



Department  
of Energy &  
Climate Change

# Fracking UK shale: water

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Hydraulic fracturing, known as fracking, is a technique used in the extraction of gas and oil from 'shale' rock formations by injecting water at high pressure. This guide explains why some people worry this technique may use too much water or pollute it, and what government and others will do to manage the risks.

## Potential contamination – underground

Because extracting oil and gas involves drilling a well on land, some worry that water held in the soil or rock (groundwater) may be contaminated by the released gas or the chemicals used to assist the fracking operation.

## Risk of gas entering groundwater via fractures in rock

Hydraulic fracturing creates tiny cracks or fractures in shale rocks. The fractures release natural gas from the rock to travel back up the well. Some worry gas might be able to move through these fractures into groundwater.

Based on evidence collected in the USA where commercial shale fracking operations have been established for 30 years, the risk of gas entering groundwater from the fractures in the rock is extremely low<sup>1</sup>. The thickness and properties of rock surrounding the fractures limit how far the fractures can reach.

Shale gas deposits are hundreds of metres to kilometres below the surface, much deeper than groundwater. The geology of the UK means that generally there are layers of rock above the shale rock that are impermeable and act as a barrier to contamination.

An independent [report by the Royal Society and Royal Academy of Engineering](#) considered whether fractures could result in gases or 'frack fluid' escaping upwards into water sources, but concluded it was highly unlikely.

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<sup>1</sup> <http://royalsociety.org/policy/projects/shale-gas-extraction/report/>

## Risk of groundwater contamination via the well

Shale gas wells are holes drilled through the soil and rock to reach gas-bearing shale rock. Each hole is lined with stages of steel casing which are cemented into place to prevent leaks<sup>2</sup>.

In the United States there is some evidence that poorly constructed wells have led to contamination of groundwater by gas<sup>3</sup>. A well that links groundwater aquifers can cause poorer quality groundwater to contaminate good quality groundwater. For more information on oil and gas wells, and how the regulatory system limits these risks, see the “Safety” factsheet (<https://www.gov.uk/government/publications/about-shale-gas-and-hydraulic-fracturing-fracking>)

There are some concerns from the United States that fracturing will lead to methane levels in water that make it flammable. But where investigated, these have proved to be due to failures in the construction of the well, or to naturally occurring background levels of methane<sup>4</sup>, rather than the use of fracking.

## Minimising the risks of groundwater contamination

Before any gas or oil operation starts in the UK, operators must submit details of their plans to the Environment Agency (EA) in England, Natural Resources Wales (NRW) or the Scottish Environment Protection Agency (SEPA) (EA, NRW or SEPA). The plans must contain a hydro-geological assessment, including details of the presence of groundwater or surface water, details of borehole construction, monitoring plan, fracturing fluids, naturally occurring radioactive minerals, water abstraction and management of abstracted water.

The environmental regulator assesses the proposal’s risks and decides whether to issue the relevant permits. If groundwater could be contaminated, either directly by drilling fluids, frack fluids or indirectly by a substance disturbed by the borehole or fracking, the authority may find the risk to the environment unacceptable and not grant a permit. A permit may be issued if the risk can be limited by, for example, the design of the well, monitoring or limiting the concentration of chemicals.

All operators must comply with [a comprehensive set of health and safety regulations](#) on well design, construction, operation and monitoring to minimise the risk of leaks. Like all oil and gas operations, drilling must be done in accordance with best industry practice and standards established by the industry body, the UK Onshore Operators Group, in consultation with the Department of Energy and Climate Change, the environmental regulator and Health and Safety Executive (HSE).

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<sup>2</sup> <http://royalsociety.org/policy/projects/shale-gas-extraction/report/>

<sup>3</sup> For example, <http://www.pnas.org/content/110/28/11250.full.pdf+html?sid=6e9e43dc-0210-4785-8c76-5819cfb92d20>

<sup>4</sup> For example <http://www.pnas.org/content/early/2013/06/19/1221635110.full.pdf+html>

## Control of chemicals in fracking water and flowback fluid

Frack fluid is the water-and-sand mixture used in fracturing<sup>5</sup>. It may also contain chemicals added to reduce friction during extraction of gas. Drilling fluids are used to drill the boreholes for the well and can be used at the drilling stages. Some of the fracking fluid returns to the surface and is called flowback fluid. It may contain dissolved minerals, including naturally occurring radioactive minerals, salts or metals, which are common in rocks this deep underground.

Chemicals used in drilling and frack fluids are assessed for hazards on a case-by-case basis for each well by the appropriate environmental regulator (EA, NRW or SEPA). Operators must declare the full details of the chemicals to the regulator and will publish a brief description of the chemical's purpose and any hazards it may pose to the environment, subject to appropriate protection for commercial sensitivity.

The only company which has hydraulically fractured for shale gas in the UK, Cuadrilla, published the chemicals which were approved for its operations<sup>6</sup>:

- polyacrylamide friction reducers (0.075%), commonly used in cosmetics and facial creams, suspended in a hydrocarbon carrier
- hydrochloric acid (0.125%), frequently found in swimming pools and used in developing drinking water wells
- biocide (0.005%), used on rare occasions when the water provided from the local supplier used in the hydraulic fracturing needs to be further purified

## Potential contamination – on the surface

When water pumped into the well returns to the surface it is known as flowback fluid. This fluid may contain:

- sand and chemicals added to assist the fracturing process
- small quantities of dissolved minerals such as chloride and sodium, and iron and other metals
- naturally occurring radioactive minerals (NORM)

In the US, flowback fluid can be stored in open pits<sup>7</sup>. In some cases, overflows from such wastewater pits have caused surface water contamination. However in the UK the regulations prevent this fluid contaminating water sources by requiring the operator to:

- make appropriate plans for storing fluid safely, and not in open pits
- design the site so spills are avoided (and are contained if they do happen)
- dispose of flowback fluid safely

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<sup>5</sup> Hydraulic fracturing – fluids (approximately 90% water with 1-2% chemical additives such as hydrochloric acid for pH control, glutaraldehyde as a bactericide, guar gum as a gelling agent, and petroleum based surfactants together with a 'proppant' (approximately 8% by volume, normally sand).

<sup>6</sup> <http://www.cuadrillaresources.com/what-we-do/hydraulic-fracturing/fracturing-fluid/>

<sup>7</sup> <http://www2.epa.gov/hydraulicfracturing#wastewater>

## Safe disposal of flowback fluid

The operator must dispose of the fluid safely. It is categorised as mining waste, so the operator must obtain an environmental permit for its disposal from the relevant environmental regulator and have an agreed waste management plan in place. The method for disposal can be:

- on-site treatment with re-use of water and disposal of remaining liquids and solids to a suitable licensed waste treatment and disposal facility
- removal off site to a suitable licensed waste treatment and disposal facility
- disposal to a special sewer with the permission of the relevant waste water utility company

Operators must carry out trials including laboratory tests, to identify the best way to dispose of the flowback fluids. All the treatment and disposal facilities that operators use must also hold the appropriate permits from the environmental regulator, who will be notified in advance of any movement of the waste.

As of December 2013, one shale gas well has been hydraulically fractured in the UK. The flowback fluids from that well were taken to a licenced waste water treatment works for treatment and disposal.

## Safe management of naturally occurring radioactive minerals

On some sites flowback fluid can contain low levels of naturally occurring radioactive minerals (NORM) such as radium, similar to those found in granite rock.

If the flowback fluid contains NORM above certain limits, the relevant environmental regulator will require the operator to apply for a radioactive substances licence. Where the flowback fluid is not radioactive enough to require a licence, it will still be covered by regulations on the disposal of mining wastes.

Any operator intending to dispose of radioactive material must make a radiological assessment, giving a detailed plan for safe handling and disposal at an approved facility. The assessment must demonstrate sufficient protection for people and the environment.

## Water use

Hydraulic fracturing for shale gas and oil is likely to use large quantities of clean water, although the amount used in fracking is not exceptional compared with other industrial activities.

Each fracking operation requires between 10,000 and 30,000 m<sup>3</sup> (10,000 to 30,000 tonnes or 2 to 6 million gallons<sup>8</sup>) of water.

The volume will depend on the site, but estimates suggest that the amount needed to operate a fracked well for a decade may be equivalent to the amount needed to water a golf course for a month, or the amount needed to run a 1,000 MW coal-fired power plant for 12 hours<sup>9</sup>.

The water may be obtained from the local water supply company or taken ('abstracted') from surface or groundwater (if permitted by the relevant environment regulator). The environmental regulator will only grant a licence to an operator to abstract water where a sustainable water supply is available. The application will be assessed in the same way as any other application from industry or business.

As of February 2014, the only company to have hydraulically fractured in the UK used water from the local water utility company.

Water companies must produce, and then update every 5 years, a long-term plan with contingency reserves in case of a drought<sup>10</sup>. Water companies will assess the amount of water available before providing it to operators.

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<sup>8</sup> <http://www.nrel.gov/docs/fy13osti/55538.pdf>

<sup>9</sup> <http://royalsociety.org/policy/projects/shale-gas-extraction/report/>

<sup>10</sup> <https://www.gov.uk/government/policies/maintaining-secure-water-supplies-high-standards-of-drinking-water-and-effective-sewerage-services/supporting-pages/water-resource-management>

## More information

The Department of Energy and Climate Change, Environment Agency (England), Scottish Environment Protection Agency and Health and Safety Executive have worked with the UK Onshore Operators Group to agree best practices for onshore shale gas wells. The [\[UK Onshore Operators Group's UK Onshore Shale Gas Well Guidelines\]](#) provide a description of the Hydraulic Fracturing Programme (HFP).

Water UK, the body for the Water Industry, has set out its [conclusions on the impact of shale gas production on water usage](#) and signed a Memorandum of Understanding with the shale gas and oil industry.

The [British Geological Survey](#) has information on shale gas and groundwater on its website, including information on the national methane baseline study.

The Environment Agency and Health and Safety Executive have published an agreement that explains their [joint approach to the regulation of unconventional oil and gas developments](#).

The [Scottish Environment Protection Agency](#) has more information on environmental regulation in Scotland.

[Natural Resources Wales](#) has more information on environmental regulation in Wales.

Public Health England produced [a radon map for England and Wales](#).

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