Understanding hydraulic fracturing in the United States

Background

NATIONAL CENTRE FOR GROUNDWATER RESEARCH AND TRAINING

The use of hydraulic fracturing, or fracking, in unconventional gas mining in Australia has raised concerns about the potential impacts on groundwater. This fact sheet examines the findings of research in the United States where fracking has been used for nearly 70 years.

FRACKING IN THE US

Hydraulic fracturing, or 'fracking', as used in unconventional gas mining, is a process that involves pumping a fluid – often water with or without the addition of sand and chemicals – into coal or shale seams under pressure to force open cleats in areas of low permeability.

Fracking was first used in the US in the late 1940s to increase production from conventional oil and gas wells. Over the past 25 years the process has been increasingly used in unconventional oil and gas mining, particularly shale oil and gas, and also coal seam gas. It is estimated that over the past 70 years hydraulic fracturing has been used in more than one million US wells, mostly at depths of between 1,200 metres and 4,200 metres[1].

Today, unconventional mining constitutes 55% of US gas production and 25% of oil production[2].

GROUNDWATER CONSUMPTION

Groundwater is one of the main sources of water used in the fracking process and significant quantities are required. Total volumes vary from mine to mine with an average of about 11.4 megalitres and a high of about 26.5 megalitres[3]. (One megalitre is one million litres.) One of the main concerns of fracking is that water consumption will result in reduced stream flow or deplete groundwater aquifers.

The US Environmental Protection Agency estimates that about 35,000 wells[4] are

currently fracked annually in the US and together they use the equivalent amount of water consumed by 5 million people. US studies show the water impacts vary considerably by location, seasonal timing and recharge rates from no noticeable effect to high impact on specific local water wells. However, on a regional basis it is difficult to distinguish their impact because groundwater withdrawals for gas wells are comparatively small compared to total withdrawals from the combined use of activities such as agriculture, municipal use, and manufacturing. The US Energy Institute believes the most reasonable approach to assessing water usage is monitoring to evaluate short and long-term impacts on the local community and environment to establish if it is sustainable.

CONTAMINATION RISKS

The fluids used in unconventional gas fracking are usually about 90% water, 9.5% proppant material such as sand, and 0.5% other chemicals[5]. The chemicals fulfil a variety of functions such as assisting fracking, preventing bacterial growth, inhibiting scale and corrosion, and cleaning and gelling. Until recent years the exact chemical composition has remained proprietary, but this is changing through voluntary disclosure by mining companies and new US state-based regulations. Greater transparency is also leading to increased use of more environmentally friendly chemicals.

The potential risk to the environment, particularly water resources, from these chemicals escaping via fracture zones or faults in wells, continues to cause controversy in the US. However, studies by authoritative organisations involving the evaluation of scientifically documented cases has found little or no evidence of groundwater contamination from actual fracking at normal depths, typically below 600 metres to 900 metres. Some of these studies include:

- A 2009 study[6] by the Ground Water Protection Council, an association of state regulators, reviewed 10,000

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wells and found only one complaint, which proved unrelated to fracturing.

- A 2004 U.S. Environmental Protection Agency (EPA) study[7] of fracturing of coalbed methane reservoirs found 'little or no threat' to underground sources of drinking water. Hydraulic fracturing continues to be studied by the EPA.
- In 2010, the Interstate Oil & Gas Compact Commission, representing more than 30 state governments, affirmed that there have been no verified cases of drinking-water contamination resulting from hydraulic fracturing operations in states where shale gas is produced.

FLOWBACK AND PRODUCED WATER

Following hydraulic fracturing about 15% to 80%[8] of the injected fluid returns to the well bore as 'flowback' water mixed with saline groundwater, known as 'produced' water. This is brought to the surface for treatment, recycling or disposal. Management of the combined flowback and produced waters is another major cause of shale gas conflict in the US.

The presence of arsenic in the water, while not uncommon in domestic wells, is a particular source of controversy in Texas and Pennsylvania with calls for increased regulation. Today there is greater emphasis in the US on recycling and reuse to conserve freshwater and to reduce the amount of flowback wastewater that must be managed.

OTHER IMPACTS ON GROUNDWATER

While there is no direct evidence of hydraulic fracturing causing groundwater contamination in the US, there are cases of groundwater being affected at other stages of mining. Data on violations from government agencies indicate environmental impacts from the actual drilling process and issues such as leakage of produced and injected fluids and methane from poorly cased or cemented wells, surface spills and pit leakage. The frequency and impact of such accidents in unconventional oil and gas production are not common and essentially mirror conventional production or other industrial processes. The incidence is very low; for example just 0.l% of 187,788 wells drilled in Texas between 1993 and 2008. According to the Groundwater Protection Council nearly 75% of these contamination accidents were from surface or disposal operations[9].

REGULATORY CONTROLS

State and federal government agencies in the US are meeting the challenge of expanded unconventional gas and oil production with new regulations which focus on three main areas of concern:

- well integrity to prevent aquifer contamination
- disclosure of hydraulic fracturing chemicals
- proper management of large quantities of wastewater.

REFERENCES AND ACKNOWLEDGEMENTS

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