

Response to IGas' exploratory drilling proposal for Misson Springs (ES/3379)

from Frack Free Notts

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Frack Free Notts objects to the proposal for exploratory and appraisal drilling for the following reasons.

IGas

- 1) IGas is a company which has been criticised in the recent past for over-reliance on debt financing. (Though it has parted company with its previous CEO Andrew Austin most associated with that strategy, it still has a problem of paying debt interest.) Its revenues have also been reduced by the fall in global oil prices and it has been operating at a loss. There are questions whether it can sustain such losses for the several years that it would take to move to commercial production of shale gas, even on IGas' most optimistic scenario. This is reflected in a steady collapse of IGas' share price from a peak of nearly 150p in January 2014 to less than 20p in December 2015.
- 2) It appears that IGas has minimal experience of extracting shale gas at depth using high volume hydraulic fracturing technology in the UK. None of the gas-only sites listed on its website have made progress beyond exploratory drilling and all of the long established ones are for oil extraction which requires a relatively shallow drill and is far less environmentally disruptive.
- 3) While shale gas exploration led by IGas in North East Bassetlaw (PEDLs 139&140) is being funded in part by Total (a French oil and gas company) it is unlikely that Total will be taking legal or financial responsibility if anything goes wrong. Given the questions over IGas' financial integrity, it cannot be assumed that the company would be able to meet the cost of any unforeseen damages. Although there is provision in the National Planning Policy Framework for requiring a bond to be paid up front in such exceptional circumstances (NPPF, para 144), it may be more appropriate to avoid the risk by rejecting the application.
- 4) Experience of exploratory drilling by Dart Energy (now owned by IGas) at Daneshill in 2014 demonstrated a cavalier attitude by the company to planning conditions, with a number of breaches observed by local people. In that case the company even started moving HGVs on to the site before constructing the required access road. It should not therefore be assumed that IGas' operations can be adequately controlled by means of planning conditions.

Geology

- 5) The objection submitted by Professor David Smythe on grounds of geology and hydrogeology identifies a number of serious errors, omissions and misleading statements in IGas' application relating to geological interpretation. This demonstrates a serious lack of competence on the part of IGas, making it impossible for the planning authority to properly understand the under land aspects of the proposed development. As

Professor Smythe suggests, it would be rational to reject the application on these grounds alone.

Economic Costs and Benefits

- 6) IGas argues that ‘the longer term potential benefits’ of possible future production of shale gas should be given material weight even though it is acknowledged that the ‘economic benefits’ associated with the current application are small.
- 7) We argue that the net long term economic benefits of industrialising the rural areas of North East Bassetlaw will be negative. The net short term benefits of approving exploratory drilling will also be negative as a result of blight. Who would want to buy a home or set up a business in an area licensed for fracking? On economic grounds alone the application should be rejected. (See Appendix 2 for a longer discussion of this.)
- 8) The draft Defra report ‘Shale Gas: Rural Economy Impacts Paper’ concludes that fracking “may reduce the number of visitors and tourists in the rural area, with an associated reduction in spend in the local tourism economy.” And “Shale gas may transform a previously pristine and quiet natural region, bringing increased industrialisation.” This possible transformation from a relatively quiet rural area into an industrialised and polluted one is a factor that could cause a significant reduction in property values. The Draft DEFRA Impacts Paper indicates that “House prices in close proximity to the drilling operations are likely to fall. There could be a 7% reduction in property values within one mile of an extraction site”. We believe that the blighting effect of this proposal will be more far-reaching because there is a real prospect of further, more intensive activity in the area, with consequential loss of residential amenity, as long as exploratory drilling continues.

Ecology

- 9) The proposed site is very close to Misson Carr SSSI (also known as Misson Training Ground SSSI) and also to a number of drains which are designated as Local Wildlife Sites. It is also fairly close to Misson Line Bank SSSI, Idle Washlands SSSI and Hatfield Moor SAC.
- 10) The nearby SSSIs and LWSs are particularly dependent on water level as well as volume and quality of water. They are supplied by both surface water and groundwater. Nottinghamshire Wildlife Trust, which manages Misson Carr SSSI, alleges that IGas failed to consult the Water Level Management Plan for the SSSI or to conduct a site visit by a water quality or flood risk specialist. It should be noted that the water level of Misson Carr SSSI has been raised at significant expense in order to protect the ecological function of the site.
- 11) IGas’ explanation of site selection shows that they considered quality of agricultural land and flood risk (and chose a site with higher flood risk). But they did not appear to consider the proximity of wildlife sites. Nor have they considered the potential for their proposed drilling activities to reduce the

water level in surrounding drains and Misson Carr SSSI.

- 12) Notts Wildlife Trust is concerned that rain falling on the proposed drilling site will, as a result of contamination, be collected and disposed of elsewhere – thus reducing flows to the surrounding drains and SSSI. IGas has failed to recognise the high sensitivity of these sites and to assess the impact of reduced run-off or to assess the dependence of the SSSI on groundwater through ‘superficial deposits’ – though IGas does recognise the possibility of spillages polluting these superficial deposits, it doesn’t recognise the significance of these for wildlife sites.
- 13) IGas has also failed to consider how, in the event of flooding which overtops the River Idle flood defences, contaminated water and other potentially toxic materials will be prevented from being washed off the site into surrounding ecologically sensitive areas.
- 14) IGas acknowledges that oxides of nitrogen could contribute more than 1% of the prescribed 24 hour limit for the three SSSIs and Hatfield Moor SAC, and in the case of Misson Carr SSSI add to critical load levels which are already exceeded. Given that Misson Carr SSSI and nearby drainage channels are already stressed in this sense, such an additional load is unacceptable.
- 15) Toxic air pollution from diesel vehicles, generators, compressors, etc and from venting or flaring waste gases will also affect the nearby wildlife sites. IGas has not provided an adequate assessment of the impact on ecologically sensitive areas.
- 16) Other issues which IGas has failed to properly consider include:
 - the impact of changes to water level in Misson Carr SSSI on great crested newts;
 - impact of water level and water quality in drains on water voles;
 - impact of noise (which could be greater than +15dBA) on breeding birds, bats, etc;
 - impact of light on bats, owls, etc;
 - impact of dust, if dust suppression systems prove to be inadequate.
- 17) We agree with Notts Wildlife Trust that the lack of information provided by IGas means that the proposal is not compliant with provisions in the NPPF, particularly para 118: “proposed development on land within or outside a Site of Special Scientific Interest likely to have an adverse effect on a Site of Special Scientific Interest (either individually or in combination with other developments) should not normally be permitted”. And it is not compliant with a number of Minerals Local Plan Policies including M3.7 (Dust and Air Quality), M3.8 (Water Environment), M3.17 (Biodiversity), M3.19 (SSSIs) and M3.20 (Local Designated Sites).

Traffic

- 18) We note that the total number of vehicle movements declared by IGas has increased by some 2,000 since the release of the initial IGas scoping report earlier in 2015. Thus some 19, 000 movements are now expected over the

lifetime of the site, of which 11,500 will be light vehicles.

- 19) We suspect that some of the figures given in the Planning Statement and Transport Assessment may still be underestimates. In particular, modelling which suggests that the increase in volume of vehicles along Springs Road will be only approx. 10% should be questioned.
- 20) We object to the overall volume of traffic that the proposed drilling will generate along roads designed for lesser loads. It would lead to an unacceptable deterioration of road safety and road surface condition as well as associated environmental impacts.
- 21) As well as increased noise levels, this type of traffic can lead to greater air pollution from dust and traffic fumes, from vibration affecting homes, farms and public buildings, and from damage to verges and pavements. There will also be a greater risk of traffic accidents for children, pedestrians, cyclists and horse riders, as well as a risk to other motor traffic being forced off the road into roadside ditches. Promised monitoring will do nothing to prevent these problems.
- 22) HGV movements are estimated at 336 per week during site construction and restoration stages. This should be considered unacceptable without widening Springs Road, the rail crossing, the B1396, and junctions upto the A614. Given that such widening would in itself represent an unacceptable industrialisation of a rural environment the proposal should be rejected on traffic grounds.
- 23) In addition, light vehicle movements are estimated at 280 per week during the drilling phase. Assuming that it will be impossible to prevent some of these movements going through Misson, Newington and Austerfield they will add to the cumulative impact on the local road network including existing and future movements from sand and gravel quarries. This should be considered unacceptable.

Landscape and Visual Impacts

- 24) We note that the proposed height of the drilling rig has been increased by some 13m to 57m since the Scoping Report, significantly increasing its prominence from distance.
- 25) IGas claims that the 'zone of theoretical visibility' can be ignored outside a 5km boundary. In fact the illuminated rig will be visible as far away as Thorne, Epworth, Messingham, Gainsborough, Retford and Bawtry. More significantly, Misterton, Walkeringham, Gringley on the Hill, Everton, Scrooby, Austerfield and Wroot have all been excluded from this zone. Yet all of these nearby villages will find their views across the Idle valley dominated by the rig as one of the most significant landscape features. IGas should be required to produce a ZTV analysis which recognises this significance.
- 26) For all of these surrounding villages, views of the rig will be a constant reminder that the whole area is threatened with a potential proliferation of

fracking rigs. This will be amplified at night by the illumination of the rig and at certain times by the ability to hear drilling activities. That will add to the problem of blight which will depress house prices and business development in the area. It will have a significant negative impact on economic development in the wider area.

- 27) We also object to the rig being located in direct line of sight between Grade 1 listed churches at Misterton and Finningley, and close to the line of sight between churches at Misson and Wroot.
- 28) IGas claims that light escaping from the site will be no greater than the effect of a full moon with a clear sky at the nearby SSSI. While an occasional full moon may not be a problem, constant brightness during what would normally be darkness will be highly disruptive for many species in the surrounding countryside. As noted above (under Ecology), this is contrary to guidance in the NPPF and contrary to Minerals Local Plan policies. It should not be permitted.

Noise

- 29) Noise levels from the site will be at their highest during the construction and rig mobilization phases and may carry across the local area for several miles in all directions, with disturbance felt in neighbouring villages and farms. The site is within 4km of Misson, Finningley and Westwoodside, thus adversely affecting people and businesses in three counties.
- 30) If well site construction and restoration takes place from 07.00 to 19.00 on weekdays and till 13.00 on Saturdays, this will create considerable disturbance in a quiet part of the countryside, even if acoustic screening is in place.
- 31) Drilling operations are proposed to take place continuously over 24 hrs. As well as continuous noise, this could also cause vibration felt over many miles and possible seismic activity where faults are located.
- 32) As noted above (under Ecology), projected noise levels at Misson Carr SSSI will be unacceptable at times.
- 33) Noise from 7,500 HGV movements is described by IGas as 'barely perceptible', which is unlikely to be the experience along the route. Noise from 11,500 light vehicle movements appears to have been ignored in this analysis even though many of these could be going through Misson and Newington. As stated above (under Traffic), we object to the additional traffic movements for a number of reasons, including noise, on an unclassified village road.

Air pollution

- 34) Sources of air pollution will include vehicle movements, particularly the 7,500 HGVs, a large 125kW diesel generator, smaller rig generators and the venting/flaring of waste gases. This will lead to unavoidable increases in NO_x, particulates, volatile organic compounds (some carcinogenic and/or

mutagenic) and dust across the site and beyond. This will be of most concern for the health and safety of workers on site and for species in the surrounding area including Misson Carr SSSI.

- 35) As noted above (under Ecology), IGas has failed to adequately assess the impact of potential air pollution and dust on the SSSI. It has however acknowledged that it will cause a significant increase in NO_x and acid deposition on the SSSI which will add to critical load levels already exceeded. That is unacceptable and should not be permitted.
- 36) It should be noted that the exploratory and appraisal activities proposed by IGas currently will cause a lot less air pollution than if hydraulic fracturing moves to a production phase. (See Appendix 3 for a summary of some of the evidence emerging of problems associated with 'gas field haze', carcinogenic hydrocarbons, silicon dust, 'fugitive methane', etc, associated with unconventional hydrocarbons.)

Water pollution

- 37) Water contamination could occur through surface spillages or through well casing and cement seal failures. Most cement seals fail eventually and around 6% within a year, allowing migration of contaminants vertically, potentially polluting groundwater and aquifers.
- 38) Surface water and groundwater near the surface migrates West to East taking any pollution towards Misson Carr SSSI and associated drains. As noted above (under Ecology), IGas has failed to adequately assess the potential for polluting water in the SSSI and also for reducing water levels.
- 39) The site is close to the edge of an aquifer used for drinking water supplies (Source Protection Zone 3). It will also require drilling through a principal aquifer. As noted above (under Geology) Professor David Smythe has pointed out that IGas has failed to identify important aquifers and other geological features including fault lines.
- 40) The Water Framework Directive requires a precautionary approach to protect groundwater from a contamination.
- 41) IGas' proposal is for two boreholes, one vertical and one horizontal. The second borehole should be considered as 'appraisal'. As it may include pressure testing ('mini-frack') there may be a significant amount of flowback water containing contaminants including radioactive material, heavy metals and carcinogenic hydrocarbons such as BTEX (benzene, toluene, ethylbenzene, xylene), and a potential for such materials to migrate along fault lines underground (as Professor Smythe explains). Because of the failure of IGas to properly assess the geology, the precautionary principle means that this proposal should be rejected.
- 42) In the case of a flood event in the River Idle over-topping the flood defences, the site would cause widespread pollution over surrounding farmland and wildlife sites.

- 43) It should be noted that the exploratory and appraisal activities proposed by IGas currently will cause a lot less water pollution than if hydraulic fracturing moves to a production phase. (See Appendix 3 for a summary of some of the evidence emerging of problems associated with unconventional hydrocarbons.) Full scale fracking would also require substantial quantities of water – in an area where over-abstraction means that no further abstraction licences will be available. So water will have to be tankered in or piped in at considerable environmental cost.

Climate Change

- 44) Development plans are required to include policies to “contribute to the mitigation of, and adaptation to, climate change” (Planning Act 2008, s182, reflected in NPPF para 93 and Policy SP4 of the emerging Notts Minerals Local Plan).
- 45) Evidence suggests that shale gas production typically results in methane leakage of around 6% while any leakage above 3% makes shale gas worse than burning coal in respect of greenhouse gas emissions. (See Appendix 3.) Therefore, with current fracking technology, shale gas production should be considered incompatible with the legal requirement to reduce greenhouse gas emissions, and with a policy emphasis on a decarbonised UK energy mix. And exploration and appraisal of unconventional hydrocarbon potential should be considered unnecessary and harmful. IGas’ proposal should be rejected because it does not conform with national planning law and policy on climate change.

Public Health

- 46) The most comprehensive analysis of public health implications of fracking is the Compendium produced by Concerned Health Professionals of New York (see Appendix 3). This reviews a wide range of peer-reviewed studies demonstrating a wide range of health problems associated with unconventional hydrocarbons.
- 47) While IGas’ proposal is not for actual shale gas production, and will therefore not in itself cause the scale of problems documented in parts of the US, this evidence will add to the anxiety of people in the surrounding area adding to the problem of blight as well as health problems associated with anxiety. The proposal should be rejected on public health grounds.

Cumulative Effects

- 48) Cumulative impacts will arise particularly from traffic associated with sand and gravel quarries, two South of Misson and one near Misson Springs, with a probability of extended workings if current applications are approved at Newington and East of Finningley. In addition, Misson already suffers noxious odour emissions from a mushroom substrate factory (TunnelTech) and noise nuisance from Robin Hood Airport. As Misson Parish Council says: “The addition of another major controversial industry within the parish will only compound residents stress, anxiety & ill health”.

- 49) There is thus a strong case for demonstrating that the sum total of these impacts, likely to be experienced concurrently with minimum mitigation, are unacceptable to both the environment and the amenity of the local community. Consequently the application should be refused for its lack of conformity with adopted Minerals Plan Policy M3.27 and Draft Policy DM8 of the emerging plan.

Appendix 1: Frack Free Notts

Frack Free Notts is a campaign group of individuals who came together in Nov 2013 with a shared concern about the potential UK practice of hydraulic fracturing of shale rocks (or coal measures) deep underground to extract methane gas. At that stage they were aware that PEDL licences had already been issued for parts of the county and that exploratory drilling was about to get underway at Daneshill, nr Lound.

FFN has engaged with the County Council on the absence of a separate policy in its draft Minerals Plan that recognises the scale and complexity of fracking activity as distinct from the extraction of other hydrocarbons, but to date this has been met with a negative response.

FFN has followed with some alarm the Government's promotion of the industry through favourable policy and the promise of incentives to local authorities and affected communities. This approach has tended to disregard the growing documented evidence of its adverse environmental, economic, social and health impacts from experience in USA and Australia.

The Group operates primarily by providing research and awareness raising support to communities on the frontline of fracking proposals in north Bassetlaw and South Yorkshire. It also prompts debate in Greater Nottingham by organising speakers and public protest activities to attract media involvement. Most Group members are familiar with the Misson area and echo the sense of intrusion felt by its residents in the face of the fracking industry.

FFN maintains that exploratory drilling for shale gas at Misson is a key step along the way to a full-scale fracking operation in the north of the county. As such and in its own right, it will be highly detrimental to the Misson area of Bassetlaw and further afield outside of the county, giving rise to unacceptable impacts upon the local environment and residential amenity. Furthermore, it will undermine the Govt's attempt to reduce the UK's dependence upon fossil fuels in line with its policy on combatting climate change.

Appendix 2: The Economic Costs of Fracking in North Notts

The IGas application argues that

"The economic benefits associated with this planning application are small scale. The economic and social benefits that could arise with the production of shale gas could be significant....This Planning Application provides the platform for enabling further development that could realise significant economic benefits. It is our contention that the longer term potential benefits are given material weight in the planning balance in the determination of this Planning Application."

Our objection argues that the opposite is more true. Granting this planning objection would be a form of negative economic development. This is because assessment of economic benefits without including costs is false accounting. Some forms of economic development have greater harms (environmental and social costs) than benefits and we believe the harms would be greater than the benefits in this case. Such economically destructive developments are more accurately described as uneconomic growth/development. Uneconomic development is taking one backwards in economic terms. Thus if the planning priority is to favour economic development there is a strong ground for rejecting the application.

The experience of Queensland in Australia provides strong evidence that unconventional gasfield development is economically destructive. The Australia Institute published a study in November 2015 which shows that local business there reported a deterioration in: financial capital; local infrastructure; local skills; social cohesion and the local environment. Unconventional gas creates few additional jobs and there were virtually no spill over jobs created in local retail or manufacturing while gas jobs will be slashed by 80% at the end of the construction period. For every 10 unconventional gas jobs created, 7 service sector jobs were lost.

When regional towns become service centers for the gas industry, existing businesses often lose their skilled staff, have to compete with inflated gas industry wages and face higher costs for rent and services.

Mark Ogge, **Be Careful what you wish for**. The economic impacts of Queensland's unconventional gas experiment and the implications for Northern Territory policy makers. Published by the Australia Institute, November 2015
<http://www.tai.org.au/downloadpopup/nojs/11923>

In the UK we can expect falling house prices represents a degradation of the residential amenity value of particular locations - which reduces welfare in direct and monetary terms. The relevant magnitudes are indicated by a redacted DEFRA report which, when released, suggested that houses within one mile of a gas well may reduce in value by 7%. Given that there are about 32 houses in Misson Springs near the exploratory well valued at perhaps £200,000 each this would decrease their combined value by £448,000, nearly half a million pounds. Further to this if a gas field were developed in the wider district the capital value of 290 houses in Misson Springs, Misson and Newington might fall by over £4million in combined value. (The calculations assume average house prices in

the Misson area of £200,000 each - if they are more then the loss in value would be even more). This would be very damaging for the local economy.

Nor are housing costs the only costs to be taken into account. For example researchers at the Rand Corporation in the USA determined that each shale well in Pennsylvania caused between \$5400 and \$10,000 damage to state roads. If a gas field of 100 wells in North Notts generated equivalent costs there would probably be the sterling equivalent of \$1 million (£660,000) to be found from somewhere on road repairs.

Cusick, M. (2014, March 27). Report finds each Marcellus gas well costs thousands in road damage. StateImpact. Retrieved from <http://stateimpact.npr.org/pennsylvania/2014/03/27/report-finds-each-marcellus-gas-well-costs-thousands-in-road-damage/>

Abramzon, S., Samaras, C., Curtright, A., Litovitz, A., & Burger, N. (2014). Estimating the consumptive use costs of shale natural gas extraction on Pennsylvania roadways. Journal of Infrastructure Systems. Retrieved from <http://ascelibrary.org/doi/abs/10.1061/%28ASCE%29IS.1943-555X.0000203>

Healthcare costs should also be accounted for. An example of costs is revealed in a recent University of Pennsylvania and Columbia University study which shows a direct correlation between proximity to gas wells and rates of hospitalisation for particular conditions. Cardiology inpatient prevalence rates were significantly associated with number of wells per zip code and their density, while neurology inpatient prevalence rates were significantly associated with density of wells. The researchers comment that "Our study...supports the concept that health care utilization should be factored into the value (costs and benefits) of hydraulic fracturing over time." They also comment "With an inpatient stay costing on average \$30K, this poses a significant economic health burden to the Commonwealth of Pennsylvania."

Jemielita T., Gerton G. L., Neidell M., Chillrud S., Yan B., Stute M., ... Panettieri, Jr., R. A. (2015), Unconventional gas and oil drilling is associated with increased hospital utilization rates. PLoS ONE 10, e0131093. doi: 10.1371/journal.pone.0131093

There would be further losses too imposed on local agriculture. The risk to agriculture from a single exploratory well may be low but is definitely real because exploratory wells can fail and leak plus there is the additional possibility of accidents and spills at the surface. If, as IGas claims, this application should be regarded as a "platform" for subsequent development then it is also the "platform" for the near certainty that if a gas field develops there will be contamination incidents. With a hundred wells when the rate for contamination incidents is for about about 7-9% of wells per annum (as in Pennsylvania) there would likely be 7 to 9 local incidents per annum. Given the track record of technical failures in the UK so far there is no reason to believe that the situation here would be any better than in the USA.

<http://www2.epa.gov/sites/production/files/documents/ingraffea.pdf>

<http://drillordrop.com/2015/05/05/investigation-finds-multiple-planning-breaches-and-technical-problems-at-cuadrillas-drilling-sites/>

To a degree local farmers and landowners also supplement their income with receipts from low level agro-tourism. Day trippers seeking a cup of tea, ramblers, people fishing, cycling and horse riding, people making visits to wildlife centres, nature facilities and animal parks, are part of the local economy. It is likely that all of these activities will be hit by a gas field - or even just the possibility of one represented by an exploratory well. Farmers could also be hit where consumers become suspicious of crops grown in areas that have become contaminated. An economic strategy based on local food, farmers markets and farm shops like those in Worksop and Retford and promoted by Notts Nosh, would be undermined if Bassetlaw and North Notts gets a reputation as an area industrialised by natural gas installations. The experience of the USA backs this up - there are now books on the dangers to agriculture and to the soil as well as press reports there.

Bamberger, M. & Oswald, R. (2014). *The real cost of fracking: How America's shale gas boom is threatening our families, pets, and food*. Boston: Beacon Press.

Royte, E. (2012, November 28). *Fracking our food supply*. The Nation. Retrieved from <http://www.thenation.com/article/171504/fracking-our-food-supply>

What this application will do, and has indeed already begun to do, is to blight the development of the area. The point here is that it will be difficult to combine unconventional gas development and other uses for the landscape, residential and economic. If the shale gas industry is given the go ahead it will override other landscape users and uses to their detriment. Other local businesses and households will put off their plans, including improvements and intentions to buy and sell property, until such time as it is clear what will happen. A recent case has already shown that this is happening - an offer for the purchase of a house being withdrawn when the would be purchases found out about the scoping request for an eventual planning application in the area near Barnby Moor. The blight on development caused by the gas fracking industry has already begun.

Nor can it be guaranteed that the industry will ever be made to pay up for the blight and the damage to the local economy and wellbeing that it causes. The current situation in North America is that the shale oil and gas industry is loss making and has been for several years. The immediate prospect is for considerable number of companies that have funded themselves on speculative loans from the finance sector when loan finance has been cheap and abundant because of quantitative easing, is that they will have to file for bankruptcy.

<http://www.wsj.com/articles/fracking-firms-that-drove-oil-boom-struggle-to-survive-1443053791>

If this were also the experience in the UK then local communities would be left paying the costs of the clean up after the exploration and production companies have gone bust. This is what has happened in Alberta in Canada where falling oil and gas prices have prompted smaller companies to abandon their operations leaving the provincial government to close down and dismantle their wells. In the past year alone the number of orphaned wells in Alberta increased from 162 to 702. At the current rates deconstructing wells abandoned in the past year will be a 20 year task.

Johnson, T. (2015, May 11). *Alberta sees huge spike in abandoned oil and gas wells*. CBC News.

Retrieved from <http://www.cbc.ca/news/canada/calgary/alberta-sees-huge-spike-in-abandoned-oil-and-gas-wells-1.3032434>

The prospect of something like this happening in Nottinghamshire should not be ruled out, indeed it is quite likely, if oil and gas prices stay low for some time as is also likely. Despite IGas making a bid for multiple exploration sites it made a £19.3 million loss last year and its share price fell to 17.25p. The model favoured by the oil and gas sector is that big players like Total will pay for the exploration and development by smaller players like IGas. However, if IGas goes bust the losses and costs of clean up will not be carried by Total and other big players - these will fall to the public purse.

Appendix 3: Summary of general literature available on unconventional hydrocarbons and the experience of fracking

There is now a growing volume of academic peer reviewed research on the health, environmental, social and economic impacts on fracking which is mainly, though not exclusively, drawn from US and Australian experience. In 2014 at least 192 peer reviewed articles were published and in the first 6 months of 2015 103 studies. (Concerned Health Professionals of New York Compendium 3rd Edition October 14th 2015 p 3) The scientific research material has therefore mostly been produced *after* the reports commonly cited by the British government for purposes of public reassurance like that of the Royal Academy of Engineering/Royal Society and a study by Public Health England. Since most of this more recent literature demonstrates potential and actual cases of harm there is a clear case that government policy is out of date. For this reason a brief overview of more recent literature is given here.

Water contamination

Risks of local ground and surface water contamination through well casing and cement seal failures as well as from surface water accidents with spills from pipelines, during transport and due to inadequate cleaning and disposal of 'produced water'. There is a huge academic literature about the going rate of well failures and accidents that occur whether there is regulation or not – e.g. Between 2009 and 2010, of 4,000 Pennsylvania shale wells, there were 630 reported environmental health and safety violations of which half were associated with leaks and spills of the flow-back fluids." (About 8% of the wells). (Chen, Al-Wadei, Kennedy, & Terry, 2014) (Dusseault, Gray, & Nawrocki, 2000) (Ingraffea, 2013) (Davies et al 2014)

Water contamination may take place from methane and other gases released by drilling and fracking, from fracking chemicals added to the frack water (including those that are claimed to be safe like biocides), as well as from the toxins and radioactivity released from deep strata (so called Naturally Occurring Radioactive Materials, NORM, are "natural" deep underground, not natural at the surface!). Previous experience shows that chemicals brought to the surface could include heavy metals including uranium and also BTEX – Benzene, Toluene, Ethyl-Benzene and Xylene – all of which are highly toxic and carcinogenic. (Osbourne 2011) (Kassotis, Tilitt, Davis, Hormann, & Nagel, 2013) (Conoco-Phillips Canada Resources Corporation, March 2013) (BC Oil and Gas Commission, 2013) (Chen, Al-Wadei, Kennedy, & Terry, 2014)

In addition to the contamination of water the volume of water required for fracking is another concern. 3 to 5 Olympic swimming pools per frack is claimed not to be very much – but it should be remembered that IGas have speculated about an eventual gas field with perhaps 100 wells. This would become a serious competitor for agricultural and residential water uses in particular areas. In parts of North Nottinghamshire water is already over extracted.

Seismic risks

Seismic activity, subsidence and interaction with existing mine workings. It is claimed by the industry that seismic activity would be barely noticeable and is unlikely to seriously damage buildings. Yet there was minor structural damage in Lancashire and, even more seriously, the earthquake caused by fracking near Blackpool distorted ("ovalised") the well casing and could have

fractured it. It is this capacity to damage the wells themselves (and other infrastructure) and thus release contaminants that is of greatest concern. (Hill, 2013) There are questions too about some structures like high speed rail lines.

A crucial question is that of eventual disposal of the water used in fracking. The locations and means for disposal for contaminated water associated with Nottinghamshire wells has not been clarified. One way of disposing of “produced water” is to re-inject it into the ground. This “slick water”, containing chemicals to reduce resistance when the water is forced at pressure down the pipes during fracking, has been shown to have the potential to lubricate underground fault lines and has been identified as the cause of hundreds of earthquakes in Oklahoma, Ohio, Arkansas, Texas and Colorado. One earthquake was as high as 5.7 on the Richter scale. (Oskin, 2014). (McNamara et al 2015) The rate of earthquake occurrence is now 600 times higher than before the onset of injection of fracking water and the strength of the earthquakes is increasing. Even were injection to stop seismicity would continue. Furthermore the unpredictable time delays between fracking and/or injection of waste water and later seismic events throws doubt on how fail-safe regulatory systems such as so called “traffic light” arrangements will actually be (The “traffic light” policies work by pausing fracking pending further investigations should earthquakes occur).

Interaction of gas industry extraction with legacy coal working is also a major concern – places like Ollerton already have a high level of seismic activity because of old mine workings already. “ (BBC 2014)

Air quality

Reduction in local air quality take the form of “gas field haze” which has negative respiratory and neurological health effects. (Gruver, 2011). Atmospheric pollution arises from the exhaust of diesel pumps, drilling machinery, flaring, pressure release venting of the gas, plus exhaust from the operation of a large volume of transport. Experience in Colorado shows residents exposed to trimethylbenzenes, aliphatic hydrocarbons, and xylenes, to ozone and other air pollutants like particulates from diesel engines and from silica dust from the sand which is added to the fracking fluid. (University of Colorado, 2012) (Kovats et al. 2014) Ozone is not only a risk to local public health but is known to reduce the yield of many agricultural crops. Another problem is that of radon with indoor levels of radon in Pennsylvania higher in areas of fracking and NORM becoming an issue of concern for environmental health experts. A Johns Hopkins Bloomberg School of Public Health study found that levels of radon in Pennsylvania homes—a region with some of the highest indoor radon concentrations in the US—have been rising since 2004, around the time the fracking industry arrived in the state. (Casey, J.A. Et al 2015) (Tait, Santos, & Maher, 2013) (Thompson, 2012) (Tait D. R., Santos, Maher, Cyrnonak, & Davis, 2013)

A report by the US National Institute of Occupational Health and Safety (NIOSH) found that many workers in unconventional oil and gas are exposed to high levels of carcinogenic hydrocarbons including benzene and to silicosis from fracking sand dust (Esswein et al, 2014)

Researchers at the Colorado School of Public Health have found increased congenital heart defects in babies born to mothers living within a mile of fracking

sites, though further research is needed to find the reasons for this. (McKenzie et al, 2014)

“Fugitive methane” emissions also give rise to fire and explosion risks from failed wells, from fractures and faults in the ground at some distance from well heads, from leaking and vented installations, holding tanks, containers, pipelines and from tanker accidents. In the USA and Canada there have been many examples of explosions and fires at wells, in compressor stations and during transport . This even includes several cases of exploding trains. One derailment in Quebec killed 47 people. Accidents involving ruptures and leaks of equipment are common, as are heavy truck crashes. The fatality rate among oil and gas workers in the United States is more than 8 times the all-industry fatality rate.(Lohan,2014)

Public Health

The academic peer reviewed studies on these many dangers are now not only about potential hazards but consists of studies showing actually increased rates of hospitalisation, self reported respiratory problems and rashes, motor vehicle fatalities, trauma, drug abuse and low birthweight among infants. (Concerned Health Professionals of New York Compendium 3rd Edition October 14th 2015 p 10). Studies show a correlation between increasing hospital admission rates for a variety of health disorders and residential proximity to wells. There is no comparable increase in areas where fracking is not occurring. (Jemielita T et al 2015)

Land take

Well development, both at the exploratory phase and especially later, is likely to involve a *considerable land area take*. It is claimed that because well heads have multiple wells radiating from them underground that the surface land-take is low – but the claim is deceptive when one also takes into account the need to include access roads, pipelines and other installations for cleaning and compression. Pipelines in a Dart planning application in Scotland involved a land take 4.5 times those of the wellpads. (Mobbs. P 2014) Pipelines disrupt footpaths, transport routes and directions of drainage. They involve taking out soil and vegetation and for a wide area around them are likely to disrupt work and communications for people, farm animals not to mention habitats for wildlife. Because shale gas wells deplete very fast and are exhausted within 2 or 3 years at the most, new ones must be sunk and attached to new infrastructure to maintain production – moving across large areas of countryside. (Hughes 2014)

Industrialisation of countryside and destruction of residential amenity values

These kind of gas developments are incompatible with current economic and residential uses of land and inappropriate to small local road infrastructures. Experience in the USA and Australia suggests that farming as well as the supplementary income earned by farmers and others in rural leisure activities would be disrupted and can be made permanently unviable. The competition for water has already been mentioned. In addition consumers would likely be suspicious of produce from areas which might be contaminated. Biodiversity and the beauty and character of the countryside would be damaged and life quality in adjacent residential areas degraded. Experience in the UK

already shows that gas field development is likely to be reflected in falling house prices as people will not want to move into fracked areas but will want to move out. (Insley, 2012) A heavily redacted DEFRA report released under the Freedom of Information Act confirms this view suggesting that property prices could fall by 7% one mile from fracking wells. Vaughan A and Mason R The Guardian 1st July 2015) A gas field across the countryside in the Misson area would very likely reduce the wealth of residents by several thousands pounds per person as a result of falling house prices and blight other forms of development.

The industrialisation of the countryside would also be evident in a high level of surface activity – since the aim of the exercise, where gas is found, is to penetrate a large underground area, a lot of equipment, materials and water would have to be fetched, carried and pumped at the surface. There would be high levels of noise and light pollution from pumps, drilling and other activity during the operational phase. Planning controls to restrict activity to daylight hours only would likely make gas extraction (even more) uneconomic and there would be intense commercial pressure to allow 24 hour operation. There will also be considerable heavy vehicle traffic on narrow rural roads – carrying rigs and equipment, pipes as well as tankers bringing water and chemicals for fracking and taking away “produced water”. According to gas industry engineer Mike Hill the number of tanker trips to take flow back water from a standard pad would amount to 3,384 standard trips and with a gas field of 120 pads and 3,000 wells this would involve over 400,000 initial tanker trips. (Hill, 2013) (See also figures in AMEC Environment and Infrastructure UK Ltd, 2013)

Regulation

Government and industry **claim the problems documented by scientists can be at least made acceptable and the industry made safe by regulation.**

However, a recent British Medical Journal editorial has criticised this point of view when it was presented in a Public Health England Report. “The report incorrectly assumes that many of the reported problems experienced in the US are the result of a poor regulatory environment. This position ignores many of the inherent risks of the industry that no amount of regulation can sufficiently remedy, such as well casing, cement failures and accidental spillage of waste water. There is no reason to believe that these problems would be any different in the UK and the report provides little evidence to the contrary....” (Law, Hays, Shonkoff, & Finkel, 2014) Indeed contrary to industry and government claims regulation is not fit for purpose in the UK and regulations are, if anything being weakened to make it easier for the industry to develop. (Hill, 2013) A review of multiple peer reviewed studies in the USA also concludes that “Growing evidence shows that regulations are simply not capable of preventing harm...Some of fracking's many component parts...are simply not controllable. Compounding the problem, the number of wells and their attendant infrastructure continue to proliferate, creating burgeoning impacts” (Concerned Health Professionals of New York Compendium 3rd Edition October 14th 2015 p. 9)

What makes this situation even more concerning is ***that the experience in Nottinghamshire has already shown that the regulatory and planning authorities do not have adequate resources to maintain oversight in the face of companies that breach planning conditions.*** Dart International breached planning conditions at its exploratory well at Daneshill on several

counts but these breaches were not noticed by the county council until local residents pointed them out. Only one of these breaches – the failure to build an access road onto to the exploratory drilling site – was subsequently enforced. Dart is now in the process of merging with IGas, the company that is making this planning application. This does not bode well for the future. (Information supplied by residents of Lound and Sutton cum Lound)

Climate change

Climate change and climate policy. As well as local effects shale and coal bed methane development is unacceptable from a climate point of view. According to the chief scientist at DECC *“If a country brings any additional fossil fuel reserve into production, then in the absence of strong climate policies, we believe it is likely that this production would increase cumulative emissions in the long run. This increase would work against global efforts on climate change.”* (quoted in Anderson, 2014)

At this point in time there are no “strong climate policies” nationally or internationally and according to scientists at Britain’s leading organisation for climate change research, the Tyndall Centre -

“The science of global warming, the maths of our emissions and our pledge to limit temperature increases to below a 2°C rise lead to the categorical conclusion that shale gas must remain in the ground if we are not to renege on our commitment to avoid “dangerous climate change” .
(Anderson 2014)

*According to the Tyndall Centre three arguments are misused to support shale gas development: (1) That shale gas **has** lower emissions than coal. This is true only if the coal displaced by shale gas remains in the ground and is not combusted elsewhere. (2) That shale offers the prospect of low-carbon energy. Gas is a high carbon energy source, emitting half the quantity of carbon dioxide per unit of electricity generated as the worst and dirtiest energy source we know, coal. Half the worst is still very high. (3) That shale **is a transition fuel to a low-carbon future**. The shale gas industry acknowledges that it will not produce significant quantities of shale gas before around 2025, when Britain’s commitments on climate change would not permit it to be combusted in any significant quantities. (Tyndall Centre 2012)*

The case for shale gas is further weakened in the light of **recent studies showing high levels of fugitive methane emissions from gas fields**, including, unexpectedly, even from exploratory wells. A 2013 study 19 researchers led by the United States NOAA concluded “measurements show that on one day in the Uinta Basin, **the natural gas field leaked 6 to 12 percent of the methane produced, on average**, on February days.” The Uinta Basin is of special interest because it “produces about 1 percent of total U.S. natural gas” and fracking has increased there over the past decade.” (Sweeney & et.al., 2013) Satellite data from the Bakken and Eagle Ford fields appears to confirm this finding. (Schneising O. et al 2014). Since methane is a much more powerful greenhouse gas than CO₂. Above a certain level of fugitive emissions this would make shale gas an even worse climate destroyer than coal combustion (Howarth, Robert W. 2014). To complete the picture it seems that studies which seem to show low fugitive emissions have been used faulty measuring equipment. (Howard T. 2015)

References

- AMEC Environment and Infrastructure UK Limited. (2013). *Strategic Environmental Assessment for Further Onshore Oil and Gas Licencing*. London: Oil and Gas Policy Unit Department of Energy and Climate Change.
- Anderson Kevin 2014 "UK international commitments on climate change are incompatible with the development of a national shale gas industry" <http://kevinanderson.info/blog/uk-international-commitments-on-climate-change-are-incompatible-with-the-development-of-a-national-shale-gas-industry/>
- BBC 2014 "Earthquake hit New Ollerton is the most seismically active town in the British Isles" 21st January 2014 <http://www.bbc.co.uk/news/uk-england-nottinghamshire-25824615>
- BC Oil and Gas Commission. (2013). *What Chemicals are Used*. Retrieved from Frac Focus Chemical Disclosure Registry: <http://fracfocus.ca/chemical-use/what-chemicals-are-used>
- Casey, J. A., Ogburn, E. L., Rasmussen, S. G., Irving, J. K., Pollak, J., Locke, P. A., & Schwartz, B. S. (2015). Predictors of indoor radon concentrations in Pennsylvania, 1989-2013. *Environmental Health Perspectives*. Advance online publication: <http://dx.doi.org/10.1289/ehp.1409014>
- Chen, J., Al-Wadei, M. H., Kennedy, R. C., & Terry, P. D. (2014). Hydraulic Fracturing: Paving the Way for a Sustainable Future? *Journal of Environmental and Public Health 2014* .
- Concerned Health Professionals of New York Compendium 3rd Edition October 14th 2015
- Conoco-Phillips Canada Resources Corporation. (March 2013). Retrieved from http://www.mvlwb.ca/Boards/slwb/Registry/2013/S13A-001%20-%20Conoco%20Phillips%20Canada/S13A-001%20-%20Appendix%209%20-%20Hydraulic%20Fracturing%20-%20Mar%202025_13.pdf
- Davies, R.J., et al., (2014). Oil and gas wells and their integrity: Implications for shale and unconventional resource exploitation, *Marine and Petroleum Geology*, <http://dx.doi.org/10.1016/j.marpetgeo.2014.03.00>
- Dusseault, M., Gray, M. N., & Nawrocki, P. A. (2000). Why Oilwells Leak: Cement Behaviour and Long-Term Consequences. *SPE International Oil and Gas Conference*. Beijing: Society of Petroleum Engineers.
- Gruver, M. (2011, September 3rd). *Wyomings Natural Gas Boom comes with Smog attached* from Environment on NBCNews.com: http://www.nbcnews.com/id/41971686/ns/us_news-environment/
- Eric J. Esswein, MSPH, CIH, John Snawder, PhD, DABT, Bradley King, MPH, CIH, Michael Breitenstein, BS, and Marissa Alexander-Scott, DVM, MS, MPH. (August 2014) Preliminary Field Studies on Worker Exposures to Volatile Chemicals during Oil and Gas Extraction Flowback and Production Testing Operations <<http://blogs.cdc.gov/niosh-science-blog/2014/08/21/flowback-2/>>
- Hill, M. (2013). Regulating the Frackers: Just How Robust is the Legislative Framework. *The Greens Shale Gas Conference*.
- Howarth Robert W. 2014. A bridge to nowhere: methane emissions and the greenhouse gas footprint of natural gas (pages 47–60) *Energy Science and Engineering* June 2014 Volume 2, Issue 2 Pages i–iii, 47–105
- Howard, T. (2015). University of Texas study underestimates national methane emissions at natural gas production sites due to instrument sensor failure. *Energy Science & Engineering*. Advance online publication. doi: 10.1002/ese3.81
- Hughes, J. David 2014 "Drill, Baby, Drill" Post Caron Institute <http://shalebubble.org/drill-baby-drill/>
- Ingraffea, A. R. (2013, January). *Fluid Migration Mechanisms Due to Faulty Well Design and/or Construction: An Overview and Recent Experiences in the Pennsylvania Marcellus Fluid Migration Mechanisms Due to Faulty Well Design and/or Construction*. at PSE Physicians and

- Scientists for Healthy Energy: <http://www.psehealthyenergy.org/site/view/1057>
- Insley, J. (2012, June 23rd). *Worry for Homeowners who face the threat of fracking* from The Observer: <http://www.theguardian.com/money/2012/jun/23/fracking-undermine-value-home>
- Jemielita, Thomas, Gerton George L, Neidell Matthew, Chillrud Steven and others
 “Unconventional Gas and Oil Drilling is Association with Increased Hospital Utilisation Rates.
<http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0131093>
- Kassotis, C. D., Tilitt, D., Davis, J. W., Hormann, A. M., & Nagel, S. C. (2013, December 16th).
 Estrogen and Androgen Receptor Activities of Hydraulic Fracturing Chemicals and Surface and
 Ground Water in a Drilling-Dense Region. *Endocrinology* .
- Law, Adam; Hays, Jake; Shonkoff, Seth B; Finkel, Madelon L, 2014. *Public Health England draft report on Shale Gas Extraction, Mistaking Best Practices for Actual Practices*, British Medical Journal. 26thth April 2014, Volume 348 p.8 <http://www.bmj.com/content/348/bmj.g2728>
- Lohan, T. (2014, January 10th). *The Four Big Dangers of Fracking* from Resilience:
<http://www.resilience.org/stories/2014-01-10/the-4-big-dangers-of-fracking>
- McKenzie LM, Guo R, Witter RZ, Savtiz DA, Newman LS, Adgate JL. 2014. Birth outcomes and maternal residential proximity to natural gas development in rural Colorado. *Environ Health Perspect* 122:412–417; doi:10.1289/ehp.1306722
- D. E. McNamara , J. L. Rubinstein , E. Myers , G. Smoczyk , H. M. Benz , R. A. Williams , G. Hayes , D. Wilson , R. Herrmann , N. D. McMahon , R. C. Aster , E. Bergman , A. Holland , and P. Earle (2015). "Efforts to monitor and characterize the recent increasing seismicity in central Oklahoma." *The Leading Edge*, 34(6), 628–630,632–634,636–636,638–639. doi: 10.1190/tle34060628.1
- Mobbs, P. (2014, March). A response to DECC's public consultation on the 14th Onshore Gas and Oil Licencing Strategic Environmental Assessment. UK: Mobbs Environmental Investigations.
- Osborne, S. G. (2011). *Methane Contamination of Drinking Water Accompanying Gas-Well Drilling and Hydraulic Fracturing*. Retrieved April 20th, 2014, from Proceedings of the National Academy of Science: <http://www.pnas.org/cgi/doi/10.1073/pnas.1100682108>
- Oskin, B. (2014, 07). Wastewater Injection Triggered Earthquake Cascade. *Live Science* .
- Public Health England. (2013, October). *Shale gas health review by Public Health England*. Retrieved April 25th, 2013, from Gov.UK: <https://www.gov.uk/government/news/shale-gas-health-review-by-public-health-england>
- Kovats et al 2014 "The Health Implications of Fracking" *The Lancet* Vol. 383, 1st March 2014
- Schneising, O., Burrows, J. P., Dickerson, R. R., Buchwitz, M., Reuter, M., & Bovensmann, H. (2014). Remote sensing of fugitive methane emissions from oil and gas production in North American tight geologic formations. *Earth's Future* 2(10), 548–558. doi: 10.1002/2014EF000265
- Sweeney, Colm et al. (2013,) *Methane Emissions estimates for airborne measurements over a western United States gas field*, *Geophysical Research Letters*, 2013, Vol 40, Issue 16
- Tait, D. R., Santos, I. R., & Maher, D. T. (2013, 12). *Atmospheric Radon, CO2 and CH4 Dynamics in an Australian Coal Seam Gas Field*. from SAO/NASA ADS Physics Abstract Service: <http://adsabs.harvard.edu/abs/2013AGUFM.A53H..06T>
- Tait, D. R., Santos, I. R., Maher, D. T., Cyrnonak, T. J., & Davis, R. J. (2013). Enrichment of Radon and Carbon Dioxide in the Open Atmosphere of an Australian Coal Seam Gas Field. *Environmental Science and Technology* , 3099-3104.
- Thompson, L. (2012, November 15th). *World-first research finds methane is 'higher in CSG areas'*. from Daily Examiner: <http://www.dailyexaminer.com.au/news/methane-higher-in-csg-areas/1622910/>
- Tyndall Centre 2012 Submission to commons select committee Shale Gas
<http://www.publications.parliament.uk/pa/cm201213/cmselect/cmenergy/writv/isg/m30.htm>

University of Colorado, D. (2012, March 19). *"Air emissions near fracking sites may pose health risk, study shows; sites contain hydrocarbons including benzene."*.from Science Daily:
<http://www.sciencedaily.com/releases/2012/03/120319095008.htm>

Vaughan, A. & Mason, R. (2015, July 1). Fracking could hurt house prices, health and environment, official report says. *The Guardian*. Retrieved from
<http://www.theguardian.com/environment/2015/jul/01/fracking-could-hurt-house-prices-health-and-environment-official-report-says>

Williams, J., Stubbs, T., & Milligan, A. (2012). *An analysis of coal seam gas production and natural resource management in Australia a report prepared by John Williams Scientific Services Pty Ltd*. Canberra: Australian Council of Environmental Deans and Directors