SCIENTIFIC INQUIRY INTO HYDRAULIC FRACTURE STIMULATION IN WESTERN AUSTRALIA

Background and Issues Paper

3 November 2017

To find out more visit www.frackinginquiry.wa.gov.au

Contents

Cover photo: A hydraulic fracture stimulation tree

1. Purpose of this Paper

The purpose of this paper is to inform the development of submissions to an inquiry into the process of hydraulic fracture stimulation. Within the scope of the Terms of Reference, the independent scientific panel is inviting submissions on the potential environmental impacts, regulation and management of hydraulic fracture stimulation to obtain oil and gas.

2. Establishment of the Inquiry

The State Government has banned hydraulic fracture stimulation (fracking) in the Perth Metropolitan, Peel and South-West regions, and put in place a moratorium for the rest of the State.

The Government has formed an independent scientific panel (the Panel) to inquire into the effects of the fracking process on the Western Australian environment.

The Government has constituted the Panel under section 25 of the *Environmental Protection Act 1986*.

3. Terms of Reference and the Panel

The inquiry will assess and report on the potential impacts arising from the implementation of hydraulic fracture stimulation on the onshore environment of Western Australia, outside of the Perth Metropolitan, Peel and South-West regions.

The Independent Scientific Inquiry will:

- Identify environmental, health, agriculture, heritage and community impacts associated with the process of hydraulic fracture stimulation in Western Australia, noting that impacts may vary in accordance with the location of the activity;
- Use credible scientific and historical evidence to assess the level of risk associated with identified impacts;
- Describe regulatory mechanisms that may be employed to mitigate or minimise risks to an acceptable level, where appropriate;
- Recommend a scientific approach to regulating hydraulic fracture stimulation; and
- Hold community meetings in Perth, and the Midwest and Kimberley regions.

The Panel consists of:

- Dr Tom Hatton – Chair
- Mr Philip Commander – Member
- Dr Ben Clennell – Member
- Dr Fiona Haslam Mckenzie - Member
- Dr Jackie Wright - Member

4. Scope of Impacts Under Consideration

The Environmental Protection Act, under which this inquiry is established, guides the scope and extent of the potential impacts examined through this inquiry. The Act provides for the prevention, control and abatement of pollution and environmental harm; for the conservation, preservation, protection, enhancement and management of the environment; and for matters incidental to or connected with those purposes.

Therefore, this Inquiry will consider the potential impacts on the environment, and any material harm that those impacts may in turn have on the social surrounds (including heritage, human health and safety) and beneficial uses of that environment.

The onshore regions of Western Australia where there is potential interest in developing unconventional oil and gas resources already have a history of conventional oil and gas development.

The infrastructure, operations and associated impacts of developing unconventional oil and gas resources through hydraulic fracture stimulation have much in common with conventional resource development, including basic well construction, access, land clearing and transport of equipment and product. There are also differences between conventional oil and gas development and unconventional oil and gas development using hydraulic fracture stimulation. It is clearly the intent for the inquiry to consider the impacts of hydraulic fracturing *per se,* together with those processes and activities that are by necessity associated with its application, over the full life-cycle of development, operations and closure.

The scope of this inquiry, and the Act, does not extend to considerations of harm to social or economic values that do not arise directly or indirectly from degradation, pollution or loss of physical or biological values.

Thus, the inquiry does not broadly extend to the future of the oil and gas industry in Western Australia, to considerations of the comparative impacts of oil and gas versus other energy sources, or to the consequences of resource development more generally.

Neither can the inquiry consider any social or economic *benefits* that hydraulic fracture stimulation might bring to the community.

5. Previous Inquiries and their Relevance to this Inquiry

Many inquiries into the risks of hydraulic fracture stimulation in other Australian jurisdictions and overseas precede this one. While the Panel will deliver independent findings and advice, these previous inquiries present a wealth of information on the potential impacts, risk pathways, and evidence of actual environmental performance of hydraulic fracturing across a wide range of geographies and practices. They are also a source to inform the variety of ways hydraulic fracture stimulation is regulated.

Previous studies and analyses provide a generic foundation to help frame and to some extent inform the Panel's advice. This allows the Panel to focus on the unique Western Australian geographical and geological settings in which hydraulic fracturing for oil and gas development may be proposed, the specific environmental values potentially harmed, and the local regulatory environment and how it might need to change.

5.1 WA Legislative Council Standing Committee on Environment and Public Affairs Report 2015

The most immediately relevant past inquiry is that undertaken by the Standing Committee on Environment and Public Affairs of the Western Australian Parliament in 2015 (http://www.dmp.wa.gov.au/Documents/Petroleum/Report42-HydraulicFracturing_UnconventionalGas.pdf).

The purpose of the inquiry was to provide a comprehensive body of information and findings to assist the Parliament of Western Australia, future decision makers and the public in understanding the implications of hydraulic fracturing for unconventional gas. That inquiry considered the technical and geographic opportunities and challenges in developing unconventional gas resources with hydraulic fracture stimulation, including regulation of hydraulic fracturing in WA, access to land and land use, the chemicals used, impacts on water resources, land, seismicity, air quality and human health. The Standing Committee made 51 separate findings and 12 recommendations regarding the risks and management of hydraulic fracturing, based on 117 submissions from agencies, industry, nongovernmental organisations and the wider public.

It would be inefficient for this Inquiry not to build on the evidence base accumulated by the 2015 WA Parliamentary Report. Recommendation 14 of that report, however, notes that "there is a need for an informed debate on hydraulic fracturing and further scientific study in some areas." The present inquiry is an opportunity to have an independent, scientific examination of evidence, together with any fresh information and perspectives arising since submissions were made in 2013/14.

6. Submissions to the Inquiry

This is a scientific inquiry, and the Panel will consider perspectives, concerns and projections of onshore hydraulic fracture stimulation in Western Australia, within the scope of the Terms of Reference, as well as technical evidence that would inform their consideration. We ask stakeholders and the wider public to assist the inquiry to ensure the Panel has:

- A full and appropriate understanding of the environmental values potentially at risk from unconventional oil and gas developments involving hydraulic fracture stimulation;
- Any data or other evidence that might inform a scientific risk analysis of those impacts, with an emphasis on local geographies and geologies, and local evidence from Western Australia; and
- Any reflections or experience on what a regulatory framework should ideally look like if the Government lifts the current Moratorium.

7. Hydraulic Fracture Stimulation

7.1 What is hydraulic fracture stimulation, how is oil and gas extracted?

Hydraulic fracture stimulation (fracking) involves pumping fluids and 'proppants' (solid material such as fine sand grains or ceramic beads) into a low-permeability rock under high pressure to induce fractures. The fluid is typically 90 per cent water with 9.5 per cent proppant and 0.5 per cent chemical additives. Additives are used to suspend the proppant in the fluid, stop microbial growth, prevent corrosion and make it easier for the fluid to move through the fractures. When the pumps are turned off, the proppant contained in the fluid remains in place, holding the fractures open and allowing the hydraulic fluids and the oil and gas to flow out of the rock formation and up the wellbore. (Figure 1)

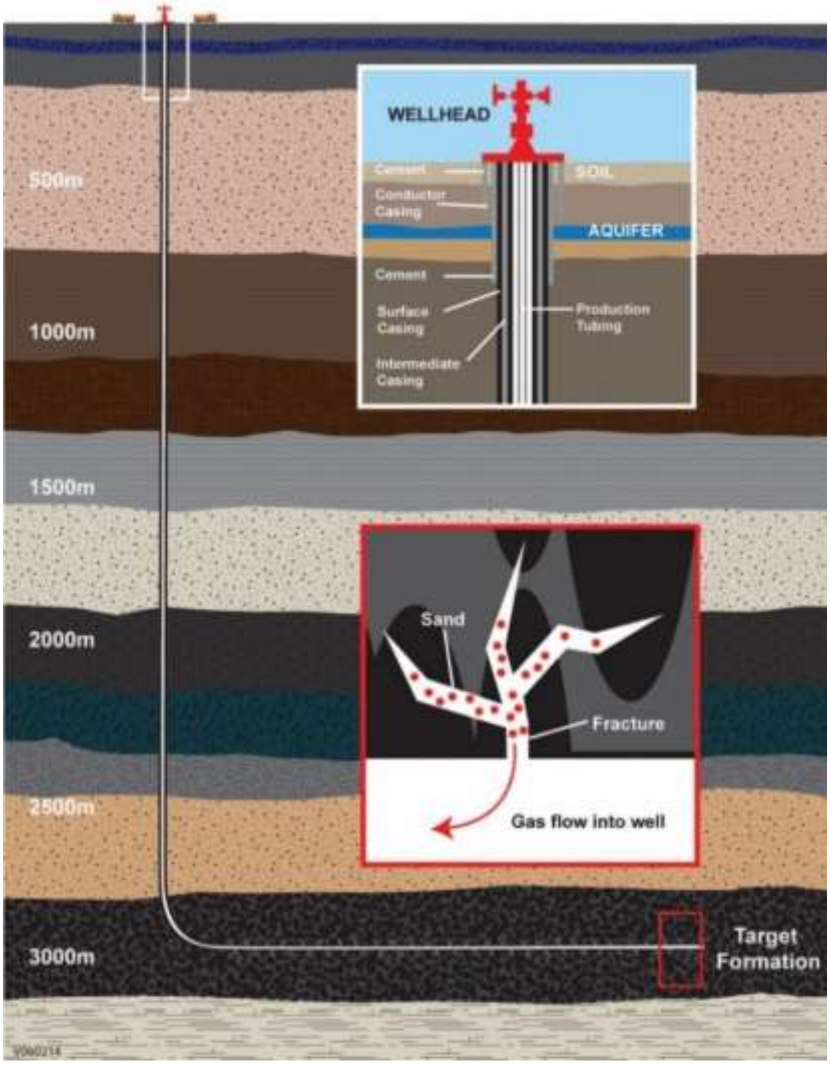

Figure 1. Schematic diagram showing a horizontal well intersecting a shale formation, in a typical Western Australian setting. At the surface, hydraulic fracture stimulation equipment (including the frack tree) is attached to the Christmas tree on top of the well. The horizontal section has undergone hydraulic fracture stimulation. Lower inset shows induced fractures in the shale formation. Source: Department of Mines, Industry Regulation and Safety, WA.

Oil and gas is extracted from the low permeability rock in the immediate vicinity of the induced fractures. Initially oil and gas production rates are high as the oil and gas that is made available by the hydraulic fracture stimulation flows to surface and is produced. This initial high production rate will decrease as the amount of oil and gas left adjacent to the fractures diminishes. The effectiveness of hydraulic fracture stimulation can be enhanced in combination with horizontal drilling, which enables multiple fracture stages in a well.

7.2 What is the difference between conventional and unconventional petroleum resources?

Shale oil and gas, tight oil and gas and coal seam gas are 'unconventional' because the resource may not flow freely into a petroleum well. The pore spaces in these rocks are tiny and not connected so that it is difficult for the oil and gas to move through the rock. These types of rock are described as having low permeability, which is the low ability for oil and gas to flow (Figure 2).

Petroleum resources that flow freely are 'conventional'. It occurs in sandstones and carbonate rocks that have higher permeability, such as those found in the offshore sedimentary basins of Western Australia's North West Shelf and many conventional gasfields in the northern Perth Basin.

Shale oil and gas is contained in a type of sedimentary rock formed of very fine-grained, or small, particles, such as clay, that have been compacted to form a layered rock. Tight oil and gas refers to petroleum resources found in low permeability reservoir rocks that are most often sandstone, but also include low permeability carbonate rocks.

Natural oil and gas from shale and tight rocks is generally the same as natural oil and gas from conventional sources. Natural gas is a mixture of combustible gases, mostly methane, with smaller amounts of ethane and propane.

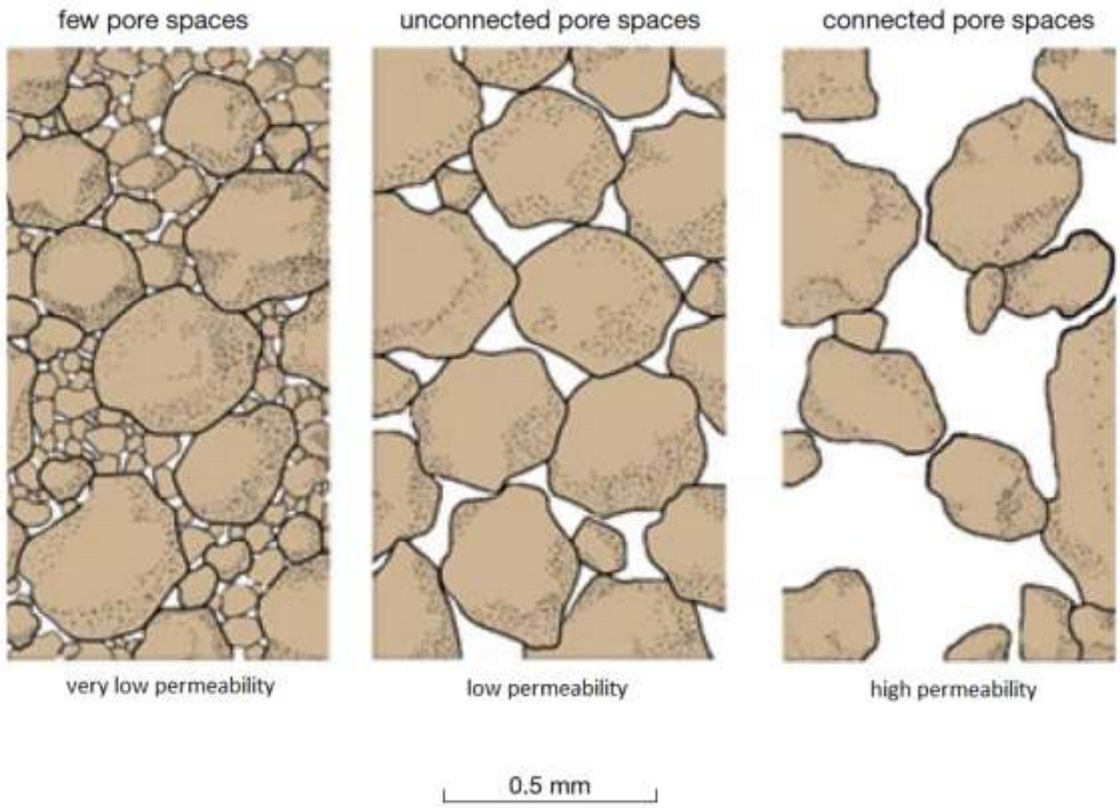

Figure 2. A microscopic view of sandstones ranging from very low permeability rock to high permeability rock. Source: Department of Mines, Industry Regulation and Safety, WA.

7.3 How do WA's shale and tight oil and gas resources differ from coal seam gas?

Coal seam gas (CSG), which is sometimes known as coal bed methane, is natural gas that is formed by, and found in association with, certain coal deposits. CSG typically lies at depths of 300 to 1000 metres. While the CSG industry is established in Queensland, to date, CSG has not been demonstrated as prospective in Western Australia.

In Western Australia, shale and tight oil and gas resources generally lie at depths between 2000 and 4000 metres. These depths usually lie significantly below groundwater resources and under multiple thick layers of low permeability rock that act as barriers between the formation and any water resources, and the land surface.

With CSG, gas is extracted by drilling wells into the coal seam. The goal is to decrease the water pressure by pumping groundwater from the well, a process known as dewatering. The decrease in pressure allows gas to be released from the coal and flow up the well to the surface. CSG extraction relies upon dewatering and only sometimes requires water for fracking the coal seam. In contrast, the production of shale and tight oil and gas does not require the removal of groundwater to release the oil and gas, but will almost always require hydraulic fracture stimulation.

Hydraulic fracture stimulation for shale and tight oil and gas would require water. The amount of water required ranges from five to forty million litres, depending upon the type of well. It is estimated that a vertical well with three fracking stages would require seven million litres of water. This is the same as approximately three Olympic size swimming pools.

A horizontal well, as shown on Figure 1 (with a horizontal length of one kilometre) with ten fracture stages is likely to require 21 million litres of water per well. This is the same as approximately 8.5 Olympic size swimming pools.

Table 1. Typical differences between coal seam gas and shale and tight oil and gas. The data given in the table below will vary from case to case. Sources: CSIRO, Northern Territory Government.

	Coal seam gas	Shale and tight oil and gas
Source	Shallow coal seams	Deeper shales and tight rocks
Depth	300m – 1000 m	2000m – 4000m
Drilling direction	Mainly vertical	Horizontal and vertical
Proximity to fresh water aquifers	Shallow and therefore closer to potable water resources	Deeper and therefore further away from potable water sources
Surface footprint	Single exploration well per drill pad (a drill pad is the area disturbed by the installation of the drilling and extraction equipment) meaning a larger number of well heads in a given area.	Multiple wells can be drilled from each well pad meaning a lower number of completed well heads in a given area than for coal seam gas.
Hydraulic fracturing	Hydraulic fracturing in some coal seams with low permeability	Always requires hydraulic fracturing
Hydraulic fracturing extent (length x height)	200 – 300 m x 5 – 30 m	200 – 6000 m x 30 – 300 m
Hydraulic fracturing pressure	35 MPa or 5,000 psi	35 – 70 MPa or 5,000 –10,000 psi
Water use	Requires dewatering of coal	No dewatering, but water is used for drilling and hydraulic fracturing
Hydraulic fracturing fluid per volume per well	Approximately 1 ML (0.1 – 3 ML)	Approximately 20 ML (5 – 40 ML)
Number of wells required	Larger number of wells	Fewer wells required than for coal seam gas
Productivity (over lifetime of well)	Lower gas recovery (0.5 – 2PJ per well)	Higher oil and gas recovery (2 - >10PJ per well)

7.4 What chemicals are used in hydraulic fracture stimulation?

Hydraulic fracture stimulation fluid is generally composed of around 90 per cent water. The next largest constituent is the proppant, which is usually sand or ceramic beads, which represent around 9.5 per cent of the fluid. Chemical additives represent approximately 0.5 per cent of the fluid (Figure 2).

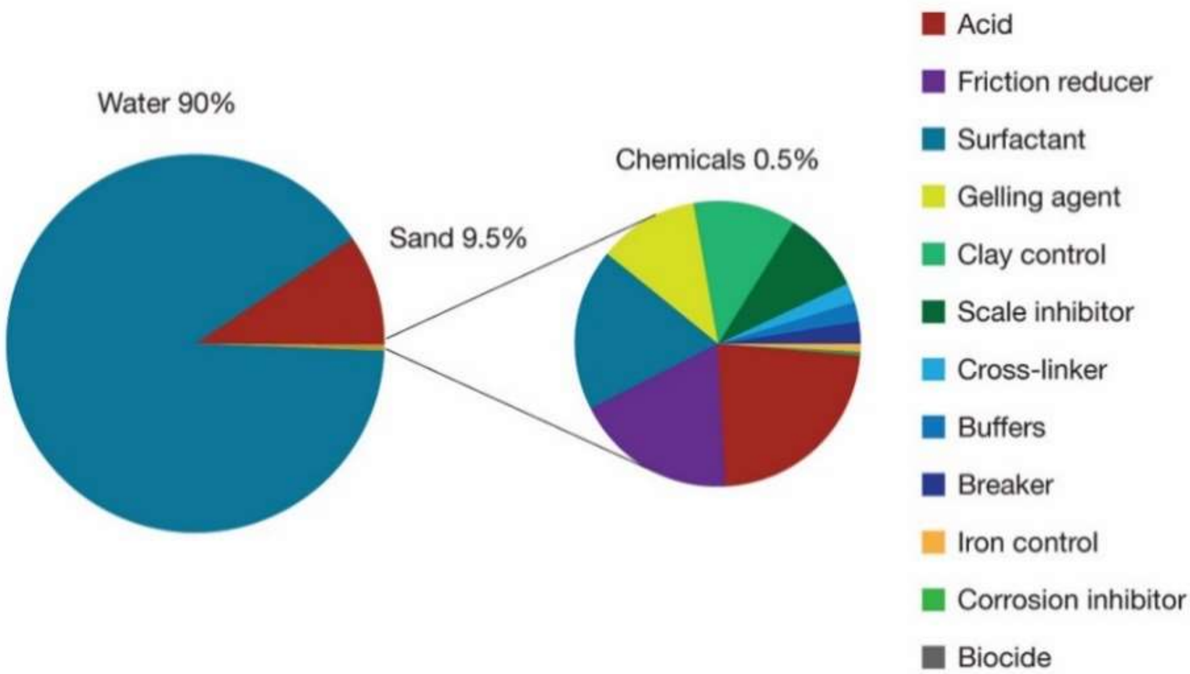

Figure 3. The make-up of typical hydraulic fracture stimulation fluid. Source: Department of Mines, Industry Regulation and Safety, WA.

While a variety of chemicals may be used in fracking fluid, mixtures vary depending on locally specific needs. They are typically 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 for any phase of a well's life, including hydraulic fracture stimulation, need government approval prior to being used and are subject to full public disclosure. Specific chemicals used in fracture fluid depend on the properties of the rock being targeted. Types of chemicals and their use in hydraulic fracture stimulations are detailed below.

Table 2. Types of chemicals used in fracking fluids, their purpose and typical examples. Source: Department of Mines, Industry Regulation and Safety, WA.

Types 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 corrosion inhibitors	Removes or deactivates oxygen and other corrosive material in fluids which contribute to well corrosion	Zinc carbonate, isopropanol, methanol, formic acid, gelatine, sodium sulfite
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, hemicellulase enzyme, ammonium persulphate, magnesium oxide
Surfactants	Reduces the stickiness of fluids to improve flow rates	2-Butoxyethanol, ethanol, lauryl sulphate

8. The history of hydraulic fracture stimulation

The application of detonating crude explosive devices in oil wells to increase oil production in the north eastern United States commenced from 1865, with some success. Pumping fluids and proppants under pressure down a well was first trialled in Kansas in 1947, followed by further commercial experiments in Oklahoma and Texas in 1949. Thereafter, the process was commercially successful in stimulating gas wells and began to grow rapidly from 1950.

The first horizontal well was drilled in the 1930's and horizontal wells were common by the late 1970's. In the mid-1970's, a partnership of private operators and US government agencies fostered technologies that eventually became crucial to the production of natural gas from shale rock, including horizontal wells and multi-stage fracturing.

Modern day hydraulic fracturing did not begin until the 1990's, when George P. Mitchell (of Mitchell Energy and Development Corporation) combined horizontal drilling with hydraulic fracturing. This enabled the commercially viable production of gas from the Barnett Shale in North-Central Texas.

The Society of Petroleum Engineers estimates that 2.5 million hydraulic fractures have been undertaken worldwide, with over 1 million in the United States. Additionally, tens of thousands of horizontal wells have been completed over the past 60 years.

In Western Australia, more than 600 wells have undergone hydraulic fracture stimulation in conventional reservoirs since 1958. These involved small scale, low-pressure fracturing to improve oil recovery. More recently twelve hydraulic fracture stimulations have occurred in Western Australia between 2004 and 2015, all conducted in vertical wells.

Recent technology trends have included the development of horizontal wells, systems that recover, treat and re-use returned water and fracture fluids (otherwise known as flowback water) and the use of lower toxicity chemicals. In the last decade, there has also been focus on developing tools and materials to increase the effectiveness of fracture stimulation treatments and exploring alternatives, or strategies to minimise, the use of water and chemicals, driven by resource recovery and public concerns. To date, hydraulic fracture stimulation using water-based fluids has been the predominant method in Australia with limited experimental application of high pressure nitrogen and propellants (high energy gas fracturing).

9. Where is it targeted in Western Australia?

Potential oil and gas resources do not exist everywhere in Western Australia. They are limited to sedimentary basins, some of which have been identified by the Department of Mines, Industry Regulation and Safety and the US Energy Information Agency. The primary two areas that have been identified are the Canning Basin and the Perth Basin. Within these basins are deep sub-basins and troughs, which are comprised of rock layers or geological formations of varying ages, from 70 million years old to more than 500 million years old. Some of these formations contain shale or tight oil and gas resources, along with other conventional oil and gas resources. Figure 4 shows the locations of the sedimentary basins, sub-basins and troughs that have potential to host shale or tight oil and gas resources in Western Australia.

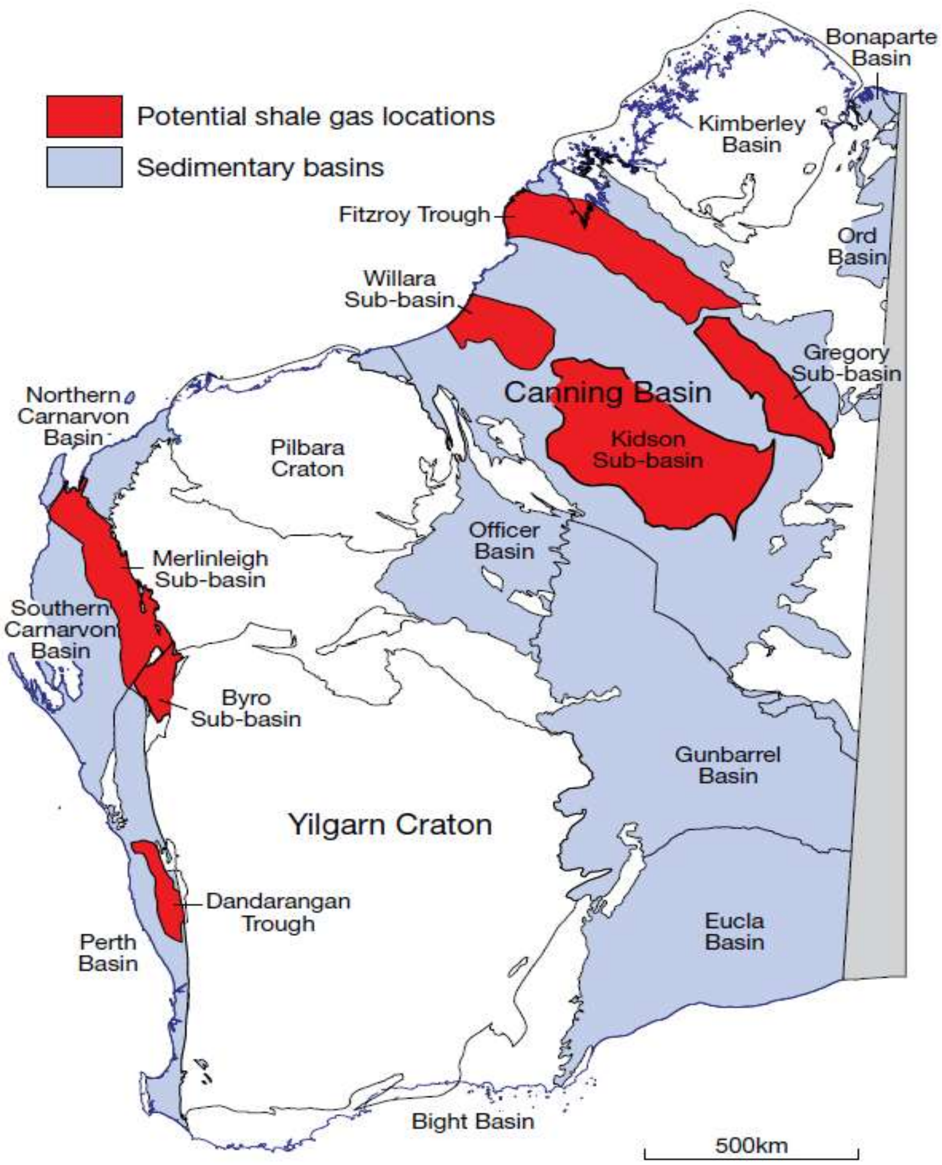

Figure 4. Sedimentary basins and troughs of Western Australia showing potential shale oil and gas locations. Source: Department of Mines, Industry Regulation and Safety, WA.

10. How is hydraulic fracture stimulation presently regulated in WA?

The regulation by government covering the development of a petroleum resource, irrespective of whether it is for conventional or unconventional petroleum, is exactly the same. All projects are assessed on a site-by-site, project-by-project basis with regard to safety and the environment.

This framework rests on five key principles:

- Transparent, effective and risk-based regulation;
- Whole-of-government approach;
- Consistent State and Commonwealth Government objectives;
- Effective engagement with stakeholders, particularly local communities; and
- Compliance and enforcement.

The Department of Mines, Industry Regulation and Safety (DMIRS) is the lead agency responsible for the regulation of petroleum activities in Western Australia. The key statutes, administered by DMIRS relating to shale and tight oil and gas, are the Petroleum and Geothermal Energy Resources Act 1967, the Petroleum (Submerged Lands) Act 1982 and the Petroleum Pipelines Act 1969 and associated regulations.

DMIRS' regulatory role is complemented by key regulatory processes undertaken by the Department of Water and Environmental Regulation.

Other State Government agencies, including the Departments of Biodiversity, Conservation and Attractions; Health; Planning Lands and Heritage; and the Radiological Council support these major regulatory agencies.

These agencies regulate and approve a variety of elements with respect to shale and tight oil and gas developments (along with all other oil and gas developments in the State's jurisdiction) under legislative powers relevant to each agency. These agencies' roles include conducting detailed environmental impact assessments where activities may result in significant environmental impacts, considering licence applications to extract water, protecting drinking water and Aboriginal heritage.

Commonwealth legislation also regulates the development of shale and tight oil and gas projects. The Environment Protection and Biodiversity Conservation Act 1999 applies where a proposed exploration or development action is likely to have a significant impact on a matter of national environmental significance.

11. Current best practice – what's allowed/what's not?

Companies undertaking any petroleum related activity in Western Australia are expected to comply with Australian and international standards.

Established standards for well integrity include the principle of having at least two barriers between the subsurface environment and the interior of the well. This assists in the prevention of petroleum loss into the subsurface or aboveground environment, while also reducing the potential for water and other material from entering the well and contributing to groundwater contamination.

Chemicals used in petroleum operations are required to be approved by the Department of Mines, Industry Regulation and Safety on behalf of the Western Australian Government. In Western Australia, all chemicals to be used in hydraulic fracture stimulation operations must be publicly disclosed. Should a company wish to substitute any component of what has been publicly disclosed, permission from government must be obtained prior to the substitution.

In recent years, standards in Western Australia have become much more stringent. Diesel, for example, has been used in the past for fracking operations, but is now disallowed.

Water use is a particular concern of the Western Australian community. All water use by petroleum companies is regulated under the *Rights in Water and Irrigation Act 1914* by the Department of Water and Environment Regulation. Petroleum companies do not have automatic access to water locally. They must apply for a water allocation licence, which will only be granted if water is available.

12. Assessing the risk of environmental impacts associated with hydraulic fracture stimulation

Within the scope of the Terms of Reference, the Panel will assess the risk of potential impacts associated with hydraulic fracture stimulation in the development of shale and tight oil and gas resources on the onshore environment in Western Australia, outside of the Perth Metropolitan, Peel and South-West regions.

Through the call for public submissions, we seek information on potential environmental impacts, together with supporting evidence, likely to be caused as a result of hydraulic fracture stimulation and associated development.

An initial set of potential impacts that the Panel considers relevant to this inquiry, has been developed based on the scope of previous inquiries and reviews of the safety of hydraulic fracturing for oil and gas. These have been grouped into the themes of Land, Air, Water and Social Surrounds, and are presented below.

Table 3. Potential Environmental Impacts proposed for assessment in the inquiry

LAND	AIR	WATER	SOCIAL SURROUNDS
Terrestrial Environmental Quality	Greenhouse Gas Emissions	Quality	Aboriginal Heritage
Biodiversity	Air Pollutants	Quantity	Amenity and Aesthetic enjoyment
Beneficial Use		Beneficial Use	Public Safety
			Seismicity

The likelihood and consequence (i.e., risk) of each potential impact in the above table will be evaluated for each prospective region across the life-cycle of development, where appropriate. This categorisation is not perfect. For example, consideration of human health and beneficial must be considered through a number of different impacts on the environment. As a set, however, this framework is intended to address the overall risk associated with hydraulic fracture stimulation for developing oil and gas in Western Australia.

Ultimately, the Panel will consider the cumulative risk of all environmental impacts for each prospective region on Western Australia, and the degree to which those impacts can be avoided, mitigated or managed through regulation.

12.1 Land impacts

Table 3.1 Lists the potential impacts that hydraulic fracturing and its associated activities may have on the land for all stages of development including exploration, pilot, development and closure for prospective regions in Western Australia.

Land	Potential Risk
Terrestrial Environmental Quality	Hydraulic fracturing and its associated activities could have an impact on soil quality. This could result from: • the spillage of chemicals used during hydraulic fracturing; or • the spillage of flowback water. This could also indirectly impact the health of people, plants and animals.
Biodiversity	Hydraulic fracturing and its associated activities could impact biodiversity. This could result from: • habitat loss or fragmentation from clearing for drill pads, roads and pipelines; • increased noise and light from operations; or • the spread of weeds and pests.
Beneficial Use	Hydraulic fracturing and its associated activities may impact beneficial use by degrading or restricting access to land that would have been used for other productive purposes including agriculture.

12.2 Air impacts

Table 3.2 Lists the potential impacts that hydraulic fracturing and its associated activities pose to air quality for all stages of development including exploration, pilot, development and closure for prospective regions of Western Australia.

Air	Potential Risk
Greenhouse Gas Emissions	A significant amount of greenhouse gases could be released during hydraulic fracturing and associated activities.
Air Pollutants	Air pollutants could be released during hydraulic fracturing and associated activities. This could result from the release of gases from the wells into the air, or fumes from drilling equipment and road traffic. This could impact the health of people and plants and animals.

12.3 Water impacts

Table 3.3 lists the potential impacts that hydraulic fracturing and its associated activities pose to water values (groundwater and surface water) for all stages of development including exploration, pilot, development and closure for prospective regions of Western Australia.

Water	Potential Risk
Quality	**Groundwater** Hydraulic fracturing and its associated activities could impact groundwater quality. This could result from: • leakage of wells due to a failure in well integrity, or degradation over the life of the well; • spillage of chemicals, flowback water or brines produced from water treatment; • on-site spills resulting from the overtopping of water storage tanks due to extreme weather events; • spills from the transportation of chemicals; • induced connectivity between hydraulically fractured shale and aquifers; or • reinjection of treated water. **Surface Water** Hydraulic fracturing and its associated activities could impact surface water quality. This could result from: • spillage of chemicals, flowback water or brines produced from water treatment; • on-site spills resulting from the overtopping of water storage tanks due to extreme weather events; or • spills from the transportation of chemicals. • This could also impact the health of people and terrestrial and aquatic plants and animals.
Quantity	Hydraulic fracturing and its associated activities might impact water quantity due to the amount of water required for the hydraulic fracturing processes. This could impact plant and animal habitats through a decrease in water availability.
Beneficial Use	Hydraulic fracturing and its associated activities could impact other beneficial uses of water due to competition for water or loss of utility due to contamination.

12.4 Social surrounds impacts

Table 3.4 Lists the potential impacts that hydraulic fracturing and its associated activities pose to social surrounds for all stages of development including exploration, pilot, development and closure for prospective regions of Western Australia.

Social surrounds	Potential Risk
Aboriginal Heritage	Hydraulic fracturing and its associated activities could impact Aboriginal heritage through the alteration or degradation of the environment. This could result from: • damage to sites of cultural significance; or • loss of bush tucker or bush medicine.
Amenity and Aesthetic Enjoyment	Hydraulic fracturing and its associated activities could impact the amenity of the local area. This could result from: • increased noise and dust from construction, operation and transport; • increased light from construction and operation; • loss of visual amenity arising from infrastructure; or • damage to recreational sites.
Public Safety	Hydraulic fracturing and its associated activities could impact public safety through transport accidents and accidents on site.
Seismicity	Hydraulic fracturing could induce seismic events that impact local infrastructure and safety.

13. We want to hear from you

The Panel is seeking information from stakeholders and the community to ensure that all potential environmental impacts and supporting evidence is captured to evaluate the potential risks caused by hydraulic fracture stimulation.

To ensure this inquiry is open and transparent all submissions will be made publicly available on the inquiry website under the name of the submitter and no anonymous or confidential submissions will be accepted. For submissions to be considered, the submitter's contact details must be provided; this will allow for any follow up the Panel requires for clarification or further information. Contact details, including email addresses, postal addresses and phone numbers will not be published.

When the submission period opens, information can be provided by:

a. making a written submission
   - online by clicking on the "Have your say" tab at: www.frackinginquiry.wa.gov.au
   - via Email to info@frackinginquiry.wa.gov.au
   - by post to:

     Independent Scientific Panel Inquiry
     Locked Bag 33
     Cloisters Square
     PERTH WA 6850

b. Speaking with Panel members at one of the planned public meetings.

Details about the public meetings, including the registration process, will be provided on the inquiry's website www.frackinginquiry.wa.gov.au by the end of 2017.

This is a scientific inquiry, and the Panel can only consider information and evidence that helps inform an analysis of potential impacts and risk, or how risk might be mitigated or managed through regulation, if possible. The Panel understands that not all our stakeholders speak the language of science and technology, and we will respect every submission that contributes information people feel is relevant. We also respect the passion that some stakeholders bring to the consideration of this technology in Western Australia. In return, we ask those wanting input into the inquiry to respect the fact that the Panel can only operate within the scope of the Terms of Reference given to us by Government, and to understand that our findings and advice cannot be based on the strength of opinion but rather the strength of evidence.

Following the public meetings and closure of the submissions period, the Panel will consider the evidence provided in the public submissions in conjunction with any other available scientific and historical evidence to assess the risks of impacts, and how those risks might be mitigated or managed through regulation, if possible. The Panel will release a report of its findings on the inquiry website by the end of August 2018.

At this stage, the anticipated timeline for the inquiry is as follows:

Scientific Inquiry announced	5 September 2017
Terms of Reference released	5 September 2017
Inquiry Chair appointed	5 September 2017
Panel members appointed	11 October 2017
Inaugural meeting of the Panel	16 October 2017
Background and Issues Paper released	3 November 2017
Additional information and case studies made available	27 November 2017
Submissions period opens	27 November 2017
Public meetings in Perth, the Midwest and the Kimberley	February 2018
Submission period closes	19 March 2018
Release of Final Report	August 2018

14. Further information

Further information about the inquiry is available on the inquiry website: www.frackinginquiry.wa.gov.au

The website will be updated regularly with further information that may inform submissions, including details of public meetings when available.

The website currently includes:

- an overview of the inquiry;
- the inquiry Terms of Reference;
- information on the Panel members;
- information about hydraulic fracture stimulation;
- "Have your say – making a submission"
- inquiry progress;
- a subscribe option to register your interest in receiving updates; and
- links to other hydraulic fracturing inquiries in Australia

The Inquiry contact information is as follows:

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