**AWE Limited:** Submission to the Environment and Public Affairs Committee – “Inquiry into the implications for Western Australia of Hydraulic Fracturing for Unconventional Gas”
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1. Introduction

AWE Limited (AWE) welcomes the opportunity to contribute to the Inquiry into the Implications for Western Australia of Hydraulic Fracturing for Unconventional Gas and progress constructive dialogue on both the merits and perceived risks of hydraulic fracturing in Western Australia, particularly given increased public interest in the matter.

AWE is a leading local energy producer and operates at industry best practice and has strict management systems in place across all of its operations, all of which will be discussed further in this submission.

The Company, along with the industry’s peak industry body, Australian Petroleum Production and Exploration Association (APPEA), has worked to ensure evidence based information is communicated directly, to properly inform and build public confidence in our operations.

The Company has also responded to public concerns by providing greater transparency around the company’s operations and processes before being required by regulation or legislation.

For the purposes of this submission AWE has sought to provide the committee with relevant information about the Company’s own operations, rather than repeating the general hydraulic fracturing information contained in the APPEA submission.

Of particular relevance are the findings from AWE’s groundwater and air quality monitoring study from the Woodada Deep-1 hydraulic fracture stimulation, which demonstrated there was no negative impact on the surrounding environment.

Hydraulic fracturing has been used commercially worldwide for more than 60 years to access natural gas and oil reservoirs and there have been significant advances and improvements in techniques over this extended period. It has developed into a sophisticated and mature technology which is highly engineered, rigorously monitored and regulated, and all operations are undertaken by specialised service contractors.

Western Australia has a robust regulatory framework in place to ensure hydraulic fracturing operations meet the highest safety and environmental standards, administered by the Department of Mines and Petroleum (DMP). The DMP oversees application processes such as drilling applications, Environment Plans (EP) and safety management plans.

Furthermore, the industry operates under regulatory frameworks that are supported by both international and national standards for exploration, development and operation.

AWE has an excellent safety and environmental history in its hydraulic fracturing operations and has achieved this through meeting international best practice.

The Company is particularly proud of its environmental record and works continuously to minimise the environmental impacts on native flora, fauna, conservation areas, surface and groundwater, soil and landform and cultural heritage sites.
Moreover, the Company’s safe and responsible operating practices comply with the industry’s voluntary *Code of Practice for Hydraulic Fracturing in Western Australia* and its guiding principles.

AWE was a founding signatory to the Code of Practice, an initiative which responded to the community’s requirement that oil and gas operators must be committed to:

1. Community, landholder and stakeholder interaction
2. Protection of aquifers
3. Sustainable use of water
4. Transparent use of chemicals in hydraulic fracturing
5. Fluid flowback and produced fluids containment
6. Low fugitive emissions
7. Continuous improvement

AWE would be pleased to host the Environment and Public Affairs Committee onsite during its planned hydraulic fracture stimulation activities in 2014 (subject to DMP approval of AWE’s drilling and hydraulic fracture stimulation plans).
2. **Company overview**

AWE is a leading Australian energy company focused on international upstream oil and gas exploration and production. It is listed on the Australian Securities Exchange (ASX) (ASX: AWE).

The Company was formed in 1997 to appraise oil and gas discoveries in its initial asset portfolio and to build a significant petroleum exploration and development entity through further asset acquisitions.

One of AWE’s strengths is on exploration and appraisal of assets in regions of proven prospectivity and where there is a high chance of commercial success. This focus includes currently marginal fields whose worth may be improved by innovative appraisal and development approaches.

The Company is a highly competent and capable operator and has extensive international experience and expertise in upstream oil and gas operations including hydraulic fracturing.

AWE currently has six main producing assets:

- Tui oil fields - offshore Taranaki basin, New Zealand (AWE 42.5%, operator)
- BassGas project - offshore Bass Strait, Tasmania (AWE 46.25%)
- Cliff Head oil field - offshore Perth Basin, Western Australia (AWE 57.5%)
- Casino gas project - offshore Otway Basin, Victoria (AWE 25%)
- Onshore Perth Basin interests, Western Australia (AWE 33-100%)
- Onshore US shale gas, Texas (AWE 10%, working interest)

In addition to its oil and gas producing assets, AWE possesses a number of exploration, appraisal and development opportunities both in Australia and overseas, as outlined below.
3. **Background and history of AWE in the WA exploration and production sector**

Following its merger with ARC Energy in August 2008, AWE gained additional equity in the BassGas and Cliff Head projects, and further production interests in the onshore Perth Basin. AWE also added equity interests in some prospective exploration permits.

AWE acquired a 34 per cent interest in Adelphi Energy Limited in 2008 and completed a takeover of the Company in 2010. Adelphi holds 10 per cent working interest in the Sugarloaf gas/condensate field in the USA (net 7.5 per cent after royalties).

The Company's main producing assets have the capacity to deliver around five million barrels of oil equivalent per year, making it one of the biggest hydrocarbon producers in the ASX energy index. AWE's substantial 2P Reserves and 2C Contingent Resources will provide a pipeline of development projects which could see the Company double production within the next five years.

4. **Perth Basin onshore operations**

AWE, and its subsidiaries, has been investing and operating in the North Perth Basin for more than 10 years and has successfully developed a number of commercial oil and gas fields over this time. The history of oil and gas operations in the Perth Basin reaches back approximately 50 years with the first discovery at Yardarino-1.

Since the initial discovery in the area, a number of commercial oil and gas operations have been developed. This has required a range of activity including field exploration, seismic acquisition, exploration and development drilling and the installation of infrastructure and gas pipelines.

Natural gas was first produced from the Dongara gas field in October 1971. Oil and condensate production from Dongara is trucked from the field facilities approximately 360 kilometres north of Perth to the Kwinana oil refinery, located south of Perth. Gas production is gathered at four gas processing facilities and injected into the Parmelia Pipeline for transport to various customers.

AWE's shale gas and tight gas hydraulic fracture stimulation program in the onshore North Perth Basin commenced in July 2012 after regulatory approvals were obtained and site preparations were completed.

Three tight gas wells have been tested during AWE’s North Perth Basin exploration program, with eight separate zones hydraulically fracture stimulated.

The initial results have been promising, with fracture stimulations being successfully completed in all zones and hydrocarbon being recovered during initial well flowback and clean-up from each of the zones.
During 2011-12, AWE worked closely with landowners, local communities and government regulators to provide open and transparent communication on its exploration plans and work program.

Table 1 outlines AWE’s has interests in exploration and production projects located in the onshore Perth Basin.

**Table 1: AWE Project Equity**

<table>
<thead>
<tr>
<th>Project</th>
<th>Reference area\s*</th>
<th>Ownership</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hovea/Erema oil fields</td>
<td>L2</td>
<td>50% AWE – Operator</td>
</tr>
<tr>
<td>Mt Horner oil field</td>
<td>L7</td>
<td>100% AWE – Operator</td>
</tr>
<tr>
<td>Dongara gas field</td>
<td>L1, L2</td>
<td>100% AWE – Operator</td>
</tr>
<tr>
<td>XAGGS gas fields</td>
<td>L1</td>
<td>50% AWE – Operator</td>
</tr>
<tr>
<td>Woodada gas field</td>
<td>L4, L5</td>
<td>100% AWE – Operator</td>
</tr>
<tr>
<td>Jingemia oil field</td>
<td>L14</td>
<td>44.14% AWE</td>
</tr>
<tr>
<td>Beharra Springs gas fields</td>
<td>L11</td>
<td>33% AWE</td>
</tr>
<tr>
<td>Exploration Permit</td>
<td>EP320</td>
<td>33% AWE</td>
</tr>
<tr>
<td>Arrowsmith Project</td>
<td>EP413</td>
<td>44.25% AWE</td>
</tr>
<tr>
<td>Drover Prospect</td>
<td>EP455</td>
<td>81.5% AWE - Operator</td>
</tr>
</tbody>
</table>

*Reference areas relate to Figure 1 on page 8 of this submission*

As at June 30, 2013, the estimated net remaining reserves for AWE’s Perth Basin assets were:

- 2P Reserves, Total Developed Plus Undeveloped Reserves: 11.61 PJ’s in Gas sales and 0.01 (10^6 bbls) Condensate
- 2C Contingent Resources: 40.35 PJ’s in Gas Sales and 0.34 (10^6 bbls) Condensate

In 2012/13, AWE’s share of production from the onshore Perth Basin assets was approximately 2,611 TJ of gas and 18,220 barrels of oil/condensate.

**The potential for natural gas from tight sandstone and shale formations in the Perth Basin**

The Perth Basin has hosted some significant oil and gas discoveries, which indicate that the area is an active hydrocarbon province. As these existing discoveries have been successfully developed, further sources of oil and gas have been sought to satisfy demand and utilise the existing pipeline infrastructure in the region.

During the previous exploration campaigns, some “tight gas” discoveries were encountered. While these were deemed uneconomic at that time, improved recovery techniques and higher commodity prices have provided the ability to commercially extract these resources.
Figure 1: AWE’s acreage areas in the onshore Perth Basin
5. **AWE hydraulic fracturing experience**

**Case study – Woodada Deep-1 well**

Between 2009 and 2012, AWE drilled and successfully hydraulically fractured three wells in Western Australia (Corybas-1, Woodada Deep-1 and Senecio-2). The Company was a joint venture partner in the Arrowsmith-2 well, which was hydraulically fractured by the operator, Norwest Energy. Each of the hydraulic fractures provided important information to assist with the understanding of the shales deep below the surface and also whether each project is economically viable.

Importantly, there has been no evidence of aquifer contamination in the Perth Basin from these hydraulic fracturing operations.

The Woodada Deep-1 well provides an important case study for the committee, as AWE undertook baseline studies of water and air quality prior to hydraulic fracturing to compare against post-hydraulic fracturing results. All results were collected and independently analysed and findings were provided to AWE.

AWE also engaged a specialist to assess the impact and extent of the hydraulic fracture process on microseismicity.

**The Woodada Deep-1 well – background**

Deepening of the existing Woodada Deep well and extraction of core samples occurred during a 27 day period in 2010 to reach the target depth of 2,552 metres.

Cores taken from the drilling indicated that the middle interval of the Carynginia Shale alone could potentially hold a gross Gas in Place volume of 13 to 20 trillion cubic feet (TCF). As a result, AWE successfully applied for permission from the Department of Mines and Petroleum to hydraulically fracture two zones of interest.

In mid-2012, AWE successfully hydraulically fractured those two zones, targeting the Middle Carynginia (2370 metres to 2425 metres) and Upper Carynginia (2283 metres to 2330 metres) shale formations (see Figure 2 on page 10).
Gemec Environmental Consultants (Gemec) was engaged by AWE to conduct the water quality monitoring and advise on potential groundwater contamination risks.

The monitoring bores that were the subject of Gemec’s evaluation accessed the Yarragadee formation located at approximately 20 to 286 metres below ground surface (as shown in Figure 3 on page 11).

Gemec analysed water obtained from the fracturing fluid flowback ponds (it is important to note, these ponds are double fenced and are double HDPE lined to prevent the leakage into groundwater) as well as water from two existing water bores and three purpose designed monitoring stations at varying distances from the Woodada Deep-1 well head.
Figure 3:

Bore locations surrounding the Woodada Deep-1 well site

Water bore at Woodada Deep-1 with a fence around the retention pond to keep small animals out
Gemec’s findings included:

- High concentration chemicals in the retention pond were not observed in the water monitoring bores (indicating no leakage into aquifers).
- No BTEX, TRH (C6-C36/C6-C40) or MTBE compounds were reported in any of the samples during groundwater monitoring.
- Trace concentrations of methane were reported in the OB4 (due to decomposition of organic material) and Top Hill Water Bore samples. Methane was not detected above the laboratory limit of reporting (therefore classified as ‘non-detect’) in the remaining samples. The detected concentrations are generally consistent with January/February 2013 results. It is unlikely that these traces are a result of hydraulic fracture stimulation operations in the area due to the low concentrations reported.
- Beryllium, cadmium, hexavalent chromium, cobalt, copper, lead, mercury, molybdenum, nickel, selenium, titanium, uranium and vanadium were not detected above the laboratory limit of reporting (classified as non-detect) in any of the samples collected.
- Of the remaining metals scanned; concentrations ranged from trace to moderate and given the levels reported, are considered to represent background concentrations for the locality.

Gemec’s analysis: “Gemec therefore conclude that comparison of the data against previous groundwater monitoring events indicates that the hydraulic fracture stimulation operations have had no discernible influence on groundwater conditions in the vicinity of the WDA1 (Woodada Deep-1) site. No chemical of potential concern was identified that had the potential to present a risk of harm to the environment.”

Of note, Gemec conducted a similar study at AWE’s Senecio-2 well and similarly concluded: “There are no chemicals of potential concern (CoPC) present in the groundwater samples. Comparison of the data against previous Groundwater Monitoring Events indicates that the hydraulic fracture stimulation operations have had no discernible influence on groundwater conditions in the vicinity of the SNO2 (Senecio-2) site.”

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**Water use**

AWE was licenced to extract 32,000kL of water from Superficial Aquifer to hydraulically fracture its Woodada Deep-1 well. It used less than 5,000kL. The total allocation for all users of Superficial Aquifer is 14,600,000kL, so AWE’s use represented less than 0.034% of total annual use.

Hydraulic fracturing of a horizontal well for commercial production would increase this figure to approximately 20,000kL.
Test results – air quality

Gemec Environmental Consultants was also retained by AWE to undertake monitoring, testing and reporting of air quality around the fracturing fluid retention ponds to ascertain any impact on surrounding air quality, and therefore on native flora and fauna populations.

Gemec was responsible for the installation of the sampling equipment and providing independent analysis of the chemical characteristics of the vapour emissions.

Samplers were installed at each of the four corners of the retention pond. The samplers were placed on custom made stainless steel tags and housed within galvanised steel cowls to protect them from inclement weather.

The readings were conducted immediately after hydraulic fracture flowback fluids were deposited in the retention pond and up to three months later.

Table 2 below presents the highest reported concentration of benzene, toluene, ethylbenzene and xylenes (BTEX) (i.e. those air toxics with MILs) compared to concentrations reported for various settings (i.e. remote rural, industrial and service station).

Table 2: Reported concentrations at Woodada Deep-1 compared with other air reference sites

<table>
<thead>
<tr>
<th>Compound</th>
<th>Location</th>
<th>Benzene</th>
<th>Toluene</th>
<th>Ethylbenzene</th>
<th>Xylenes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Woodada Deep-1</td>
<td>0.51</td>
<td>0.59</td>
<td>1.01</td>
<td>0.22</td>
</tr>
<tr>
<td></td>
<td>Remote rural area</td>
<td>0.2 - 16</td>
<td>0.5 - 260</td>
<td>0.2 - 1.6</td>
<td>&lt;0.1 - 3</td>
</tr>
<tr>
<td></td>
<td>Industrial centre with high traffic density</td>
<td>Up to 349</td>
<td>Up to 1,310</td>
<td>Up to 360</td>
<td>Up to 775</td>
</tr>
<tr>
<td></td>
<td>Refuelling a car at a service station</td>
<td>Up to 10,000</td>
<td>Up to 9000</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Notes: concentrations reported in micrograms per cubic metre (µ/m³)
Source of data: A short primer on benzene, toluene, ethylbenzene and xylenes (BTEX) in the environment and in hydraulic fracturing fluids, Dr Frederic Leusch and Dr Michael Bartkow, Griffith University – Smart Water Research Centre (Nov 2010)

The comparison indicates that the concentrations reported at the Woodada site are considered to be minor compared to those reported at the reference locations.

The source of the BTEX elements is the hydrocarbons extracted during the hydraulic fracturing process.

No Trihalomethanes were detected during the sampling and testing process.

Gemec concluded: “Given the generally minor to trace concentrations reported (at or marginally above the limit of reporting, the vapour emissions emanating from the flowback fluid contained in the retention pond do not present an adverse risk to native fauna in the vicinity. The wind dispersion factor would further reduce concentrations away from the immediate vicinity of the retention pond.”
“In a human health context, a comparison of the benzene, toluene, ethylbenzene and xylene concentrations reported during the sampling programme with the ATNEPM MILs and those reported in various settings indicate that the concentrations reported at the Woodada site are negligible and do not pose an adverse risk to human health.”

Test results – microseismicity

AWE contracted Pinnacle (a Halliburton company) to undertake microseismic testing during the hydraulic fracturing operation.

Pinnacle was primarily contracted to undertake hydraulic fracturing efficiency diagnostics to maximise completion efficiency and production economics for future hydraulic fracturing programs at Woodada Deep-1 and/or future wells.

The testing also provided valuable information on the scale and location of microseismic events from hydraulic fracturing which can be used to interpret the safety of hydraulic fracturing.

Based on the results, Pinnacle reported three observations which were of significance to AWE (as outlined in Table 3 on page 15).
Table 3: Pinnacle’s observations

<table>
<thead>
<tr>
<th>Observation</th>
<th>Importance of observation</th>
</tr>
</thead>
<tbody>
<tr>
<td>The shallowest (closest to surface) mapped event was 700 metres in vertical distance away from the base of the closest known aquifer (Lesueur Sandstone)</td>
<td>No aquifer contamination from frac fluid likely due to distance between fracturing zone and the aquifer (Note: The Leseur Sandstone is 1186-1485 metres deep and saline and is not used for human/stock consumption)</td>
</tr>
<tr>
<td>All events showed seismic moment magnitude between -3.0 and -1.9, which is typical for hydraulic fracture treatments (as outlined in Graph One on page 15).</td>
<td>The smallest moment magnitude that can be felt by a person at surface is around 2.0 to 3.0. Each unit in moment magnitude is 30 times larger than the one before. Therefore, the largest events detected during the fracture stimulation at Woodada Deep-1 are ~27,000 times smaller than the smallest size of event that could be detected at surface. This is 729 million times smaller than the earthquake near Newcastle, NSW in 1989 which is the smallest known earthquake in Australia to have caused fatalities.</td>
</tr>
<tr>
<td>No linear out of zone features in mapped events with abnormally high moment magnitude.</td>
<td>It is unlikely that any faults were intersected as all events were contained within the targeted Carynginia section.</td>
</tr>
</tbody>
</table>
Figure 4:

The cross section illustrates the containment of the microseismic events within the target formation.
6. **Measures to protect surrounding environment during onshore oil & gas operations**

AWE takes a systematic and deliberate approach to protecting the environment during all of its operations. The Company is committed to employing industry best practice at every stage of the project’s lifecycle. There are a number of contributing factors which each play a unique role in protecting the environment during operations. Each provides individual protection, but when combined provide multiple redundancy safeguards against environmental harm.

**Table Four: Elements of protection during drilling activities**

<table>
<thead>
<tr>
<th>Element of Protection</th>
<th>Why it’s important</th>
<th>AWE examples</th>
</tr>
</thead>
</table>
| **Depth of shale and tight gas formations** | - Shale and tight gas reservoirs are located deep below the surface, up to 5,000 metres below ground level  
- Fresh water aquifers are not impacted by drilling and hydraulic fracture operations (fresh water aquifers are usually within 100 metres below ground level) | - On average, AWE’s wells are drilled to approximately 2,500 metres below ground level (equivalent to the height of ~10 Central Park Towers) |
| **Robust well construction and design** | - Well planning and design is undertaken by a team of highly qualified and experienced professionals  
- Each well design is overseen and approved by the DMP | *please refer to Figure 5 on page 19 outlining the structure of the well casing and multiple barriers involved in its design* |
| **Multiple steel casing and cement barriers used during well design** | - Multiple layers of cement and steel casing provide a six layer barrier to shallow aquifers, ensuring that drilling activities remain completely separate from the surrounding outer environment below ground  
- This form of well design is industry best practice and used globally to ensure the integrity of the drilling operations  
- The barriers are pressure tested | *please refer to Figure 6 on page 20 outlining an illustration of the Woodada Deep-1 well design, in which there were no negative impacts on the surrounding environment (as supported by AWE’s water and air quality testing results)* |
### Significant natural barriers between target reservoir & aquifers
- Shale and tight gas formations exist deep underground and are separated from surface aquifers by natural geological barriers in the form of rock formations such as salt layers (in some cases these can be 700 metres thick)
- Natural geological barriers such as these are impermeable to hydrocarbon migration

*Figure 7 on page 21 outlines the deepest aquifer (Lesueur), which has 689 metres of low permeability strata between it and the target zone (making any hydrocarbon migration risk immeasurable)*

### Environment Plans
- Every activity which takes place during a drilling program is firstly detailed in an Environment Plan (EP) which companies submit to the DMP for review and approval
- EPs include a thorough and detailed report of every single function relating to the drilling program including risk factors, land clearing, spill response plans and well design

### Experienced regulator
- The DMP is a highly experienced and robust regulator which oversees every aspect of a drilling campaign, from the initial awarding of acreage to the approval to drill an exploration well

### Safe treatment of hydraulic fracture fluids returned to surface
- Fluid used for hydraulic fracture stimulation is returned to surface and stored in a pond lined with two layers of HDPE plastic
- Once tested, the fluid is either transported to a special waste treatment facility or recycled

- AWE’s Woodada Deep-1 well possessed natural barriers between the formation that was hydraulically fractured and the closest aquifer

Figure 5:

Illustration of a typical well design outlining the multiple protection barriers made up of steel casing and cement, protecting aquifers and the surrounding environment.
Figure 6: AWE well design of the Woodada Deep-1 well (diagram not to scale).
Figure 7:

The deepest aquifer (Lesueur) has 689 metres of low permeability strata between it and the target zone for the Woodada Deep-1 well (map drawn to scale).
7. **Definitions – correcting the ‘unconventional’ misconception**

‘Unconventional’ gas deposits are traditionally defined as gas accumulations that require more technology than normal to prove their commercial potential. The three most common forms of unconventional gas are Coal Seam Methane (CSM), shale gas and tight gas.

In the context of AWE’s work in the Perth Basin, unconventional gas is confined to tight gas and shale gas. Figure 8 below illustrates the primary differences between these target areas.

**Figure 8:**

![Diagram](image)

Differentiating target formations between conventional and shale/tight gas formations

Source: U.S. Energy Information agency

However, it is important to note that the gas produced from both ‘unconventional’ reservoirs or ‘conventional’ reservoirs is the same product, natural gas. AWE believes that the term ‘unconventional’ is somewhat out-dated as extracting natural gas from low permeability reservoirs is fast becoming mainstream.

The term conventional and unconventional is used to define the reservoir structure, not the physical properties of the gas itself. Figure 9 on page 23 outlines the similarity in the produced gas from different well site locations which are sourced from conventional reservoirs and two different tight gas wells.
Providing greater clarity through a more accurate description will assist community understanding of the sector and shale/tight gas extraction.

**Figure 9:**

![Comparative gas compositions of conventional wells and gas from shale and tight gas wells](image)

Comparative gas compositions of conventional wells and gas from shale and tight gas wells, showing similarity of the natural gas produced from the different well locations.

8. **Terms of Reference**

I. **How hydraulic fracturing may impact on current and future uses of land**

The hydraulic fracturing of a well occurs deep below ground level, between 2,000 metres and 5,000 metres – well below the surface and surface aquifers used for agricultural, industrial and human uses.

The microseismic study conducted by AWE at the Woodada Deep-1 well in the onshore Perth Basin (see case study on page 9) indicated that microseismic events are confined to the target formation.
Onshore drilling and hydraulic fracturing uses relatively small amounts of land. The use of all land relating to oil and gas operations is regulated and closely monitored by the DMP. A typical well site is approximately 100 metres by 150 metres. The size of pad reduces significantly once exploration is completed and production commences.

The use of horizontal drilling in onshore gas production minimises surface disturbance as fewer well pads are required to access the natural gas resources below. In some cases, six separate well bores can be drilled from the same drill pad, and in some instances as many as 18 are able to be drilled.

In comparison to traditional vertical wells, wells that can be drilled horizontally have advanced the industry’s ability to minimise the surface disturbance from onshore oil and gas exploration.

AWE is conscious that in the Mid-West the farming community relies on sub-surface aquifers for both irrigation and stock water.

The combination of target formation depth, multiple casing well design, pressure testing of casings and low toxicity of hydraulic fracturing fluids all serve to protect the purity of the aquifers. Similarly double lining of flowback ponds provides protection against leakage into groundwater.

These artificial, natural and regulatory barriers provide redundancy and efficacy for the protection of aquifers.

The Australian onshore gas sector’s relative immaturity compared to the United States enables Australian oil and gas operators, and their stakeholders, to benefit from the technological advances in the United States.

These advances have increased the efficiency of the hydraulic fracturing process; the safety of the operations and components used; and the efficiency of water used, while reducing the number of well pads (and therefore surface disturbance) required.

For example, one operator has developed a hydraulic fracturing fluid formulation made entirely with ingredients sourced from the food industry. Another operator’s new technique requires 60 per cent less water and produces 20 per cent more gas.

It is also important to differentiate between the number of wells required to extract natural gas from coal seams and the number of wells required to extract natural gas from sandstone or shale, which are significantly less.

II. The regulation of chemicals used in the hydraulic fracturing process

The DMP’s regulatory requirements for Western Australian onshore drilling operations are some of the most onerous in the world, particularly with respect to chemical disclosure. The application of the new guidelines is not limited to the chemicals used during the hydraulic fracturing process, but extends to all chemicals used to drill a well.
The updated guidelines for chemical disclosure complement the onshore oil and gas industry’s own commitment to transparency.

One issue that the committee may choose to consider is the possible unintended consequences the new chemical disclosure regime may have on the use of more efficient products.

AWE is concerned that the disclosure regime may actually prevent the use of more environmentally friendly or more efficient chemical products due to issues relating to intellectual property rights.

It is AWE’s understanding that some third party contractors who supply the highly specialised chemical products used in the hydraulic fracturing process, are sensitive to releasing full chemical makeups as the information may be used by their competitors to undermine their commercial position globally. As a result, those new products are at risk of being withheld from the WA market to protect their Intellectual Property.

This is to the detriment of the industry and the environment if those products can provide a superior outcome, but are withheld from the market.

AWE understands this must be balanced with the need for transparency and disclosure.

III. The use of groundwater in the hydraulic fracturing process and the potential for recycling of produced water

AWE is committed to minimising the impact of its operations on the surrounding environment, including minimising water use.

The water required for onshore oil and gas drilling activities is usually sourced from local underground aquifers. Licences to extract water are issued by the Department of Water (DoW) which evaluates the application to extract on a cumulative basis for the aquifer.

As detailed in Section 5, the Woodada Deep-1 hydraulic fracturing process used less than 5,000kL of water, the equivalent of two Olympic swimming pools. Figure 10 on page 26 highlights the water use for the fracturing process in relation to the local water allocations for the surrounding local communities.

A multistage hydraulic fracture stimulation of a horizontal well would require approximately 20,000kL.
AWE and its partners recycle water that is used during the drilling and hydraulic fracturing process. During the Arrowsmith-2 well five separate fracturing stages were undertaken to complete the hydraulic fracturing process. The operator (Norwest Energy) was able to minimise water use during the process by reusing returned hydraulic fracturing fluid for the subsequent fracture stage.

These initiatives reduce the amount of water required to drill and hydraulically fracture wells. AWE is supportive of any processes which allows for the reuse or recycling of water used during onshore oil and gas drilling.

IV. The reclamation (rehabilitation) of land that has been hydraulically fractured

Under the Petroleum and Geothermal Energy Resources (Environment) Regulations 2011, AWE is required to, and is committed to rehabilitate land used for drilling activities. AWE considers the rehabilitation of land used for onshore drilling activities to be an important phase in the lifecycle of a well. Despite the fact that drilling results in minimal surface disturbance, AWE commits itself, in line with the regulatory standards and best practice, to rehabilitate land to mirror its former presence.

Once land has been rehabilitated, it is audited by an experienced member of the DMP and the Company is required to honour the commitments in the original EP for the specific well site.
Figure 11: Mountain Bridge-1 well site post rehabilitation work, wellhead location highlighted by the yellow box

Figure 12: Prior to site rehabilitation at the Kingia-1 well site in 2006
Figure 13:

Post site rehabilitation at the Kingia-1 well site in 2006

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