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Summary

This report looks at the issue of shale gas extraction and the environmental issues raised by Cuadrilla Resources' test drilling in Lancashire. The report draws upon my twenty years experience in the field of environmental regulation, and in particular my work over the past decade looking at energy and resource use. In 2010 I was asked to examine the issue of unconventional gas on behalf of campaign groups in South Wales. This led to a more detailed research initiative on how unconventional gas might function within the UK – concentrating on the likely environmental impacts of these processes, their regulation, and whether the hype surrounding unconventional gas has any merit.

As the supply of conventional oil and gas begins to run short the energy industry is looking for alternative sources of hydrocarbons. For gas there are three “unconventional gas” technologies being considered for the UK – shale gas, coalbed methane and underground coal gasification. Shale gas is created by the same geological processes as conventional gas, but as it is trapped in low permeability rock it can't migrate to form a conventional gas reservoir. To be produced the rock strata have to be shattered using the hydraulic fracturing – or “fracking” – method, and the hydrocarbons chemically flushed from the rock.

Modern deep drilling is a highly technical process which utilises a wide range of man-made chemicals and materials. Drilling utilises large quantities of ‘drill mud’, laced with heavy metals, oils and chemical compounds. As the drilling bit descends metal casings must be installed. For safety reasons, the installation and cementing of the well casing is even more significant for hydraulic fracturing – the high pressures used in the process can force polluted fluids and gases outside the well casing, then upwards to near-surface rock strata. Once the production well has been drilled the target strata is fractured. This uses high fluid pressure and explosive shocks to fracture the target source rock, and chemicals to enhance the size of fractures and gas migration.

In order to assay the scale of the gas deposit Cuadrilla Resources will have to carry out fracturing operations with a similar range of chemicals and processes used for gas production – conceivably a wider range of chemicals in order to optimise the correct formulation of chemicals required for each well. A large proportion of the chemicals used to manage/facilitate the well construction and production process are not recovered – they're lost to the surrounding environment. The loss rate, and the type of chemicals used are often source rock and even site specific. For that reason it is difficult to generalise on the impacts of the process. Using quoted industry figures, around 300 to 400 tonnes of chemicals may be expended in drilling and fracking the well – half of which are likely to be lost to the surrounding environment.

The impact of the chemicals used to create and operate the wells is largely dependent upon the geology of the area in which the operation takes place. If the well casing isn't properly sealed fluid can leak back up the well bore into the near-surface strata. There is related debate on the extent to which hydraulic fracturing creates new or enlarges existing vertical pathways for contaminant migration, and thus the increased potential for pollution arising at the surface. Nearby geological faults may become conduits to bring the pollutants to the surface, or to connect the deep strata to shallower water-bearing strata.
Whilst it is possible to engineer any gas well to meet certain standards, it is never possible to eliminate all risks from the operations involved. The low probability for the failure of a single well does not preclude the possibility that exploratory wells might fail. The greatest difficulty in assessing these effects is the unknown nature of sub-surface geology. All hydrogeological surveys are largely an inference from a very few data points; if the characterisation of local geology is in error, any assumptions made about the likely effects of gas production will be in error too.

During 2009/10, Cuadrilla Resources applied for planning permission from Lancashire County Council for five sites. Cuadrilla have avoided the need for an environmental assessment as each site covers an area of less than one hectare. Even so, it is arguable that, as the Environment Agency did not require a permit for these works, the planning authority should have asked for detailed assessments of the impact of these works on the environment. For the Banks site, no detailed assessment of the impacts were sought by the planning authority – nor did the information provided as part of the application meet the terms required by the law. That the planning authority failed to undertake the required assessments of the likely impacts of the development means that (in the absence of a pollution permit from the Environment Agency) relevant EU law may not have been properly complied with. If so, the planning consent granted to Cuadrilla Resources for the Banks site would not be lawful.

Primary responsibility for environmental protection under UK law falls upon the Environment Agency. The Agency has the legal responsibility for issuing permits, monitoring and ensuring compliance with the Environmental Permitting Regulations 2010 (EPR). I carried out a search of the Environment Agency’s on-line public register for any information, a permit or licence relating to Cuadrilla Resources drilling sites. This produced no results. Having established that Cuadrilla had no permits I attempted to discover why this was the case.

Under the EPR, shale gas well drilling and fracking constitute a “groundwater activity” as it clearly meets the criteria set in Government guidance. The EC Water Framework and Groundwater Directives, enacted in UK law by the Groundwater Regulations 1998, creates a ban on the discharge of the most toxic, persistent and bioaccumulative “List 1” substances, and requires strict conditions to limit the release of “List 2” substances which have a harmful effect on groundwater. Cuadrilla’s operations have the potential to release at least one “List 1” substance into groundwater, and it’s quite likely, during drilling especially the fracking process, that a number of the compounds used are likely to appear in “List 2”. Therefore, irrespective of the scale of these operations, the Environment Agency is under an obligation to impose controls upon this process.

In my view the Environment Agency have seriously erred in law by not requiring that Cuadrilla Resources seek an authorisation under the EPR for their operations. Not only does this mean that Cuadrilla are operating unlawfully due to their failure to comply with the EPR. Arguably the Environment Agency may be liable for a review of their decision due to their failure to enact the requirements of the Water Framework and the Groundwater Directives.

In its totality, the process driving the development of unconventional gas in the UK has been subject to no public scrutiny. As a signatory to the Aarhus Convention, UK government bodies have a responsibility to consult the public on the environmental effects of development. Although “exploratory” works do not automatically qualify for consultation, in this case I believe the exception
in relation to the potential scale of impacts is applicable. There are various sources of evidence to cite regarding the applicability of the “significance” exception, all of which suggest that serious consequences could result from the exploratory use of hydraulic fracturing. In my view, the public’s legitimate expectation for participation under the Aarhus Convention has been procedurally withheld. This arguably renders all such decisions on unconventional gas developments to date illegitimate because they have not been subject to an open and inclusive debate.

In compiling this report, the principal question raised has been to the “lawfulness” of the activities of Cuadrilla Resources at the Banks site. In my view, there are grounds to question whether the activities being carried out were permitted in a lawful manner. In conclusion, there are various grounds upon which complaints could be legitimately made:

- About the activities being carried out by Cuadrilla Resources in Lancashire;
- About the conduct of both the Minerals Planning Authority and the Environment Agency in identifying the potential impacts of shale gas developments in Lancashire;
- About the conduct of the Environment Agency in their interpretation of the law and guidance on groundwater activities, and their resulting failure to demand/issue a permit for the operations at the Banks site; and ultimately,
- On the failure of national policy, and the discharge of the legal obligations upon Government ministers to protect the environment and consult the public on the substance of those policies.

I believe that all these factors cast doubt upon the lawfulness of the activities of Cuadrilla Resources' exploratory drilling at Banks.
Evidence

1. Introduction

This report looks at the issues of shale gas extraction, shale gas/unconventional gas resources in the UK, and the regulation of the shale gas exploration activities by Cuadrilla Resources in Lancashire. It examines the environmental issues raised by Cuadrilla Resources test drilling for shale gas in Lancashire, and the legal issues raised as a result of the subsequent court case against those mounting protests against these activities.

This report draws upon the twenty years experience I have built up in the field of environmental regulation, energy and ecological futures. After working for five years as an engineering technician in the injection moulding industry, in early 1992 I set up Mobbs' Environmental Investigations – and have continued a successful career within the environment movement since then. Over the last 20 years I have worked mostly within the UK, but my skills have also led me to work on projects in Eastern Europe/former Soviet Central Asian states and the Caribbean.

Whilst I began my business carrying out fairly conventional environmental consultancy commissions, in 2001, dissatisfied with the increasingly “reactive” nature of environmental campaigns in Britain, I began a long-term research project looking at “ecological futures” – the aim being to set the agenda for the ecological debate by asking difficult questions about the trends that govern the operation of the world today. Drawing upon my experience over the previous decade, I began looking at energy and resource use across society, how these trends underlay most aspects of the “environmental agenda”, and how the effects of resource depletion might impact upon our future well-being. The novel nature of this work has led to commissions and guest lectures for commercial organisations, universities, and international agencies such as the British Council. I also regularly conduct tours of the UK with presentations to the general public which describe and explain my research – and as a result my work has fed into the development of other grassroots groups exploring these issues, such as the Transition Towns movement.

In 2005 I published a book on energy depletion and energy futures, *Energy Beyond Oil* – which prefigured many of the recent trends related to energy price rises and the economic problems that this has created. Shortly before the publication of the book I was commissioned to write a short article explaining these trends for Chatham House’s magazine, *The World Today*. Other associated work on the future viability of uranium supplies, and the impact this might have upon the proposed “nuclear renaissance” in the UK and elsewhere, was published by the Oxford Institute for Energy Studies in May 2005. In November 2009 I gave a presentation to the All Party Parliamentary Group on Peak Oil (APPGOPO) on “peak energy” and its effects in the UK. This concentrated on the issues of energy prices, trade and debt – the content of which prefigured a large part of the current debate on energy supplies and sovereign debt. In 2010, I produced new research on resource depletion and its effects upon the use of ICT systems for the international civil society organisation, The Association for Progressive Communications.

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1 R v Edward Lloyd Davies, Lauren Christina Pepperell (Barbara Ann Cookson)
2 An archive of some of my past work is on-line at http://www.fraw.org.uk/mei/archive/

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Given my experience in energy and environmental issues, in 2010, through my association with the Free Range Network, I was asked to look at the issue of unconventional gas on behalf of campaign groups in South Wales. They were concerned about the awarding of exploration licenses for shale gas and coalbed methane, and the environmental effects that this might have within an area already heavily impacted by the energy, chemicals and metals industries. This has led, over the past 18 months, to a much more detailed research initiative on how unconventional gas might function within the UK's current energy systems – concentrating on the likely environmental impacts of these processes, their regulation, and whether the perceived hype surrounding unconventional gas has any merit. As part of this work I have prepared new educational resources and a public presentation on unconventional gas in the UK for the Free Range Network, and I will be touring the UK with this presentation during 2012.

Given my experience on the issues related to unconventional gas I have been asked to investigate and give an opinion upon the activities of Cuadrilla Resources in Lancashire – and in particular their recent drilling at Banks on the edge of the Ribble Estuary near Preston.

2. “Unconventional” natural gas

Britain began the large-scale use of gaseous energy sources at the beginning of the Nineteenth Century with the production of town gas – produced by the carbonisation/gasification of coal produced from domestic coal mines. This carried on for a century and a half until the 1960s when we began to import small quantities of natural gas in a liquefied form from North America and Algeria. Large quantities of “conventional” natural gas were discovered in the North Sea during the 1960s, and from the late 1960s to the early 1980s Britain progressively created a national natural gas grid fed by North Sea natural gas supplies, resulting in the closure of all town gasworks.

Britain has a growing energy crisis. Today the North Sea supplies discovered in the 1960s are rapidly depleting. The peak of gas production in the British sector occurred during 2003. This creates a challenge to the UK economy as 43% of our total energy demand is sourced from natural gas – and over three quarters of domestic energy demand is supplied directly or indirectly by natural gas. The scale of our current energy problems are not readily apparent from the everyday media coverage of energy issues; this tends to focus on carbon emissions, fuel prices, or the clash between the pro- and anti-renewable energy lobbies rather than on longer-term global trends.

Whilst all these arguments are part of the greater energy predicament that we face today, the popular debate does not state clearly the fundamentally disruptive nature of the global energy and resource trends (and note, the use of the term “predicament” is important in this context – “problems” have potential solutions which preserve the continuity of a system, whilst a predicament entails the acceptance of more fundamental change). At present the world is experiencing the effects created by the plateau in global oil production – a fact acknowledge by the French Prime Minister in the National Assembly in April 2011. This has been the principle driving factor behind rising fuel prices for the last decade. Unfortunately the UK government doesn't subscribe to the idea that there are ecological limits to the human system, and so has to date ignored the growing body of evidence that the global economy is likely to undergo a significant and long-term

contraction as a result of the natural limitations on energy and resource supply.

Into this complex debate we now have a new issue being introduced – *unconventional gas*; that’s the general term for three related sources of natural gas – shale gas, coalbed methane (also known as ‘coal seam gas’) and underground coal gasification (UCG). Just as deep-water drilling or the search for oil in the Arctic regions are indicative of a great structural change in oil production, so unconventional gas is an indication of the systemic restrictions upon conventional gas supplies. Whilst we can look at unconventional gas as an isolated issue of pollution or ecological risk, it’s only when we pull back and look at how these technologies fit into the wider energy system that we can truly understand what is happening. And of course, if we don’t have such a complete understanding then not only might we underestimate the scale of the problems, but the efficacy of the “solutions” we propose might not address the problems that we perceive to exist.

To understand the difficulties of producing gas from shale we must first look at how we produce the bulk of the natural gas we produce today – via “conventional” drilling and production. Conventional gas is produced from natural sub-surface reservoirs, created by the displacement of water within highly porous conglomerates, sandstones and limestones by migrating methane gas. It requires no significant artificial stimulus to flow – by piercing the underground reservoir the gas will naturally flow from the network of porous rocks within which it is trapped towards the surface.

Hydrocarbons – both oil and gas – are produced by the geological “cooking” of organic matter. When organic matter from river sediments is buried and heated by the geothermal heat from the Earth’s core, the material (concentrated by the compressed sediments into a tarry substance called kerogen) breaks down to produce tar and oil compounds; these are the source of crude oil. Heat those materials to even higher temperatures and the hydrocarbons break down further to produce natural gas. What happens to the oil or gas produced by this process is dependent upon what the source rock is composed of, its permeability, and how the rocks in the region are folded and fractured. Whilst the formation of oil and gas might be a common geological process, the conditions that allow it to be easily tapped and produced as a “conventional” petroleum deposit are not.

To create the conditions for conventional oil and gas production, the hydrocarbons created by geological processes must migrate through the rock strata to a point where they become trapped within a rock structure capable of trapping the hydrocarbons. These occur when rock strata are folded or fractured to produce a dome-like structure, with an impermeable layer of rock above to trap the fluids/gases migrating through the more porous rocks below. Oil and gas are lighter than water, and so float to the top of permeable rock structures to create oil and gas reservoirs. Drilling into the reservoir releases the oil or gas (or both) that it contains.

As the supply of conventional oil and gas begins to run short, the energy industry is looking at various alternative sources of hydrocarbons. For gas there are three “unconventional gas” technologies now being considered for development around the UK:

- Shale gas\(^{13}\) is produced by the hydraulic fracturing of low permeability or “tight” source rocks, and then chemicals are used to enhance the production of gas from the cracks and fissures created by the mechanical pressure;


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Coalbed methane uses similar fracturing processes inside coal seams, flushing out the methane gas trapped within the carbon matrix of the coal – and whilst similar to shale gas the effects are subtly different because of the different rock types involved; and

Underground coal gasification involves “burning” coal underground, starved of oxygen, to produce gases which can be burnt at the surface.

Both coalbed methane and underground coal gasification are potentially viable technologies for use in Lancashire. As these do not form part of Cuadrilla Resources works in Lancashire they are not considered further in this report.

3. Shale gas

Shale gas is created by the same geological processes as conventional gas (organic-rich sediments are buried and heated to create hydrocarbon compounds) but as the material produced is contained in very low permeability clay, shale, or highly cemented sandstone it can’t migrate to a reservoir. The source of the gas for fracking is usually shale or clay strata. Unlike the sandstone, chalk and limestone from which conventional gas is produced, the much smaller particles in shale and clay obstruct the movement of fluids and gases. For this gas to be produced the rock strata have to be shattered using the hydraulic fracturing – or “fracking” – method, and the hydrocarbons flushed from the rock. This involves drilling vertically or horizontally through the rock strata which contains the trapped gases, using high fluid pressures and small explosive charges to shatter and force the rock apart, and then filling the resultant cracks with sand to allow the fluid/gases to escape and be flushed out in the production or “flow-back” water.

In Britain the rocks get younger as you move from the north-west toward the south-east. In northern Scotland the rocks are too old to contain useful hydrocarbons; they formed long before there was enough terrestrial life to create organic-rich sediments. In the South East they are too young to have been buried and cooked to form sizeable gas deposits. What lies in between can, if it has been subjected to the right geological processes, be capable of producing gas.

Across much of the north of England, the Namurian or Millstone Grit Series of rocks contain organic-rich shales and mudstones. These were lain down during the Carboniferous era, about 320 million years ago, when Britain was a shallow sea depositing organic-rich sediments within sand and limestone. Cuadrilla Resources exploration work in Lancashire taps the Bowland Shale, a strata of black shale and mudstone which forms the base layer of the Millstone Grit Series. Whilst these strata

outcrop at the surface along the Pennines, due to large geological faults along the the western edge of the Pennines the strata are buried deep beneath the surface (known as a “subcrop”) in West Lancashire. The Namurian shale is also the target of Coastal Oil and Gas UK in their proposed exploratory drilling in South Wales, and UK Methane in the Mendips.

There are other potential sources of shale gas in the Midlands and Southern England. Across the middle of England stretch the Liassic rocks. These were laid down on the boundary between the Triassic and the Jurassic eras, around 180 to 200 million years ago. Britain was a shallow inland sea, with large amounts of clay and silt rich in organic matter being washed into it. At the base of the Lias is the Rhaetic or Penarth formation, a series of shales and mudstones. Above this are the Lias clays, laid down at the beginning of the Jurassic era, which contain layers of organic-rich shale and mudstone. Later strata – the Oxford and Kimmeridge clays – were deposited on top of the Lias. For much of the south and middle of England, the Lias forms the base of the hydrocarbon producing source rocks – and are the source for the conventional oil and gas deposits now being extracted around Dorset, Hampshire and Sussex (including other exploratory works by Cuadrilla Resources near Balcombe in West Sussex), and the proposed areas for future exploration in the English Channel. There are also much older sediments capable of producing gas, such as the Tremadoc shale. Whilst the outcrop of Tremadoc shale is small, it occurs at depth under much of England and Wales.

4. Shale gas well drilling and “fracking”

Modern deep drilling is a highly technical process. It's not just the hardware of the drill bit that has been adapted to improve the performance of the system. Drilling utilises large quantities of a specially engineered slurry or ‘drill mud’. In modern drilling operations this is far more than the simple solution of clay and water used only a few decades ago. It can be laced with heavy metals, oils and chemical compounds used as lubricants or coolants for the drill bit, surfactants and emulsifiers to keep compounds in solution, or chemicals which assist in breaking-down compounds in the rock to allow the slurry to bring them to the surface more easily. Many drill muds are supplied as a proprietary products, often tailored to certain applications or types of rock, and so an inventory of the additives used may be restricted by the patent protection given to proprietary formulations. Unless they are pre-approved with the relevant regulatory agencies, there is no way of being certain whether they breach UK/European pollution laws or not.

Deep drilling is a complex operation. In addition to drilling the hole, as the bit descends progressively deeper metal casings must be installed to keep the drilling string straight and centrally aligned, and prevent the movement of drilling mud into surrounding rock strata. The installation and cementing of the well casing is even more significant for hydraulic fracturing. The high pressures required can force polluted fluids and gases from the end of the well bore along the outside of the casing, creating a vertical migration pathway for pollutants to near-surface rock strata. In the USA this has been one of the likely causes of many of the pollution incidents involving shale gas extraction – although this does not exclude other potential migration paths.

Once the production well has been drilled in the desired position within the target strata, and the well casing installed and cemented, the well is then, as part of a separate operation, fractured. Hydraulic fracturing involves the use of high fluid pressure and explosive shocks to fracture the target source rock. Despite the fact that Cuadrilla Resources are only conducting exploratory works in Lancashire, in order to assay the scale of the gas deposit they will have to carry out fracturing operations using a similar range of chemicals and processes used for gas production. They might

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conceivably use a wider range of chemicals in order to optimise the correct formulation of chemicals required for operations in that area.

There are two principal problems with flushing the gas from the low permeability rock strata that it is held within:

- Firstly, the nature of the rock means that flowing liquids don't easily penetrate the rock and open up the cracks. For that reason the fluid used has to contain a range of chemicals to dissolve and open-up small cracks in order to increase the amount of rock in contact with the circulating process water – and the range of chemicals used must vary according to the specific qualities of the rock being fracked. A proppant – usually a high quality form of silica sand – is then forced into the cracks to hold them open once the pressure has been released from the system.

- Secondly, once fracked, the ongoing flushing process produces sludge which can clog the cracks – often the result of other minerals flushed from the rock. To control this more chemicals are used to prevent fouling of the channels by keeping the minerals in solution. The minerals in solution may also give rise to other chemical reactions which obstruct either the movement of gas into solution or the flow of production water, and these reactions may be controlled by the use of other chemicals which regulate acidity and other properties of the production water.

The difficulty is that a large proportion of the hundreds of chemicals which may be used to manage/facilitate the well construction and production process are not recovered – they're lost to the surrounding environment. The loss rate, and the types of chemical which may be used, are often source rock and even site specific. For that reason it is difficult to generalise on the impacts of the process: Whilst some wells might lose a large quantity of production water, not all will; and whilst some wells might require a large quantity of chemicals to maintain production, not all will. Quoted figures suggest that a well can use up to 17 million litres of water during the initial drilling and fracturing operations. Assuming that the fracking chemicals have roughly the same density as water, and that around 2% of the total fluids used are fracturing chemicals, then around 300 to 400 tonnes of chemicals may be expended in drilling and fracking the well – half of which are likely to be lost to the surrounding environment.

5. Pollution from hydraulic fracturing

Much of the evidence for pollution from shale gas operation comes from the USA, is largely anecdotal, and is related to a small number of studies. That's for two reasons:

- Firstly, as part of the 2005 Energy Act, shale gas operations were exempted from the oversight of various pollution laws, and so federal environmental regulators were not able to conduct monitoring of operations. What work has been carried out to date has largely been the result of local and state regulators carrying out their public health functions.

- Secondly, the use of commercial confidentiality to avoid the disclosure of information has restricted the ability of campaign groups and academic organisations to carry out independent research on the effects of shale gas development. Even where environment sampling finds pollution, without disclosure of the geological information, and materials being used in drilling/hydraulic fracturing, it's not possible to demonstrate a link to shale gas operations.

The impact of the chemicals used to create and operate the wells is largely dependent upon the

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geology of the area in which the operation takes place. The pressures used to create fractures in the source rock are very high; up to 1,000bar or 15,000psi (Cuadrilla have quoted 4,000psi\textsuperscript{21}). If the casing of the well below the drilling platform isn't properly sealed, fluid can leak back up the well bore into the near-surface strata – most commonly used to supply drinking water, and which act as the reservoir for local natural springs.

There is also a debate at present related to the extent to which hydraulic fracturing creates vertical pathways for contaminant migration, and thus an increased potential for pollution arising at the surface. Even at depth the release of fracking fluids can still give rise to longer-term contamination hazards. Where the chemicals are less dense/more buoyant than water – such as the hydrocarbon additives used in drilling mud or fracking fluids – they can more easily rise to the surface. If there are nearby geological faults these may become conduits to bring the pollutants to the surface, or to connect the deep strata to shallower strata used to supply drinking water. The recent geotechnical report on the earthquakes\textsuperscript{22} following fracking activities notes that fluid pressure lubricates local faults causing movement. At the same time though, apart from the earthquake hazard, those faults can also act as conduits for the movement of fluids away from the target area towards the surface. Gas can travel more easily underground than heavier/more viscous liquid pollutants. This means that any location where methane gas from deep formations has been forced into near-surface groundwater by gas fracking (a phenomena recently identified in scientific research\textsuperscript{23}) could later see the arrival of other pollutants used in or mobilised by the fracturing operations – although it might take years for this to take place.

Whilst it is possible to engineer any gas well to meet certain standards, it is never possible to eliminate all risks from the operations involved. Whilst individually the statistical likelihood of a failure is small, when multiplied across the hundreds of wells required to achieve gas production the probability of well failure causing pollution increases. That's partly due to the economic pressures of drilling and maintaining adequate inspection of the hundreds of wells required to keep large-scale gas production flowing. Even so, this low probability for the failure of a single well does not preclude the possibility that exploratory wells might fail. The greatest difficulty in assessing these effects is the unknown nature of sub-surface geology. All hydrogeological surveys – required as part of the permitting process for groundwater operations – are largely an inference from a very few data points. As a result it is possible that the characterisation of the local geology could be in error, and any assumptions made about the likely effects of gas production will be in error too.

Due to the largely unregulated nature of shale gas development in the USA, and the lack of effective disclosure of the chemical and emissions from the process, health and environmental researchers in the USA are having to catch-up with the impacts of the industry to date. The lack of baseline data also means that proving shale gas operations have caused pollution incidents is difficult. Even so, recent research\textsuperscript{24} by the US Environmental Protection Agency (EPA), following complaints about water quality in Wyoming, suggests that hydraulic fracturing was the cause. The most recent EPA report\textsuperscript{25}, published for consultation in December 2011, states –

\textsuperscript{21} Geomechanical Study of Bowland Shale Seismicity, Dr. C.J. de Pater and Dr. S. Baisch on behalf of Cuadrilla Resources, 2\textsuperscript{nd} November 2011 – http://www.cuadrillaresources.com/cms/wp-content/uploads/2011/12/Final_Report_Bowland_Seismicity_02-11-11.pdf
\textsuperscript{22} Ibid.
\textsuperscript{25} Investigation of Ground Water Contamination near Pavilion, Wyoming – Draft (EPA 600/R-00/000), National Risk
Alternative explanations were carefully considered to explain individual sets of data. However, when considered together with other lines of evidence, the data indicates likely impact to ground water that can be explained by hydraulic fracturing.

Once production of shale gas commences there are various issues related to gas processing, the emission of pollutants to atmosphere, greenhouse gas emissions, and the impact of noise, pipeline installation and transport movements creating local impacts. As this is not yet an issue with Cuadrilla’s activities in Lancashire – since they have not yet moved towards full gas production – these effects are not considered in detail in this report. However, new research is indicating that the gaseous, liquid and solid wastes from shale gas production regions can have health impacts as a result of the pollutants released to the terrestrial environment\textsuperscript{26,27}.

6. Development consents

In the UK all mineral rights were nationalised in the 1930s and licences are awarded by the Government to exploit the nation’s mineral wealth. Except for land in the ownership of certain members of the landed gentry, who may separately register and exploit their rights, the exploration and winning of minerals must be carried out only with a licence awarded by the state.

In May 2008, Cuadrilla Resources and Lucas Energy received a Petroleum Exploration and Development Licence (PEDL), No.165\textsuperscript{28} (illustrated in the map), from the Department for Business, Enterprise and Regulatory Reform (BERR – now the Department for Energy and Climate Change, DECC) under the 13\textsuperscript{th} Onshore Licensing Round\textsuperscript{29}. The PEDL issued to Cuadrilla Resources only grants permission, under defined conditions, to explore for and then exploit minerals. It does not confer any other development consent or environmental permit. Nor is there any inference that the granting of a PEDL should necessarily result in the granting of any other required consents before development takes place. Any other consents must be applied for separately and be determined by the responsible authority independently of the factors governing the issuing of petroleum exploration and development licences.


\textsuperscript{28} PEDL165, awarded to Cuadrilla Resources under the Petroleum Act 1998 – available from \url{http://og.decc.gov.uk/en/olgs/cms/licences/licence_data/recent_licence/recent_licence.aspx}

\textsuperscript{29} 13\textsuperscript{th} Onshore Licensing Round, DECC Oil and Gas portal, accessed January 2012 – \url{http://og.decc.gov.uk/en/olgs/cms/licences/lic_rounds/13th_round/13th_round.aspx}
During 2009/10, Cuadrilla Resources applied for planning permission from Lancashire County Council – the Minerals Planning Authority. Five sites have been given planning consent – these are listed in the table above.

Thus far Cuadrilla have avoided the need for an environmental assessment of their works because there is a 1 hectare limit for exploratory works – and all their development sites are less than one hectare. Arguably though, if the position of the Environment Agency (outlined in the next section) is that these activities do not require an environmental permit, then it would have been open to the Minerals Planning Authority to ask for detailed assessments of the impact of these works on the environment. The EU Water Framework, protecting surface and groundwater quality, as well as the EU Air Quality Directive, apply to local planning authorities. Whilst planning authorities must not seek to duplicate the controls imposed by the Environment Agency, they have the responsibility to ensure that the requirements of various laws on environmental protection are applied in the absence of control by other agencies – and that requires them to seek the appropriate assessments required under those laws to demonstrate compliance. Whilst local planning authorities are often reluctant to take such steps, these responsibilities are highlighted in national planning guidance. For example, Planning Policy Statement 23 states –


This is amplified in the main policy statement on pollution –

Development control decisions can have a significant effect on the environment, in some cases not only locally but also over considerable distances... LPAs must be satisfied that planning permission

Consents issued to Cuadrilla Resources by Lancashire County Council

| Location                     | LCC ref. | App. Date | Postcode | Development status*
|------------------------------|----------|-----------|----------|---------------------
| Preese Hall, Weeton          | 05/09/0572 | 31/07/09 | PR4 3HT  | Well drilled and fracked |
| Grange Road, Singleton       | 05/10/0091 | 05/02/10 | FY6 8LP  | Well drilled, not yet fracked |
| Marsh Road, Banks            | 08/10/0973 | 26/07/10 | PR9 8HB  | Drilling started    |
| Anna's Road, Westby          | 05/10/0634 | 01/09/10 | FY8 4NH  | Construction of pad completed |
| Inskip Road, Wharles         | 05/09/0813 | 03/12/09 | PR4 3SN  | No work started     |

* post code estimated from nearest property  
* as at September 2011

30 Full details of these planning applications can be accessed from the Lancashire Country Council web site:
- Grange Road, Singleton – http://planningregister.lancashire.gov.uk/PlanAppDisp.aspx?recno=5317


can be granted on land use grounds taking full account of environmental impacts. This will require close co-operation with the Environment Agency and/or the pollution control authority, and other relevant bodies such as English Nature, Drainage Boards, and water and sewerage undertakers, to ensure that in the case of potentially polluting developments:

- the relevant pollution control authority is satisfied that potential releases can be adequately regulated under the pollution control framework; and
- the effects of existing sources of pollution in and around the site are not such that the cumulative effects of pollution when the proposed development is added would make that development unacceptable. LPAs may wish to set out principles and policies to deal with cumulative impacts when drawing up their LDDs. Decisions on individual cases must always be justified on the facts applying to those cases.

For the Banks site, no detailed assessments of the impact of the development on the environment were sought by the planning authority – nor did the information voluntarily provided by Cuadrilla Resources as part of their application meet the terms required by the law. The planning authority should have consulted with the Environment Agency in order to see if a pollution permit was required because, if not, the responsibility to implement environmental protection law falls upon the planning authority. For example, the planning authority could have sought the disclosure of all the chemicals to be used in the process in order to ensure compliance with the EC Groundwater Directive.

It should be noted that neither of the letters on the planning file34,35 related to the Banks site contains any reference to the control of List 1/List 2 substances under the Groundwater Directive. The concerns expressed by the Environment Agency to the planning authority relate to the transfer of pollutants between geological strata, not the introduction of man-made substances controlled under the law. In the absence of any information from the Environment Agency, the responsibility for compliance with the Groundwater Directive should have fallen to the local planning authority.

That the planning authority failed to undertake the required assessments of the likely impacts of the development means that (in the absence of a pollution permit from the Environment Agency) relevant EU law may not have been properly complied with. If so, the planning consent granted to Cuadrilla Resources for the Banks site would not be lawful.

7. Pollution consents

Whilst the responsibility for implementation of European law on environmental protection fall upon all public authorities, the body with primary responsibility for policing environmental pollution controls under UK law is the Environment Agency. In relation to polluting developments, the Agency has the legal responsibility for issuing permits, monitoring and ensuring compliance of various industrial processes under The Environmental Permitting Regulations 201036 (EPR). These regulations unify the regulation of solid waste, air, water and radioactive pollution. The regulation of water pollution and radioactive substances was only recently brought under the single permit regime, and, in relation to water pollution, these regulations significantly amend the Water Resources Act 1991 which previously governed groundwater activities. As a result of these changes to the law the Environment Agency has been under a greater burden over recent months, whilst at the same time having their budgets cut37, in order to ensure that all existing permits comply with the law. It is too early to tell if this is having a negative effect on their regulatory duties.

In devising the programme of research for this report, the first thing I did was to search the Environment Agency’s on-line public register\(^{38}\), using the post codes for each of Cuadrilla development sites (listed in table earlier), for a three kilometre radius, under each of the categories offered by the database for which I might find information, a permit or licence\(^{39}\). This produced no entries for Cuadrilla Resources. To ensure the accuracy of the data I repeated this exercise a week later, with the same result. Having established that Cuadrilla had no permits for the sites at which they were/are actively drilling – Weeton, Singleton and Banks – I attempted to discover why this was the case.

The Environment Agency’s regulatory system, under the unified process, operates around guidance notes\(^{40}\) which are devised to cover classes of industrial process. There is no specific guidance note covering the on-shore exploitation of gas, and so it has to be approached as a ‘bespoke’ process using the ‘core’ permitting guidance and the text of the EPR.

The waste and air pollution aspects of exploratory drilling are far smaller than those which would result from the full-scale production of shale gas. Therefore I have only considered groundwater as the indication as to whether exploratory drilling and fracking of the well would require a permit. To test if Cuadrilla’s exploratory drilling operations would require a permit I have sought to replicate the same process which should have been carried out by the Agency.

Under the Environmental Permitting Regulations, shale gas well drilling and fracking constitute a “groundwater activity” by virtue of the fact it involves either\(^{41}\) –

- “the discharge of a pollutant that results in the direct input of that pollutant to groundwater”,
- “the discharge of a pollutant in circumstances that might lead to an indirect input of that pollutant to groundwater”, or
- “any other discharge that might lead to the direct or indirect input of a pollutant to groundwater”

– and it is not reasonably exempted by any of the exclusion clauses. These criteria are repeated in DECC/DEFRA’s recently revised core guidance on environmental permitting\(^{42}\). Section 8 of the Environment Agency’s own regulatory guidance\(^{43}\) on permitting also indicates that this process should be controlled by a permit. The activities involved in Cuadrilla’s exploratory drilling clearly meet the criteria set in Box 3 –

8.5. Para 8 of Schedule 22 lists inputs to groundwater which can be permitted provided they do not compromise the groundwater objectives in Article 4 of the Water Framework Directive. These are reproduced in Box 3 –

Box 3. (a) the injection of water containing substances resulting from the operations for exploration and extraction of hydrocarbons or mining activities, and injection of water for technical reasons, into geological formations from which hydrocarbons or other substances have been extracted or into geological formations which for natural reasons are permanently unsuitable for other purposes, provided that the injection does not contain substances other than those resulting from the above operations

Note that the guidance specifically raises the issue of compliance with Article 4 of the EC Water

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\(^{39}\) Five search categories: Water quality/pollution; Environmental Permits (IPPC); Environmental Permits (IPC); Radioactive Substances Information; and Environmental Permits (WML).


Framework Directive\textsuperscript{44}, which in the case of groundwater [Article 4(1)(b)] states –

\textit{Member States shall implement the measures necessary to prevent or limit the input of pollutants into groundwater and to prevent the deterioration of the status of all bodies of groundwater, subject to the application of paragraphs 6 and 7 and without prejudice to paragraph 8 of this Article and subject to the application of Article 11(3)(j)}

Note that the text quoted from Box 3(a) of the Agency's regulatory guidance is almost a word-for-word implementation of Article 11(3)(j), which sets basic permitting standards under the Directive.

Further requirements for the protection of groundwater are enacted by the Groundwater Regulation \textsuperscript{1998\textsuperscript{45}}, which implement the EC Groundwater Directive\textsuperscript{46} in UK law. This creates an absolute ban on the discharge of the most toxic, persistent and bioaccumulative “List 1” substances, and requires strict conditions to limit the release of “List 2” substances which have a harmful effect on groundwater. Arguably it is possible, unless steps are taken to prohibit the use of cheaper oil-based drilling muds, and instead opt for more expensive synthetic or water-based muds, that Cuadrilla’s operations have the potential to release at least one “List 1” substance into groundwater (specifically “mineral oils and hydrocarbons”). It’s quite likely, during drilling especially during the fracking process, that a number of the compounds used are likely to appear in “List 2” – for example a number of the metal compounds, biocides, and compounds likely to “deleteriously affect the taste/odour” of groundwater. \textbf{Therefore, irrespective of the scale of these operations, the Environment Agency is under an obligation to impose controls upon this process.}

As a result of interpreting the various sources of law, and the guidance developed from them, I cannot see how the Environment Agency can allow this process to take place. The law requires that a consent be issued in order to control both the effects of the operations on groundwater, and also the use of certain chemicals, hydrocarbon and biocides which might be used as part of the process. In searching for a justification for why a consent might not have been issued I came across a memorandum to the Commons Energy and Climate Change Select Committee, from the Environment Agency, in the Committee's recent report on shale gas \textsuperscript{47} –

\textit{The Environment Agency has assessed the permitting requirements for one exploratory shale gas activity operated by Cuadrilla Resources in North West England. Local Environment Agency staff have assessed the potential impact of Cuadrilla’s operations on the water environment and have decided that, at present, it does not require permitting under the EPR. This is a site specific decision. Our local staff have determined that the activity currently planned does not require a permit because:}

- There is no groundwater in or around the deep shale formation. The formation has a very low permeability and therefore is not considered part of the saturation zone so will not contain “groundwater”, as defined by the Water Framework Directive and EPR.
- There are no vulnerable near-surface aquifers.
- There are no nearby surface water features such as streams, rivers or lakes.

\textit{If Cuadrilla’s operation changes they will need further planning permission and we will review whether it needs a permit under EPR.}

I can find absolutely no justification to support this statement in relation to the Banks site.

Firstly, let’s take the issue of the “saturation zone”. This is defined in Article 2 of the 1980


\textsuperscript{47} Page EV107, Shale Gas, Volume I: Report, together with formal minutes, oral and written evidence, Fifth Report of 2010-2012 Session (HC795), Energy and Climate Change Select Committee, 23\textsuperscript{rd} May 2011 – \url{http://www.publications.parliament.uk/pa/cm201012/cmselect/cmenergy/795/795.pdf}
Groundwater Directive –

‘groundwater’ means all water which is below the surface of the ground in the saturation zone and in direct contact with the ground or subsoil

This is an all-encompassing definition since it includes both saturated soils/rocks, as well as the semi-saturated zone between the surface of the ground and the top water saturated zone/water table. The Bowland Shale is saturated. What this interpretation appears to confuse is the concept of “saturation” and “permeability”. Saturation is the filling of pore spaces or fractures/joints within underground rocks with water. In contrast permeability is a measure of how fast water moves through those strata. Shale is a very low permeability rock type; it can take tens or hundreds of years for water to percolate through a metre of rock. However, that low permeability does not render the rock “unsaturated” – and in any case the Directive definition arguably includes both saturated and unsaturated rocks provided that they are beneath the surface of the ground. What’s more, old shales such as the Bowland Shale are naturally fractured, and hydraulic fracturing is designed to enhance these natural fractures in order to increase the permeability of the rock. Therefore, whilst the shale might at an isolated point have a very low permeability, as a broad unit the permeability will by higher due to the fracturing of the rock. Groundwater movement may be enhanced due to the anisotropic nature of the shale. Whilst it has a low permeability perpendicular to the strata, along the strata the permeability can be much higher, and in combination with fractures this allows the faster movement of groundwater and hence the potential for leakage into surrounding rock strata.

Secondly, let's take the point about aquifers. The Agency's memorandum states that “there are no vulnerable near-surface aquifers”. Yet if we look at the Environment Agency's letter to Lancashire Country Council in response to the application at Banks, we can see that it states –

Groundwater

Deep groundwater in the Carboniferous Age strata may contain significant pollutants such as metals, chlorides and hydrocarbons which have the potential to pollute the Permo-Triassic aquifer above if allowed to discharge into it. There is a licensed groundwater abstraction nearby at Marsh Nurseries therefore it must be ensured that this licensed supply is not interfered with or derogated as a result of the proposed drilling operations...

Again, the justification that there is no aquifer in the area is invalidated by the Agency's own advice to the local planning authority.

Finally, let's take the point that “There are no nearby surface water features such as streams, rivers or lakes.” Once again, the Environment Agency's letter to Lancashire County Council on the planning application at Banks contradicts this when it states –

Aquatic Environment

The site is bounded by ditches and watercourses...

A short distance away there is also the Ribble Estuary – a Special Protection Area under the Habitat Regulations, and which thus requires a much higher standard of protection than that granted to other watercourses.

Finally, we are currently in the transition period between the 1980 Groundwater Directive and the 2006 Groundwater Directive. Whilst it doesn't take full effect until 2013, one of of the transitional

The effect of these transitional provisions is to require the Environment Agency to set a baseline quality level for groundwater, and seek to protect against degradation from that level by human activity. This is of course highly relevant to the fracking issue. As fracking takes place across a region rather than a single point, it has the potential to alter groundwater quality across a wide area. This raises a rather uncomfortable issue for both the unconventional gas industry, and the Governments who support it (primarily Poland and the UK). It’s arguable that the current practices involved with all unconventional gas technologies, not just fracking, are incompatible with the current wording of the law on groundwater protection. Both the French national Government, and the German state of Rhineland Westphalia, have enacted measures to restrict unconventional gas development until its effects can be carefully assessed. Most recently, the Bulgarian Cabinet amended the licence it had previously granted in order to prevent the use of hydraulic fracturing.

In my view the Environment Agency have seriously erred in law by not requiring that Cuadrilla Resources seek an authorisation under the Environmental Permitting Regulations 2010 for their exploratory drilling. Not only does this mean that Cuadrilla are operating unlawfully due to their failure to comply with the EPR. Arguably the Environment Agency may be liable for a review of their decision due to their failure to enact the requirements of the Water Framework Directive and the Groundwater Directive(s).

8. National policy and public consultation

Over the last few years the Department of Energy and Climate Change (DECC), and its predecessor the Department for Business, Enterprise and Regulatory Reform (BERR), have produced a number of reports promoting the development of “unconventional gas” – shale gas, coalbed methane and underground coal gasification. At the same time licences have been issued by DECC and the Coal Authority which permit the these technologies to exploit petroleum or coal reserves. There has, however, been no parallel development of the environmental regulatory system to encompass these new technologies, nor has there been any formal public consultation or debate involving the public on the merits of developing these technologies.

The principal framework of Government energy policy is outlined in the Energy White Paper 2007. With regard to electricity, this was amended (to introduce policies on new nuclear power plant construction) by the Electricity Markets White Paper in 2011. These documents, and their published supporting research, does not propose nor outline the development of unconventional gas production systems within the UK. In fact, there has been no specific nor incidental public consultation on the proposals to develop unconventional gas technologies within the UK’s energy system. This raises certain questions not only about the competency of the regulatory process, but also the democratic process governing these decisions.

As revealed in a recent written reply by Minister of State Charles Hendry to a Parliamentary

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53 Fracking ban, The Sofia Echo, Friday 20th January 2012 – http://www.sofiaecho.com/2012/01/20/1748944_fracking-ban
Government ministers have not actively considered the issues surrounding the regulatory regime for unconventional gas. The Minister stated –

*Neither I nor other DECC Ministers have met with representatives of the Environment Agency to discuss issues relating to hydraulic fracturing. However my officials are involved in a regular dialogue with all of the UK environment agencies, and other key UK regulators, on issues relating to unconventional gas exploration and hydraulic fracturing.*

In November 2011, the Government's Spokesperson in the Lords, Baroness Stowell of Beeston, was less than forthcoming about the safety and regulation of unconventional gas activities to date – and did not outline the failure of the Environment Agency to issue a permit – when in a written response to a Parliamentary Question she stated –

*Shale gas exploration is relatively new to the UK and in its early stages and the department and other key regulatory bodies, including the Health and Safety Executive, the Environment Agency, and the corresponding bodies in Scotland and Northern Ireland, are working closely together to ensure effective monitoring and appropriate control of these activities.*

It's arguable whether there is any "control" over the environmental effects of these activities to date. The licences issued by DECC under the Petroleum Act provide no specific environmental safeguards, certainly not to a standard to meet UK and European environmental law, and other responsible regulatory bodies on the environment have not issued any permits to assess and control such impacts.

As noted earlier in this report, in granting planning permission for Cuadrilla Resources to carry out exploration work, Lancashire County Council's Minerals Planning Authority took no steps to assess the possible environmental impacts of the exploration activities, including the use of hydraulic fracturing. As outlined above, they arguably had the powers to do so under Planning Policy Statement 23. Likewise, the Environment Agency have no formal policy for assessing or licensing proposals for unconventional gas developments. In refusing to issue a permit for the works by Cuadrilla Resources, the Environment Agency have not carried out any public consultation on the development of unconventional gas, or on the impacts of hydraulic fracturing – even though, in my opinion, such a procedure should have been carried out in order to satisfy the requirements of both UK and European law.

*In its totality, the process driving the development of unconventional gas in the UK is a radical departure from existing energy policy, and which has been subject to no formal public scrutiny. There has been no political debate on the policy which has involved an opportunity for the general public to give their views. Whilst the Commons Energy and Climate Change Select Committee have discussed the issues surrounding shale gas, they have done so in arrears to the roll-out of the technology, and the Government's response to that report promises future regulation once the industry has established itself.*

In my view, the legitimate expectations of the public to be consulted, under the procedures established by the Aarhus Convention, have not been fulfilled by any public body with the responsibility to enact consultation on public policy. As a signatory to the Convention, which came into force in UK law in May 2005, under Article 6 both Government departments, the Environment Agency and Lancashire County Council arguably had a responsibility to consult with the public in advance of any new development in relation to unconventional gas technologies. Under Annex I of

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56 Natural Gas: Exploration, Tom Greatrex MP, Column 135W, Hansard, 10th January 2012 – [http://www.publications.parliament.uk/pa/cm201212/cmhansrd/cm120110/text/120110w0005.htm](http://www.publications.parliament.uk/pa/cm201212/cmhansrd/cm120110/text/120110w0005.htm)


the Convention, “exploratory” works do not automatically qualify for consultation. In this case, however, I believe that the exception under paragraph 21 of Annex I, in relation to the potential scale of impacts, is applicable –

The provision of article 6, paragraph 1 (a) of this Convention, does not apply to any of the above projects undertaken exclusively or mainly for research, development and testing of new methods or products for less than two years unless they would be likely to cause a significant adverse effect on environment or health. (my emphasis)

There are various sources of evidence to cite regarding the applicability of the “significance” exception under Annex I of the Convention. For example:

- The concern expressed across the USA in relation to the impacts of unconventional gas development60,61;
- Recent documented environmental impacts from unconventional gas development in other states, such as Australia62,63;
- The confirmation by the US Environmental Protection Agency that hydraulic fracturing was the likely cause of the contamination of public water supplies64; and
- The report from the Directorate General for Internal Policies of the European Parliament on the general regulatory and safety issues related to unconventional gas65

– all suggest that serious consequences could result from the exploratory use of hydraulic fracturing. Arguably the use of this exception is legitimate since even Cuadrilla Resources own consultants have linked the occurrence of earthquakes with the fracturing activities that have taken place to date66.

In the Government’s recent report on compliance with the Convention67, in relation to Article 6 they imply that public participation is guaranteed by virtue of the consultation required for planning and pollution consents to be issued. In fact, as Lancashire County Council failed to take account of the environmental effects, and the Environment Agency did not consult, and as there has been no formal Government consultation on the general policies applied to the development of unconventional gas technologies in the UK, arguably the requirements of Article 6 have not been complied with. Irrespective of the outcomes of the case for which this report has been

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commissioned, it is possible that the public with an interest in this issue may have grounds for complaint to the UNECE against the UK Government, for failure to undertake adequate consultation on the evolution of unconventional gas policy and the safeguards governing that process.

In my view, the public's legitimate expectation for participation granted under Article 6 of the Aarhus Convention, to be consulted over all developments with significant environmental effects, has been procedurally withheld. This arguably renders all such decisions on unconventional gas developments to date illegitimate because they have not been subject to an open and inclusive debate.

68 Guidelines for communications from the public under the Aarhus Convention, UNECE, 2009 – http://www.unece.org/fileadmin/DAM/env/pp/compliance/Pubcom1109.doc
Conclusion

Whether or not shale gas will form part of our future energy supply is a complex issue. In this report I have dealt with the available facts relating to the activities of Cuadrilla Resources at Banks, and elsewhere in Lancashire. That in part relies upon looking at similar developments around the world in order to assess the potential impacts of the activities being carried out by Cuadrilla Resources.

The issue as to the validity of their stated gas discovery, the impact of extracting and supplying that gas to the UK economy, and the amount of gas this might ultimately produce, are open to a wide interpretation and embody a large degree of uncertainty – in part because the information required has not been subject to disclosure and review as part of environmental permitting procedures. Despite this lack of specific data, using my previous experience in examining industrial processes and assessing the regulation of sites under planning and pollution control regimes, it is a simpler process to look at the procedures which should be applied at the Banks site – and whether the law and guidelines have been appropriately applied by the planning authority, the Environment Agency, and ultimately Government ministers.

In compiling this report, the principal question raised has been to the “lawfulness” of the activities of Cuadrilla Resources at the Banks site. In my view, there are grounds to question whether the activities being carried out (and in fact the whole UK policy framework allowing unconventional gas development to take place) were permitted in a lawful manner.

Firstly, and most significantly, in my view the Environment Agency should have controlled these operations, with appropriate standards to protect groundwater and ensure the full disclosure of the materials/chemicals used in the process, under a permit issued under the Environmental Permitting Regulations 2010. This is necessary in order to comply with the requirements of the 1980 Groundwater Directive (control of List 1/List 2 substances), and the transitional requirements of the 2006 Groundwater Directive (protection of groundwater quality). Arguably the Environment Agency should be challenged on their application of the law, and their ability to retroactively control unconventional gas exploration works without the aid of permits.

There is a growing body of evidence that unconventional gas developments have a deleterious impact upon the environment. There are uncertainties associated with such development, and the impacts identified clearly vary from site to site – largely a factor related to the variations in geological conditions. The potential scale of these impacts is such that the Environment Agency should have sought more stringent standards through the use of a permit. Arguably their reasoning for not doing so – identified in their memoranda to the Environment and Climate Change Select Committee – do not apply at the Banks site. In my view, the absence of an appropriate permit to regulate the impacts and protect groundwater renders the activities at Banks unlawful.

The development of unconventional gas raises a more problematic issue for the regulator and for the Government. Can unconventional gas technologies be developed within the current framework of the law on groundwater protection, or do we need to look at certain aspects of these processes in order to be certain that the law can be complied with in its current form? – for example, the potential for hydraulic fracturing to lead to the movement of groundwater pollution outside the target strata. I have not touched upon the effects created by full-scale production as they do not apply in this case, but arguably this would raise further regulatory issues, predominantly in relation to air quality and the ecological impacts of pollution.

Secondly, in the absence of an appropriate control regime which could be applied by the Environment Agency, it is my view that Lancashire County Council's Minerals Planning Authority should have undertaken their own studies in order to demonstrate compliance with both UK and European law. Whether Lancashire County Council have erred in their duty is a matter of legal interpretation, and in any case the normal time limits for a formal review of the planning decisions in this case have expired. Despite this, I believe that it is a valid complaint to make with respect to
the manner in which the planning application for the Banks site was dealt with. More importantly, whilst for the issue of planning control the relevant time limits for review may have expired, the other legal requirements which the local planning authority should have investigated – principally the issue of groundwater protection – are still material to the lawfulness of the activities on the site.

Finally, it is my view that the public's rights to be consulted over developments which pose a threat to the environment, established under Article 6 of the Aarhus Convention, has been procedurally withheld – both in the case of developments by Cuadrilla Resources in Lancashire, and nationally due to the failure to consult on the general policies for and regulation of unconventional gas development/exploitation. In relation the Banks site, whilst there is an exemption for exploratory works under Annex I of the Convention, the conditional test on the material impacts of the development is relevant in this case. The scale of impacts associated with unconventional gas developments elsewhere demonstrates this. The fragmented nature of the regulation of planning and pollution control means that certain developments can all too easily fail to receive the appropriate scrutiny in order to satisfy the concerns of the public – and this is an exemplar of such a case.

Whilst arguably the public participation of those with an interest in Lancashire has been withheld in this case, at the national level it's also possible to argue that the unconventional gas issue has not been subject to sufficient public scrutiny – both to assess its impacts, and also to balance those impacts with the wider trends in the energy system identified at the beginning of the report, and the impacts that our demands for energy have upon the environment. There has been no public policy review of unconventional gas, and its potential role in meeting our energy needs. Whilst the failure of national policy has far more relevance to a complaint regarding the application of Article 6 of the Aarhus Convention, by that same reasoning this national policy failure also impacts upon the validity of local decisions. In turn, the problems of assessing and regulating the impacts of this development through the local planning and pollution control systems are symptomatic of the failure of national policy.

In conclusion, there are various grounds upon which complaints could be legitimately made:

- About the activities being carried out by Cuadrilla Resources in Lancashire;
- About the conduct of both the Minerals Planning Authority and the Environment Agency in identifying the potential impacts of shale gas developments in Lancashire;
- About the conduct of the Environment Agency in their interpretation of the law and guidance on groundwater activities, and their resulting failure to demand/issue a permit for the operations at the Banks site; and ultimately,
- On the failure of national policy, and the discharge of the legal obligations upon Government ministers to protect the environment and consult the public on the substance of those policies.

I believe that all these factors cast doubt upon the lawfulness of the activities of Cuadrilla Resources' exploratory drilling at Banks.