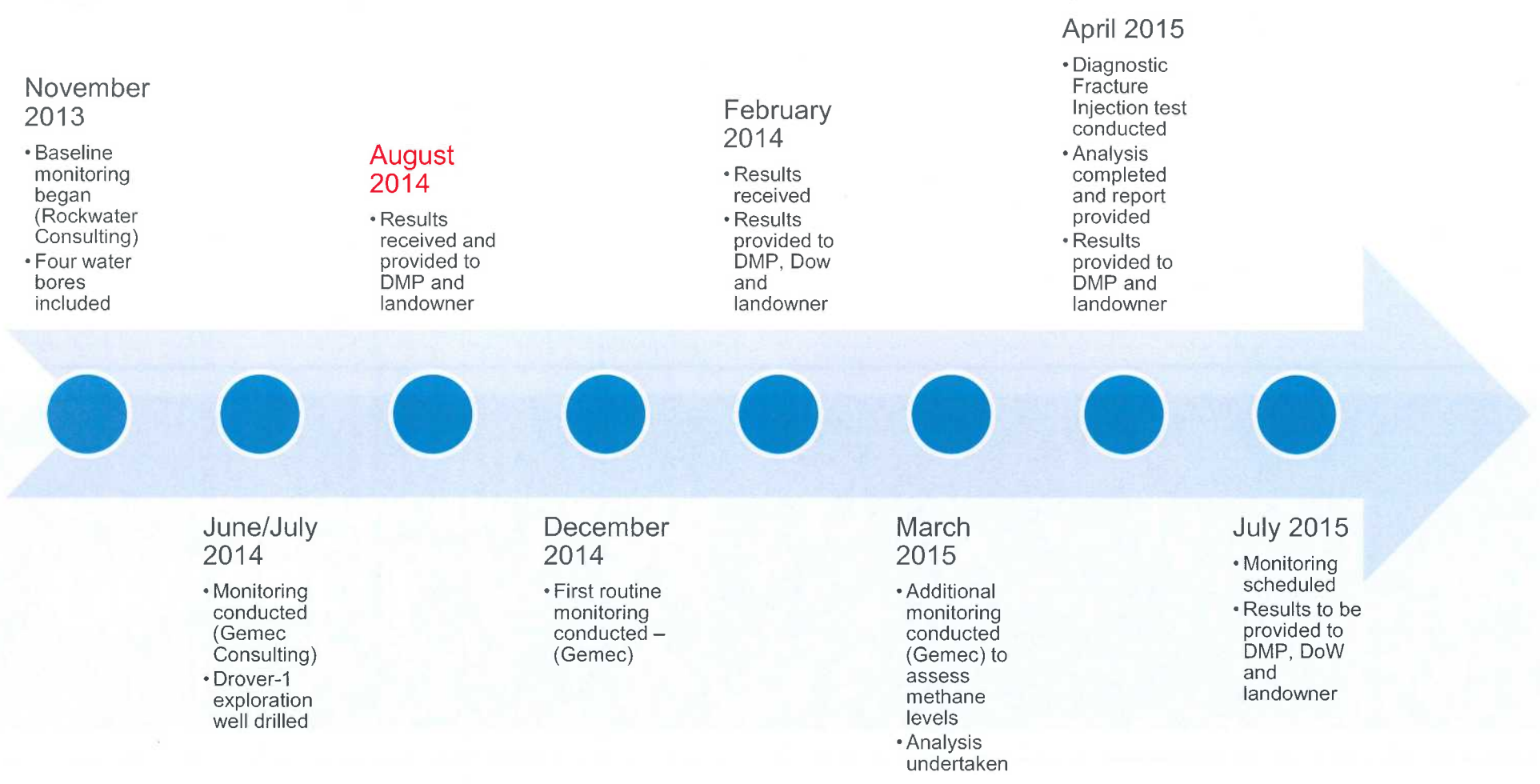
Drover-01 Groundwater Monitoring

AWE



Sampling consistently prior to drilling and following

Drover-1

Recent monitoring results

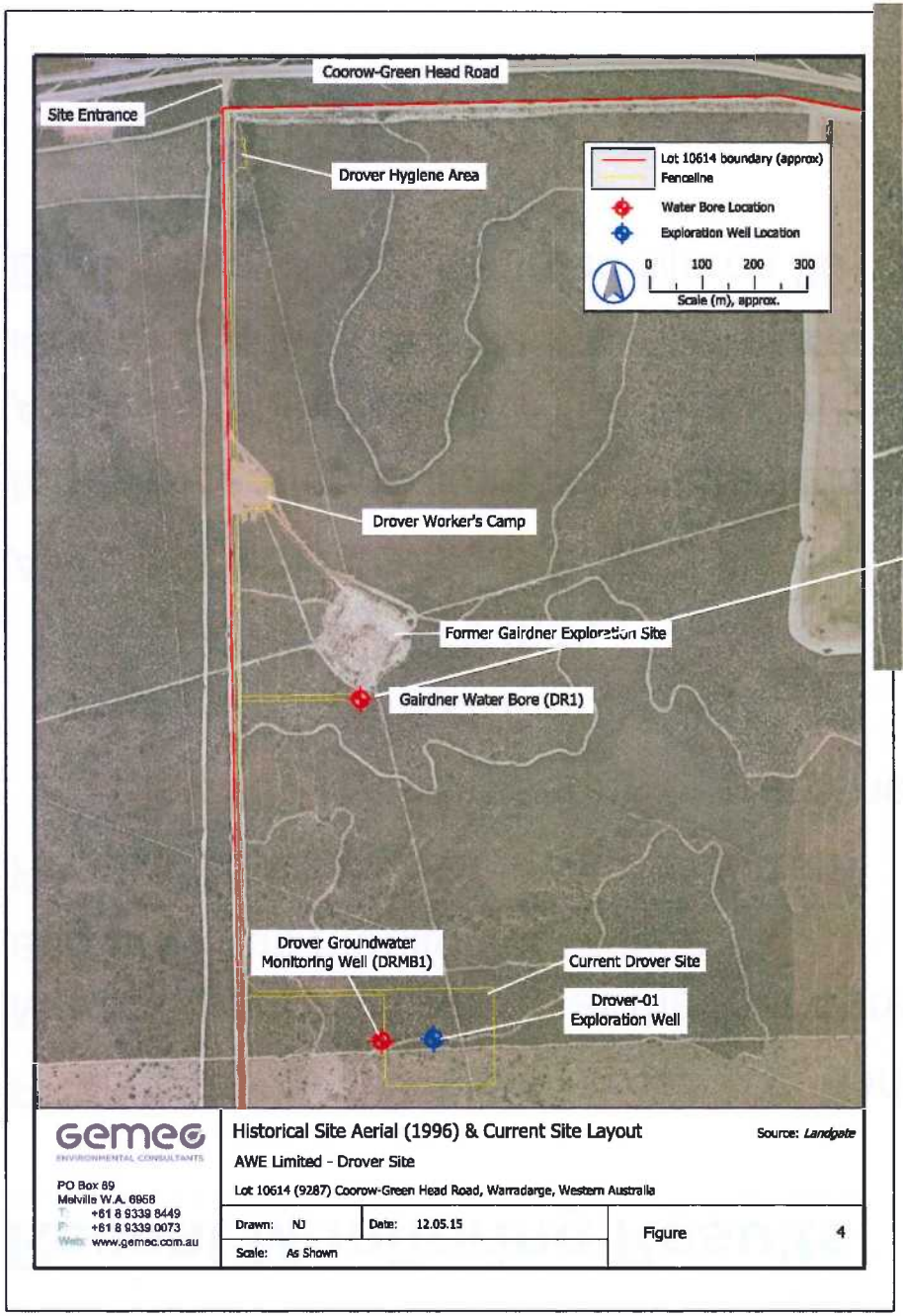
AWE

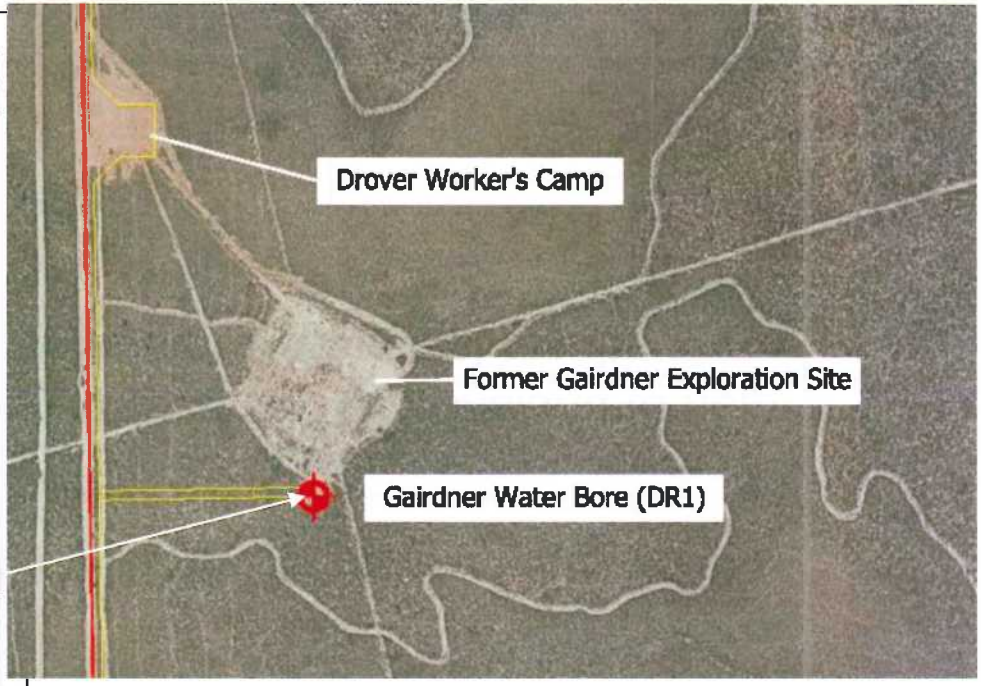
Recent Monitoring Results

AWE

- Preliminary results were provided in early February to AWE
- Most components tested at the four bores were in accordance with the baseline and previous monitoring results
- Results from two bores were different
  - Elevated concentrations of methane found
    - DR1 (4 mg/L)
    - DRMB1 (0.5 mg/L)
- AWE promptly advised DMP, DoW and the landowner of the initial results
- Independent consultant resampled the bores
- Analysis (stable isotopic) undertaken by University of Queensland to help identify the methane source and better understand the initial results
- Both bores were resampled March 2015

Potential Source





- Discussion with landowner (March) highlighted Gairdner-01 well mud sump as a possible source of hydrocarbon contaminants.
- Landgate aerial photo (1996) reveals well site immediately north of Gairdner water bore (DR1)

Methane isotope analysis

AWE

Background:

- Gemec commissioned University of Queensland (UniQuest) to undertake methane isotope analysis of samples collected from both bores.
- Dissolved methane can be of inorganic, microbial or mixed origin with the distinction made primarily on the basis of the stable isotope compositions of methane and associated groundwater.
- The carbon isotope differences between methane and CO2 and the hydrogen isotope difference between methane and associated groundwater may provide a better indication of the origin of the gases than the absolute carbon and hydrogen isotope values.

Methodology:

- Carbon, hydrogen and oxygen stable isotopic analyses were conducted using gas source isotope ratio mass spectrometry (IRMS) in The University of Queensland (UQ) Earth Sciences Stable Isotope Geochemistry Laboratory (UQ-SIGL).

Conclusions

- The methane found within DR1 and DRMB1 is of microbial origin
- The methane sources for each bore are not related, although both are linked to the biodegradation of hydrocarbon
- The source of TRH (Total Recoverable Hydrocarbons) within DRMB1 has been identified as from the drill muds and casing glue
- The TRH source within DR1 appears to be a result of the Gairdner exploration well activities, possibly an unlined mud sump buried on site

Based on the additional studies, Gemec concluded that:

The presence of hydrocarbons is not considered a result of AWE activities in relation to the drilling of Drover-01 exploration well.

Future plans

AWE

- Advise other stakeholders (ie CRG and Shire) of report findings
- Based on results and discussions with regulators, no further methane isotope analysis planned
- Continue six-monthly monitoring, including methane levels, at Drover-01 as per Environment Plan commitments
- Discuss any further steps when, and if, required

Supporting slides

As required

AWE

Results

DR1 - Methane concentrations similar to previous ~4,000 ug/L.
DRMB1 – Increase to 500 ug/L.

GROUNDWATER MONITORING EVENT
AWE LIMITED - DROVER-01 LOCATION
LOT 10614 (9287) COOROW-GREEN HEAD ROAD
WARRADARGE, WESTERN AUSTRALIA
MARCH 2015

Table 1: Historical and Current Groundwater Analytical Results - BTEXN, TRH, MTBE & Methane

Sample ID	Date	SWL (m btoc)	PID (ppm_v)	BTEXN						TRH				MTBE	Methane
				Benzene	Toluene	Ethylbenzene	m+p Xylenes	o-Xylenes	Naphthalene [1]	C6-C10 less BTEX	>C10-C16 less Naphthalene	>C16-C34	>C34-C40		
DR1	13.11.13 [2]	103.880	NP	<1	18	77	172	47	<5	150	120	390	<100	<5	15
				Silica Gel Cleanup							<100	290	<100		
	10.02.14	104.084	-	<0.5	2	21	18	9.5	<0.5	93	110	<500	<500	<0.5	NT
	10.06.14 [3]	-	-	<1	2	6	<2	3	<1	<10	<50	<100	<100	<1	48
	17.12.14	104.086	0.0	<1	6	13	20	7	<1	40	150	140	<100	<1	4000
	11.03.15	104.227	2.9	<1	9	37	71	20	<1	100	180	<100	<100	<1	3800
	Dup 1			<1	9	34	64	18	<1	93	160	<100	<100	<1	3500
	RPD			NA	0	8	10	11	NA	7	12	NA	NA	NA	8
	Split 1			<1	10	40	70	23	<1	67	90	<100	<100	<1	4000
	RPD			NA	11	8	1	14	NA	40	67	NA	NA	NA	5
DRMB1	12.06.14	103.748	12.6	<1	<1	<1	<2	<1	<1	360	150	120	<100	<1	<5
				Silica Gel Cleanup							<50	110	<100		
	16.12.14	103.533	0.0	<1	<1	<1	<2	<1	<1	210	220	190	<100	<1	160
	11.03.15	103.558	-	<1	<1	<1	<2	<1	<1	250	200	120	<100	<1	500
Holmes (Farm) [3] Bore	21.10.13 [2]	-	NP	<1	<2	<2	<2	<2	<5	<20	<100	<100	<100	<5	<10
	10.06.14	-	-	<1	<1	<1	<2	<1	<1	<10	<50	<100	<100	<1	10
	19.12.14	-	-	<1	<1	<1	<2	<1	<1	<10	<50	<100	<100	<1	<5
Murray Bore [3]	21.10.13 [2]	-	NP	<1	<2	<2	<2	<2	<5	<20	<100	<100	<100	<5	<10
	19.12.14	-	-	<1	<1	<1	<2	<1	<1	<10	<50	<100	<100	<1	<5
Domestic Non-potable Use (NPUG)				10	25 [4]	3 [4]	20 [4]		NE	NF	NF	NF	NF	12 [4]	NF
Long-term Irrigation Water (LTV)				NE	NE	NE	NE	NE	NE						
Stock Watering (SW)				NE	NE	NE	NE	NE	NE						
Groundwater HSL-D (sand)				5000	NL	NL	NL	NL	NL	70					
Laboratory Limit of Reporting - MPL				1	1	1	2	1	1						
Laboratory Limit of Reporting - SGS				0.5	0.5	0.5	1	0.5	0.5						
Laboratory Limi															

Notes: all concent
77 sha
'NA' denotes not a
'NE' denotes scree
'NP' denotes data
'NL' denotes scree
'NT' denotes 'not
'RPD' denotes rela

1. nap
2. sam
3. grou
4. aes
5. con

DRMB1 – TRH concentrations chromatograms indicate source to be: Liqui-Pol (drilling mud) and Pipe master (PVC pipe cement)
DR1 – Possible source of TRH identified as Gairdner drilling mud sump.

Note: The sampling methodology has varied across the 5 GME's as outlined below:
13.11.13 – Airlift and bailer
10.02.14 – Low flow pump (methane not tested)
10.06.14 – Sampled directly from PVC pipe outlet at freshwater pond
17.12.14 - Low flow pump
11.03.14 - Low flow pump

Methane isotope analysis results

- Results indicate the dissolved methane in both wells is of microbial origin and linked to the biodegradation of hydrocarbon.

- The very different concentrations of BTEXN, C6-C36 TRH and methane in the two wells, together with the methane carbon and hydrogen isotope systematics indicate the presence of methane in the two wells is unrelated.

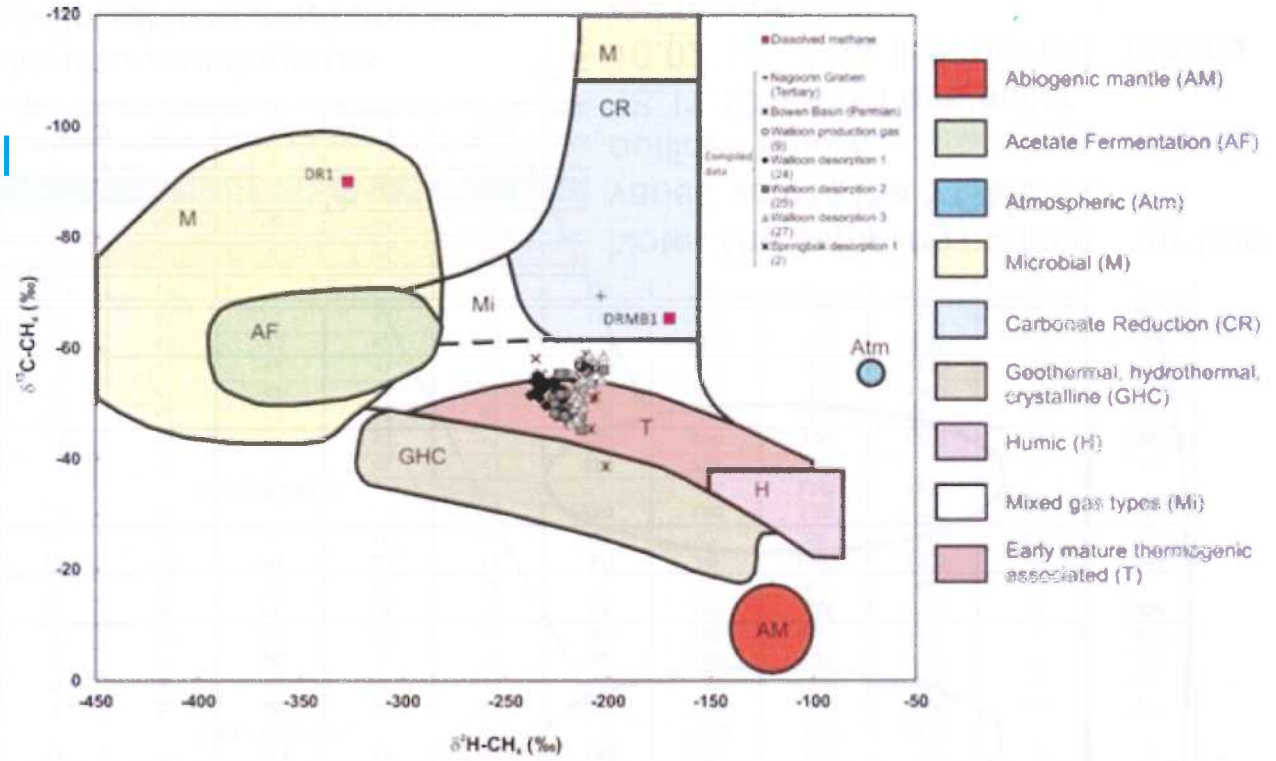


Figure 4. $\delta^{13}C$ vs $\delta^{2}H$ plot of CH_4 stable isotope compositions for dissolved methane samples DR1 and DRMB1. Results from coal measures in Queensland are included for comparison. Walloon Subgroup production gas data are from Draper and Boreham (2006). Walloon and Springbok desorption data from Hamilton et al. (2014). Bowen Basin production gas data are from Draper and Boreham (2006) and Kinnon et al. (2010). Nagoorin Graben data are from Draper and Boreham (2006). Fields on plot modified from Draper and Boreham (2006) after Whiticar et al. (1990) and Whiticar and Schaefer (2007).

Source: Groundwater methane isotope analysis, UniQuest, University of Queensland, 5 May 2015.

Drover-1 Shire of Coorow Community Reference Group

DMP: Community Partnership Awards

The journey of the Drover-1 Shire of Coorow Community Reference Group: from a place of mistrust, frustration and cynical attitudes to a position of trust, respect and finding common ground between the coastal towns of the Coorow community and AWE Pty Ltd. A humbling and fascinating story on how community empowerment in any project can be beneficial and rewarding for all stakeholders and projects.

"This community process was an eye opener. It was a great experience"

Bev Port-Louis (CRG Yued Aboriginal representative)

2016

Joint Submission: Drover 1 CRG and AWE Limited Pty Ltd

Foreword

At the outset, I was very sceptical about the then proposed **Drover-1 Shire of Coorow Community Reference Group (CRG)**. In the end, I was very pleased with the many positive outcomes achieved by the group. As a Shire councillor and community member, I served as a Steering Group member for the CRG from the first meeting in November 2014 until the end of 2015.

There were many things I liked about the CRG process. Firstly, the CRG gave us an independent, community body which allowed us to have our say about the Drover-1 Exploration Project (Project) and explore the key issues. Secondly, we were provided an independent resource which helped us design, facilitate and run the process of the CRG. This was invaluable as it enabled us to focus on the Project rather than the administration of the CRG. Finally, the outcomes. The unique process we adopted to run the CRG enabled us to learn about the Project through open, non-threatening dialogue with AWE and the various government agencies (DMP, DoW, DoH, CSIRO). This enabled us to identify and seek answers to key questions as well as obtain clarification and certain commitments concerning the Project.

We certainly did have our share of disagreements – especially in the early meetings. After all, we were dealing with a highly emotive issue – potential fracking. We also didn't solve everything in our journey and we didn't get everything we would have liked. But we absolutely had community empowerment and importantly we managed to have a significant positive influence on the Project as well as government department processes. This is something I did not think we would achieve before we started this journey.

I believe that the CRG process created real benefit and value for our community. I give enormous credit to AWE and the community for sticking with the CRG process and working together in a collaborative and empowering manner. Credit must also be given to the various government departments who sent guest speakers to inform the CRG on matters such as departmental policy and assurances to the community, risk assessment and their views of the science and engineering relating to Drover-1. I believe our CRG set a great example to future projects on how to place the community at the heart of a project and have open, two-way communication that fosters trust and respect between all parties.

I am very pleased to have been involved in the journey that was the Drover-1 Shire of Coorow CRG and I welcome a shared nomination with AWE for the DMP Community Partnership Award.

Guy Sims

(Coorow Shire Councillor, Drover-1 Shire of Coorow CRG Steering Group member)

Submission Highlights

CRG: Building Trust and Respect

2014 – Our beginning

"I was very anxious before the first meeting. I didn't know what to expect"

Bev Port-Louis (Traditional Owner representative)

"There was zero trust with AWE and there was a bit of emotion and heat at the first meeting"

Guy Sims (Coorow Councillor)

"I had initial doubts about the CRG process. I thought it was too touchy feely"

David Guise (AWE Regional Manager)

"I was very suspicious of most people at my first meeting. I tried to keep an open mind"

Tim Gilbertson (Community member)

"When I heard that a CRG was being established, I found AWE scary and I was negative towards them"

Jenny Griffiths (Community member)

2015 - Final thoughts

"The CRG process created value to our community and enabled it to grow. I take my hat off to AWE"

Bev Port-Louis (Aboriginal representative)

"We got the real facts from the process. The CRG created real value for the community"

Guy Sims (Coorow Councillor)

"The CRG process worked. We developed strong relationships and trust with the community"

David Guise (AWE Regional Manager)

"Top marks. Well informed. People had their say. We should use this process in the future. It's hard for anyone to hijack the CRG. DMP and DoW provided powerful information"

Tim Gilbertson (Community CRG member)

"We would definitely use this CRG process in the future for community engagement"

Jenny Griffiths (Community CRG member)

Submission Highlights

Summary

Drover-1 Exploration Project

The Drover-1 exploration well site is located on private, agricultural land in the Shire of Coorow, adjacent to the Lesueur National Park and near the Mount Peron Water Reserve (refer map). It is approximately 220 km north of Perth.

The well site was prepared for gas exploration in mid 2014 following initial stakeholder consultation undertaken in late 2013. The well site was successfully drilled in mid-2014 without any significant health, safety or environmental incidents.

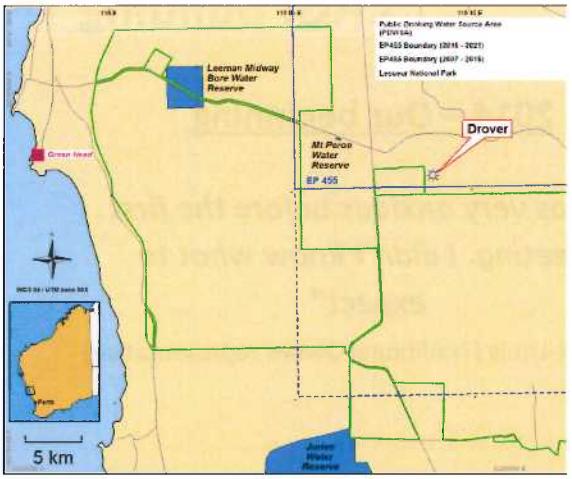


Figure 1: Location of Drover-1 (Source: AWE, April 2016)

Further information about the Project can be found here http://www.awemidwest.com.au/what-we-do/drover-1-exploration/

Following a series of tests between 2014 and April 2015, it was concluded that Drover-1 was unlikely to have a sufficient commercial flow rate of gas. As a result, the well site has been decommissioned and the site will be rehabilitated by mid-2016.

Community Reference Group (CRG)

Prior to the CRG being established, AWE had received all necessary approvals for the Project. However, due to a spike in community concerns arising in August 2014 around drinking water protection for the coastal towns of Green Head and Leeman, the approvals processes and potential lifestyle changes, an independently facilitated Community Reference Group (CRG) was established in late 2014 and met through to the end of 2015.

The purpose of the CRG was to place local community members at the centre of the consultation process with a clear line of communication between AWE and other stakeholders. The CRG also was designed to help reestablish trust and respect between community, industry and government.

All interested community members living and/or working or with other interests in the Shire of Coorow were welcome to attend meetings. This included Traditional Owners or their representatives with a current and/or historical connection to land in the Shire of Coorow. Meeting venues were shared between coastal towns within the Shire of Coorow at Green Head and Leeman.

Although independently facilitated, the CRG (refer Figure 2) was governed by a community selected Steering Group. Representation on the Steering Group included: local community and business owners (mainly from Green Head and Leeman), Traditional Owner (Yued), Shire of Coorow (staff and council) and NGO groups.

The independent resource was used by the Steering Group to assist in the design, facilitation and background administration of the CRG. This was helpful as it enabled community members to focus on the Project rather than the processes involved in running the CRG. The CRG funding was provided by AWE but not tied in any way to outcomes. The community was the monitor of independence of

the facilitator.

Once established, the CRG was open to invite input from external organisations as relevant. This included AWE, Conservation Council of WA, state government agencies such as Department of Mines and Petroleum, Department of Water, Water Corporation, Department of Parks and Wildlife, Department of Health and also academics and/or third party consultants to address technical or specialist questions.

Figure 2: Drover-1 Community Reference Group 2015 (Photo: with permission CRG)

Although uncommercial results from the exploration program led to AWE deciding to decommission the well site, post-CRG interviews with participants indicated that the CRG process was an overwhelming success and created real value for the community (Source: Independent Lessons Learned Report: Appendix A). Furthermore, all parties would definitely use this process again – they felt heard and respected and genuine human connections were made.

AWE

AWE is a medium size Australian energy company. AWE, and its predecessors, have been operating in the Mid West since the 1960s. All of AWE's operations staff live in the communities in which they operate. AWE does not employ FIFO employees in its Mid West operations.

Figure 3: Mid West AWE facilities employees

The Drover-1 well site is an exploration site in the Shire of Coorow located 17 km to the east of Green Head (Refer Figure 1). The well site was established to find more gas resources in the Mid West in order to complement those that the company already owns. Further information about the Project can be found here: http://www.awemidwest.com.au/what-we-do/drover-1-exploration/.

Selection Criteria

1.0 Selection Criteria: Leadership/Innovation in Engagement

1.1 How and when did the partnership come about?

Prior to the CRG forming, AWE had undertaken project planning that included stakeholder engagement activities for the Project. This had involved meetings with the Coorow council as well as council staff in 2013. AWE also hosted an open community information session, with assistance from the Coorow Council, and then circulated flyers and project update letters to shire residents at key project milestones. During this time, no significant concerns were raised about the proposed Project.

Leeman and Green Head are small coastal towns on the edge of a predominately agricultural shire. Green Head has a high demographic of retirees and holiday home owners. Both communities get their drinking water supply from the Mt Peron Water Reserve. Exploration has been occurring in the project area since 1978, however there has been limited resources activity in the Coorow Shire since 1990.

Following media focus on a group of concerned residents' views about potential contamination of their drinking water by the Project, a late agenda item was then raised at the August 2014 Council meeting. Council subsequently carried a resolution, which resulted in developing a Petroleum, Mining and Extractive Industries Policy, which specifically covered hydraulic fracture stimulation within the Shire. Meanwhile, further discussions were occurring between AWE, the Shire of Coorow and some community members. From this, AWE offered to fund an independent CRG *process* to identify and work through shared community concerns about the Project in the Shire of Coorow.

The independent CRG option was explored during a community meeting held in Greenhead on 8 October 2014 and a decision was made by those present to proceed with the offer. The first formal CRG was held on 5 November 2014 and the final official meeting held 9 September 2015. Informal relationships are continuing as rehabilitation of the well site progresses.

An independent facilitator was funded by AWE to design and facilitate the CRG process. The role of the facilitator was not tied to ensuring achievement of any particular outcome or agenda.

1.2 How did parties interact to promote inclusive dialogue and relationship building?

Formal Interactions

The CRG met to discuss progress against key issues and at key project milestones. From the beginning, all participants believed open dialogue was an important part of working through issues involving the Project. As such, invited guests such as AWE, Department of Mines and Petroleum, Department of Water, Department of Health and CSIRO were asked to come to certain meetings to listen to and understand the views of the community and respond to their queries. This exchange of information often involved presentations and the occasional use of physical materials to help demonstrate operational practice.

Conversations during each meeting were captured on a white board by the facilitator at the front of

the meeting using 'spider mapping' technique. This technique helped enable the threads of the conversation to be better tracked and for participants to see how their issues were being tracked and recorded. Points of difference were also captured during the meeting along with outstanding actions.

The initial meetings were focussed on establishing the CRG with AWE briefly introducing the Project and initial engagement activities. As meetings progressed and topics were discussed in more detail, AWE and other presenters were invited to stay for longer periods of time. Ground rules were established early in the CRG process based on respect and inclusion. The CRG participants welcomed Shire non-residents although they discouraged people from using the forum for their own purposes.

Draft minutes were prepared and distributed for comment by the independent facilitator to everyone attending meetings or wishing to be on the mailing list (Refer Figure 4). More than 200 people were on the distribution list which covered a wide range of organisations and locations. Final minutes with agreed corrections were then sent out, which enabled progress on key issues to be tracked.

The independent facilitator and the community also established a small Steering Group that could work and plan scheduling, preparation for, and notifying people about future CRG meetings. There was enormous power in the local community acting as a unified group for the CRG.

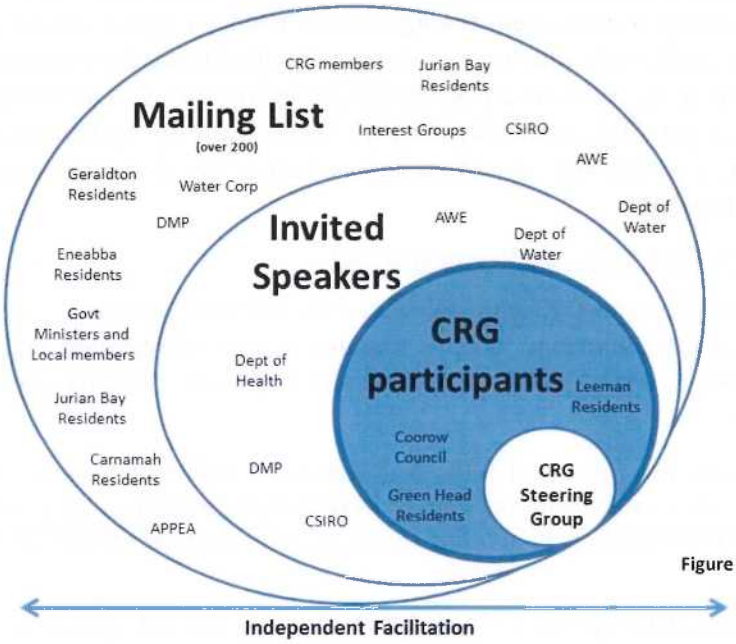


Figure 4: CRG relationships

Informal Interactions

CRG members advised that one of the most powerful relationship building mechanisms during the journey of the CRG was the informal meetings (Refer Appendix A). For example, site tours (refer Figure 5), post meeting catch-ups and afternoon teas were critical in developing human connections and understanding each other's point of view. These sessions significantly contributed to building trust and respect.

Supporting documentation

Supporting documentation such as minutes, ground rules, maps are available on request.

Figure 5: Site tours helped with relationship and trust building

1.3 How did the engagement practices demonstrate leadership, or an improvement to or establishment of innovative approach?

Classical Community Consultation

Classical community consultation in Western Australia has often placed the company at the centre of the consultation process. Under these consultation models, the company controls the project information and how it is communicated. It tends to be a one way flow of information. For example, often, a public meeting is held where the agenda has been set by the company without effective prior consultation with people who are most likely to be affected by the proposal. Such consultation prevents the community from effectively collaborating together to identify common issues and concerns as well as potential community benefits. This can lead to the community feeling like that they are isolated, voiceless and part of an administrative "tick and flick" exercise. This leads to everyone feeling frustrated.

Drover-1 Shire of Coorow CRG – a different approach

The Drover-1 Shire of Coorow CRG approach placed the community at the centre of the engagement process. It enabled the community to come together in a non-threatening environment to form a united collective and to articulate the important issues and what additional information they wanted about the Project.

The community was also resourced with an independent facilitator to help organise, design and facilitate the process. This enabled meetings to have an independent voice to keep the meetings on track and to hold all participants to account. It also prevented interest groups from manoeuvring the meeting agenda.

This innovative approach required a "leap of faith" by AWE and the community and required trust and respect between all parties in order to work.

In the oil and gas industry in Western Australia, such comprehensive consultation and resourcing for a single well exploration project is unusual and unprecedented. However, the extra effort given to this Project was in response to community interest in groundwater management aspects and reflects a genuine desire by all participants to improve the understanding of everyone's views.

1.4 How were the community's values integrated into the business operations?

Key community values and questions were identified early in the CRG meetings (Refer Table 1). These items led to a number of commitments being made by AWE and government agencies to

ensure that community values were being addressed by the Project. Examples of community values being heard and implemented into the project included (sourced from minutes):

Table 1: Community Values and Resolutions

Community Value	Resolution	Responsible	Status
Community empowerment around being heard on issues of concern	Offer and acceptance to support independently-facilitated and resourced Community Reference Group – Oct 2014	AWE/community	Agreed and implemented
Fracking concerns and perceived impacts on water supply	No hydraulic fracture stimulation of Drover-1 Well before April 2015 – Nov 2014	AWE	Agreed
	Presentations on fracking from DMP, DoW, DoH	Government	Ongoing
Water supplies assured	Leeman and Green Head potable water supplies assured – Nov 2014	Department of Water	Agreed
Site Access	Agreed public access to site (subject to safety requirements) – April 2015	AWE	Agreed
Available information, trusted information	Agreed timely access to monitoring results - April 2015	AWE	Agreed
	Appointment of independent scientist – agreed but not pursued by CRG (not required)	CRG	Agreed
	Information from government agencies	Govt agencies	Agreed
Future protection of sensitive water areas	AWE agreed to facilitate a CRG meeting with DMP and DoW to determine if Mt Peron water supply could be permanently removed from future exploration leases.	CRG	Meeting held

2.0 Selection Criteria: Benefits of the collaboration

2.1 What initiatives arising from the partnership have benefited the community?

This process benefited the community and AWE because it allowed the Project to be better shaped to match community expectations.

Dealing with Community Questions

The CRG process enabled the community to develop and track a list of questions that were specific to their needs and interests. For example, the following questions were asked and answered in the first CRG meeting in November 2014.

- How are leases assigned to companies like AWE to drill wells like Drover-1?
- What is AWE entitled to do at Drover-1 under its current lease or equivalent?
- What factors were considered by whom in the lead-up to and during the approval process for Drover-1?

New questions from the community continued to be identified and tracked via minutes of subsequent meetings. If questions were not addressed, then attempts were made at the subsequent meeting to respond.

Working towards commitments

The CRG process enabled the community to articulate and seek from AWE and the government a number of key commitments concerning the Project. Many of these commitments helped to shape the Project (Refer Table 1).

2.2 What are the specific beneficial outcomes for the community?

There were many beneficial outcomes that the community and AWE were able to obtain by participating in the collaborative CRG process. Many of these benefits are captured in Appendix A. Some of the significant benefits included:

- The community was able to establish a formal group that empowered them to have a high level of influence on the Project (refer section 2.1)
- The community was able to use an independent facilitator as a resource to design, organise and run its meetings. This enabled the community to focus on the Project rather than the administration of the CRG. This saved the community considerable personal time
- A high level of trust and respect was established between the community and AWE
- Stronger relationships and friendships were built within the community as a result of the CRG process
- The community was able to learn more about the broader onshore energy industry especially the regulatory processes involved
- AWE and government agencies were provided an opportunity to listen to the community in a non-threatening environment and were then able to provide tailored information based on the community concerns and issues
- At a regional and state level, AWE and government agencies were able to better understand the key community issues around the onshore energy industry. For example, a community top 10 questions list was developed for use in the Mid West region so that future projects can better understand and tailor their consultation to answering these 10 questions.

2.3 How was consensus reached on the value of such projects?

The CRG process generated a list of common questions and various commitments sought through consultation with the community. Each outstanding question and commitment was tracked throughout the CRG process (Refer 1.4).

3.0 Selection Criteria: Commitments to providing sustainable and enduring outcomes

3.1 How has the partnership made a positive sustainable difference for the community?

The CRG process has reconnected the community, government and AWE. At the heart of the process, human connections have been made with the core outcomes being mutual respect and trust. This is an outstanding achievement given the highly contentious issue of "fracking" in some sections of society. Other communities in the area are now considering using a similar CRG framework in relation to future industry projects and use the lessons learned (refer appendix A) and top 10 questions to enable community empowerment in any project.

The model applied at the Drover-1 Shire of Coorow CRG has been accepted as a new method for empowering community in project development. The same successful model is being considered for another AWE proposal in the Shire of Irwin in 2016. There have also been discussions for a broader Mid West regional CRG forum as a result of the Drover-1 CRG work.

The process was also the first time that many of people in the local community had an opportunity to work with and hear the views of a Yued Traditional Owner. The Yued Traditional Owners also felt that they had a voice and ownership in the process, which was a welcome outcome.

3.2 How will the collaboration benefit the community beyond the life of the resource project?

The CRG has set a benchmark for collaboration and community empowerment. In the future, it is highly likely that other resource companies will be encouraged to undertake a similar method of community engagement in the Mid West region.

Beyond the life of this Project, the CRG has set the scene for AWE's next exploration phase in the recently renewed permit area. The goodwill and trust that has already been established between community, AWE and government departments will facilitate engagement for further exploration activities AWE may propose to undertake.

3.3 How does the project extend beyond normal requirements and obligations?

In mid 2014, AWE had already received approval to commence its exploration activities associated with the Project. The company was not legally obligated to undertake any further community consultation processes. However, when there was a spike in community concerns in August 2014, AWE offered to place the community at the centre of the consultation process through establishing an independently facilitated CRG process. This "extra" community consultation is not traditionally part of an onshore energy exploration project. However, this step proved to be extremely beneficial to all stakeholders with relationships that are lasting beyond the timeframe of the project.

Updated April 20 2016

Drover 1 CRG – Lessons Learned

Where we were

August 2014

- Community had strong concerns with drilling (and the fracking process) near the Mt Peron water reserve
- Existing community engagement wasn't working (had limited effectiveness and reach)
- Community and interest groups had reservations about establishing a Community Reference Group (CRG) – is this an AWE trick to get a social licence, do we really need one?
- CRG process seen to be too "touchy feely"

First 3 meetings

Good

- AWE trusted the process and the community
- Some trust with facilitator – although some concern he was being paid by AWE and couldn't maintain independence
- Yued participation valued by all
- CRG steering group formed and started to function after third meeting – maybe too many representatives
- Community started to like inclusive nature of CRG

Not so good

- Pretty "rough" first two meetings – lots of emotion and suspicion
- General distrust of AWE (and Govt departments) by community
- Attendees didn't know each other very well
- Emotionally, mentally and physically draining on AWE staff. Took time to recover
- Needed more formal presentations and handout material at first few meetings
- Difficult to hear what was being said for some attendees
- Sometimes difficult to hear things being said – need mic

Source: Confidential 1on1 interviews between facilitator and CRG Steering Group, AWE, Sustainable Consulting

Where we are today

August 2015

Good

- CRG process an overwhelming success and created real value
- All parties would definitely use this process again – they felt heard and respected. Human connections made
- Trust levels improved throughout the journey for all parties
- Process was inclusive and not divisive
- Indigenous owner representation invaluable and strongly contributed
- Facilitator(s) have a high level of respect/trust and independence
- Government departments helped to reshape opinions of many (not all) - although some presenters were a little technical
- Visits to site helped to put the Project in perspective
- Steering group invaluable in getting things organised and done
- Informal activities such as afternoon tea seen as very positive

Not so good

- Although many commitments to community by AWE was completed (positive), some disappointment that the important and complex Commitment 1 (water supply) could not be resolved quicker
- Meetings in 2015 were at times too far apart. Tracking of progress against actions could have been better managed
- Minutes could have come out quicker. Occasional disagreement with the content of minutes and if they reflected what was said
- Outside of CRG meetings, it took a little long to get community questions answered – Facilitator(s) helped with this process
- Media arriving to February 20th 2015 meeting was disruptive and seen as a stunt (but ended up binding the CRG)
- Sometimes, facilitator(s) could have stood up more for both community and AWE
- AWE was seen to occasionally overreach its role by some participants – but were generally good in this regard
- AWE presentations were at times too technical and long
- Presenters found it stressful to get up in front of the community from fear of occasional verbal attack
- Sometimes difficult to hear things being said – need a mic

Rod Copeland

From: Rod Copeland [redacted]
Sent: 27 October 2016 10:00
To: [redacted]
Subject: RE: Community Roundtable: Statement your read

Kris,
I've thought a lot about the Roundtable Community gathering since yesterday, and considering that you asked for single words to describe our thoughts about the On-shore Energy Industry, I will use one word to describe what I thought was the outcome of yesterday, for me personally and the impact on my life/business/farming property, and after all it is all the same.

DISAPPOINTING

My reasons, without going into it too much, but....

(1) To be so broad about the on-shore energy industry is, self-defeating straight away, when we are concerned about the on-shore UNCONVENTIONAL energy (mainly gas) industry
(2) We have lived in an area, overshadowed for many years by a conventional gas field, though small in nature, and accepted that as a fait accompli but what is now proposed is a threat too big to ignore
(3) 40% of the people who attended the first meeting, did not attend, but the concerning fact was they are representatives of the community
(4) Many of the people who were invited, originally, still have not attended
(5) Substitution of attendees from departmental, state and local governments with different attendees that may not be right across all discussions
(6) The people most affected by the industry and its insidious practices, were in the most part neglected
(7) I can-not see the connection between many of the originally invited attendees and how this industry will affect their lives in the immediate future, if at all
(8) It's the same as people who live in Dongara, Geraldton, Perth, and Sydney etc who make decisions without taking into account, those who live in the IMMEDIATE area and keep telling us how good it is going to be ...FRACKING BULLSHIT..... NO-ONE from the industry who makes decisions, lives within a bull's roar (or perhaps the roaring of a flaring event like we endured with Waitsia -01) of Irwin
(9) BUT typical of governments who allow and encourage it
(10) take out yourself, industry, state government and local government who are represented at both meetings, and what do you have—numbers do not lie, perhaps a measure of the publics apathy and the attitude of "if they can't see, smell, feel, hear it and it's not in their backyard, then they're not worried about it". I have no answer for the APATHY, but the real fact is that the sooner, and we REALISTICALLY prefer that it does not happen, that there is a major environmental event, accident or blow-out, come what may, that brings home the realism of what may/can/will happen, then the earlier it will dawn on the whole community that this industry could be a major threat if fracking is allowed.
(11) At this point in time, Queensland is TOO far away for most people to understand the relevancy.
(12) The questions presented for answering, were too broad and not specific enough with the Irwin area, obviously as they were drawn from, so-far, under-informed public who have genuinely attended forums or Expos to gather more info, but then they're not at the coal face
(13) I know the answers or have a more than fair assessment of what will be trotted out, to most of the questions, by either side, and it's the same old spiel
(14) I consider the gatherings should be IRWIN specific, and as for "other works", no one in that room should even consider blindly agreeing to that.

I realise that we have to start somewhere, but it's obvious the majority of people are NOT interested unless it's in their backyard, so all effort has to be put into addressing the concerns of those directly impacted at this place in time.
And that is Irwin.
I could say a lot more but I'll save some powder for later.

It will not stop me from attending as I want to be at the forefront of making a difference.

Now for the DECLARATION
"I, Rod Copeland, farmer at Irwin, declare that I have attended this gathering and would attend future gatherings to glean information, listen to other points of view, and follow the progress of AWE development of the Waitsia Gas-field but I have not come here, and will not unilaterally rubber-stamp that I "support the Awe Waitsia Gas-field Project and other works" ,at any time, and that my attendance here is NEVER to be used or misconstrued as mine, and my families' and my communities ENDORSEMENT of AWE, and what they may propose now or in the future without, fully researching any proposal put forward.
I do not recognise that AWE has social licence to "frack' in any part of the Midwest.
I have witnessed other instances of creative number crunching and my name/attendance is NEVER to be used as part of those figures.
Moreover, I do not accept that any of the information given by AWE or any other party to these meetings, is considered confidential and that I am at liberty to discuss any matters pertaining to these gatherings with whomever I think is appropriate.

Rod Copeland"

From: [redacted]
Sent: 27 October 2016 08:21
To: 'Rod Copeland' [redacted]
Subject: Community Roundtable: Statement your read

Hi Rod,

Thanks for coming yesterday. I am preparing the notes from the day. I was wondering if I could get a copy of your statement that you read?

I will put it in the notes.

Thanks again,
Kris

Meet2Create

Shire of Irwin Community Roundtable

Q&A Tracking Table

This document tracks progress of questions and answers raised by the community during the Shire of Irwin Community Roundtable Workshops. This document was prepared as a request from the community at the 7/12/2016 workshop. Please contact Kris Barnes (Independent Facilitator) for any further information (0411 700 259, krisbarnes@iinet.net.au).

Updated 1/12/2017

Purpose of Workshop

- Further encourage two way conversations between stakeholders and AWE regarding onshore energy projects in the Shire of Irwin, particularly those associated with the proposed Waitsia Gas Project development
- Answer key priority questions that were identified by the community
- Get a project update from AWE
- Discuss nominations for community roundtable membership
- Focus on clarifying what the community wants and how to best help deliver benefits from AWE's ongoing presence in the region

Questions yet to be 100% answered

Questions answered or actions complete

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Questions Raised By Community	Page	Status
Question 1: Does our attendance here (Community Roundtable) give blanket approval for a social licence?	5	Completed
Question 2: What is the specific process and chemicals to be used particular to each well to be fracked in this region? How much of a risk is it to human health and the environment. How is this risk managed?	5	Completed
Question 3: How do land access agreements work in practice?	6	Completed
Question 4: What is the project schedules for AWE: when, start-up time, notice to community?	9	Completed
Question 5: What monitoring is in place.- Baseline, Air and Water. CSIRO Project?	10	10%
Question 6: What are the potential benefits of the industry to each stakeholder? E.g. jobs, sponsorship, infrastructure, subcontracting opportunities?	11	50%
Question 7: What are the chemicals used in the fracking process and how much of a risk are they to the environment and human health should they get into the water supply?	11	Completed
Question 8: What are the processes and procedures used to ensure well integrity – especially in the long term? When has there been a problem in WA with well integrity and what has been done to ensure that similar problems don't happen again?	11	20%
Question 9: What is the approvals process?	11	20%
Question 10: Is it possible to get more public information on the DMP website relating to audits of company performance (e.g. what checks have been done, when?)	12	Completed
Question 11: What is the relevance/significant of toxicity of the chemicals used in the industry compared to other industries (e.g. farms and Roundup)?	12	Completed
Question 12: What soil and water testing is done? Who does it and when?	13	Completed
Question 13: If a tailings dam wall breaks – how is it managed? Does it go into the soil and how is this cleaned?	14	Completed
Question 14: How are chemicals managed at the end of their life of use?	14	Completed
Question 15: How advanced is the science on the chemicals used and what is the confidence level that they are safe (e.g. we thought asbestos was safe)? (raised 7/12/2016 as supplemental question to DMP brief)	14	Completed
Question 16: If there is a well integrity issue, how are chemicals managed?	15	Completed
Question 17: What information is available for historic wells and can we access this?	16	Completed
Question 18: What is the Water for Food program?	17	Completed

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Questions Raised By Community	Page	Status
Question 19: How will the Water for Food program work if there are existing/future resource leases over the same area?	17	Completed
Question 20: How does Water for Food fit with Irwin Park Farm?	18	Completed
Question 21: Where does Dongara gas go?	18	Completed
Question 22: If we cut of gas in Mid West what impact would it have to the state?	18	Completed
Question 23: Does decommissioning of wells include full rehabilitation?	18	Completed
Question 24: Will local services be used?	19	Completed
Question 25: What is the cost (of the Rehabilitation)?	19	Completed
Question 26: What does rehabilitation (of decommissioned wells) involve?	19	Completed
Question 27: What is landowner wants full rehabilitation (from decommissioning activities)?	19	Completed
Question 28: Who is responsible for clean-up at Jingemia and compliance (referring to whistleblower case)?	20	20%
Question 29: Is the mineral sands company going to mine?	20	Completed
Question 30: What percentage is conventional vs unconventional?	20	Completed
Question 31: CSIRIO: Offered to speak about the work that they have been doing in Mid West relating to the oil and gas industry	20	0%
Question 32: Is Beach Energy about to be onsold?	21	Completed
Question 33: How many more wells are coming in the area?	21	Completed
Question 34: How big is the area to be consumed by the activity? Can this be put into perspective with other activities in the area?	21	Completed
Question 35: How many people in the community will receive training so that they can apply for some of the potential jobs?	22	Completed
Question 36: Can we get a breakdown of the $16m in FY16 and $10m in FY17 into the Mid West economy? Who are the top 10 beneficiaries?	22	50%
Question 37: What does the local community get long term?	23	Completed
Question 38: Has AWE modelled how money is tracked and used in the community?	23	Completed
Question 39: How much land has AWE brought up and is there a plan to buy up more land for future activities?	23	Completed
Question 40: How many wells are we going to get close to the townsite?	23	Completed

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Questions Raised By Community	Page	Status
Question 41: How many employees since 2014 has AWE employed?	23	Completed
Question 42: What is the acreage of the Irwin Farm?	24	Completed
Question 43: Has any consideration been given to use some of the land at Irwin Farm by community organisations to raise money for their cause?	24	Completed
Question 44: Can industry continue to use horizontal drilling?	24	Completed
Question 45: How many slick water practices have been used in WA?	24	Completed
Question 46: How can problems in Pennsylvania be prevented from coming here?	24	Completed
Question 47: How much water is used in the fracking process and how does this compare to other industries?	25	Completed
Question 48: Only 60% of water is returned to the surface. Is this right? There is a general concern on bringing water from other areas and depositing it to new areas.	25	Completed
Question 49: Is the scientific enquiry any different to the one in 2014?	25	Completed

Q&A: Progress Status

Stakeholder to Answer	Action	Who	When	Notes on Progress	Priority (H,M,L)	% Complete
Question 1: Does our attendance here (Community Roundtable) give blanket approval for a social licence? (raised 26/10/2016)						
AWE	AWE answered on 26/10/2016.	Jane Aberdeen	26/10/2016	This question was answered at the 26/10/2016 workshop.	M	**Completed**
ANSWER	AWE Answer No, participation in the workshop does not indicate social licence approval. The roundtable is in response to stakeholder feedback and the intention is to provide a mechanism for discussion of issues of interest from a range of stakeholders.					
Question 2: What is the specific process and chemicals to be used particular to each well to be fracked in this region? How much of a risk is it to human health and the environment. How is this risk managed? (raised 26/10/2016)						
Department Mines and Petroleum	DMP to prepare to answer these questions at 7th December 2016 workshop.	DMP	7/12/2016	This question was answered at the 7/12/2016 workshop. Link: Additional questions were also raised and are contained in Supplemental Questions and then tracked from Questions 10-17.	H	**Completed**

Stakeholder to Answer	Action	Who	When	Notes on Progress	Priority (H,M,L)	% Complete
ANSWER	DMP Answer: What is the specific process and chemicals to be used particular to each well to be fracked in this region? • All chemicals used by the industry must be disclosed in a transparent process as required by regulation • Chemicals used in all wells are available on the DMP website https://ace.dmp.wa.gov.au/ACE/Public/PetroleumProposals • During the workshop the community visited the DMP website to confirm this process How much of a risk is it to human health and the environment? How is the risk managed? • Fracking fluid is made up of 90% water, 9.5% sand, 0.5% chemicals. Chemicals are added for different reasons (e.g. breakers) • Brad provided an analogy of the chemicals used in the onshore energy industry. He used the example of fracking fluid having similar toxicity to a backyard swimming pool. Risk to human health was minimal • There is a specific process to assess chemical risk AS/NZS ISO 31000:2009 Risk Management Standard • Brad explained that there are 3 key aspects – chemical hazard source, pathway and exposure receptor. All three of these are needed for a risk to be realised.					
Question 3: How do land access agreements work in practice? (raised 26/10/2016)						
Sally O'Brien (Landowner)	Sally to provide her personal experience on how the land access agreements have worked from her perspective.	Sally O'Brien	7/12/2016	This question was answered at the 10/5/2017 workshop. Further questions were also raised and are captured as subsets below.	H	**Completed**

Stakeholder to Answer	Action	Who	When	Notes on Progress	Priority (H,M,L)	% Complete
ANSWER	Early Days • Sally's family came to the area in the 1930's • There had been some "cowboy" oil and gas companies come through the region in the past and undertook seismic surveys. Companies approached farmers individually. • In the early days, Sally felt that there wasn't much that her family could do about oil and gas companies coming onto their land. This had caused her concern because she felt the integrity of her products and family was important • Sally expressed to the workshop that her family cared deeply for the land and wanted to hand it over to the next generation in even a better condition than how they received it. 2011 • Origin, with AWE as a minor shareholder, approached Irwin landholders regarding conducting bar far the most intensive seismic survey ever to be conducted in the region • All landholders initially worried about what work they wanted to do • Sally was also concerned that companies were approaching farmers individually rather than as a collective. Local landholders joined together to collectively negotiate access agreement and compensation rates. Successful outcome. 2014 - today • AWE sought regulatory approval for Irwin-1 appraisal well and approached our business to negotiate an access and compensation agreement • We had a family discussion on what this meant to us. We believe that we are consumers of energy and that it would be hypocritical of us if we didn't do it. Having it on our land gives us the opportunity to influence how the process is conducted and managed for all. Developed what we felt was a fair access and compensation agreement with AWE representatives over a period of nearly 12 months • The families experiences from many years of dealing with oil and gas companies assisted in the development of a land user access agreement template, a joint initiative of farming groups and industry • We had good input into appropriate site access (i.e. avoiding direct access in some circumstances and getting a good new road where we wanted it) • We will get a new agreement it the company chooses to go into production phase. We feel our agreements give us some control • We are always looking out for new technology with oil and gas so that things can be done better • It is always best to keep communicating and trying to find common ground and agreement; all the while getting you the best outcome. This was a key theme of Sally's conversation.					

Stakeholder to Answer	Action	Who	When	Notes on Progress	Priority (H,M,L)	% Complete
	Questions Do you have a sunset clause? ANS: Yes Does AWE have a right to purchase the farm if gas comes in? Ans: No What happens to compensation if something happens onsite or offsite? Ans: AWE is responsible for operating within the approvals granted and would have to clean-up any contamination caused as a result of its activities (i.e. on or off-site). If I don't have a baseline study am I protected? Ans: Yes, however, baseline studies help to show cause and effect. Have you had any abandoned wells on your property? Ans: Yes. Two exploration wells but these have been rehabilitated. Comment: Jane Aberdeen. When you take on exploration you take on decommissioning. Has your family had baseline health checks as there could be health issues associated with this industry? Ans: No Facilitator comments: There were also some Q&A related to the commercial interests of Sally O'Brien. The facilitator does not believe that it is appropriate that these conversations are recorded in these notes. It is recommended to contact Sally directly on these questions and answers as they are of a personal nature.					
DMP	DMP provided a brief overview of the process at the 16/2/2017 workshop and contributed to the discussions at the 10/5/2017 workshop.	DMP	10/5/2017		M	100%

Stakeholder to Answer	Action	Who	When	Notes on Progress	Priority (H,M,L)	% Complete
ANSWER	DMP ANSWER The DMP provided a short overview of the land access working group. Key points included: • A Land Access Working Group has been established to review the statutory framework for land access by the resources industry • The move is a direct response to recommendations from the Standing Committee on Environment and Public Affairs report on 'Implications for Western Australia of Hydraulic Fracturing for Unconventional Gas'. • The Land Access Working Group comprises representatives from industry and farmer bodies, local government (WALGA), NGO's and various State Government agencies • The working group is chaired by DMP's Director General • Community consultation will occur in the mid west of Western Australia in the coming months • The first stage of the group is looking at access to free hold land for petroleum activities • The group will provide a report and recommendations no later than 30 June 2018 for consideration by the State Government in relation to resources land access issues.					
AWE	Provide perspective on their land access agreements.	Jane Aberdeen	7/12/2016	Made comment at 10/5/2017 workshop.	M	100%
Question 4: What is the project schedules for AWE: when, start-up time, notice to community? (raised 26/10/2016)						
AWE	Provide update on project schedules.	Jane Aberdeen	7/12/2016	This question was answered at the 7/12/2016 workshop.	H	**Completed**

Stakeholder to Answer	Action	Who	When	Notes on Progress	Priority (H,M,L)	% Complete
ANSWER	AWE Answer Waitsia Gas Project - to date • Senecio-3 well discovered the Waitsia Gas Field in September 2014 • Appraisal wells, Waitsia-1 and Irwin, drilled in 2015 • Diagnostic Fracture Injection Tests conducted in July 2016 at Waitsia-1 and Irwin-1 • Stage 1A - Extended Production Test • Involved installing infrastructure to allow gas to flow from two wells through a newly constructed 7km pipeline to the existing Xyris Production Facility • Mid West businesses contracted to help (~$12 m of contracts to local service providers) • The Extended Production Test results will help plan for further development (e.g. Stage 2) • Commissioned in August 2016 and community launch held, including a site tour. Waitsia Gas Project - Next steps • Waitsia Gas Project Stage 2 – planning is underway • Exploration/appraisal • Two wells planned in April-June 2017 • Waitsia-3 – will be on private land near the Yardanogo Nature Reserve. and on the same block as the Mondarra-2 well. • Waitsia-4 will be on private, cleared agricultural land near the Xyris Production Facility • Required approvals are nearing completion • Results will help Waitsia Gas Project field development planning • Stage 2 production will be from free flowing gas (i.e. does not involve hydraulic fracture (fracking) stimulation) • Gas production • A new gas production facility is in early stages of planning. It will be located somewhere east of the Xyris Production Facility on private, cleared agricultural land and provide up to 100 TJ of gas a day when it is operating • Following further internal approvals, construction will commence in 2018 with gas being produced in 2020 • Procurement process will again include local service providers, similar to Stage 1A process					
Question 5: What monitoring is in place.- Baseline, Air and Water. CSIRO Project? (raised 26/10/2016)						
AWE	Provide an outline at the next workshop.	Jane Aberdeen	10/5/2017	In development for 10/5/2017 workshop.	H	10%

Stakeholder to Answer	Action	Who	When	Notes on Progress	Priority (H,M,L)	% Complete
Question 6: What are the potential benefits of the industry to each stakeholder? E.g. jobs, sponsorship, infrastructure, subcontracting opportunities? (raised (26/10/2016)						
TBA	TBA	TBA	TBA	TBA	H	10%
Question 7: What are the chemicals used in the fracking process and how much of a risk are they to the environment and human health should they get into the water supply? (raised 26/10/2016)						
DMP	DMP to prepare to answer this question at the next Community Roundtable.	DMP	7/12/2016	This question was answered at the 7/12/2016 workshop. Refer also Question 2 above. Link: Additional questions were also raised and are contained in Supplemental Questions and then tracked from Questions 10-17.	H	**Completed**
ANSWER	DMP Answer Refer question 2 above.					
Question 8: What are the processes and procedures used to ensure well integrity – especially in the long term? When has there been a problem in WA with well integrity and what has been done to ensure that similar problems don't happen again? (raised 26/10/2016)						
DMP	TBA	TBA	TBA	This question overlaps with Question 16.	M	20%
Question 9: What is the approvals process? (raised 26/10/2016)						
TBA	TBA	TBA	TBA	TBA	M	0%

Stakeholder to Answer	Action	Who	When	Notes on Progress	Priority (H,M,L)	% Complete
Question 10: Is it possible to get more public information on the DMP website relating to audits of company performance (e.g. what checks have been done, when?) (raised 7/12/2016 as supplemental question to DMP brief)						
DMP	DMP to provide written answer and if necessary talk about this at the next workshop.	Lyn Reid	1/2/2017 (written) 16/2/2016 (talk)	Some informal discussions took place on this question at the 7/12/2016 workshop. Link: Written answers provided by in supplementation Q&A document.	H	**Completed**
ANSWER	DMP Answer Answer: In response to stakeholder interest, DMP has developed a Transparency Policy and has several transparency improvement initiatives underway that respond to key issues of interest. An example is DMP's introduction of the down-hole chemical disclosure in 2012, which includes monitoring and reporting. From a regulatory perspective, there are some associated legal issues with publicly releasing site inspection results and data if it may be used at some point as evidence in a prosecution case. Notwithstanding, DMP is investigating ways of presenting a succinct summary of compliance inspections on the DMP website to help improve confidence in operational performance.					
Question 11: What is the relevance/significant of toxicity of the chemicals used in the industry compared to other industries (e.g. farms and Roundup)? (raised 7/12/2016 as supplemental question to DMP brief)						
DMP	DMP to provide written answer and if necessary talk about this at the next workshop.	Lyn Reid	1/2/2017 (written) 16/2/2016 (talk)	Some informal discussions took place on this question at the 7/12/2016 workshop. Written answers provided by DMP in supplementation Q&A document.	H	**Completed**

Stakeholder to Answer	Action	Who	When	Notes on Progress	Priority (H,M,L)	% Complete
ANSWER	DMP Answer Chemicals used in the resources sector are comprehensively assessed prior to use and carefully monitored during use for each specific activity. As mentioned, the chemical disclosure requirements are rigorously applied. Environment Plans approved for each activity include information about the specific chemical products approved for use. These are available on the DMP website. Use of similar chemicals in other sectors (e.g. broad acre farming, intensive horticulture) are not as closely regulated. The Department of Agriculture and Food (DoAF) is the lead agency for regulating chemical use in agricultural sector. DoAF does not require activity specific assessment, monitoring or reporting. There is lots of information available on the internet for the relative toxicity of various chemicals used by agriculture, mining, medicines, petroleum, etc. The DMP Environmental Risk Assessment for Chemicals provides a good overview: http://www.dmp.wa.gov.au/Documents/Environment/ENV-PEB-165.pdf					
Question 12: What soil and water testing is done? Who does it and when (raised 7/12/2016 as supplemental question to DMP brief)						
DMP	DMP to provide written answer and if necessary talk about this at the next workshop.	Lyn Reid	1/2/2017 (written) 16/2/2016 (talk)	Some informal discussions took place on this question at the 7/12/2016 workshop. Written answers provided by DMP in supplementation Q&A document.	H	**Completed**
ANSWER	DMP Answer Answer: Soil and water quality are key factors assessed and regulated for each activity. Baseline monitoring is required so once activities are underway and completed, any significant changes in monitoring results can be detected and acted upon promptly to mitigate any impacts. DMP assesses and approves proposed monitoring protocols that have been developed by technical specialists prior to the activities starting. Monitoring protocols focus on the potential contamination source, the pathway and any potential receptor. Ongoing non-specific water monitoring within sumps for chemicals is extremely expensive and not a good use of tax payer resources – instead DMP inspects the chemicals being stored on site against what has been approved for use. Sumps may contain a mixture of drilling, cementing, fraccing and waste fluids – so concentrations of chemicals would not be identical to what is in the chemical disclosure information. Water testing of sumps is not undertaken as this water is contained in a lined sump and not released to the environment. If any leaks or spills occur to the environment, then DMP requires companies to undertake soil and water testing as part of their clean up (to ensure that the environment is returned to a non-polluted state). Water quality monitoring is generally undertaken by independent consultants. Baseline groundwater monitoring is also best practice for any drilling activities to get an understanding of water quality pre and post drilling. Monitoring continues throughout the activity and afterwards too.					

Stakeholder to Answer	Action	Who	When	Notes on Progress	Priority (H,M,L)	% Complete
Question 13: If a tailings dam wall breaks – how is it managed? Does it go into the soil and how is this cleaned? (raised 7/12/2016 as supplemental question to DMP brief)						
DMP	DMP to provide written answer and if necessary talk about this at the next workshop.	Lyn Reid	1/2/2017 (written) 16/2/2016 (talk)	Some informal discussions took place on this question at the 7/12/2016 workshop. Written answers provided by DMP in supplementation Q&A document	H	**Completed**
ANSWER	DMP Answer Answer: Sumps are required to be constructed to overflow rather than break. DMP requires companies to have freeboard (extra) volume in their sumps to cater for exceptional rainfall events. Spill contingency plans must also be approved by DMP to deal with any type of spill (large or small). Overflows / breaches must be reported to DMP, investigated and cleaned up.					
Question 14: How are chemicals managed at the end of their life of use? (raised 7/12/2016 as supplemental question to DMP brief)						
DMP	DMP to provide written answer and if necessary talk about this at the next workshop.	Lyn Reid	1/2/2017 (written) 16/2/2016 (talk)	Some informal discussions took place on this question at the 7/12/2016 workshop. Written answers provided by DMP in supplementation Q&A document.	H	**Completed**
ANSWER	DMP Answer All chemicals are disposed of at an appropriate DER licensed waste facility. Chemicals contained within evaporation ponds are tested after drilling activities have ceased. If these chemicals are found to be above guideline levels they are removed and disposed of at an appropriate DER licensed waste facility.					
Question 15: How advanced is the science on the chemicals used and what is the confidence level that they are safe (e.g. we thought asbestos was safe)? (raised 7/12/2016 as supplemental question to DMP brief)						
DMP	DMP to provide written answer and if necessary talk about this at the next workshop.	Lyn Reid	1/2/2017 (written) 16/2/2016 (talk)	Some informal discussions took place on this question at the 7/12/2016 workshop. Written answers provided by DMP in supplementation Q&A document.	H	**Completed**

Stakeholder to Answer	Action	Who	When	Notes on Progress	Priority (H,M,L)	% Complete
ANSWER	DMP Answer Answer: Chemicals are a part of everyday life – and we are exposed to a larger number of chemicals every day. The body of scientific knowledge on approved chemicals is significant and is the foundation for the assessment of risk. If this body of knowledge changes, then we apply that to our new understanding of risks and controls. This is exactly the same for any industry and medical science too. At DMP all chemicals proposed for use by a petroleum company are risk assessed according to WA environment and safety regulations before they are approved or rejected. DMP uses the most current scientific knowledge to assess the toxicity and biodegradability of chemicals. Petroleum companies must demonstrate that the chemicals used do not pose significant risk to human health, the environment or groundwater resources. If a significant risk or potential impact is identified then the proposal is referred to the EPA for an independent environmental assessment.					
Question 16: If there is a well integrity issue, how are chemicals managed? (raised 7/12/2016 as supplemental question to DMP brief)						
DMP	DMP to provide written answer and if necessary talk about this at the next workshop.	Lyn Reid	1/2/2017 (written) 16/2/2016 (talk)	Some informal discussions took place on this question at the 7/12/2016 workshop. Written answers provided by DMP in supplementation Q&A document.	H	**Completed**

Stakeholder to Answer	Action	Who	When	Notes on Progress	Priority (H,M,L)	% Complete
ANSWER	DMP Answer There are many classifications of well integrity issues (see Petroleum in Western Australia magazine, April 2015, pp 24—25, available at http://www.dmp.wa.gov.au/Petroleum/Publications-1601.aspx). The majority of well integrity issues do not allow interaction between the internal contents of the well and the groundwater or surface environment. In circumstances where external well casing may be compromised, if the integrity issue cannot be remediated, the well will be decommissioned. Decommissioning involves installing a series of cement plugs that provide isolation internally between different vertical zones in the well and also provides isolation from the external rock formation. If repair is possible, a steel casing patch (a sort of internal sleeve) may be installed, or a seal can be created by squeezing cement through holes usually involves the application of a patch onto the interior of the casing. To enable patching, the well is filled with fluid containing chemicals including biocides, corrosion inhibitors, and pH adjustors. These chemicals degrade into inactive versions over time. In some cases, fluid density is increased with the use of salts. After the well is patched and normal operations re-commence, the fluid is retrieved to surface from inside the well casing. Loss of the fluid into the rock formation is minimised. Once the repair is completed, the fluid is replaced by a clean water-based fluid which also contains small amounts of corrosion inhibitors, biocides and pH adjustors. This fluid stays within the casing to protect it from internal corrosion. In line with other chemical usage in petroleum wells, the highest risk of using chemicals during well integrity operations occurs at the ground surface. Mitigation measures are kept in place to minimise the risk of such events. A DMP speaker on well management may be available to further answer this question at a later date.					
Question 17: What information is available for historic wells and can we access this? (raised 7/12/2016 as supplemental question to DMP brief)						
DMP	DMP to provide written answer and if necessary talk about this at the next workshop.	Lyn Reid	1/2/2017 (written) 16/2/2016 (talk)	Some informal discussions took place on this question at the 7/12/2016 workshop. Written answers provided by DMP in supplementation Q&A document.	H	**Completed**

Stakeholder to Answer	Action	Who	When	Notes on Progress	Priority (H,M,L)	% Complete
ANSWER	DMP Answer Answer: Information about historical wells is available online through the Department of Mines and Petroleum WAPIMS system (information and free access at http://www.dmp.wa.gov.au/Petroleum-and-Geothermal-1497.aspx). To learn about a particular well, select the Wells tab at top and type in the well name and press Search. In the next screen, click on the well name until the row turns blue. Press View Details for Selected Rows and all the publically available information about the well will be displayed in multiple tabs. In general, detailed information becomes publically available two years after the well activity is completed. The Well Completion Report contains significant amounts of information about how the well was constructed, chemicals used during drilling, and the surrounding geology. The report, although highly technical, is often clear enough to be understood by members of the public. For specific questions about available information, please contact the DMP.					
Question 18: What is the Water for Food program? (raised 7/12/2016)						
Department of Water	DoW to provide written answer and if necessary talk about this at the next workshop.	Darryl Abbot	1/2/2017 (written) 16/2/2016 (talk if necessary)	Some informal discussions took place on this question at the 7/12/2016 workshop. Documentation and presentation provided at 16/2/2017 workshop. Written answers provided by DoW in supplementation Q&A document.	H	**Complete**
ANSWER	DOW Answer The following links are two brochures that summarise the program and provide detail on the midlands projects. (Link)					
Question 19: How will the Water for Food program work if there are existing/future resource leases over the same area? (raised 7/12/2016)						
Department of Water	DoW to provide written answer and if necessary talk about this at the next workshop.	Mark Canny	1/2/2017 (written) 16/2/2016 (talk if necessary)	Some informal discussions took place on this question at the 7/12/2016 workshop. Documentation and presentation provided at 16/2/2017 workshop. Written answers provided by DoW in supplementation Q&A document.	M	**Completed**

Stakeholder to Answer	Action	Who	When	Notes on Progress	Priority (H,M,L)	% Complete
ANSWER	DoW Answer Agriculture, including irrigated agriculture, and mining/petroleum activities have co-existed in the Midlands region for a considerable period. Additionally, the government has a clear policy position supporting multiple land use, including petroleum activities and irrigated agriculture, to make the best use of land and water resources. Water for food is about providing updated information to existing landowners to assist them make investment decisions underpinning a move into, or expanding, irrigated agriculture. The program will not impact on existing or future "onshore petroleum" petroleum resource leases, and any future investment decisions by the landowner, and associated approval processes, will not change. Existing regulatory procedures will still apply.					
Question 20: How does Water for Food fit with Irwin Park Farm? (raised 7/12/2016)						
AWE	Answered verbally during the workshop (7/12/2016) and captured in notes.	Jane Aberdeen	7/12/2016	This question was answered at the 7/12/2016 workshop.	M	**Completed**
ANSWER	AWE Answer Jane explained that the Minister for Water announced the initiative on Christmas Eve 2015. Water for Food staff subsequently met with AWE as Irwin Park Farm had been included in the Water for Food Midlands project area. The project helps provide another example of agriculture and gas sectors coexisting. AWE agreed to assist the project by allowing DoW to install shallow groundwater monitoring bores on Irwin Park Farm					
Question 21: Where does Dongara gas go? (raised 7/12/2016)						
AWE	Answered verbally during the workshop (7/12/2016) and captured in notes.	Jane Aberdeen	7/12/2016	This question was answered at the 7/12/2016 workshop.	M	**Completed**
ANSWER	AWE Answer Transported via pipeline to Perth for domestic and industrial consumer consumption					
Question 22: If we cut of gas in Mid West what impact would it have to the state? (raised 7/12/2016)						
DMP	Answered verbally during the workshop (7/12/2016) and captured in notes.	Brad Jakowyna	7/12/2016	This question was answered at the 7/12/2016 workshop.	M	**Completed**
ANSWER	DMP Answer Security of supply impact, cost/price of gas impact					
Question 23: Does decommissioning of wells include full rehabilitation? (raised 7/12/2016)						
AWE	Answered verbally during the workshop (7/12/2016) and captured in notes.	Jane Aberdeen	7/12/2016	This question was answered at the 7/12/2016 workshop.	M	**Completed**

Stakeholder to Answer	Action	Who	When	Notes on Progress	Priority (H,M,L)	% Complete
ANSWER	AWE Answer Yes					
Question 24: Will local services be used?						
AWE	AWE answered on 16/2/2017.	Jane Aberdeen	16/2/2017	This question was answered at the 16/2/2017 workshop.		**Completed**
ANSWER	AWE Answer AWE will continue using as many local business services as possible in the project, although decommissioning the actual well requires specialist services. The procurement process includes local service providers for general activities required during site rehabilitation like earthworks. AWE is using similar procurement approach to the Stage 1A process.					
Question 25: What is the cost (of the Rehabilitation)?						
AWE	AWE answered on 16/2/2017.	David Guise	16/2/2017	This question was answered at the 16/2/2017 workshop.		**Completed**
ANSWER	AWE Answer This year project costs will be about $7 million.					
Question 26: What does rehabilitation (of decommissioned wells) involve?						
AWE	AWE answered on 16/2/2017.	David Guise	16/2/2017	This question was answered at the 16/2/2017 workshop.		**Completed**
ANSWER	AWE Answer Decommissioning involves installing plugs within the well to isolate it from any aquifers, then cutting the wellhead below ground and backfilling to restore the soil profile. Rehabilitation then depends on the landowner's preference for final land use and what area is to be rehabilitated. Usually the land is returned for broad acre cropping or pasture. Need to also be mindful of weeds and soil hygiene especially if working in a conservation area. (Consultant's note: This issue might be worth exploring in a separate workshop agenda item).					
Question 27: What is landowner wants full rehabilitation (from decommissioning activities)?						
AWE	AWE answered on 16/2/2017.	David Guise	16/2/2017	This question was answered at the 16/2/2017 workshop.		**Completed**
ANSWER	AWE Answer Our agreements with landowners require us to restore the land to its previous land use and in negotiation with the landowner. Specific details are negotiated with each landowner as some prefer keeping infrastructure such as gravel roads and fences as they are seen as improvements. For example, the Drover-1 well took six months to complete decommissioning and rehabilitation.					

Stakeholder to Answer	Action	Who	When	Notes on Progress	Priority (H,M,L)	% Complete
Question 28: Who is responsible for clean-up at Jingemia and compliance (referring to whistleblower case)?						
Origin	Answered verbally during the workshop (16/2/2017) and captured in notes. However, AWE cannot speak on behalf of Origin. Action: Rod to send list of questions to Jane Aberdeen for passing onto Origin. Origin to be asked if they would present at a future workshop.	Rod Copeland/ Jane Aberdeen	10/5/2017	Waiting on questions. Origin potentially available to speak at future workshop.		20%
Question 29: Is the mineral sands company going to mine?						
AWE	Answered verbally during the workshop (16/2/2017) and captured in notes.	Jane Aberdeen	16/2/2017	This question was answered at the 16/2/2017 workshop.		**Completed**
ANSWER	AWE Answer Tronox has environmental approvals to proceed with the minerals sands mine although they said they have no immediate plans to do so. This reflects the low global demand for mineral sands and low market prices.					
Question 30: What percentage is conventional vs unconventional?						
AWE	Answered verbally during the workshop (16/2/2017) and captured in notes.	Jane Aberdeen	16/2/2017	This question was answered at the 16/2/2017 workshop.		**Completed**
ANSWER	AWE Answer Stage 2 gas is free flowing (conventional). Future appraisal well results may show tight sands present.					
Question 31: CSIRIO: Offered to speak about the work that they have been doing in Mid West relating to the oil and gas industry						

Stakeholder to Answer	Action	Who	When	Notes on Progress	Priority (H,M,L)	% Complete
CSIRO	CSIRIO: Present at the next workshop about the work that they have been doing in Mid West relating to the oil and gas industry			The community agreed at 16/2/2017 to have CSIRO speak at 10/5/2017. However, two factors prevented this. First, the CSIRO representative was not available on 10/5/2017. Also, the priority of this item needs to be discussed against other previous high priorities (see above). Kris Barnes to raise this at 10/5/2017 meeting.		0%
Question 32: Is Beach Energy about to be onsold?						
AWE	Answered verbally during the workshop (8/11/2017) and captured in notes.	Steve McCracken	8/11/2017	This question was answered at the 8/11/2017 workshop.		**Completed**
ANSWER	AWE Answer Beach Energy is buying the Lattice Energy assets. No participant knew of any other sales plans. Beach Energy is best placed to answer this question.					
Question 33: Question: How many more wells are coming in the area?						
AWE	Answered verbally during the workshop (8/11/2017) and captured in notes.	Steve McCracken	8/11/2017	This question was answered at the 8/11/2017 workshop.		**Completed**
ANSWER	AWE Answer About 17 or 18 planned, less than number of wells used for Dongara field. Some will be from same well pad. No need to frack for Stage 2. May be less wells over life of the project depending on appraisal results.					
Question 34: How big is the area to be consumed by the activity? Can this be put into perspective with other activities in the area?						
AWE	Answered verbally during the workshop (8/11/2017) and captured in notes.	Steve McCracken	8/11/2017	This question was answered at the 8/11/2017 workshop.		**Completed**

Stakeholder to Answer	Action	Who	When	Notes on Progress	Priority (H,M,L)	% Complete
ANSWER	AWE Answer Proposed new facility will have smaller footprint than the Hovea Production Facility area. Refer to Dongara gas field area, producing since 1971, which looks like farm land (e.g. existing wells and infrastructure are not noticed by many people now and new development will be similar in appearance). Decommissioning project means overall number of wells will decrease despite Stage 2 development.					
Question 35: How many people in the community will receive training so that they can apply for some of the potential jobs?						
AWE	Answered verbally during the workshop (8/11/2017) and captured in notes.	Jane Aberdeen	8/11/2017	This question was answered at the 8/11/2017 workshop.		**Completed**
ANSWER	AWE Answer Facilities operators live locally and are employed through a contracting firm who trains them for the job. Most of the jobs will be through contractors during construction phase. Noted after the meeting: AWE sponsors a STEM scholarship at Geraldton TAFE and people interested are welcome to apply. Participant Jenny Devereux (Community/MidWest Labour Pool) – provided an example of an 18 year old who was employed for two weeks work experience by a contractor to AWE. (In addition, please refer to Question 24).					
Question 36: Can we get a breakdown of the $16m in FY16 and $10m in FY17 into the Mid West economy? Who are the top 10 beneficiaries?						
AWE	Answered verbally during the workshop (8/11/2017) and captured in notes.	Jane Aberdeen	8/11/2017	This question was partially answered at the 8/11/2017 workshop. Action: Jane offered to provide a breakdown of expenditure into local economy once the update is available.	M	50%
ANSWER	AWE Answer The amount for FY 16 reflects local spend increased as a result of the Stage 1A development. Some of the top ten local companies included Dongara Skip Bins, Mitre 10, MidWest Labour Pool, Dongara Drilling and Dongara IGA. Estimated FY 17 amount provided is based on rates, sponsorships, local wages and work contracted in the Shire. An updated local spend analysis is underway and will be made available.					

Stakeholder to Answer	Action	Who	When	Notes on Progress	Priority (H,M,L)	% Complete
Question 37: What does the local community get long term?						
AWE	Answered verbally during the workshop (8/11/2017) and captured in notes.	Jane Aberdeen	8/11/2017	This question was answered at the 8/11/2017 workshop.		Completed
ANSWER	AWE Answer Refer to question 24 and 36.					
Question 38: Has AWE modelled how money is tracked and used in the community?						
AWE	Answered verbally during the workshop (8/11/2017) and captured in notes.	Jane Aberdeen	8/11/2017	This question was answered at the 8/11/2017 workshop.		Completed
ANSWER	AWE Answer To a degree. We track sponsorships and partnerships and some of our local expenditure. We are starting a more complete analysis.					
Question 39: How much land has AWE brought up and is there a plan to buy up more land for future activities?						
AWE	Answered verbally during the workshop (8/11/2017) and captured in notes.	Jane Aberdeen	8/11/2017	This question was answered at the 8/11/2017 workshop.		**Completed**
ANSWER	AWE Answer AWE owns Irwin Park Farm and Locksley Farm. No plans to buy more land for AWE.					
Question 40: How many wells are we going to get close to the townsite?						
AWE	Answered verbally during the workshop (8/11/2017) and captured in notes.	Jane Aberdeen	8/11/2017	This question was answered at the 8/11/2017 workshop.		Completed
ANSWER	AWE Answer Senecio-3, drilled in 2014, is the closest well to the Irwin town site (Refer to project map presented at workshop 6: www.meet2create.com). No wells are planned for drilling next year and no additional wells will be required for Stage 2 of the development.					
Question 41: How many employees since 2014 has AWE employed?						
AWE	Answered verbally during the workshop (8/11/2017) and captured in notes.	Jane Aberdeen	8/11/2017	This question was answered at the 8/11/2017 workshop.		**Completed**
ANSWER	AWE Answer Depending on activity levels, AWE engages 12-14 full-time contracted operators at the facilities. These employees live locally. Other companies use fly-in/fly-out and drive-in/drive-out contractors.					

Stakeholder to Answer	Action	Who	When	Notes on Progress	Priority (H,M,L)	% Complete
Question 42: What is the acreage of the Irwin Farm?						
AWE	Answered verbally during the workshop (8/11/2017) and captured in notes.	Jane Aberdeen	8/11/2017	This question was answered at the 8/11/2017 workshop.		Completed
ANSWER	AWE Answer Unsure. Think about 12,000 acres.					
Question 43: Has any consideration been given to use some of the land at Irwin Farm by community organisations to raise money for their cause?						
AWE	Answered verbally during the workshop (8/11/2017) and captured in notes.	Jane Aberdeen	8/11/2017	This question was answered at the 8/11/2017 workshop.		Completed
ANSWER	AWE Answer This suggestion had been mentioned and briefly discussed. No proposal to AWE presented and not yet considered.					
Question 44: Can industry continue to use horizontal drilling?						
DMIRS	Answered verbally during the workshop (8/11/2017) and captured in notes.	Jeff Haworth	8/11/2017	This question was answered at the 8/11/2017 workshop.		Completed
ANSWER	DMIRS Answer Yes, this practice is part of conventional drilling.					
Question 45: How many slick water practices have been used in WA?						
DMIRS	Answered verbally during the workshop (8/11/2017) and captured in notes.	Jeff Haworth	8/11/2017	This question was answered at the 8/11/2017 workshop.		Completed
ANSWER	DMIRS Answer Two. In addition, over 600 wells fracked in WA with no reported incidents. Post workshop, DMIRS provided a link for the community on stimulated wells in WA. http://www.dmp.wa.gov.au/Documents/Petroleum/PD-SBD-NST-126D.pdf					
Question 46: How can problems in Pennsylvania be prevented from coming here?						
DMIRS	Answered verbally during the workshop (8/11/2017) and captured in notes.	Jeff Haworth	8/11/2017	This question was answered at the 8/11/2017 workshop.		Completed

Stakeholder to Answer	Action	Who	When	Notes on Progress	Priority (H,M,L)	% Complete
ANSWER	DMIRS Answer USA EPA report said that there has been no systemic contamination of water by fracking. Western Australia has a strict regulatory framework for this industry.					
Question 47: How much water is used in the fracking process and how does this compare to other industries?						
DMIRS	Answered verbally during the workshop (8/11/2017) and captured in notes.	Jeff Haworth	8/11/2017	This question was answered at the 8/11/2017 workshop.		Completed
ANSWER	DMIRS Answer Approximately 10 million litres of water (10,000KL) are required for a 10 stage deep shale hydraulic fracture stimulation program of which anywhere from 40 to 60% returns to the surface. This is the equivalent to the annual usage of 15-20 households and much lower than irrigated agriculture. (NB during the workshop the group also agreed that 10 commercial mango trees would use this amount of water in one year). In terms of sustainability of the groundwater resource, the Department of Water and Environmental Regulation would generally consider this a low volume and have a low risk of impacts on the environment or other users.					
Question 48: Only 60% of water is returned to the surface. Is this right? There is a general concern on bringing water from other areas and depositing it to new areas.						
DMIRS	Answered verbally during the workshop (8/11/2017) and captured in notes.	Jeff Haworth	8/11/2017	This question was answered at the 8/11/2017 workshop.		Completed
ANSWER	DMIRS Answer Use of water volume is low compared to other uses. The value of the end use of water is not assessed by the Department of Water and Environmental Regulation, and unless it is clearly wasteful, the Department of Water and Environmental Regulation would not make a value judgement on the best end use for water taken. (NB Please also refer to Q&A questions 10, 12, 18 and 19 relating to water. The Q&A document can be found on the website hosting the community roundtable information: www.meet2create.com)					
Question 49: Is the scientific enquiry any different to the one in 2014?						
DMIRS	Answered verbally during the workshop (8/11/2017) and captured in notes.	Jeff Haworth	8/11/2017	This question was answered at the 8/11/2017 workshop.		Completed
ANSWER	DMIRS Answer It is different because it is a scientific inquiry focused on environmental issues whereas the previous inquiry was a parliamentary inquiry.					

Commitments: Progress Status

Organisation	Action	Who	When	Notes on Progress	% Complete
Commitment 1: AWE to provide continued support for an independently-facilitated and resourced Community Roundtable					
AWE	Funding obtained from AWE.	AWE	August 2016	Funding obtained for independently facilitated process. However, any person or organization may contribute to these costs if there is concern over conflict of interest of the facilitator.	**Completed**
Commitment 2: Shire of Irwin to provide Community Roundtable with a workshop venue to use at no cost – Aug 2016					
Shire of Irwin	Shire of Irwin to provide a workshop venue at no cost for the Community Roundtable.	Shire of Irwin	August 2016	Shire of Irwin agreed to provide a workshop location at no cost.	**Completed**
Commitment Sought Number 3:					
Commitment Sought Number 4:					

Snapshot: Shire of Irwin Onshore Energy Industry (2017)

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World around us

1. Cleaner energy push worldwide and within Australia
2. Energy supply concerns on the east coast of Australia is refocussing WA public attention to the importance of local energy supplies. This appears favourable for the WA onshore energy industry
3. Perceived poor environmental records from energy industries in the USA and eastern Australia continue to negatively impact on attitudes to the industry in WA – but to a lesser degree over the past 12 months
4. WA continues to be in a significant economic downturn, low oil price is pressuring industry – many businesses in the Mid West are struggling
5. Industry and government continue to struggle to find ways to address the 10 common questions raised by stakeholders (see reverse side)
6. There has been an increased sensitivity within industry and government to use the term "Fracking" (or similar terminology). This word is now owned by interest groups
7. *Consultant's observation: Despite a number of government enquiries across Australia and continued negative media articles about the industry, there now appears to be less concern about the risks associated with the industry with most stakeholders.*

Industry

10. Many good success stories (jobs, energy security, successful safe decommissioning, environmental record) but these are not well communicated
11. Language used by industry and proponents to communicated with stakeholders continues to be too technical and confusing (Tcf, Xmas tree, conventional vs unconventional gas, aquifers). Diagrams explaining the industry are generally poor
12. There are inconsistent approaches by industry to "how" community engagement is undertaken in the Mid West. Lack of guidelines around how this should be done
13. Representative bodies of industry are seen as combative to interest groups which has put some of the community off-side
14. Concerns some companies are "fly-by-the-night" – drill and sell.

AWE

20. AWE has the best stakeholder relations program for the industry in WA – positive landowner interactions, community roundtables, community open days, coordinating Expos, 1on1 discussions and interviews, bus tours and local employment
21. AWE stakeholder representatives are highly respected and trusted by all stakeholders and are a critical linchpin for the company in stakeholder relations
22. Many locals benefit both directly and indirectly from AWE's existing operations – but these benefits (i.e. stories) could be better told in more easily digestible, modern mediums (e.g. video, audio, interactive education)
23. There are high expectations that AWE's future procurement policy for Waitsia will favour local Shire of Irwin businesses. Such policy being measurable with clear targets
24. Community Roundtable has been very well received by all Stakeholders.

Green Interest Groups

30. Value protection of water quality, well integrity, surface pollution, chemicals usage
31. Very vocal and well organised in Mid West, do not like fossil fuels
32. Emotive video documentaries initially very successful but loosing effectiveness. Still no industry equivalent despite numerous recommendations to do so
33. Tactics of bullying, passive aggressive behaviour and release of continual doomsday information have started to work against these groups. Community are now starting to use the terminology "fake news" to apply to information released by these groups.

Community

40. The community believe that face-to-face interactions from industry and government have been far more successful in building trust and openness than traditional communication strategies such as media releases, websites and handouts
41. Information complexity continues to be passed to the community – most company and government websites are hard to navigate, language used is inconsistent or complex, There is no one centrally designed portal where the community can source information
42. Community is very vulnerable to slick marketing campaigns by interest groups using modern mediums of communication. Industry and government are a long way behind in using modern mediums as effectively as interest groups
43. In the Shire of Irwin, anecdotal evidence suggests that the majority of people are supportive of the energy industry. This assumption should be tested quantitatively
44. Some landowners who aren't directly involved in projects and don't have land access agreements, feel they're missing out on benefits. What about farms around those areas that miss out from compensation?
45. There is a desire from community to have independent people outside of government, industry and interest groups to run good engagement and present the facts.

Government

50. Government departments have embraced stakeholder engagement as a core function for enabling the onshore energy industry to work effectively in communities
51. Involvement in community roundtable forums, expos and open days has dramatically improved the trust and respect with those communities receiving this attention
52. Uncertainty over State Govt. policy direction relating to the onshore energy industry poses a risk to the industry
53. Desire from key stakeholders for Government to show leadership in developing a definitive integrated energy strategy (i.e. coal, gas, renewables, uranium)
54. Government approval processes difficult to follow or understand by stakeholders
55. Unclear to stakeholders which government department is responsible for what - approval, regulation and promotion of the industry (i.e. DMIRS, DPIRD, DWER)
56. Community is unclear of the role of three tiers of Governments (i.e. Commonwealth, State and local government) in developing and implementing key policy in this industry (e.g. council bans on industry, energy security policy at state level, carbon tax)
57. Perception with some stakeholders that the cumulative effects from the onshore industry are not well understood or focussed on by regulators
58. Government departments recommending industry to undertake more stakeholder engagement. However, the key issue of "how" good stakeholder engagement should be implemented (e.g. face-to-face, workshops) is rarely discussed or valued
59. Rights of landusers vs industry continues to be area of concern for sections of the community.

All stakeholders: Environmental and Social

60. Value protection of water quality – e.g. from well integrity (long term), chemicals used and volumes of water used in the process
61. Very limited stakeholder concern about conventional gas extraction
62. Clean-up and rehabilitation process are considered very important
63. Industry needs to show leadership in being good corporate citizens.

Positive feedback √

Top 5 most significant issues – Kris Barnes opinion

Updated Dec 8th 2017

Mid West Key Stakeholder Questions

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1. What are the potential benefits of the industry to me? E.g. direct and indirect jobs, family employment, sponsorship, infrastructure?
2. When will projects come into production and will industry commit to using local people and local businesses?
3. Relative to other landuses in the region (i.e. agriculture, mining, light industry), how do the impacts to the environment from the onshore energy industry compare?
4. What does a full production field look like? Is it 10,000 wells?
5. What is fracking, what are the risks and how are these controlled?
6. What's the difference between fracking in WA vs other parts of the world where there is a perception of considerable environmental damage and health impacts?
7. What wells in the Mid West region will require fracking in either the exploration or production phase?
8. When has there been a problem in WA with well integrity and what has been done to ensure that similar problems don't happen again?
9. What formal, written guarantees will the company and government provide to the local community to ensure that local drinking water supplies are not affected by the industry?
10. Why should local residents accept the risks associated with the onshore energy industry when there is already plenty of gas in other parts of the state?

www.waterforfood.wa.gov.au/projects/midlands-groundwater-and-land-assessment/ 80% Search

Department of Primary Industries and Regional Development
Department of Water and Environmental Regulation
Department of Planning, Lands and Heritage

GOVERNMENT OF WESTERN AUSTRALIA

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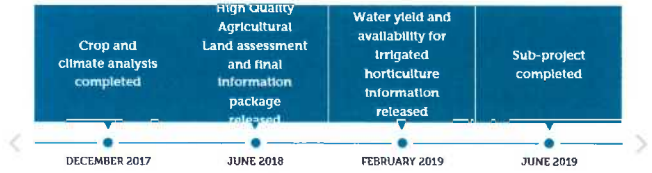
Home Projects Midlands: Groundwater and Land Assessment

PROJECTS

- Fitzroy Valley Groundwater Investigations
- Gascoyne Master Plan
- Knowsley Agricultural Area Water Investigation

Proposed Timeline

Expand



Midlands: Groundwater and Land Assessment

La Grange-West Canning Basin: Groundwater for Growing Opportunities

Land Tenure Pathway for Irrigated Agriculture

Midlands: Groundwater and Land Assessment

Mowanjum Irrigation Trial

Myalup-Wellington: Water for Growth

Southern Forests Irrigation Scheme

Water Information Conversion

Bonaparte Plains - Ord East Kimberley Expansion

Already producing a significant proportion of Western Australian fresh fruit and vegetables, and with large tracts of relatively inexpensive grazing land close to Perth, the Midlands region offers extensive opportunities for irrigated horticultural expansion.

In partnership with a range of local stakeholders, this project will undertake detailed groundwater investigations in the Irwin area near Dongara and the Dinner Hill area north of Dandaragan, to determine the quantity and quality of water available, as well as further infrastructure, soil and crop analysis to identify suitable land to support growth in the region.

A comprehensive information package covering the region's local water resources, soil types, crop suitability and local infrastructure, is being compiled and will be made available to the community, local growers and potential investors as it becomes available.

RELATED PUBLICATIONS

TITLE	DATE	PROJECT	TYPE
High quality agricultural land in Western Australia – a new decision tool for planning	2016	Midlands: Groundwater and Land Assessment	Environmental
Midlands - Regional And Localised Infrastructure Assessment Report	2016	Midlands: Groundwater and Land Assessment	Social/Cultural
Northern Perth Basin	2017	Midlands: Groundwater and Land Assessment	Water
Preliminary Groundwater Assessment of the Midlands Region	2015	Midlands: Groundwater and Land Assessment	Water
Midlands brochure	2016	Midlands: Groundwater and Land Assessment	Water for Food

VIEW ALL

Our latest newsletter is out! Have a read of our major project updates: https://t.co/DoDUfIK8Tu #WaterforFood... https://t.co/ZwM0mZsWNu @WaterForFood

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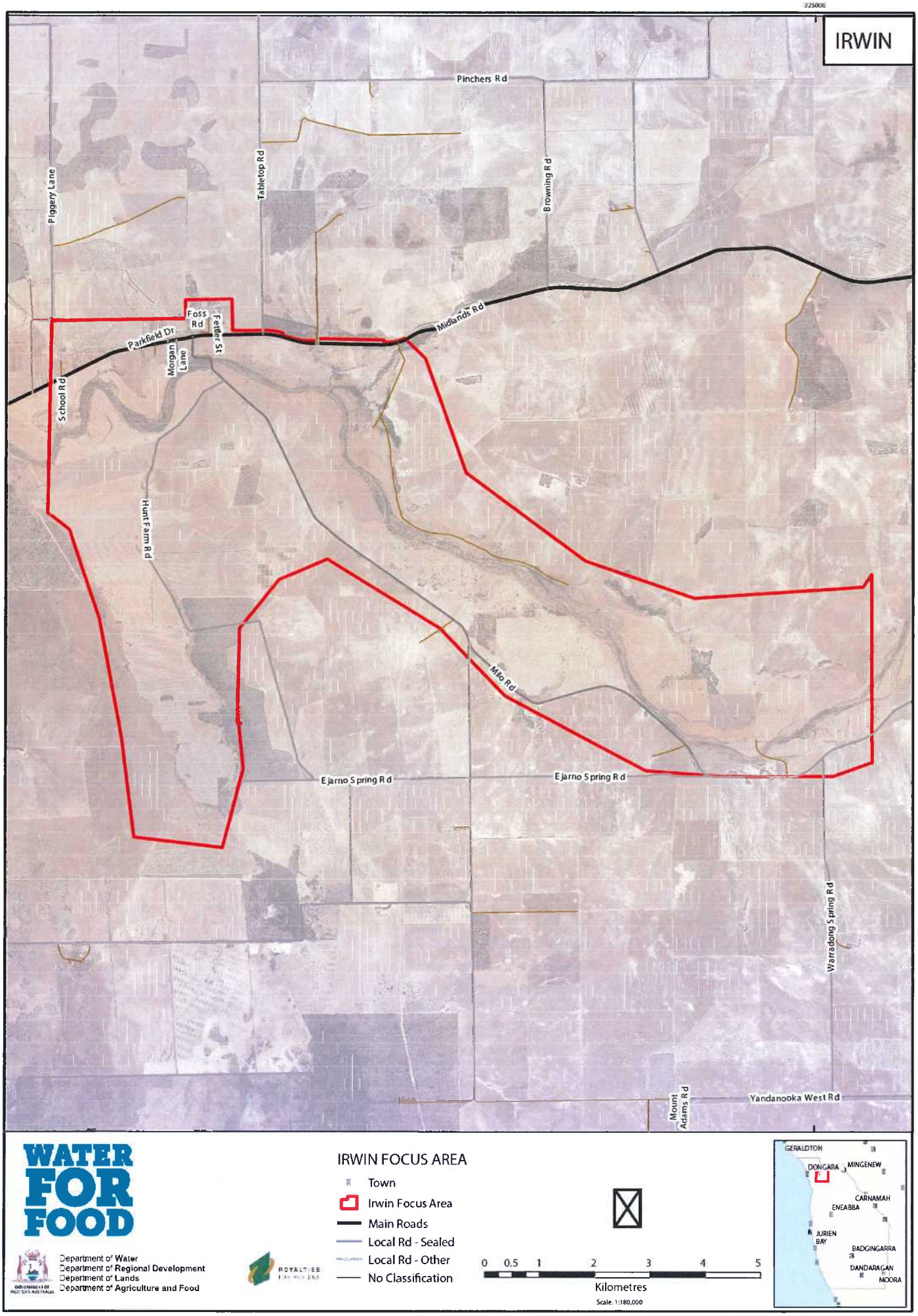
IRWIN
Pinchers Rd
Piggery Lane
Tabletop Rd
Browning Rd
Foss Rd
Fender St
Parkfield Dr
Morgan Lane
Midlands Rd
School Rd
Hunt Farm Rd
Milo Rd
Ejarno Spring Rd
Ejarno Spring Rd
Warradong Spring Rd
Mount Adams Rd
Yandanooka West Rd
WATER FOR FOOD
Department of Water
Department of Regional Development
Department of Lands
Department of Agriculture and Food
IRWIN FOCUS AREA
Town
Irwin Focus Area
Main Roads
Local Rd - Sealed
Local Rd - Other
No Classification
0 0.5 1 2 3 4 5
Kilometres
Scale: 1:180,000
GERALDTON
DONGARA
MINGENEW
CARNAMAH
ENEABBA
JURIEN BAY
BADGINGARRA
DANDARAGAN
MOORA

FARMING LAND ACCESS AGREEMENT TEMPLATE

FOR PETROLEUM EXPLORATION ACTIVITIES UNDER THE PETROLEUM AND GEOTHERMAL ENERGY RESOURCES ACT 1967

October 2015

THIS DOCUMENT

This document has been prepared to provide a guide for farmers, graziers and petroleum companies for land access negotiations.

The content of this template document is intended only to provide generic terms for an agreement. It does not constitute legal advice. The reader should seek legal or other professional advice before acting or relying on any of the content

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COMPANY AND LAND HOLDER DETAILS

DETAILS OF AGREEMENT			
Owner of the Land		**Operator - Exploration**	
Name		Name of Operator	
ABN		ABN	
Property Name		Project Name (if applicable)	
Address		Permit Type	
		Permit Number	
		Location	

Occupier of the Land		**Petroleum Licence Holder**	
Name		Name of Licence Holder	
ABN		ABN	
Property Name		Project Name (if applicable)	
Address		Permit Type	
		Permit Number	
		Location	

NOMINATION OF RESPONSIBLE PERSON	Owner / Occupier	Operator - Exploration
Operations		
Name		
Postal Address		
Email		
Fax		

AGREEMENT

The Land Holder and the Operator agree to the matters set out below:

1. Application of Agreement

This agreement applies to **petroleum activities** pursuant to an **exploration permit,** including any renewals or substitutions of that **exploration permit**.

For the avoidance of doubt, this Agreement covers and applies to the exploration activities to be conducted by the Operator during the Term.

2. Appointment of Responsible Person for Exploration

(a) To facilitate effective communication the Operator, the Petroleum Licence Holder, the Land Holder and the Occupier of the Land are each to appoint a 'Responsible Person' to act as a point of contact during the term of this Agreement. The Responsible Person should have appropriate knowledge of the project and the Land and act as the primary point of contact for all communications.

(b) The Responsible person should keep records of relevant plans of the Land, discussions and commitments relating to this Agreement.

(c) Either party may change its Responsible Person acting on its behalf by giving notice in writing to the other party.

(d) Matters within the knowledge of the Responsible Person shall be deemed to be within the knowledge of the party appointing that Responsible Person.

3. Warranties

(a) The Land Holder warrants that the Land Holder is the owner of the Land and that it has the right to grant access to the Land pursuant to this Agreement.

(b) The Licence Holder warrants that it is and that it is entitled to be the holder of the Licence for the purposes of the Act and this Agreement.

4. Term of the Agreement

(a) The Term of this Agreement is from the date of execution of this Agreement to:

(i) the date on which all of the Petroleum Activities have been completed; or

(ii) the date nominated at Item 2 of Schedule A.

whichever occurs first, and in either event the requirements to rehabilitate the Land as set out in this Agreement are to be satisfied.

(b) Notwithstanding any other provision, this Agreement may be terminated prior to the expiry of the Term:

(i) by agreement between the Parties; or

(ii) by the Operator in its sole discretion in the event any permits, approvals or consents are not obtained.

(c) Termination of this Agreement will not prejudice any right any Party may have against any other Party arising out of any breach of this Agreement which occurred prior to the termination.

5. Operator's Commitments

The Operator agrees that the Land Holder is entitled to carry out the **farming enterprise** without undue interference from **petroleum activities**. In the conduct of the **petroleum activities**, the Operator will:

(a) keep the Land Holder informed about the nature and timing of all **petroleum activities**;

(b) ensure that the farming enterprise on the Land is not unduly disrupted, except as set out in this Agreement, and in particular:

(i) keep all gates, whether open, closed or locked, in the state in which they are found;

(ii) ensure stock on the Land is not unduly disturbed, injured or killed;

(iii) take all precautions to reduce fire risk on the Land and adhere strictly to any fire restrictions imposed by any Authority;

(iv) ensure that infrastructure on the Land is not damaged;

(v) provide the Land Holder with copies of plans for well construction and protection of groundwater aquifers;

(vi) implement a comprehensive biosecurity program to:

A. protect the Land from Pest incursion;

B. protect the Land from the spread of Pests;

C. ensure the wash down of vehicles entering and exiting the Land.

(c) carry out all activities in accordance with the requirements of the Petroleum Act and all other applicable laws and regulations.

(d) take all reasonable steps that are consistent with the efficient conduct of the **petroleum activities;**

(e) not cause any pollution on the Land, including any groundwater or soak, dam, bore or water course on the Land.

(f) take all reasonable steps to prevent damage being caused to the Land by water run-off or soil erosion.

(g) obtain any necessary approvals required under the Environmental Protection Act 1986 (WA) and comply with any conditions of those approvals.

(h) maintain and keep in good repair any roads or tracks used in the conduct of **petroleum activities** whether or not constructed by the Operator.

(i) operate vehicles at speeds that are:

  (i) appropriate in relation to the farming enterprise; and

  (ii) minimise noise, dust and disturbance to the Land.

(j) not bring firearms, domestic animals or alcohol onto the Land.

(k) ensure that all the Operator's employees and Contractors are not, when on the Land, affected by drugs (including over the counter or prescription drugs) or affected by alcohol.

(l) collect and remove all rubbish and waste from the Land;

(m) where appropriate and agreed with the Land Holder, construct fences around the **petroleum activities**.

(n) ensure that any water, fluid or slurry ponds are properly lined to prevent leakage into and / or contamination of the Land, whether on or below the surface.

(o) ensure that all the Operator's employees and Contractors are appropriately inducted, trained and qualified to conduct the **petroleum activities** and all other works that may be required on the Land.

(p) manage the **petroleum activities** so as to accommodate the seasonal farming enterprise, such as seeding and harvesting.

The Operator is responsible for all such activities in accordance with this Agreement, including those undertaken by its employees and Contractors.

6. Land Holder's Commitments

The Land Holder acknowledges that the Operator is entitled to carry out **petroleum activities** provided that the Operator has first obtained all necessary **approvals** for the **petroleum activities**.

The Land Holder must:

(a) not interfere with the **petroleum activities**;

(b) act in a responsible manner and comply with any requirements which arise from the Petroleum Act;

(c) consider a request for the use of facilities, such as water supply facilities, on the Land;

(d) assist the Operator if required to obtain consents and **approvals** relating to access to the Land, provided that the Operator shall pay for all costs (including for the Land Holder) associated with obtaining such consents and **approvals**.

7. Information

Without limiting the information that is to be provided, during the Term of this Agreement the Operator shall provide to the Parties:

(a) a map showing any variation to the location of **petroleum activities** (where such has not already been discussed and agreed);

(b) notification of any additional substantial plant or equipment (such as drilling rigs, accommodation camp and storage and maintenance areas) the Operator proposes to bring onto the Land;

(c) a copy of an emergency response management procedure (including fire management) and all environmental management and safety plans;

8. Meetings

If requested by the Land Holder, the Operator must be in contact with the Land Holder to discuss any issues and respond to any questions the Land Holder has regarding the **petroleum activities** in a timely manner.

9. Inspection

The Operator shall provide to the Land Holder, upon request, the right to inspect the **petroleum activities** in the presence of the Operator and in compliance with the requirements of the Petroleum Act.

10. Notification

The Operator agrees to provide the Land Holder with at least 48 hours' notice of its intent to enter upon the Land for the first time. Thereafter the Operator shall keep the Land Holder informed, on a reasonably timely basis, of the petroleum activities and proposed petroleum activities.

11. Temporarily Restricted Access

(a) If during the Term any Party requires, for reasonable occupational health, safety, security or farming enterprise reasons, that access to a defined area of the Land should temporarily be prohibited or restricted, then the Party seeking such prohibition or restriction shall give notice to the other Parties, such notice to specify the reason for the temporary prohibition or restriction, the relevant area of the Land and proposed time period that such prohibition or restriction is sought to operate for.

(b) After receiving a notice in accordance with this clause, the Parties must discuss the identified concerns and any mitigating actions that may be taken to minimise disruption to the petroleum activities or the farming enterprise as the case may be.

(c) In the event that there is any dispute in relation to matters raised in a notice provided pursuant to this clause the Parties shall resolve such dispute using the dispute mechanism as set out in this Agreement.

12. Compensation

The Operator shall pay compensation to the Land Holder in accordance with Schedule B of this Agreement.

Nothing in this Agreement prevents the Parties from varying the terms of Schedule B from time to time during the Term, provided that such variation is in writing and signed by the parties or by the parties' respective Responsible Person.

13. Other Damages

(a) Nothing in this Agreement prevents the Land Holder from seeking damages, pursuant to section 19 of the Act or otherwise where, as a

result of the petroleum activities undertaken by the Operator, there is damage or loss caused to the Land Holder's Land, infrastructure or the **farming enterprise**.

(b) Prior to taking any action pursuant to this clause, the Land Holder shall give the Operator notice detailing the extent of the damage or loss and how that damage or loss resulted from **petroleum activities**.

(c) Where:

(i) the damage or loss is capable of repair, the Land Holder shall give the Operator notice directing the Operator as to the manner in which and the time by which the Land Holder acting reasonably requests the repair be made;

(ii) the damage or loss is not capable of repair, the Land Holder shall:

A. provide the Operator with a reasonable period of time in which to assess and pay damages;

B. otherwise take whatever action that the Land Holder determines necessary to address the damage or loss.

14. Rehabilitation

(a) The Operator undertakes to meet the approval conditions set out in the regulatory environmental approval and in accordance with its rehabilitation plan as submitted to the Department.

(b) Prior to commencing restoration of the Land, the Operator will consult with the Land Holder to determine whether the Land Holder desires to make use of any improvements placed on the Land and if the Land Holder gives notice in writing of its desire to make use of any such improvement, then to the extent agreed in writing between the parties, the Operator shall not be obligated to restore the relevant area or improvement on the Land as the case may be.

(c) In addition to the obligation in clause 13(a) above and before the expiry of the Term (or sooner determination of this Agreement), the Operator must:

(i) vacate the Land;

(ii) ensure that the Land is cleaned up and made free of any rubbish or contamination created as a result of the petroleum activities; and

(iii) surrender all keys in respect of the Land to the Land Holder.

(d) In developing and implementing a rehabilitation plan, the operator will:

(i) Consult with the Land Holder about the rehabilitation program to be incorporated in the environmental management plan required by PGER regulations;

(ii) Prepare a short non-technical summary of the rehabilitation proposal for the Land Holder;

(iii) Incorporate all statutory rehabilitation requirements – in addition to any specific programs agreed between the Land Holder and the Operator – in the environmental management plan; and

(iv) Meet all regulatory requirements for such rehabilitation.

(e) For the avoidance of doubt, the provisions of this clause shall survive the termination of this Agreement.

15. Independent Assessment of Remediation

(a) Prior to commencement of petroleum activities, the Parties shall, unless agreed otherwise, jointly instruct independent professional advisors to report to both Parties on the condition of the Land where the petroleum activities are to take place.

(b) Upon the cessation of the exploration activities and prior to the commencement of rehabilitation, and subject to clause 14(b), jointly instruct independent professional advisors to report to both Parties on what specific remediation is required to return the Land, as far as practical, to its former condition as outlined in assessments undertaken at sub-paragraph (a).

(c) The Operator will ensure that the proposed rehabilitation conforms with the provisions of all environmental approvals and applicable regulations.

(d) The agreed reasonable costs of any professional advisors engaged jointly by the parties pursuant to sub-paragraph (a), including costs

incurred in instructing, as required, agronomists, farming consultants, accountants, shall be paid solely by the Operator as outlined at Schedule B.

(e) In the event that a disagreement arises between the Parties in the operation of paragraphs (a) and (b), or in relation to any reports so obtained, the parties shall seek to initiate Dispute Resolution, as outlined under Section 17.

16. Release

To the extent permitted by **law**, the Operator waives and releases the Land Holder from all claims in respect of:

(a) the death of, or injury to, any of the **Operator's personnel**;

(b) damage to or loss of any property which is from time to time in or upon the Land including vehicles, plant and equipment in the custody or control of the Operator; and

(c) consequential loss, including loss of profits, loss of opportunity or business interruption or restriction of income or opportunities in relation to the **petroleum activities** (including any loss or damage suffered by the Operator as a result of any notice provided pursuant to this Agreement).

The Release provided for in this clause does not apply to claims to the extent that they arise out of the wilful failure of the Land Holder to comply with the **law** or this Agreement or for the gross negligence of the Land Holder as the case may be.

17. Dispute Resolution

(a) If a difference or dispute (together called a **Dispute**) between the parties arises out of or relates to this Agreement, then any party (the Disputer) may give the other parties (the Disputee) a written notice of dispute adequately identifying and providing details of the Dispute (**Notice of Dispute**)

(i) If a notice of dispute is given then the Responsible Person for the Disputer and the Responsible Person for the Disputee(s) must in the first instance use their reasonable endeavours to resolve the dispute.

(ii) If the dispute is not resolved within 30 days, a Party may seek to refer the dispute to mediation.

(iii) The mediation shall be conducted before a **mediation panel** convened for that purpose.

(iv) The mediation shall be governed by the rules for mediation adopted from time to time by The Institute of Arbitrators & Mediators Australia.

(v) The mediation shall be conducted within 30 days of the referral of the dispute to mediation.

(vi) Whilst a matter is in dispute, the parties shall be entitled to continue any activity authorised by this Agreement unless any or all such activities have not been approved by the Department.

(vii) A decision by mediation does not affect the right of any party to refer the dispute to a Magistrate's Court pursuant to the provisions of the **Petroleum Act**, provided that such proceedings shall not be commenced at any time whilst the dispute process set out in this clause has been invoked by a Party and reasonable attempts have been made in good faith to resolve the matter through mediation

18. Confidentiality

Unless the parties otherwise agree, the existence of this Agreement and the contents of this Agreement are not confidential as between the parties.

19. Indemnity

(a) To the extent permitted by law, the Operator indemnifies and holds harmless the Land Holder, its officers, employees, agents, advisers, contractors and representatives from and against all claims, demands, expenses, costs, actions and proceedings of any kind arising out of or in connection with the Operator's entry onto the Land and the **petroleum activities** and for any damage, or injury or death to any person or to any property caused by the Operator.

(b) The Operator's liability to indemnify the Land Holder under this clause will be reduced proportionately to the extent that any unlawful or wilful misconduct of the Land Holder has contributed to the relevant

liability, loss, damage, expense or cost.

(c) For the avoidance of doubt, the indemnities provided under sub-clauses (a) and (b) apply without variation to the benefit of any lawful occupier of the Land.

(d) To the extent permitted by law, the Land Holder indemnifies the Operator from and against all claims for compensation by any Occupier of the Land during the Term of this Agreement.

20. Insurance

(a) The Operator must, at its own cost, effect and maintain appropriate insurance to industry standards and as required by law in respect of its activities. Such insurances shall include, but not be limited to:

(i) public liability insurance for at least $20,000,000 for any one event relating in any way to the Land or the petroleum activities or the Operator's use of the Land; and

(ii) worker's compensation insurance

(b) If requested by the Land Holder, the Operator will provide written confirmation (by way of a certificate of currency or, where this is not available, such means as is reasonable in the circumstances) that relevant insurance is up-to-date and in place.

21. Assignment

(a) The Operator shall not assign, transfer, charge, encumber or otherwise deal with all or any part of its rights or obligations under this Agreement without first procuring that any assignee, transferee or joint venturer enters into a deed of covenant by which the assignee, transferee or joint venturer convents in favour of the Land Holder to be bound by this Agreement.

(b) The Land Holder must not:

(i) assign, sell or transfer all or any part of its rights or obligations under this Agreement; or

(ii) assign, sell, transfer, lease, sub-lease, licence or part possession with all or any part of the Land,

without first procuring that the assignee, purchaser or transferee enters into a deed of covenant by which the proposed person

referred to in clause 21(b)(i) and (ii) convents in favour of the Operator to be bound by this Agreement.

(c) For the purposes of sub-clauses (a) and (b) the parties shall not unreasonably withhold their consent to the proposed transaction.

22. Costs and duty

(a) The Operator will pay the Land Holder's reasonable costs incurred in obtaining legal, financial or technical advice in relation to the discussions, negotiation and preparation of this Agreement, provided that the Land Holder and Operator identify the likely costs and seek to agree those costs prior to advice being sought.

(b) The Operator will pay any duty or taxes assessed or payable in relation to this Agreement.

23. Amendment

No variation or waiver of, or any consent to any departure by a Party from, a provision of this Agreement is of any force or effect unless it is confirmed in writing signed by all the Parties and then that variation, waiver or consent is effective only to the extent for which it is made or given.

24. Good Faith

The Land Holder and the Operator will act in **good faith** in dealings toward each other under this Agreement.

25. Termination

(a) The Land Holder may terminate this Agreement by written notice, effective upon that notice, if:

(i) there is a material breach by the Operator of any of its obligations under this Agreement; or

(ii) an **insolvency event** occurs in relation to the Operator or the Petroleum Licence Holder.

(b) The Land Holder may only exercise the right to terminate this Agreement under clause 25(a)(i) :

(i) where such breach has resulted in imminent danger to property or life; or

(ii) a notice of the breach has been given by the Land Holder to the Operator and the breach has not been remedied

following discussions between the Land Holder and the Operator;

(c) Any dispute as to whether any matter or circumstance constitutes a material breach shall be dealt with under the Dispute Resolution provisions of this Agreement.

(d) The Operator may terminate this Agreement:

(i) by notice to the Land Holder that it abandons its rights pursuant to this Agreement; or

(ii) by notice resulting from the Operator / Petroleum Licence Holder wholly surrendering the Licence.

26. Guarantee

(a) Where the Petroleum Licence Holder is not the Operator, the Petroleum Licence Holder:

(i) guarantees to the Land Holder the due and punctual performance, compliance and discharge by the Operator of the Operator's obligations and liabilities under this Agreement;

(ii) indemnifies the Land Holder against any claim, damage, loss or liability of any nature arising directly out of the non-compliance with any of the obligations or liabilities of the Operator under this Agreement.

(b) The Petroleum Licence Holder's guarantee:

(i) is a continuing guarantee and is not discharged by any one payment or any one act; and

(ii) will continue for so long as any of the Operator's obligations and liabilities remain unsatisfied.

(c) The Petroleum Licence Holder's guarantee is absolute and unconditional.

(d) The Land Holder is entitled to require the Petroleum Licence Holder to pay to the Land Holder any outstanding compensation or other amount to compensate the Land Holder for any loss or damage without the Land Holder having made any claim or instituted any

proceedings against the Operator in respect of such claims or breaches.

(e) Until the Land Holder's claims against the Operator and against the Petroleum Licence Holder have been fully satisfied, the Petroleum Licence Holder will hold on trust for the Land Holder any money received by the Petroleum Licence Holder under any arrangement, composition, assignment, liquidation or bankruptcy of the Operator.

(f) The Petroleum Licence Holder enters into and provides the guarantees in this clause in consideration of the Land Holder entering into this Agreement with the Operator at the request of the Petroleum Licence Holder.

27. Counterparts

This Agreement may be executed in any number of counterparts, each of which is an original and all of which constitute one and the same document.

28. Severance

If any provision of this Agreement is invalid and not enforceable in accordance with its terms, other provisions which are self-sustaining and capable of separate enforcement with regard to the invalid provision, are and continue to be valid and enforceable in accordance with their terms.

29. Waiver

The failure, delay, relaxation or indulgence on the part of any Party in exercising any power or right conferred upon that Party by this Agreement does not operate as a waiver of that power or right, nor does any single exercise of any power or right preclude any other or further exercise of it or the exercise of any other power or right under this Agreement.

30. Governing Law

(a) This Agreement is to be governed and construed in accordance with the laws of Western Australia.

(b) The Parties submit to the non-exclusive jurisdiction of the courts of Western Australia.

31. Definitions

In this Agreement, unless the contrary intention appears:

approvals means any **authorisation**, lease, licence, permit, approval, certificate, consent, direction or notice from any government or governmental or other competent authority and which is necessary for the carrying out of **petroleum activities**.

associate means, in respect of the Operator, its related body corporates.

assumption means, in respect of the Operator, Petroleum Licence Holder, the Land Holder, the assumption of the obligations on any of them under this Agreement.

authorisation means any permission required under the **Petroleum Act** in order to carry out petroleum activities (other than an Petroleum Title).

Authority any municipality, authority or person exercising any powers or functions under any applicable laws or legal requirements

commencement date means the date nominated at Item 3 of Schedule A.

Contractors includes, but is not limited to, the agents, contractors and subcontractors of the Operator.

Corporations Act means the Corporations Act 2001 (Cth).

Department means the Department of Mines and Petroleum.

Exploration permit means the exploration permit issued to the Licence Holder by the Department and as identified in Item 4 of Schedule A.

Farming enterprise means any and all activities that the Land Holder is and is entitled to carry out on the Land.

good faith includes:

(a) not delaying in responding to questions

(b) give genuine consideration to the proposals of the other party;

(c) disclose relevant information (other than confidential or commercially sensitive information)in a timely manner;

(d) refrain from capricious or unfair conduct that undermined negotiation;

(e) make reasonable offers and counter offers;

(f) refrain from acting for an improper purpose.

improvement means:

(a) a building used as a residence, or for a business or an agricultural purpose, and any other building or structure;

(b) a road constructed by or for the Land Holder of the Land;

(c) a yard, fence, wall and any other barrier (for example, a gate);

(d) a pipe, tank, trough, pump and any other thing for storing or raising water or another liquid;

(e) a garden, orchard, plantation and any other similar land use.

insolvency event means, for a person, being in liquidation or provisional liquidation or under administration, having a controller (as defined in the **Corporations Act**) or analogous person appointed to it or any of its property, being taken under section 459F(I) of the **Corporations Act** to have failed to comply with a statutory demand, being unable to pay or stops or suspends or threatens to stop or suspend payment of its debts or otherwise insolvent, dying, ceasing to be of full legal capacity or otherwise becoming incapable of managing its own affairs for any reason, taking any step that could result in a person becoming an insolvent under administration (as defined in section 9 of the **Corporations Act**), entering into a compromise or arrangement with, or assignment for the benefit of, any of its members or creditors, or any analogous event.

Land is the land as described at Item 1 of Schedule A.

Land Holder means the person who owns the Land and includes the occupier of the Land, where those persons are not the same.

law means any law or regulation of Western Australia or the Commonwealth or other law in force in Western Australia.

Licence means the licence issued to the Licence Holder by the Department.

Licence Holder means the Petroleum Licence Holder as shown in the Company Land Holder Details

Mediation Panel means a panel comprising an independent chairman and one representative from each of the agricultural and petroleum industries where such persons are to have some experience with respect to access and compensation arrangements (whether mining or oil & gas) within the agricultural sector.

Occupier means the occupier of the Land.

Operator's personnel means officers, employees, agents, contractors or sub-contractors of the Operator.

Pest (or Pests) means any declared pest, disease or prohibited organism as those terms are dealt with and defined in the Biosecurity and Agriculture Management Act 2007.

petroleum has the meaning set out in the **Petroleum Act**.

petroleum activities means the exploration activities of the Operator on the Land as set out in Item 5 of Schedule A.

Petroleum Act is the Petroleum and Geothermal Energy Resources Act 1967 (WA)

related body corporate means a related body corporate as defined in section 50 of the **Corporations Act**.

Term means the term of this Agreement as set out in Item 2 of Schedule A.

transfer of operatorship of the **Exploration permit** occurs when parties with an equity interest in the exploration permit agree to remove the Operator and appoint an alternate Operator.

32. Interpretation

In this Agreement, unless the contrary intention appears:

(a) headings and bold type are for convenience only and do not affect the interpretation of this deed;

(b) the singular includes the plural and the plural includes the singular;

(c) words of any gender include all genders;

(d) other parts of speech and grammatical forms of a word or phrase defined in this Agreement have a corresponding meaning;

(e) an expression importing a person includes any company, partnership, joint venture, association, corporation or other body corporate and any Government Agency as well as an individual;

(f) a reference to any thing (including any right) includes a part of that thing but nothing in this clause implies that performance of part of an obligation constitutes performance of the obligation;

(g) a reference to a clause, party, schedule, attachment or exhibit is a reference to a clause of, and a party, schedule, attachment or exhibit to, this Agreement;

(h) a reference to any legislation includes all delegated legislation made under it and amendments, consolidations, replacements or re-enactments of any of them;

(i) a reference to a document includes all amendments or supplements to, or replacements or notations of, that document;

(j) a reference to a party to a document includes that party's successors and permitted assignees;

(k) a promise on the part of 2 or more persons binds them jointly and severally;

(l) a reference to an agreement other than this Agreement includes a deed and any legally enforceable undertaking, agreement, arrangement or understanding, whether or not in writing;

(m) a reference to an asset includes all property of any nature, including a business, and all rights, revenues and benefits;

(n) a reference to liquidation or insolvency includes appointment of an administrator, compromise, arrangement, merger, amalgamation, reconstruction, winding up, dissolution, assignment for the benefit of creditors, scheme, composition or arrangement with creditors, insolvency, bankruptcy, or a similar procedure or, where applicable, changes in the constitution of any partnership or person or death;

(o) a reference to a document includes any agreement in writing, or any certificate, notice, instrument or other document of any kind;

(p) no provision of this Agreement will be construed adversely to a party because that party was responsible for the preparation of this Agreement or that provision;

(q) a reference to a body, other than a party to this Agreement (including an institute, association or authority), whether statutory or not:

A. which ceases to exist; or

B. whose powers or functions are transferred to another body, is a reference to the body which replaces it or which substantially succeeds to its powers or functions;

(r) references to time are to Perth, Western Australia time; and

(s) where this Agreement confers any power or authority on a person that power or authority may be exercised by that person acting personally or through an agent or attorney.

(t) Specifying anything in this Agreement after the words 'include' or 'for example' or similar expressions does not limit what else is included unless there is express wording to the contrary.

(u) Where the day on or by which any thing is to be done is not a Business Day, that thing must be done on or by the next following Business Day.

SCHEDULE A – KEY TERMS

Item 1 - Description of the Land	
Item 2 - Term of Agreement	
Item 3 - Commencement Date	
Item 4 - Petroleum permit reference	
Item 5 - Petroleum activities	

SCHEDULE B – COMPENSATION

Compensation	Due Date for Payment

APPENDIX 1 - COMPENSATION PRINCIPLES

Each agreement will include a provision for compensation payments, specific to each project or land holder. Recognising that each property and farming enterprise is unique, the model agreement does not attempt to draw up a prescriptive formula for compensation on private land. However, the parties to this agreement propose that compensation should be based on the following principles:

1. The Land Holder should not be financially disadvantaged by the exploration activity.
2. The Land Holder will be compensated for any loss of income, damage, inconvenience or loss of amenity.
3. The Operator will pay all reasonable costs, including:
   (a) legal costs; and
   (b) other professional costs,
   incurred by the Land Holder in seeking advice or information
   (c) on this Agreement; and
   (d) any potential impact(s) to the Land from the petroleum activities.
   Those costs are to be agreed between the parties within the initial negotiations.
4. Wherever possible, or practical, the Land holders' requests and preferences will be taken into account during the exploration program.
5. Provision for compensation should consider potential long term losses as well as immediate impacts.
6. Compensation – or an agreed portion of the compensation – will be paid before the start of any exploration activity.
7. Notwithstanding the compensation priorities listed below, Operators agree to compensate farmers for any losses which are shown to be attributable to exploration activity.

Impacts to be considered in a compensation package include

1 The cost of securing independent expert advice on legal, financial and technical matters (outlined in Item 3 in this section)

2 Loss of income from cropping, grazing, horticulture or other agricultural activity

3 Disruptions to farm management, including stock movement, fencing changes, livestock breeding, transport and other disturbances

4 The cost of rehabilitation and biosecurity measures such as the replacement of like soils and weed control (additional to conditions imposed by Government regulators)

5 Seasonal restrictions on vehicle movements

6 Soil compaction and other ground disturbance

7 Potential agistment costs

8 Reduced efficiency in roughened paddocks

9 Cropping delays

10 Access to water

11 Management of fire risks

12 Monitoring and assessment of rehabilitation and other remedial work

13 Temporary disturbance during drilling, well construction and hydraulic fracturing

14 Land use for flaring and management of hydraulic fracture fluid or produced water.

15 Vehicle movement and storage areas

16 Devaluation of property – where this can be independently verified to the satisfaction of both parties

The potential impacts above are related to exploration.

Potential impacts from commercial production would be considered in a separate agreement for field development and operation.

APPENDIX 2 –
Relevant passages on land access from
the Petroleum and Geothermal Energy Resources Act 1967

Section 16 - Consent of owner or trustees required in certain cases for exploration etc.

(1) A permittee, holder of a drilling reservation, access authority or special prospecting authority, lessee or licensee shall not enter upon any land to which this section applies for the purpose of —
(a) exploring for petroleum or geothermal energy resources; or
(b) carrying out operations for the recovery of petroleum or geothermal energy, unless the consent in writing of the owner or trustees, as the case may be, of the land has been first obtained.

(1a) This section applies to land that is comprised in the permit, drilling reservation, access authority, special prospecting authority, lease or licence and is —
(a) private land not exceeding 2 000 m2 in extent; or
(b) used as a cemetery or burial place; or
(c) less than 150 m in lateral distance from any cemetery or burial place, reservoir or any substantial improvement.

(2) For the purposes of this section —
(a) **reservoir** includes any natural or artificial storage or accumulation of water, spring, dam, bore, and artesian well; and
(b) the Minister is the sole judge of whether any improvement is substantial.

Section 17 - Compensation to owners and occupiers of private land

(1) A permittee, holder of a drilling reservation, lessee or licensee may agree with the owner and occupier respectively of any private land comprised in the permit, drilling reservation, lease or licence as to the amount of compensation to be paid for the right to occupy the land.

(2) Subject to subsections (3) and (5), the compensation to be made to the owner and occupier shall be compensation for being deprived of the possession of the surface or any part of the surface of the private land, and for damage to the surface of the whole or any part thereof, and to any improvements thereon, which may arise from the carrying on of operations thereon or thereunder, and for the severance of such land from other land of the owner or occupier, and for rights-of-way and for all consequential damages.

(3) In assessing the amount of compensation no allowance shall be made to the owner or occupier for any gold, minerals, petroleum, geothermal energy resources or geothermal energy known or supposed to be on or under the land.

(4) If within such time as may be prescribed the parties are unable to agree upon the amount of compensation to be paid, either party may apply to the

Magistrates Court at the place nearest to where the land is situated to fix the amount of compensation.

(5) In determining the amount of compensation, the Court shall take into consideration the amount of any compensation which the owner and occupier or either of them have or has already received in respect of the damage for which compensation is being assessed, and shall deduct the amount already so received from the amount which they would otherwise be entitled to for such damage.

Section 18 - Owner of private land in vicinity of permit area, drilling reservation, lease area or licence area may be entitled to compensation

If any private land or improvement thereon adjoining or in the vicinity of the land comprised in any permit, drilling reservation, lease or licence is injured or depreciated in value by any operations carried on by or on behalf of the permittee, holder of the drilling reservation, lessee or licensee or by reason of the occupation of any portion of the surface, or the enjoyment by the permittee, holder of the drilling reservation, lessee or licensee of any right-of-way, the owner and occupier of the private land or improvements thereon shall severally be entitled to compensation for all loss and damage thereby sustained, and the amount of compensation shall be ascertained in the same manner as is provided in section 17.

Section 19 - Compensation for further damage

If while in occupation of any land comprised in a permit, drilling reservation, lease or licence the permittee, holder of the drilling reservation, lessee or licensee, as the case requires, causes any damage to the surface of any private land comprised within the boundaries of the land the subject of the permit, drilling reservation, lease or licence belonging either to the same or any other owner, or to any improvement on any such private land, not being damage already assessed under the provisions of this Part, the owner and occupier of the private land or improvement shall severally be entitled to compensation for the damage sustained by each of them, and the amount of such compensation shall be ascertained in accordance with the provisions of section 17.

Section 20 - Holder of permit, drilling reservation, lease or licence not to commence operations on private land until compensation tendered or agreed upon

(1) A permittee, holder of a drilling reservation, lessee or licensee shall not commence any operations on private land unless or until he has paid or tendered to the owner and to the occupier of the land the amount of compensation, if any, which he is required to pay under and as ascertained in accordance with this Act or he has made an agreement in writing with the owner or occupier as to the amount, times and mode of payment of the compensation, if any.

(2) Where the owner is dead or cannot be found any payment of compensation may be made to the Minister in trust for the owner.

Section 22 - Determination of partial compensation

In an action under section 21, if the Court considers it impracticable or inexpedient to assess the amount of compensation to be paid in full satisfaction for the damage sustained by the compensable lessee to the improvements and consequential damage, the Court may on the application of a party or of its own motion give judgment or make a declaration as to the compensation payable in respect of any specified period and in respect of the whole or part of the total claim or compensation.

Section 23 - Security for compensation

The Court before whom proceedings in relation to compensation have been commenced may, at any stage of those proceedings, make an order against the person concerned in them and from whom compensation is sought, from commencing or, as the case may be, continuing any operations under this Act until he has given such security as the Court thinks fit for payment of any compensation for which he may be or become liable.

Section 24 - Matters for which compensation not payable

(1) Except where and then only to the extent agreed to by the parties or authorised by the Court compensation is not payable under the provisions of this Act to the lessee of land leased by way of a pastoral lease within the meaning of the **Land Administration Act 1997**, a lease otherwise granted for grazing purposes only, a lease for timber purposes or a lease for the use and benefit of the Aboriginal inhabitants (in this subsection called the **affected lessee**)

- (a) for deprivation of the possession of the surface of the land or any part of the surface; and
- (b) for damage to the surface of the land; and
- (c) where the affected lessee is deprived of the possession of the surface of any land, for severance of the land from any other land of the affected lessee; and
- (d) for surface rights of way and easements.

(2) Compensation is not payable for any gold, minerals, petroleum, geothermal energy resources or geothermal energy known or supposed to be on or under the land.

Scientific Inquiry into Hydraulic Fracture Stimulation in Western Australia

Public Meeting – Additional Comments

Table number: 3 Name: [redacted]

Email Address: [redacted]

Fracking is an insidious, dangerous and invasive practice that should never be allowed.
The industry and even some community members welcome it. The government past and maybe now approve it.
IF it all goes pear-shaped, and believe me it will because there is nothing science that mankind "fracks" everything it handles, especially the more importance that it has, will there be anyone who stands up and says they will compensate the community members affected.

You can bet that those responsible will run for cover.

Scientific Inquiry into Hydraulic Fracture Stimulation in Western Australia

Public Meeting – Additional Comments

Table number: 2 Name: [redacted]

Email Address: [redacted]

I would like ~~to~~ have independent geologists assess & give the community a clear ~~assessment~~ summary of the geological make-up underlying the Irwin valley, gas fields surrounding Dongara, etc.

Thank you, Fiona, for being such a wonderful facilitator.