HYDRAULIC FRACTURE PLAN

HFP-WNA2-001

Rev 2

September 2025

West Newton – Regulatory - HFP

Submitted to NSTA

APPROVAL LIST

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Revision History

Revision	Reason for Revision	Date of Revision
Rev 0	Draft	June 2024
Rev 1	Issued as draft for comment	July 2025
Rev 2	Updated following comments received from NSTA	September 2025

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1 Introduction

Rathlin Energy (UK) Limited (Rathlin) is a private company with its head office in Beverley, East Riding of Yorkshire. Rathlin is a petroleum exploration, development and production company with operations in the United Kingdom and is operator of PEDL 183.

Rathlin holds 66.67% equity in the Petroleum Exploration and Development Licence 183 (PEDL183) with the remaining interests held by Reabold Resources (16.665%) and Union Jack Oil (16.665%).

The West Newton A (WNA) wellsite, which resides within the boundaries of PEDL183, was originally granted planning approval and constructed in 2013. Following the site construction, the West Newton A-1 (WNA-1) well was drilled as an exploration borehole in 2013, targeting 6 individual exploratory targets, with a gas discovery being made in the Kirkham Abbey formation. The WNA-1 well was completed and tested in 2014 after the introduction of the Environmental Permitting Regulations (EPR) to onshore oil and gas in the UK.

In 2019, Rathlin, as licence Operator, successfully drilled and cased a second well, the West Newton A-2 (WNA-2) well, from the West Newton A (WNA) wellsite. The well was subsequently completed, and flow tested in 2019 and again in 2021. It should be noted that all fluids utilised during drilling and completion operations, including acid treatments, were water based. The same holds true for all the West Newton wells drilled to date.

Appendix 1 illustrates the location of the West Newton A site and both wells.

Although hydrocarbons, predominantly natural gas, were tested from each of the wells, sustained flow rates were not achieved. These well test results were unexpected and subsequent analyses of the test data provided evidence of poor connectivity between the Kirkham Abbey carbonate reservoir and the wellbore. Additional third-party analyses, focused on the more complete WNA-2 well information, confirmed multiple mechanisms of formation damage within the Kirkham Abbey formation as a result of interactions between the aqueous-based drilling and completion fluids and the reservoir. This formation damage, or "high" skin, impairs the reservoir in the immediate area of the wellbore resulting in a significant reduction of the formation permeability directly adjacent to the well. The reduced reservoir permeability in turn impairs the ability of the reservoir to flow hydrocarbons to the wellbore.

Rathlin and its partners have determined that the WNA-2 well presents the best opportunity within the existing West Newton wells to address the skin issue. In order to overcome near wellbore damage and improve the flow rate from the Kirkham Abbey reservoir, Rathlin plans to re-enter the well to pull the existing completion and run a new completion string, undertake a low volume reservoir stimulation and flow the well.

The reservoir stimulation will involve a small-scale propped hydraulic fracture to be created in the near wellbore area and extending beyond the zone of impaired permeability to provide better connection to the reservoir. The whole operation will be undertaken using less than 85m^3 of injected fluid. This includes approximately 15m^3 fluid used in a Diagnostic Fracture Injection Test (DFiT) and less than 70m^3 fluid for the main stimulation, totalling no more than 85m^3.

In the Infrastructure Act 2015[(1)], associated hydraulic fracturing is defined as:

hydraulic fracturing of shale or strata encased in shale which […] involves, or is expected to involve, the injection of *(i) more than 1,000 cubic metres of fluid at each stage, or expected stage, of the hydraulic fracturing, or*

(ii) more than 10,000 cubic metres of fluid in total.

It can be seen that this definition is specifically intended to apply to large-scale, high volume hydraulic fracturing of shale gas formations. The reservoir stimulation activities proposed here are not into shale (or strata encased in shale), and the volumes involved are much less than 1,000 m^3. Hence, the definitions of associated hydraulic fracturing as per the Infrastructure Act 2015 do not apply to the proposed operation.

2 Scope

This document sets out how Rathlin will control and monitor the fracturing process. As stated in the '*Consolidated Onshore Guidance (OGA June 2018 v2.2)'* it is a requirement to submit an HFP to the NSTA prior to undertaking the proposed reservoir stimulation due to the fact that purpose of the operation is to create and reinstate natural fractures which will require pressures to exceed the fracture gradient and the fractures shall be held open with proppant, although the injection volumes fall well below the associated hydraulic fracturing thresholds.

To allow the NSTA to assess any risk of seismic activity, this document has identified any nearby faults to the well and formation stresses, local background seismicity and an assessment of induced seismic activity from the operation, compared this operation to other similar operations previously conducted, laid out the planned operational parameters, assessed the risks of seismic hazards and to groundwater from the operation. This document also describes the other regulatory permissions in place and the planned communication methods.

This HFP is applicable to Rathlin, its contractors and subcontractors and can be used in support of applications and notifications to the NSTA, EA and HSE.

3 Definitions

EA	Environment Agency
NSTA	North Sea Transition Authority
MPA	Minerals Planning Authority
HSE	Health and Safety Executive
BGS	British Geological Survey
MD	Measured Depth
BGL	Below Ground Level
TVD	Total Vertical Depth
MDBRT	Measured Depth Below Rotary Table
TVDSS	Total Vertical Depth Subsea
Reservoir Stimulation	A technique used to improve fluid flow through the formation to the wellbore
Hydraulic Fracturing	A stimulation treatment often performed in oil and gas wells in low permeability reservoirs. Fluid is pumped into the reservoir at pressures higher than the fracture pressure of the rock to generate a fracture in the formation. Proppant is often pumped to 'prop' open the fracture to increase permeability to the wellbore.
Proppant Squeeze	Defined by other operators as a localised operation which is used to increase the gas flow from the rock formations* or a small-scale hydraulic fracture treatment to overcome and bypass skin damage (formation damage) in the near wellbore area** *Europa Oil and Gas material 'Explaining the proppant squeeze' (1). www.europaoil.com **Egdon Wressle1 HFP (2)
DFiT	Diagnostic Fracture Injection Test.

	A relatively small volume of fluid injected into the formation to determine the breakdown pressure of the formation and then monitor the pressure response of the formation.
Associated Hydraulic Fracturing	Also known as High Volume Hydraulic Fracturing (HVHF) Defined in the Infrastructure Act, 2015 [(3)]; Section 50 as; *hydraulic fracturing of shale or strata encased in shale which […] involves, or is expected to involve, the injection of* *(i) more than 1,000 cubic metres of fluid at each stage, or expected stage, of the hydraulic fracturing, or* *(ii) more than 10,000 cubic metres of fluid in total.*
High Skin	Skin is a dimensionless factor calculated to determine the production efficiency of a well comparing it to actual conditions with theoretical or ideal conditions. A high skin factor indicates damage or some other factor severely impairing the productivity of the well compared to ideal conditions.
ISIP	Instantaneous Shut in Pressure
WNA	West Newton A wellsite
WNB	West Newton B wellsite
WNA-1	West Newton A-1 well on the WNA wellsite Wellbore registration number L46/05-3
WNA-2	West Newton A-2 Well on the WNA wellsite Wellbore registration number L46/05-4
WNB-1z	West Newton B-1z well on the WNB wellsite Wellbore registration number L46/10-2z

4 Well Summary

4.1 Well Location

The WNA-2 (wellbore registration number **L46/05-4**) well has been drilled from the West Newton A (WNA) wellsite located in PEDL 183 with site address;

West Newton A wellsite,
Fosham Road,
West Newton,
East Riding of Yorkshire
HU11 5DA

The site is located to the north of West Newton and east of Marton. It is located within the parish of Aldbrough, in the East Riding of Yorkshire.

The surrounding landscape consists of flat open fields that are interspersed with patches of woodland and divided by hedgerows and ditches. There are a number of mature hedgerows that border the field in which the site is located.

The nearest conurbations are West Newton, circa 1,130m to the south and Marton, circa 800m to the west.

The WNA-2 well has been drilled directionally away from the surface location. The coordinates, both surface and subsurface, are provided in Table 1.

Description	Easting (m)	Northing (m)
Surface Location	519271	439160
Kirkham Abbey Top (1715m MDBRT)	519428	439235
Kirkham Abbey Base (1781.5m MDBRT)	519440	439240
Total Depth of Well (2061m MDBRT)	519482	439259

Table 1 - WNA-2 Coordinates (British National Grid) OSGB36

4.2 Well Construction

The WNA-2 well was constructed in 2019. The well was drilled as an appraisal well after making a gas discovery in the Kirkham Abbey at WNA-1. The primary target was the Kirkham Abbey with a secondary target of the Cadeby formation, both Permian age carbonate formations. WNA-2 was drilled slightly deviated from surface to a total depth of 2061m (MD) (-2020.19m TVDSS) just below the Permian age formations. The well was drilled using water-based and salt-saturated drilling muds.

A summary of the geology encountered is shown below and a full lithology log can be found in Appendix 2.

Age	Formation name	Depth (m) TVDSS
	Ground Level	12
Quaternary	Boulder clay	
Upper Cretaceous	Chalk	-30 -491
	Carstone Fm	
Jurassic	Lias Group	-495 -612
Upper Triassic	Mercia Mudstone	
Lower Triassic	Sherwood Sandstone	-918 -1492
Upper Permian (Zechstein)	Roxby Fm	-1537
	Sherburn AN	-1543
	Carnalitic Marl	-1572
	Boulby Halite	-1584
	Brotherton Fm	
	Fordon Evap	-1640 -1690
	Kirkham Abbey Formation	-1765
	Hayton Anhydrite	-1905
	Cadeby Fm	-1944
	Marl Slate	-1946
Lower Permian	Rotliegendes	-1968
Upper Carboniferous	Coal Measures	
	TD	-2010

Figure 1 - WNA-2 Lithlog

A conductor casing was set at 74.5m BGL using a water well drilling rig. The main section of the well was spud on 26/04/2019. Casing was set at the following intervals;

Casing			Depth (m)				Formation
Size	Weight (lb/ft)	Grade	MDBRT		TVDSS		
			Top	Bottom	Top	Bottom	
20”	94	K55	Surface	77.8	Surface	61.1	Carstone Chalk
13-3/8”	68	L80	Surface	561.0	Surface	543.5	Lias
9-5/8”	40	L80	Surface	1447.6	-Surface	1418.5	
9-5/8”	47	L80	1447.6	1519.6	1418.5	1488.5	Roxby
5-1/2”	15.5	L80	Surface	2009.3	Surface	1969.5	
5 1/2”	17	L80	2009.3	2058.0	1969.5	2017.0	Carboniferous Coal Measures

Table 2 - WNA-2 Casing Depths and Specification

The casing strings were cemented and pressure tested as follows;

Casing Size	Cement Top	Cement Type	Pressure Test
20”	Surface	15ppg Portland Slurry	
13-3/8”	461m MDBRT	12.5 RHC slurry	2000psi on bump plug 14.0ppge FIT
9-5/8”	100m inside 13-3/8” shoe	12.5ppg RHC Slurry	1500psi after WOC 14.3ppge FIT
5-1/2”	Surface	12.5 Class G Lead & 80bbl 15.7ppg Class G tail slurry	4710psi on plug bump

Table 3 - WNA-2 Cementing of Casing

The well was perforated on two occasions; the original perforations undertaken in the 2019 testing programme were over the interval 1739-1761m MD. When the well was tested again in 2021, the well was re-perforated over intervals 1715-1724m MD and 1736-1739m MD.

This leaves the two perforated intervals of 1715-1724m MD and 1736-1761m MD.

The well shall be completed with premium grade tubing and a packer above the perforations prior to undertaking the reservoir stimulation.

5 Background Analysis

This section provides background information and analysis of the WNA-2 well, its geological and structural setting and the proposed operation.

5.1 Zechstein Group and Kirkham Abbey Formation Geology

Petroleum Exploration and Development Licence (PEDL) 183 and the West Newton project are located within the Humber Basin, a sub-basin of the Southern Permian Basin (SPB). The SPB, along with the Northern Permian Basin (NPB), were formed in the late Carboniferous to Early Permian and were located in the arid subtropical belt of Northern Pangea. During the early Zechstein marine transgression, the subsiding basin was flooded with normal marine seawater from the Panthalassa world ocean to form the vast epicontinental Zechstein Sea. The SPB is comprised of a series of sub-basins extending from eastern England across the North Sea into Poland and southern Lithuania, a distance of approximately 1,700 km (Figure 2). Significant hydrocarbon accumulations of economic importance are contained in the SPB, specifically in Poland, Germany, the Netherlands and the North Sea (the Hewett field).

The SPB was subject to periodic intense evaporation and exhibits depositional facies similar to most Paleozoic epicontinental basins in arid paleoclimates that are subject to the formation of intermittent barriers and separation from the world ocean. Five carbonate-evaporate cycles (EZ1-EZ5) are correlated basin wide.

In England, the basal transgressive EZ1 cycle is comprised of the Rotliegendes, Marl slate, Cadeby Formation and Hayton Evaporite, while the subsequent basin filling, restricted marine carbonate-evaporite EZ2 cycle is comprised of the Kirkham Abbey and Fordon Evaporite/Salt (Figure 3). The EZ3 (Brotherton Carbonate, Billingham Anhydrite and Boulby Halite), EZ4 (Carnallitic Marl and Sherburn Anhydrite) and the EZ5 (Sleights Siltstone, Littlebeck Anhydrite and Roxby Formation) complete the stratigraphic sequence for the Zechstein basin.

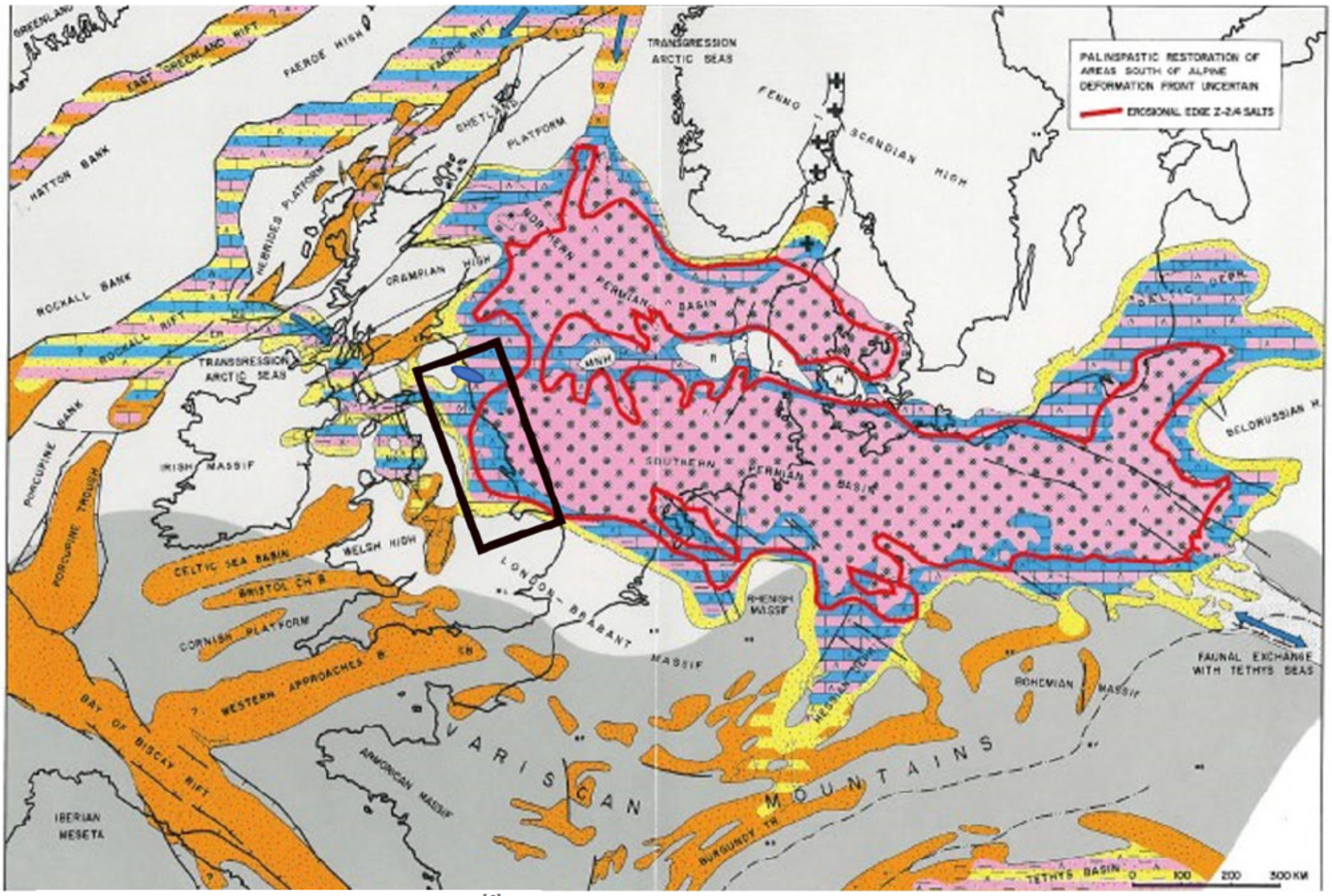


Figure 2 - Zechstein Paleogeography [4]

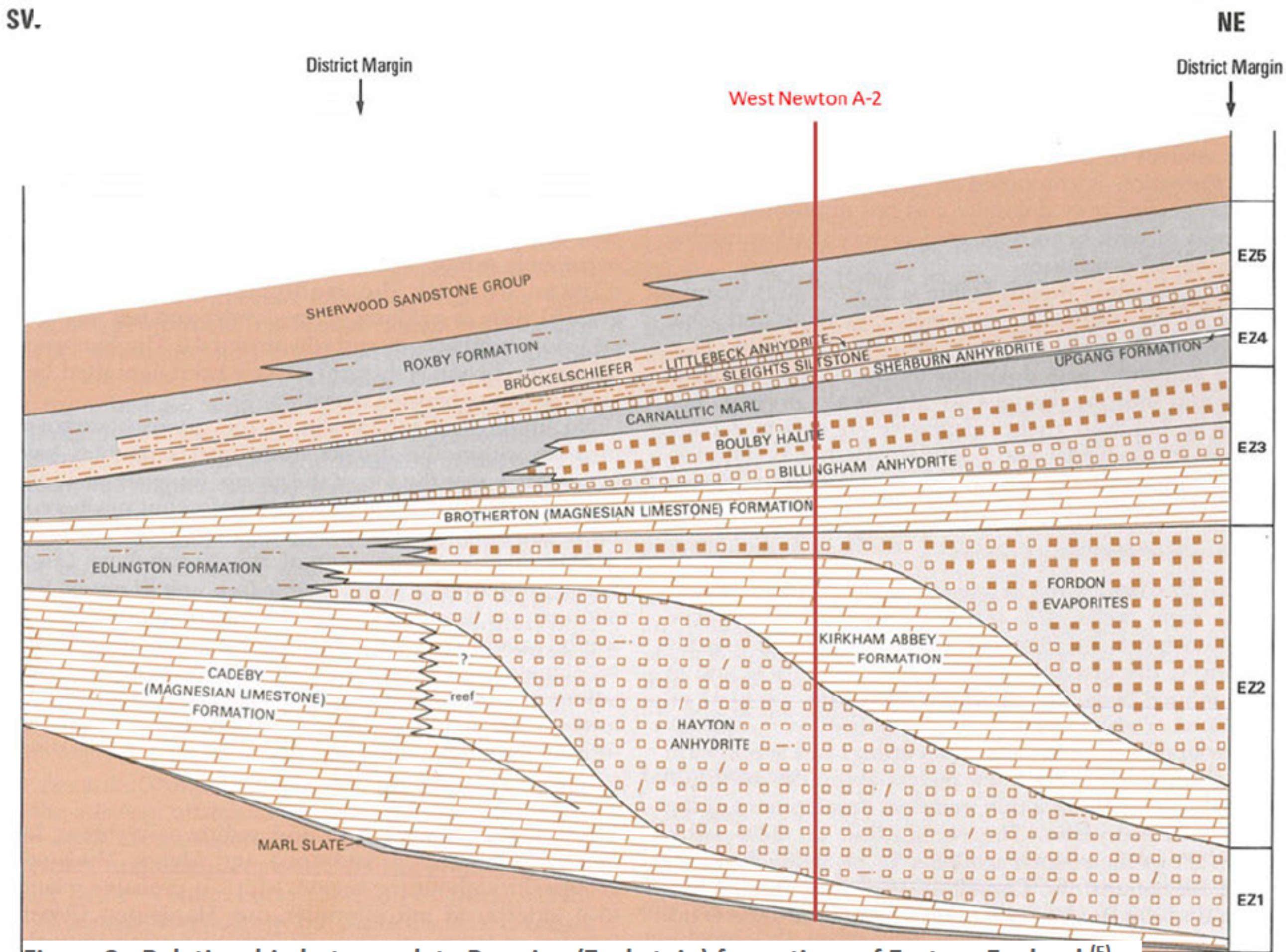


Figure 3 - Relationship between late Permian (Zechstein) formations of Eastern England [5]

During deposition of the EZ1 cycle, a basal transgressive sequence of normal marine carbonate deposition consisting of continental red beds and littoral deposits moving seaward to a back-reef lagoon, to shelf and fringing reef complex, to a platform comprised of a proximal belt of platformal carbonate with localized developments of coalescing patch reef complexes and a distal belt of thinner platformal carbonates with scattered pinnacle reef development, to thinned starved basin exhibiting euxinic varved deep water laminates is repeated throughout the SPB. This shoreline, lagoon, shelf fringing reef, platform and starved basin configuration defines the basinal geometry that will control the subsequent deposition of the four restricted marine carbonate-evaporite couplets that will eventually fill in the basin in NE England.

5.2 Background Seismicity

The seismicity of the UK is monitored by the British Geological Survey (BGS), using a network of permanent stations, as well as a transportable array of sensors known as the UK Array.

The specially commissioned report prepared by Outer Limits Geophysical LLP, *Seismic Hazard Assessment for Proposed Stimulation Activities Operation at the West Newton Site* in Appendix 5, provides a detailed analysis of background seismicity.

In summary, WNA-2 is located in a region with relatively low rates of natural seismicity. Figure 4 shows all earthquakes within the 100 × 100km square centred on WNA-2 since 1970.

The most notable event of interest in the study region is the 2008 M 5.2 Market Rasen earthquake and its associated aftershocks. This event is located roughly 50 km to the south of the West Newton site. The 2008 Market Rasen earthquake was one of the largest earthquakes to have been instrumentally recorded in the UK. It was widely felt across England and Wales. Heyburn and Fox (2010) constrained the depth of this event to 22 km using a combination of surface and body wave observations. At least 12 aftershocks from this event were also detected. This event is accepted to be a tectonic earthquake.

The nearest 4 events within 22.5 km of West Newton Site. Their details are:

Time	Latitude	Longitude	Depth (km)	Magnitude
11th April 2009	53.697	-0.249	15.3	3
5th April 2016	53.692	-0.43	6.5	1.5
20th March 2018	53.944	-0.351	12.5	0.9
22nd January 2022	53.84	-0.449	9.2	1.6

Table 4 - Nearest 4 seismic events within 22.5km of West Newton Site

The cause for each is natural (at least, there is no obvious nearby industrial activity that could be imputed as a cause).

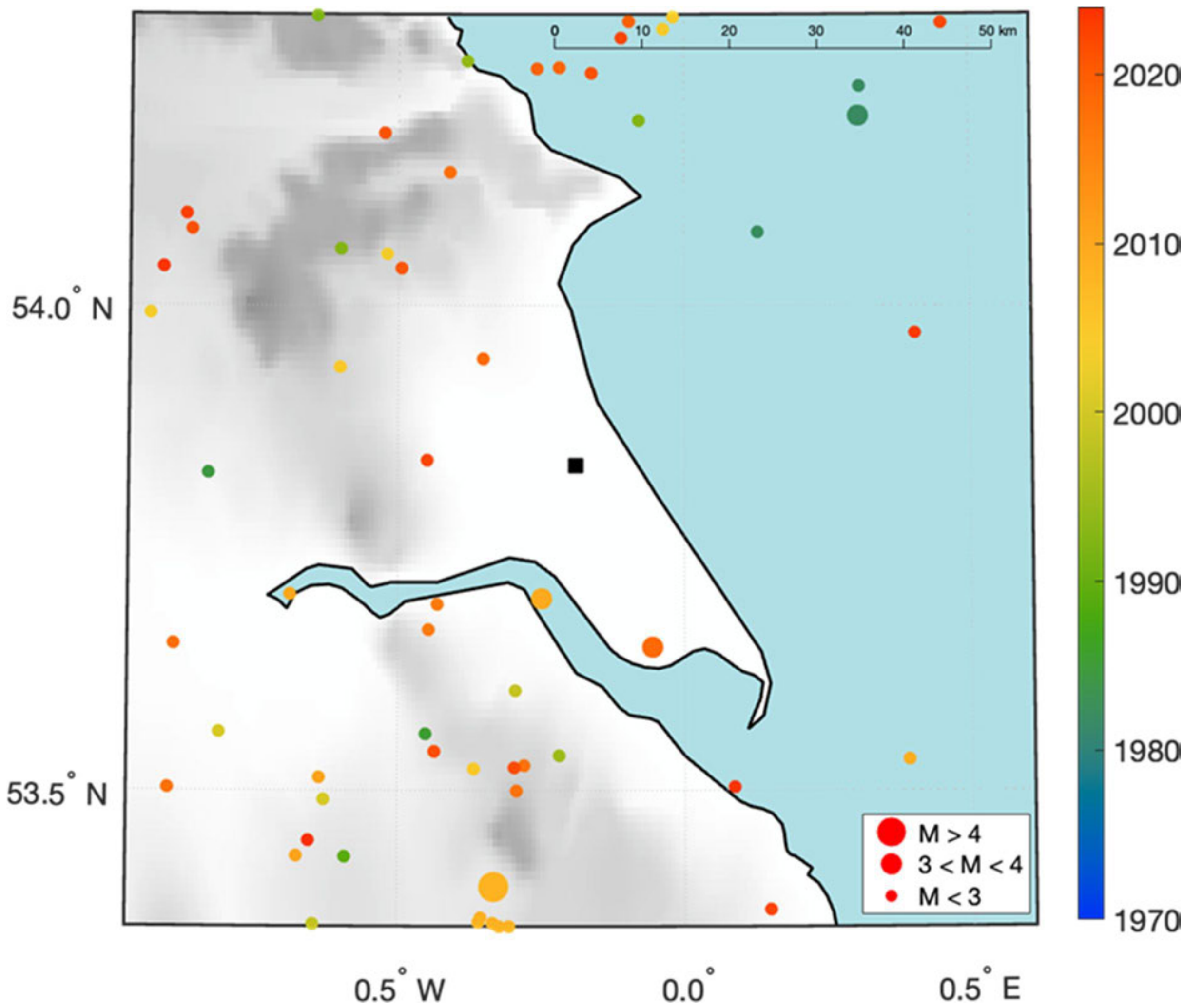


Figure 4 - Outer Limits [6] map (see Appendix 5m Figure 3.2) showing Locations of instrumentally recorded earthquakes in a 100 x 100km region around the West Newton site (black square). Events are coloured by date and sized by magnitude

5.3 Background to Proposed Operations

WNA-2 was drilled and completed in 2019. The primary target formation of the well was the Kirkham Abbey, which was drilled using an NaCl/KCl polymer fluid. 28 metres of core were cut and recovered from the Kirkham Abbey which, in combination with an extensive logging suite, provides very good information over the targeted reservoir and indicates that the Kirkham Abbey reservoir is hydrocarbon charged.

The well was tested on two occasions, hydrocarbons were recovered, but sustained flows of commercial quantities of hydrocarbons were not achieved.

The following processes were used in attempting to flow the well; perforating in suspension fluid, an acid squeeze using 15% HCL, nitrogen lifting the fluids from the well to create an underbalance, using a downhole pump and linear rod pump assembly to lift fluids and associated gas from the well, reperforating additional sections of the reservoir, selectively acidizing using an acid blend of 7.5% HCl / 10% Acetic acid and finally using the down hole pump and linear rod pump on the newly perforated interval. Fluid and gas samples were taken and analysed at a laboratory. Throughout these operations, it was necessary to kill the well using CaCl brine on a number of occasions to undertake the various operations.

Following each of the acid jobs, increased pressures were noted which led to the flow of fluid to surface, but quickly reduced and sustained flow was not achieved.

Given the results of the testing, an internal review was conducted using all of the other WNA-2 well data including core and sample data, log data, petrophysical analysis, mud gas information and all drilling information. This review heightened the suspicions of reservoir formation damage. PEDL183 partners decided to seek independent evaluations from leading third-party specialists to help resolve the reservoir flow issues.

A petrophysical review was undertaken by an industry recognised consultant including the utilisation of their proprietary software. The results of this evaluation were consistent with internal understanding of the reservoir and most importantly, showed no evidence of free water in the reservoir.

Core sections from WNA-2 were analysed at a highly renowned laboratory for reservoir characteristics and potential mechanisms of formation damage due to the drilling and completion methodologies utilised.

Roller Oven Stability (ROS) testing was conducted which showed that the WNA-2 Kirkham Abbey samples show high to extreme sensitivity to water-based fluids and associated erodibility. This can lead to fines being mobilised and accumulating within the pore throats and natural fractures within the reservoir, causing a significant reduction in permeability. The same ROS test was conducted using a hydrocarbon-based fluid which resulted in a substantial reduction in the erodibility of the samples.

Unpropped Fracture Conductivity (UFC) testing and Capillary Suction Time (CST) testing were conducted at the same laboratory. UFC testing showed that the fluid conductivity after acidization (using 15% HCl) was reduced rather than enhanced, as would have been expected. Following the UFC testing it was found that both iron (Fe) and chromium (Cr) were mobilised during the tests. It is unclear whether the source of Fe and Cr is internal to the Kirkham Abbey or whether it has been introduced through the water-based drilling mud used to drill through the Lias group, Mercia Mudstone group and Sherwood Sandstone formations prior to drilling the Kirkham Abbey.

The UFC test showed that water based dilute acid clearly offered no benefit and, in fact, was detrimental to the fracture conductivity.

The CST test is primarily designed to test for clay swelling. The Kirkham Abbey samples have no clay content (as shown by X-Ray diffraction analysis), though the samples still show some sensitivity to water-based fluids.

The results from these independent studies along with the West Newton well data and analyses were reviewed by independent technical specialists in order to provide feedback on the Kirkham Abbey reservoir, drilling and completion practices/methodologies and assess the productive potential of both unstimulated (undamaged) wells and wells following reservoir stimulation (small, gelled oil treatment).

Reservoir modelling based on the WNA-2 Kirkham Abbey reservoir parameters determined that a stimulated vertical / deviated well was capable of significant and sustained gas flow. The stimulation utilises a non-damaging gelled oil-based fluid with a small quantity of proppant.

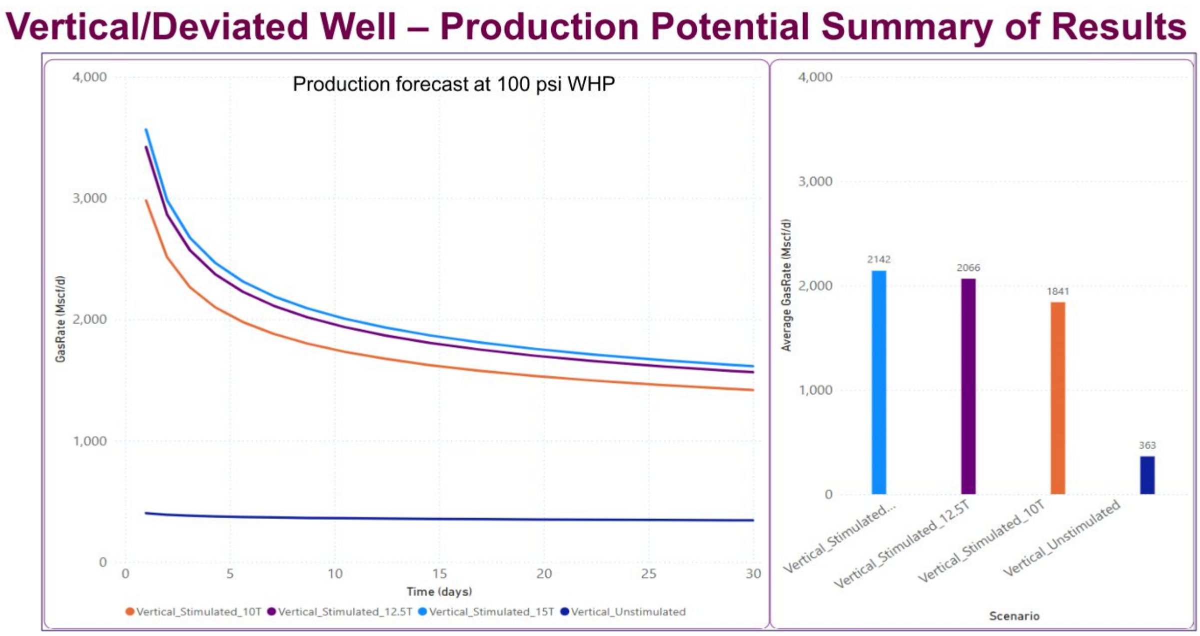


Figure 5 - Chart showing the potential production from an unstimulated vertical well and following various size stimulations

Rathlin, as operator of PEDL183, believes that, based on internal analyses and those undertaken by well-respected third parties, the Kirkham Abbey reservoir in the WNA-2 well represents a viable candidate for a propped, oil-based reservoir stimulation.

The modelled stimulation is designed to bypass the near wellbore area, that lab studies indicate has suffered significant formation damage. The modelled results demonstrate increased connectivity between the reservoir and the wellbore which yield significant initial gas flow rates in the study. The proposed stimulation of the Kirkham Abbey reservoir in the WNA-2 well represents a cost-effective method of confirming the productive capability of a non-damaging stimulation of the Kirkham Abbey reservoir. A successful outcome could yield a well capable of gas production associated with a larger development and will help inform future drilling and completion techniques and methodologies.

5.4 Historical Fracturing in the West Newton Region

Within our study area, 14 small scale reservoir stimulation activities have taken place. The most recent being in 2021 at the Wressle-1 well where a 150 m3 reservoir stimulation was conducted in the Carboniferous Millstone Grit formation. The primary target for reservoir stimulations in the Vale or Pickering area was the Kirkham Abbey formation. A review of historical reservoir stimulations can be found in the Outer Limits Geophysical report in

Appendix 5. No cases of induced seismicity have been reported or identified from any of these reservoir stimulation activities

5.5 Planning and Environmental Permitting

5.5.1 Minerals Planning Authority – East Riding of Yorkshire Council

Planning approval was initially granted for the West Newton A site by the Minerals Planning Authority (MPA), the East Riding of Yorkshire Council (ERYC), in 2013. A summary of the planning approvals is given below.

Application Number	Proposal	Date of Approval
DC/12/04193/STPLF/STRAT	Construction of a temporary drilling site with associated access, to drill a borehole for the purposes of mineral exploration (petroleum)	17th January 2013
DC/15/03056/STVAR/STRAT	Variation of Condition 2 (time period) of planning permission 12/04193/STPLF to allow extension of time period for a further 36 months	21st December 2015
18/0924/CM	Variation of Condition 1 (temporary period) to extend the period of exploration and testing of planning reference 15/03056/STVAR for a further 36 months	11th September 2018
21/04625/CM	To construct an extension to the existing West Newton A (WNA) wellsite, test, appraise and produce from the two existing wells and drill, test, appraise and produce from up to four (4) new wells followed by decommissioning and wellsite restoration (Revised scheme of 21/02464/STFUL)	28th March 2022

Table 5 - Summary of planning approvals for the WNA wellsite

A submission of Information was made to the MPA in May 2024 which set out details of the proposed reservoir stimulation and that the operation will be conducted in accordance with planning permission reference 21/04625/CM.

5.5.2 Environmental Permitting – Environment Agency

A bespoke Environmental Permit has been issued under ERP 2016 for the management waste and flaring of waste gas, a surface water activity, an installation activity, the storage and handling of crude oil at the WNA wellsite along with a Standard Rules permit, SR2014 no4; accumulation and disposal of radioactive waste from the NORM industrial activity of the production of oil and gas.

An application was submitted in July 2024 for the variation of the bespoke permit to include for a mining waste facility and a groundwater activity to allow for the Reservoir stimulation activity within the WNA2 well.

6 Proposed Operation

In order to re-establish permeability within the target formation, it is necessary to undertake a reservoir stimulation, which is designed to create channels of communication through the near wellbore formation, the natural permeability having been impeded by formation damage as a result of the initial drilling and completion operation. For clarity, the primary purpose of the reservoir stimulation is to re-establish permeability, however, due to the design of the reservoir stimulation, although as minimal as is reasonably practicable, the reservoir stimulation will extend beyond the near wellbore damage, providing some degree of secondary benefit in the form of enhanced permeability within the target formation.

In the case of WNA-2 operations, the reservoir stimulation activity will be undertaken in phases to ensure that the stimulation is carried out as effectively as possible. A hydrocarbon-based fluid will be utilised as the formation has been shown to be highly sensitive and easily damaged by water-based fluids. Eliminating the use of water-based fluids will reduce the potential for any further formation damage.

The main reservoir stimulation will be undertaken in a single stage treatment, however a DFiT will be conducted in advance. A DFIT injects a small volume and monitors pressures both during injection (breakdown) and afterward (leak-off). The DFiT results are then used to verify or fine-tune the reservoir parameters such as leak-off coefficient, permeability, breakdown and closure pressures, magnitude of minimum principal stress and formation pressure which are important factors in determining fracture geometry in fracture modelling.

The DFiT will involve a number of steps. Firstly, the well will be circulated to oil-based fluid to ensure that the current water-based suspension fluid in the well is not injected to the formation. Once the wellbore is full with oil-based fluid (step 1), approximately 4m^3 will be pumped into the formation to establish the breakdown pressure (step 2). A step test will then be performed to determine the pressure required for propagation of the fraction, the fracture closure pressure and to understand any near wellbore friction implications. The step rate test (step 4 & 5) will use varying pump rates, using approximately 11m^3 of oil-based fluid and will record the associated pressures.

Although the pumping time associated with these steps is very short, there will be time to monitor the pressure dissipation prior to moving onto the next step which is expected to be a few hours.

#	Step Name	Pump Rate m3/min	Fluid Volume (m3)	Cum. Volume to formation (m3)	Pump Time (min)	Cum. Pump Time (min)
1	Fill Up	1	5	0*	5	5
2	Breakdown	0.6-1.2	4	4	3.3	8.3
3	ISIP/Decline	0			0	8.3

4	Step Up Test	0-4.8	6	10	1.3	9.6
5	Step Down Test	4.8-0	5	15	1	10.6
6	ISIP/Decline	0				

Table 6 - Pumping Schedule for DFiT

* this volume is to fill surface equipment and wellbore and does not constitute as part of the volume being considered as pumped to formation

Information determined from the DFiT will be analysed. If any on the reservoir parameters are different to the parameters used in the model, the model will be adjusted, and changes may need to be made to the pump schedule, rate, or fluid rheology to ensure that the geometry remains in the targeted interval. The most common change made at this point would be to adjust the volume of the pad in the main treatment based on the leak-off determined from the DFiT. In this case the pump schedule would be adjusted such that the total volume pumped in the main stimulation remains within the permitted value of no more than 70m^3. The proposed pumping schedule for the main stimulation is shown in Table 7.

It is proposed to pump 10m^3 of the gelled stimulation fluid as a calibration (step 2) followed by a flush of 5.2m^3 (step 3), prior to pumping the fluid with proppant, to ensure the fluid interacts with the reservoir as planned.

Once the final volumes of fluid and proppant have been determined, the main reservoir stimulation shall be pumped. It is anticipated that a total of 48.6m^3 (steps 5 – 12) of gelled fluid and 12.5tonnes of 20:40 grade sand will be used as proppant. This will be pumped using a stepped approach by pumping a pad volume of fluid and then adding the proppant in steps to form a slurry. The total time to pump the entirety of main stimulation (steps 1 -12) is just under 14.5 minutes.

#	Step Name	Pump Rate m3/min	Fluid Volume (m3)	Cum. Fluid Volume (m3)	Proppant Concentration (kgPA)	Proppant Mass (kg)	Slurry Volume (m3)	Pump Time (min)	Cum. Pump Time (min)	Step type
1	Fill up	1	0.0	0.0	0			0	0	Pad
2	Calibration	3.7	10.0	10.0	0		10.0	2.08	2.08	Pad
3	Flush	3.7	5.2	15.2	0		5.2	1.08	3.16	Flush
4	ISIP/Decline	0	0.0	15.2	0		0.0	0	3.16	Flush
5	Pad	3.7	13.6	28.8	0		13.6	2.84	6	Pad
6	1PPA	3.7	5.0	33.8	120	600	5.2	1.1	7.09	Slurry
7	2PPA	3.7	5.0	38.8	240	1200	5.5	1.1	8.23	Slurry
8	3PPA	3.7	5.0	43.8	360	1800	5.7	1.2	9.41	Slurry
9	4PPA	3.7	5.0	48.8	480	2400	5.9	1.2	10.64	Slurry
10	5PPA	3.7	5.0	53.8	600	3000	6.1	1.3	11.92	Slurry
11	6PPA	3.7	5.0	58.8	720	3500	6.4	1.3	13.25	Slurry
12	Flush	3.7	5.0	63.8	0		5.2	1.1	14.33	Flush

Table 7 - Pumping Schedule for Main Stimulation

The total volume of fluid to be pumped during the whole operation (DFiT and main stimulation) shall not exceed 85m^3 and 12.5tonnes proppant as specified in the Environment Agency permit which has been applied for.

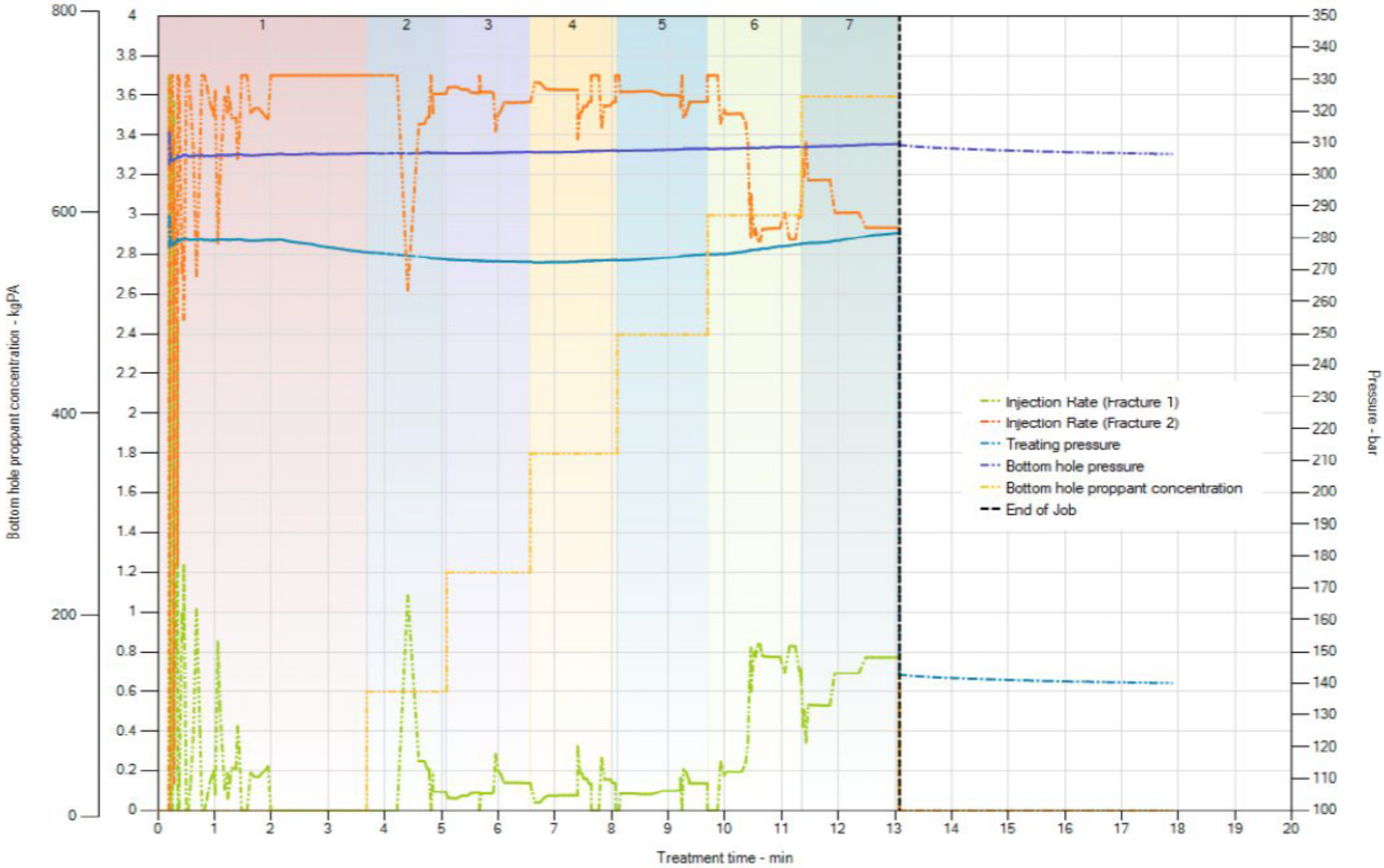


Figure 6 – Plot of expected pumping pressures and proppant schedule during the reservoir stimulation

Throughout the treatment it is expected that bottom hole pressures will be less than 5000psi. Surface pressures are dependent on pump rate and frictional effects. At maximum rate, surface pressures are also expected to be less than 5000psi.

7 Seismic Hazard Risk Assessment

The section deals with the potential for induced seismicity associated with the proposed operations at WNA-2. A detailed third-party Seismic Risk Assessment (SRA) dealing with the proposed WNA-2 reservoir stimulation activities was undertaken by Dr. James Verdon of Outer Limits Geophysical (OLG) and is included here as Appendix 5. An Environmental Risk Assessment of Induced Seismic Activity can be found in Appendix 6.

The OLG assessment concludes that, given the small scale of the proposed stimulation, combined with the stress state and proximity of faults to the proposed zone of stimulation, the probability of triggering an induced seismicity event that is measurable at surface is highly unlikely. The assessment further concludes that the probability of the proposed stimulation triggering an induced seismicity event that could be felt by the public (M 0.8) is negligible.

Outer Limits reviewed the background seismicity in a 100km x 100km area centred on the West Newton A-2 well location. Within this area only 4 events >M 3.0 have been recorded since 1970. The largest being the Market Rasen M 5.2 event in 2008, which was determined to be a tectonic event at a depth of ~ 22 km, well below the depth of the proposed WNA-2 stimulation activity or previous oilfield activities in the area. The other 3 events > M 3.0 originate from depths > 10 km. This is a region with a relatively low baseline level of seismicity.

Based on the magnitude and frequency of events with the study area we can establish a magnitude of completeness of M 2.0. This is the magnitude above which all events will be detected. This measure is consistent with the BGS estimates for detection threshold by the UK's national seismic monitoring system in the area.

Figure 8 shows the current BGS seismometer network[6]. There are 4 monitoring stations within 60 km of the WNA-2 well location.

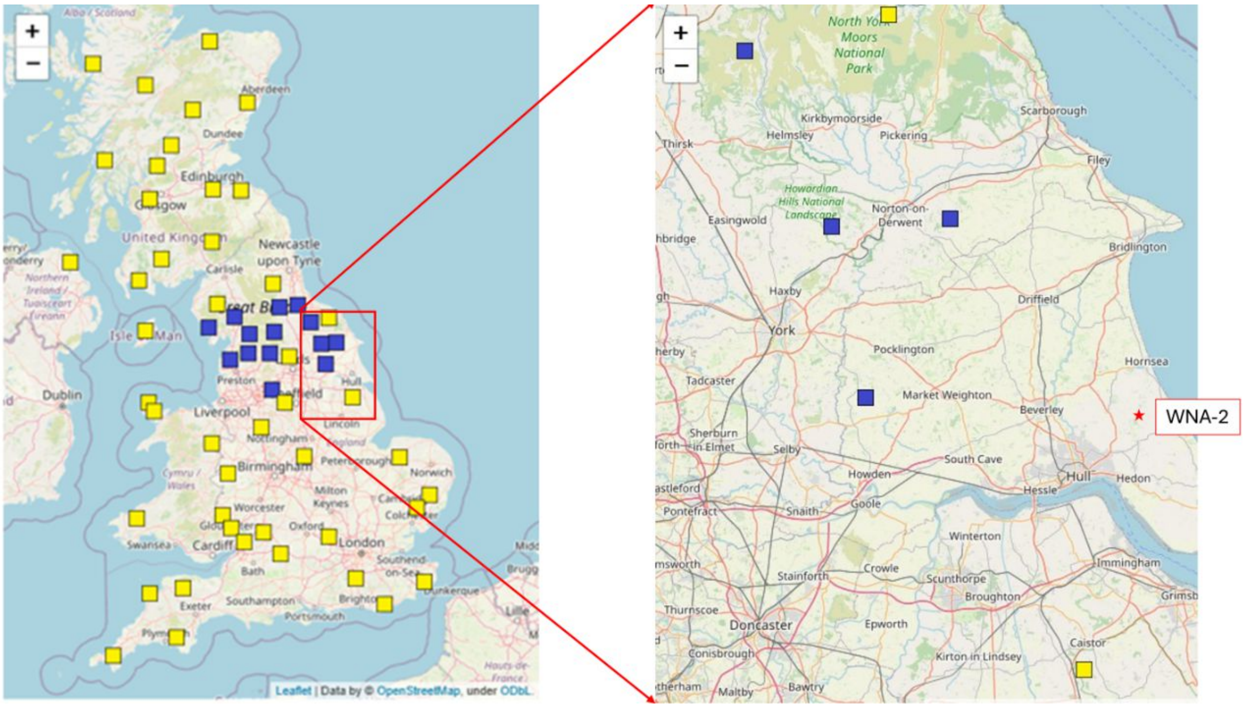


Figure 7 - Current BGS seismometer network. National Network stations in yellow and UK Array stations in blue (September 2025)[6]

Within the study area a total of fourteen (14) wells with stimulation activities, which include hydraulic fracs, proppant squeezes and acidisations, have been identified. These small-scale stimulation activities are a good comparison for the proposed WNA-2 activity. Ten (10) of these operations were located to the south of WNA-2 and targeted the Carboniferous Millstone Grit clastics, the remaining four (4) operations, located north of the WNA-2 well in the Vale of Pickering, targeted the Permian and Carboniferous sand formations. None of these activities resulted in reports of any induced seismicity. In 2021, a proppant squeeze using a fluid volume ~150 m^3, was conducted in the Millstone Grit formation at the Wressle well, located approximately 35 km south of WNA-2. The Wressle operation included the deployment of a microseismic monitoring array with an event detection threshold of M -1.0. No induced seismicity events associated with the proppant squeeze were detected.

Induced seismicity associated with injection operations is primarily triggered by the reactivation/failure of critically stressed faults, typically at basement level. Rathlin has conducted a detailed fault interpretation and analysis, included here as Appendix 4, which provides fault locations and orientations based on a proprietary 3D3C seismic survey. The mapped faults all appear to be intra-Permian with no clear connection to deeper formations. The closest identified fault to the WNA-2 well is located ~ 1 km to the W-NW of the WNA-2 well. This is well beyond the planned effective fracture length of approximately 15 m, proposed for the WNA-2 operation.

Outer Limits Geophysical conducted an evaluation of the in-situ stress conditions relative to the orientation of the mapped faults to determine if they are likely to slip, given the proposed operations. Stress gradients from the Wressle operation, which are consistent with regional stress data, were used in this evaluation along with pore pressure gradients from the WNA-1 well to calculate in-situ stress conditions at the planned depth for operations at WNA-2. Based on this evaluation we conclude that there are no critically stressed faults mapped that would be influenced by the proposed scale of operations at WNA-2. Faults, which may be subject to slip, may exist below the limit of the 3D seismic resolution and are evaluated by a probabilistic seismic hazard assessment.

The seismogenic index ∑ is a measure of how seismically sensitive the rock is to fluid injections at any particular location. It can be used, combined with injection volume V, to estimate the total number of events that will occur, larger than magnitude M. V is the planned injection volume for WNA-2. For the Kirkham Abbey at WNA-2 a best estimate of ∑ is based on results from the Wressle proppant squeeze, but a range of values is used to predict the largest expected event magnitude.

A prediction of the magnitude of the largest event that will most likely occur during operations is M -2.0. An event of this magnitude would be too small to be detected with a microseismic monitoring array at surface. There is a 95 % likelihood that the largest event size is less than M 0.0 and a 99% likelihood that an M 0.8 event will not be exceeded.

Based on these analyses we conclude that there is a very low probability of the proposed reservoir stimulation triggering any induced seismicity reaching a level that would be detectable by either the public or a surface monitoring array. In addition, the short duration (<30 minutes) for the proposed injection process would leave insufficient time to initiate any traffic light system (TLS) response prior to termination of the operation. Therefore, the installation of a seismicity monitoring array, for the proposed operation is not warranted, given the low risk with respect to seismic hazard and likelihood of triggering a measurable seismicity event.

8 Risk to Groundwater

Rathlin have applied to the EA for a Groundwater Activity permit to conduct the reservoir stimulation. Included in the application was a Hydrogeological Risk Assessment (HRA) which was undertaken by an independent, competent consultant. When deciding whether to issue the permit the EA shall assess the risk to groundwater before determining the permit. This HRA was an addendum to the original Hydrogeological Risk Assessment and Flood Risk Assessment submitted as part of the planning permission in 2022.

The original HRA and FRA is included in Appendix 7 and the Reservoir Stimulation HRA is included in Appendix 8.

The HRA assessed the risk of both storage and use of chemicals and fluids associated with the reservoir stimulation activities as well as the downhole application of the reservoir stimulation activity.

The report concluded that the storage and use of chemicals and fluids will not result in a different risk profile from conventional drilling and other oilfield operations, that "with the imbedded mitigation measures in place, the risks to all receptors reduce to low or very low, which are not significant in EIA / planning terms(7)".

The risk associated with the proposed reservoir stimulation was evaluated using the BGS/EA 3DGWV tool and demonstrates that the downhole procedures do not present an unacceptable risk to surface water and groundwater receptors.

8.1 Site containment

The WNA wellsite has been constructed by using a High Density Polyethylene (HDPE) liner and perimeter containment ditch in order to collect and store any fluids that fall onto the site surface. The wells are drilled from sealed drilling cellars which is designed to contain any fluids on the site.

Rathlin adheres to Ciria C736 (Containment systems for the prevention of pollution) guidance when storing hazardous materials on site. Any hazardous substances held on site shall be stored in a separate, suitable bund meaning the HDPE site liner can be viewed as tertiary containment. The site is built on approximately 50m of low permeability glacial till which acts as a hydraulic barrier between the surface water system and underlying groundwater in the bedrock.

The fluids collected on site in the perimeter ditch are tested for a range of pollutants, described in the EA permit documentation, to ensure that contaminated water is not discharged from site.

8.2 Drilled WNA-2 well

The WNA-2 wellbore was drilled following internal Wells Design and Operation Standard which takes into account The Offshore Installations and Wells (Design and Construction, etc.) Regulations 1996 (DCR) as well as other applicable legislation and guidance.

A WR11 Application was submitted to and approved by the Environment Agency prior to drilling the WNA-2 well. The approval of 3rd October 2018 stated; 'we consider the measured proposed sufficient to protect water resources'. The construction of the well was assessed against the approved design by the EA compliance officer during drilling. It was noted on EPR Compliance Assessment Report, Report ID PP3833VA/0335980 that 'No non-compliances were identified'.

8.3 Groundwater Monitoring

The WNA wellsite has an established routine for protecting and monitoring both groundwater and surface water from the site which have been written into working practices set out in the EA permits. Two groundwater monitoring boreholes are constructed onsite which have been used to monitor groundwater since 2014, these are shown on 'Indicative Reservoir Stimulation layout plan' (ZG-RE-WNAEXT-PROD-EPR-010) in Appendix 1.

The routine water sampling allows for detection of fluids used on the site which have the potential to migrate from the site surface or through the well into the groundwater system.

Groundwater monitoring is conducted every 3 months or every month during testing / stimulation activities. Surface water monitoring is conducted every month when discharging surface water from the site, with a full suite of analysis of the surface water held on site every three months. The analysis suite is consistent with hazardous materials handled on site so that any pollutants found in groundwater can be compared with any pollutants found on site.

The results of the groundwater and surface water monitoring are reported to the EA as stipulated in the EA permits.

9 Controls, Monitoring and Reporting

This section sets out the control measures and monitoring, identified through risk assessment, which Rathlin is proposing to demonstrate that the planned operation is safe and will have no adverse impact on those living and working nearby. As input to this HFP, Rathlin has performed an extensive third-party seismic risk assessment including a probabilistic prediction of the maximum induced seismic event for the Reservoir Stimulation planned for WNA2. This is summarised in the preceding Section 7 and detailed in Appendix 5. It should be noted that the proposed WNA2 Reservoir Stimulation is a short duration, low volume hydraulic stimulation operation, designed to extend circa 15m in a bi-lateral direction with no vertical height growth above the current uppermost perforation interval and less than 3m vertical propagation below the current lowermost perforation.

The WNA2 reservoir stimulation of the Kirkham Abbey formation is a significantly smaller operation, both in duration and impact, to that of associated hydraulic fracturing and hydraulic fracturing of other unconventional reservoirs. As such, the control measures and monitoring are proportionate to the potential impact.

9.1 Proposed Monitoring Plan

As identified through Seismic Risk Assessment (Appendix 5), the risk of an induced seismic hazard occurring as a result of the reservoir stimulation operation is low.

A prediction of the magnitude of the largest event that will most likely occur during operations is M -2.0. There is a 95 % likelihood that the largest event size is less than M 0.0 and a 99% likelihood that an M 0.8 event will not be exceeded. M 0.8 remains significantly lower than the threshold for a felt event at surface. As such, the likelihood, and consequence, of such an event causing harm to health, safety, or the environment (e.g. from ground shaking) is extremely low. Based on Rathlin Environmental risk assessment for induced Seismic activity (Appendix 8) the Residual Risk Rating for induced seismic risk has therefore been assessed as Low.

Moreover, as the expected magnitude of seismic events are smaller than the threshold of detection for surface monitoring arrays, it will not be possible to monitor or locate fracture propagation or height growth through micro-seismic monitoring. As such Rathlin, proposes an alternative monitoring plan based on extensive modelling performed and calibration to real time pressure recordings and leak-off as determined during a DFiT prior to the proppant squeeze.

Initially the DFIT will determine actual reservoir properties and near wellbore fracture characteristics. This will include in-situ stress, permeability and reservoir pressure, fluid leak off characteristics and tortuosity. This information will be used to refine the stimulation model, which will demonstrate expected fracture growth. The stimulation design will be refined to ensure the re-modelled fractures remains within the target formation.

Following the main stimulation, the observed pressures will be calibrated with the pressures modelled, based on the DFIT, to confirm the validity of the model.

Provided the model assumptions prove valid, we would conclude that the fracture growth predicted by the model is also valid and that the fractures have remained within the target formation.

9.2 Fracture Height Growth Assessment and Monitoring Plan

Mathematical models to design a fracture treatment have been in existence since the mid-1950s. Advances in computing technology supported by laboratory research and development, in mathematical modelling and 70 years of field experience have provided very sophisticated models to predict fracture growth. It is standard practice to first design the treatment based on data collected while drilling the well.

This model is then fine-tuned on site by pumping a small volume of fluid without proppant and allowing it to leak off into the formation (DFiT). The data received from the DFiT provides measurements of fracture growth and closure that can be used to make design changes and improve the success of stimulation treatments as well as to confirm or validate the predictions of the model prior to commencing the main reservoir stimulation operation. If the results of the DFiT reveal differing results, the design of the stimulation can be adjusted in real time by reducing pump rate, volume or altering the fluid rheology to ensure that the placement of the stimulation fluid and proppant will remain in zone.

The DFiT is run prior to the stimulation and the pressure is bled off prior to commencement of the main stimulation operation. The DFiT will inject 15 m^3 of hydrocarbon-based fluid (non-viscous). The main stimulation treatment will inject no more than 70m^3 of viscous, oil based, crosslinked gel and no more than 12.5 tonnes of proppant. The stimulation operation itself will be less than 30 minutes in duration.

Petrophysical logs acquired from WNA-2 have been processed to characterise the rock mechanics of the Kirkham Abbey reservoir as well and the bounding formations, the Fordon Evaporite (above) and Hayton Anhydrite (below). Growth of the fracture is taken to be in the plane of the maximum **horizontal** stress which regional data suggests is along an azimuth of ~147.5 degrees, with elliptical geometry.

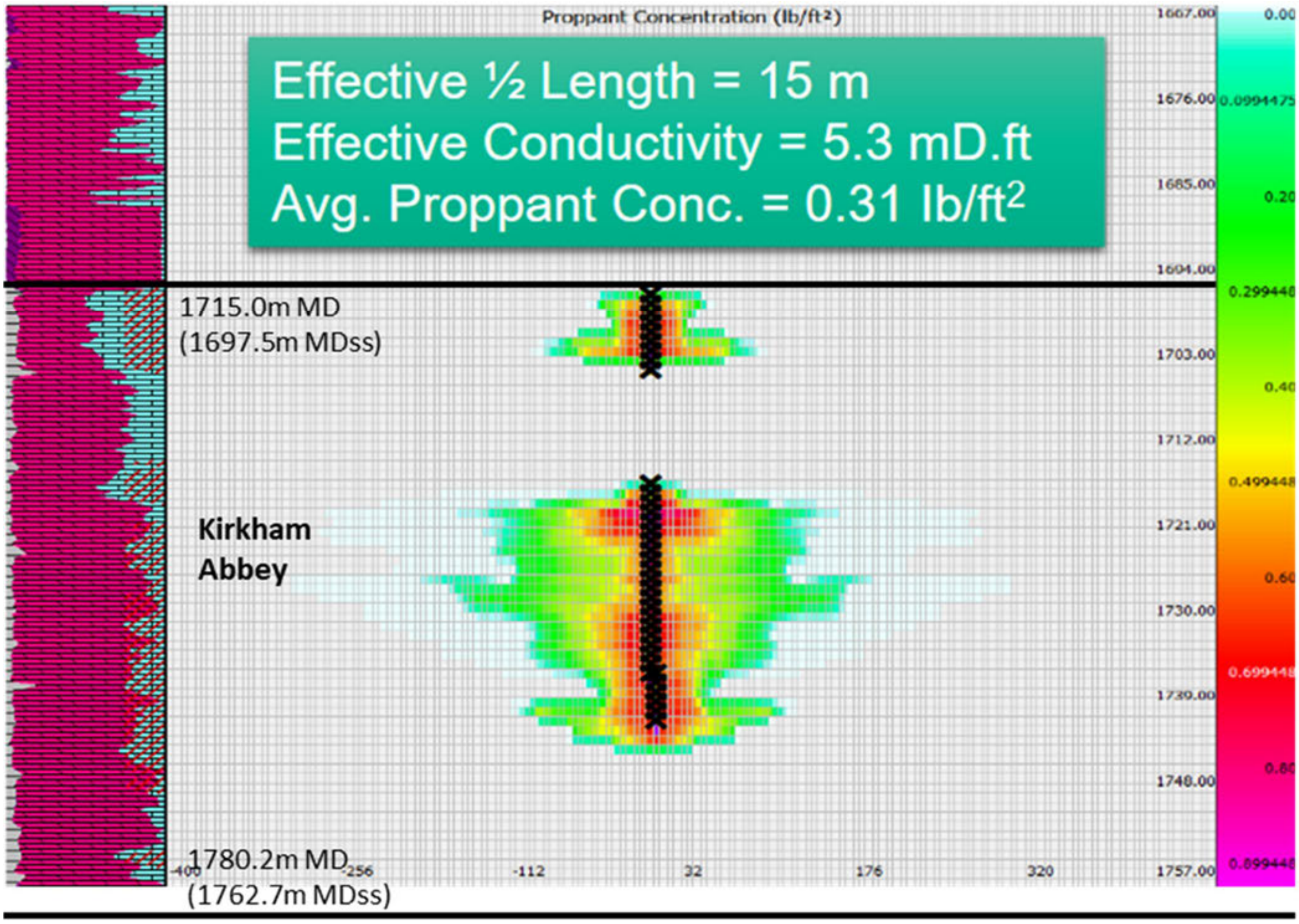


Figure 8 - Output of fracture modelling for 12.5t reservoir stimulation. Various colours show placement of fluid and proppant by vertical depth and fracture extension away from the wellbore with pale blue representing the pad (zero proppant concentration) and red representing the highest concentration close to the wellbore. Top and base of KA denoted by horizontal black lines

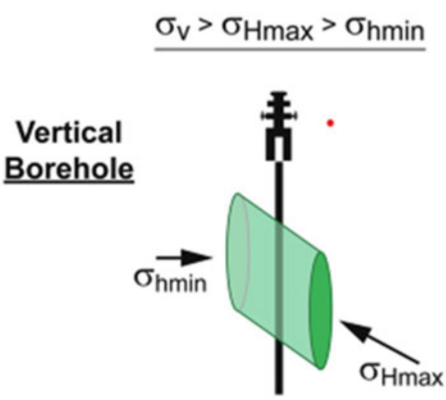


Figure 9 - Theoretical depiction of growth of a fracture in a vertical well. Elliptical fracture extends in the direction of σ_{Max} with vertical grown restriction at boundary due to variation in rock properties

It should be noted that the proposed WNA-2 reservoir stimulation is a short duration, low volume, low-rate hydraulic stimulation operation, designed to extend circa 15m in a bi-lateral direction with no vertical height growth above the current uppermost perforation interval and less than 3m vertical propagation below the current lowermost perforation. The reservoir stimulation is designed to remain entirely withing the Kirkham Abbey formation.

Rathlin repeated the modelling over a range of stimulation sizes (+/- 20% sand tonnage and +/- 10% fluid volumes). Results demonstrate that moderate increases in the size of the proppant and stimulation fluid used, increases the extension of the fracture in the direction of $\sigma_{Max,}$, the horizonal plane and the concentration of proppant placed around the wellbore, without any corresponding increase in upward height growth of the fracture due to the constraining nature of the overlying rock.

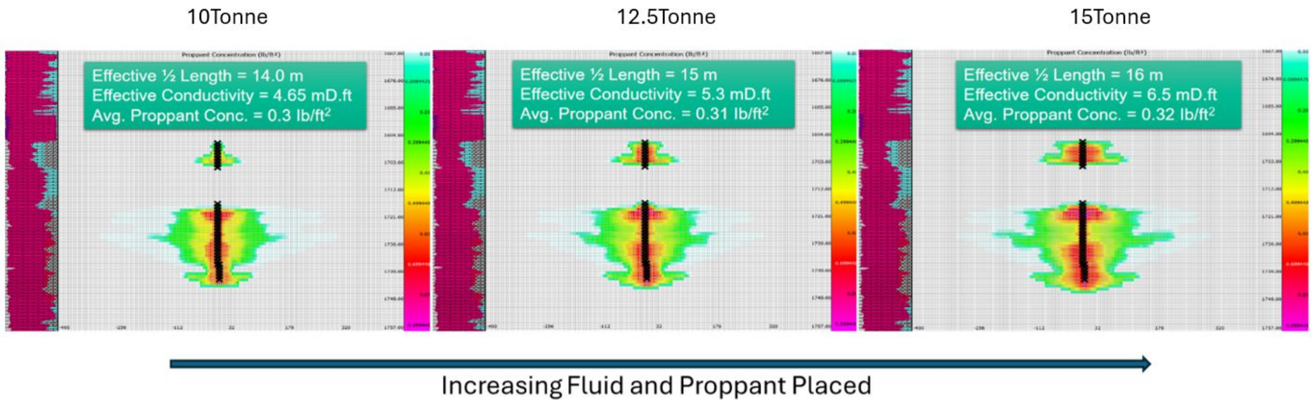
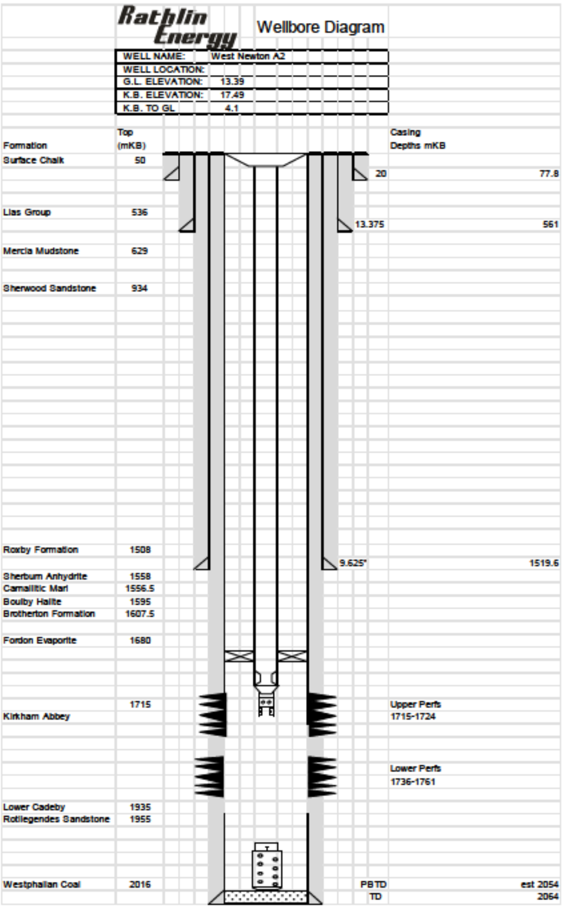


Figure 10 - Modelling of WNA-2 fracture placement with various stimulation sizes

9.3 Well Integrity Monitoring

The WNA-2 wellbore was drilled while following internal Wells Design and Operation Standard which takes into account The Offshore Installations and Wells (Design and Construction, etc.) Regulations 1996 (DCR) as well as other applicable legislation and guidance.

The well will be set up with tubing and a packer downhole such that the tubing and casing pressures may be monitored separately, by way of pressure gauges on both the tubing and annular sides, to continuously ensure pressure integrity.



Type	Size	Weight	Grade	Thread	Interval		Burst	Collapse
	in	#/ft			(mKB)		PSI	PSI
Conductor	20	94	K-55	BTC	0	77.8	n/a	n/a
Surface	13.375	68	L-80	BTC	0	561	n/a	n/a
Intermediate	9.625	40	L-80	BTC	0	1519.6	n/a	n/a
Production	5.5	15.5	L-80	VA Superior	0	2064	7000	4989
Tubing	2.875	6.4	L80	EUE	0	1730	10570	11160

Figure 11 - Wellbore layout for WNA-2 including working pressure ratings for tubing and casing. Also included as appendix 3

On the tubing side, pressure is monitored at the pump and pump trips, which limit the maximum pressure seen on the tubing, will be set to ensure casing and tubing and wellhead design loads are not exceeded. Each pump also has a PSV set above the pump trip pressure but below the design pressure of the well components to ensure no components of the system can be over-pressured.

The casing above the packer is isolated from the treatment pressure with a packer. Positive pressure will be held on the annulus during treatment. This positive pressure is lower than the treatment pressure and monitoring of annular pressure will confirm integrity of the tubing and casing. Should an unexpected, increase or decrease in pressure of the annulus occur during pumping, the treatment will be stopped immediately.

10 Communication and Engagement

10.1 Communication and Reporting to Regulators

In order to perform the Reservoir Stimulation, there are a number of regulators who must be made aware and issue permits / consents in order for the operation or formally notified of the details in advance of it commencing.

Once all permits and consents are in place a notification must be made to the HSE at least 21 days in advance of the activity being undertaken.

Although there are no statutory conditions to inform the EA or MPA of the timing of the reservoir stimulation, Rathlin will inform the local officers prior to undertaking the activity.

Weekly reports are sent to the HSE during the operations.

10.2 Community Engagement

A community liaison group (CLG) has been in operation since the WNA wellsite was constructed in 2013. The group consists of a Parish Council representative and a Resident representative for all Parishes and conurbations surrounding the WNA wellsite, and the local Ward Councillors are also invited to attend. Representatives from Rathlin meet with the group in advance of, and during, times of high information flow. The intent of the liaison group is that the local representatives can disperse information into their community and provide a contact to ask any information of the company.

An update was produced and sent to liaison committee members and other interested stakeholders in September 2024 and was also displayed on the Rathlin website (https://www.rathlin-energy.co.uk/latest-update). Rathlin followed up with members of the liaison committee to ensure there were no queries and also advised them when the initial EA consultation was open.

It is the intention to discuss the operation with the liaison group in advance of the operation being conducted.

Appendix 1 – Wellsite Location

Appendix 2 – WNA-2 Lithology Log

Appendix 3 – WNA-2 Completion Schematic

Appendix 4 – WN Fault Interpretation and Analysis

Appendix 5 – Seismic Hazard Assessment for the Proposed Stimulation Activities

Appendix 6 – Environmental Risk Assessment for an Induced Seismic Event

Appendix 7 – West Newton A wellsite Hydrogeological Risk Assessment & Flood Risk Assessment

Appendix 8 – Reservoir Stimulation Hydrogeological Risk Assessment

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