THERE IS NO INDUSTRY THAT WOULD INCUR SUCH AN UNACCEPTABLE LEVEL OF RISK IF THEY HAD TO BEAR THE RISK.*

PART THREE: THE HAZARDS AND DANGERS OF FRACKING.

1. **(a) While, in 2013, a writer, told us that the Environmental Protection Agency (EPA) in America *had found no contamination,* in 2016, the same EPA reports:**

> ***"…Contamination happens at every stage of fracking*: *Cases of impacts were identified for all stages of the hydraulic fracturing water cycle …"***

(b) Never forget fracking's inevitable environmental devastation: the infrastructure for fracking (silica, chemicals, generators, compressors, silos, workshops, accommodation blocks, waste disposal, fracking kit, drill pipe, drill mud, huge rigs, compressors, portakabins, water storage, roads' and verges' destruction, miles of gas pipelines through farmland and countryside together with the tens of thousands of heavy goods vehicles).

In a sentence, this means: "the environmental destruction of rural England".

***THE POINT IS THIS: THE UNFORTUNATE RESIDENTS IN THE SACRIFICE ZONES WHO SUSTAIN THE DAMAGE FROM FRACKING ARE THE PEOPLE OF RURAL ENGLAND WHO BEAR THE RISK, AND NOT NATIONAL GOVERNMENT, LOCAL GOVERNMENT, OR THE CONTRACTORS WHO CAUSE THE DAMAGE, AND PROBABLY ESCAPE THE CONSEQUENCES – see page 12.**

2. ***FRACKING* IS NOW HALTED:**
ALBANY, N.Y. (December 17, 2014) - The state Department of Health has completed its public health review of high-volume hydraulic fracturing (HVHF) and Acting DOH Commissioner Dr. Howard Zucker recommended that high-volume hydraulic fracturing should not move forward in New York State. Dr. Zucker said, at a Cabinet Meeting in Albany:

> **"I have considered all of the data and find significant questions and risks to public health which as of yet are unanswered. I think it would be reckless to proceed in New York until more authoritative research is done. I asked myself, 'would I let my family live in a community with fracking?' The answer is 'no'. I therefore cannot recommend anyone else's family to live in such a community either" …**

Is this not a line of thought for the English regulators to follow …

Every major European Union country except England and Spain have now banned fracking, including all the UK except England, where only the Conservative party supports it. And States –Australia, Victoria; Canada, Quebec, Newfoundland, New Brunswick, Alberta suspends fracking when the earthquakes reach Richter scale 4; USA, New York State, Maryland, Vermont.

3. In the medical profession it is well known that, in clinical trials, (as Lord Mair is advising the government these fracking wells should be a trial as in "*experimental*") *if the risks outweigh the benefits, then the ethics committee would not allow the trial to proceed.*

Fracking needs its own ethics in England.

The Pennsylvanian Medical Society's 300 strong House of Delegates, representing 16,000 members, unanimously approved a resolution for a fracking moratorium on the basis that "growing evidence has shown its increasing deleterious effects outweighs economic benefit" – October 2016.
http://www.post-gazette.com/local/region/2016/10/27/Doctors-group-calls-for-moratorium-on-fracking-in-Pennsylvania/stories/201610270226

4. **Also in October 2016, Yale University evidence confirmed:** ***numerous carcinogens involved in the controversial practice of hydraulic fracturing have the potential to contaminate air and water in nearby communities.*** https://publichealth.yale.edu/news/article.aspx?id=13714

5. **DANGERS OF PERPETUAL AND ORPHANED WELLS.**

(a) Abandoned wells are specifically mentioned on page 5 of the Royal Society/Royal Academy of Engineering report, calling for them to have risk assessments: but the regulators have no such provisions.

> ***An Environmental Risk Assessment (ERA) should be mandatory for all shale gas operations. Risks should be assessed across the entire lifecycle of shale gas extraction, including risks associated with the disposal of wastes and abandonment of wells. Seismic risks should also feature as part of the ERA.***

(b) **Amy Nassif, a citizen of Pennsylvania with personal experience there, in January 2017, writes:**

> *Unconventional well sites are often large open areas. When a company has completed the fracking operations, the site remains intact.*

(c) Abandoned wells were a subject Richard Storey raised in his first objection to North Yorkshire County Council of 13th November 2015, partly reproduced below:

> ***Oil and gas wells and their integrity: implications for shale and unconventional resource exploitation (peer reviewed) contained in marine petroleum geology journal homepage at: http://www.sciencedirect.com/science/article/pii/S0264817214000609 has further damning evidence on the inadequacy of regulation in England. Several points are of specific interest in this article, excerpts from which are included below. First, cemented steel casings are not necessarily indefinitely or at all permanent: on the contrary, they are susceptible to breakdown and corrosion of the concrete and the steel casings. They need, therefore, permanent inspection, but they are not getting that. These points are well encapsulated in a paragraph from conclusion:***
>
> > *"Only 2 wells in the UK have recorded well integrity failure (Hatfield Blowout and Singleton Oil Field) but this figure is*

based only on data that were publicly available or accessible through UK Environment Agency and only out of the minority of UK wells which were active. To the best of our knowledge and in line with other jurisdictions (e.g. Alberta, Canada) abandoned wells in the UK are sealed with cement, cut below the surface and buried, but are not subsequently monitored. This number is therefore likely to be an underestimate of the actual number of wells that have experienced integrity failure. A much tighter constraint on the risks and impacts would be obtainable if systematic, long-term monitoring data for both active and abandoned well sites were in the public domain. It is likely that well barrier failure will occur in a small number of wells and this could in some instances lead to some form of environmental contamination. Furthermore, it is likely that, in the future, some wells in the UK and Europe will become orphaned. ***It is important therefore that the appropriate financial and monitoring processes are in place, particularly after well abandonment, so that legacy issues associated with the drilling of wells for shale gas and oil are minimised."***

(d) **An extract taken from "the anecdotal truth" on page 10, see below.**

Wells are normally shut-in and abandoned when they become unprofitable. However, gas is usually still available (often a lot) - but is just not flowing fast enough to warrant continuing the extraction. Fracked wells have many leakage modes, some easy to monitor and some difficult. Leakage can occur from either failure of the well itself, where it acts a conduit (similarly to conventional wells), or from the fracking process connecting to other conduits. One of the key issues with shale fracking is that after the well is abandoned and shut in, the well remains pressurised. The continuing pressure means that any conduits that do appear later, as a result of failures or geological movement, will have gas and fluids travel along them. This is different to coal seam gas (CSG) where the pressure is reduced after (if) water returns to the area …. Generally the data is sketchy at best, does not (and cannot) include hidden failures where the effects are not yet noticeable, and has been collected over a short period of only 10-50 years. What we do know is that all types of failures tend to occur in three phases:

** Early life ….*
** Steady state ….*
** Maturity (old wells) where deterioration has occurred and failure rates increase.*

We only have data on the first two phases as the majority of wells haven't reached the third phase and we don't really know when they will get there. How long will the materials used in constructing the wells last? What slow-acting geographical processes are happening? Could be 50 years, could be 100 years. What we do know is that it will happen. It is also likely that the industry will no longer be there to clean it up.

….. from a ground water contamination perspective, the potential for disaster is huge. If only one of those 60 wells or future conduits connects to a water aquifer, that aquifer can be contaminated with methane, drilling fluids and their by-products, and by any other toxins released from the shale by the fracking.

…. Once contaminated, that aquifer is effectively contaminated FOREVER (although perhaps not at levels over acceptable limits – maybe).
Taking a more realistic failure rate of 5% over 30 years and 20,000 wells, we get an expected failure rate of 3,000 expected failures.
With this level of failure, we would expect all water aquifers to become toxic and there to be significant methane gas releases.

(e) Mike Hill, June 2017, writes:

On abandoned wells Princeton in the US did a large study. Found that many 1000s of old wells were leaking and the business that owned them long gone. Miller told me this in 2012 that I should add a Bond for Abandonment to me list of Regs. Every pad is a separate limited co. This can limit the risks to operators as any issues that are proven with one pad cannot get back to the whole company. Once they abandon a pad the ownership is moved along to sister / daughter companies that are setup for the sole purpose of going bankrupt. This leaving the state with the bill of checking for and clearing up leaking wells. This cost will run into millions of pounds as time goes on and that's something the Councils

didn't even realise they need to check. Many originally didn't in US.

(f) ***The only well fracked in UK - PH1 - has been abandoned. The pad removed. The well plugged. Farming back on that land. Looks great! What they don't realise is there's a 2 mile well there fracked. 848,000 gallons of fracking toxic waste left. It can and will leak over time. It must be monitored. Neither Fylde Borough Council nor Lancashire County Council are prepared for this. Nobody is. Nobody seems to realise the need.***

6. **Environmental damage*:***

(i) **England's already crumbling rural roads will be subjected to Heavy Goods Vehicle damage, now costing billions of $ in USA where it has long been known that a single fracking operation causes tens of thousands of dollars in road damage, and that roads designed for the last twenty years actually decay in only five. In short: fracking is costing USA hundreds of millions of dollars in road damage annually. In England, the finances of all those Highways Departments having to endure fracking, already seriously overstretched, already unable to keep pace with present repair schedules, will be shattered. <u>In some parts of the USA where fracking is prevalent, road fatalities have quadrupled.</u>**

(ii) Recent 2017 report published in newspapers of the Centre for Economic and Business Research (CEBR) at the World Economic Forum's assessment of British roads showing the UK was already 27th in the world table of bad condition of roads.

(iii) One person, apparently seriously, said "fracking is no more damaging to the environment than a pig farm" – see contrasting photographs, and remember the environmental impact of both: eg fracking's thousands of heavy goods vehicles.

7. **Thousands of spills at US oil and gas fracking sites, as reported by Matt McGrath, BBC, February 2017. Up to 16% of hydraulically fractured oil and gas wells spill liquids every year – new research from US scientists:**
http://www.bbc.co.uk/news/science-environment-39032748

8. **Texas drilling will cause more health problems:**
https://www.texastribune.org/2016/08/31/study-texas-oil-and-gas-pollutants-trigger-most-as/

Within a decade, Texas will lead the nation in sicknesses linked to ozone-forming pollutants from oil and gas activity, according to a new analysis from a pair of environmental groups. In the 2025 "ozone season," those pollutants will trigger more than 144,000 childhood asthma attacks, nearly 106,000 lost school days and 313 total asthma-related emergency room visits in Texas, the research said.

9. **The Dallas-Fort Worth region — home of the gas-rich Barnett Shale — would see roughly a third of the Texas cases of asthma, school days lost and emergency room visits linked to oil and gas activity, the study said:**

> *Drilling-related smog in Dallas-Fort Worth area could cause highest number of children's asthma attacks in U.S.*

http://www.dallasnews.com/news/environment/2016/08/31/oil-gas-drilling-smog-expected-cause-tens-thousands-asthma-attacks-among-dallas-area-children

10. **In September 2013, Sir David King, former chief scientific adviser to the government, warned of the "enormous environmental consequences" of attempting to fulfil the UK's gas needs by fracking and played down the idea that it would have a major impact on the UK's energy market.**

11. Paul Mobbs's 6th June 2016 writes:

New study shows injected fracking wastewater contaminates local streams... a study funded by the United States Geological Survey –
https://www.usgs.gov/news/evidence-unconventional-oil-and-gas-wastewater-found-surface-waters-near-underground-injection

12. **Wastewater Disposal from Unconventional Oil and Gas Development Degrades Stream Quality** at a West Virginia Injection Facility: Akob et al., Environmental Science and Technology May 2016 article:

http://pubs.acs.org/doi/abs/10.1021/acs.est.6b00428

13. **Scientists say chemicals from fracking wastewater can taint fresh water** nearby: Denise Akob, Washington Post May 2016: https://www.washingtonpost.com/news/energy-environment/wp/2016/05/11/this-mystery-was-solved-scientists-say-chemicals-from-fracking-wastewater-can-taint-fresh-water-nearby/

14. **Paul Mobbs's work for the American Geophysical Union** released April 28th 2016 Abstract:

> *Ethane is the second most abundant atmospheric hydrocarbon, exerts a strong influence on tropospheric ozone, and reduces the atmosphere's oxidative capacity. Global observations showed declining ethane abundances from 1984 to 2010, while a regional measurement indicated increasing levels since 2009, with the reason for this subject to speculation. The Bakken shale is an oil and gas-producing formation centered in North Dakota that experienced a rapid increase in production beginning in 2010. We use airborne data collected over the North Dakota portion of the Bakken shale in 2014 to calculate ethane emissions of 0.23 ± 0.07 (2σ) Tg/yr, equivalent to 1-3% of total global sources. Emissions of this magnitude impact air quality via concurrent increases in tropospheric ozone.* ***This recently developed large ethane source from one location illustrates the key role of shale oil and gas production in rising global ethane levels.*** *[our emphasis]*

15. **Real life recent disasters** – any one of which would be a major national catastrophe in rural England:

    (i) **Very serious property destruction by earthquakes in Holland from conventional drilling in October 2015:**
    http://www.theguardian.com/environment/2015/oct/10/shell-exxon-gas-drilling-sets-off-earthquakes-wrecks-homes
    http://www.reuters.com/article/us-netherlands-gas-groningen-idUSKBN0LM0LG20150218,

    (ii) **A gas leak in California (December 2015):**

http://theantimedia.org/unstoppable-california-gas-leak-being-called-worst-catastrophe-since-bp-spill/

(iii) **Massive Fracking Explosion in New Mexico, 36 Oil Tanks Catch Fire:**
http://www.ecowatch.com/massive-fracking-explosion-in-new-mexico-1919567359.html

IMPORTANT ANECDOTAL TRUTHS from a retired Australian Fracking Executive, who writes:

"I'm a principal engineer and worked in oil and gas most of my life, including "fracking"….

…. In my considered view:
* Fracking CAN be done in some places with acceptable risk – same as putting someone on Mars can theoretically be done.
* Fracking CAN be done economically.
* Widespread fracking CANNOT be done both economically AND with acceptable risk.
* Fracking MAY be possible in a very few locations and be both economical AND with acceptable risk.
* But even if fracking could be done both economically and with acceptable risk, IT WOULDN'T BE.

Over the years I've seen some pretty bad stuff happen. On oil rigs, refineries, pipelines – everywhere and on a regular basis. I've seen even more near misses. And I've also seen the cover-ups!
Bad stuff happens for all sorts of reasons, including mechanical failures. But generally, the root cause can be traced back to (at least partially) human behaviour – NORMAL human behaviour. Things like laziness, incompetence, corruption, GREED, pride, ego…

…. The economics of fracking are very different to conventional wells. The **ONLY** reason we are fracking shale for gas is because most of the easy to get gas is gone …. the economics of fracking are very different to conventional wells.

Each fracked well produces far less gas than a conventional well ….Consequently, the budget for each fracked well (to be economical ie profitable) is much less and many more of them are required to get to a commercial scale. But fracked wells are actually more complex

than most conventional gas extraction wells as the process requires the additional step of hydraulic fracturing itself. So we have the triple hit of many, many more wells of a higher complexity (read higher expense and more failure modes) on a tight budget. The direct consequence is a huge pressure to cut costs …. As a result, the failure rates in fracked wells are higher than for conventional wells. This is exactly what you don't want when you are drilling far greater numbers of them. All this happens regularly in conventional developments and CSG. Of course it will occur with shale fracking.

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Industries routinely use a RISK ASSESSMENT MATRIX to determine if a project should be undertaken, plotting the probability of a problem occurring against the potential impact of that problem. The chart below shows the risk assessment of fracking contaminating our water aquifers:

			LIKELIHOOD					
			1	2	3	4	5	6
			Remote	Highly Unlikely	Unlikely	Possible	Quite Likely	Likely
CONSEQUENCE	1	Slight						
	2	Minor						
	3	Moderate						
	4	Major						
	5	Massive						
	6	Catastrophic						Shale Gas is Here!!!

THERE IS NO INDUSTRY THAT WOULD INCUR SUCH AN UNACCEPTABLE LEVEL OF RISK IF <u>THEY</u> HAD TO BEAR THE RISK.

…. Over the years, my view of the industry has changed radically, from initially one of almost adulation, through misgivings, cynicism and finally disgust.
I have now left the industry as I could no longer bear to be part of it.

http://www.frackfreefuture.org.au/why_he_quit. A reflection on the paragraphs 17 above is to be found in the report.

14th July 2017, Sir Richard Storey, Bt CBE.