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Groundwater and fracking

Why fracking should be prohibited in Groundwater Source Protection Zones.

The risk of groundwater contamination

Groundwater contamination is one of the key environmental and public health risks from fracking. **Lord Smith, when Chair of the Environment Agency said "**Groundwater contamination is the biggest environmental risk in this activity"[1].

The British Geological Society concludes that *"Groundwater may be potentially contaminated by extraction of shale gas both from the constituents of shale gas itself, from the formulation and deep injection of water containing a cocktail of additives used for hydraulic fracturing and from flowback water which may have a high content of saline formation water."* [2]

Groundwater can be contaminated by:

- Chemical additives used in fracking
- Hazardous oil-based muds used in drilling
- Methane leaking from the well
- Naturally Occurring Radioactive Materials disturbed by the fracking
- Flowback water, which is saline.

The Pennsylvania Department of Environmental Protection recently published details of 243 cases where oil and gas drilling contaminated drinking water wells between 2008 and 2014.[3]

Groundwater Source Protection Zones

The Environment Agency has designated 2000 groundwater sources such as wells, boreholes and springs used for public drinking water supply as source protection zones. These together provide a third of our drinking water. Groundwater Source Protection Zones (SPZs) are defined by how long it would take for water to travel to the drinking water source:

- SPZ 1 is defined as the area in which water would get back to the drinking water source within 50 days, and has a minimum radius of 50 meters.
- SPZ 2 is where this would take just over a year (400 days), and has a minimum radius of 250 meters,
- SPZ 3 designates the full catchment area where water would travel back to the drinking water source.

The size of SPZs can change because water stress can cause water to travel faster. The size of the zone is also dependent on the geological formation. A fourth zone SPZ 4 or 'Zone of Special Interest' can also sometimes exist. This is usually a surface water catchment which drains into the aquifer feeding the groundwater supply.

All SPZs (1, 2 and 3) feed aquifers used for drinking water.[4]

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[1] The Economic Impact on UK Energy Policy of Shale Gas and Oil - Economic Affairs Committee of the House of Lords http://www.publications.parliament.uk/pa/ld201314/ldselect/ldeconaf/172/17210.htm

[2] 3 Stuart et al, 2012, Potential groundwater impact from exploitation of shale gas in the UK, page 19

[3] Washington Times, 5 things to know about shale gas and polluted water http://www.washingtontimes.com/news/2014/sep/5/5-things-to-know-about-gas-boom-and-polluted-water/?page=all

[4] http://apps.environment-agency.gov.uk/wiyby/37833.aspx

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Gaps in regulation to protect drinking water

Currently, the Environment Agency is not permitting fracking in SPZ 1, but has not yet said whether it would be allowed in SPZs 2 and 3. However, as all SPZs feed aquifers used for drinking water, it is clear fracking should not be allowed in the catchment area as a whole. The Chartered Institute of Water Environmental Management has said that fracking should not be permitted in areas where there is a genuine risk to valuable drinking water resources located in groundwater. [5]

This is in part because of the risk of well leakage[6]. Research shows that 'injection wells' into which liquids or gasses are pumped are 2-3 times more likely to leak than conventional 'production wells'[7]. Shale gas wells are drilled horizontally underground in order to access gas over a wider area. Research into conventional wells indicates that horizontal or other 'deviated' (i.e. non-vertical) wells have a failure rate four times higher than for vertical wells in the same area. Research looking specifically at shale gas wells found failure rates in newly-drilled wells in Pennsylvania over three years to be between 6.9% and 8.9%.[8] This was characterised as *"consistent with previous industry data, and not improving"*. Bloomberg New Energy Finance has estimated that between 10,000 and 20,000 wells may be needed for shale gas to replace current UK imports. Even assuming the more conservative well failure rates found in the literature - between 4.6% and 8.9% - this suggests that between 460 and 1,780 wells in the UK could have well integrity failures such as methane leaks.

It is imperative that these leaks do not occur in Groundwater Source Protection Zones.

Other risks to water unaddressed by regulation

- Baseline monitoring of water quality is not required by Environmental Impact Assessments (which themselves are not mandatory).
- No clarity on process for disposal of contaminated 'flowback' water.
- Groundwater permits are not routinely required.
- No requirements to avoid fracking near surface water, or to ensure storage of flowback water is resilient to heavy rainfall and flooding.
- Fracking companies are not required to have insurance for groundwater contamination, risking taxpayers footing the bill.

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[5] http://www.ciwem.org/policy-and-international/policy-position-statements/hydraulic-fracturing-(fracking)-of-shale-in-the-uk.aspxhttp://www.ciwem.org/policy-and-international/policy-position-statements/hydraulic-fracturing-(fracking)-of-shale-in-the-uk.aspx

[6] All references in this section are taken from Friends of the Earth 'Drilling without Fail?' http://www.foe.co.uk/sites/default/files/downloads/drilling-without-fail-review-empirical-data-well-failure-oil-gas-wells-46473.pdf

[7] Randhol and Carlsen (2008) 'Assessment of Sustained Well Integrity on the Norwegian Continental Shelf' http://www.ieaghg.org/docs/wellbore/Wellbore%20Presentations/4th%20Mtg/01.pdf

[8] Ingraffea (2012) 'Unconventional Development of Natural Gas from Shale Formations: Impacts on Water and Climate' http://www.chesapeake.org/stac/presentations/208_Ingraffea%20Part%201.pdf and Ingraffea (2013) 'Fluid Migration Mechanisms Due to Faulty Well Design and/or Construction: An Overview and Recent Experiences in the Pennsylvania Marcellus Play' http://psehealthyenergy.org/site/view/1057 Analysis of data recorded by the Pennsylvania State Department of Environmental Protection (DEP), carried out by Ingraffea (2012) of Cornell University, found a 6.2% failure rate among newly-drilled shale gas wells in each of 2010 and 2011, and a 7.2% failure rate in January and February of 2012. These rates were characterised as "consistent with previous industry data, and not improving". The data was obtained through searching the DEP's Marcellus Violations Database for all violations or inspector comments indicating that a well was leaking outside its production casing. Ingraffea (2013) updated this data in January 2013, after "a more complete and revealing search" of the Department of Environmental Protection database revealed further evidence of well failures. This revised the well failure rates for 2010 and 2011 to 6.9% and 7.2% respectively, and updated the 2012 figure to include the whole calendar year, recording a failure rate of 8.9% in this period.