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HYDROGEOLOGICAL IMPACT ASSESSMENT

BURNISTON MILL – CLOUGHTON (PEDL 343)

Report Reference: 3729/HIA
Final version F3
December 2024

Report prepared for:

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GENERAL NOTES

Title of report: Hydrogeological Impact Assessment

Site: Burniston Mill – Cloughton (PEDL 343)

Report ref: 3729/HIA

Date: December 2024

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3729/HIA/A1 Monitoring boreholes location

1 INTRODUCTION

1.1 Background

Europa Oil and Gas Limited has identified a site at Burniston in North Yorkshire to drill an appraisal well to assess the Cloughton gas accumulation on block TA09 under PEDL 343.

North Yorkshire Council (NYC) issued a formal screening opinion on 1st August 2024. The Screening Opinion, reference number NY/2024/0113/SCR, states the following:

> *Water Resources: "The site is within Flood Zone 1 so there is a low risk of flooding on site. The site is 150 metres to the northeast of the nearest Flood Zone 2 and 130 metres east of the nearest Flood Zone 3. The Environment Agency identified a Secondary 'A' typology of bedrock aquifer and raised minimal environmental concerns for them."*

Hafren Water has been commissioned to undertake a Hydrogeological Impact Assessment (HIA) and Flood Risk Assessment (FRA) to support the Planning Application. This HIA assesses the implications of the proposals on the water environment.

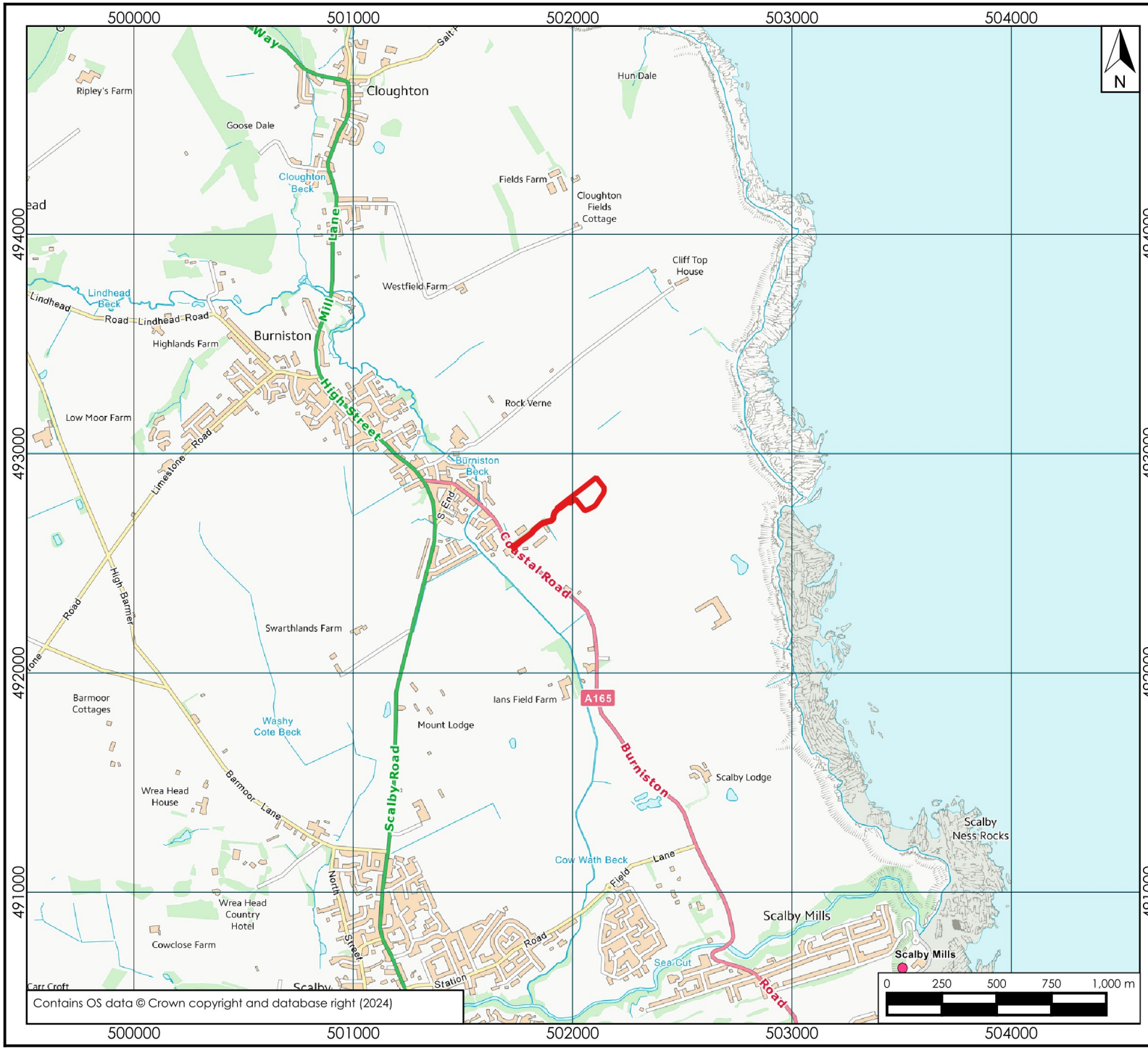
1.2 Location

The site is located immediately to the southeast of Burniston village. It is centred on National Grid Reference (NGR) TA 02057 92800 and shown on *Drawing 3729/HIA/01*. Access to the site is from Coastal Road (A165) through the Mill Yard industrial area entrance. The coastline is approximately 650 metres (m) east of the site, with a predominantly north-south orientation. The planning application site extends to approximately 1.41 hectares (ha) in area. The site slopes downwards from north to south and is between 48 and 58 m Above Ordnance Datum (mAOD). A small photovoltaic panel array, several industrial units, farmland and a feedstock mill are located southwest of the site. In contrast, to the northeast lies a grass-covered field, with some trees and hedgerows separating it from the surrounding fields and the industrial area to the south.

1.3 Scope of assessment

The scope of the investigation is as follows:

- Determination of baseline conditions of the water environment at the site and its environs
- Identification of potential impacts of the proposed operation
- Assessment of the magnitude and significance of potential impacts of the appraisal drilling and the proposed subsequent restoration
- Derivation of mitigation measures for any identified potential impacts



Scale correct at A4

Client	Europa Oil and Gas Limited, 30 Newman Street, London, W1T 1PT
Title	Site Location
Project	Burniston Mill
Drawing	3729/HIA/01
Version	1
Date	01/09/2024
Scale	1:25,000

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1.4 Data sources

The characteristics of the water environment have been investigated using published data and reports, assessment of site data, a walkover survey, and experience of other sites in broadly similar settings. The data sources used in the investigation are provided below:

Ordnance Survey (OS) mapping

- 1:25,000 scale
- 1:10,000 scale

Environment Agency

- Licensed abstractions
- Consented discharges
- Rainfall data

MAGIC maps website (DEFRA)

- Source Protection Zones (SPZs)
- Sites of Special Scientific Interest (SSSI)
- Special Area of Conservation (SAC)
- Special Protection Areas (SPA)
- Ramsar sites
- LiDAR survey

North Yorkshire Council

- Private water supplies

British Geological Survey (BGS)

- Geological Survey of England and Wales 1:50,000 geological map series, Sheets 35 & 44, Whitby and Scalby
- Borehole records
- GeoIndex (www.bgs.ac.uk/geoindex/)

Hafren Water

- Site walkover (8th October 2024)

Europa Oil and Gas Limited

- Location plans showing site boundary
- Indicative drilling phase layout plan
- Pre-application topographic survey concept

- Deep geology description and stratigraphy
- Well design & operational plans

1.5 Methodology

Baseline conditions of the water environment were defined by collating and analysing existing data, field observations, a site walkover and communication (e-mail, Teams meetings and telephone calls) with the client. The baseline conditions refer to the area in its current existing state, not the natural, pre-human intervention conditions. The potential effects of the development on the extant water environment have been assessed, and mitigation measures have been proposed where appropriate.

2 BASELINE CONDITIONS

2.1 Landform

The highest point in the immediate surroundings of the site attains 67 mAOD in elevation. The lowest elevation point is 0.47 km south, 36 mAOD, at the Cow Wath Beck watercourse. The boundary of the North York Moors National Park is approximately 0.8 km north of the site, where the topography comprises elevated upland dissected by deep valleys (dales) associated with cultivated land or woodland[1]. The coastline is located approximately 650m to the east, where the topography is dominated by undulating terrain and cliffs, facing the North Sea.

2.2 Hydrology

2.2.1 Rainfall

Monthly rainfall data between 1999 and 2020 was obtained from the Meteorological Office for the Scarborough climate station located at Spring Hill Lane (NGR TA 02921 87522). The Scarborough climate station is part of the Met Office's Climate Stations network and is close to the application site. The long-term average (LTA) annual rainfall is 705 mm.

The LTA monthly rainfall for this period is shown in *Table 3729/HIA/T1*.

3729/HIA/T1: Average monthly total rainfall (1999-2020) – Scarborough Climate Station

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rainfall (mm)	57	49	45	50	45	66	57	70	57	68	73	68

Source: Meteorological Office

2.2.2 Watercourses

The site is located within the catchment of the River Derwent, which is situated approximately 5.7 km southwest of the site boundary at its closest approach.

The closest watercourse to the site is the Burniston Beck, located approximately 115 m southwest of the site's entrance. This watercourse flows southeastwards, becoming the Cow Wath Beck before discharging into the Scalby Beck (Sea Cut), 2 km south of the site. Daily river flow data is available for the Scalby Beck monitoring station (Grid Reference Location TA0271290737)[2].

1 https://www.nationalparks.uk/park/north-york-moors/
2 https://environment.data.gov.uk/hydrology/station/88ef1864-14bd-47e0-8bb3-bebc8e97e706

A small drainage ditch runs northwest to southeast, approximately 180 m southwest of the centre of the site, between the photovoltaic panel array field and the Mill Yard Industrial units. Another small drainage ditch is located on the southeast border of the site, southeast of the woodland and discharges into the Burniston Beck.

The locations of the water features described are shown on *Drawing 3729/HIA/02*.

2.2.3 Waterbodies

A small pond is located approximately 100 m to the southwest of the centre of the site, immediately to the south of the photovoltaic panel array. Another small pond is located 80 m north of the site's entrance. At least 20 other smaller ponds are present within a 3 km radius of the site boundary.

2.2.4 Springs

Seven springs have been identified on OS mapping within a 3 km radius of the site. Two are located upstream of the site, around the Burniston Beck and its tributaries. Several springs form headwaters of local watercourses, including the Lindhead Beck, Quarry Beck and Cloughton Beck.

The closest spring to the site is located 250 m to its northeast, at an elevation of 49 mAOD. The remainder of the springs are located at some distance from the site. The locations of the springs are shown on *Drawing 3729/HIA/02*.

2.2.5 Surface water abstractions

North Yorkshire Council holds no records of unregulated private water supplies within a 3 km radius of the centre of the site.

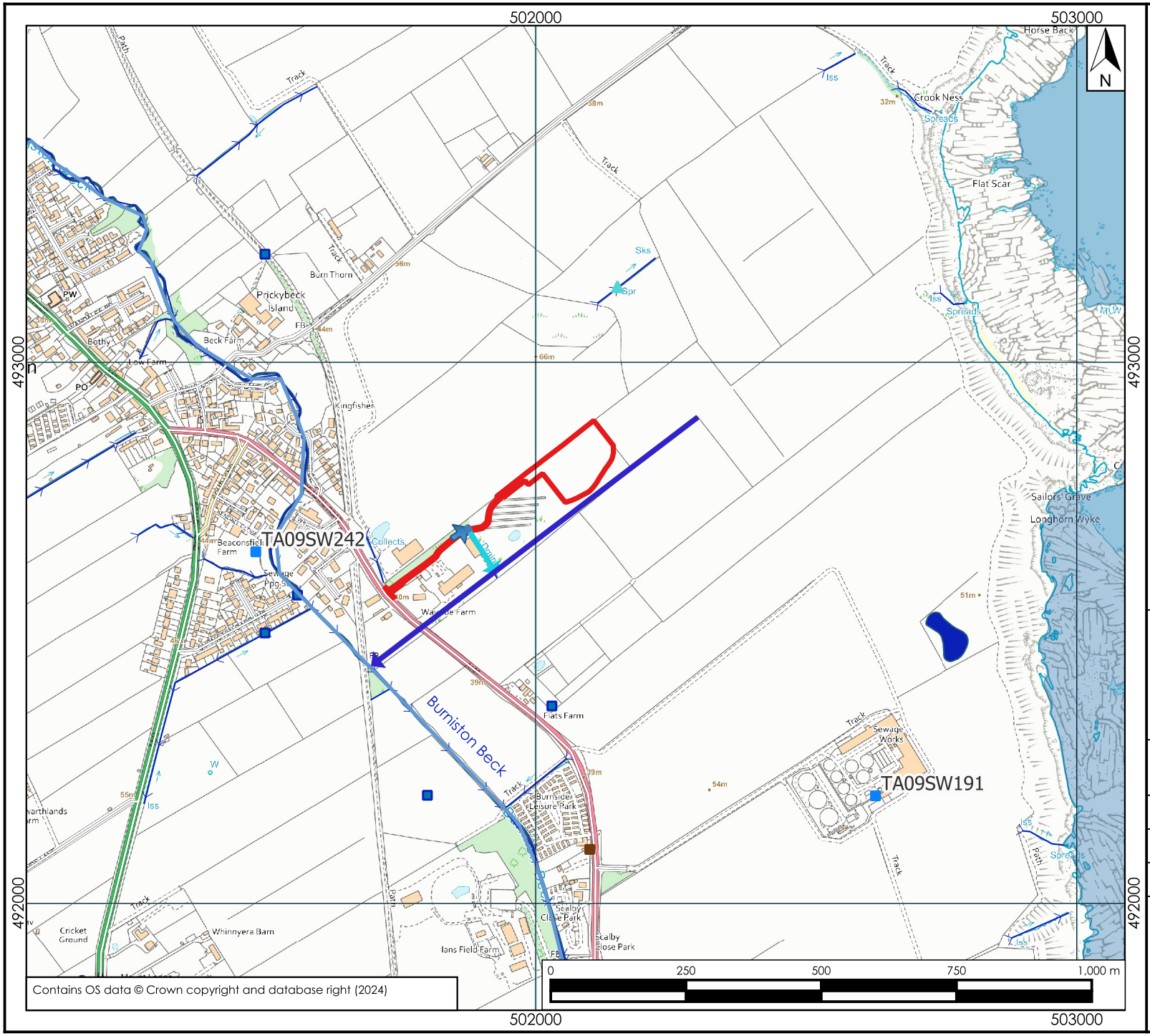
The Environment Agency holds no records of surface water abstractions in the area.

2.2.6 Surface water discharge consents

Twenty-eight discharge consents to surface waterbodies exist within a 3 km radius of the centre of the site; the closest is located 0.38 km northeast of the site, at Flatts Farm. Six permits for discharge to groundwater through infiltration in drainage fields and soakaways exist within a 3 km radius of the site. Their locations are shown on *Drawing 3729/HIA/02*.

2.2.7 Flooding

The site is located within an area designated as Flood Zone 1 by the Environment Agency.



Legend

- Site boundary
- waterbodies
- Surface Water
- Discharge sites - GW
- Discharge sites - surface
- BGS selected boreholes
- springs

Site Features From Walkover

- Culvert
- Roadside Drainage
- SouthEast Drainage
- Southwest Drainage

Scale correct at A4

Client	Europa Oil and Gas Limited, 30 Newman Street, London, W1T 1PT
Title	Surface Water Features
Project	Burniston Mill
Drawing	3729/HIA/02
Version	1
Date	01/09/2024
Scale	1:10,000

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A Flood Risk Assessment (FRA) compliant with the statutory requirements of the National Planning Policy Framework (NPPF) (December 2023) and associated Planning Practice Guidance (PPG) for Flood Risk and Coastal Change (last updated August 2022) has been undertaken due to the nature and scale of the development and the area of the application site boundary. Fluvial and surface water flood risk zones are shown on *Drawings 3729/HIA/03 and 04*.

The Northeast Yorkshire Strategic Flood Risk Assessment (SFRA) produced in March 2006 by Arup and updated in 2010 mapped the coastal area between Burniston and Filey as a soil zone where the dominant soil type is slowly permeable, seasonally wet, slightly acid but base-rich loamy and clayey soils, indicating that this type of soil is prone to slight waterlogging[3].

The Agricultural Land Classification and Soil Resource Survey, which accompanies this Planning Application notes that:

The 1:250 000 scale reconnaissance soil map of the area (Soil Survey, 1983) shows the whole of the site to be mapped as soils of the Salop Association. Salop Association soils are briefly described by the Soil Survey (1983) as 'Slowly permeable seasonally waterlogged reddish fine loamy over clayey, fine loamy and clayey soils associated with fine loamy over clayey soils with slowly permeable subsoils and slight seasonal waterlogging'.

Therefore, waterlogging is possible in winter months.

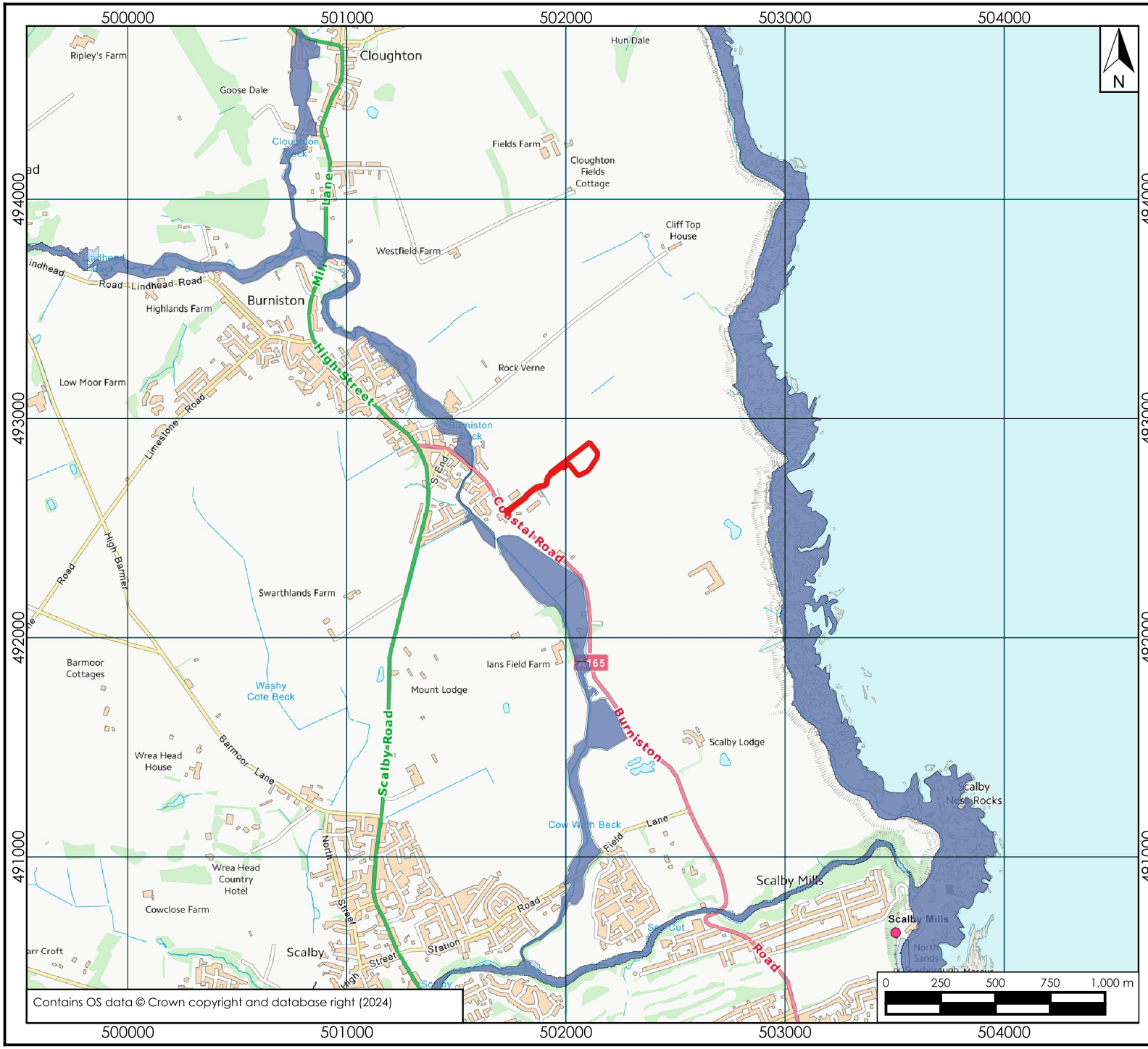
2.3 Geology

2.3.1 Regional

Superficial deposits, predominantly comprising glacial-related material, occur extensively within the region. Most of these are diamicton (till), the primary component of which is assumed to be clay-rich. BGS data indicates that the thickness of the superficial deposits is between 20 to 30 m. Alluvium deposits are generally confined to valleys and around the headwaters of watercourses.

The bedrock in the region comprises a vertically extensive sequence of Middle and Upper Jurassic sedimentary strata. The lithology predominantly comprises mudstone, with sandstone, siltstone and argillaceous limestones also occurring within the sequence. They have a uniform easterly dip. They are primarily clastic, although calcareous strata are also present.

3 https://nora.nerc.ac.uk/id/eprint/7369/1/IH_126.pdf



Legend

- Site boundary
- Flood Zone 1
- Flood Zone 2
- Flood Zone 3

Scale correct at A4

Client	Europa Oil and Gas Limited, 30 Newman Street, London, W1T 1PT
Title	Flood Risk Zones
Project	Burniston Mill
Drawing	3729/HIA/03
Version	1
Date	01/09/2024
Scale	1:25,000

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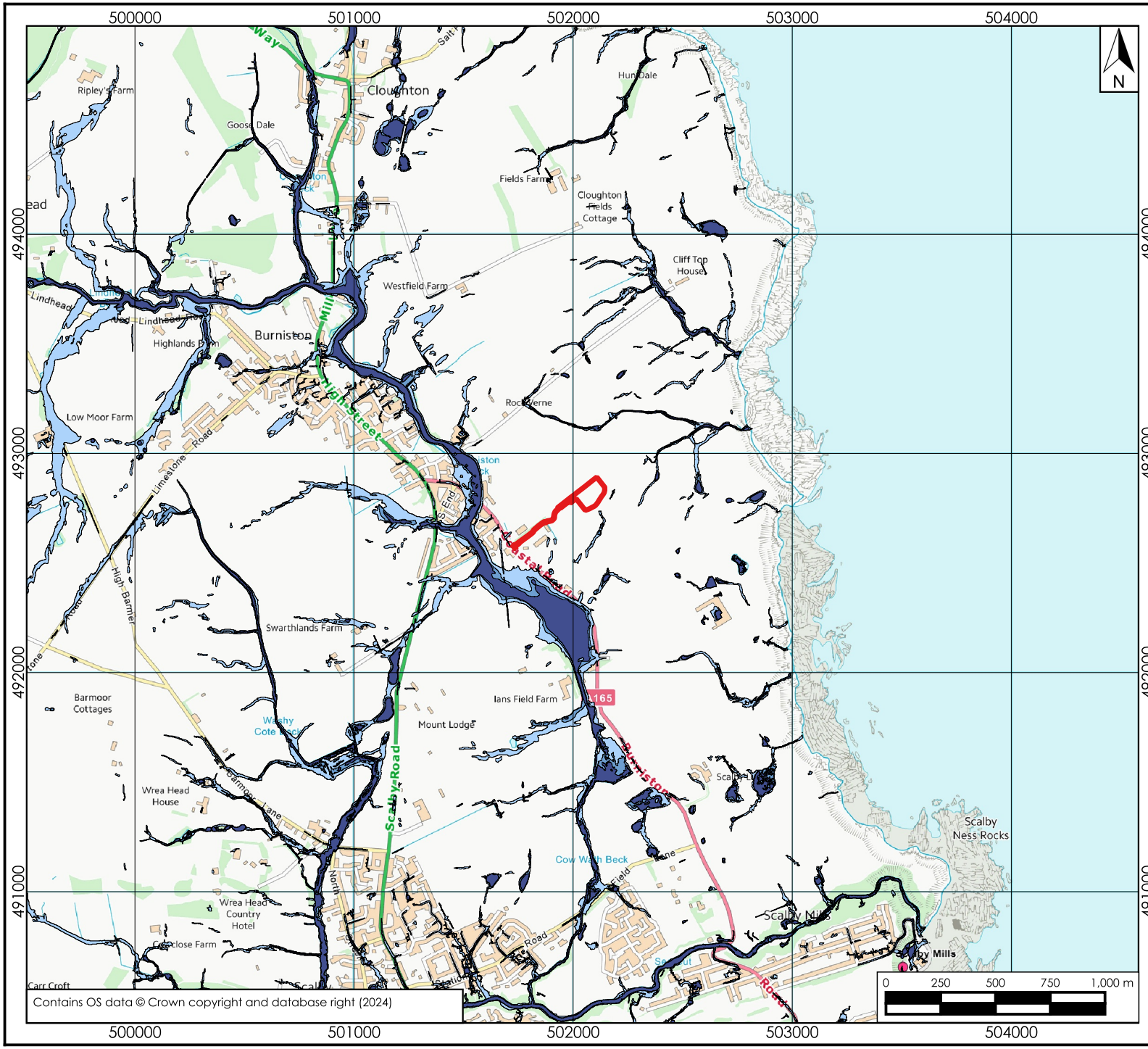

Legend

- Site boundary
- High risk - 1 in 30 year
- Low risk - 1 in 1000 year
- Medium risk - 1 in 100 year
- Very low risk - 1 in 1000 year

Scale correct at A4

Client	Europa Oil and Gas Limited, 30 Newman Street, London, W1T 1PT
Title	Flood Risk from Surface Water
Project	Burniston Mill
Drawing	3729/HIA/04
Version	1
Date	01/09/2024
Scale	1:25,000

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The superficial and bedrock geology are shown on *Drawings 3729/HIA/05 and 3729/HIA/06,* respectively. The latter is taken from the 1:50,000-scale BGS geological sheets 35 & 44 for Whitby and Scalby. The geological succession is summarised in *Table 3729/HIA/T2*.

3729/HIA/T2: Geological succession in the region[4]		
Formation (Fm)	**Lithology**	**Thickness**
Superficial		
Alluvium	Clay, silt, sand, and gravel	Thin- variable
Till	Diamicton (till)	20 – 30 m
Bedrock		
Long Nab Member	Laminated grey mudstones and siltstones with planar bedded sandstone	Up to 60 m
Moor Grit Member	Grey, medium to coarse-grained trough cross-bedded sandstone	8 – 12 m
Scarborough Formation	Fossiliferous argillaceous limestone, calcareous mudstone, siltstone	Up to 30 m
Gristhorpe Member	Grey mudstone, yellow-grey siltstone and yellow fine sandstone	Up to 30 m

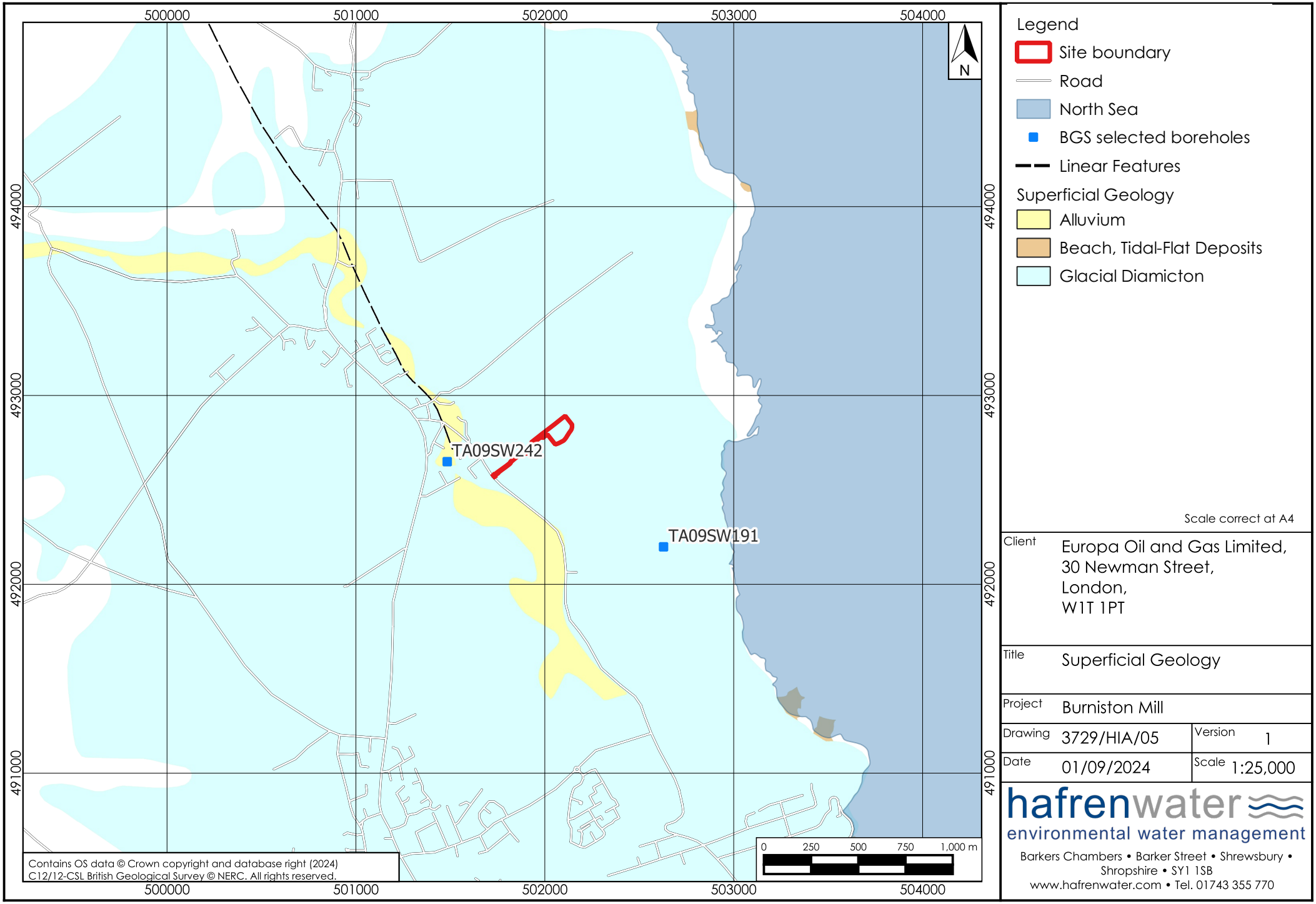
Geological faulting in the area has a predominant north-to-northwest orientation, with most faults in the Mesozoic section and soling out onto decollements in the Triassic and Permian section. Deeper Carboniferous faults have a different orientation and do not appear to pierce the overlying Zechstein formation. There appears to have been decoupling between deep faulting at sub-Zechstein level and extensive movements in the Mesozoic and more recent cover. Triassic Bunter Shales/Saliferous marls and much of the Jurassic strata also contain thick shales which could provide slip planes at a multitude of levels. Younger rocks of Jurassic age are in contact with older rocks due to faulting[5].

The geological feature targeted by the appraisal drilling is the Cloughton anticline, a NNW/SSE-trending feature with significant dip closure in all directions, where previously 60 m of Carboniferous net sandstone was found[6].

2.3.2 Local shallow geology

The local superficial geology predominantly comprises glacial deposits characterised by firm, stiff, brown sandy clay with angular gravel sandstone and mudstone pockets.

4 https://www.bgs.ac.uk/technologies/the-bgs-lexicon-of-named-rock-units/
5 BGS GeoIndex portal
6 https://www.europaoil.com/operations/united-kingdom/pedl343/



Scale correct at A4

Client	Europa Oil and Gas Limited, 30 Newman Street, London, W1T 1PT
Title	Superficial Geology
Project	Burniston Mill
Drawing	3729/HIA/05
Version	1
Date	01/09/2024
Scale	1:25,000

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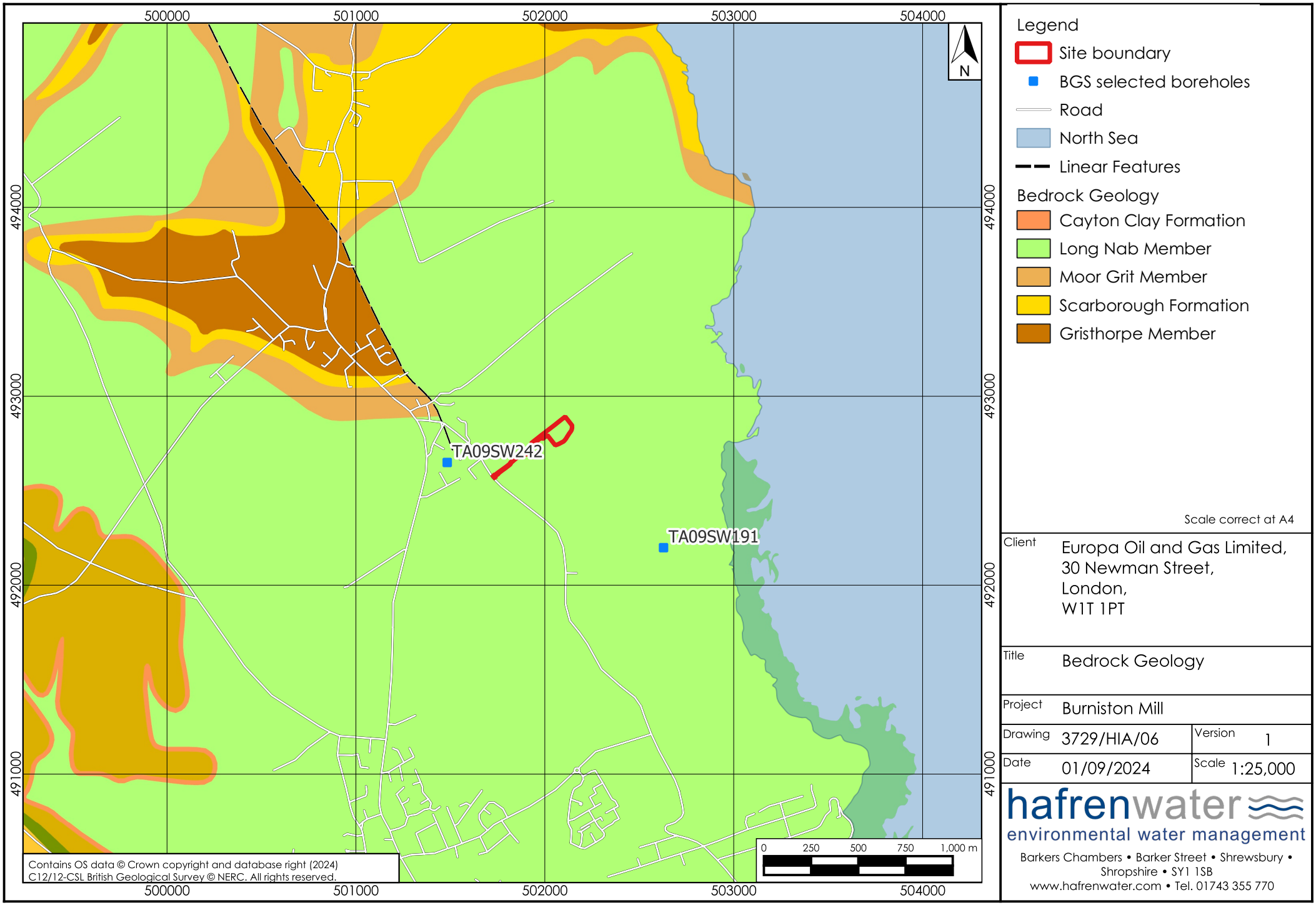

Legend

- Site boundary
- BGS selected boreholes
- Road
- North Sea
- Linear Features

Bedrock Geology

- Cayton Clay Formation
- Long Nab Member
- Moor Grit Member
- Scarborough Formation
- Gristhorpe Member

Scale correct at A4

Client	Europa Oil and Gas Limited, 30 Newman Street, London, W1T 1PT
Title	Bedrock Geology
Project	Burniston Mill
Drawing	3729/HIA/06
Version	1
Date	01/09/2024
Scale	1:25,000

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The local bedrock geology is the Long Nab Member of the Scalby Formation. It comprises "*grey laminated mudstones and siltstones with yellow-grey, fine- to medium-grained, planar-bedded and cross-stratified sandstones. Trough cross-bedded channel-fill sandstones are also present. Plant fragments, plant rootlets and drifted wood casts are common, with occasional thin coals and grey mudstone seatearths...*[7]".

The Long Nab member is up to 60 m thick. The 8 to 12 m thick Moor Grit Member, comprises grey, medium to coarse-grained trough cross-bedded sandstone and occurs beneath the uppermost bedrock strata at the site. This, in turn, occurs above the Scarborough Formation and the Gristhorpe Formation; these two formations consist of a) limestone, calcareous mudstone, siltstone and b) grey mudstone, yellow-grey siltstone and yellow fine sandstone, respectively. The shallow geology is illustrated on *Drawing 3729/HIA/07b*.

The four formations described above constitute a variable sequence of sedimentary strata dominated by argillaceous deposits. Their combined maximum thickness is approximately 130 m, and their base is 150 m below the surface, assuming a 20 m thickness of superficial deposits. It is considered that the active groundwater system is substantially less than this depth and as such this shallow geology is the main focus of the HIA.

2.3.3 Deeper geology

The deeper strata that the proposed drilling would encounter are detailed below. The deeper stratigraphy is as illustrated on *Drawing 3729/HIA/07a*.

The expected geology for the length of the appraisal well is summarised below (provided by the Europa geologist):

<u>Middle Jurassic: Surface to 50.7 m TVDSS</u>

The proposed well site sits within the Middle Jurassic Formations that outcrop at the nearby cliffs. The Middle Jurassic is referred to locally as the Ravenscar and Dogger Formations. The formations are composed of yellow/brown sandstones which are fine-grained in nature with occasional coarser material. Intercalated with the sandstones are light grey carbonaceous siltstones.

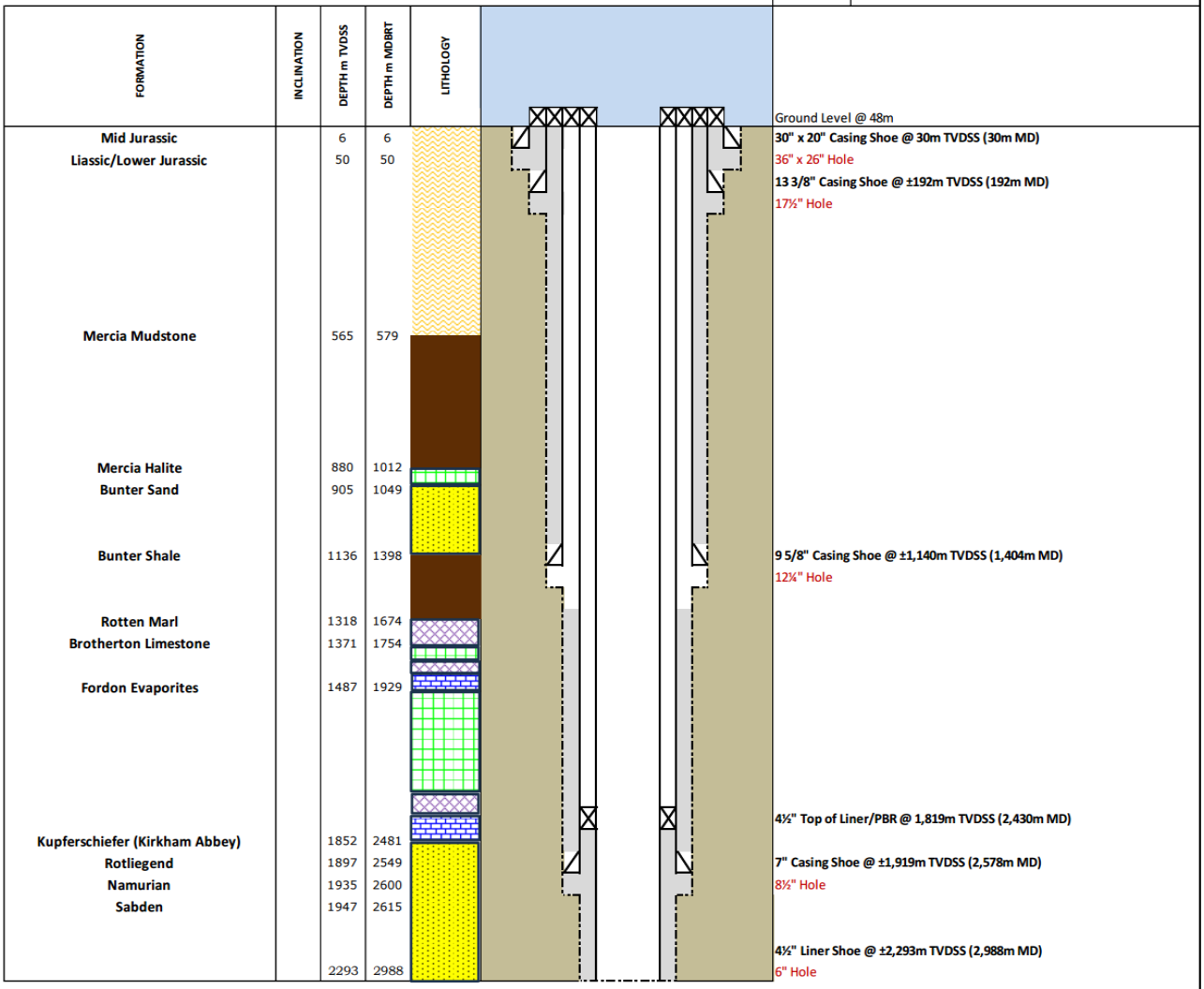
<u>Lower Jurassic: 50.7 m to 564.5 m TVDSS</u>

The Lower Jurassic is composed of shales and siltstones with minor sandstones. The siltstones are described as light grey brown with occasional dolomite and limestones. Towards the base of the Lower Jurassic the section gets a little sandier when entering the Penarth Group.

7 https://www.bgs.ac.uk/technologies/the-bgs-lexicon-of-named-rock-units/

CLOUGHTON-2 CONCEPTUAL SLIM HOLE WELL DESIGN

REV: Conceptual Well Design May 2024 Rev B



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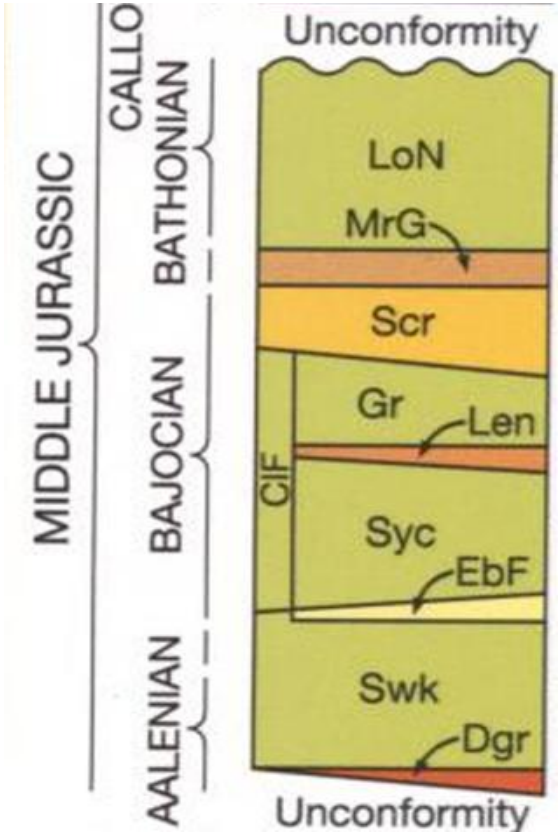
Client	Europa Oil & Gas Limited, 30 Newman Street, London, W1T 1PT
Title	Deeper well stratigraphy
Project	Burniston Mill
Drawing	3729/HIA/07a
Version	1
Date	14/01/2025
Scale	n/a



Long Nab Member Mudstone and sandstone	SCALBY FORMATION	RAVENSCAR GROUP (RG)
Moor Grit Member Quartz sandstone		
Limestone and mudstone	SCARBOROUGH FORMATION	
Gristhorpe Member		
Lebberston Member	CLOUGHTON FORMATION Sandstone, mudstone and thin coals	
Sycarham Member		
Ironstone and sandstone	ELLER BECK FORMATION	
Sandstone, mudstone and thin coals	SALTWICK FORMATION	
Sandstone and ironstone	DOGGER FORMATION	

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Client: Europa Oil & Gas Limited, 30 Newman Street, London, W1T 1PT

Title	Shallow geology (BGS Whitby and Scalby 35 & 44 (S&D)		
Project	Burniston Mill		
Drawing	3729/HIA/07b	Version	1
Date	14/01/2025	Scale	n/a

Sandstones are described as off white to light grey, rounded and well sorted with siliceous cements.

Triassic – Keuper Marl/Mercia Mudstone/Keuper Halite: 564.5 m to 905.3 m TVDSS

The Mercia Mudstone is composed of red-brown blocky shales, which grade into grey-green interbeds with occasional gypsum and anhydrites. The section also contains occasional light grey crystalline limestones. The basal section locally referred to as the Keuper Halite consists of orange-brown halite with interbedded grey claystones.

Triassic – Bunter Sandstone/Sherwood Sandstone: 905.3 m to 1136 m TVDSS

The Sherwood Sandstone is a thick homogenous sandstone unit described as light brown to orange, fine to medium-grained occasionally grading to sandy siltstone. Very minor claystones are present, which are dark red-brown in colour.

Permian - Bunter Shale/Eskdale Group: 1136 m -1318.9 m TVDSS

The Bunter Shale section is a heterogeneous formation composed of interbedded sandstone, siltstone and claystone. The claystone is described as red-brown to pale green, hard, blocky and grading into red-brown siltstones. The sandstones are pale red-brown, fine-grained, moderately sorted with abundant loose grains.

Permian – Rotten Marl/Stantondale Group: 1318.9 m -1371.6 m TVDSS

The Stantondale Group comprises intercalated halite, anhydrite, claystone and minor marls. The salt is described as clear, translucent, medium hard, blocky and massive. The anhydrite is described as massive, white and blocky. The claystone is orange-brown in nature and mixed with salt, sylvite and other potassium bearing minerals.

Permian – Brotherton Limestone/Teesdale Group: 1371.6 m -1486.8 m TVDSS

This section is headed by a clear, orange, translucent halite, which is described as blocky and massive. This passes into the Billingham Main anhydrite, which is white, light grey and micro crystalline. The Brotherton Limestone is composed of alternating formations of dolomite and limestone with minor anhydrite. The dolomite is grey, medium-grained and hard and cryptocrystalline. This limestone was found to have a gas peak of 9% in the Cloughton-1 well and a gas peak in Cloughton-2 should be expected and planned for.

Permian – Fordon Evaporites/Aislaby Group: 1486.8 m -1852 m TVDSS

The upper section of this formation comprises clear, translucent and occasionally orange halite, which is described as blocky and massive. Towards the base of the formation are interbedded anhydrites described as massive, white or brown-white and cryptocrystalline in nature. The basal section comprises the Kirkham Abbey Formation, which is a reservoir within

the local area. Within the Cloughton well this formation appeared as an intercalated section of limestones and dolomites with minor anhydrites. The limestones are described as light grey-brown, moderately hard with anhydrite cement and vein fill. The dolomites are light to medium grey and microcrystalline. This section was not hydrocarbon bearing within the Cloughton-1 well but the possibility remains that this section could be hydrocarbon bearing in Cloughton-2 although this is not expected.

Permian – Don Group/Kupferschiefer: 1852 m -1897 m TVDSS

This section is very similar to the overlying Kirkham Abbey Formation but is marked by the presence of the Hayton Anhydrite. This passes into the Lower Magnesian Limestone, which is described as light grey, firm and cryptocrystalline in nature. The Lower Magnesian Limestone then passes into a black firm shale that is potentially fossiliferous.

Permian – Rotliengend Sandstone: 1897 m -1935 m TVDSS

The Rotliengend comprises red-brown, medium to hard and well cemented sandstones with calcitic cement. The sandstone is described as loose and occasionally coarse-grained and grades into red-brown siltstones with minor red-brown claystones.

Carboniferous – Namurian: 1935 m - 1947 m TVDSS

Due to erosion at the Base Permian Unconformity it is possible that the Namurian section may be absent within the Cloughton-2 well. If the section is present it will look very similar to other Carboniferous sections comprising grey-brown, hard cemented sandstones with siliceous and minor calcitic cements. Gas shows are expected in any sandstones. Intercalated with the sandstones are grey-black, hard and indurated shales and occasional black and shiny coals.

Carboniferous – Sabden: 1947 m - 2292 m TVDSS

The Sabden section will comprise intercalated sandstones, shales and coals with minor siltstones. Sandstones are described as off white, hard and fine-grained with occasional medium to coarse-grained intervals. The sandstones are hard and well cemented with limited visible porosity. The coals are described as black, moderately hard and brittle with occasional pyrite. Siltstones are described as grey to dark grey, medium to hard and blocky. Gas shows are expected within the sandstones and coals.

Carboniferous – Skipton Moor Grits/Bowland Shale: 2292 m - 2618 m TVDSS

This section will be very similar to overlying sediments in the Sabden section. Sandstones are described as light grey-brown, medium to grey-brown with silt and calcite cement. Fractures and vein material are noted with poor visible porosity. Towards the base of the succession

there is a change to the Bowland Shale Formation, which comprises dark grey-black, firm and blocky shale. The shale is fractured with calcitic vein infilling.

Carboniferous – Yoredale Succession: 2618 m -2736 m TVDSS

The Yoredale Succession comprises intercalated sandstone, claystones, silts and coals. The sandstones are described as off white to hard and medium to coarse-grained in nature and well cemented with siliceous cements. The siltstones are medium to dark grey, firm to medium and hard and cemented with occasional micro veins. The coal is black, medium to hard and blocky. Gas peaks are to be expected within the sandstone layers.

2.3.4 Sites of ecological and conservation interest

There are no water-supported sites of ecological or conservation interest within a 3 km radius of the site.

The Heritage Coastal cliffs are 0.69 km to the northeast, facing the North Sea. The site lies within the North Yorkshire and Cleveland Heritage Coast Management Area[8]. The North York Moors National Park boundary is located 0.8 km north of the site. This upland area contains one of the largest expanses of heather moorland in the United Kingdom[9].

The Iron Scar and Hundale Point to Scalby Ness Site of Special Scientific Interest (SSSI) is located approximately 0.66 km northeast of the site. It comprises the cliffs and intertidal reefs between Iron Scar and Scalby Ness.

2.3.5 Landfill facilities

Two historic landfills or active waste sites are located within a 3 km radius of the site centre. The closest and largest of them is 0.6 km southwest of the centre of the site and is associated with the Burniston Household Waste and Recycling Centre. The second is 1.2 km south of the main site area, off the Coastal Road.

2.4 Hydrogeology

2.4.1 General

The hydrogeology at the site can be divided between superficial deposits and an underlying system within the sedimentary bedrock strata.

8 https://www.planning.data.gov.uk/entity/7600015
9 https://www.northyorkmoors.org.uk/

The superficial glacial diamicton deposits are classified by the Environment Agency as Secondary (undifferentiated) Unproductive Aquifers[10]. This means that they are largely unable to provide usable water supplies and are unlikely to have surface water and wetland ecosystems dependent on them[11]. However, sand and gravel pockets within the clay mass can lead to local perched aquifers in this unit – as evidenced by active springs nearby (250 m to the northeast) and local borehole evidence. Details are provided in *Table 3729/HIA/T3*.

3729/HIA/T3: Selected BGS boreholes				
BGS ID	**X, Y coordinates**	**Elevation (mAOD) / distance (km)**	**Water strike (mbgl)**	**Geology – metres below ground level (mbgl)**
TA09S W242	501483 492650	40.5 / 0.54 SW	2.9	Alluvium 0 – 3.3 Glacial Diamicton 3.3 – 15
TA09S W191	502628 492199	49.4 / 0.77 SE	5 4.5 (Rest GWL)	Topsoil 0 – 0.2 Sandy Clay 0.2 – 5.5 Sand, Clay and Gravel 5.5 – 8.4 Clay 8.4 – 20
GWL – groundwater level				

The bedrock comprises a vertically extensive sequence of predominantly argillaceous sediments. The aquifer properties of the mudstones and siltstones are considered likely to be 'poor', with relatively small volumes of groundwater storage and low rates of groundwater flow. Slightly larger volumes of water could be expected within coarser deposits. The lithology of the sequence is such that a multi-layered aquifer system with restricted vertical groundwater movement is anticipated.

A borehole drilled for the Scarborough Revised Bathing Water Directive (BH1-7-01, NGR TA 03448 90543), 2.6 km to the southeast, indicates that groundwater is derived from sandstone layers within the Long Nab Member at around 33 and 42 mbgl. In this borehole, two horizons, approximately 1-1.5 m thick, were installed with a screen.

The Environment Agency classifies the Jurassic bedrock as a Secondary 'A' aquifer[10], which can support local water supplies and may form an essential source of baseflow to rivers[11].

10 https://magic.defra.gov.uk/MagicMap.aspx
11 https://www.gov.uk/government/publications/protect-groundwater-and-prevent-groundwaterpollution/protect-groundwater-and-prevent-groundwater-pollution

The groundwater flow direction from regional geological mapping and cross-sections can be inferred to be eastwards[12]. Groundwater vulnerability mapping suggests a medium degree of vulnerability to surface-level pollutant discharge[13].

2.4.2 Groundwater abstractions

Licensed abstractions

One licensed groundwater abstraction is located within a 3 km radius of the site. It is 2.36 km to the southeast and is used for 'spray irrigation' at the Scarborough North Cliff Golf Club. The licence allows a maximum abstraction of 3000 m³ per annum and 70 m³ per day.

Source protection zones

The site is not within a source protection zone (SPZ) for a public water supply.

Unlicensed abstractions

NYC has no records of unregulated private water supplies within a 3 km radius of the centre of the site. Through local research one unregulated 70 m borehole has been identified located close to Fields Farm at a distance of 1.4 km to the north of the development site.

2.4.3 Conceptual hydrogeology

The hydrogeology at the site can be broadly subdivided into an upper unit within the superficial deposits above a laterally and vertically extensive sequence of sedimentary strata.

The superficial geology comprises a 20 to 30 m thickness of glacially-derived diamicton, a predominantly clay-rich material. It is considered that the volume of groundwater within the superficial deposits and the flow rate through them will be minimal. Isolated sand pockets and silts are likely to occur within the superficial deposits and may store and convey small volumes of near-surface groundwater. The arenaceous sections of the superficial deposits are considered likely to source the springs, which occur sporadically in the area.

The bedrock strata consist of a sequence of sedimentary strata of differing lithologies. Most nearer surface bedrock strata comprise argillaceous (clay-rich) units interbedded with thinner limestones, siltstones and sandstones. The whole sequence is considered to form an aquifer system with significantly greater horizontal than vertical permeability.

12 https://largeimages.bgs.ac.uk/iip/mapsportal.html?id=1001515
13 https://magic.defra.gov.uk/MagicMap.aspx

Based upon the strata dip and ground elevations, the overall groundwater flow direction within the bedrock is anticipated to be broadly eastwards. Egress of some groundwater from the aquifer will occur from the coastal cliffs to the east of the site.

The active zone of groundwater movement is considered likely to occur within the top 150 m of the bedrock. Compaction with increasing depth will rapidly reduce the fracture sizes and associated secondary permeability of the bedrock aquifer system with restricted vertical and horizontal groundwater movement.

The low permeability characteristics of the superficial aquifer and the small volumes of water that are anticipated to be present within it are such that there is not anticipated to be any hydraulic connectivity between groundwater within the surface and bedrock aquifers.

3 PROPOSED DEVELOPMENT AND WATER MANAGEMENT

3.1 Phase 1: Site preparation

Earthworks will first be undertaken to establish a level surface for operations, commencing with the removal of topsoil, which will be stored in bunds located to the north and east of the site. Subsequently, subsoil will be excavated from higher elevations and utilised as fill material on lower elevations to create a level surface.

Site preparation does not involve using liquids apart from those associated with concrete or cement, which will be utilised to construct the well cellar.

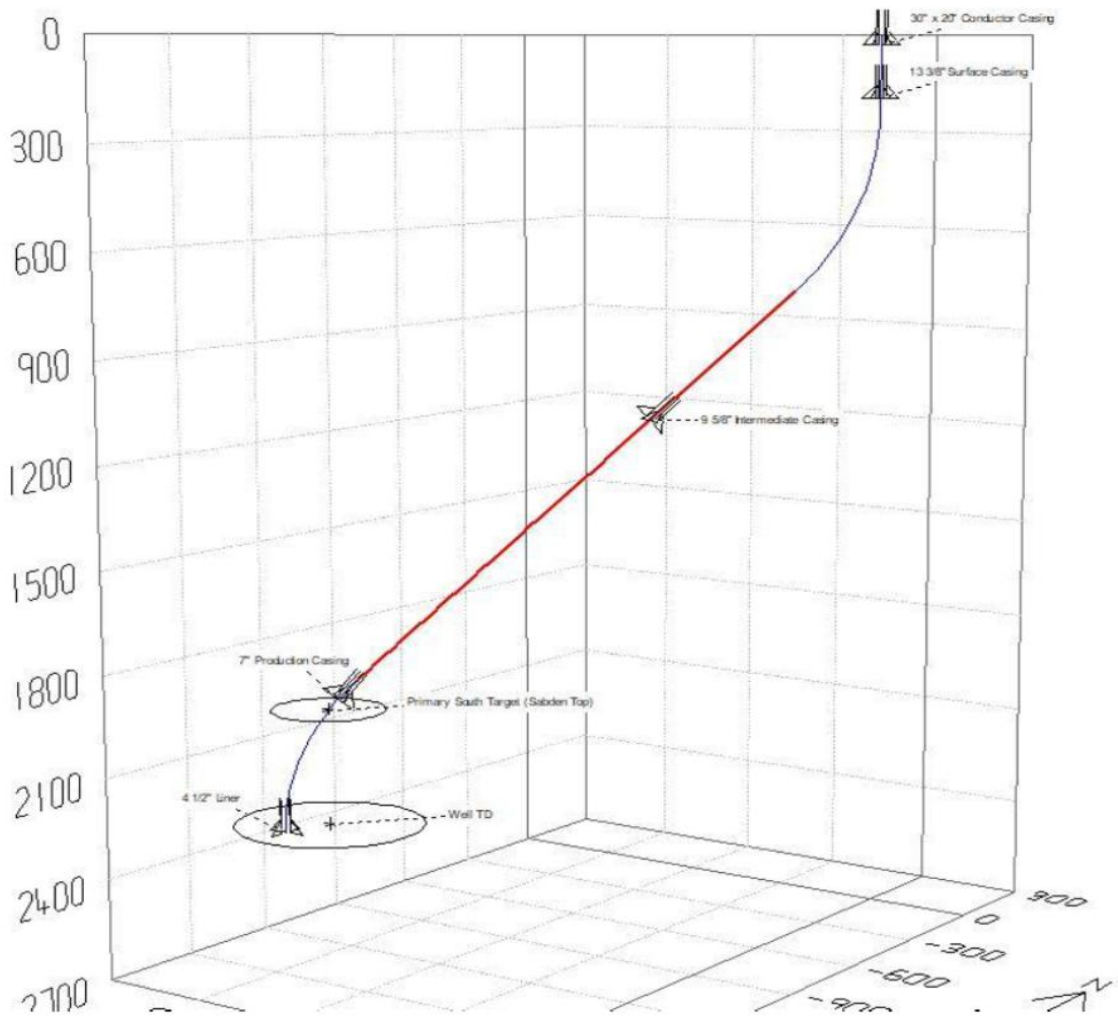
A fully sealed containment system, comprising a water-tight membrane, will be installed beneath the entire site and perimeter containment ditches. The membrane will consist of a 2 millimetre (mm) thick, smooth, High-Density Polyethylene (HDPE) sheet, which is fully welded and protected by layers of geotextile above and below, forming a composite structure. The appropriate geotextile weight will be determined via cylinder testing to ensure compatibility with the chosen aggregate.

The design and installation of the impermeable membrane will follow an approved Construction Quality Assurance (CQA) Plan, with all phases supervised by a qualified CQA Engineer. The installation will be inspected before additional protective geotextile and surface aggregates are applied.

3.2 Phase 2: Drilling operations

The well will be deviated 1.6 km and target a total depth of 2990 m. The well will be constructed in full compliance with the applicable regulations, in full regulatory oversight of the Environment Agency, the Health and Safety Executive and the NSTA. The well construction is detailed in *Table 3729/HIA/T4*. The well path, casing setting depths and target ellipses at depth are illustrated on *Drawing 3729/HIA/08*.

3729/HIA/T4: Well casing design			
Hole section	**Casing**	**Formation**	**Shoe depth (TVDss)**
36" x 26"	30" x 20"	Mid Jurassic	30 m
17½"	13⅜"	Lower Jurassic	192 m
12¼"	9⅝"	Bunter Shale	1404 m
8½"	7"	Rotliegendes	2578 m
6"	4½"	Sabden Base	2988 m



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Client	Europa Oil & Gas Limited, 30 Newman Street, London, W1T 1PT	Title	Well path with casing depths and target ellipse
		Project	Burniston Mill - Cloughton
		Drawing	3729/HIA/08
		Version	1
		Date	Jan 2025
		Scale	n/a

Well construction is designed to prevent the vertical migration of fluids between the different geological layers; with each casing string cemented and pressure tested on completion. As such there are three cemented casings (13⅜", 9⅝" and 7") through the active shallow groundwater system to prevent any potential gas or fluids migration from deeper levels.

A conductor tube or "stove pipe" (the initial section of the casing for the well) will be installed to a depth of around 30 mbgl. It will be cemented and sealed at the base of the drilling cellar (around 2.5 mbgl). This installation will be undertaken by driving the casing into place or using a drill rig that employs air circulation to remove material from the wellbore. The conductor tube will be cemented in place with quick-setting cement, ensuring no fluid ingress to the surface or ground. The next phase will be drilling a 17½" diameter hole inside the conductor pipe. The depth of this phase will be determined following a final well design, but it is anticipated to be at around 192 mbgl. The design will be submitted to the North Sea Transition Authority (NSTA), HSE, and EA as part of the well program for approval. Water-based drilling mud of conventional characteristics will flush and stabilise the wellbore. A 13⅜" diameter steel casing will be run and set in the wellbore, with cement returns to the surface[14].

The wellbore is anticipated to encounter groundwater once the bedrock Secondary 'A' aquifer is reached. Drilling in open hole will make use of a water-based drilling mud with physicochemical properties to impede fluid contact between the geological formation and the drilling string. The drilling mud will rapidly create an impermeable mud cake at the face of the formation. This in turn will isolate the formation from the wellbore, preventing the ingress of any fluids used in the drilling operation into formations at depth. Periodically during drilling, solid steel, hence Impermeable, casing will be run into the hole and cemented in place. This will act as another physical barrier to prevent ingress into the formation.

During this phase of work, vehicular traffic will have no significant impact on the public highway, access road or the site itself. Most chemicals will be transported in powder form and mixed with water on-site. The only liquids transported to the site during this phase will be water and fuel oil for machinery. Standard road tankers will deliver fuel directly into the drilling rig's fuel tanks, located within the active drilling site's secured and controlled area.

Foul drainage from the cabins will be stored in dedicated under-cabin tanks or connected to a buried cess tank, which a registered contractor regularly empties at an approved treatment facility.

14 Europa Oil & Gas written communication

3.3 Phase 3: Well testing

Once the well has been drilled, a proppant squeeze and testing operation will be conducted without an on-site drilling rig. Low permeability formations above and below the target formation will prevent fluids from entering lower groundwater resources. The proppant squeeze involves pumping gelled fluids and very small solid particles (silica sand or ceramic beads) called proppant down the sealed wellbore and out through perforations at depth in the steel casing. This slurry is pumped at pressure, which creates a very thin fracture 2 mm in width in the rock that will extend between 40-80 m vertically and up to 200 m horizontally from the wellbore. The operation will be carried out with all fluids assessed for suitability and use by the Environment Agency. The operation will be targeting sandstone formations at around 2000 mbgl. As described in the deeper geology section the targeted Namurian sandstones are interbedded with extensive shales with limited vertical permeability. In addition, there is a proven thick (~500 m) world class reservoir seal directly above the targeted reservoir sections in the form of evaporites (anhydrites and halites) which will have zero vertical or horizontal permeability. These units have prevented the escape of gas over millions of years.

The limited nature of the induced fracture will ensure it stays within the bounds of the target formation and in addition the physical properties of the overlying evaporites, which will not support shear or fracture, will continue to provide a robust seal. As such the deeper geology, in combination with the multiple cemented casing strings at depth, will ensure no communication with the active shallow groundwater system that is thousands of metres above.

The authority for approval of the proppant squeeze operation rests with the Environment Agency, Health & Safety Executive and the NSTA and will require the submission of a Hydraulic Fracture Plan.

Any fluids produced from the well during this phase of the operations will be stored in bunded tanks. The operator will transport this and any surface water off-site in road tankers by a licensed waste contractor and managed via a licensed facility. Controlled discharge is therefore not relevant and will not be pursued in this report.

3.4 Phase 4: Restoration of the site

Phase 4 involves the decommissioning of the well and restoration of the site. All residual liquids remaining after the testing phase will be extracted using suction tankers before the bunds and ditches around the site are dismantled. After the wellbore is plugged and sealed according to specifications set by regulatory authorities (NSTA, HSE, EA and Independent Well Examiner),

the drill pipe within the cellar will be cut to a depth of at least 2 m below the finished ground level and a sealing cap welded in place. The concrete well cellar will be broken down and removed from the site.

Subsequently, the site will be restored to its former profile, following a reverse process of the initial excavation. Once restored, the site will be returned to agricultural use, with an aftercare period (typically five years) ensuring the area regains its former productivity.

The restoration process will comply with Europa's Site Closure and Restoration Programme.

4 ASSESSMENT OF IMPACTS

4.1 General

The investigation of baseline conditions has provided a detailed understanding of the extant water environment. Based upon this understanding, the potential for impact which may result from the proposed mineral extraction has been assessed.

The potential impacts can be subdivided into those that may occur during the site's operational and post-restoration phases. The characteristics associated with each can be summarised as below:

- During operational phases
  Potential impacts are generally of shorter duration but larger magnitude than those that may occur after restoration.

- Post-restoration
  Any impacts are generally of smaller magnitude but longer, possibly perpetual, duration. Their mitigation must be incorporated into the restoration design as long-term active water management is not considered practical.

4.2 Method of assessment

The method of assessment of surface water and groundwater effects has involved:

- characterisation of the baseline environment
- determination of the sensitivity of key receptors, catchments and watercourses
- evaluation of the significance of predicted effects, considering the magnitude of effects (before and after mitigation)
- evaluation of the sensitivity of the baseline environment affected

A rigorous and consistent approach to the assessment has been adopted using matrices to help classify the resource's sensitivity and determine the scale and significance of effects.

These are explained below.

4.2.1 Baseline sensitivity matrix

The characterisation of the baseline water environment involved the review of site-specific data and the identification of sensitivities. The characterisation of catchment sensitivities has been guided by the matrix below (*Table 3729/HIA/T5*), which lists indicative criteria.

3729/HIA/T5: Catchment sensitivity classification		
Sensitivity/ Importance	**Description**	**Example criteria**
Very High	Nationally or internationally significant attributes of high importance	▪ Surface water and its ecology at the site are protected under the UK National Site Network ▪ Principal aquifer providing a nationally important resource or supporting a site protected under wildlife legislation ▪ SPZI ▪ Flood risk receptor classified as essential infrastructure or highly vulnerable development in the NPPF
High	Regionally significant attribute of high importance	▪ Surface water downstream of the site protected by national designation ▪ Principal aquifer providing a regionally vital resource or supporting a nationally important water-dependent protected site ▪ Flood risk receptors are classified as a more vulnerable development in the NPPF
Medium	Locally significant attribute of moderate importance	▪ Near surface water and its ecology protected by a local designation ▪ Secondary aquifer providing locally vital resource, with limited connection to surface water ▪ Flood risk receptors classified as less vulnerable development in the NPPF
Low	Low quality and rarity on a local scale	▪ Waterbody with no significant habitat ▪ Secondary aquifer, with no local water abstraction ▪ Flood risk receptor classified as water-compatible
Not sensitive		▪ No aquatic habitats or watercourses present ▪ Unproductive strata

The criteria for sensitivity are guided by a hierarchy of factors relating to the nature of the surface water and groundwater environment. The criteria have been used to assess the sensitivity of the baseline surface water and groundwater environment. Based on the requirements in the above table, the catchment sensitivity is assessed to be 'low'.

4.2.2 Impact prediction and evaluation

The prediction and assessment of effects on surface water, groundwater and the extant water environment have been undertaken using tables to document the various potential impacts of the proposed development. Impacts have been predicted for the proposed development based on the guideline criteria for impact magnitudes in *Table 3729/HIA/T6*.

3729/HIA/T6: Impact magnitude	
Impact magnitude	**Guideline criteria**
High	Total loss of, or alteration to, key features of the baseline resource such that post-development characteristics or quality would be fundamentally and irreversibly changed, with high likelihood of occurrence
Medium	Total loss of, or alteration to, key features of the baseline resource such that post-development characteristics or quality would be partially changed, with moderate or low likelihood of occurrence
Low	Small changes to the baseline resource which are detectable but the underlying characteristics or quality of the baseline situation would be similar to pre-development conditions
Negligible	A very slight change from baseline conditions, which is barely distinguishable and approximates to the 'no change' situation

These criteria have predicted a series of generic impacts for the proposed development. Residual effects have been predicted, considering proposed mitigation measures.

The significance of the predicted effects has been assessed in relation to the sensitivities of the baseline resource. A significance matrix allows a consistent framework for evaluation and is presented in *Table 3729/HIA/T7*. Guideline criteria for the various effect categories are included in *Table 3729/HIA/T8*.

3729/HIA/T7: Significance matrix					
Magnitude	**Sensitivity**				
	Very High	**High**	**Medium**	**Low**	**Not sensitive**
High	Major	Major	Major	Moderate	Minor
Medium	Major	Moderate	Moderate	Minor	Minor/Negligible
Low	Moderate	Moderate	Minor	Minor/Negligible	Negligible
Negligible	Minor	Minor/Negligible	Negligible	Negligible	Negligible

The matrices used to guide the assessment have been applied flexibly since the evaluation of effects is always subject to location-specific characteristics, which need to be considered. For this reason, the evaluation of impact significance does not always correlate precisely with the cells in the relevant matrix, where professional judgment and knowledge of local conditions may result in a slightly different interpretation of the impact concerned.

3729/HIA/T8: Significance of effects categories		
Significance	**Definition**	**Guideline criteria**
Negligible	No detectable change to the environment	No effects on drainage patterns, surface and groundwater quality or aquatic habitat
Minor	A small but detectable change to the environment	Localised changes in drainage patterns or groundwater flows or changes resulting in minor and reversible effects on surface and groundwater quality or aquatic habitats
Moderate	A larger but non-fundamental change to the environment	Changes in water quality or quantity affecting part of a catchment or groundwaters of moderate vulnerability or changes resulting in loss of conservation value to aquatic habitats or designated areas
Major	A fundamental change to the environment	Changes in water quality or quantity affecting widespread catchments or groundwater reserves of strategic significance or changes resulting in substantial loss of conservation value to aquatic habitats and designations

In the above classification, fundamental changes are permanent and detrimental and would result in widespread change to the baseline environment.

4.3 Assessment of impacts

An assessment of potential impacts has been undertaken based on understanding the extant water environment derived from the baseline assessment and using the objective criteria defined above. The potential consequences have been assessed at four phases of site development: during operational phases and after the completion of restoration. They are discussed in turn below.

4.4 Potential impacts during Phase 1: Site preparation

4.4.1 Waterlogging

The earthworks will involve topsoil removal and its storage in bunds. This will change the ground surface gradient, creating a level area where surface run-off could accumulate instead of flowing downslope. Waterlogging could occur during winter months. The magnitude of the impact is considered to be 'negligible' giving a significance of 'negligible'.

4.4.2 Surface water (quality and quantity)

Mobile plant, and its movement, is the primary source of potential contamination of surface and groundwater during site preparation.

The movement of mobile plant on exposed earth could lead to the generation and transport of suspended solids. Significant volumes of water within the subsoil are not anticipated; however, the interception of areas with sand could generate water. The expected duration of the time that earth was exposed, before the placement of the liner, is extremely limited.

The magnitude of the impact is considered to be 'low' giving a significance of 'minor'.

4.4.3 Groundwater

Contamination could potentially enter groundwater before the membrane is installed if it occurs at the surface. However, there is a considerable thickness of clay-rich superficial deposits at the site (20-30 m), which would prevent surface water infiltration into the bedrock aquifer. The magnitude of the impact is considered to be 'low', giving a significance of 'minor'.

4.5 Potential impacts during Phase 2: Drilling

4.5.1 Surface water quality

Potential impacts during Phase 2 arise from chemicals transported in powder form and mixed with on-site water. Standard tankers will deliver fuel and water on-site and transfer it to a secure and controlled storage area. Additional potential pollution sources are rainwater mixed with fuel and oils used for the operations. The magnitude of the impact is considered to be 'low,' giving it the significance of 'minor'.

4.5.2 Groundwater

The preliminary drilling stages involve the construction of a concrete well cellar and installing a steel conductor pipe. These operations will employ quick-setting concrete. The magnitude of the impact is considered to be 'low,' giving it the significance of 'minor'.

4.6 Potential impacts during Phase 3: Well testing

4.6.1 Surface water

During well testing, fluids will be used in a proppant squeeze to facilitate gas flow from the wellbore. These will have been transported to the site and stored temporarily before use. However, safeguarding measures that mitigate the impacts of the chemicals used in the

preceding drilling phase will remain in place. The magnitude of the impact is considered to be 'low' giving a significance of 'minor'.

4.6.2 Groundwater

The testing operation, including the proppant squeeze, will occur more than 2000 mbgl, which is considerably deeper than the active groundwater system in the area. The latter is likely restricted to 150 m below the ground surface. The aquifer is protected by steel casing cemented and sealed during the drilling phase. The well-testing operation will not occur at the same depths as the existing groundwater aquifers but separated by over 2000 m in which stratigraphically there are numerous regional impermeable strata including 500 m of sealing evaporitic rock directly overlying the target formation. The proppant squeeze operation is designed to produce a low volume fracture contained within the target formation at depth precluding any risk of groundwater pollution. All of the proposed chemical additives are non-hazardous. The magnitude of the impact is considered to be 'negligible,' giving it the significance of 'negligible'.

4.7 Potential impacts during Phase 4: Post-restoration

4.7.1 Surface water

Residual chemicals could potentially cause an impact after the restoration of the site. The magnitude of the impact is considered to be 'low' giving a significance of 'minor'.

4.7.2 Groundwater

The wellbore will be plugged and sealed according to specifications set by the regulatory authorities (NSTA, HSE, EA, and IWE). The drill pipe within the cellar will be cut to a depth of at least 2 m below the finished ground level, and a sealing cap welded in place. The concrete well cellar will be broken down and removed from the site. These actions will isolate the cased wellbore from contact with the external environment, removing the possibility of adverse impact. The magnitude of the effect is considered to be 'negligible' giving a significance of 'negligible'.

5 MITIGATION MEASURES

5.1 Mitigation measures during Phase 1: Site preparation

5.1.1 Waterlogging

Due to the minimal period when earth will be exposed and the small volumes of water anticipated to be encountered, it is not proposed that specific mitigation measures for waterlogging be adopted.

5.1.2 Surface water (quantity and quality)

Regular inspections of vehicles arriving on-site, plus overnight storage with drip trays beneath the engine sumps to capture leaks, will minimise the risk of surface water pollution. Fuel will be stored within a secured bunded area capable of containing the total stored volume or be in a reinforced container with a fitted drip tray. In compliance with the construction phase plan, all refuelling operations for construction vehicles will be conducted in a designated, controlled area adjacent to the fuel storage bowser. Lined perimeter ditches, designed to manage rainwater run-off from the site, will allow water to be re-used in the operation or transported off-site in sealed tankers.

Fresh concrete containing minimal free water will be used for construction works. During concrete and cementing operations, the contractor will provide a lined waste skip to allow ready-mix concrete trucks to dispose of excess concrete and perform washouts before leaving the site. As a result, there is no risk of contaminated liquids escaping from the partially constructed site.

Earthworks could generate and mobilise fines, which could potentially enter the external water environment. The adoption of measures appropriate to temporary works would mitigate this potential impact. These could include the excavation of temporary, shallow peripheral ditches to intercept run-off, wedge pits and deploying silt fences and/or silt mats to entrap fines before they can leave the site.

The magnitude of the impact on surface water was considered 'low' in Section 4 during Phase 1, giving a significance of 'minor'. However, with mitigation measures, it is assumed that the significance will be reduced to 'negligible'.

5.1.3 Groundwater

A fully sealed containment system comprising a welded impermeable membrane with geotextile layers will extend beneath the site and perimeter containment ditches. This will ensure total containment of potential contaminants in the unlikely event of spills, ruptures or

failures. This system can manage a hypothetical uncontrolled fluid release at 50 barrels per day over 30 days (equivalent to 57,000 gallons or 259,127.1 litres). Any spills from equipment will be contained within the site, and in the unlikely event of a rupture in a double-skinned or bunded fuel tank, the fuel will be fully contained on-site for clean-up.

The magnitude of the impact on groundwater was considered 'low' in Section 4 during Phase 1, giving a significance of 'minor'. With the implementation of the proposed mitigation measures, the significance is considered reduced to 'negligible'.

5.2 Mitigation measures during Phase 2: Drilling

5.2.1 Surface water (quantity and quality)

Rainwater will be collected in the perimeter containment system and re-used on-site for drilling mud preparation or removed from the site via tanker. Mud cuttings and fluids from drilling and testing operations will be removed by licensed operators and disposed of at authorised facilities with relevant environmental permits. Foul drainage from the cabins will be transported to an approved treatment facility.

The magnitude of the impact on surface water during Phase 2, explained in Section 4, was considered 'low,' giving it the significance of 'minor'. However, mitigation measures reduce the significance to 'negligible'.

5.2.2 Groundwater

The conductor pipe will isolate the preliminary 30 m of superficial rocks (and potential aquifers) from contact with surface fluids. Subsequent drilling stages will employ drilling mud to isolate the formation from contact with the drilling string. A mud cake will form a protective layer to this end. The mud cake is a millimetric to centimetric thick zone where the drilling fluid solidifies to seal the formation and prevent fluid loss or gain. The hole integrity during the drilling phase relies heavily on the mud cake's effectiveness, which precludes any fluid interaction, thereby mitigating the potential for groundwater contamination.

To monitor the effectiveness of the mitigation measures Europa Oil & Gas will install three groundwater monitoring boreholes to establish conditions for groundwater flowing beneath the site before it enters the drilling platform perimeter and after leaving it. Periodic monitoring of groundwater level and quality in the boreholes will be undertaken. The borehole locations can be found in *Appendix 3729/HIA/A1*.

The magnitude of the impact in groundwater was considered 'low' in Section 4.5, giving it the significance of 'minor'. Furthermore, with the implementation of the mitigation measures, the significance remains 'negligible'.

5.3 Mitigation measures during Phase 3: Well testing

5.3.1 Surface water (quantity and quality)

Rainwater will be transported off-site in tanks for disposal at an approved treatment facility. Furthermore, the magnitude of the impact on surface water was considered 'low' in Section 4.6, giving a significance of 'minor'.

5.3.2 Groundwater

The risk to the active groundwater system in the area is considered negligible during well-testing and the proppant squeeze operation as the risk is mitigated by the integrity of the well design and the nature of the geology at depth. There is significant vertical hydraulic separation (thousands of metres), within which numerous non permeable, hydraulically sealing strata exist, between the active aquifers and the targeted formation of the well test operation.

Operational designs will be adhered to and the operations carried out in accordance with the directives of the Environment Agency, the Health & Safety Executive and the NSTA as approved in the Hydraulic Fracture Plan

The magnitude of the impact is considered to be 'negligible' giving a significance of 'negligible'. The significance remains 'negligible'.

5.4 Mitigation measures during Phase 4: Post-restoration

5.4.1 Surface water (quantity and quality)

All residual liquids and contaminants remaining after the testing phase will be extracted using suction tankers, and any contaminated stone will be removed in sealed lorries before the bunds and ditches around the site are dismantled.

The impact on surface water during Phase 4 is considered 'low', giving a significance of 'minor'. However, with the mitigation measures, it is assumed that the significance will be reduced to 'negligible'.

5.5 Monitoring scheme

In order to measure the effectiveness of the mitigation measures and facilitate the safe and compliant control of the operation to the relevant authorities an appropriate scheme of groundwater monitoring is required.

A scheme of monitoring that takes into account the hydrogeological setting and the risk profile of the development is proposed as a base scheme and will be agreed with the Environment Agency as part of the environmental permitting; the requirements of which are summarised below.

5.5.1 Water monitoring boreholes

The base scheme comprises three secured shallow boreholes constructed to monitor the groundwater system. The location of the boreholes is as illustrated in *Appendix 3729/HIA/A1*. These are all located outside the sealed bunded area of the site; one located on the upstream side of the site and two on the downstream side. All boreholes will be constructed with a 50 mm standpipe, slotted from 0.5 m above the phreatic surface to 0.5 m from the base. A bentonite sanitary seal will be placed in the borehole annulus from 200 mm above the slotted screen to surface.

5.5.2 Monitoring parameters

The scheme of monitoring will require the collection of water samples from secured boreholes by an independent third party for laboratory analysis by an independent third party. Analysis will be carried out for an extensive range of chemical parameters that are defined in the environmental permit

5.5.3 Monitoring frequency

The environmental permit requires that monitoring of any groundwater must commence 3 months prior to any well operations being undertaken. This pre-operational "baseline" monitoring will be undertaken once a month. The frequency of monitoring will increase to weekly during the drilling and testing phase of the operation and return to monthly when these phases of the operation are complete.

5.5.4 Sampling methodology

Water samples will be collected with reference to the British Standard for guidance on sampling of groundwaters (BS ISO 5667-11:2009, BS 6068-6.11:2009) and National Water Hygiene technical guidance.

5.5.5 Reporting

The data from the baseline monitoring will be reviewed and validated by the MPA/ Environment Agency prior to commencement of the well operations. Data obtained during the different phases of the operation will be reviewed and reported to the EA on a weekly basis. In the event of the detection of any potential contamination operations will be suspended and the EA immediately notified. Any investigative or potential remediation measures will be agreed with the MA/EA before progressing with operations.

6 WATER FRAMEWORK DIRECTIVE ASSESSMENT

6.1 Introduction

The Water Framework Directive (WFD) (2000/60/EC) was implemented in England and Wales in 2003 by regulations since replaced by The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017. The regulation requires that the water environment is managed to the following standards:

- Prevent deterioration in the status of aquatic ecosystems, protect and improve the ecological condition of waters
- Aim to achieve 'Good' status by 2021 or 2027, subject to the criteria set out in the Directive
- Meet the requirements of Water Framework Directive Protected Areas
- Promote sustainable use of water as a natural resource
- Conserve habitats and species that directly depend on water
- Reduce or phase out the release of individual pollutants or groups of pollutants that present a significant threat to the aquatic environment
- Progressively reduce the pollution of groundwater and prevent or limit the entry of pollutants
- Contribute to mitigating the effects of floods and droughts

An assessment of the proposed development is required to ensure no impacts on the current or future status of the relevant waterbodies.

6.2 Location

The site is located within the Derwent – Upper Yorkshire operational catchment (ID GB104027067980). In 2022, this catchment was classified as having a Moderate ecological status. The bedrock aquifer in the area is classified as the Derwent – North Yorkshire Moors – Ravenscar Water Body (ID GB40402G700800). In 2019, the waterbody was classified by the Environment Agency as having a Poor overall status[15].

6.3 Assessment

6.3.1 Quantitative status

No water abstraction or dewatering will be discharged to the watercourses adjacent to the site. Rainwater will be collected within a perimeter drainage ditch system. Some of this water will be reused on-site for the operation (drilling mud preparation). The remaining water will be transported and disposed of off-site at an approved treatment facility during the drilling and

15 https://environment.dta.gov.uk/catchment-planning/WaterBody/GB40402G700800

testing phases of the project. However, rainwater will be discharged off-site during non-operational phases at greenfield run-off rates, provided water quality standards are met after chemical testing.

There are no anticipated groundwater discharges.

It is considered that the proposal will have no impact on the current quantitative status of groundwater or surface waterbodies.

6.3.2 Qualitative status

Spill prevention, a fully sealed containment system with an impermeable layer and emergency response procedures will be in place at the site during the operational phase, reducing the risk of contamination.

Once the drilling rig has been removed and the site thoroughly cleaned of drilling mud and other chemicals, the water collected in the perimeter ditches will be transported off-site to be disposed of at an approved treatment facility.

The material used to restore the site will be the removed topsoil to be cleared before construction begins.

It is considered that the proposal will have no adverse impact on the current or future chemical status of the groundwater or surface waterbodies.

7 CUMULATIVE IMPACTS

The development is in a rural location, and no other operations that significantly impact the extant water regime occur in the vicinity. The closest licensed groundwater abstraction is 2.36 km south. The nearest industrial activity is a photovoltaic panel array 20 m southwest of the central area. The array consists of five rows, each 80 m long, of photovoltaic panels standing off-ground on fixed metallic ground mounts. This activity should not have any additional impact on the surface and underground. Additionally, farmland exists to the south, east and north, which will not be affected by the operations as there will be no increase in surface run-off.

8 SUMMARY AND CONCLUSIONS

Europa Oil and Gas Limited wishes to drill an appraisal well to assess potential gas accumulation on block TA09, under licence PEDL 343.

The site is located southeast of Burniston village and extends to approximately 1.41 ha. The site is between 48 and 58 mAOD. The coastline is approximately 550 m east of the site; a small photovoltaic panel array, several industrial units, farmland and a feedstock mill are located southwest of the site, with trees and hedgerows acting as boundaries. In contrast, the northeast is a grass-covered field.

The site is located mainly within the catchment of the Derwent River, located 5.7 km to the west. The closest watercourse to the site is the Burniston Beck, located approximately 115 m southwest of the site's entrance. This watercourse flows southeastwards, becoming the Cow Wath Beck before discharging into the Scalby Beck (Sea Cut), 2 km south of the site.

A small drainage ditch runs northwest to southeastwards, approximately 180 m southwest of the centre of the site, between the photovoltaic panel array field and the Mill Yard Industrial units. A small drainage ditch is located close to the southeast border of the site, southeast of the woodland. It drains directly into the Burniston Beck.

Superficial glacial diamicton deposits underlie the site. The bedrock comprises Jurassic strata, with the upper unit being the Long Nab Member, which can reach up to 60 m in thickness.

The hydrogeology at the site can be divided between superficial deposits and an underlying system within the sedimentary bedrock strata.

The Environment Agency classified the superficial glacial diamicton deposits as Secondary (undifferentiated) Unproductive Aquifers. However, sand and gravel pockets within the clay mass can lead to local perched aquifers in this unit – as evidenced by active springs nearby (0.25 km NE) and local borehole evidence.

The bedrock comprises a vertically extensive sequence of predominantly argillaceous sediments. The aquifer properties of the mudstones and siltstones are considered likely to be 'poor', with relatively small volumes of groundwater storage and low rates of groundwater flow. Slightly larger volumes of water could be expected within coarser deposits. The lithology of the sequence is such that a multi-layered aquifer with restricted vertical groundwater movement is anticipated. The Environment Agency classifies the Jurassic bedrock as a Secondary 'A' aquifer.

Based on regional geological mapping and cross-section, the groundwater flow direction can be inferred to be eastward.

The proposed development will be undertaken in four phases: site construction, drilling, well-testing, including a proppant squeeze, and restoration. The potential impacts on the water environment associated with each stage of work have been assessed. Objective criteria, defined using a series of matrices, have been ascribed to each element of the water environment.

The entire lining of the site, with a welded membrane, will mitigate against the potential for contamination of both surface water and groundwater from surface sources.

Rigorous procedures and mitigation measures will be adopted when drilling and testing the appraisal well. The operational programme has been devised with environmental protection at its core, and the work programmes for each phase will be submitted for approval by the relevant authorities and regulators.

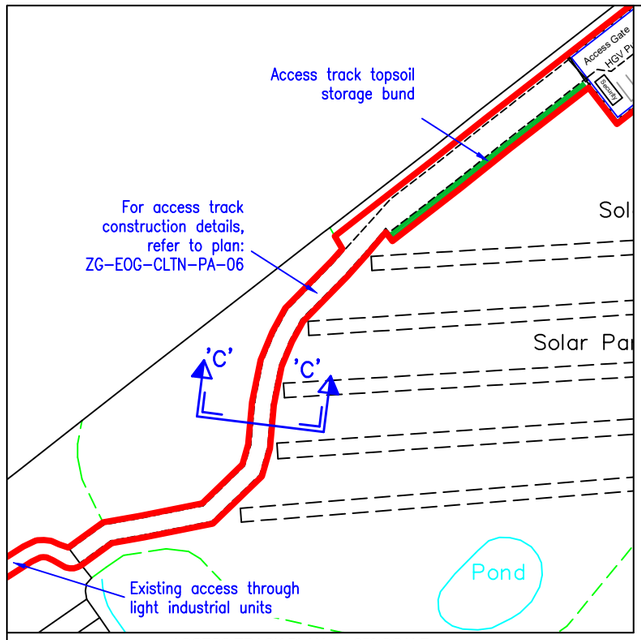
The composition of the drilling mud, the successive lining of the wellbore with steel casing and the nature of the deeper geology will ensure no fluid interchange between the wellbore and the surrounding groundwater environment.

Three monitoring boreholes will be installed and sampled to determine groundwater conditions within the upper bedrock aquifer.

After removing imported materials used during site construction, the restoration phase will return the site to its previous landform and agricultural use.

APPENDIX 3729/HIA/A1

Monitoring boreholes location



ACCESS TRACK PLAN 1:1,250 SCALE

KEY:

- PLANNING APPLICATION BOUNDARY
- CUT BATTER
- FILL BATTER
- PERIMETER CONTAINMENT DITCH
- SECURITY FENCING
- GROUNDWATER MONITORING BOREHOLES (GWMBH)

NOTES:

CROSS-SECTION VIEW DETAILS INDICATED BY THE DIRECTION THE ARROWS ARE FACING, FROM POINT 'A' TO POINT 'A', AS SHOWN BELOW:

'A' 'A'

FOR SECTION DETAILS, REFER TO PLAN NO: ZG-EOG-CLTN-PA-06

REVISION HISTORY				
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0	OCT24	JF	FIRST ISSUE	JF
REV	DATE	BY	DETAILS	APR

ZETLAND GROUP
FROM CONCEPTION TO COMPLETION

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SITE: CLOUGHTON WELLSITE, BURNISTON, NORTH YORKSHIRE

PROJECT: APPLICATION FOR PLANNING PERMISSION

TITLE: SITE LAYOUT PLAN - INDICATIVE CONSTRUCTION PHASE

CLIENT: EUROPA OIL & GAS LIMITED

Scale:	1:500
Size:	A3
Sheet:	1 of 1

DWG. No: ZG-EOG-CLTN-PA-05