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### Drawings

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### INTRODUCTION

- 5.1 The Town and Country Planning (Environmental Impact Assessment) Regulations 2011 (Schedule 4, Part I Paragraph 2 and Part II, Paragraph 4) requires the applicant to include in the ES an outline of alternatives which have been considered and an indication of the main reasons for the choice made, taking into account the environmental effects. Alternative sites have been considered and this section of the ES provides an account of the site selection process.

### KEY CONSIDERATIONS

#### Introduction

- 5.2 Three factors have established the context for the site selection exercise described below:
- the extent of the land over which the Applicant has been granted the right to explore for (and develop) hydrocarbons under Petroleum Exploration and Development Licences (PEDL), in this case PEDL 12 and 200;
  - the objectives of the proposed exploratory drilling programme; and
  - the subsurface geology.
- 5.3 These have been used to select an area of search within which the proposed wellsite has been identified by consideration of both the environmental constraints which are likely to apply both within and nearby the areas of search and the question of site availability.

#### Licence Areas

- 5.4 The Applicant has the right to explore for petroleum hydrocarbons within PEDL 12 and PEDL 200 (see Drawing TL5/01).

#### Objectives of the Drilling Programme

- 5.5 The proposed exploratory drilling at Tinker Lane is to locate and evaluate the resource potential of the:
- Bowland Shale (primary target);
  - Sandstones within the Millstone Grit Group which overlie the Bowland Shale (secondary target)
- 5.6 To achieve these objectives, a vertical well is to be drilled through each of the above targets in order to allow full characterisation of these strata.

### METHODOLOGY

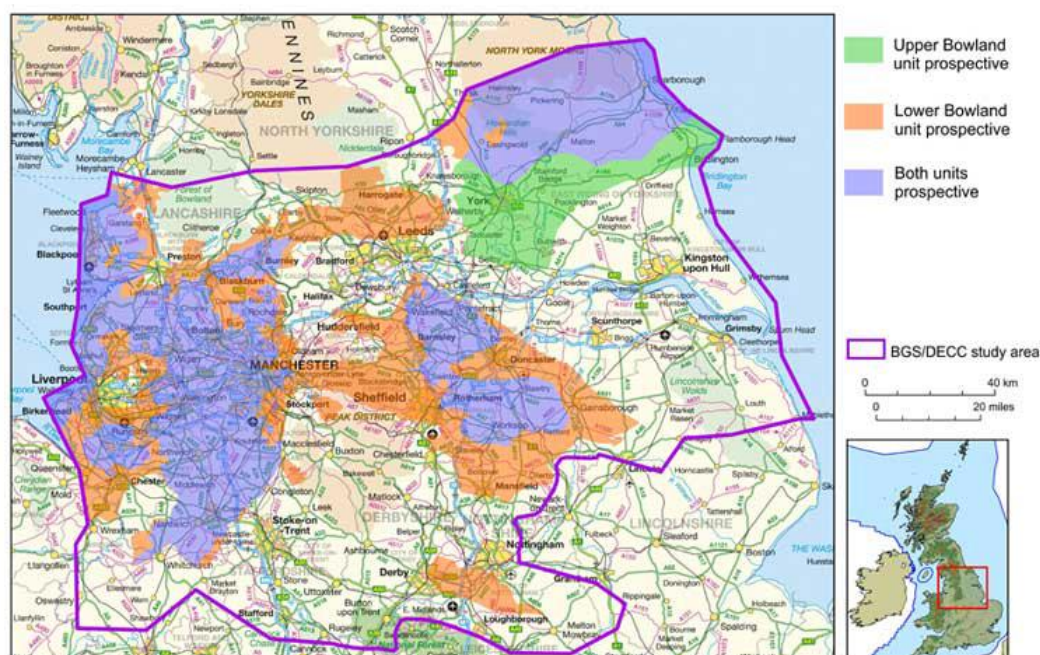
- 5.7 Given the above key considerations, a four stage methodology to identify a suitable site within either PEDL 12 or PEDL 200 was adopted:

- undertaking a desk study of published and unpublished geological information to identify the most prospective area;
- undertaking a review of all available 2D seismic survey to assess the thickness of the target strata and the geological structure; this is undertaken in conjunction with an assessment of historical wells drilled in the proximity of PEDL12 and PEDL200;
- defining of “areas of search” for the drilling of the exploratory wells needed to verify the results of the 2D seismic survey; and
- selection of a proposed wellsite involving a consideration of the environmental constraints which are likely to apply both within and nearby the areas of search, historical mine workings, and the question of site availability.

### DESK STUDY

#### Gainsborough Trough

- 5.8 PEDL12 and PEDL 200 are located over part of the Gainsborough Trough, a buried rift basin which formed during the early part of the Carboniferous period and which contains a thick sequence of sedimentary rocks including the Millstone Grit Group and Bowland Shale.
- 5.9 The Bowland Shale is the main hydrocarbon source rock for shale gas and oil across the East Midlands. The secondary target, the Millstone Grit Group contains prospective intervals within low porosity and permeability deltaic sands within the Gainsborough Trough.
- 5.10 The British Geological Survey (BGS) report The Carboniferous Bowland Shale gas study: geology and resource estimation (BGS/DECC, 2013), contains estimates of the thickness of the Bowland Shale across northern and central England based on integration of outcrop, well and seismic data.
- 5.11 The location of the Gainsborough Trough as mapped by the BGS and is shown below (extracted from the BGS Bowland Shale Gas Study report). The primary Bowland target discussed in this group is referred to as the Upper Bowland by the BGS.



## Offset Wells

- 5.12 A number of wells have been drilled in the surrounding area in the past (see Drawing TL5/02). These include Grove-3, Claborough-1, Ranskill-1 and Manton-1. These wells are termed “offset wells” and are the primary data sources. All of the offset wells penetrated the formations down to the Millstone Grit. Shallower wells have been drilled in the area including Torworth-1 which sits only 0.2km from the Tinker Lane site and is used as the primary data source for information on the shallower formations. Data from the offset wells has been used to help define the area of search.
- 5.13 Both Grove-3 to the East and Manton-1 to the South intersected all formations down the Carboniferous Limestone Supergroup which sits below the Bowland and Millstone Grit targets. These are seen as the key offset wells. Grove-3 was drilled by BP in 1960 and reached a depth of 1,745m True Vertical Depth - Sub Sea (TVDS). Manton-1 was drilled by BP in 1985 to a depth of 1,556m TVDS. The most recent well is the coal bed methane well Lound-1 drilled by Dart Energy (Europe) Limited down to 833m TVDS in 2014. A coal bore hole, Torworth-1 was drilled 0.2km from the site down to 939m TVDS in 1953.
- 5.14 Grove-3 encountered 63m of apparent gas bearing shales in the Bowland with Manton-1 intersecting 67m. No core or mineralogical data was taken across these formations on either well however total organic carbon (TOC) measurements from the Manton-1 cuttings show the presence of gas bearing shale. Gas shows were observed in Manton-1 across the Millstone grit with total gas increasing to up to 20% in parts. Neither well was tested although Everton 1, north of the Tinker Lane-1 site, successfully tested gas and condensate from a sandstone within the Millstone Grit Group.

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## **SEISMIC SURVEY**

- 5.15 PEDL12 and PEDL200 are situated in an area of reasonable to good seismic quality. All available data was licensed and reprocessed to enhance the geological understanding. By tying the seismic to offset wells both on the licences and in surrounding areas, an understanding of the subsurface geological structure including formation thickness and depth was estimated.
- 5.16 Analysis of the data confirmed a relatively simple geological structure in an area to the south of the primary Gainsborough Trough basin centre.

## **AREAS OF SEARCH**

- 5.17 Having reviewed the offset well and 2D seismic, a primary search area was defined spanning a region running NW-SE across the border of PEDL12 and PEDL200. This region defined the best position for the placement of an exploration well from a reservoir and structure point. This took into account factors such as geological structure as well as thickness and depth of the targets. The Area of Search is shown on Drawing TL5/01.

## **SITE SELECTION**

### **Background**

- 5.18 Within the Area of Search the site requirements remain the same as those which dictated the location of the Area of Search itself. Following identification of the most prospective area within PEDL 12 and PEDL 200 and review of all available 2D seismic surveys to assess the thickness of the target strata and geological structure the Area of Search was established, enabling detailed analysis of the area to find the most appropriate site for selection.
- 5.19 Evaluation of the Area of Search involved detailed desk-based assessment of the study area to appraise the development potential of sites within the area for the proposed wellsite. Sites identified have been weighed up against environmental and planning constraints which would have the potential to be effected by the proposed development.

### **Constraints Influencing the Site Selection Process**

- 5.20 Within the identified Area of Search, features and designations that have protected status have been identified in order to ensure that the proposed development does not unacceptably / disproportionately impact upon the following environmental and planning constraints:
- National Parks;
  - World Heritage Sites;
  - Areas of Outstanding Natural Beauty;
  - Special Areas for Conservation;
  - Special Protection Areas;
  - Ramsar Sites;
  - National Nature Reserves;

- Sites of Special Scientific Interest;
- Local Nature Reserves;
- Local Wildlife Sites;
- Nature Improvement Areas;
- Ancient Woodland;
- Air Quality Management Areas;
- Groundwater Source Protection Zone 1;
- Environment Agency Flood Zones 2, 3a, and 3b;
- Flood Zones from Strategic Flood Risk Assessment (SFRA);
- Scheduled Monuments;
- Listed Buildings;
- Conservation Areas;
- Registered Parks and Gardens;
- Registered Battlefields;
- Settlements;
- Residential properties – with a 200m buffer zone;
- Sensitive land uses outside of settlements, such as schools, nurseries, hospitals, care homes;
- Public Rights of Way (PROW); and
- Higher Grades of Agricultural Land Classification.

- 5.21 The desk-based assessment of the Area of Search incorporates a 2 kilometre buffer surrounding the Area of Search. It is considered that this method ensures that potential indirect impacts on features / designations and their setting which are located outside of the Area of Search itself are regarded within the scope of the desk-based assessment.
- 5.22 Drawings TL5/03 to 06 (see sections 5.25 to 5.43) show the locations of the environmental and planning constraints in relation to the Tinker Lane site and its setting with the Area of Search and surrounding buffer as defined above.
- 5.23 Based on the constraints mapping, the following key criteria have been identified as providing a basis for the identification of a suitable location for a potential wellsite. Ideally:
- Sites should be greater than 200m from residential properties, settlement boundaries and isolated sensitive land uses;
  - There should be no access constraints, including the presence of PROW on potential access routes;
  - Sites should not be located within designated sites of environmental protection;
  - Sites should not be located within designated sites of cultural heritage protection – or within 200m of listed buildings / scheduled monuments;
  - Sites should not be located within areas of Groundwater Source Protection Zone 1;
  - Sites at a lower risk of flooding should be selected if possible; and
  - Land with a lower agricultural land classification grade should be identified where possible.
- 5.24 Constraints affecting the above criteria are shown on the Drawings below along with a summary of the key findings.



## Constraints Mapping

### *Historic England Designations*

- 5.25 Drawing No. TL5/03 demonstrates that there are a number of Historic England designations dispersed throughout the Area of Search, predominately Grade II Listed Buildings. There are particular concentrations of Listed Buildings within the settlements of Oldcotes and Blyth. In addition to Listed Buildings within settlements, there are isolated Listed agricultural buildings dispersed throughout the Area of Search which act as constraints for a wellsite as their setting must also be considered as a planning constraint in addition to the Listed structure itself.
  
- 5.26 The Area of Search benefits from a lack of Scheduled Monuments and a very limited number of Grade I Listed Buildings. Although Listed Buildings do not have as high level of designation as Scheduled Monuments, the potential impact of a wellsite on Listed Buildings and their settings should be avoided wherever possible in order to maintain the heritage value of the feature.
  
- 5.27 As the Tinker Lane site is located at least 1.3 kilometres from the closest Listed Building, it is considered to have a significant buffer from Listed Buildings. This buffer is sufficient to minimise the potential for impact on Historic England designations. The dispersed nature of Listed Buildings across the Area of Search means that there are a limited number of accessible sites across the Area which benefit from such a sizeable barrier between the site and closest Listed Building.
  
- 5.28 Consideration has also been given in the site selection process to the potential for the proposed development to impact upon registered parks, gardens and battlefields. The potential for impact includes both direct and indirect impacts on the features themselves, and the cultural heritage value attributed to their setting.
  
- 5.29 There are no registered battlefields within the Area of Search and therefore there is no constraint. However, Sandbeck Park and Roche Abbey together form a large Registered Park and Garden designation which acts as a major constraint for the north-west extent of the Area of Search and the wider north-western area. The proposed wellsite is best located outside of the areas with the potential to negatively affect the setting of the designation. Similarly, although located outside of the Area of Search, Babworth Hall and grounds is a Registered Park and Garden situated approximately 2 kilometres west of the centre of Retford. The scope of the setting of the designation is somewhat open to interpretation, but the proximity of the south-eastern of the Area of Search to the feature adds to the cumulative constraints located in this area, including numerous urban land uses, flood risk, and Sutton and Lound Gravel Pits SSSI.
  
- 5.30 Based on the above, it is considered that the constraints in terms of site selection are not greatly limited by Registered Parks and Gardens. Sandbeck Park and Roche Abbey are the only potential feature of this nature that has the potential to be directly impacted upon by the proposed

development. The settings of Sandbeck Park and Roche Abbey and Babworth Hall have the potential for indirect impact, but these are located at the extremes of the Area of Search, with the vast majority of the Area of Search unaffected by Registered Parks and Gardens designations.

### *Natural England Designations*

- 5.31 Natural England protective designations incorporate the inventory of ancient woodland as well as Local Nature Reserves (LNR) and Sites of Special Scientific Interest (SSSI) designations. Drawing no. TL5/03 demonstrates that there are remarkably few Natural England designations located within the Area of Search.
- 5.32 The only pockets of ancient woodland identified are located towards the north-west of the Area of Search, in the vicinity of Sandbeck Park, Oldcotes, and Blyth. The south-eastern half of the Area of Search is free from ancient woodland constraints. Conversely, there are Local Nature Reserves located within the south-eastern half of the Area of Search situated east of Torworth, approximately 1.7 kilometres north-east of the Tinker Lane site.
- 5.33 The Area of Search itself contains a single SSSI which is located along the western bank of the River Idle. The SSSI is located almost 4 kilometres due south-east of the Tinker Lane site. Despite its high level / national designation, this is considered to be a more than adequate stand-off distance between the proposed wellsite and the SSSI. The location of the SSSI does however limit the opportunities for sites within the far south-east of the Area of Search as there are numerous built development constraints and areas of high flood risk in the area that would result in a likely unacceptable cumulative impact from a wellsite development in this far tip of the Area of Search.

### *Source Protection Zones*

- 5.34 The majority of the Area of Search is categorised as Groundwater Source Protection Zone 3 'Total Catchment' which is compatible with the proposed development. The Environment Agency groundwater protection policy (Groundwater Protection: Principles and Practice (GP3)) states that Inner Zone (Zone 1) Groundwater Source Protection areas are inappropriate for the development proposed. Therefore greater weight will be given to potential sites located outside of the zone of influence of Groundwater Source Protection Zone 1.
- 5.35 There is a single area of Groundwater Source Protection Zone 1 within the Area of Search, which has a radius of 50 metres and is located east of the village of Barnby Moor, towards the south-eastern end of the Area of Search. A buffer of Groundwater Source Protection Zone 2 is located surrounding the Zone 1 area to provide a significant level of constraint in this location.
- 5.36 The small isolated area of Groundwater Source Protection Zone 1 and its adjacent Zone 2 acts as a significant localised constraint in the Barnby Moor and Sutton cum Lound area of the Area of Search. However this is the only



location within the Area of Search and wider interest area that are constrained by groundwater protection to the greatest extent.

### *Residential Properties and Institutions*

- 5.37 As with most development of an industrial nature, it is preferential for both the operator and local people to locate new development in locations with a sufficient standoff to residential properties / institutions as not to have a potential significant impact on their amenity.
- 5.38 Drawing No. TL5/03 shows the settlements and isolated properties and farmsteads (with a surrounding 200m buffer) that are situated across the Area of Search and wider area of interest. 'Residential institutions' considered to be additional constraints alongside general settlements and residential properties includes caravan/mobile home parks that are intended for permanent residential use. The Area of Search is located across a predominantly rural area and contains few small rural villages, sparsely distributed farm properties, and one Caravan Park. This makes the vast majority of the Area of Search unconstrained by residential properties and institutions, which is to be expected as the Area of Search has been designed not to incorporate larger settlements, where it is clear that the constraints would be numerous and have the potential to impact upon many local people.
- 5.39 A potential constraint arising from the isolated properties and farmsteads located across the Area of Search is that these dwellings are typically found along rural roads which would otherwise be ideal locations for the proposed wellsite – as the wellsite requires access without unacceptably / disproportionately impacting upon nearby receptors. However, it is considered that there are sufficient sites potentially available that could meet the criteria set by the operator that can avoid unacceptable / disproportionate impact upon the wider area. The location of these sites can generally be summarised as with a greater proportion available in the north-west and central areas within the Area of Search, as opposed to the generally more constrained south-east section of the Area of Search. The south-east section of the Area of Search towards Retford is generally higher populated than the remainder of the Area of Search.

### *Non-Residential Uses*

- 5.40 Health services and education establishments within the Area of Search are all located within settlements (see TL5/06), namely: Blyth, Ranskill, Sutton cum Lound, and Retford. There are therefore no anticipated conflicts between health and education institutions and the proposed development, as sites within built-up areas are not considered appropriate by the Applicant.
- 5.41 The Area of Search is generally a mixture of Agricultural Land Classification (ALC) Grades 2 and Grade 3, which represent 'Good to Moderate' and 'Very Good' quality soils respectively. The mix of agricultural land grades present within the Area of Search is typical of the wider region. There is a corridor of ALC Grade 4 (poor quality) which follows the River Ryton along its course, in

the centre of the Area of Search. Drawing TL5/04 shows Agricultural Land Classification across the Area of Search.

- 5.42 Although the wellsite is not proposed to be spread across a wide surface area leading to the loss of swathes of agricultural land, it is appreciated that development involving the loss of agricultural land should be directed to lower ALC grades wherever possible in order to preserve the best and most versatile agricultural land. The presence of Grade 2 agricultural land within the Area of Search somewhat restricts the sites available to the Applicant in locations away from settlements, isolated rural properties and other built development constraints.
- 5.43 Whilst it is preferred practice to divert greenfield development towards the poorest ALC grades within the Area of Search, the location of the Grade 4 (poor quality) land is unsuitable for the proposed wellsite. This is because it is located entirely within such close proximity to the River Ryton that access is limited, and the ALC Grade 4 land is simultaneously that at highest risk of flooding.
- 5.44 On balance, with all of the poorest agricultural land inaccessible / at high risk of flooding, the site selection process should steer development away from the higher Grade 2 land and onto Grade 3, of which there is an abundance across the Area of Search.
- 5.45 Unlike the peatlands to the north of the Area of Search, flood risk within the Area of Search itself is predominately limited to land in the immediate vicinity of rivers, namely Oldcotes Dyke in the west of the Area of Search, the River Ryton running south-north through the centre, and the River Idle in the east. There are a very limited number of pockets of land at 'high' risk of flooding (annual probability of flooding of 3.3% or greater) which are dispersed across the Area of Search and usually located where there are existing waterbodies.
- 5.46 Based upon the constraints mapping evidence, there is overall a very limited proportion of the Area of Search which is not a preferred location for the proposed wellsite due to flooding concerns. Although the wellsite is a 'less vulnerable' land use which is compatible with higher flood risk zones, it is nevertheless an objective of the Applicant to divert new greenfield development to lower risk areas wherever possible.
- 5.47 Aside from the 'high' risk areas shown on Drawing TL5/05, the Plan shows 'medium' and 'low' risk areas which despite being preferential to high risk areas, retain a risk from flooding that the residual areas of the Plan are not constrained by. Therefore, where possible, the wellsite should be diverted to areas which have a lower than 0.1% annual probability of flooding. As Drawing TL5/05 shows, flood risk is not considered to be major constraining factor in the site selection process, due to the relatively low coverage of flood risk areas across the Area of Search.

### *Public Rights of Way*

- 5.48 There are numerous footpaths and bridleways, and a limited number of byways, located across the Area of Search which are designated public rights of way. The proposed wellsite has the potential to impact upon the integrity of the public rights of way directly and indirectly in terms of directly crossing the public right of way and indirectly through visual impact. For the protection of the public rights of way integrity within the site selection process, all footpaths, bridleways and byways were weighted equally, as there are sufficient swathes of the Area of Search with no potential for impact upon public rights of way – therefore, there is no requirement to protect one type of public right of way over another.
- 5.49 The location of public rights of way within the Area of Search and wider area of interest is shown on Drawing TL5/06. Generally, there is a greater number of public rights of way in the south-eastern section of the Area of Search, particularly east of the railway line. There is another conglomeration of public rights of way around the village of Blyth. The criteria / requirements of the Applicant in selecting an appropriate site within the Area of Search (rural location, accessibility) mean that it is quite likely that a potential site will impact upon public rights of way. However, Drawing TL5/06 shows that there are many sites within the Area of Search with access to the strategic highway network and which are not located in close proximity to public rights of way.
- 5.50 In terms of negating impact upon public rights of way, sites along the A60 north of Oldcotes and along the A634 west and east of Blyth offer potential for access to A-class roads without impacting upon nearby public rights of way.

### **Assessment of Sites within Area of Search**

- 5.51 Underpinning the environmental and planning constraints identified on the above Constraints Maps, the requirements of the site such as the sub-surface geology/strata, availability of sites, and logistics are weighed against any potential for impact on surrounding land uses.
- 5.52 Assessment of the Constraints Maps has shown that there are a limited number of appropriate areas within the Applicant's Area of Search that meet all of the criteria and requirements for the proposed well site.
- 5.53 The site requirements of the proposed wellsite are demonstrable at few alternative sites within the identified Area of Search. There are limited pockets of land within the Area of Search that are also relatively free from constraints and have the potential to be appropriate for the proposed development. These are located in the following areas:
- The A60 north of Oldcotes;
  - The A634 west of Blyth; and
  - The A634 east of Blyth at Graves Moor Lane/Long Brecks Lane.
- 5.54 The above areas have been vetted within the site selection process for their compatibility with a proposed wellsite, and have been assessed as being less appropriate in comparison with the Tinker Lane site. All of the above

alternative areas benefit from access onto an A-classification public highway and are within PEDLs 12 and 200. However all are located within closer proximity to sensitive residential receptors than the Tinker Lane site. Additionally, the A60 site is located within an area with the potential to impact upon the setting of Sandbeck Park. The preferred A634 site at Tinker Lane is the most isolated of all potential sites and is considered to be the most appropriate when weighed against all of the criteria.

### CONCLUSIONS

- 5.55 Despite the alternative sites listed above benefitting from a limited number of environmental and planning constraints, the site requirements for the proposed wellsite extend further than a relatively constraint-free site. Upon consideration of the logistical, topographical, geological, and other requirements of the Applicant, it can be concluded that the Tinker Lane site is the preferred option and is best equipped to accommodate the proposed wellsite.
- 5.56 Having considered the findings of the constraints mapping and weighed potential opportunities for development against planning policy and guidance, the Tinker Lane site has been assessed to be the preferred choice for the following main reasons:
- The site is directly accessible from an A-class road (A634) with only some upgrade works required to an existing access;
  - The site is not located within any statutory ecological designation;
  - The site is significantly in excess of 200m from residential and other sensitive properties and any settlement boundary; and
  - The site is not crossed by a PROW.
- 5.57 In short, the Tinker Lane site can demonstrate that all of the key criteria identified in this section are met, and has the fewest number of constraints. It is therefore considered that the Tinker Lane site is most appropriate to deliver the requirements of the site selection criteria whilst not proposing an unacceptable / disproportionate adverse impact upon surrounding land uses.