

**Planning application no. SDNP/13/05896/CM**  
**by Celtique Energie to drill at**  
**Fernhurst, West Sussex:**  
**Additional comments on environmental statement**  
**in the context of relevant geology and hydrogeology**

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## NON-TECHNICAL EXECUTIVE SUMMARY

I have been asked by Lynchmere Parish Council to supply it with comments on the additional information furnished by the Applicant in response to the request by SDNPA for such information. My new comments also take into account the report on unconventional hydrocarbon resources of the Weald published by the BGS in May 2014. The present report is ancillary to my report dated 25 January 2014, and should be read in conjunction with the latter. This report is also being submitted in its own right as an **OBJECTION** to the development.

SDNPA asked the Applicant to demonstrate, *inter alia*, the 'exceptional circumstances' that have led the Applicant to choose a particular locality within the SDNP; why areas elsewhere within PEDL231 are unsuitable; why areas within other licence blocks of the Weald licensed to the Applicant are unsuitable; why no other area within the Weald Basin, including areas not licensed to the Applicant, is suitable; and why the Weald Basin itself comprises an 'exceptional circumstance'. The Applicant has failed to supply any satisfactory information in answer to the request. Having thoroughly assessed the additional information furnished by the Applicant, I have come to the conclusion that the Applicant continues to mislead the SDNPA as to the true purpose of the exploration, which is the extraction of unconventional oil from a wide area of the Weald. This purpose is revealed by a letter from the Applicant to DECC dated December 2011, reproduced herein.

The removal of the contingent horizontal well from the original application makes no difference to the overall nature of the proposal. The target geological layers remain a limestone within the Kimmeridge Formation, the Kimmeridge Clay itself, and deeper Lias shale. To be developed, all would require fracking.

There are serious internal inconsistencies of geological interpretation within the application; these are not only misleading, but demonstrate that the Applicant's technical work is of substandard quality. The errors include depths to layers being in error by the order of 100 m or more; this is simply unacceptable.

The Applicant has refused to answer the questions put to it, and is choosing to restrict itself to describing activities which will require between 21 to 38 weeks to carry out; this is less than half the time in the original proposal which included the horizontal well. But the period being sought for planning permission remains at three years. The suspicion is raised that once on site the Applicant will seek to add in extra project work such as horizontal drilling and fracking, perhaps obtaining permission without having to involve the planning process. The Applicant has not definitively ruled out the need for fracking. Celtique Energie should have responded to the request for further information with evidence to show that fracking is unlikely to be required, citing as examples other basins in the world; but such examples do not exist.

The geology of the exploration programme that the Applicant has drawn up is spurious, involving fanciful but non-existent variations of rock porosity over the licence area, inaccurate descriptions of layer thicknesses and lithologies, while avoiding mention of how the very low permeability of the oil-producing formations will be enhanced.

In my view the SDNPA was wholly justified in its request for additional information. The evasive and blunt manner by which the request has been rebutted or simply ignored may well be sufficient reason to refuse the application. The attitude of non-compliance also calls into question the good faith of the Applicant. There is no doubt in my view that extensive fracking would eventually be required to make the exploration project commercially viable, and there is no doubt that such a development would turn the licence area into a semi-industrialised landscape dominated by heavy traffic.

It would be reasonable and rational to refuse the application on the grounds that the proposed work has not been adequately described, or else has been misleadingly described, and that the additional information requested is inadequate for the purpose of determining the application. Perhaps legal opinion should be sought as to whether allowing the application in spite of these material errors may expose the council to judicial review.

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### 1.1 Additional information

The South Downs National Park Authority (hereinafter SDNPA) requested further information from Celtique Energie Weald Limited (hereinafter Celtique, or the Applicant) in two letters dated 12 March 2014 and 19 March 2014 respectively. Independently of the progress of the application, the British Geological Survey (hereinafter BGS) published a report on the unconventional resources of the Weald Basin (Andrews 2014).

The present report is ancillary to my report dated 25 January 2014 (Smythe 2014), and should be read in conjunction with the latter.

### 1.2 Request for additional geological information

The SDNPA letter to the Applicant dated 12 March 2014 stated:

***"Consideration of Alternatives and demonstration of 'Exceptional Circumstances'***

*The site search methodology is flawed as the determining factors are the geology and landownership issues and not environmental considerations ... It also fails to consider alternatives outside the designated area, which is a requirement of para 116 of the National Planning Policy Framework.*

*The application as it currently stands does not give sufficient consideration towards the statutory purposes and duty of the South Downs National Park ... exceptional circumstances must be demonstrated for major development proposed in National Parks.*

*Therefore, a revised site assessment is required which should, in order to demonstrate the cost of, and scope for developing outside the designated area, or meeting the need for it in some other way:*

- *Include consideration of alternative sites outside the South Downs National Park, including other areas which are not subject to a national landscape designation (this should*

*not necessarily be restricted to license [sic] areas or the Weald Basin);*

- *Provide evidence as to how the alternative sites identified above have been evaluated in terms of suitability for oil and gas exploration;*
- *Provide evidence of any comparative evaluation that has been carried out in respect of those alternative locations; and*
- *Use environmental factors as the main determinate [sic] of site suitability."*

It is evident from this request that the SDNPA wants the Applicant to demonstrate the 'exceptional circumstances' that have led the Applicant to conclude:

1. Why the particular locality within the SDNP has had to be selected.
2. Why areas elsewhere within PEDL231 are unsuitable.
3. Why areas within other licence blocks of the Weald licensed to the Applicant (viz. PEDL234, PEDL243 and PEDL232) are unsuitable.
4. Why no other area within the Weald Basin, including areas not licensed to the Applicant, is suitable.
5. Why the Weald Basin itself comprises an 'exceptional circumstance'.

### **1.3 Information that should have been provided**

Celtique Energie is, according to its website, a "*privately owned, British based, oil and gas exploration and production company. We have subsidiaries and operations across six European countries*". It has a book value, or net asset worth, of £7.6M. In oil company terms, this is tiny; a so-called 'minnow' oil company could be defined as one valued at under \$100M. So this implies that the Applicant has the resources to specialise in just a few onshore exploration projects at any one time.

A full and adequate explanation in answer to the five questions posed above should have started with a statement as to why the onshore UK was selected, and not one of the other five European countries. It would then have needed to justify why it applied for three blocks on offer in the Weald for which it would be the Operator (in addition to being a minority partner in other blocks in Cheshire and Lincolnshire which were awarded at the same time). The three contiguous licences are made up out of 10 Ordnance Survey 10 km<sup>2</sup> blocks as shown in pink in

Figure 1, of which there were about 1000 on offer in the 13th onshore licensing round of 2008.

Note from inspection of Figure 1 that DECC does not employ any social or societal filtering of the areas it offered in 2008; the pink blocks are simply where the sedimentary basins exist. For example, Celtique could have applied for the pair of blocks TQ27 and TQ37 comprising Westminster and Kensington, west to Chiswick, south over the Thames down to Wimbledon, east over to Streatham and Catford, and back up north to Greenwich and onto the Isle of Dogs. But the acquisition of such a licence would not confer any automatic right to drill in, say Richmond Park or Greenwich Park. In other words, Celtique's argument that:

- It is restricted to exploring within its licence area (Planning Statement, para. 9.16c),
- The target hydrocarbons lie where they are and cannot be moved (paras. 9.16d and e),
- In its opinion the only place it can drill is within the SDNP (para. 9.16e), and
- It should therefore be permitted to drill within the SDNP

is false, because the Applicant is implying that its Petroleum and Exploration Development Licence (PEDL) has given it the authority to drill somewhere. In fact the granting of a PEDL does no such thing, as the example given above of a hypothetical licence in the centre of London demonstrates.

In essence what is missing from the Applicant's planning statement (whether in its original or revised form) at this level of overview is any mention of its exploration strategy, or justification as to why the Weald Basin was selected from the dozen or more basins in England and Scotland on offer for licensing at that time (Fig. 1). Transparency in this regard would have led to a statement such as:

*"The structurally low area of the central Weald Basin has no conventional traps, but is a vast resource for unconventional shale oil in the Kimmeridge Clay and Lias (Lower Jurassic)."*

Instead, the Applicant has been evasive and misleading in its discussion of whether it is seeking conventional or unconventional hydrocarbons.

An essential element of the Applicant's explanation of why the wellsite has to be located at

Fernhurst would have been an interpreted seismic line through the wellsite showing the particular geological structure there that justifies further study. But no extra seismic data have been provided; on the contrary, the only sample of such data, which was supplied in the original application, is not even within the licence area of PEDL231.

In place of providing this further information, the Applicant has tried to explain at length why the chosen site cannot be targeted by a well drilled just outside the SDNP, but deviated towards the target within the park. This argument is digressionary and irrelevant since it has failed to justify the target *a priori*.

#### **1.4 Letter demonstrating intent to explore unconventional resources**

A letter from Celtique to DECC dated 15 December 2011 (reproduced in the Appendix) reveals that the chief prospects in PEDL234 are **unconventional**:

*“The best quality Liassic source rocks with the highest maturity lie in the central licence, PEDL 234,*

*...*

*As we have shown in the presentation we gave you, the unconventional prospectivity we have defined at Kimmeridgian [sic], Middle Liassic and Lower Liassic levels are all laterally extensive. The rich, mature source rocks will extend well outside any areas we will be able to retain after the relinquishment at the end of the First Licence Period. As a result our planned drilling will prove the plays extending into acreage within our licence and beyond. Within our licence area we will be forced to relinquish an unconventional trend proven by drilling, under the 50% area relinquishment rule.”*

This letter proves that the Applicant is seeking unconventional resources, or plays, within PEDL231. It also demonstrates that these plays are very large, of the same order of area as a DECC licence block. This fact makes a mockery of the site selection exercise, which is discussed in the next section.

The letter demonstrates that the Applicant entered a firm commitment to drill one well in each of the three contiguous blocks. If the commitment had been so-called 'drill or drop' then the

licences would have had to have been relinquished by now. But the commitment given to DECC to drill does not imply that the planning authorities must grant permission to drill at any place chosen by the Applicant, nor even, necessarily, anywhere within the PEDL. In fact, as the letter quoted above shows, the Applicant was seeking to modify the terms of the three licences such that three wells would be drilled, but not necessarily one per licence area.

## 2.1 What new information has been supplied?

I stated in my initial objection paper that the only semblance of any geological detail is provided in Celtique's planning application, chapter 4:

*"4.53 ... the 8½" hole is drilled with some **coring in the Kimmeridge Clay and Kimmeridge Limestone**, to the top of the Upper Lias at which point 7" casing is then run and cemented to surface to isolate the Kimmeridge, Corallian and Oxford Clays. Finally, a 6" hole is drilled to the **target Middle Lias, and cores taken.**" [my emboldening]*

Nothing in the additional information clarifies what the targets are. The only extra information provided is that Celtique is now overtly targeting oil rather than gas, and that the contingent horizontal well proposal has now been dropped without explanation. By this act, the suspicion is reinforced that the Applicant is 'salami-slicing' a progression towards fracking.

A new paragraph has been inserted into chapter 11A (Ground and groundwater protection), as follows:

*"11.28a Geological information is available from published BGS mapping and the records of two 'offset' hydrocarbon exploratory boreholes, that is, boreholes drilled previously in the same area to a similar depth by third party operators. The relevant boreholes are at Godley Bridge and Baxter's Copse (Figure 11.2). The records include lithological and petrophysical data reference the formations penetrated."*

The figure 11.2 cited here must be the same as the original figure 11.2, because no updated version has been made available. I have kept images of the SDNPA web pages listing the documents available, as of 25 June 2014, as proof of this statement.

No information is provided to justify the statement that the two wells cited are "*relevant*". They do not appear on the Applicant's figure 11.2; in fact they are way off the map, as shown in Figure 2 herein. PEDL231 is shown by the green square. The smaller rectangle with the proposed well at the centre is the area covered by the Applicant's figure 11.2. Note that the "*relevant*" wells, Godley Bridge and Baxter's Copse, are a long way outside the area of figure

11.2. There are two vertical Godley Bridge wells, plus a horizontal Godley Bridge 2Z, therefore it is unclear to which of these three wells the Applicant is referring. Why are these two, and only these two, wells relevant? They lie at about 11 km distance from the proposed wellsite, whereas other existing wells are closer.

## 2.2 Well data on the Kimmeridge limestones

All the exploration wells shown in Figure 2 are likely to have had at least a basic set of wireline geophysical logs run just after they were drilled. These include the logging tools from which porosity can be estimated. So it is again unclear why the Applicant fails to refer to this publicly available information when discussing porosity of the Kimmeridge limestones.

The BGS Weald report (Andrews 2014, Appendix F) provides 'fence diagrams' linking many of the wells in the Weald. For each well there is portrayed a column indicating the rock type, with a wireline log graph on either side. To the left the log is the gamma ray (or spectral gamma ray in the case of Baxter's Copse 1), while to the right there is a sonic log. These two logs can be used to estimate porosity of the limestones. The revised chapter 4 states:

*"In a similar central basin location to the east of the proposed well location, for example in Balcombe-1, a previous well drilled in 1986 has shown fair porosity with oil shows in the Kimmeridge Limestones. However, wells drilled outside of the current SDNP boundaries at the basin edges, such as Coxbridge-1 drilled in 1994, showed there to be little or no porosity in the Kimmeridge Limestones, in addition to the layers being thinner." [para. 4.20]*

Figure 3 shows an extract from the BGS geology map with locations of 'fence diagrams' linking wells in the Weald (Andrews 2014). The added labels 'thinner' and 'thickest' refer to the thickness of the Kimmeridgian limestone sequence relative to the four wells around the Fernhurst wellsite linked by a red quadrilateral. The logs of these four wells are shown in the next figure. There are generally two Kimmeridgian limestones, an upper one (the I-micrite) and a lower one (the J-micrite). In the extreme east of the map area shown there is also a thin K-micrite recognised below the J-micrite.

There is a general increase in thickness of the I-J sequence towards the east to the area north of the Balcombe-1 well (BAL). In addition, the thickness of the upper I-micrite achieves a

maximum thickness of over 40 m in the area labelled 'thickest', between the CFM (Collendean Farm-1), BAL (Balcombe-1) and SWA (Southwater-1) wells.

Figure 4 shows a comparison of four logs spanning the Kimmeridgian limestone sequence (the two green layers). BOR - Bordon-1; GB1 - Godley Bridge-1; ROG - Rogate-1; BAX - Baxter's Copse-1. The four wells are the nearest existing wells to the proposed Fernhurst wellsite for which the BGS has published the logs. The vertical scale of the Godley Bridge log has been reduced by 10%, while the Baxter's Copse log has been expanded by 25%, relative to the two logs on the left, to enable easy comparison. The vertical scale adjustment compensates for the fact that the Godley Bridge-1 sequence is 10% thicker, and the Baxter's Copse-1 sequence 20% thinner, respectively, than the Bordon and Rogate sequences shown on the left in Figure 4.

Figure 5 is an overlay of part of the well logs for Coxbridge-1 and Bordon-1 covering the two Kimmeridgian limestones I and J. The Coxbridge well is 11 km north of the Bordon well (see Fig. 3). The vertical scale of the former has been expanded by 127% so that the logs can be compared; in other words the thickness of the Coxbridge geological sequence is about 20% thinner than that at Bordon. The two wireline logs are remarkably similar; the sonic logs are essentially identical, and the gamma ray logs are closely similar, except that Coxbridge is offset about 10 API units higher (to the right). This is not significant, and may be due to instrumental or borehole factors, and not to a uniformly increased radioactive content. Below the J limestone the gamma ray reading in the shale is, however, slightly higher.

The conclusions which can be drawn from the data discussed above follow next.

### **2.3 Discussion of the Kimmeridge limestones**

The Applicant's revised planning statement states:

*"4.20 The Kimmeridge Limestones are interpreted to be near to their thickest (>100ft) in this central region of the Weald Basin. A thick layer is targeted because it gives more reservoir volume. A thick porous reservoir may potentially increase the total storage capacity for oil or gas, if found to be present, therefore it is necessary to test and acquire data at the basin centre. In a similar central basin location to the east of the proposed well location, for example in Ba1combe-1, a previous well drilled in 1986 has shown fair porosity*

*with oil shows in the Kimmeridge Limestones. However, wells drilled outside of the current SDNP boundaries at the basin edges, such as Coxbridge-1 drilled in 1994, showed there to be little or no porosity in the Kimmeridge Limestones, in addition to the layers being thinner. Therefore, outside of the SDNP, the target horizon is not thick enough and has little or no porosity. It is also the porosity variations within this Limestone layer that provides a trap to stop the oil migration out of the basin centre that may retain hydrocarbons at the location proposed by Celtique."*

I am assuming in this discussion that the wire logs discussed in the previous section are sufficient for an estimation of limestone porosity, and that the Applicant does not have access to additional undivulged data which might lead to a modification of the standard industry method.

Porosity, the proportion of void space available to trap fluid, is clearly an important factor in reservoir potential estimation. Coccolith limestones, of which the Kimmeridgian micrites are an example, can have very good porosity while at the same time having negligible permeability. This latter parameter is a measure of the interconnectedness of the pore space; that is, how well the fluid can move through the rock. The limestones in question are 'tight', which means that they have very little or no permeability (whatever the value of porosity may be). The only feasible way to extract significant quantities of hydrocarbons (in this case, oil) is to frack the limestone and the shales above and below. Acid treatment of just the limestone (which dissolves in strong hydrochloric acid) is insufficient.

The Applicant has made no mention of permeability. On the question of the supposed porosity variations in the limestones in the Applicant's statement quoted above, Figure 4 demonstrates from the well logs that the porosity is essentially identical in the four wells. Figure 5 further demonstrates that this constant porosity extends north to the Coxbridge-1 well. Therefore the assertion that porosity variations have guided the site selection process is false. The porosity is effectively much the same over the whole central and eastern part of PEDL231 and beyond to the north and east.

Since the Applicant describes the porosity in Balcombe-1 as "*fair*", then the porosity over the whole central region of the basin is also 'fair'; this is based on inspection and comparison of the

logs from this well with thirteen other wells west of Balcombe, as published by the BGS. The thickness of the two limestones does, however, vary, as the Applicant states, and thicker is better from the oil trapping perspective. But again, this thickness variation is gradual, varying by the order of 10% within PEDL231, and becoming progressively thicker to the east (the green arrow in Figure 3).

In conclusion the statement by the Applicant that *"outside of the SDNP, the target horizon is not thick enough and has little or no porosity"* is untrue and misleading. There is no justification whatsoever for siting the proposed well within the SDNP on grounds of favourable limestone properties. If anything, the north-east quarter of the licence area is more favourable in this respect.

## **2.4 Secondary targets; Kimmeridgian and Lias shales**

Chapter 4A, Project description states:

*"A 6" hole is then drilled and cored to the target depth of just over 8,400ft MD [2560 m MD] taking cores in the Upper and Middle Lias formations."* [para. 4.53]

Chapter 11A states:

*"11.31a In terms of hydrocarbon exploration and evaluation, the primary targets are the Kimmeridge Limestones. Secondary targets are the Kimmeridge Clay and the Middle Lias."*

One of the most important exploration criteria for these unconventional 'plays' is the net thickness. Figure 6 shows the estimated net thickness of mature target Kimmeridge Clay from the new BGS map (Andrews 2014, appendix G, fig. 38). The contours have been traced from the map after colour conversion to 8-bit, which displays the colour spectrum of the original images in discrete bands. The Kimmeridge Clay is up to about 300 m thick. The hatched area is the outer limit of the shale, and the thickness increases smoothly towards a maximum within the lilac area. It is evident that the proposed drillsite, although within the mature Clay zone, is nowhere near the area of maximum thickness.

Apart from Tables 11.1 and 11.2 tabulating rock depths and lithologies, the quotations above are the only mention of the secondary target, the Upper and Middle Lias. The original chapter 4

stated that *"Finally, a 6" hole is drilled to the target Middle Lias, and cores taken."* Again, no further details were provided. But I pointed out (Smythe 2014, section 2.5) that Celtique had made an explicit comparison of the Middle Lias with the unconventional Bakken play of North America. I also pointed to the similarity of the Fernhurst primary search area and Celtique's maturity map contours (Smythe 2014, fig. 14).

Figure 7 shows the estimated net thickness of mature target Middle and Upper Lias from BGS maps (Andrews 2014, appendix G, figs. 29, 30). Contours have been traced from the maps after colour conversion to 8-bit, which displays the colour spectrum of the original images in discrete bands. The Middle Lias area shown in lilac is up to 19 m thick; the Upper Lias up to 35 m thick. The dotted line is the outer limit of the two mature shales. The thickest areas both lie towards the southern margin. As with the Kimmeridge Clay, the areas of maximum thickness are nowhere near the proposed wellsite.

## **2.5 Oxford Clay, Kellaways Beds and Cornbrash**

Coring of the Oxford Clay, Kellaways Beds and the Cornbrash is shown in Chapter 4a, Schematic 4.2A, as an objective of the drilling, but there is no mention of these layers in the text.

## **2.6 Conclusions on site selection**

The primary targets, the two Kimmeridgian limestones or micrites, and the secondary targets, the Kimmeridgian and Lias shales, are all unconventional plays. Production from any or all of them will require fracking. A Kimmeridgian limestone is a good target for this type of exploitation because it is hard and may have some intrinsic fracture permeability. But fracking will be required, and the fracks must penetrate into the Kimmeridge shale above and below the limestone in order to feed the horizontal wells with oil.

The thicknesses of the three mature shales each vary in a smooth and gradual way over the western Weald Basin. None of the three shale layers reaches a maximum thickness at or near the proposed site. In conclusion, there is no possible geological or exploration justification for drilling within the SDNP. The site selection has been made on opaque grounds, which, whatever they may be, have little or no connection with the 'best' geology.

### 3.1 Cross-section through the proposed well

Figure 2 shows the location of a north-south cross-section through the proposed well. The cross-section is shown in the Applicant's figure 11.3, 'Indicative Geological Structure'. Figure 8 shows this cross-section split apart at the borehole location to allow insertion of a geological column. The upper diagram shows a geological column taken from Celtique table 11.1, 'Expected Geological Sequence', showing the expected depths to the various layers. These figures have not changed in the revised chapter 11. Allowance is made for the site elevation of 70 m above sea level, and the height of the drilling platform, about 7 m above site level, from which these depths are measured. Figure 8 shows that the depths to the Base of the Weald Clay are reasonably consistent, to within about 10 m, but the deeper layers are grossly in error. Either the table is wrong or the cross-section is wrong; the top of the Wadhurst Clay (red cross-hatching) is 80 m deeper according to the table, as compared to the cross-section; the Grinstead Clay (green cross-hatching) is 34 m thick according to the table, but about 125 m thick on the cross-section.

The Upper and Lower Tunbridge Wells Sand layers, between which the Grinstead Clay is sandwiched, are labelled the wrong way round (red boxes). The horizontal scale shows units which are clearly in metres and not kilometres.

The lower part of Figure 8 shows the Weald Clay as a column, taken from the BGS contour map which forms part of the Haslemere solid geology Sheet 301 (British Geological Survey 1981). The -250 m contour (negative, because depths are measured upwards from sea level) of the base of the Weald Clay runs through the proposed well location. This depth, marked by the horizontal line at the base of the column in Figure 6, is 100 m higher than the -350 m depth shown by the Applicant.

### 3.2 Shallow geological structure through the proposed well

Not only are the depths and thicknesses shown on the Applicant's figure 11.3, 'Indicative Geological Structure' in serious error, but the main features of the structure are misleading as

well. I have reconstructed the cross-section using the BGS 1:50,000 geology sheet and the OS digital terrain model. This is shown in Figure 9 as overlain lines on the Celtique cross-section.

The line colouring is:

- Correct topography (black)
- Correct Base Hythe Beds (blue)
- Correct Base Atherfield Clay (green)
- Correct Base Weald Clay (brown)

The two versions of the topography match closely, confirming that there is no lateral positioning error to north or south. Axes of synclines and anticlines (down-folds and upfolds of the layers) are indicated by an X and by a diamond, respectively. The blue and green lines shown above ground level indicate the 'ghost' structure before the rocks in the central valley between the two scarps were eroded away. The coloured arrows at the left-hand side indicate the correspondence between the Celtique horizons (boundaries between layers) and the re-drawn lines.

There are positioning errors in the outcrops of the rocks below the northern scarp, in that the Atherfield Clay crops out several hundred metres south of the location shown by Celtique. The Celtique structure of a simple anticline has been oversimplified. If account is taken of the various structural axes shown by the BGS then the structure is flatter in the central valley area. The culmination of the structure, or high point, is not in the area of the proposed well, but in fact lies about 3 kilometres to the south. The most serious error is in the overestimate of the Weald Clay thickness by 100 to 150 m, or 30-50%.

Lastly, the location of the proposed well itself is mispositioned on the cross-section, being shown as 400 m north of its actual location.

### **3.3 Thickness of the upper Kimmeridge limestone**

The Kimmeridge Clay layer separating the two Kimmeridge limestones, missing in the original chapter 11 table 11.1, was inserted in the revised chapter 11A table 11.1. According to both versions of the table the thickness of the upper limestone is prognosed to be 82 m, by conversion from 270 ft. This is an error in the table which should have been corrected. The

depths to the top and bottom are 4513 ft and 4613 ft, respectively, so the thickness should have been calculated as 100 ft, not 270 ft. This converts to 30 m, and corresponds well with the thicknesses shown in Figure 4.

### **3.4 Conclusions on geological inconsistencies**

I have concentrated on the geological cross-section of figure 11.3 and the table of geological depths of table 11.1, because these are the only substantive data provided by the Applicant. As shown above, they are full of errors, both in terms of internal consistency and of mismatch with published data such as exploration well logs and BGS geological maps.

#### 4.1 Request for further information

The SDNPA letter to the Applicant dated 12 March 2014 stated:

*"Further Information:*

*The ES should consider all aspects of a project over its lifetime to ensure that full consideration of potential environmental impacts has been taken. In this instance, it should consider the whole exploration process and if hydraulic fracturing is a necessary requirement of exploration, then it should be considered by the ES and as part of the application.*

*Paragraph 118 (ref ID:27-118-20 140306) of the Planning Practice Guidance for Onshore Oil and Gas (July 2013) which states that 'as far as it is practical to do so, any application for exploratory drilling should cover as much of the exploratory activity as possible, including the likely number of wellheads and extent of drilling, to avoid further planning applications at a later date'.*

*Likelihood of hydraulic fracturing*

*The application (paragraph 4.2 of the ES) states that "For the avoidance of doubt, the planning application is for a conventional exploration well and does not seek permission for, or require the use of, hydraulic fracturing". This is in line with the pre-application advice provided by the Authority in July 2013. To provide certainty the following information is required:*

- A full and detailed explanation, backed up by evidence that the current application and ES considers the whole exploration phase and not just part of it, particularly where any part of exploration may indeed require hydraulic fracturing.*
- Evidence to confirm whether hydraulic fracturing is necessarily an inevitable requirement at the exploratory stage for shale gas/oil."*

It is clear from the above that SDNPA requires an overview of the whole project, which could last for a generation, and in particular is concerned about the probability of fracking.

The Applicant's response remains unchanged from the original Planning Statement of November 2013 to the Revised Planning Statement of April 2014:

*"4.13 From this evaluation it will be possible to establish whether hydraulic fracturing might be required in the future, although no hydraulic fracturing will be used as part of this exploration activity and therefore, does not form part of this planning application."*

However, the Applicant has added to the Revised Planning Statement:

*"6.46 an exploration application that does not involve hydraulic fracturing is unlikely to require an EIA. In addition, individual applications should be considered on their own merits and should not consider hypothetical future scenarios."*

#### **4.2 Comments on the likelihood of fracking**

The Applicant has refused to answer the questions put to it, and is choosing to restrict itself to describing activities (table 4.3) now requiring between 15 and 28 weeks. Although the original project description called for a total of 29 to 72 weeks if the horizontal well was drilled and tested, the overall planning permission period requested remains at three years. It is difficult to see why the worst case scenario of 28 weeks, plus at most 10 weeks of restoration, as calculated in the revised project description, should require planning permission for 156 weeks, the three-year period for which the planning application would apply if consent were granted.

The suspicion is raised that, once established on site for three years, and when only 21 to 38 weeks of activity is currently proposed, the Applicant will seek to add in extra project work such as horizontal drilling and fracking. It is noteworthy that nowhere has the Applicant definitively ruled out the need for fracking. Presumably it expects or hopes that the current weak UK regulatory process will enable it to bypass local planning authorities in future, and obtain legal permission via more central agencies of the government. Alternatively the Applicant may be anticipating favourable changes in the law, including the obligation to surrender 50% of the acreage awarded after the initial licence term has expired. This last requirement was alluded to in the letter to DECC reproduced in the Appendix herein.

Celtique Energie should have responded to the request for further information with evidence to show that fracking is unlikely to be required, citing, for example, other basins in the world where similar alleged configurations of stratigraphy, porosity and permeability are being successfully exploited without fracking. But the fact is that such examples do not exist. On the

contrary, Celtique's own web pages in 2012 discussed the north American Bakken play (limestone sandwiched between shale) as a successful analogue. These pages, since removed, have been summarised in my previous report (Smythe 2014, section 2.5). The Bakken formation was first drilled in about 1952, and horizontal drilling without fracking was tried unsuccessfully between 1987 and 1993. It was only when fracking was introduced in 2000 that the Bakken has developed into a major unconventional oil producer.

In summary the geology of the exploration programme that the Applicant has drawn up is spurious, involving fanciful but non-existent variations of rock porosity over the licence area, inaccurate descriptions of layer thicknesses and lithologies, and no comment on how the very low permeability of the oil-producing formations will be enhanced.

In my view the SDNPA was wholly justified in its request for additional information. The evasive and blunt manner by which the request has been rebutted or simply ignored may well be sufficient reason to refuse the application. The attitude of non-compliance also calls into question the good faith of the Applicant. There is no doubt in my view that extensive fracking would eventually be required to make the exploration project commercially viable, and there is no doubt that such a development would turn the licence area into a semi-industrialised landscape dominated by heavy traffic.

## REFERENCES

Andrews, I. J. 2014. *The Jurassic shales of the Weald Basin: geology and shale oil and shale gas resource estimation*. British Geological Survey for Department of Energy and Climate Change, London, UK.

British Geological Survey 1981. *Haslemere Sheet 301. 1: 50,000 series solid and drift edition*.

Smythe, D. K. 2014. *Planning application no. SDNP/1305896/CM by Celtique Energie to drill at Fernhurst, West Sussex: Critique of environmental statement in the context of relevant geology and hydrogeology*. Report and objection to SDNPA, 25 January 2014, 60 pp.

## APPENDIX

# Celtique Energie Weald Ltd

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Thursday 15<sup>th</sup> December 2011

Dear [REDACTED]

It was good to meet with you at your offices on 30<sup>th</sup> November. We found our discussions very useful.

At that meeting we discussed two key issues; well obligations and relinquishment at the end of the first licence term.

On our Central Weald Licences (PEDLs 231, 234 and 243) we currently have an obligation to drill one well on each licence in order to be eligible to hold each licence into the second licence term. However, as we explained, there are technical reasons as well as planning permission constraints that lead us to formally request your approval to modify the obligation to a floating obligation to drill three wells across three licences, not one well in each Licence.

The technical reasons are predicated on the following:

- The best quality Liassic source rocks with the highest maturity lie in the central licence, PEDL 234,
- The most attractive Triassic conventional prospects lie to the east as does the Kimmeridgian oil shale potential,
- The planning permission problems have become more difficult in the west with the creation of the South Downs National Park. As a result we now realise that the already slow process of getting permissions has slowed even more and this means that whilst planning permission should eventually be obtainable, the timing is such that approvals will not be forthcoming within the current licence timeframe. Of course this also means we will not have sufficient time to fully evaluate post drilling.

The second issue is the 50% relinquishment at the end of the First Licence Term. Such a relinquishment schedule is not a problem in the 'conventional exploration space' where the prospect extent can be defined with some confidence. However in the 'unconventional exploration space', where the hydrocarbon accumulations are continuous and cover a large area, the extent of any discovery is difficult to define exactly but clearly has the potential to extend over a large area. As we have shown in the presentation we gave you, the unconventional prospectivity we have defined at Kimmeridgian, Middle Liassic and Lower Liassic levels are all laterally extensive. The rich, mature source rocks will extend well outside any areas we will be able to retain after the

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relinquishment at the end of the First Licence Period. As a result our planned drilling will prove the plays extending into acreage within our licence and beyond. Within our licence area we will be forced to relinquish an unconventional trend proven by drilling, under the 50% area relinquishment rule. The very long lead times for the obtaining of planning permission, with respect to the Licence term, will not allow us to optimise the relinquishment with outpost wells to prove the trend and to better define the limits of the prospectivity within the first licence period.

We would therefore appreciate your guidance on the two issues described in order that we can best plan our exploration activities in the Central Weald. We request your agreement to allow 3 wells drilled in the Central Weald area in any licences to qualify and hold all three licences in to the next licence term. We further request your position on relinquishment policy and areas as applied to unconventional resources proven by drilling.

If you have any questions please do not hesitate to contact me,

Yours sincerely



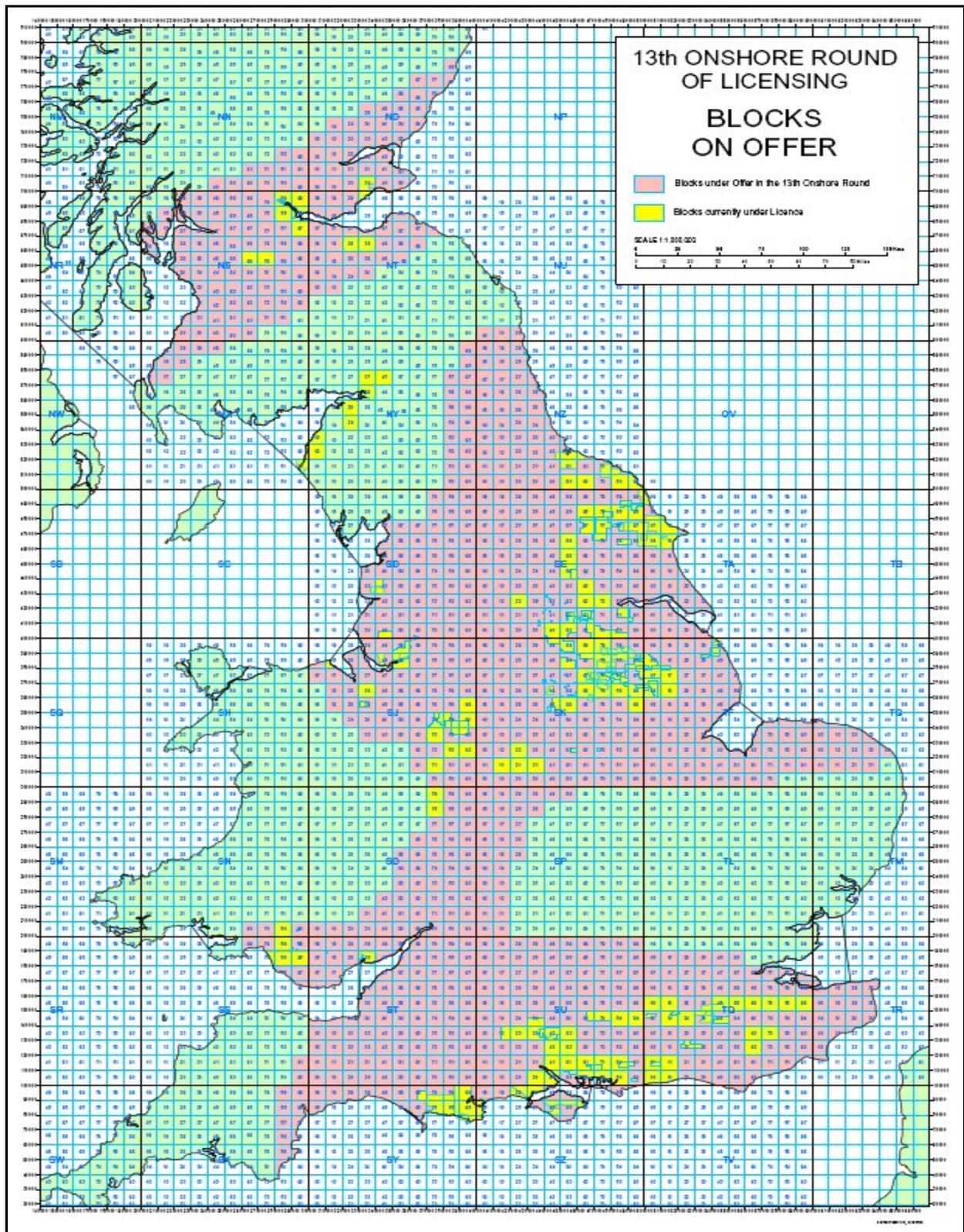


Fig. 1. The approximately 1000 blocks offered for licensing by DECC in the 13th onshore round of licensing, February 2008 (pink), The yellow blocks are previously licenced blocks.

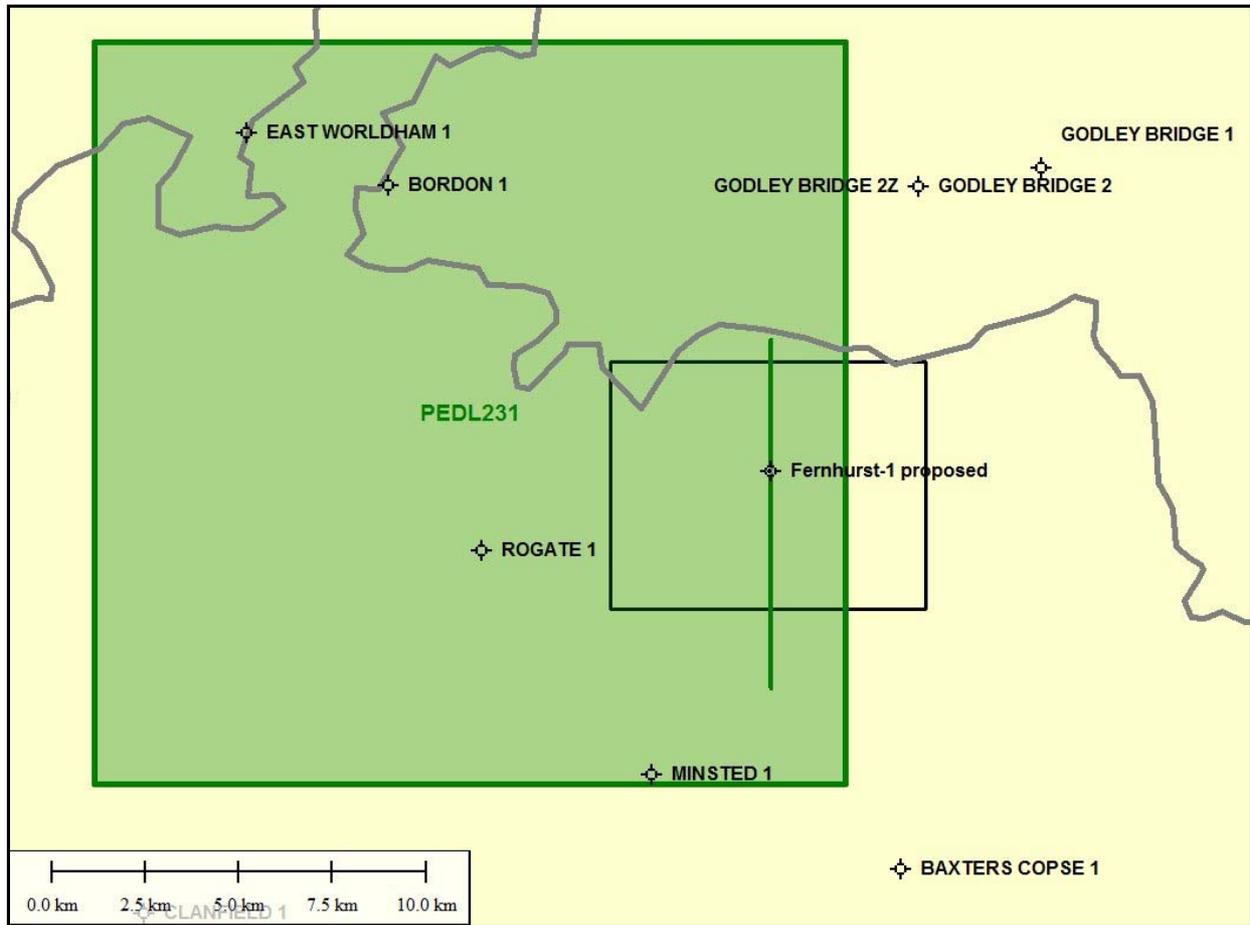


Fig. 2. PEDL231 is shown by the green square. The smaller rectangle with the proposed well at the centre is the area covered by the Applicant's figure 11.2. Note that the "relevant" wells Godley Bridge and Baxter's Copse are a long way outside the area of figure 11.2. There are two vertical Godley Bridge wells. The vertical green line is the location of a geological cross-section discussed in the text and shown in the next figure. The grey line is the northern boundary of the SDNP.

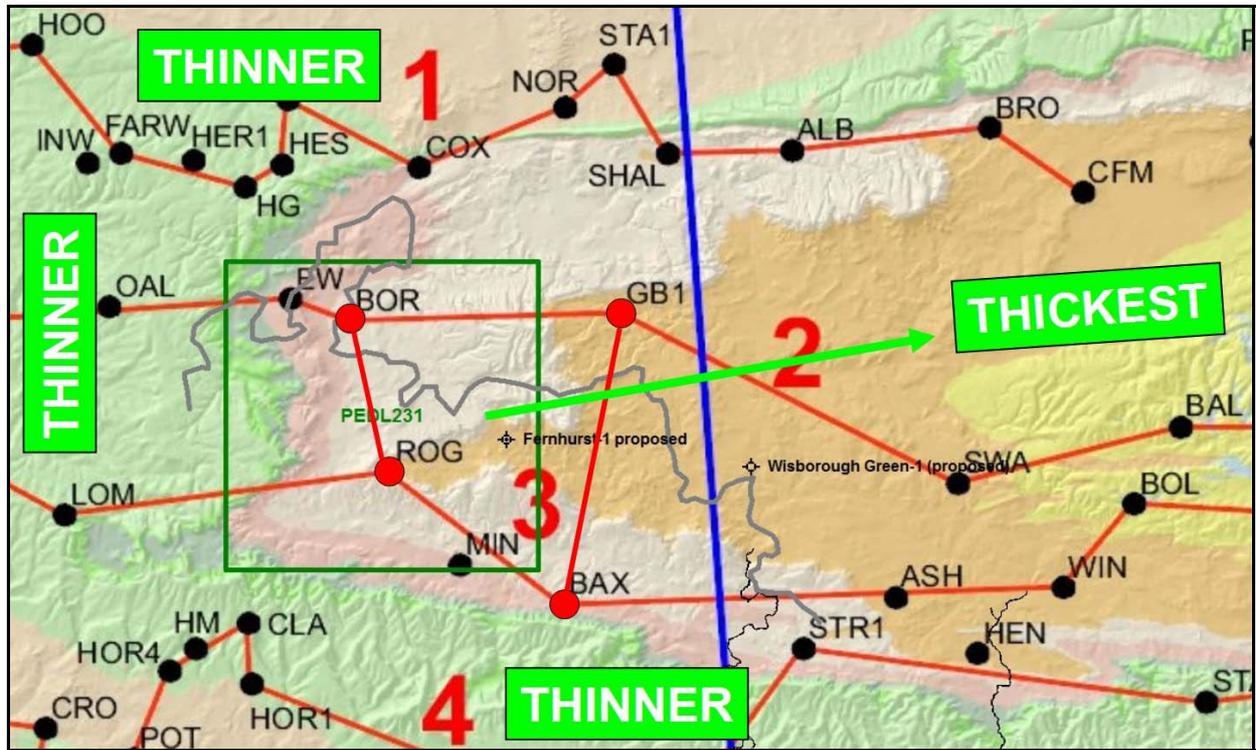


Fig. 3. BGS geology map with locations of 'fence diagrams' linking wells in the Weald (Andrews 2014). Each one is numbered with large red arabic numerals. The added labels 'thinner' and 'thickest' refer to the thickness of the Kimmeridgian limestone sequence relative to the four wells around the Fernhurst wellsite linked by a red quadrilateral. The logs of these four wells are shown in the next figure. There is a general increase in thickness towards the east to the area north of the Balcombe-1 well (BAL).

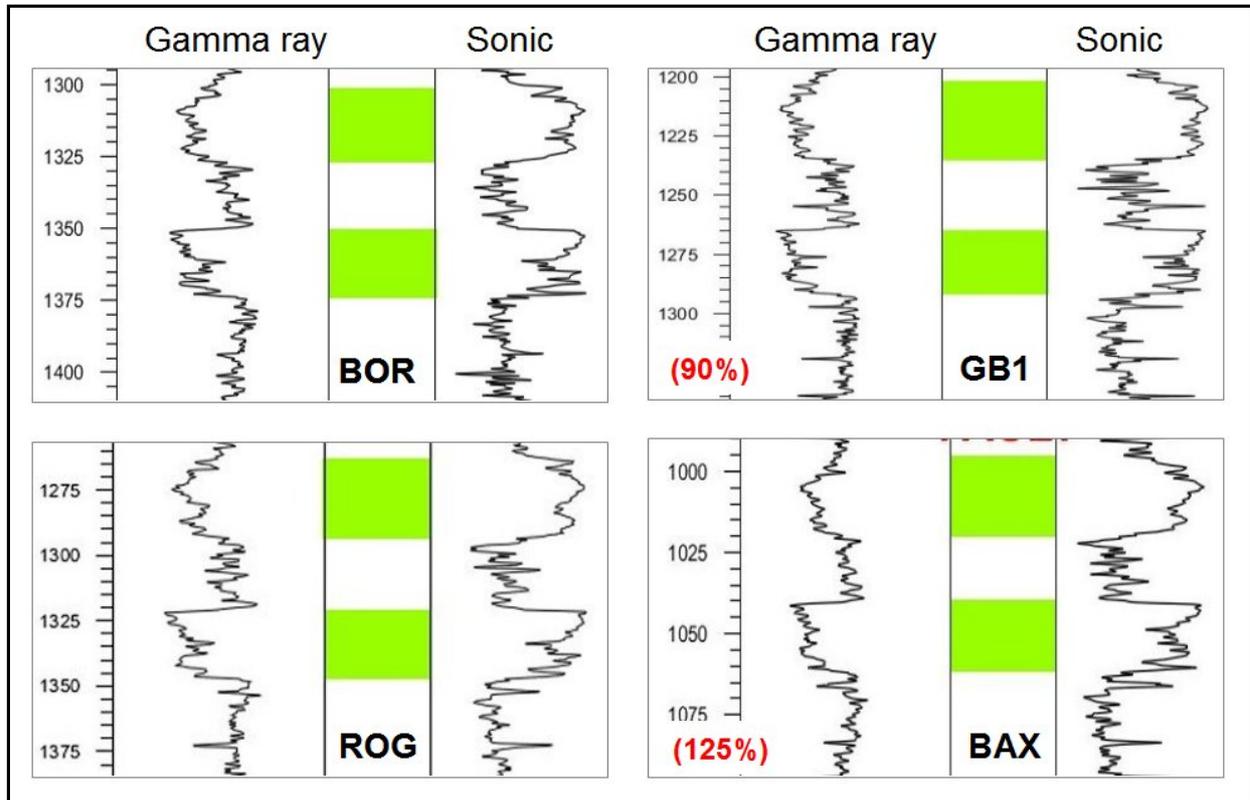


Fig. 4. Comparison the the logs spanning the Kimmeridgian limestone sequence (two green layers). BOR - Bordon-1; GB1 - Godley Bridge-1; ROG - Rogate-1; BAX - Baxter's Copse-1. The vertical scale of the Godley Bridge log has been reduced to 90%, while the Baxter's Copse log has been expanded to 125%, relative to the two logs on the left, to enable comparison. Thus scaled, the four logs are identical in all essential aspects, and demonstrate that the porosity of the limestones is also constant across the area spanned by these wells, as shown in Figure 3.

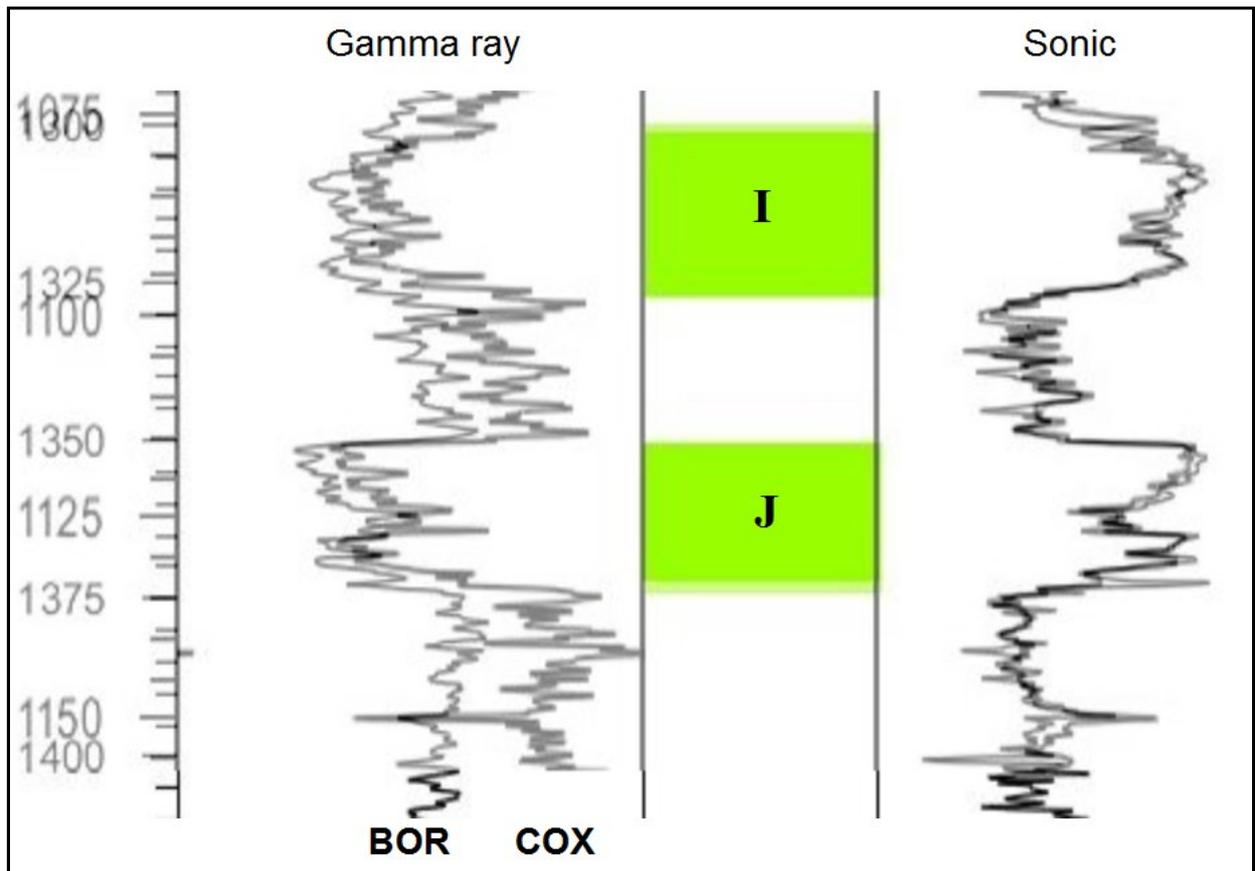


Fig. 5. Overlay of part of the well logs for Coxbridge-1 and Bordon-1 covering the two Kimmeridgian limestones I and J. The Coxbridge well is 11 km north of the Bordon well (see Fig. 3). The vertical scale of the former has been expanded by 127% so that the logs can be compared; in other words the thickness of the Coxbridge geological sequence is 80% that of Bordon. The wireline logs are remarkably similar; the sonic logs are essentially identical, and the gamma ray logs are closely similar, except that Coxbridge is offset about 10 API units higher (to the right). This is not significant, and may be due to instrumental or borehole factors and not geology. Below the J limestone the gamma ray reading in the shale is, however, slightly higher. The porosity of the limestones is the same in both wells.

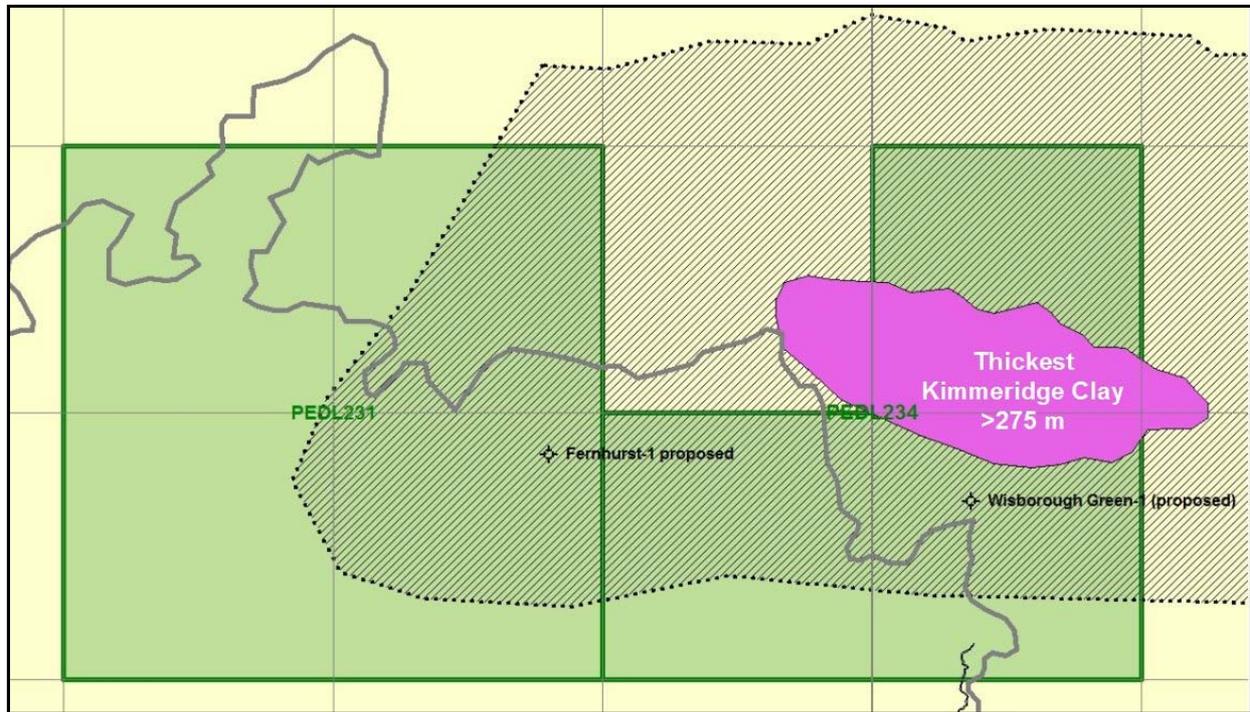


Fig. 6. Estimated net thickness of mature target Kimmeridge Clay from a BGS map (Andrews 2014, appendix G). Contours have been traced from the maps after colour conversion to 8-bit, which displays the colour spectrum of the original images in discrete bands. The Kimmeridge Clay attains 300 m in thickness. The hatched area is the outer limit of the shale.

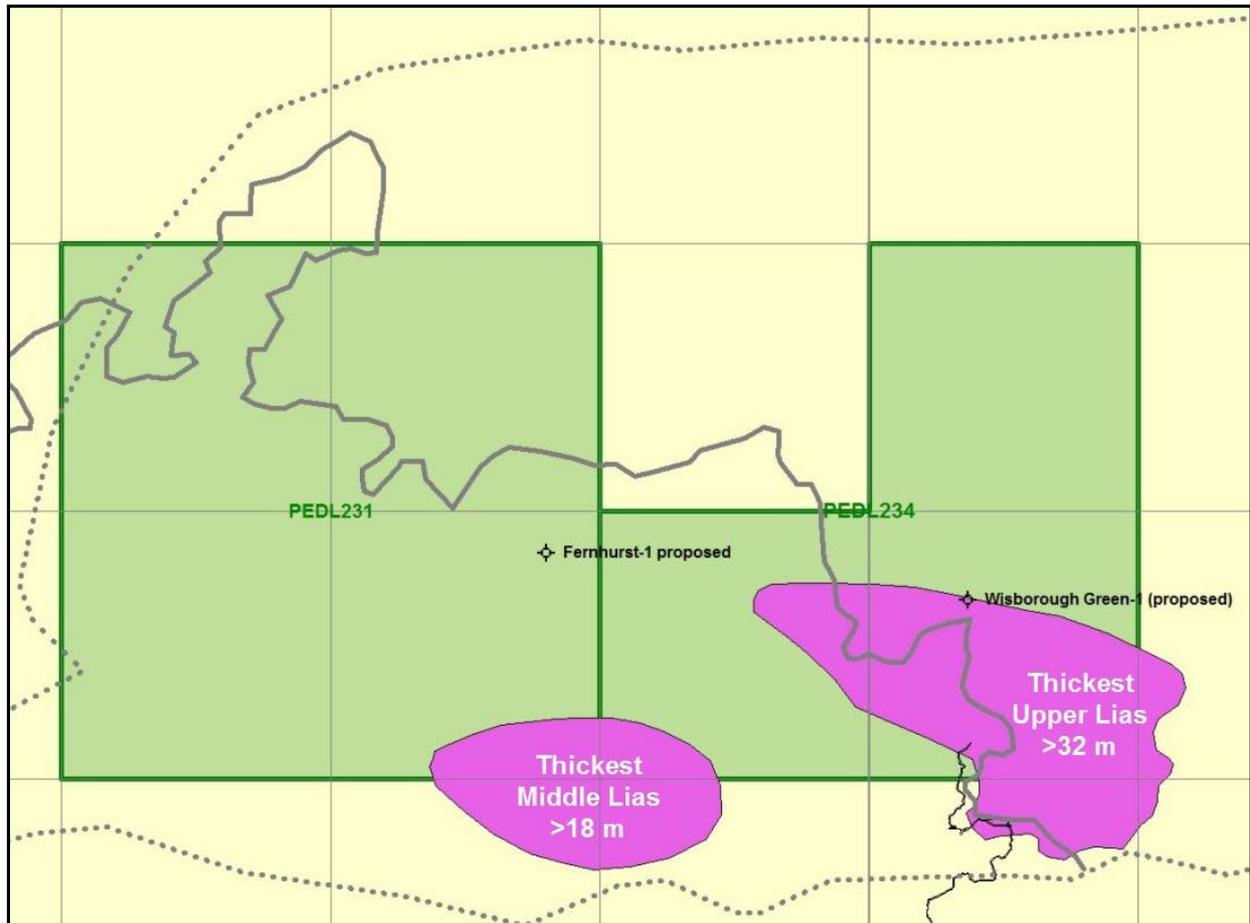


Fig. 7. Estimated net thickness of mature target Middle and Upper Lias from BGS maps (Andrews 2014, appendix G). Contours have been traced from the maps after colour conversion to 8-bit, which displays the colour spectrum of the original images in discrete bands. The Middle Lias area shown in lilac is up to 19 m thick; the Upper Lias up to 35 m thick. The dotted line is the outer limit of the two mature shales.

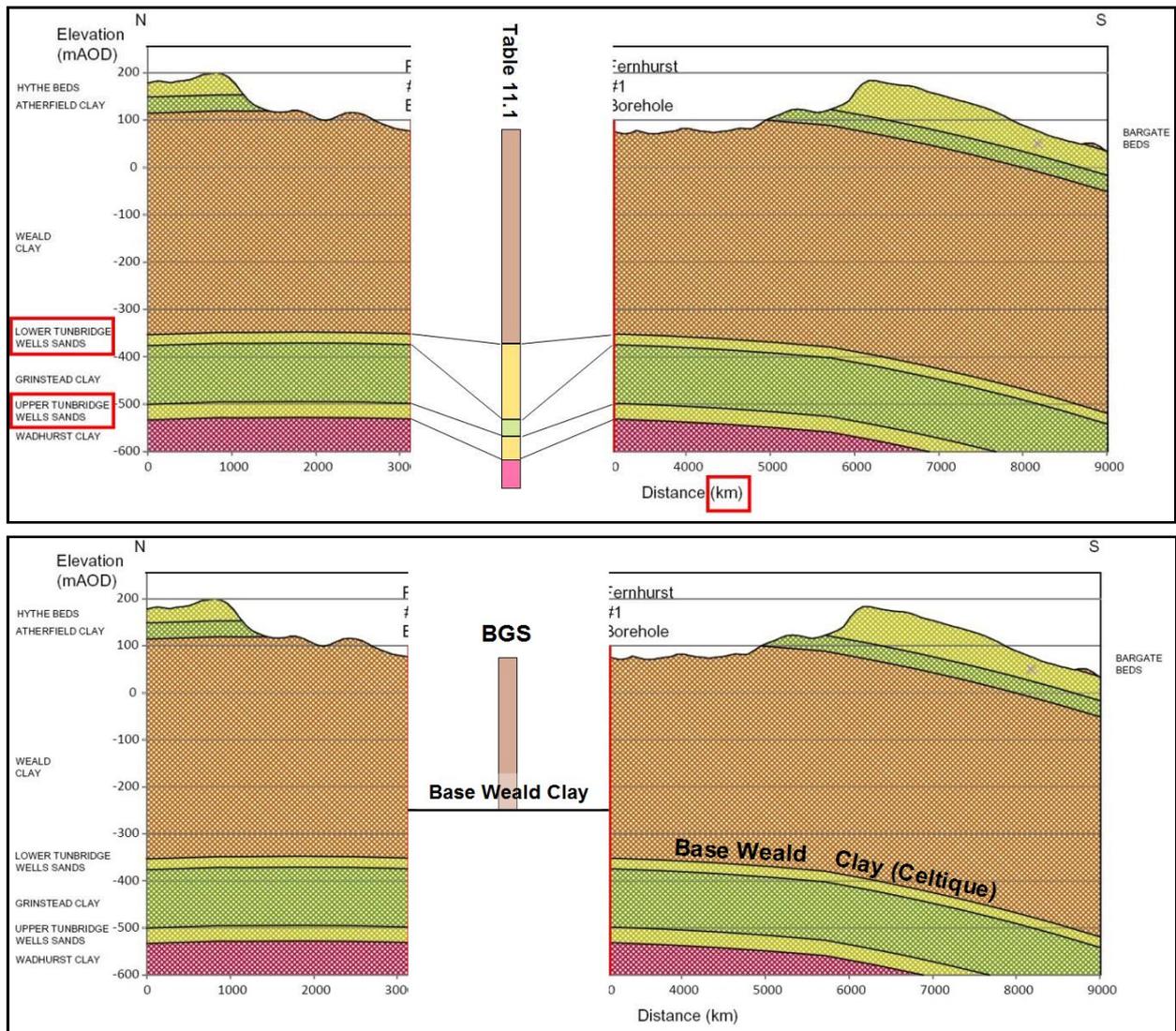


Fig. 8. Celtique N-S cross-section of the uppermost 600 m through the proposed wellsite (from the Applicant's fig. 11.3). The section has been split apart at the borehole location to allow insertion of a geological column. Upper section: column constructed from Celtique table 11.1. Red boxes indicate labelling errors. Lower section: correct depth of the Base Weald Clay at the borehole site, -250 m, taken from BGS mapping.

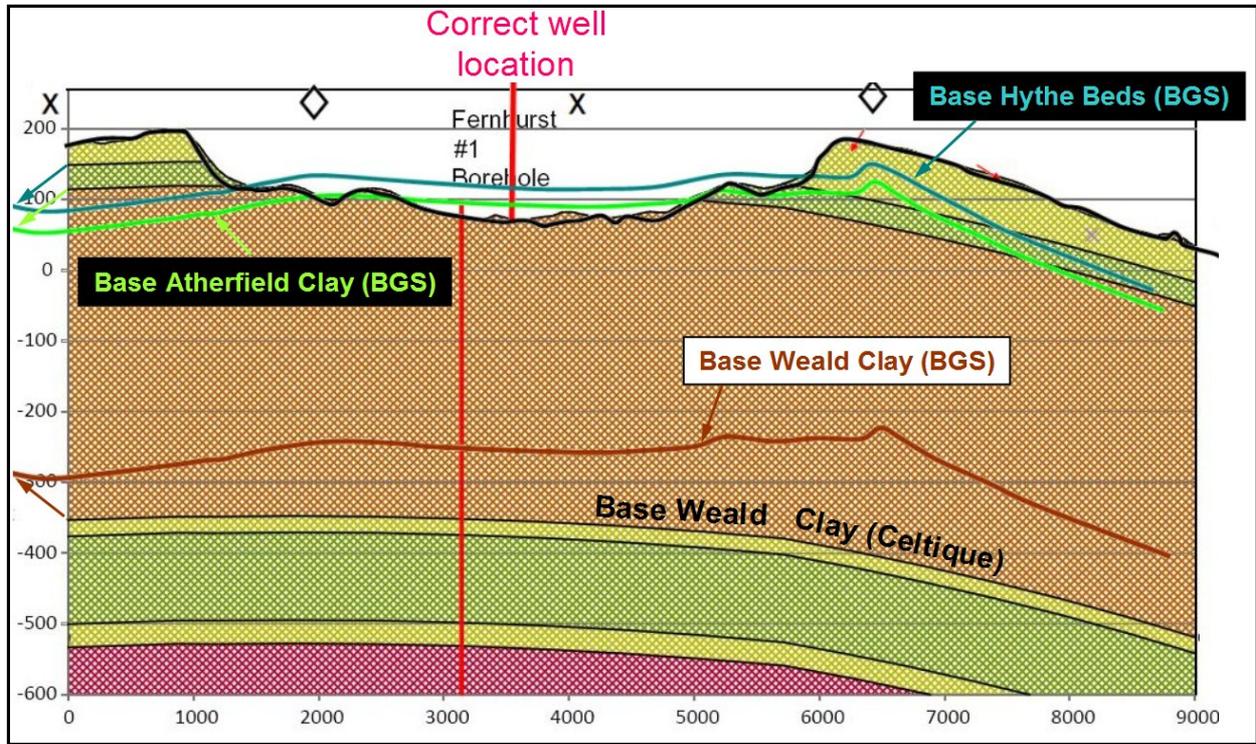


Fig. 9. Celtique cross-section (location shown in Figure 2 above) through proposed wellsite (solid colours) with overlain lines of:

- Correct topography (black)
- Correct Base Hythe Beds (blue)
- Correct Base Atherfield Clay (green)
- Correct Base Weald Clay (brown)

taken from the BGS 1:50,000 sheet and OS digital terrain model. Arrows at left indicate link of Celtique layer to overlain corrected layer. Axes of synclines and anticlines are indicated by an X and by a diamond, respectively. The blue and green lines shown above ground level indicate the 'ghost' structure that existed before the rocks in the central valley between the two scarps were eroded. The correct location of the proposed well is 400 m south of the location marked by the Applicant.