



Oil and gas

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Groundwater and Contaminated land

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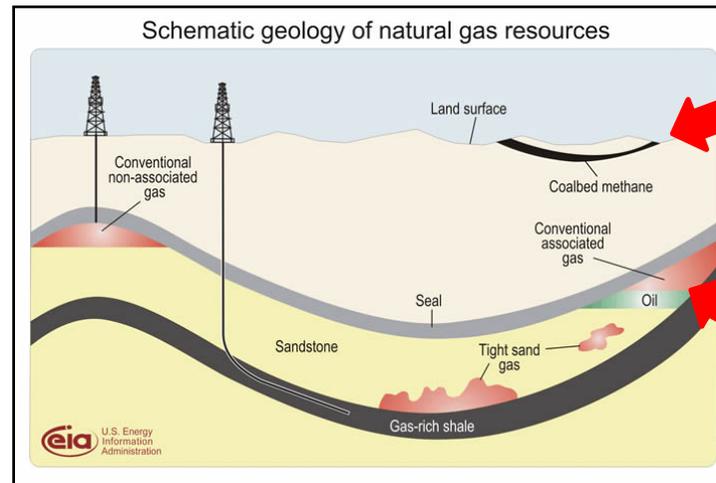
16th December 2014

Outline

- ➔ Conventional methods
- ➔ Unconventional methods
- ➔ Regulatory regime
 - ➔ PEDL
 - ➔ Planning
 - ➔ Permitting
 - ➔ HSE approval
- ➔ Frequency asked questions
- ➔ Baseline methane concentrations

Conventional coal, oil and gas production

- ➔ Coal, oil and gas have been extracted from the rocks beneath the ground for many years. **Conventional methods include:**



Mining thick layers of coal directly from the ground

Extracting oil and gas from oil rich sandstones and limestone

Conventional and unconventional oil and gas exploration / production

Oil and gas flows relatively easily through the pores in limestone and sandstone rocks but supplies are running out.....



... so researchers have been looking at getting gas out of coal and shale



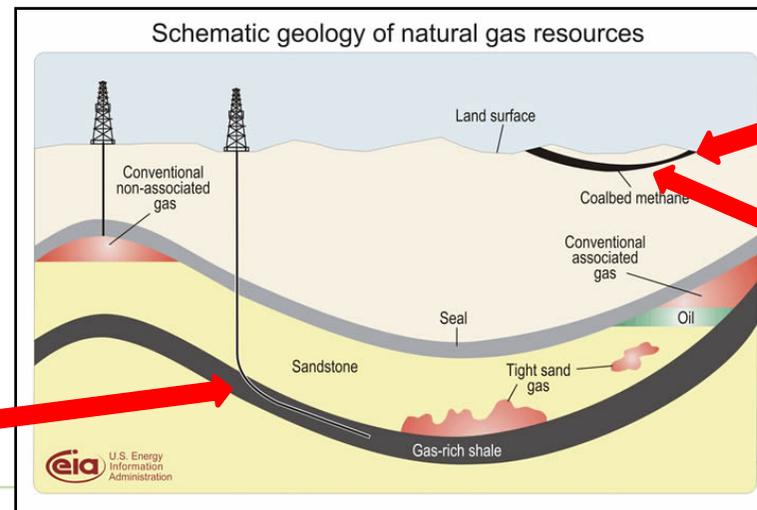
Unconventional gas exploration

- ➔ Researchers have discovered shale rocks contain large volumes of gas
- ➔ The new methods are known as “unconventional” as they differ from traditional methods of extracting oil and gas



Methods include:

- Hydraulic fracturing of shale to extract the gas



- Coal Bed Methane extraction
- Underground Coal Gasification

Conventional oil and gas exploration in UK

- ⇒ Exploration boreholes were drilled in the 1970s and 1980s to test for oil and gas.
- ⇒ Production commenced soon after.
- ⇒ Recently there has been renewed interest in developing more conventional oil and gas sites.

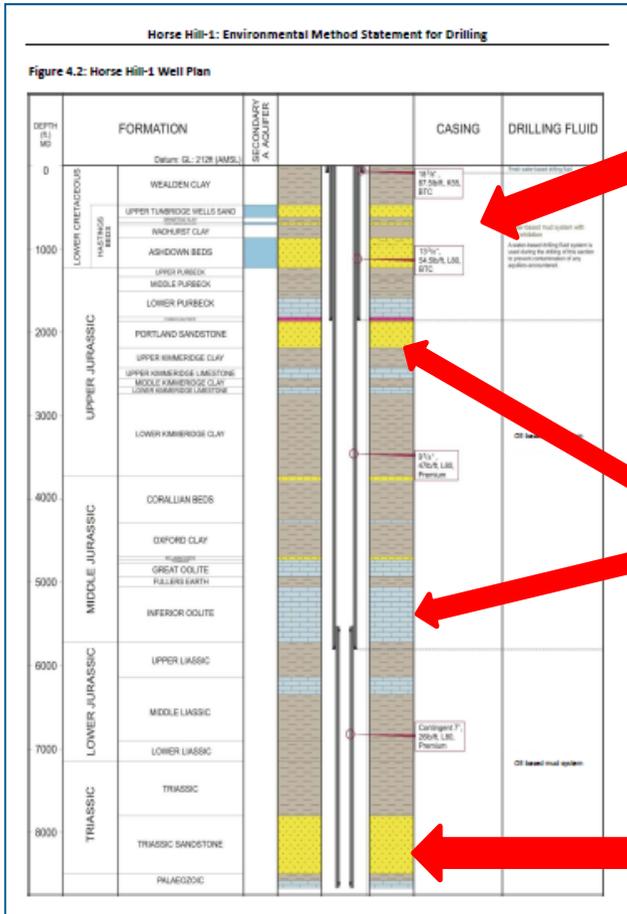


Nodding donkey, Nottinghamshire

From: Dave Lauberts, Panoramio, Google maps

Conventional oil and gas production:

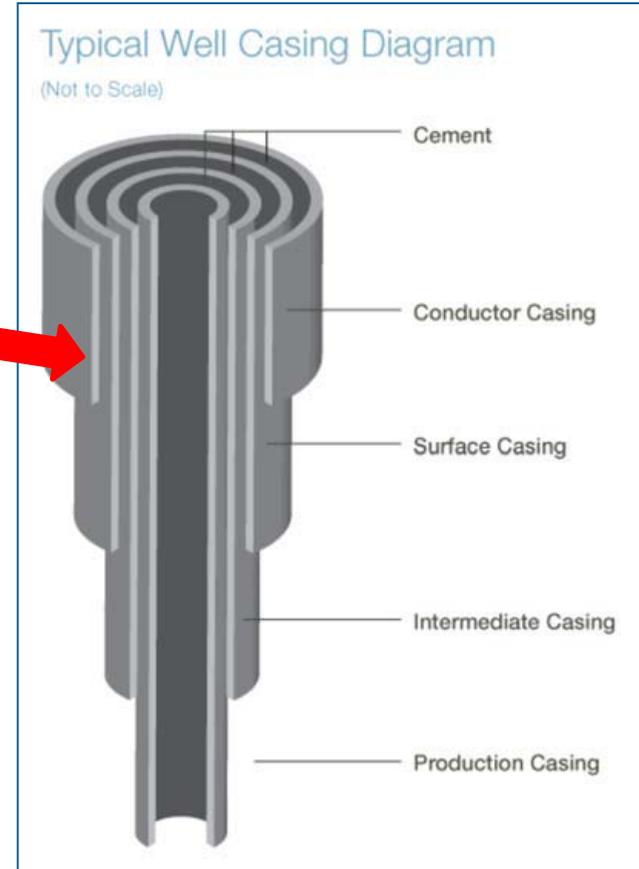
example from Horse Hill Permit application



➡ Aquifers containing groundwater suitable for drinking are protected using well casings.

➡ Target formations for oil production include limestone and sandstone

➡ Target formation for gas production include the Triassic sandstone

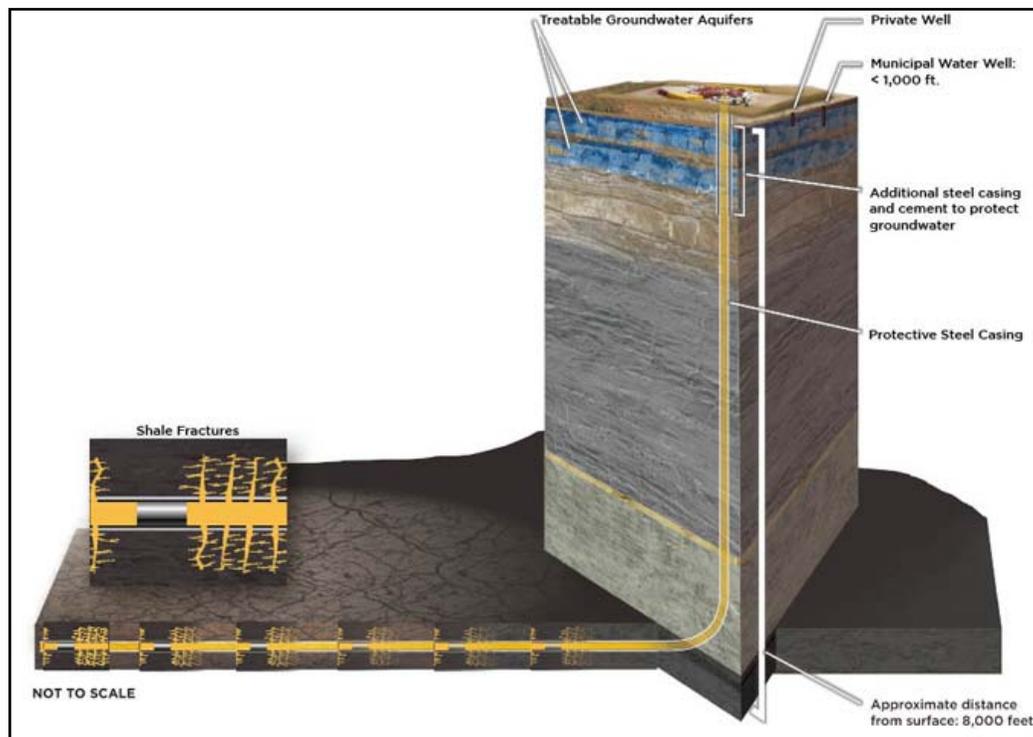


Unconventional oil and gas exploration

- ⇒ Increased number of proposals to explore the use of “unconventional methods”, including:
 - ⇒ Hydraulic fracturing of shale
 - ⇒ Coal bed methane extraction
 - ⇒ Underground coal gasification

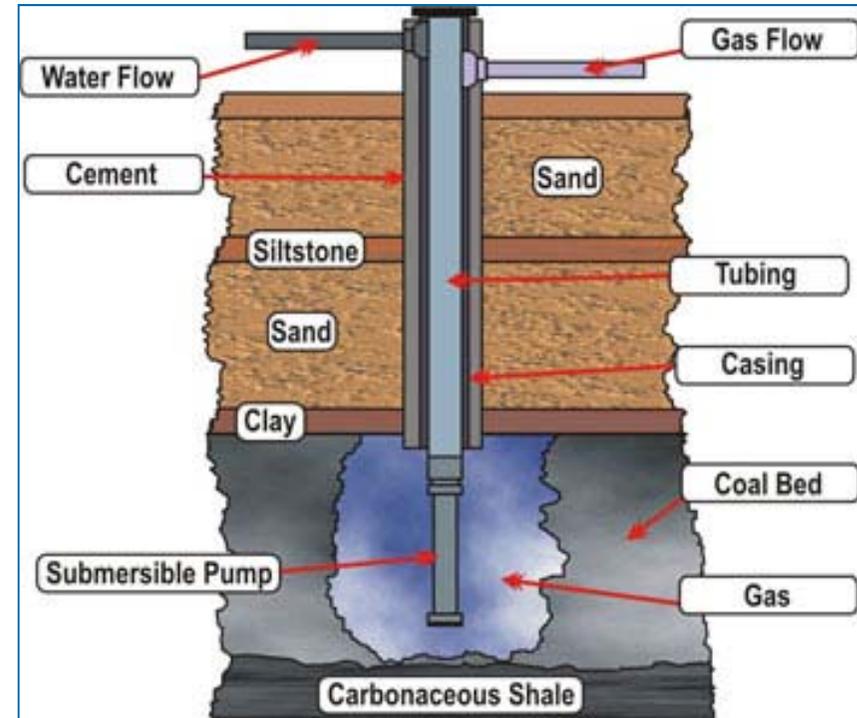
Hydraulic fracturing

- ➔ Hydraulic fracturing is the process used to get the gas out of the shale
- ➔ They drill a deep borehole in to the shale layer, including directional drilling
- ➔ Inject water and proppant (e.g. Sand)
- ➔ Decrease water levels and allow gas to come out of borehole



Coal Bed Methane

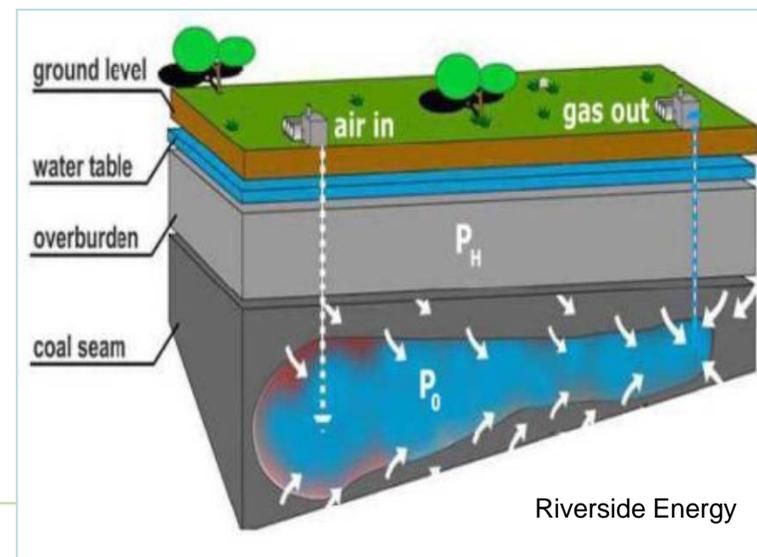
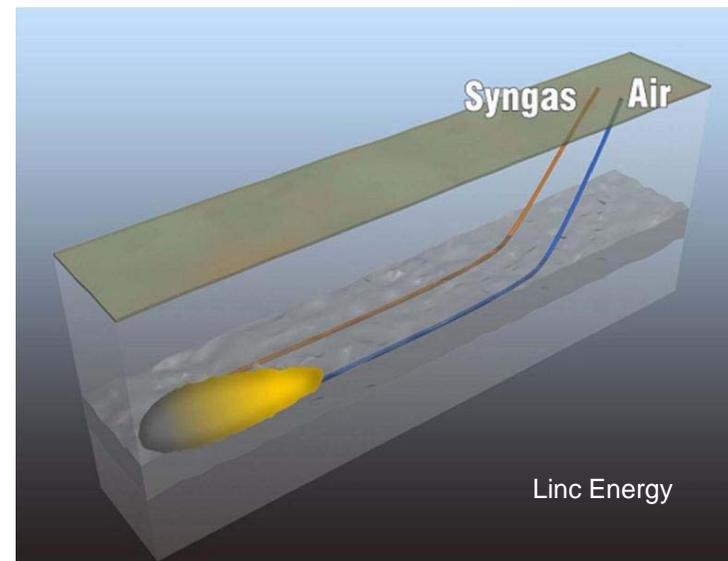
- ⇒ Coal Bed Methane extraction is the process used to get gas out of the groundwater within a coal seam
- ⇒ Drill several boreholes in to coal seam
- ⇒ Pump water out, lowering the watertable
- ⇒ Allow gas to come out of borehole



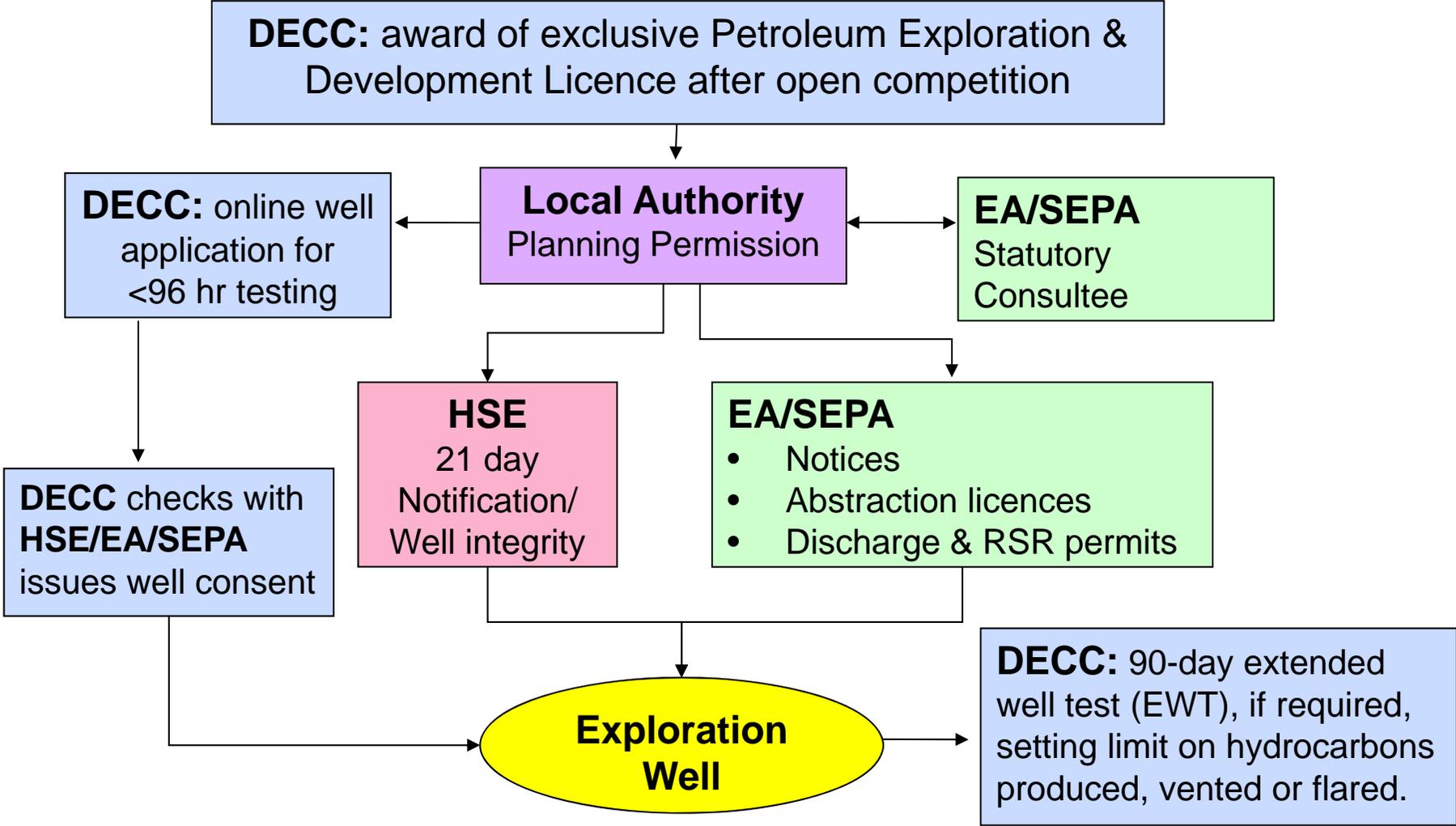
Ground Water Practitioners gvv.co.za

Underground Coal Gasification

- ⇒ Underground Coal Gasification is the process used to get gas out of a coal seam
- ⇒ Drill two boreholes in to deep coal seam.
- ⇒ Ignite so that coal burns, injecting air, oxygen or steam to keep process going
- ⇒ Use second borehole to bring gases to surface

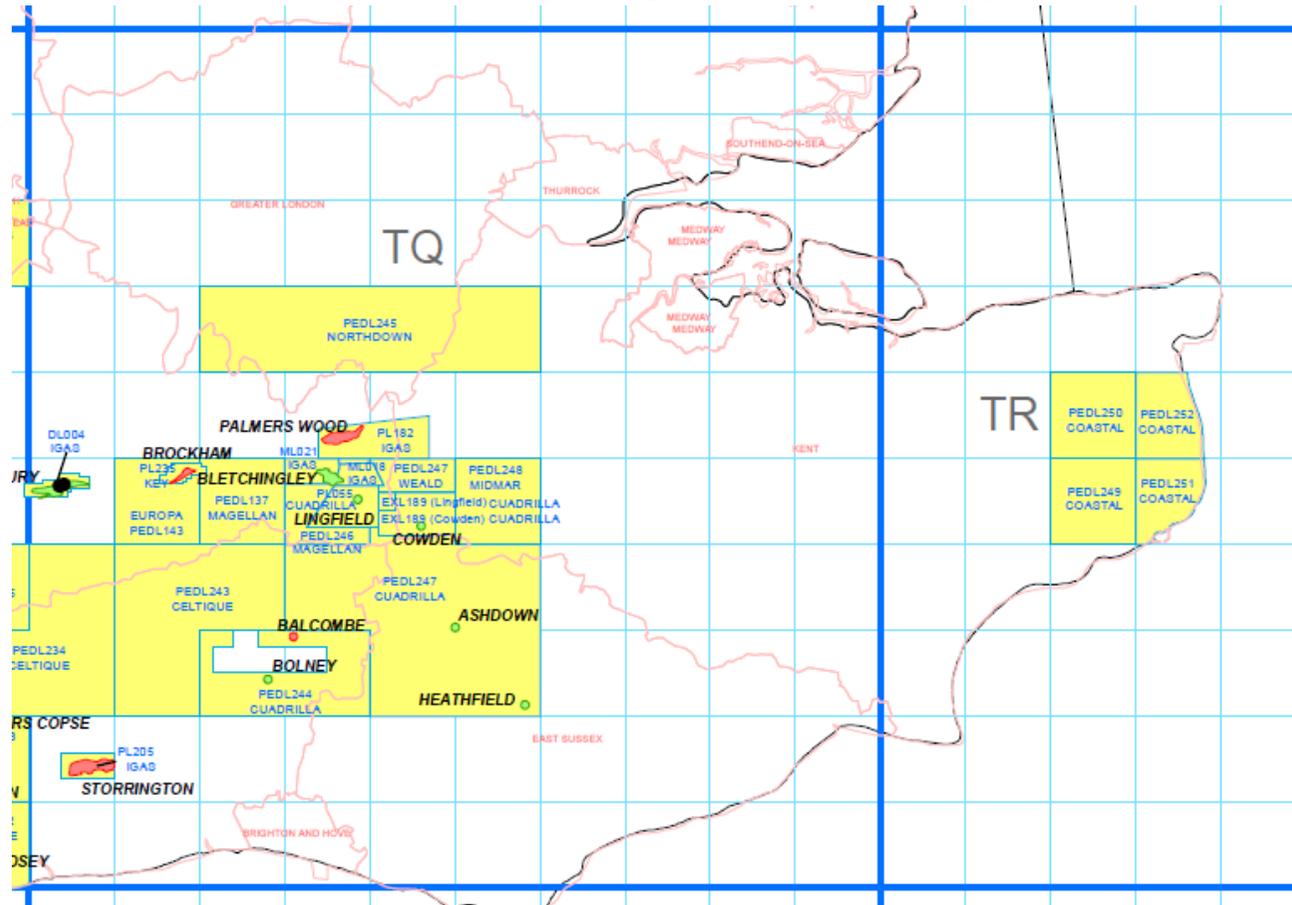


Great Britain's regulatory regime - exploration

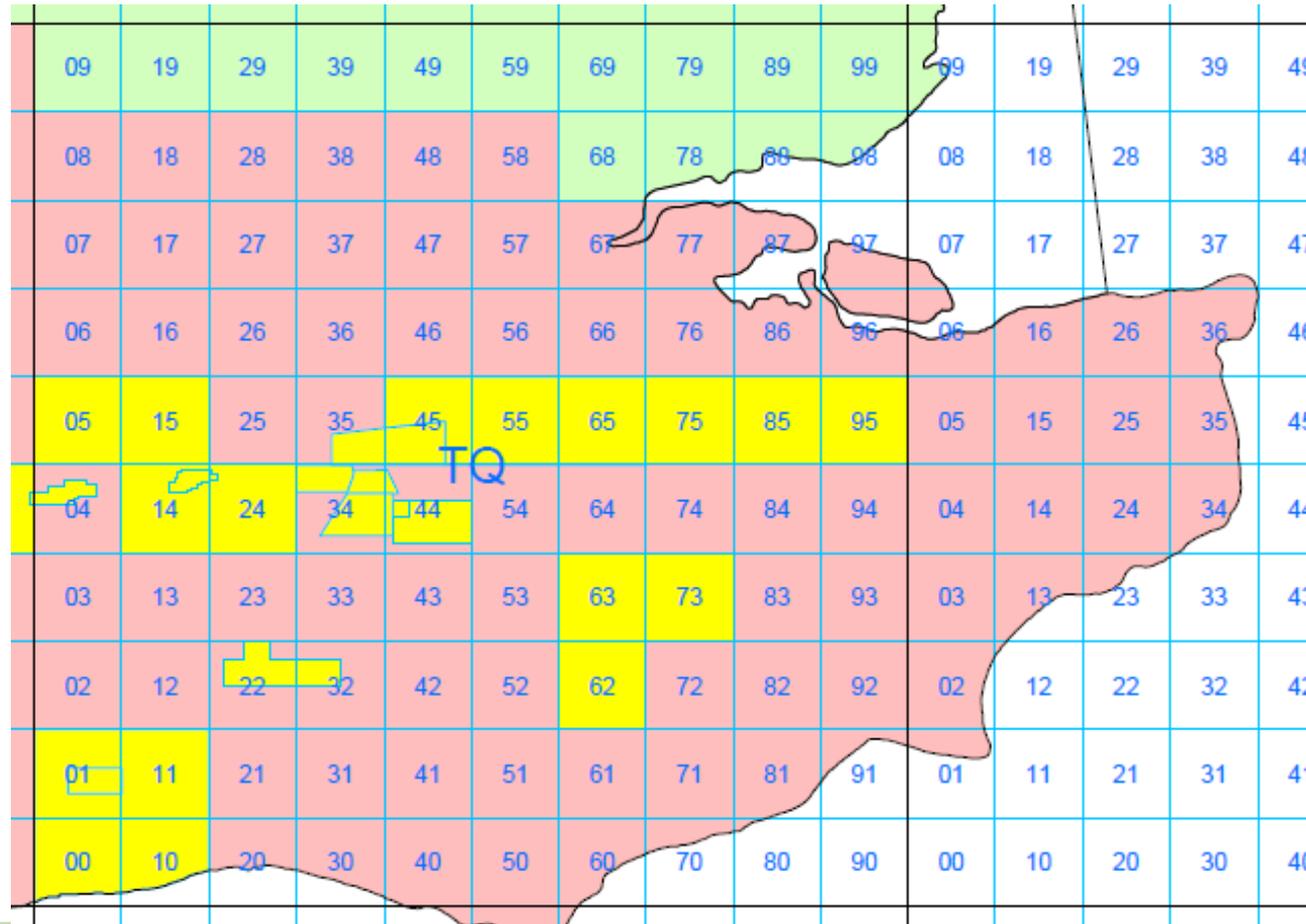


PEDL – Petroleum Exploration and Development Licence – DECC

Previous round of licences:



PEDL – 14th round due imminently



Geophysical Survey – what rocks are there? Do they have gas or oil in them?

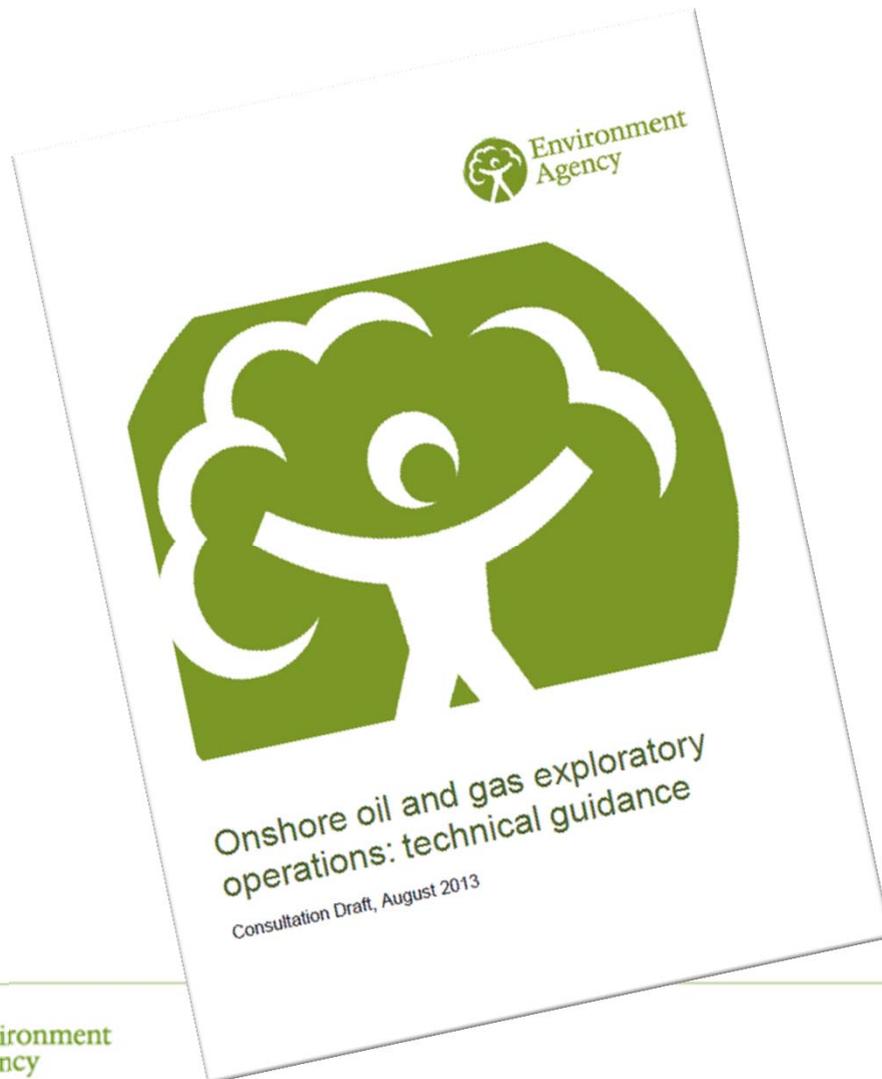
Environment Agency's regulatory approach

- ➔ Proportionate and risk based
 - ➔ Permits will be required where there is significant risk
 - ➔ Require full disclosure of chemicals used
 - ➔ Powers to control and (where necessary) prohibit dangerous activities
- ➔ Encourage best industry practice
 - ➔ Well design, site management
- ➔ Work closely with DECC, Local Planning Authorities and the Health and Safety Executive

Planning and permitting

- ➔ Planning permission
- ➔ “Notice to drill” – Section 199 WRA
- ➔ Mining Waste activity
- ➔ Radioactive Substances activity (NORM)
- ➔ Groundwater activity
- ➔ Industrial Emissions activity
- ➔ Water Discharge activity
- ➔ Water Abstraction licence

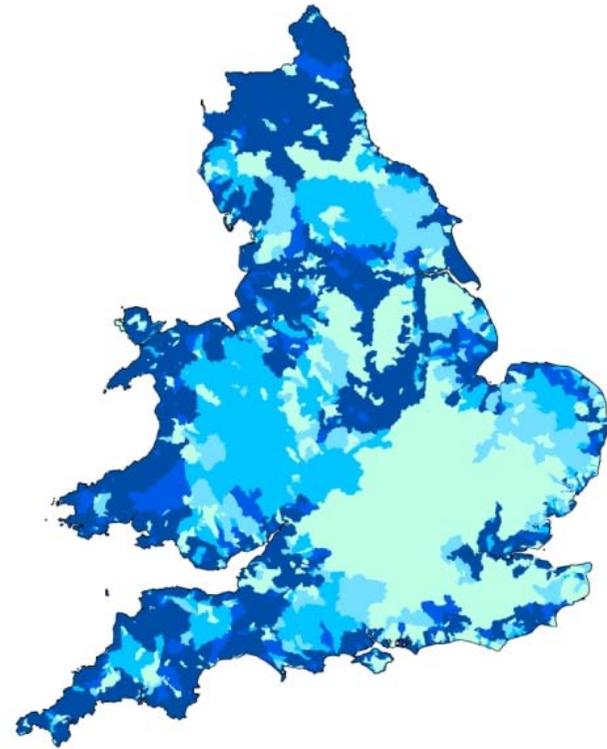
Draft technical guidance - consultation



Consulted in 2013 but there have been many changes so we are likely to be consulting again in early 2015

Catchment Abstraction Management Strategies

- ⇒ We use CAMS to assess the amount of water available for further abstraction, taking into account what the environment needs.



- ⇒ Abstraction Licensing Strategies set out how we are manage abstraction licensing in a particular area

Flowback water

	Sea Water (grams per litre)	The Dead Sea (grams per litre)	Flowback Fluid (grams per litre)
Sodium	10.1	36.3	34.8
Chloride	19.4	230.4 (for chloride plus bromide)	92.8
Bromide			1.0
Magnesium	1.3	45.9	2.1
Potassium	0.4	7.8	0.1

- ➔ Chemical additives
- ➔ Some dissolved organics (included BTEX, PAH)
- ➔ Suspended oil (non-polar)
- ➔ Traces of heavy metals
- ➔ Naturally occurring radioactive material (NORM)

Public involvement and questions are valued



British Geological Survey aquifer separation

- ⇒ British Geological Survey have just published work to show where the principal aquifers are and how their location and depth relates to the shale gas target formations.
- ⇒ They are considering extending this work to cover conventional oil and gas target formations.
- ⇒ <http://www.bgs.ac.uk/research/groundwater/shaleGas/aquifersAndShales/maps/separationMaps/home.html>

British Geological Survey aquifer separation

water science » Research areas » Shale gas » Aquifers and shales » Aquifer, shale and clay maps » Aquifer/shale separation maps

Aquifer/shale separation maps

Use this page to choose one of the 25 maps showing the vertical separation between aquifer/shale or aquifer/clay pairs.

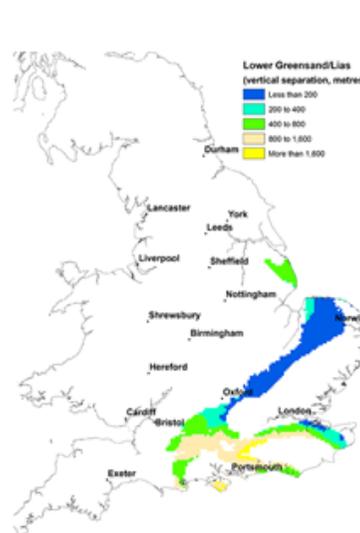
Click on any one of the units from either list. 'Information' icons will appear against units in the other list where a shale underlies the aquifer selected or where an aquifer overlies the shale that was originally selected. Click on any of the information icons to see a thumbnail separation map for the two units and follow the link for a more detailed map and information about the about the relationships between the two selected units.

Use the clear button to re-set the map selection and start again.

Aquifers

Crag ⓘ
Chalk ⓘ
Lower Greensand ⓘ
Spilsby Sandstone ⓘ
Corallian Limestone ⓘ
Oolites
Triassic Sandstone
Magnesian Limestone
Permian Sandstone
Carboniferous Limestone
Fell Sandstone and Border Group

Aquifer/shale maps



Click the info icon to get more information about the separation maps where available.

Clear selections

Shales

Kimmeridge and Ampthill Clay
Kellaways, Oxford Clay and Osgodby Formation
Lias
Marros Group
Bowland and Craven Groups
Upper Cambrian Shales

Baseline methane concentrations

- ➔ The Environment Agency and water companies are working with the British Geological Survey to enhance our monitoring of baseline concentrations of methane
- ➔ Methane in groundwater may be of
 - ➔ Thermogenic origin - gas trapped beneath ground derived from organic matter that has been heated or under pressure from earth's processes (for example, oil or gas) OR
 - ➔ Biogenic origin – gas derived from the breakdown of organic matter near the surface for example, from a local pond, landfill, sewage works, farm, wetland etc.

Concluding comments

- ➔ There are risks to the environment from oil and gas industry, as in any industrial process
- ➔ It is considered that these risks can be successfully managed through effective management and regulation
- ➔ To ensure effective controls and successful development public involvement is key