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Geoscience
Natural Resources Wales
Cambria House
29 Newport Road
Cardiff
CF24 0TP

Date: 19/12/13

Dear Sir or Madam

**SECTION 199 WATER RESOURCES ACT (1991)
PLANNING APPLICATION REFERENCE P/2013 /0660
TEMPORARY MINERAL EXPLORATION WELL – METHOD STATEMENT
LAND SOUTH OF BORRAS ROAD, HOLT, WREXHAM
PEDL 187 SITE 2**

Dart Energy has applied for planning permission reference: P/2013 /0660 for a temporary mineral exploration borehole at land South of Borrass Road, Commonwood, Holt, Wrexham. This submission has been prepared to provide Natural Resources Wales with the necessary information to enable them to remove their objection (NRW ref: NT/2013/115044/01-L01) to this planning application as well as to fulfil the requirements of Section 199 of the Water Resources Act (1991).

Dart Energy's predecessor company, Greenpark Energy Ltd, was granted UK Onshore Petroleum Exploration and Development Licence (PEDL) 187 by the Department of the Energy and Climate Change (DECC – formerly Department of Business Enterprise and Regulatory Reform, DBERR) in May 2008. Following granting of this licence, Dart Energy is obligated under this licence commitment to the Government to drill one mineral appraisal borehole across the Licence to establish the potential for gas production in the area. The purpose of the temporary borehole is to remove a core of coal to surface for analysis.

To fulfil the requirements of Section 199 of the Water Resources Act (1991) we have completed the WR11 form and prepared the enclosed Method Statement, Data sheets, Abandonment Sketch and plans as background information to demonstrate the method of drilling, borehole abandonment and how risks to ground water will be controlled.

We would be grateful if you could confirm that we have satisfied the requirements of Section 199 of the Water Resources Act (1991) and provided sufficient information for the objection to planning application P/2013/0660 to be removed. In the meantime, please do not hesitate to contact us should you require any further information.

Yours sincerely



Euan Brown
Land and Planning Operator

Enc



Notice to Natural Resources Wales of intention to construct or extend a boring for the purpose of searching for or extracting minerals

Name of person or organisation

Take notice that Dart Energy (Europe) Ltd

Date - except in emergency this should be at least one month after service of this notice (See below #)

intends on or after 1st July 2014

to construct* ~~extend*~~ a boring* ~~børings*~~ at the place* in the area*

marked _____ on the accompanying map (see below §)

for the purpose of searching for* and* ~~extracting*~~ minerals.

Give all relevant details of works e.g. depth, diameter, orientation, method of construction or extension, etc.

The proposed construction* ~~extension*~~ will be

Please see the accompanying letter, Method Statement, Data Sheets, Abandonment Sketch, site location plan and indicative site layout for details.

State e.g. 'water will be pumped and allowed to run to waste'. If to be used, state use and proportion of water used that will be discharged afterwards

Water entering the boring during or after its construction* ~~extension*~~ will be disposed of by

Please see the accompanying letter, Method Statement, Data Sheets, Abandonment Sketch, site location plan and indicative site layout for details.

To the best of my knowledge the statements made above are true.

Communications about this notice should be addressed to

Dart Energy Ltd, Laurel House, Laurel Business Park, Polmaise Road, Stirling, FK7 9JQ

Your address or if applicable the name and address of your agent or professional adviser

for the attention of Euan Brown

Signed Euan Brown

Insert 'the undersigned', agent's name, etc.

Name/on behalf of Dart Energy Ltd Date 19/12/13

Note that Natural Resources Wales may serve a counter-notice on you requiring you to take measures to conserve water. You may incur additional expense if you begin work before Natural Resources Wales has had a reasonable time to serve such a conservation notice.

* Delete as appropriate.

§ Unless agreed otherwise with Natural Resources Wales this should be an Ordnance Survey map with scale not less than 1:10,000 scale

TEMPORARY MINERAL APPRAISAL WELL – METHOD STATEMENT**PLANNING APPLICATION REFERENCE: P/2013/0660****PEDL 187 Site 2 : Holt-1****Background**

Dart Energy (West England) Ltd intend to drill a temporary mineral appraisal well to obtain coal samples from the Pennine middle and lower coal measures. This well is situated within zone 3 of a Groundwater Source Protection Zone. The drilling method statement provided below is designed to meet industry best practice and current regulatory requirements and, in doing so, provide appropriate protection to the groundwater aquifers.

Functions Of Drilling Fluid

Dart Energy drill mineral appraisal boreholes with water as the base drilling fluid. Oil based mud will not be used.

The main functions of a drilling fluid are to:

- Maintain well control over the fluids in the drilled formations via the drilling fluid's density or weight.
- Maintain wellbore integrity by controlling the drilling fluid's weight and/ or by controlling the drilling fluid's chemistry.
- Transport the drilled material (cuttings) to the surface quickly and efficiently.
- Reduce losses of any drilling fluid to any porous, permeable formations in the well.

Offset Data Review

A review of the offset wells drilled in the general area of the proposed well highlights the potential for wellbore instability due to various highly water sensitive mudstones and shales in the Warwickshire Group (the Salop, Halesowen and Etruria Formations) and in the Pennine Middle and Lower Coal Measures Formations. Other wells have had problems with pipe overpulls and large washouts have been reported in some wells. Most of the offset wells have been drilled with inhibitive drill fluids containing Potassium Chloride or Calcium Sulphate, both of which will maintain wellbore stability by preventing the hydration of water sensitive mudstones and shales.

The offset data review also shows that the Chester Pebble Beds and Kinnerton Sandstone Formations are regional aquifers, but do not show problems with water sensitive clays.

The other feature highlighted by the offset well review is that there are no overpressured formations (except for possible water strikes and Artesian flow) , so a drilling fluid with a high weight should not be required to maintain well control: previous mud weights were in the range of 8.7- 9.7ppg (and as high as 10.7ppg).

Proposed Drilling Fluid

The ideal fluid for Dart Energy's wells is water: environmentally friendly, easy to use and inexpensive. However, the physical properties of water on its own are not suitable for use as a drilling fluid. Water has a low viscosity so its cuttings carrying capability is limited. Also

water is not a thixotropic liquid (a fluid which gels when it is not flowing) so its cuttings holding capacity is limited. Additionally water can react with many highly water sensitive clay minerals found in a wide variety of rock formations leading to wellbore instability and collapse. Consequently the planned fluids for the well are :

- Air for the conductor section (with water and polymer as contingency).
- Polymer / water drilling fluid from conductor to base Kinnerton.
- Potassium chloride – polymer drilling fluid from the 13-3/8” shoe to total depth through the Warwickshire Group (Salop, Halesowen, Etruria) and the Pennine Coal Measure Group, as this is sufficiently inhibitive to stabilise the drilled formations.

Conductor

The conductor will be pre-installed at approximately 30m at the top Kinnerton Formation though there is uncertainty on the thickness of the Kinnerton. The conductor will be installed by a specialist drilling contractor using a “dual rotary” drilling rig and air as the drilling fluid. Contingency for the dual rotary rig method is the use of water with Purebore in the event there is some flow from aquifers within this section. Purebore is a biodegradable starch which provides viscosity and gels (plus some fluid loss control). Purebore has been approved under the Water Supply Regulations for use as a drilling fluid in applications relating to the supply of drinking water (approval note attached).

Filling the well with water should help stop any natural water flow into the well and transport cuttings to surface. If artesian flow is experienced, the fluid weight can be increased, by adding barite, to balance the pressure of the artesian flow. The viscosity and gel strength of the fluid will reduce the amount of fluid that potentially may flow into the sandstone. If losses are experienced Dril-Sorb (sodium polyacrylate) maybe be added. This is a granular lost circulation material which expands to help seal any highly fractured and porous zones.

Other contingency chemicals are Clear Stabiliser (CMC – high purity Sodium Carboxymethyl Cellulose – a biodegradable polymer) or calcium carbonate for fluid loss control. As well as small amounts of sodium carbonate, sodium bicarbonate or citric acid if required to prevent the polymers suffering biological degradation by keeping the drill fluid pH at approximately 9.0. If necessary, small volume high viscosity sweeps or 'pills' made of water mixed with either Pure Bore or other biodegradable polymers such as Xanthan Gum or Clear Stabiliser will be pumped to aid hole cleaning.

Once installed the conductor will be cemented in place.

16” Hole

The 16” hole will be drilled from the conductor shoe at approximately 30m to section TD into the Salop (expected at approximately 130m). There is uncertainty in the expected thickness of the Kinnerton and it is possible the Kinnerton Formation may continue deeper. Also the Salop maybe thin and not be present at all due to erosion. If this is the case, the Halesowen and Etruria will replace the Salop. The Kinnerton Formation will be drilled using water with Purebore and Clear Stabiliser polymer as the drilling fluid. The polymers used will be PureBore, a biodegradable starch based polymer, which provides viscosity and gels to improve the solids carrying capacity and provides some fluid loss control. Also Clear Stabiliser (CMC – high purity Sodium Carboxymethyl Cellulose – a biodegradable cellulose base polymer) for fluid loss control. If necessary, small volume high viscosity sweeps or 'pills' made of water mixed with either PureBore or Clear Stabiliser or other biodegradable polymers such as Xanthan Gum will be pumped to aid hole cleaning. To prevent the polymers suffering biological degradation, the drill fluid pH will be kept at approximately 9.0 by the addition of small amounts of sodium carbonate, sodium bicarbonate or citric acid as necessary. The weight of the drilling fluid will be maintained as required to maintain

inhibition and stop any hole stability problems, and will also have sufficient weight to maintain primary well control.

At the end of the 16" hole, 13-3/8" casing will be run and cemented in place. This will isolate the Kinnerton formation and associated aquifers.

12-1/4" Hole

The 12-1/4" hole will be drilled from the 13-3/8" shoe at approximately 130m to section TD into the Halesowen (expected at approximately 460m). There is uncertainty in the formations expected within this section and it is possible the Salop maybe thin and not be present at all due to erosion. If this is the case, the Halesowen and Etruria will replace the Salop. The drilling fluid utilised will be KCl brine added to the water plus Purebore and Clear Stabiliser polymer drilling fluid to provide clay and shale inhibition. The polymers used will be PureBore, a biodegradable starch based polymer, which provides viscosity and gels to improve the solids carrying capacity and provides some fluid loss control. Also Clear Stabiliser (CMC – high purity Sodium Carboxymethyl Cellulose – a biodegradable cellulose base polymer) for fluid loss control. If necessary, small volume high viscosity sweeps or 'pills' made of water mixed with either PureBore or Clear Stabiliser or other biodegradable polymers such as Xanthan Gum will be pumped to aid hole cleaning. To prevent the polymers suffering biological degradation, the drill fluid pH will be kept at approximately 9.0 by the addition of small amounts of sodium carbonate, sodium bicarbonate or citric acid as necessary. The weight of the drilling fluid will be maintained at approximately 9-9.3ppg, as this will ensure a high enough potassium chloride concentration to maintain inhibition and stop any hole stability problems, and will also have sufficient weight to maintain primary well control. If inhibition is not found to be sufficient, more salt can be added to the mud system upto saturation point at 9.7ppg.

At the end of the 12-1/4" hole, 9-5/8" casing will be run and cemented in place.

8-1/2" Hole

The 8-1/2" section from the 9-5/8" casing shoe to TD at around 1000m will also be drilled with KCl brine plus PureBore and Clear Stabiliser polymer drilling fluid. Again, if necessary, small volume high-viscosity sweeps or 'pills', made of water mixed with either PureBore or Clear Stabiliser or other biodegradable polymers such as Xanthan Gum, will be pumped to aid hole cleaning. To prevent the polymers suffering biological degradation, the drill fluid pH will be kept at approximately 9.0 by the addition of small amounts of sodium carbonate, sodium bicarbonate or citric acid as necessary. The weight of the drilling fluid will be maintained at approximately 9-9.3ppg, as this will ensure a high enough potassium chloride concentration to maintain inhibition and stop any hole stability problems, and will also have sufficient weight to maintain primary well control. However if inhibition is not found to be sufficient, more salt can be added to the mud system up to saturation point at 9.7ppg. Use of a weighted drilling fluid, with a BOP, will eliminate the risk of an uncontrolled release or flow from the reservoir section of the well during drilling operations.

Drill Fluid Preparation and Storage

The drilling fluid will be mixed on site by adding the powdered KCl, and other additives using the rig's dedicated mixing facilities. All drilling fluids will be stored and operated in a "closed loop system". The fluids are stored in a series of steel mud tanks and the entire circulating system is designed to prevent any release of drilling fluids to the environment under normal operating conditions. In addition, the wellhead area will be enclosed with a bund and all the drains on the drill rig will go to a tank, to prevent any accidental spills of drilling fluid on the surface. All cuttings and waste drilling fluid will be taken from the site treated, and disposed of in an approved manner by dedicated waste disposal contractors.

Contingency Drilling Chemicals

In all hole sections, should minor losses (up to ~8bbls/hour) of drilling fluid to porous formations be experienced, a high viscosity "pill" of Purebore, Clear Stabiliser or Xantham Gum would be pumped to stop the losses. If major losses were experienced, the first step would be to pump a high viscosity pill. If this does not work, then a pill of sized calcium carbonate (ground up limestone in distinct particle sizes) would be pumped to stem the losses. Stopping major losses is critical to maintaining well control and if the use of sized calcium carbonate was unsuccessful, other lost circulation material such as DrillSorb, (Sodium polyacrylate, used as a soil improver and very similar to the super absorbent gel in women's hygiene products and children's nappies) and ultimately, a cement plug, would be pumped. All other possible contingency chemicals are noted within the table in the next section.

Chemical Classification (Surface Hole to TD)

The list of the chemicals proposed for the mud system, as well as contingency chemicals, are noted in the table below. Where available the chemical classification is also included. PLONOR and Cefas are classifications for chemicals used offshore however they provide information that is relevant for onshore use too.

Material Safety Data Sheets (MSDS) for the chemicals can be found in the Attachments. None of the mud chemicals pose a physical, health or major environmental hazard, with the exception of Soda Ash and Lime which are classified as irritants. Defoamer and Drill-Slip are not known to have an ecological impact. Drill Sorb is considered non eco-toxic.

Mud Chemicals

P or C*	Chemicals	Chemical Name	Purpose	Chemical Classification**
P	Potassium Chloride (Salt)	KCl	Provide shale and clay inhibition, dissolve totally in water giving a weighted solids free fluid.	PLONOR
P	Purebore Polymer	Modified starch	Natural biodegradable starch. Provides viscosity and gel strength to aid hole cleaning. Plus filter cake limiting losses to formation.	Drinking Water Inspectorate Approval. Cefas Gold Rated.
P	Clear Stabiliser Polymer	Sodium Carboxymethyl Cellulose	Assists in forming thinner, less permeable filter cake, provides viscosity to remove drill cuttings from the hole and clay/shale inhibition.	PLONOR
P	Citric Acid	Citric Acid	Reduces PH, removes calcium when treating cement contamination.	PLONOR
P	Soda Ash	Sodium Carbonate	Used to reduce soluble calcium in fluid, increases PH.	PLONOR
P	Sodium Bicarbonate	Sodium Bicarbonate	Alters PH (used if have any cement contamination in mud). Deflocculates cement contaminated fluids.	PLONOR
C	Calcium Carbonate	Calcium Carbonate	Sized particles, along with polymers above control fluid loss.	PLONOR
C	Clear Gel	Xanthan Gum	Control and increase drilling rheology and	PLONOR

			provide stable gel strength aiding hole cleaning.	
C	Defoamer	Silicone based liquid antifoam	Reduce any foaming in fluid.	./
C	Drill-slip	Non ionic surfactant	Designed to inhibit the hydration and dispersion of clay and shale by increasing the surface tension of the drilling fluid.	./
C	Drill-sorb	Sodium Polyacrylate	Granular lost circulation material which expands to help seal any highly fractured and porous zones.	./
C	Lime	Calcium Hydroxide	To control PH.	PLONOR
C	Barite	Barium Sulphate	Weighting agent. Contingency for high pressure is seen – use to weight up mud. Also used in cement spacer (to separate out the mud from the cement).	PLONOR

* P – Primary chemical which will be in the mud system used. C – Contingency chemical.

** PLONOR and Cefas are classifications for chemicals used offshore however they provide information that is relevant for onshore too.

** PLONOR : OSPAR Commission List of Substances Used and Discharged Offshore which are Considered to Pose Little or No Risk to the Environment (PLONOR).

** Cefas : Centre for Environment, Fisheries & Aquaculture (which is an executive agency of Defra – UK Government Department for Environment, Food and Rural Affairs).

Appropriate PPE will be used while mixing chemicals and all chemicals will be stored in line with current recommendations.

Cement Spacer

P or C*	Chemicals	Chemical Name	Description	Chemical Classification**
P	Tuned Spacer E+	Bentonite with possible small quantities of crystalline silica, quartz, tridymite, cristobalite.	Viscosifier : To provide hole cleaning & help maintain fluid separation throughout the cementing operation.	PLONOR
P	Barite	Barium Sulphate	Weighting agent.	PLONOR

Risks of Aquifer Contamination from Drilling Fluids

Aquifers maybe present within the Kinnerton Formation of the Sherwood Sandstone Group. Air will be used to drill out the conductor section, with water and polymers (as described above) as contingency. Additives are required to provide viscosity, gel strength and filter cake to limit losses into the Sandstone and aid hole cleaning. If artesian flow is experienced, barite (barium sulphate) will be added to increase the weight of fluid to balance the artesian flow. The polymers and chemicals are either biodegradable or naturally occurring, and non-hazardous, thus posing a very low risk to the freshwater aquifers.

The conductor will then be run and cemented in place sealing off any freshwater aquifers present. The Kinnerton Formation will then be drilled in the next section (16" section), drilling will commence with water and polymers again to provide viscosity, gel strength and filter cake to limit losses into the sandstone. If artesian flow is experienced, barite (barium sulphate) will be added to increase the weight of fluid to balance the artesian flow. The polymers and chemicals are either biodegradable or naturally occurring, and non-hazardous, thus posing a very low risk to the freshwater aquifers.

Once through the Sherwood, the 13-3/8" casing will be run and cemented, isolating the sandstone aquifer. Whilst drilling in the 12-1/4" section below this, KCl will be added to the system to provide clay and shale inhibition through the Salop.

Holt-1 is within Zone 3 of a Groundwater Source Protection Zone. The nearest water abstraction point is a farm located 448m away (from Envirocheck reports). No specific details are supplied for this abstraction point. A list of water wells from BGS shows the deepest water well in the area being at 31m, at 479m away. The closest well in the area, according to the BGS, is 159m away and is at a depth of 18m. The risk of contaminating the freshwater aquifers is considered very low as the fluids used will be non-hazardous as well as biodegradable or naturally occurring. KCl (salt) will only be added to the system once the Kinnerton Formation is cased off. The polymers within the mud system will help limit fluid loss into the aquifer due to the viscosity of the fluid, fluid loss control and thin filter cake built up on the formation.

The Kinnerton Formation will be cased off with the 13-3/8" casing and cemented to surface to isolate the aquifers from deeper formations.

Isolation of Aquifers – During Drilling Operations

The near surface drift deposits will be isolated from the wellbore by 18" steel conductor pipe, set into firm bedrock at around 30m MDBGL and cemented in place. This conductor will be installed by a specialist contractor using a unique "dual-rotary" method using air (and freshwater with polymer if required) as the drilling fluid. The conductor will be cemented, with Portland cement, to ensure a seal and isolate the freshwater aquifers. No cement spacer will be used. The cement will also prevent mixing of ground water from different aquifers.

The permeable Kinnerton Formation (Sherwood Sandstone Group) will be isolated from the wellbore by 13-3/8" steel casing, set into firm bedrock at around 130m MDBGL (or as deep as required) and cemented in place. This casing will be installed by the drilling rig and freshwater with polymer utilised as the drilling fluid. The casing will be cemented, to ensure a seal and isolate the freshwater aquifers. No cement spacer will be used. The cement will also prevent mixing of ground water from different aquifers.

This section will then also be isolated from deeper formations.

Isolation of Aquifers – Abandonment

The proposed abandonment of the well will be carried out in line the "Oil and Gas UK Guidelines for the Suspension and Abandonment of Wells, July 2012", with a column of cement over the entire 8-1/2" open hole section from TD to a minimum of 30m above the 9-5/8" casing shoe. This cement plug will be weight tested and pressure tested.

The use of a cement column over the open hole section and the cement in the 13-3/8" and 9-5/8" casing annulus will isolate all drilled formations (including the Kinnerton Formation (Sherwood Sandstone Group) from each other and from surface.

A second cement plug will be set within the 9-5/8" casing as a second barrier. This plug will be weight tested to ensure that there are two permanent, tested, barriers between any deep formations and the surface.

The wellhead and near surface casings would then be cut approximately 3.5m below ground level and removed.

Drawings showing the proposed casing and abandonment status of the well are attached.

Attachments:

Material Safety Data Sheets (MSDS) for :

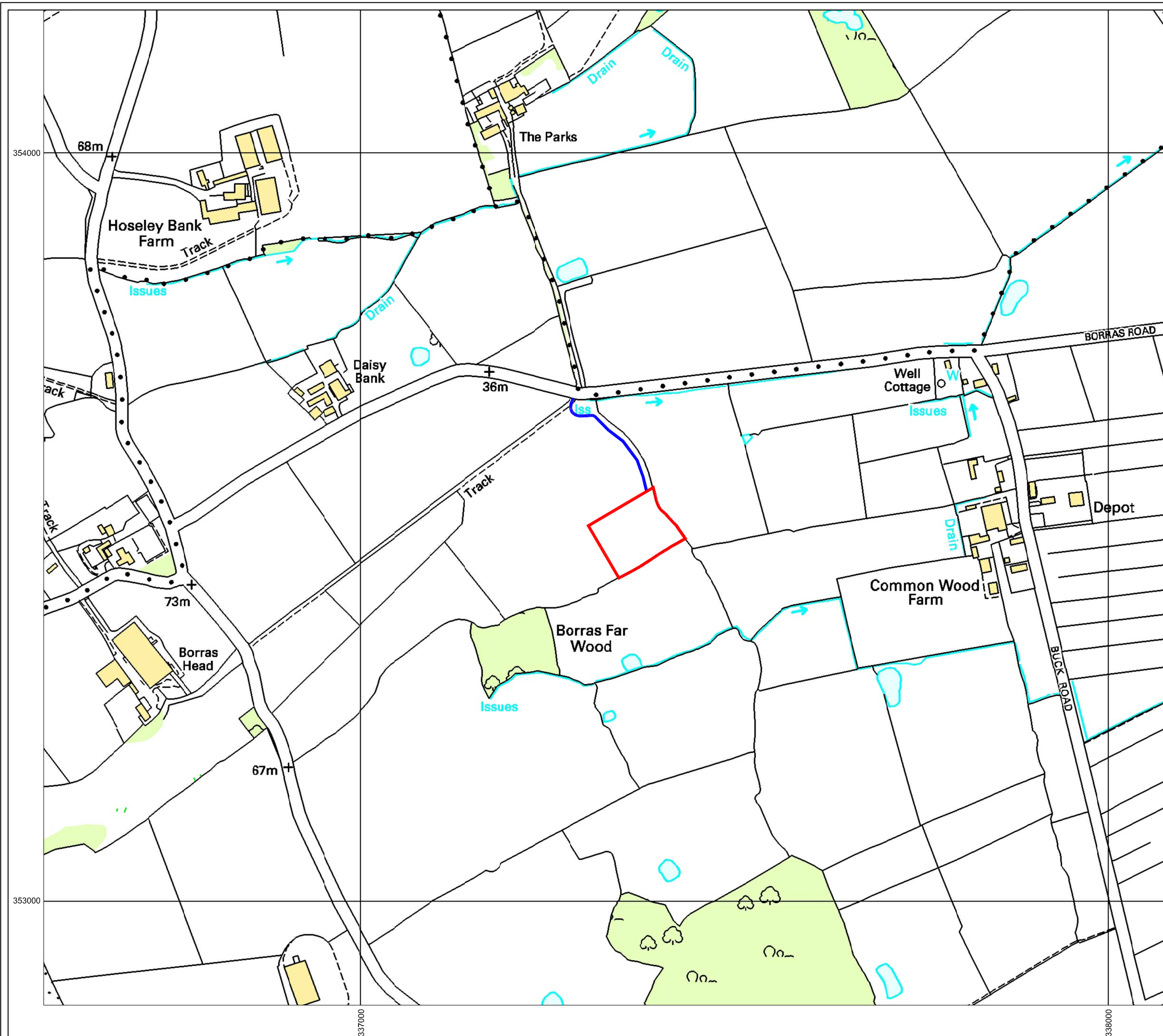
- Potassium Chloride (KCl)
- Pure Bore
- Clear Stabiliser (CMC)
- Citric Acid
- Soda Ash (Sodium Carbonate)
- Sodium Bicarbonate
- Calcium Carbonate
- Clear Gel (Xanthan Gum)
- Defoamer (Silicone Based Liquid Antifoam)
- Drill Slip (Non Ionic Surfactant)
- Drill Sorb (Sodium Polyacrylate)
- Lime (Calcium Hydroxide)
- Barite (Barium Sulphate)
- Tuned Spacer E+
- Purebore Water Supply Approval Confirmation
- Purebore Cefas Certificate

Oil & Gas UK Guidelines for the Suspension & Abandonment of Wells (Issue 4, July 2012)

Proposed Holt Well Schematic (After Drilling)

Proposed Holt Well Abandonment Schematic

Drawing Ref: S:\Graphics\023 - PEDL187\Drawings\023_005C - Site 2 Location & Access



Legend

- Proposed Site Location (337362E,353491N)
- Proposed Site Access



0 50 100m
Scale 1:5,000 @ A3

GP Energy part of: **DART ENERGY**
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Project: PEDL187

Title:
**Site 2 Location & Access
PEDL187**

Date: 13.05.13 Scale: 1:5,000 Original Paper Size: A3

Drawn: nf Checked: lc Rev: C

Drg Number: 023/005C

Well : PEDL 187 Site 2 Holt-1 Proposed Well Schematic

Surface Co-Ordinates :
(OS Grid)

337,362mE
353,491 mN

Rev 3
Date : 19/12/2013

Formation Tops	Casing and Hole	Well Schematic	Feature	MD BGL	TVD BGL	Comments
			Ground level			
Quaternary deposits 30m BGL	18" cond.		18" shoe	30m	30m	16" conductor pre-installed
Kinnerton Sandstone 130m BGL	16" hole					13-3/8" casg cemented to surface
	13-3/8"		13-3/8" shoe	130m	130m	
Salop FM 448m BGL	12-1/4" Hole					9-5/8" csg cemented w/ tail & lead slurry to surface
	9-5/8" casing		9-5/8" Shoe	460m	460m	9-5/8" casing shoe at top of Halesowen
Halesowen FM 608m BGL						Geological uncertainty - depth control confidence is low due to limited data in area. Sherwood may or may not be present. If the Salop is not present, it will be replaced with the Halesowen and Etruria.
Etruria FM 807m BGL						Core from 860m to 895m and 940m to 1000m.
Pennine Middle Coal Measures 979m BGL	8-1/2" hole		8-1/2" hole	1000	1000	Well TD

Well : PEDL 187 Site 2 Holt-1 Proposed Abandonment Schematic

Surface Co-Ordinates :
(OS Grid)

337,362mE
353,491 mN

Rev 2
Date : 19/12/2013

Formation Tops	Casing and Hole	Well Schematic	Feature	MD BGL	TVD BGL	Comments
Quaternary deposits 30m BGL	18" cond.		Ground level			Casing cut approx 3.5m MDBGL Cement Plugs <u>Plug 2</u> : Will be tagged. <u>Plug 1</u> : Open hole plug with sacrificial stinger to inside the casing. Or will set conventional balanced cement plugs. Plug inside casing will be tagged and pressure tested.
Kinnerton Sandstone 130m BGL	16" Hole		18" shoe	30m	30m	
Salop FM 448m BGL	12-1/4" Hole		13-3/8" shoe	130m	130m	
Halesowen FM 608m BGL	9-5/8" casing		9-5/8" Shoe	460m	460m	
Etruria FM 807m BGL						
Pennine Middle Coal Measures 979m BGL	8-1/2" hole		8-1/2" hole	1000	1000	
Lower Coal Measures						Well TD