



Hydrogeological and Flood Risk Assessment and Surface Water Drainage Strategy

Weaverthorpe Drill Site

Report No. C57/2055/AYE/R/ENV/002-01

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[1] Introduction

[1.1] Report Context

This combined Hydrogeological Risk Assessment (HRA) and Flood Risk Assessment (FRA) for the proposed hydrocarbon (gas) exploration borehole near Weaverthorpe in North Yorkshire (“the Site”) has been prepared by Ayesa (ByrneLooby Partners (UK) Limited) and commissioned by Egdon Resources U.K. Limited (Egdon).

[1.2] Site Location

The Site (shown as the area within the red line boundary of Drawing Ref. ZG-ER-WRP1-FH-PA-02 Location Plan (Site of Application)), comprising the proposed wellsite, the Site access track and visibility splays (1.3 ha in area), known as the “Weaverthorpe Prospect”, is located north of Butt Lane, ~860 m to the east of the village of Foxholes in North Yorkshire, ~14 km to the south of Scarborough.

At surface, the Site is located within Petroleum Exploration Development Licence area PEDL347, immediately adjacent to PL081, which contains the prospect (Figure 1). The Site is located within the administrative boundary of North Yorkshire Council and within Foxholes with Butterwick Parish.

The Weaverthorpe Prospect is a c. 1 km deep Sherwood Sandstone (Triassic) conventional (gas) prospect. The Weaverthorpe 1 well will be drilled from the Site in a structurally up-dip location ~4.5 km west of the Fordon-2 well, drilled by BP in 1974. The drilling operation encountered what was interpreted at that time to be a potential gas-saturated reservoir in the Sherwood Sandstone, but the well was not tested at the time. Updated interpretation and mapping of the top of the Sherwood Sandstone reservoir has indicated that the Weaverthorpe prospect is an east-west trending elongate structure of approximately 16 km² that spans the licence boundary of PL081 and PEDL347.

[1.3] Constraints

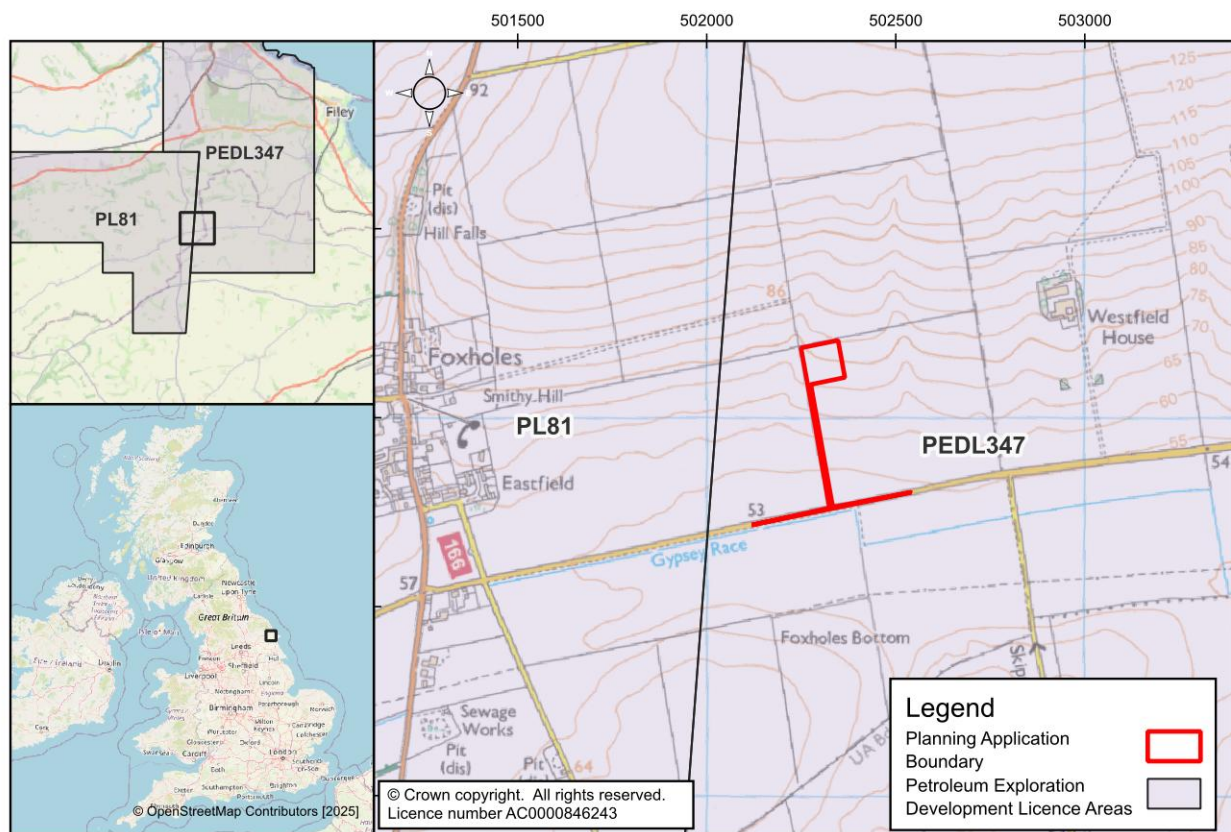
The Site is located within Flood Zone 1 (*i.e.* a very low likelihood of flooding). To the south of the access road entrance off Butt Lane and some 12 m topographically lower than the Site itself lies Gypsy Race, a small Chalk stream. The race and surrounding valley bottom area are designated as being within Flood Zone 2/3.

There are groundwater abstraction wells located in the area (Figure 20) and the Site is located within Zone 3 (‘total catchment’) of a Source Protection Zone (SPZ) for a series of abstractions which are located more than 5 km to the south-east (Figure 2).

[1.4] Scope of Work

This report has been produced to support a Planning Application for an exploratory wellsite. This report will assess the environmental risks posed by the proposed activities, through Hydrogeological Risk Assessment, a robust Conceptual Site Model (CSM), as well as Flood Risk Assessment with Drainage Strategy.

Figure 1 Site Location



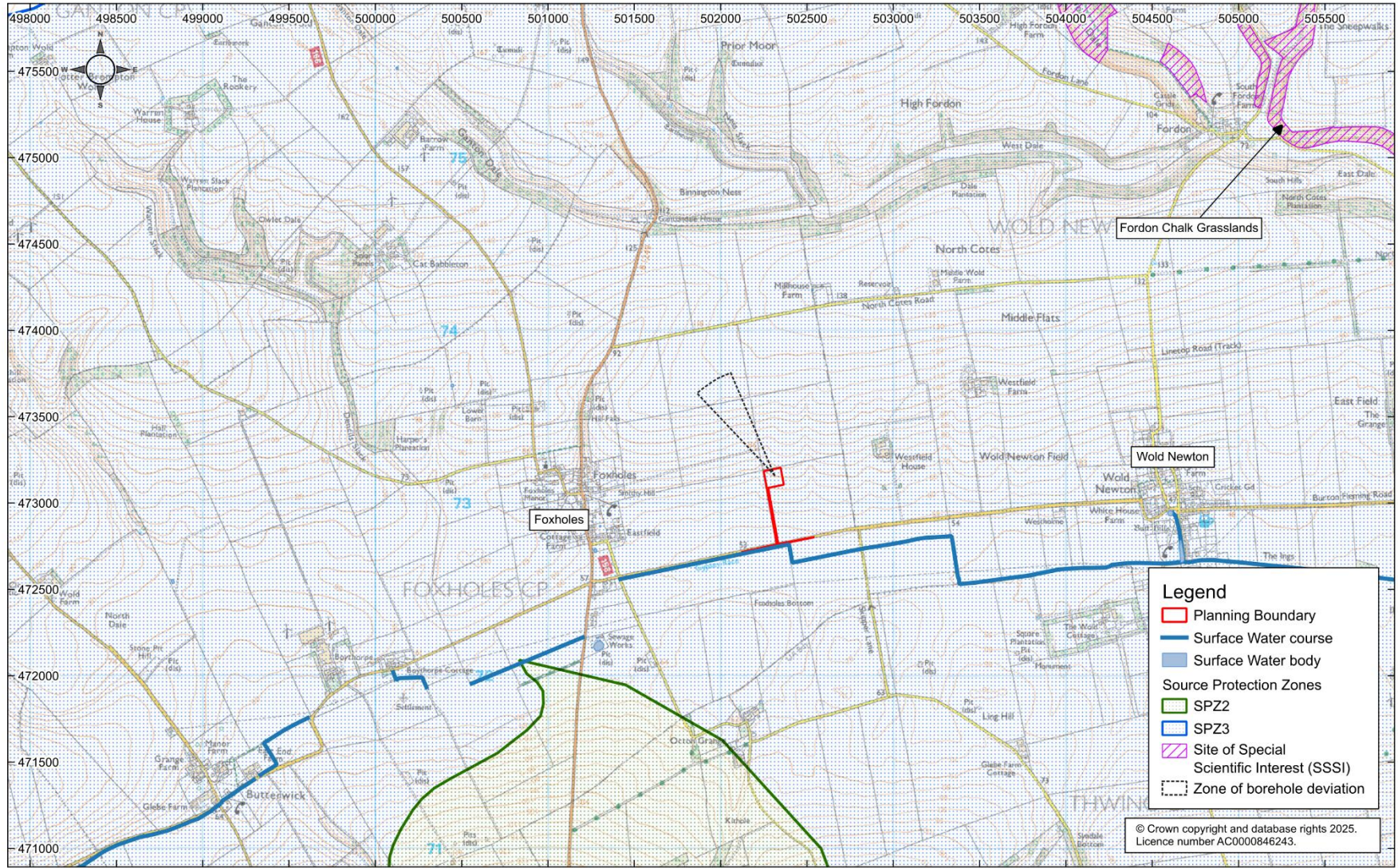
[1.5] Data Sources

The following data sources have been consulted in the preparation of this report:

- Plans and data produced by Zetland Group and Egdon;
- British Geological Survey (BGS) published and online mapping;
- Ordnance Survey mapping;
- Private Water Supply data held by North Yorkshire Council and East Riding of Yorkshire Council;
- Environment Agency data, including LIDAR, Flood Risk and Groundwater;
- Designated site data from Natural England;
- Borehole Sites and Operations Regulations (BSORS), 1995;
- Minerals and Waste Joint Plan, 2022;
- The Ryedale Local Plan Strategy; and
- North Yorkshire County Council (NYCC) Strategic Flood Risk Assessment (SFRA)¹.

¹ North Yorkshire County Council, 2016. Strategic Flood Risk Assessment (Level 1). Volume 1: Mineral, Waste and Flood Risk: A Data Review Document.

Figure 2 Site Setting



[2] Proposed Development

[2.1] Existing Development

The Site is undeveloped agricultural land that has an Agricultural Land Classification (ALC) of 'Grade 3b', based upon the Agricultural Land Classification and soil survey undertaken by Ray Leverton. The Site has a long history of intensive arable agriculture, typically given over to cereal or potato crops.

No previous planning applications have been submitted for the Site. The previous operator for petroleum Licence (PL081), Third Energy, previously submitted a planning application to drill an exploratory borehole from a different well site off North Cotes Road, but this was withdrawn before it was determined.

[2.2] Development Proposals

The Site comprises an area of 1.3 ha, including a 330 m length access track to Butt Lane. The proposal is to drill a single hydrocarbon (gas) exploratory borehole from the proposed site through a sequence of Chalk, Jurassic strata, then Triassic marls to investigate the potential for exploitable natural gas contained within the Sherwood Sandstone.

The upper ~250 m of the borehole will be vertical through the Cretaceous-age Chalk Group, which will be cased off and isolated before the borehole is directionally drilled to the top of the reservoir target.

The borehole will be directionally drilled up to 400 m laterally to the north-west, through Jurassic-age clays (Kimmeridge Clay) and mudstones, a thin carbonate formation (Corallian Formation) and the Upper Liassic Mudstones. At approximately 680 m True Vertical Depth below ground level (TVDbgl) the Triassic-age marls of the Penarth Group are expected to be encountered. Beneath this is anticipated to be 140 m of the Mercia Mudstone Group, before the Sherwood Sandstone reservoir is reached, into which drilling will continue for approximately 200 m (as illustrated in Appendix A). The total depth of the borehole is therefore expected to be ~1,130 m RKB.

A drilling well cellar will be constructed in the centre of the 'active area' of the Site for housing the wellhead. A concrete drilling pad will be constructed at surface, immediately surrounding the drilling well cellars.

[2.3] Development Area

The proposed Planning Application boundary is shown on Figure 3. All drilling, testing and retention-phase activities (including site security, staff car parking and welfare facilities) will take place within this boundary.

Figure 3 Proposed boundary



[2.4] Development Phases

There are four distinct phases of development, summarised in Table 1.

Table 1 Proposed Development Phases for “Weatherthorpe-1” Exploration Investigations

Phase	Description
Phase 1: Site and Access Construction	▪ Access track civils from Butt Lane; construct access track along field boundary ▪ Earthworks on well pad; install fencing and gates ▪ Create perimeter containment system ▪ Install liner / tertiary containment ▪ Construct well cellar ▪ Install temporary matting as useable surface platform
Phase 2: Drilling	▪ Set conductor ▪ Mobilise rig and services ▪ Drill Weaverthorpe-1 well ▪ Log well to evaluate reservoir ▪ Rig down equipment and release drilling rig
Phase 3: Testing	▪ Mobilise test spread ▪ 5-7 days operational well test, with shut-in periods to gather downhole data ▪ Gas management via enclosed approved ground flare system ▪ Suspend well to evaluate results ▪ Remove equipment and facilities
Phase 4: Restore or Suspend site	▪ Success case (proven gas from test evaluation): with well suspended, reduce site area size, remove temporary matting, install aggregate to create smaller working platform ▪ Failure case (no gas encountered during drilling, or insufficient gas following test evaluation): plug wellbore with cement plugs to surface, cut conductor below ground level and remove well cellar, remove matting and liner, backfill perimeter ditches and restore site to agricultural land

[2.5] Well Construction and Operation

[2.5.1] Well Cellars

Well cellars are the below-ground excavations which facilitate the setting of the conductor casing and provide an area for drilling fluids to collect.

The exploration well will be drilled from a 2.4 m diameter well cellar, a minimum of 2.75 m bgl, with a concrete base surround at surface. Well cellars are typically constructed around the large diameter casings using precast concrete rings encased in a concrete jacket surround. An impermeable membrane will be incorporated into the well cellar construction to maintain environmental integrity of the active area of the wellsite. The exact design of the well cellar has yet to be confirmed.

[2.5.2] Well Design

The well will be constructed to target an expected reservoir within the Sherwood Sandstone. It will be constructed according to the outline design summarised in Table 2 and shown in Table 3. The well design will be subject to review by an Independent Well Examiner, and then by the Health and Safety Executive (HSE).

Table 2 Well Design Schematic summary for Weaverthorpe 1

Depth (m RKB)	Formation	Hole and Casing sizes	Drilling fluid	Casing	Interval (m)
0	Cretaceous Chalk group	16" hole set at approx. 0-15 m RKB into superficial deposits and Chalk	Air / Water	13-3/8" conductor casing	±15 m to surface
	Hunstanton Formation	12-1/4" hole 15-280 m	Bentonite	9-5/8" to surface	From 280 m to surface
Fault					
250	Speeton Clay	8-1/2" hole section drilled 280 m to approx. 780 m	KCl polymer	7" intermediate casing to surface	From 780 m to surface
	Kimmeridge Clay				
	Corallian Group				
	Oxford Clay				
500	Estuarine Group				
	Lower Lias				
Fault					
	Mercia Mudstone				
750	Muschelkalk				
1,000	Sherwood Sandstone	6" hole 780 – 1,130 m TD; ~50 m below GWC	KCl polymer	4-1/2" (or 5") production liner (success case) to surface	From plugged back depth (above GWC) or TD to surface
1,125	Target Depth				

m RKB = metres below Rotary Kelly Bushing; TD = Total Depth; GWC = gas-water contact.

[2.5.3] Drilling Fluids

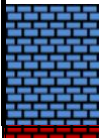
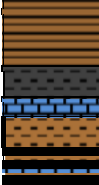
Weighted drilling fluids will be used during well drilling to lubricate the drill bit, remove arisings and prevent the ingress of formation fluids into the wellbore.

Water-based drilling fluids will be used when drilling through any aquifer-bearing formations, and a potassium chloride polymer is anticipated to be required from 280 m to the well's TD (total depth) target depth of the well at 1,130 m RKB.

[2.6] Management of Produced Gases and Fluids

If drilling is successful and indicates the need to test hydrocarbon flow rates, well testing will be progressed and this will be facilitated through the use of an enclosed gas flare. As the proposal is for an exploration well only at this stage, no gas will be exported offsite.

Table 3 Well Design Schematic

Well Design Schematic for 'Weaverthorpe I'							Option I: "Slant well" 29-Nov-2024			
Operator:		Egdon Resources U.K. Limited					Surface Locations (BNG OSGB1936) & Elevations (m) (all provisional)			
Well Name:		Weaverthorpe I (L41/28- 2 provisional)								
County, Country:		North Yorkshire, onshore UK					Surface Location: E: 502370.00 , N: 473150.00			
Licence:		PEDL347					Bottom Hole Location: E: 502230.55 , N: 473452.33			
Well Type:		Deviated Exploration Well for gas in Triassic aged Sherwood Sandstone					Elevations: Ground level at c.75m above Mean Sea Level (MSL), Rig-18's RKB at nominally 5m (ref Rig-18) above Ground Level (GL), c.80m above MSL			
Drilling Unit:		to be confirmed								
Prognosed Total Depth:		±1,130m.RKB (approx. -970m TVDSS, c.50m below anticipated GWC)								
Measured Depth (m.RKB)	Formation Names	Prognosed Lithology	Fault cuts	Objective	Hole & Casing sizes, setting depths (all RKB unless noted)	Anticipated bit (IADC code)	Drilling Fluid, Type and Density	Casing (provisional)		
				● oil ⚙ gas				Casing	Interval (m)	Casing Specification
0	Cretaceous Chalk Group		Fault		16" hole set at approx. 0-15m RKB into superficial deposits and Chalk	4-3-7 tricone or similar	Air Water	13-3/8" conductor casing	±15m to surface	TBD
250	Hunstanton Fm Speeton Clay				12-1/4" hole 15-280m	4-3-7 tricone or similar	Bentonite	9-5/8" to surface	From 280m to surface	TBD
500	Kimmeridge Clay Corallian Group Oxford Clay Estuarine Group		Fault		8-1/2" hole section drilled 280m to approx. 780m	PDC bit	KCl Polymer	7" intermediate casing to surface	From 780m to surface	TBD
750	Lower Lias Mercia Mudstone				6" hole 780 - 1,130m TD; ~50m below GWC	PDC bit	KCl Polymer	4-1/2" (or 5") production liner (success case), to surface	From plugged back depth (above GWC) or TD to surface	TBD
1,000	Muschelkalk			⚙						
1,125	Sherwood Sandstone									
	TD									

[2.7] Waste Management

During drilling operations, waste will be produced comprising drilling muds, rock cuttings, well cellar fluids, cement, and other well treatment fluids. These materials will be contained and stored within suitable waste containers prior to transfer offsite to an appropriately permitted waste facility. Wastes will be disposed of in accordance with their relevant European Waste Catalogue (EWC) coding. All waste streams, during all phases, will be quantified and identified through the Environmental Permit application.

[2.8] Relevant Local Plan Policies and Material Considerations

The following local plan policies are relevant in assessing the flood risk, hydrology and surface water drainage arising from the proposed development.

Minerals and Waste Joint Plan 2022²

MWJP Policy M17 (Other spatial and locational criteria applying to hydrocarbon development), which states that applications for appraisal activities should address the potential for cumulative impacts of development upon climate change;

MWJP Policy D02 (Local amenity and cumulative impacts) which states that minerals and waste development will be permitted where there will be no unacceptable impacts on emissions to water;

MWJP Policy D09 (Water environment) which states that proposals for minerals and waste developments will be permitted where there will be no unacceptable impacts on surface or groundwater quality and / or surface or groundwater supplies and flows;

Ryedale Local Plan Strategy 2013

Policy SP17 (Managing Air Quality, Land and Water Resources) which states that water resources will be managed by the use of sustainable drainage systems, attenuating surface water run off, managing water quality and protecting surface water and groundwater from potentially polluting development and activity.

Other material considerations

National Planning Policy Framework (NPPF) Chapter 2 (Sustainable Development) and Chapter 17 (Facilitating the Sustainable Use of Minerals); and

the Climate Change Planning Practice Guidance (PPG) and with NPPF Chapter 14 (Meeting the Challenge of Climate Change, Flooding and Coastal Change).

² https://www.northyorks.gov.uk/sites/default/files/fileroot/planning_migrated/minerals_and_waste_plan/LPA128%20-%20%20MWJP%20Policy%20adopted%20document%20-%20Final%20-%20accessible.pdf

[3] Hydrogeological Conceptual Site Model

[3.1] Background

A Conceptual Site Model (CSM) is used to develop an understanding of the site setting and potential pathway linkages between the site, operational activities and potentially sensitive receptors resulting from the activities taking place as part of the construction, drilling, testing and restoration or suspension of the Site.

[3.2] Terminology

The Water Framework Directive (WFD)³, and its Groundwater (Daughter) Directive, define the following key terms for ‘**groundwater**’, ‘**aquifer**’ and ‘**groundwater body**’ as follows:

- ‘Groundwater’ means all water which is below the surface of the ground in the saturation zone and in direct contact with the ground or subsoil;
- ‘Groundwater body’ means a distinct volume of groundwater within an aquifer or aquifers; and
- ‘Aquifer’ means a subsurface layer or layers of rock or other geological strata of sufficient porosity and permeability to allow either a significant flow of groundwater or the abstraction of significant quantities of groundwater.

Guidance aimed at implementing the Water Framework Directive in the UK by the UK Technical Advisory Group (UK TAG)⁴ defines a ‘default’ maximum thickness of 400 m for a dominantly porous bedrock aquifer such as the Sherwood Sandstone aquifer. This is because at depth the groundwater loses its value as a resource that can be either exploited for human activities or support surface water flows and ecosystems.

Therefore, within the context of the WFD, a groundwater body is considered to be a resource which is utilisable as a potable water resource up to 400 m in thickness. The WFD does not consider the geothermal resource potential of deeper aquifers.

Based on the geological formations anticipated to be encountered during the drilling of the exploration borehole, and their anticipated depths (see Appendix A), for the purposes of this report the base of the **groundwater body** is deemed to be the base of the Hunstanton Formation, just below the Chalk Group, at the top of the Speeton Clay at an approximate depth of 250 m bgl. The ‘Weaverthorpe 1’ well has therefore been designed to screen off this formation in order to provide protection during the continued drilling to the target depth.

³ Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy - <https://eur-lex.europa.eu/eli/dir/2000/60/oj>

⁴ UK TAG, 2011. Defining & reporting on Groundwater Bodies. https://www.wfduk.org/sites/default/files/Media/Characterisation%20of%20the%20water%20environment/Defining%20Reporting%20on%20Groundwater%20Bodies_Final_300312.pdf

[3.3] Site Description and Topography

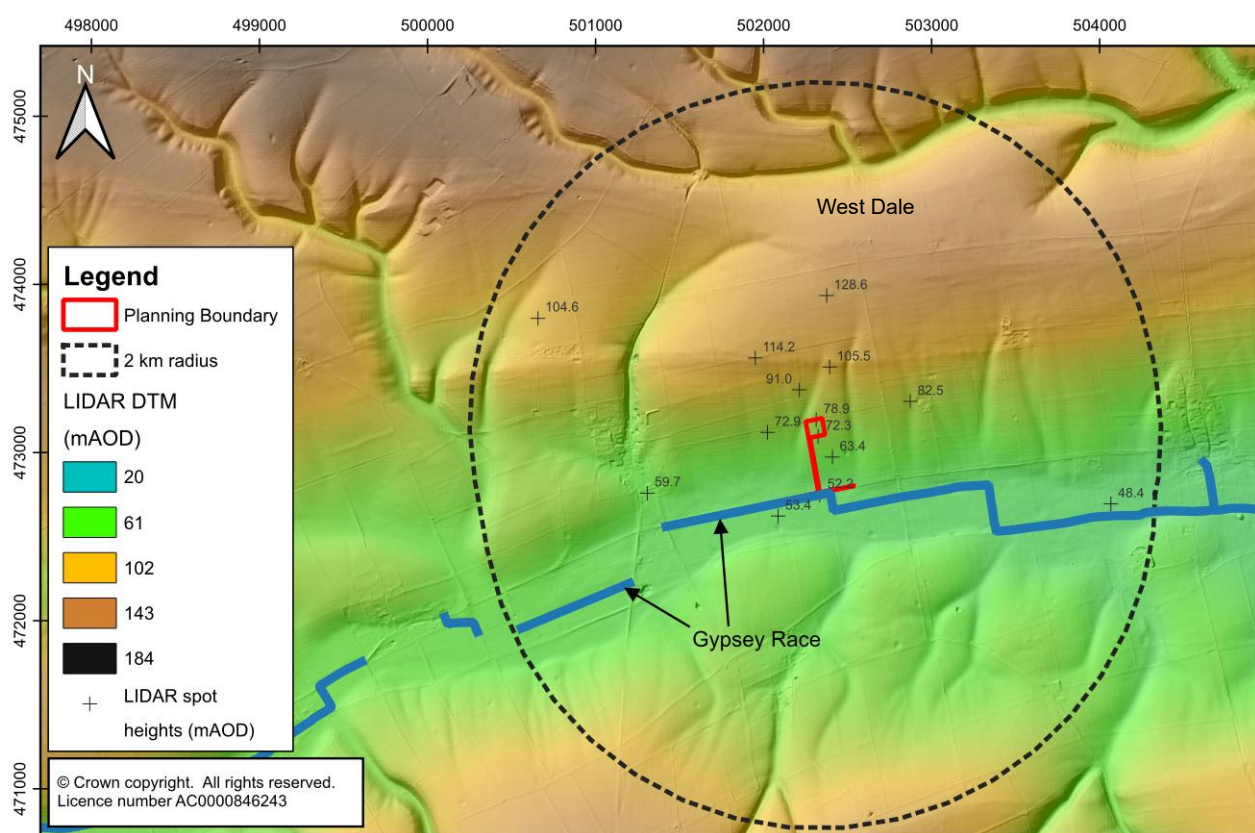
The landscape within which the Site sits is part of the Yorkshire Wolds, an area of Chalk Hills which lie to the south of the North York Moors. The area is characterised by numerous dry valley features, such as that located at North Cotes, ~1.4 km to the north of the Site and visible in the LIDAR DTM topography shown in Figure 4.

Land immediately to the north, east, south and west of the Site is agricultural in nature, with intensive arable production of cereal crops, potatoes etc. There is a grid-like pattern of fields and little in the way of local woodland cover, with minimal and poor field hedges present. Isolated farmsteads are present at Westfield House ~580 m to the east and Westfield Farm ~1.1 km to the east, with other residential properties generally limited to the nearby villages of Foxholes ~860 m to the west and Wold Newton ~2 km to the east.

The Site itself is situated on the southern flank of a hill which rises to ~125 mAOD around 1.2 km to the north of the Site in the location of the dry valley feature associated with 'West Dale' at Gantondale. The Site elevation is from 79 mAOD along the northern boundary to 72 mAOD on the southern boundary, with the elevation decreasing to ~53 mAOD at the southern extent of the site access track.

The Gypsy Race Chalk Stream is at an elevation of approximately 52 mAOD as it passes Butt Lane to the south of the Site.

Figure 4 Topography and elevation



A search of the DEFRA 'MAGIC' website⁵ has not identified any habitats / European sites (RAMSAR, SPA, SAC) within a 2 km radius of the Site.

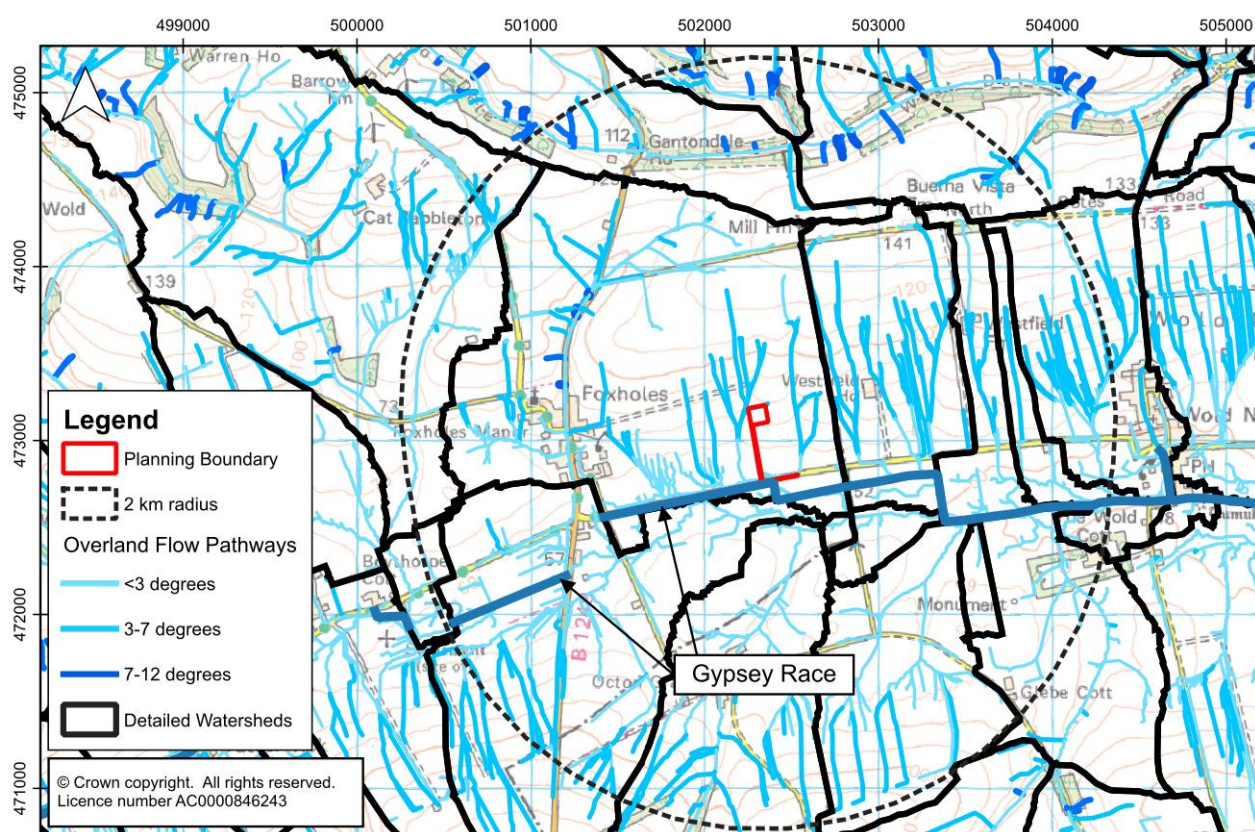
Dry valley features are mapped as overland flow pathways on Figure 5, indicating that a proportion of the surface water runoff from the north of the drill site that cannot directly infiltrate into the Chalk hills will be channelled to the west and bypass the site before flowing into Gypsy Race.

[3.4] Hydrology

The Site is situated on the side of a hill and in the catchment of the Gypsy Race water course, which is ephemeral and flows in a west-to-east direction ~340 m to the south to discharge into the North Sea at Bridlington 17 km to the southeast. Gypsy Race rises in the Great Wold Valley near Wharram-le-Street, ~16.5 km to the west and is a winterbourne stream (*i.e.* which typically only flows during the winter and is typically dry during the summer months). Between West Lutton to the west and Rudston to the south-east (*i.e.* past the Site) the stream typically flows underground in the chalk aquifer – the stream only becomes perennial around 10.5 km to the south-east at Low Caythorpe.

The nearest Environment Agency Statutory Main River is the River Derwent, which is located ~7 km to the north-west and has been heavily modified and straightened. The River Derwent is in a separate hydrological catchment.

Figure 5 Detailed watersheds and overland flow pathways



⁵ <https://magic.defra.gov.uk/MagicMap.html>

[3.4.1] Water Framework Directive Classifications

The Site is located in the 'Gypsey Race Operational Catchment'⁶ which has a hydromorphological classification of 'not designated artificial or heavily modified'. Water Framework Directive Regulations Cycle 3 Classifications for 2022 indicate that the water body has a 'bad' ecological status. Amongst the reasons for not achieving a 'good ecological status' are groundwater abstractions impacting on flow, point-source sewage discharge and diffuse-source agricultural pollution.

[3.5] Soils

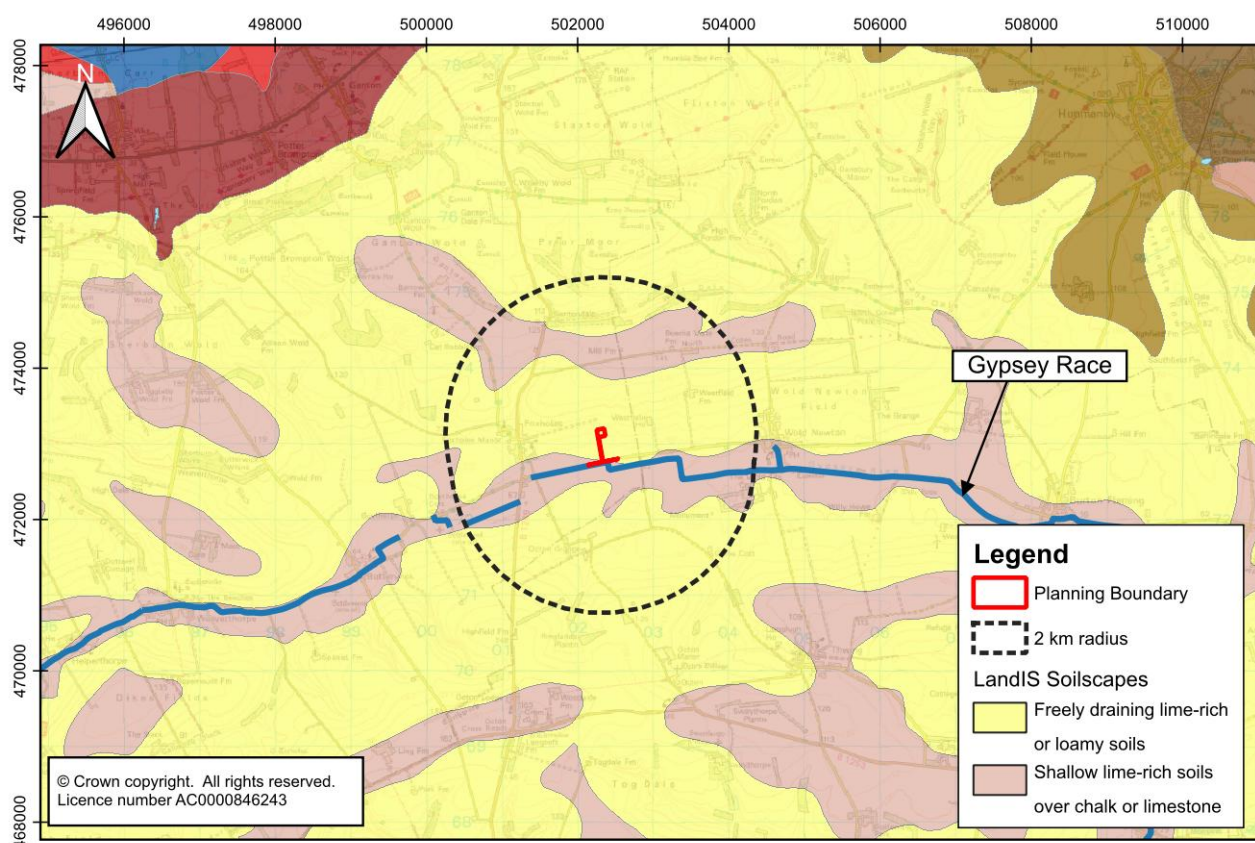
Geological mapping shows there are no superficial sediments, and that the soil type at and around the Site is mapped by LandIS Soilsclapes site⁷ as "shallow lime-rich soils over chalk or limestone". Further information on soils at the Site is provided in the Agricultural Land Classification and Soil Resource Survey⁸, which reports that the 1:250,000 scale reconnaissance soil map of the area shows the whole site to be mapped as soils of the Andover 1 Association. Andover 1 Association soils are briefly described by the Soil Survey as "Shallow well drained calcareous silty soils over chalk on slopes and crests. Deep calcareous and non-calcareous fine silty soils in valley bottoms. Striped soil patterns locally." In the vicinity of the Gypsey Race watercourse, the soils are described as being "freely draining lime-rich loamy soils" which are typically given over to arable or grassland at higher altitude. Soilsclapes are shown on Figure 6. The Site features approximately 6% soils of subgrade 3a and 94% of subgrade 3b⁸.

⁶ <https://environment.data.gov.uk/catchment-planning/OperationalCatchment/3214>

⁷ <https://www.landis.org.uk/>

⁸ Levertton, R. (2025). Proposed Weaverthorpe Exploratory Well site, Land North of Butt Lane, Foxholes, North Yorkshire - Agricultural Land Classification and Soil Resource Survey.

Figure 6 LandIS Soilscales



[3.6] Geology

[3.6.1] Overview

The British Geological Survey (BGS) 1:50,000 geology map (Sheet 54, Scarborough) indicates that the Site is directly underlain by the Flamborough Chalk Formation, with no mapped superficial deposits directly at the Site. The surface bedrock and superficial geology is shown in Figure 7.

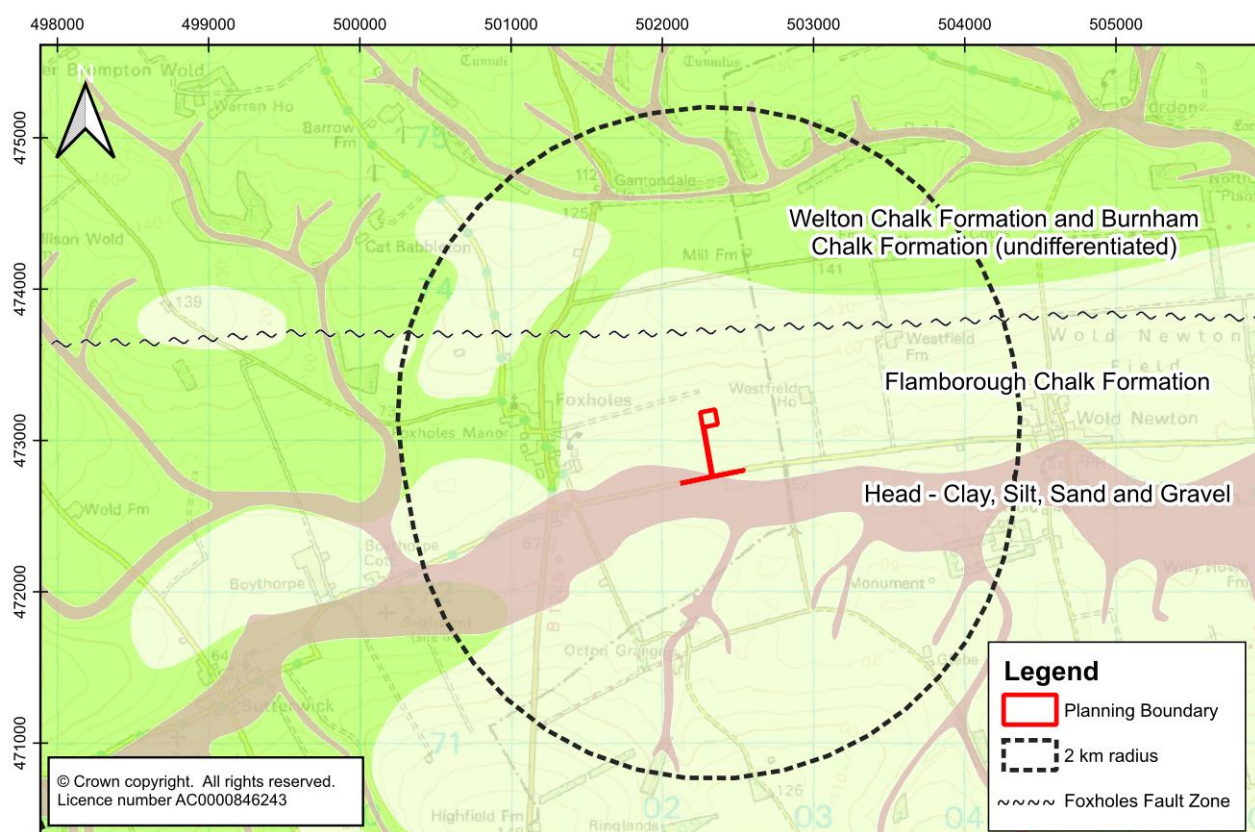
The area is dominated by the Yorkshire Wolds, which are the northernmost Chalk hills in the United Kingdom.

[3.6.2] Superficial Geology

The Site itself is not mapped as having any superficial deposits present (Figure 7).

Head deposits are present at lower elevations within surface water courses including the course of the Gypsy Race to the south in the south and Ganton Dale to the north. The superficial deposits associated with both of these local deposits are classified by the Environment Agency as 'Secondary (undifferentiated) aquifers' as shown on Figure 16 and discussed further in Section 3.7.2.

Figure 7 Bedrock and Superficial Geology at surface



[3.6.3] Bedrock Geology

The following bedrock geology sequence as summarised in Table 4 has been identified in the local area. A generalised section, reproduced from BGS Sheet 54, is presented in Figure 8.

At the Site, the following Formations are anticipated to be encountered, as summarised in the Well Design Schematic included in Appendix A:

- Flamborough Chalk Formation – directly beneath the Site;
- Ferriby Chalk Formation / Hunstanton Formation;
- Speeton Clay Formation;
- Kimmeridge Clay Formation;
- Corallian Group;
- Oxford Clay Formation;
- Estuarine Group;
- Lias Group;
- Mercia Mudstone Group; and
- Sherwood Sandstone Group.

Table 4 Geological Sequence

Period	Formation	Description	Thickness
Cretaceous	Flamborough Chalk Formation	White, well-bedded, flint-free chalk with common marl seams	71 m
	Welton Chalk and Burnham Chalk Formations	White, massive or thickly bedded chalk with common flint nodules	Unspecified
	Ferriby Chalk Formation	Grey, soft, marly, flint-free chalk	38 – 60 m
	Hunstanton Formation	Rubbly to massive chalks with marl bands	12 – 30 m
	Speeton Clay Formation	Mudstones, cementstones and sporadic bentonites	92 – 500 m
Upper Jurassic	Kimmeridge Clay Formation	Mudstones, thin siltstone and cementstone beds; locally sands and silts	410 m
	Upper Calcareous Grit Formation	Sandstone, fine-grained, calcareous	8 – 33 m
	Coralline Oolite Formation	Limestone, interbedded with, and passing laterally into fine-grained sandstone	36 m
	Lower Calcareous Grit Formation	Sandstone, fine-grained, quartzose, spiculitic, bedded, variably calcareous	41 – 50 m
	Oxford Clay Formation	Grey-green mudstone, with sporadic beds of argillaceous limestone nodules	36 – 76 m
Middle Jurassic	Osgodby Formation	Calcareous sandstone and poorly lithified sand	3 – 13 m
	Cayton Clay Formation and Cornbrash Formation (undifferentiated)	Limestone and mudstone	1.5 – 3 m
	Scalby Formation	Mudstone and sandstone	60 m
	Scarborough Formation	Limestone and mudstone	11 m
	Cloughton Formation	Sandstone, mudstone and rare thin coals	Variable
	Eller Beck Formation	Ironstone, sandstone and mudstone	3 m
	Saltwick Formation	Sandstone, mudstone and locally thin coals	31 m
	Dogger Formation	Sandstone and ironstone	9 m
Lower Jurassic	Whitby Mudstone Formation	Mudstone with limestone concretions	82 m
	Cleveland Ironstone Formation	Mudstone, siltstone and sandstone with seams of ironstone	27 m
	Staithes Sandstone Formation	Silty sandstone	12 m
	Redcar Mudstone Formation	Mudstone with thin limestone and sandstone beds	250 m
Triassic	Mercia Mudstone Group	Red and green mudstone with gypsum and thin sandstone beds	100 – 312 m
	Sherwood Sandstone Group	Red sandstone	316 – 547 m

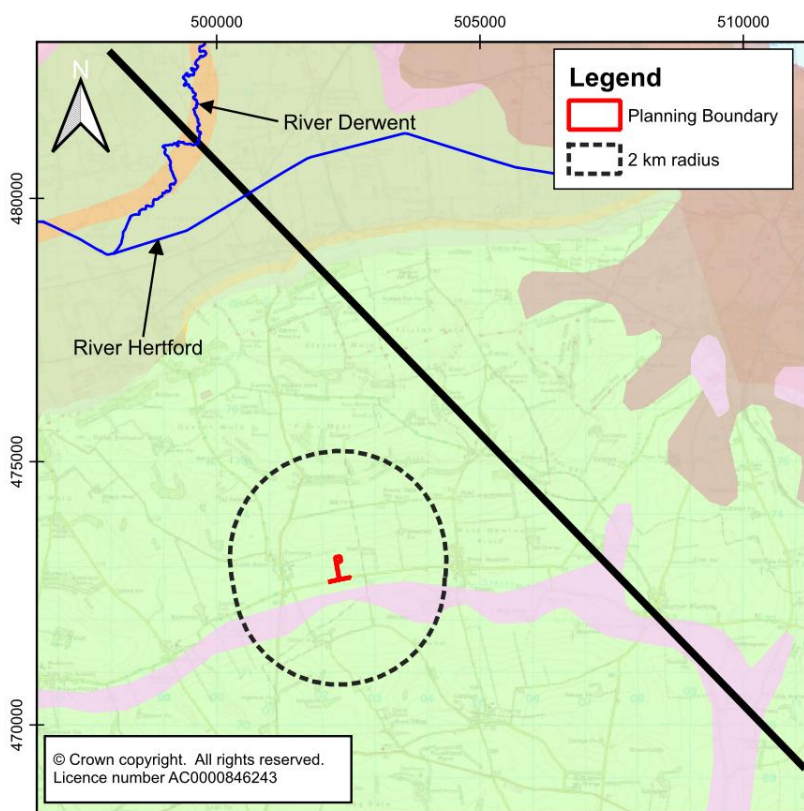
Note: Thickness data from BGS Sheet 54; thickness of the Welton Chalk and Burnham Chalk Formations is not stated.

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The Cretaceous Chalk in the north of England is subdivided into groups. The Flamborough Chalk Formation outcrops at the Site and is underlain by the Welton Chalk, Burnham Chalk, Ferriby Chalk and the Hunstanton Formation. The Hunstanton Formation is locally expected to be up to 30 m thick in the area near Fordon⁹. The contact between the Hunstanton Formation, which comprises marly chinks, and the Lower Cretaceous Speeton Clay is sharp. The Speeton Clay Formation underlies the Chalk Group, and, according to the well design schematic included in Appendix A, is likely to be offset from the Hunstanton Formation by a fault.

Figure 9 Line of Section presented in Figure 10



The Flamborough Chalk Formation is described as a 'white, well-bedded, flint-free chalk with common marl seams' according to the BGS¹⁰.

An extract from the section line presented on BGS Map Sheet 54 is included in Figure 10, with the extent of the section illustrated on Figure 9 adjacent.

A 'zone of deformation' is noted in the vicinity of Fordon No.2 well (4.5km to the west), illustrated as the Foxholes Fault Zone demarked with ~ on Figure 7.

The Flamborough Chalk, previously referred to as the 'Upper Chalk' and the 'Chalk without Flints', has an uncertain boundary with the Welton Chalk and Burnham Chalk Formations (which were previously referred to as the 'Middle Chalk'), with the

boundary reportedly only able to be shown as a general line separating the beds with flints from those without flints¹¹. The section indicates that the Flamborough Chalk thickens northwards in the vicinity of the Site.

The Kimmeridge Clay, Upper Calcareous Grit, Coralline Oolite Formation, Lower Calcareous Grit and the Oxford Clay Formation outcrop >8 km to the north in the Vale of Pickering. The upper part of the Speeton Clay belongs to the Lower Cretaceous beds, whilst the lower part belongs to the Kimmeridge Clay¹¹. The Kimmeridge Clay is a calcareous mudstone with siltstone and cementstone beds. Water obtained from a bore sunk into the Kimmeridge Clay at Knapton Lodge, ~15 km to the west, was noted to be saline¹¹. The Upper Calcareous Grit is a fine-grained calcareous sandstone which is estimated to be between 8 and 33 m thick in the vicinity, underlain by the limestones and

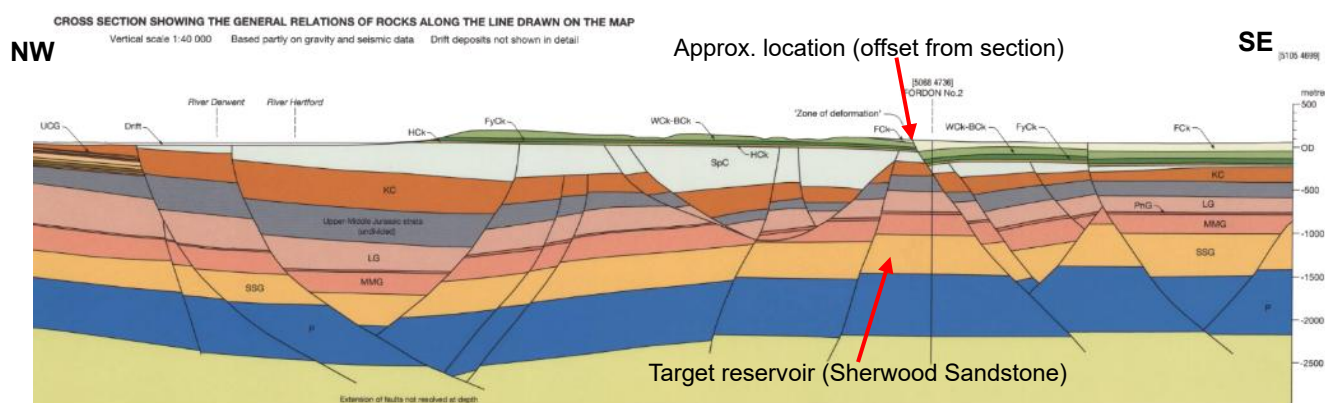
⁹ Sumbler, M.G., 1999. The stratigraphy of the Chalk Group in Yorkshire and Lincolnshire. British Geological Survey Technical Report WA/99/02.

¹⁰ <https://webapps.bgs.ac.uk/lexicon/lexicon.cfm?pub=FCK>

¹¹ BGS, 1904. The geology of the Oolitic and Cretaceous rocks south of Scarborough. Explanation of Sheets 54 and 55.

sandstones of the Coralline Oolite and Lower Calcareous Grit. The Oxford Clay is typically 36 to 76 m thick and represents the boundary with the Middle Jurassic beneath.

Figure 10 Partial section from BGS Sheet 54

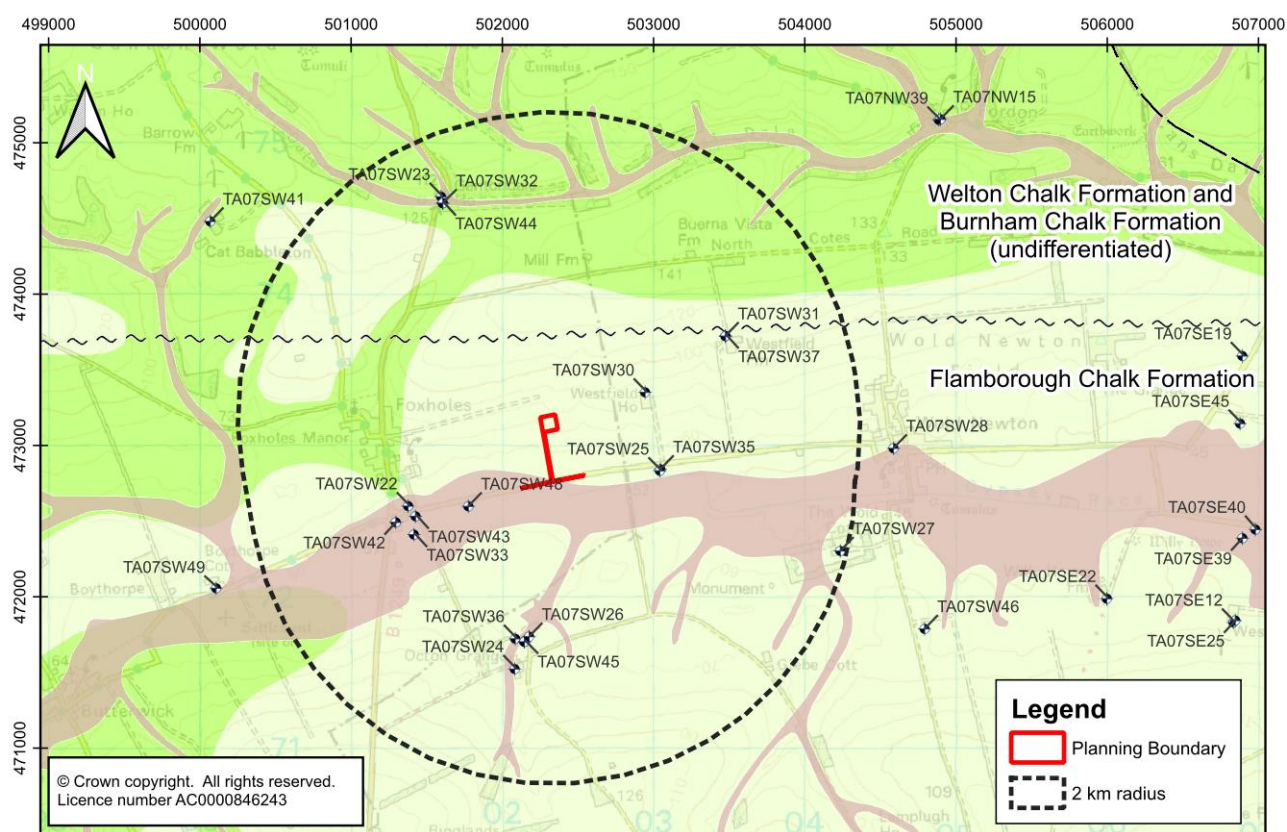


Note: FCK = Flamborough Chalk Formation, WCK-BCK = Welton Chalk Formation-Burnham Chalk Formation, FyCK = Ferriby Chalk Formation, HCK = Hunstanton Formation, SpC = Speeton Clay Formation, KC = Kimmeridge Clay Formation, LG = Lias Group, PnG = Penarth Group, MMG = Mercia Mudstone Group, SSG = Sherwood Sandstone Group, P = Permian.

A series of limestone, mudstone, ironstone and sandstone formations make up the Middle Jurassic strata, some of which (Cayton Clay Formation, Eller Beck Formation and the Dogger Formation) are noted to be thin, with thicker mudstone bands (*i.e.* the Scalby Formation). Within the Lower Jurassic strata, thicker mudstone bands dominate (Whitby Mudstone Formation, Cleveland Ironstone Formation and Redcar Mudstone Formation) consisting of mudstone and siltstone with rare sandstone beds or limestone (in the lower part of the Redcar Mudstone Formation), with thinner silty sandstone formations in between (*i.e.* the Staithes Sandstone Formation). These rocks overlie the Triassic Mercia Mudstone Formation (mudstones and siltstones), which is of considerable thickness (100 to 312 m) in the region and locally anticipated to be up to 300 m at the Site (Table 2).

BGS borehole records, the locations of which are shown on Figure 11, indicate a significant thickness of Chalk in the vicinity of the Site. TA07SW30 associated with Westfield House, 600 m to the north-east of the Site, shows at least 40 m of White Chalk (there were no returns for the final 21 m of drilling). Borehole TA07SW31, ~1.2 km to the north-east, shows at least 90 m of Chalk, equivalent to ~17 mAOD. None of the BGS boreholes in the area prove the base of the Chalk, due to the thickness in the area and the wells being drilled as early 20th Century water supply wells, for which drilling beyond the base of the strata was not required.

Figure 11 BGS Borehole locations



[3.7] Hydrogeology

[3.7.1] Groundwater levels and flow

Groundwater levels at the Site are anticipated to be at ~40-45 mAOD. The regional hydrogeological map for the area (an extract of which is included in Figure 12) indicates that the Site sits on a 40 mAOD groundwater contour. Given an approximate ground level at the Site of between 72 and 79 mAOD, it is likely that groundwater is between 27 and 32 m bgl, depending upon the seasonal fluctuation.

There is noted to be a high degree of faulting in the locality of the Site, denoted by the presence of the Foxholes Fault Zone (as marked on Figure 7 by ~ symbol). Fissure permeability is well-developed in the Chalk, making it highly productive in terms of water quantity. According to the hydrogeological map¹², the water table generally responds to recharge within three weeks, with seasonal fluctuations some 10-15 m but in the highest parts of the outcrop they may exceed 30 m. Data from monitoring boreholes near to the Site support this, as Weaverthorpe Slack exhibits a higher seasonal range than Willy Howe Bottom due to its higher (~55 m) elevation. With a high degree of fissure flow, the near-surface geology at the Site will remain dry except during very heavy rainfall events.

The hydrogeological cross section (Figure 13) shows that the Gypsy Race downgradient of Foxholes, approximately 3.4 km to the north-west of Haisthorpe, sits at the top of the saturated aquifer, where it typically becomes a permanent watercourse; upstream of this the watercourse is ephemeral.

Figure 12 Hydrogeological Map Extract¹²

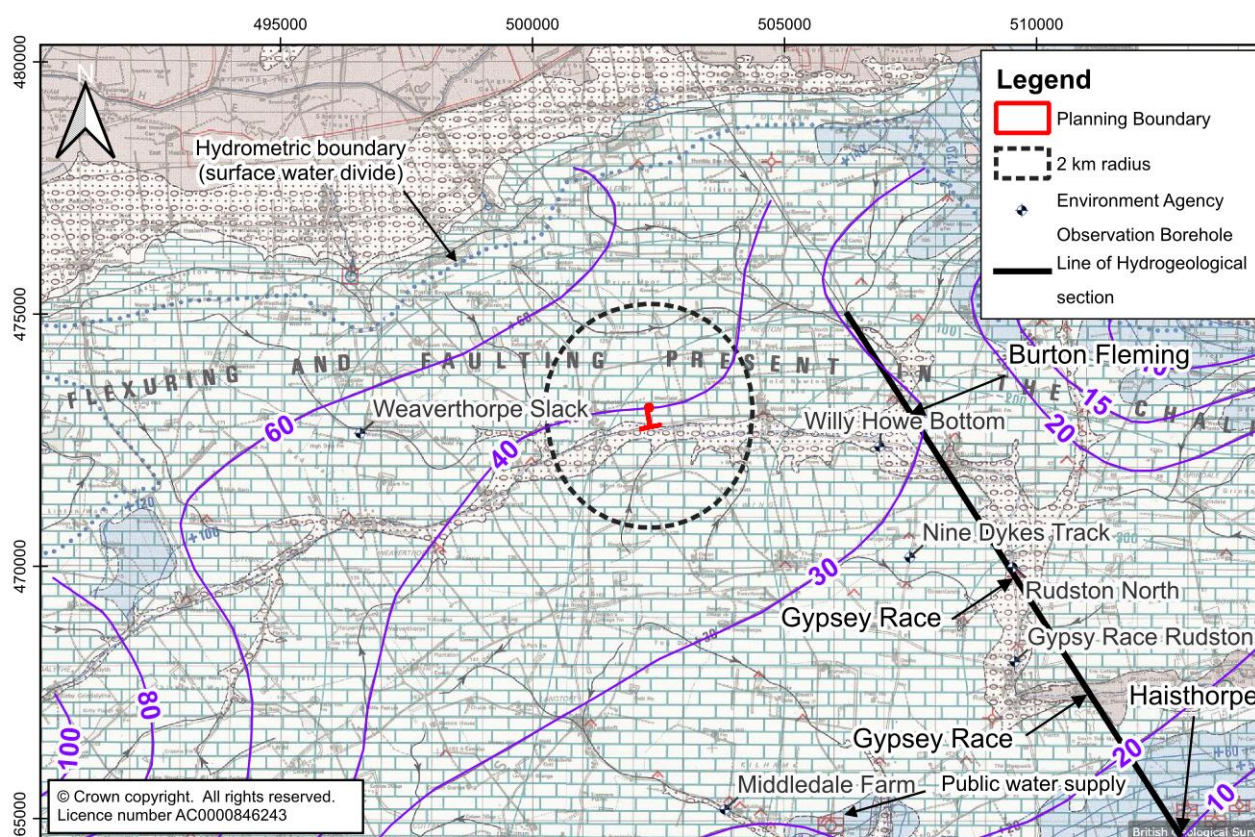
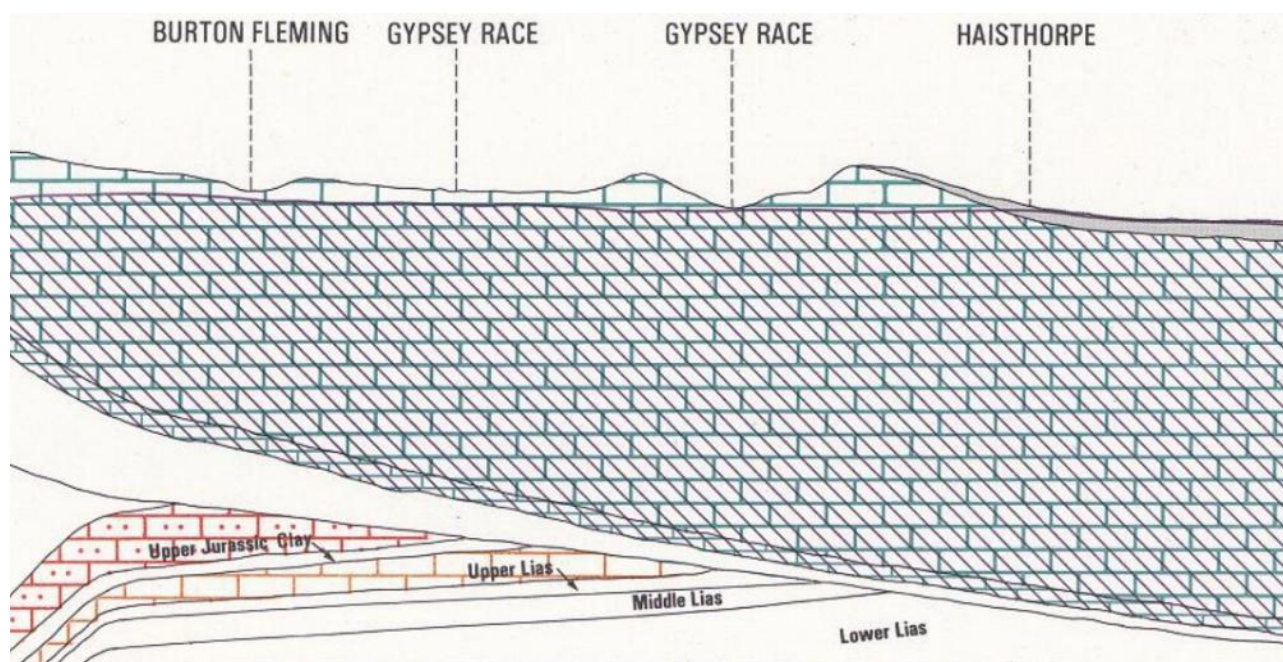


Figure 13 Extract of Cross Section from BGS Hydrogeological Map



The Environment Agency conducts monitoring within the Upper Chalk at several locations within the region. Data has been obtained for two monitoring boreholes: Willy Howe Bottom near Burton

¹² BGS, 1980. Hydrogeological Map of East Yorkshire. Map No. 10.

Fleming, ~4.6 km to the east, and Weaverthorpe Slack near Weaverthorpe, ~5.6 km to the west, with the data and locations presented on Figure 15. The monitoring at Willy Howe is noted to include data for the 'bottom', 'middle' and 'drift' however all three locations correlate closely, so only data for the 'bottom' is presented.

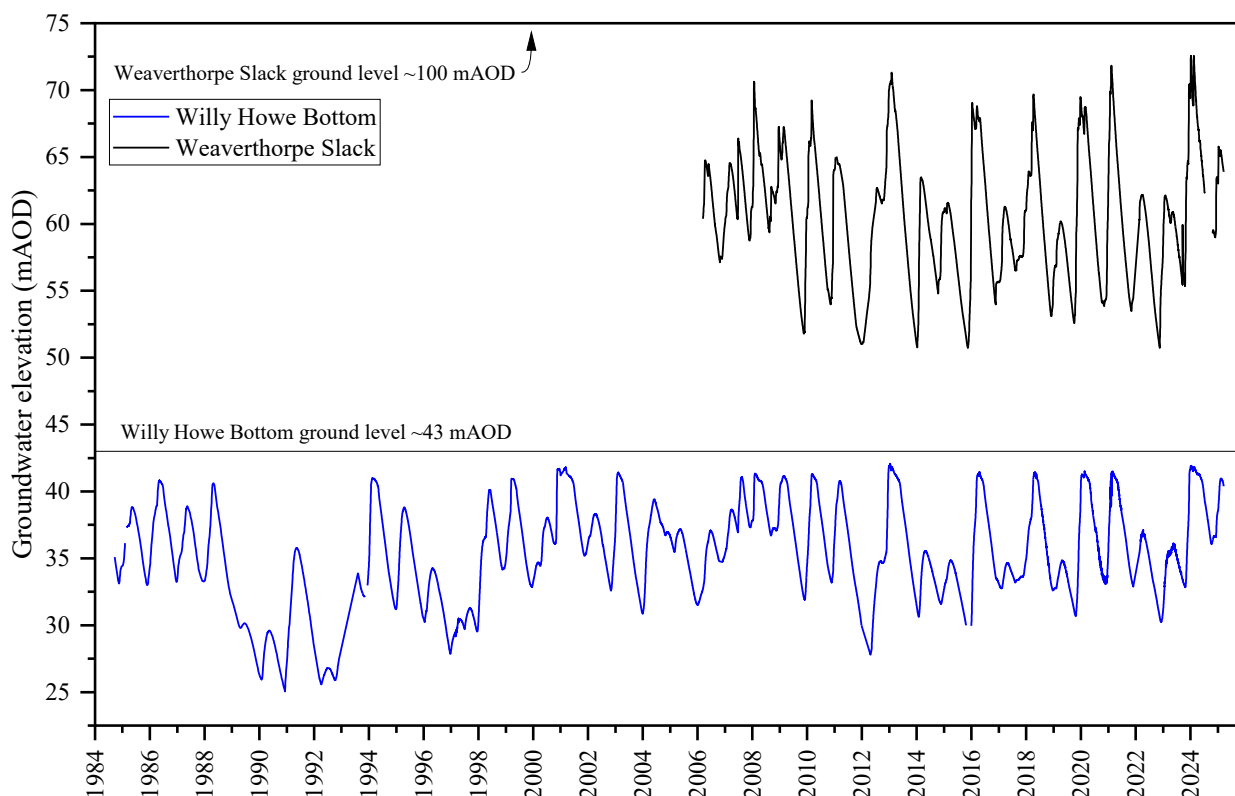
Weaverthorpe Slack monitors within the Welton Chalk Formation and Burnham Chalk Formation whilst Willy Howe Bottom monitors within the Flamborough Chalk Formation. The data indicates the seasonal variations within the Chalk, which are closely correlated between the formations. There is a significant difference in ground elevation between the two locations, with Weaverthorpe Slack located some 57 m higher than Willy Howe.

The annual fluctuation in water levels is typical for chalk strata whereby winter seasonal recharge is hosted within the fissure network, which then dissipates over summer. Seasonal recharge in chalk strata is variable on an annual basis dependent on annual climatic effects and wider water supply demands, hence at Weaverthorpe Slack seasonal recharge can vary by between 6 m and 20 m, and by 2 m to 14 m at Willy Howe Bottom. Groundwater elevation at these monitoring locations shows a large degree of consistency over the past four decades (Figure 14), with peak levels limited by a combination of regional hydrogeological gradients and surface water courses in valley bottoms.

Groundwater in the study area is unconfined, both where it is at outcrop beneath surficial soils and where limited superficial deposits are present in the Wolds. To the east, approaching the coast, the Chalk becomes confined by glacial till.

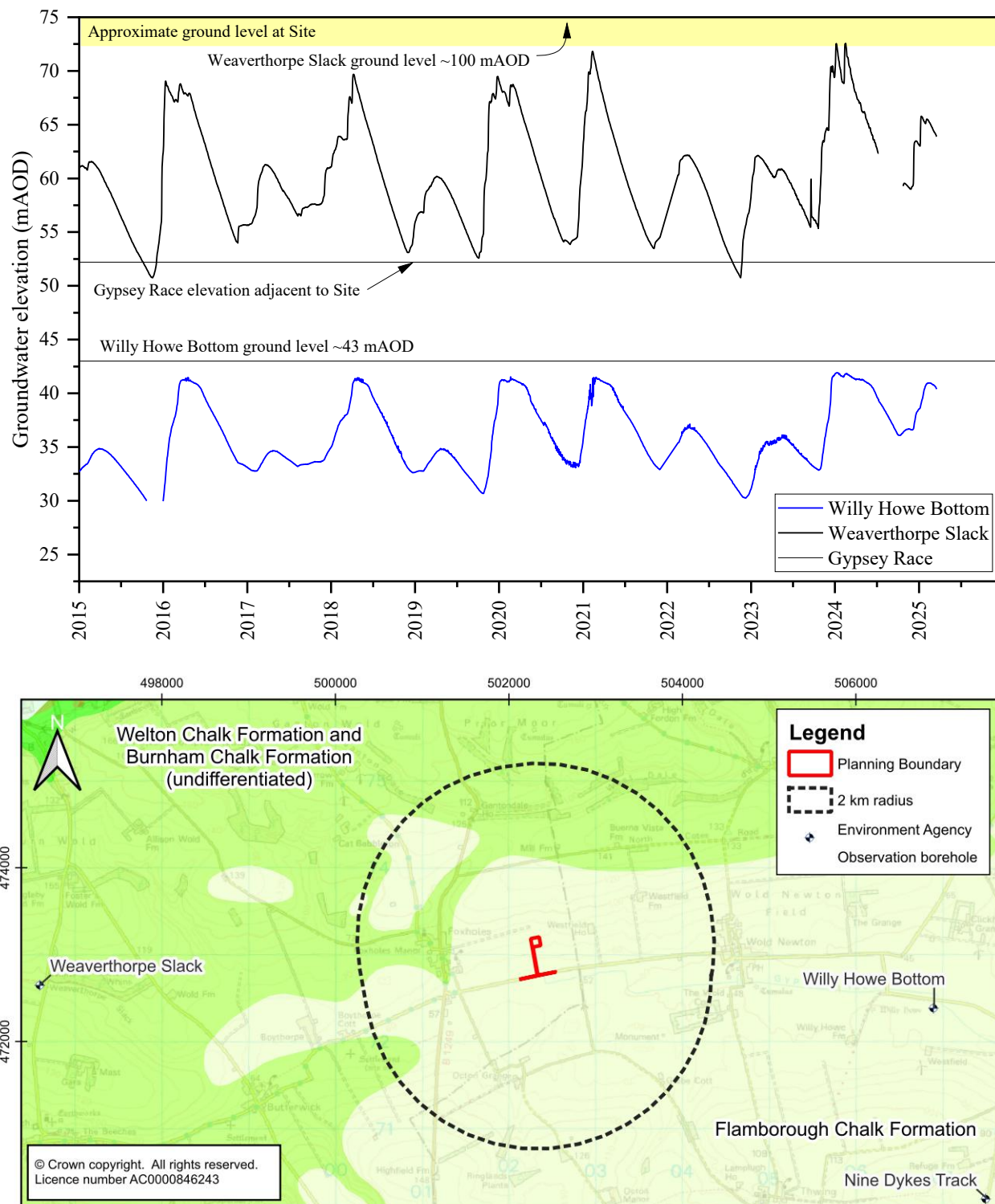
Groundwater flow is from the north-west to the south-east. Based on March 2025 data, the regional hydraulic gradient is estimated to be 0.002 from Weaverthorpe Slack to Willy Howe Bottom and 0.003 from Weaverthorpe Slack to Middledale Farm (~8 km to the south of the Site). The approximate gradient based on the regional hydrogeological contours (shown on Figure 12) is 0.004.

Figure 14 Groundwater elevation at Weaverthorpe Slack and Willy Howe Bottom (1984 – 2025)



The base of the primary “at risk” groundwater is at the base of the various chalk units which are underlain by clay strata, *i.e.* the Speeton Clay. Lower confined groundwater is, however, present whereby the Kimmeridge Clay Formation confines the aquifers beneath.

Figure 15 Groundwater elevation at Weaverthorpe Slack and Willy Howe Bottom (2015 – 2025)



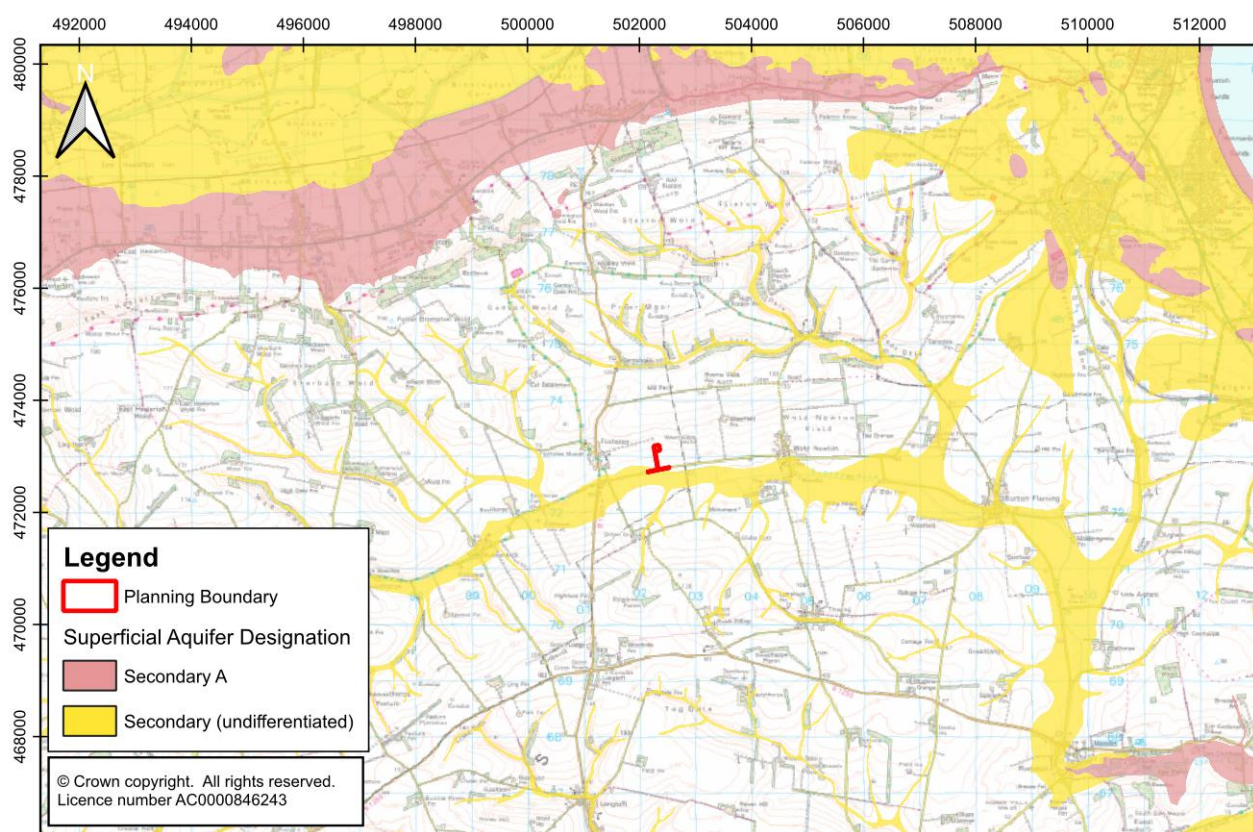
Data on deeper groundwater is unknown, with little groundwater data available for the Triassic rocks at depth in the region, although the Sherwood Sandstone Group upgradient of the Site is known to be an important aquifer in the west and south-west towards York. However, within the region of the

Site, the hydrogeological map reports that chlorides and sulphates tend to be high within the Triassic rocks, due to being clay-rich, at depth and with minimal flushing, resulting in saline conditions which are of limited resource value.

[3.7.2] Aquifer Designations

The superficial head deposits associated with the Gypsey Race water course are designed as a 'Secondary (undifferentiated)' aquifer, meaning areas where it is not possible to apply either a Secondary A or B definition because of the variable characteristics of the geology (Figure 16).

Figure 16 Superficial Aquifer Designations



The Chalk is designated as a Principal Aquifer (Figure 17), denoting a unit with a substantial water supply which has high permeability and can support water supply on a baseflow or strategic scale. The Chalk is a regionally important water body.

Due to the significance of the surface or near-surface Chalk aquifer, all local water supplies utilise this formation. As such, no nearby abstractions have been extended beyond the Chalk aquifer, meaning the Principal and Secondary A aquifers situated at depth beneath the Speeton Clay and Kimmeridge Clay Formation are unexploited in the area.

Table 5 summarises the aquifer designations of the geological formations which are expected to be encountered during the drilling of the exploration borehole, including surrounding formations present in the area. Much of the Cretaceous and Upper Jurassic formations are given 'Principal' aquifer status, with the exception of the clay formations (Speeton, Kimmeridge and Oxford) which will act as confining layers to the underlying water bearing units. Some of these formations, such as the Upper Calcareous Grit, Coralline Oolite and Lower Calcareous Grit which are part of the Corallian Group,

are likely to be of limited thickness and therefore resource potential at the Site. Therefore, whilst their 'Principal' aquifer status is based on their nomenclature, these formations are locally of very limited significance and unlikely to provide recharge to surface water or the overlying chalk.

The water bearing units below the Speeton Clay can be generally considered as being part of three overarching confined water units.

The Speeton Clay Formation and Kimmeridge Clay Formation are likely to function as aquitards (low permeability units limiting the flow between formations) at the Site location. Below the Upper Jurassic Principal Aquifers, the Oxford Clay is also likely to function as an aquitard. Beneath this are a series of Middle Jurassic 'Secondary A' aquifers above the Whitby Mudstone aquitard classified as moderately productive but in reality, likely to be naturally highly saline due to their depth.

A fourth group of moderately productive 'Secondary A' aquifers is then present in the Lower Jurassic formations. The Redcar Mudstone and the Mercia Mudstone are likely to act as an aquitard over the Sherwood Sandstone Principal Aquifer, although there may be some water-bearing layers within these largely aquitard formations.

Egdon has previously conducted a petrophysical analysis of the Fordon-2 well ~4.5 km to the east, which concluded that the Sherwood Sandstone contains salt-saturated brine. Given the depth of the Sherwood Sandstone aquifer and natural mineralisation effects at that depth, it is not considered to be capable of acting a potable water resource.

Figure 17 Bedrock Aquifer Designation

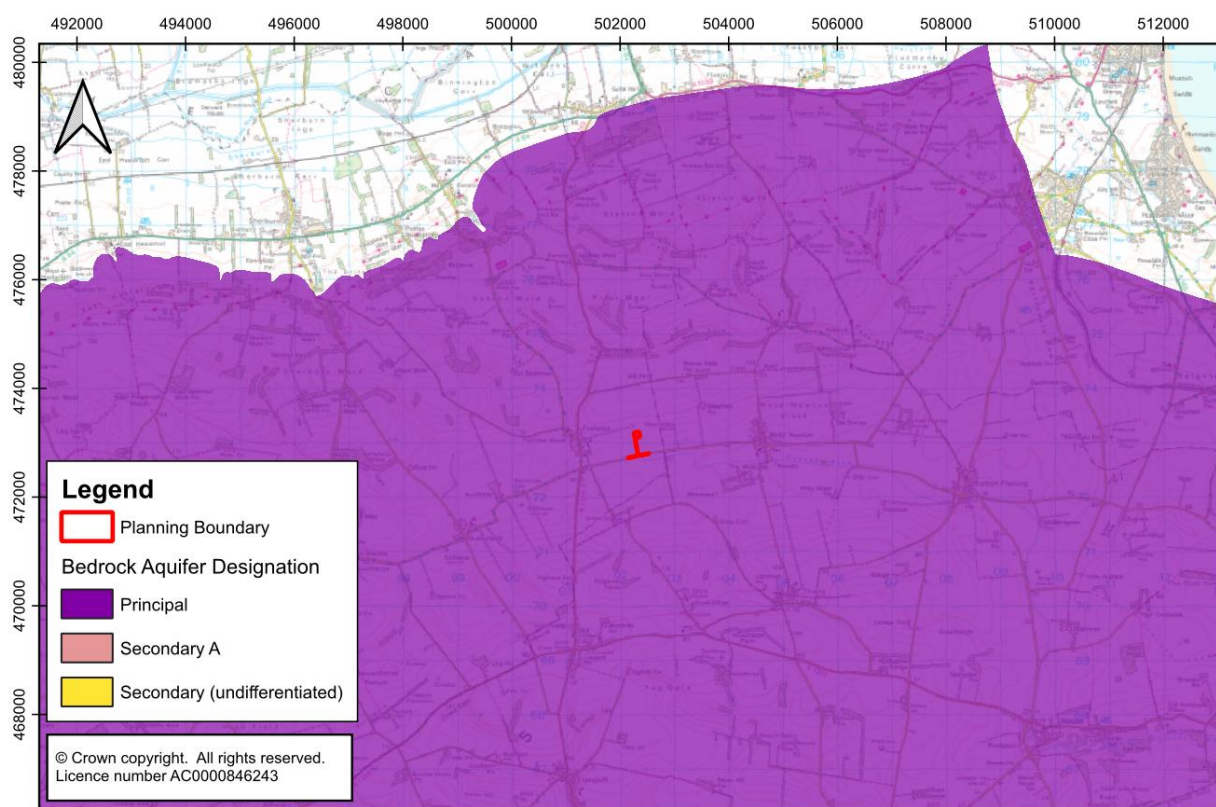


Table 5 Hydrogeological Aquifer Designations of Geological Formations

Period	Formation	Aquifer Designation
Recent	Superficial Head Deposits	Secondary Undifferentiated
Cretaceous	Flamborough Chalk Formation	Principal
	Welton Chalk and Burnham Chalk Formations	Principal
	Ferriby Chalk Formation	Principal
	Hunstanton Formation	Principal
	Speeton Clay Formation	Unproductive Strata
Upper Jurassic	Kimmeridge Clay Formation	Unproductive Strata
	Upper Calcareous Grit Formation	Principal
	Coralline Oolite Formation	Principal
	Lower Calcareous Grit Formation	Principal
	Oxford Clay Formation	Unproductive Strata
Middle Jurassic	Osgodby Formation	Secondary A
	Cayton Clay Formation and Cornbrash Formation (undifferentiated)	Secondary A
	Scalby Formation	Secondary A
	Scarborough Formation	Secondary A
	Cloughton Formation	Secondary A
	Eller Beck Formation	Secondary A
	Saltwick Formation	Secondary A
	Dogger Formation	Secondary A
Lower Jurassic	Whitby Mudstone Formation	Unproductive Strata
	Cleveland Ironstone Formation	Secondary A
	Staithes Sandstone Formation	Secondary A
	Redcar Mudstone Formation	Secondary Undifferentiated
Triassic	Mercia Mudstone Group	Secondary B
	Sherwood Sandstone Group	Principal

[3.7.3] Hydraulic Properties

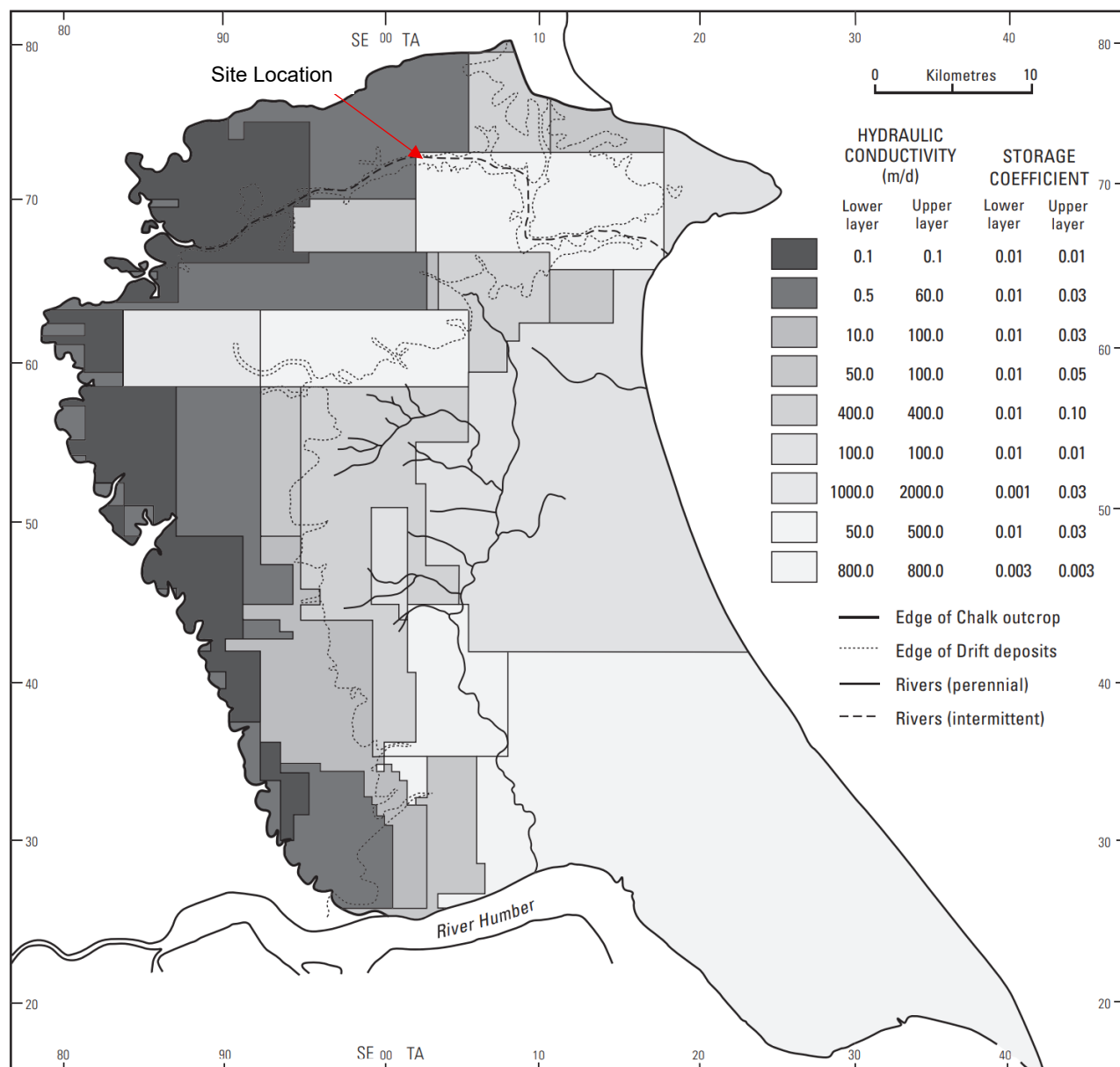
There are no site-specific data available regarding the hydraulic properties of the aquifers present on-Site. The Major Aquifer Properties Manual¹³ reports that transmissivity values in the Yorkshire Chalk can range from less than 1 m²/d to over 10,000 m²/d with a geometric mean of 1,258 m²/d. Storage coefficients have a geometric mean of 7.2 x 10⁻³.

High transmissivity values are associated with the buried cliff line, which is over 15 km to the east of the Site and unlikely to affect aquifer permeability at the Site. Figure 4.5.8 of the Major Aquifer Properties Manual (reproduced in Figure 18) shows that the area of the Great Wold Valley in which the Site is located has amongst the highest hydraulic conductivity values modelled in the region.

¹³ Allen, D J, Brewerton, L J, Coleby, L M, Gibbs, B R, Lewis, M A, MacDonald, A M, Wagstaff, S J, and Williams, A T. 1997. The physical properties of major aquifers in England and Wales. British Geological Survey Technical Report WD/97/34

Transmissivities of up to 8,000 m²/d along the Wold Valley, an order of magnitude higher than those on the Octon Ridge ~2 km to the south, have been recorded¹⁴.

Figure 18 Modelled distribution of transmissivity and storage coefficients in the Yorkshire Chalk (Figure 4.5.8 of Major Aquifer Properties Manual, after Aspinwall and Co. Ltd, 1995)



[3.7.4] Drinking Water Protected Areas (DrWPA's)

The online data service <https://data.catchmentbasedapproach.org/datasets/therivertrust:wfd-groundwater-bodies-cycle-2/about> presents The '1:50k WFD Groundwater bodies' as a polygon dataset, created to align with the requirements of the WFD and specifically Article 2, clause 2 (WFD Groundwater Bodies Cycle 2). The Site is located within a DrWPA (all groundwater bodies in

¹⁴ University of Birmingham. 1985. Yorkshire Chalk Groundwater Model Study; Final Report to Yorkshire Water Authority

England and Wales are designated, identified as a requirement of the Water Framework Directive¹⁵⁾ – the Site is within the Hull and East Riding Chalk Aquifers (reference GB40401G700700¹⁶⁾):

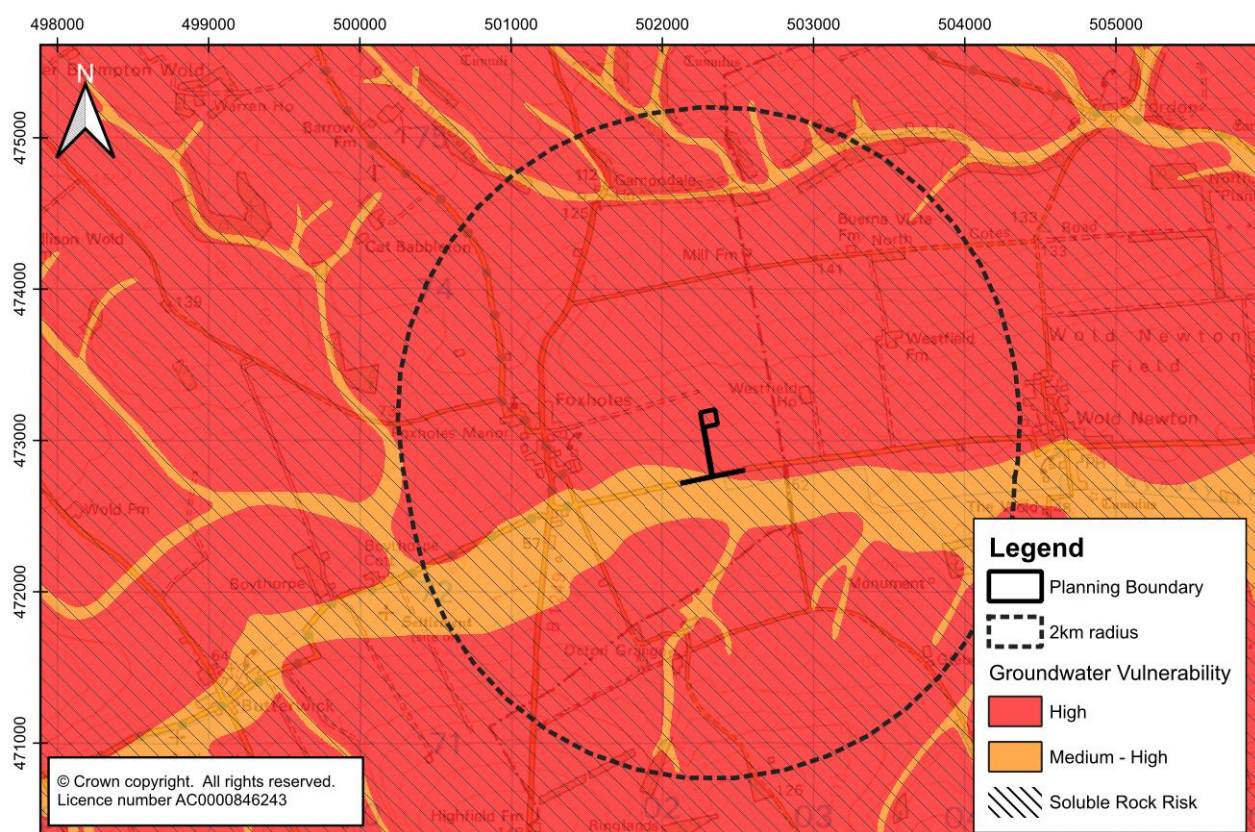
- Overall Rating – Poor
- Chemical Rating – Poor
- Quantitative – Poor

271 groundwater bodies in England are identified as DrWPA's covering 86% of England¹⁷⁾, Data can also be viewed at <https://mapapps2.bgs.ac.uk/ukso/home.html?layers=WFDGwBPollutionEng>.

[3.7.5] Groundwater Vulnerability

Groundwater Vulnerability, presented on Figure 19, is classified as “high”. The level of vulnerability reflects the lack of superficial deposits at the Site, with the Chalk directly outcropping extensively in the region.

Figure 19 Groundwater Vulnerability



[3.7.6] Springs

Ordnance Survey and online mapping does not record any springs within a 2 km radius of the Site.

¹⁵Water Framework Directive (2000/60/EC) <https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=celex%3A32000L0060>

¹⁶ <https://environment.data.gov.uk/catchment-planning/WaterBody/GB40401G700700>

¹⁷Drinking water protected areas: challenges for the water environment (Environment Agency 2022)
<https://www.gov.uk/government/publications/drinking-water-protected-areas-challenges-for-the-water-environment>

[3.7.7] Source Protection Zones

The Site is situated within the ‘total catchment’ Zone 3 of a Source Protection Zone (Figure 2). The SPZ3 is associated with a number of abstractions, stretching from Bridlington to Driffeld Wold. The closest designated inner source protection zone (SPZ1) is ~6.2 km to the south at Kilham.

[3.7.8] Abstractions

The Environment Agency has provided information on licensed groundwater abstractions within the vicinity of the Site. Only one abstraction has been identified: an agricultural spray irrigation licence, as summarised in Table 6 and the location presented in Figure 20.

Details regarding Private Water Supplies were obtained from East Riding of Yorkshire Council and North Yorkshire Council. These are summarised in Table 7 and the locations presented in Figure 20.

Table 6 Environment Agency licensed groundwater abstractions within 5 km of the Site

Licence	Holder	Purpose	Source	Easting	Northing	Distance (m)
NE/026/0030/011	C B Ravis & Son	Agriculture – direct spray irrigation	Chalk Groundwater	501779	472606	690 m SW

Table 7 Registered Private Water Supplies

Location	Easting	Northing	Supply type	Nature	Frequency of use	Distance From site
Westfield House Farm, Foxholes Road, Wold Newton, East Riding of Yorkshire, YO25 3HY	502968	473260	Borehole	Domestic	Unknown	620 m E
Westfield Farm, Foxholes Road, Wold Newton, East Riding of Yorkshire, YO25 3HY	503488	473628	Unknown	Unknown	Unknown	1,200 m NE
Low Octon Grange, Octon Grange Lane, Octon, East Riding of Yorkshire, YO25 3HJ	502137	471778	Borehole	Domestic	Unknown	1,315 m S
Willy Howe Farm, Wold Newton Road, Burton Fleming, East Riding of Yorkshire, YO25 3HW	505962	471970	Unknown	Unknown	Unknown	3,780 m SE
Fordon Lane, Fordon, East Riding of Yorkshire, YO25 3HT	504932	475155	Unknown	Unknown	Unknown	3,245 m NE

The BGS National Well Record Archive¹⁸ has been searched, which identified 13 well records within a 2 km radius of the Site (Table 8, Figure 20). This includes locations registered as private water supplies in Table 7.

The BGS data reflects records of water wells which has been recorded, but these wells may be historical and no longer in use or recorded insufficient yield when constructed. With the exception of the two wells at Ganton Dale, all other records are within the Flamborough Chalk Formation.

¹⁸ <https://www.bgs.ac.uk/information-hub/borehole-records/>

The closest well to the Site is at Westfield House Farm, 600 m to the east. This well recorded groundwater at ~34.5 mbgl (~51.3 mAOD) and was installed to a total depth of 63 m (22.9 mAOD) into the Chalk.

Figure 20 Groundwater abstractions (Environment Agency, BGS & private) within the Site vicinity

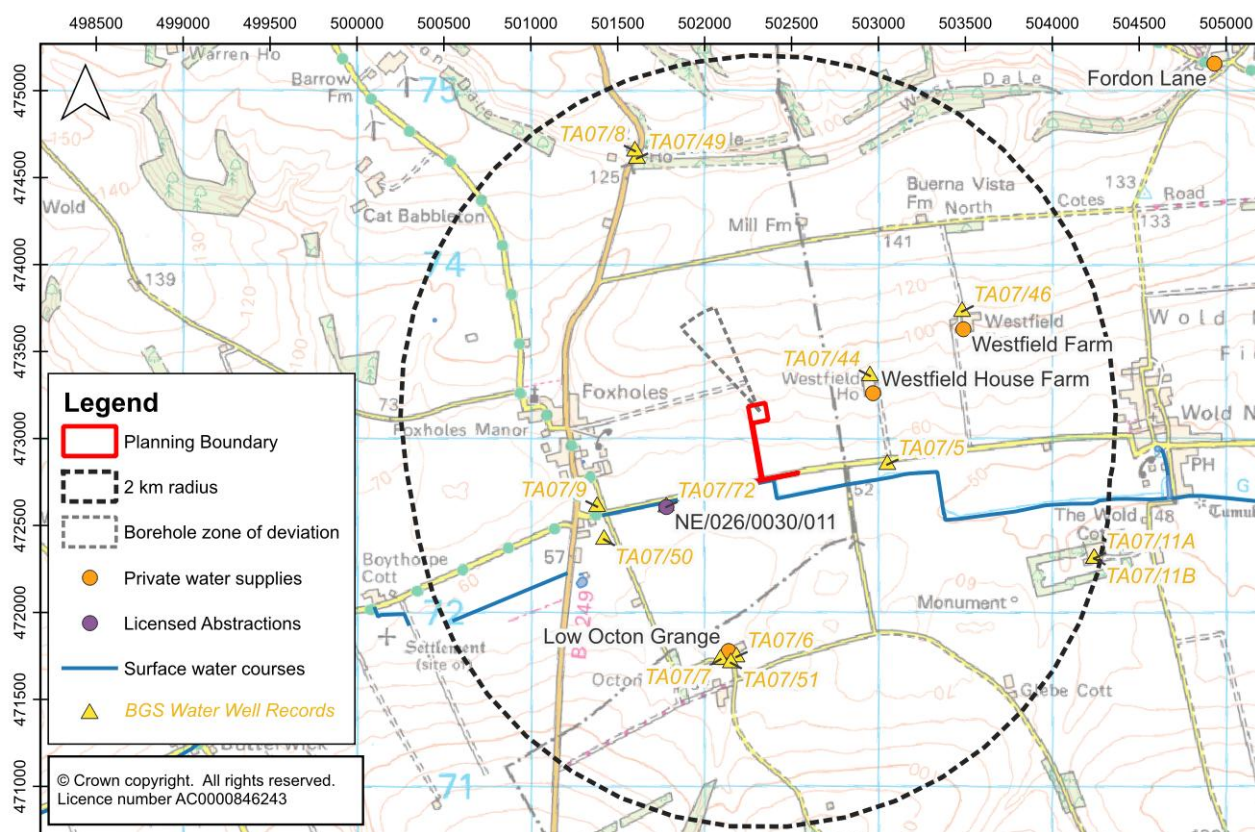


Table 8 BGS Water Well Records within 2 km

BGS Ref.	Location	Aquifer	Depth (m)	Easting	Northing	Distance From Site
TA07/44	Westfield House Farm	Flamborough Chalk	63.0	502950	473360	620 m E
TA07/72	Wold Newton Farm Foxholes	Flamborough Chalk	60.0	501779	472606	690 m SW
TA07/5	Westfield House Farm	Flamborough Chalk	10.5	503050	472850	732 m SE
TA07/9	Village Pump Foxholes	Flamborough Chalk	14.0	501380	472608	1007 m W
TA07/50	Foxholes 2	Flamborough Chalk	34.6	501420	472420	1080 m SW
TA07/46	Westfield Farm Wold Newton	Flamborough Chalk	90.0	503480	473730	1250 m NE
TA07/6	Lower Octon Grange Farm	Flamborough Chalk	24.4	502182	471744	1350 m S
TA07/7	Higher Octon Grange Farm	Flamborough Chalk	23.6	502090	471730	1370 m S
TA07/51	Octon Grange 3	Flamborough Chalk	47.5	502150	471710	1388 m S
TA07/49	Ganton Dale 1	Welton Chalk / Burnham Chalk	66.5	501610	474610	1560 m N
TA07/8	Ganton Dale House	Welton Chalk / Burnham Chalk	82.3	501598	474652	1603 m N
TA07/11A	Wold Cottage	Flamborough Chalk	13.1	504240	472310	2040 m SE
TA07/11B	Wold Cottage	Flamborough Chalk	10.3	504240	472310	2040 m SE

[3.7.9] Discharge Consents and Pollution Incidents

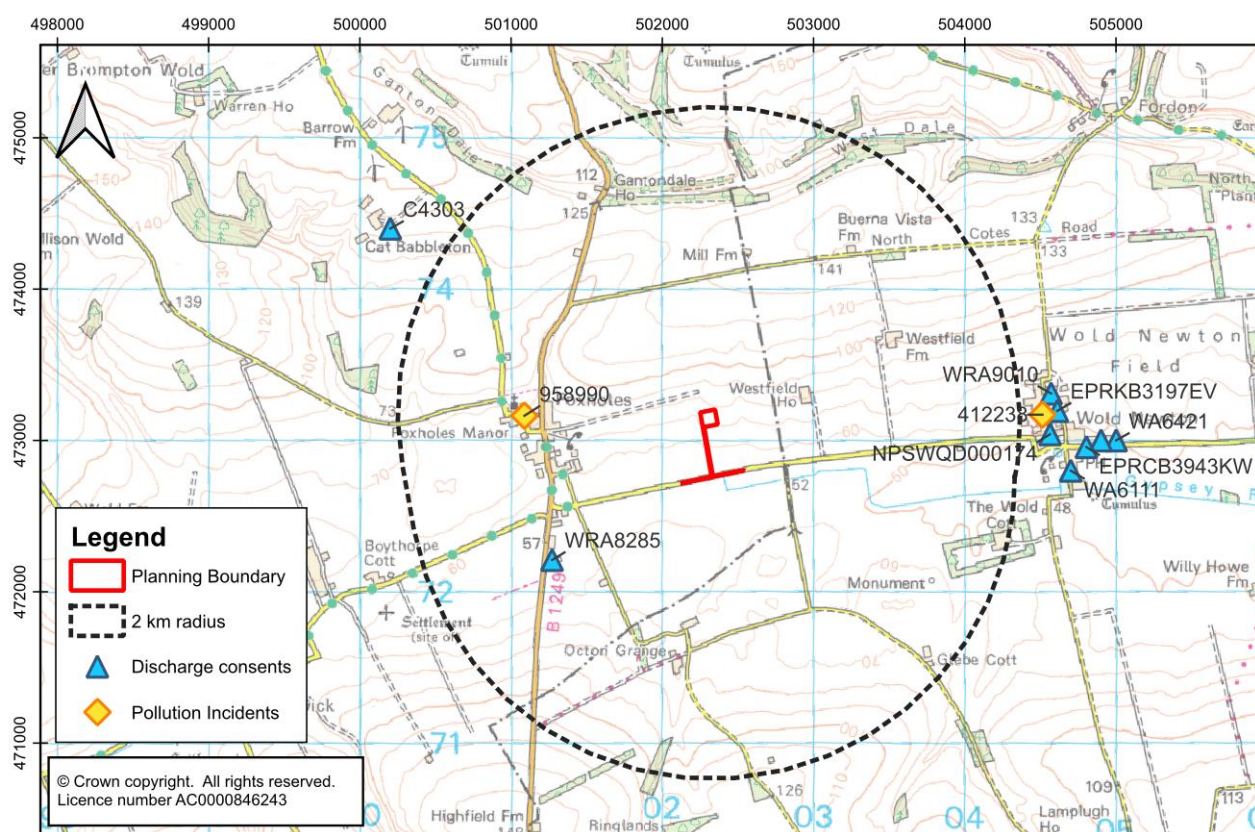
The Environment Agency has provided details on discharge consents and pollution incidents, which are shown on Figure 21. Within a 2 km radius of the Site, there is only one discharge consent and one pollution incident. A wider search within 4 km, shown in Table 9, identifies that the majority of consents relate to domestic property discharges.

Table 9 Discharge consents within 4 km

Consent No.	Effective	Address	Easting	Northing	Type	Direction
WRA8285	09/06/2017	Foxholes STW	501270	472210	WWTW	1,320 m SW
NPSWQD000174	26/07/2012	White House Farm	504563	473041	Domestic property	2,215 m E
WRA9010	14/11/2006	Boulton Cottages	504570	473310	Domestic property	2,215 m E
EPRKB3197EV	18/07/2018	Highfield Close	504611	473195	Domestic property	2,250 m E
WA6111	26/07/2012	Bridge Farm	504700	472800	Domestic property	2,350 m E
C4303	26/07/2012	Cat Babbleton	500200	474400	Domestic property	2,385 m NW
EPRCB3943KW	03/03/2025	1-6 Laking Mews	504803	472956	Domestic property	2,445 m E
WA6339	26/07/2012	LG and D Gray	504900	473000	Domestic property	2,540 m E
WA6421	26/07/2012	Laking Lane	505000	473000	Domestic property	2,640 m E
NPSWQD005219	26/07/2012	Willerby Wold Farm	501192	476295	Cultural / Zoo / Community Centre / Museum / Library	3,285 m N

The single pollution incident which occurred within a 2 km radius of the Site (958990) was on 02/02/2012 and related to the burning of waste, being deemed a 'Category 3 (Minor)' incident to air only. Incident 412238, some 2.1 km to the east, related to a containment and control failure of oils and fuel on 01/07/2006, but was given a 'Category 3 (Minor)' impact to land and no impact elsewhere.

Figure 21 Discharge Consents and Pollution Incidents



[3.7.10] Groundwater Quality

The Environment Agency has no groundwater quality monitoring data within the vicinity of the Site.

The BGS Baseline Report series¹⁹ reports that the Chalk is a calcium bicarbonate groundwater which meets a potable water supply quality. However, in 2004 when the review was prepared the principal issue affecting groundwater quality in the Yorkshire and North Humberside Chalk was the impact from agriculture. This resulted in a rise in concentrations of nitrate in several unconfined water sources over the last few years or decades, in some cases to concentrations in excess of drinking-water standards. Increases in the concentrations of other constituents such as chloride, sulphate and calcium have also been observed.

In order to assess the potential for an impact from the deep exploration borehole, groundwater monitoring will be implemented during the investigation period from one upgradient and two downgradient monitoring boreholes within the Chalk. Baseline monitoring will commence prior to the commencement of operations at the Site.

¹⁹ Smedley, P.L., Neumann I. and Farrell, R. 2004 Baseline Report Series 10: The Chalk aquifer of Yorkshire and North Humberside British Geological Survey Commissioned Report No. CR/04/128.

[4] Hydrogeological Risk Assessment

The identification of sources of impact is based upon the details of the scheme as presented by Egdon Resources, which is summarised in Table 1.

There are four distinct phases to the proposal – site and access construction, drilling, testing and restoration or site suspension.

[4.1] Methodology

This Hydrogeological Risk Assessment (HRA) has been carried out in accordance with the guidance outlined within DEFRA²⁰ and Environment Agency²¹ documentation. A simple conceptual model has been constructed based on the source-pathway-receptor relationship.

[4.2] Hazards Identification

Hazards identified for the Site are:

- Mobilisation of potentially contaminated soils during the preparation of the Site;
- Spillages of fuels or oils at the surface during the operation of drilling plant and machinery;
- Spillages of other chemicals at the surface during well drilling;
- Loss of drilling muds or additives to groundwater from the borehole during drilling;
- Migration of hydrocarbons or well treatment fluids through the borehole;
- Loss of contaminated water run-off from the perimeter containment ditch;
- Creation of preferential vertical pathways for the movement of poor quality groundwater between otherwise hydraulically isolated geological formations.
- Produced water or hydrocarbons lost from the well head at surface, collecting in the well cellar.

[4.3] Sources

Sources identified for the Site are:

- Fuels and chemicals associated with plant, machinery and vehicles required during the well drilling;
- Drilling fluids, chemicals and additives used in the well construction phase;
- On-Site storage tanks and chemical storage;
- Produced hydrocarbons, waters or chemicals present in the well, well cellar and storage tanks; and
- Oil, gas or non-potable 'saline' waters in the well and geological formations encountered.

²⁰ DEFRA, 2011. Guidelines for Environmental Risk Assessment and Management: Green Leaves III.

²¹ <https://www.gov.uk/guidance/groundwater-risk-assessment-for-your-environmental-permit>

[4.4] Pathways

The pathway provides a route via which a potential source of contamination could impact upon a receptor.

The pathways considered in this HRA are:

- Overland flow from Site / drainage ditches to Gypsy Race and pathway infiltration to ground;
- Vertical pathways into underlying aquifers and potential creation of preferential vertical pathways through otherwise isolated hydraulic layers;
- Horizontal and vertical pathways for drilling fluid migration from the well annulus into the underlying aquifers and possible transmission along fault lines or fractures; and
- Leaks in the installed well casing.

The Site is noted to be located in close proximity to the Foxholes Fault Zone (Figure 7), with a zone of deformation associated with the fault which could influence site geology.

The site is underlain by the Chalk.. Chalk fissure flow is rapid, and therefore the component of mobilised contaminants that flow through fissures could reach groundwater which is of local importance to private water supply abstractions. Upon reaching the water table, potential contamination could move rapidly with groundwater flow.

[4.5] Receptors

The identified receptors are:

- Gypsy Race;
- Flamborough Chalk Formation (Principal Aquifer);
- Groundwater within the superficial deposits aquifer associated with Gypsy Race;
- Licensed and Private Water Supplies within the Chalk aquifer (Figure 20);
- Groundwater within the Corallian Group (Principal Aquifer);
- Groundwater within the Middle Jurassic Secondary A aquifers; and
- Groundwater-bearing strata beneath the Site, such as the Sherwood Sandstone aquifer which may have resource potential for non-potable uses (*i.e.* geothermal energy).

[4.6] Receptor Sensitivity

The sensitivity of each receptor is based upon the methodology outlined in Table 10.

Table 10 Receptor Sensitivity

Receptor Sensitivity	Description	Examples
Very High	Water resource with an importance and rarity at an international level with limited potential for substitution.	A water resource making up a vital component of an SAC or SPA under the EC Habitats Directive. A waterbody achieving a status of 'High Ecological status or potential' under the WFD. Principal aquifer providing potable water to a large population. EC designated Salmonid fishery.
High	Water resource with a high quality and rarity at a national or regional level and limited potential for substitution.	A water resource designated or directly linked to a SSSI. Principal aquifer providing potable water to a small population. A river designated as being of Good Ecological status or with a target of Good status or potential under the WFD. EC designated Cyprinid fishery.
Medium	Water resource with a high quality and rarity at a local scale; or water resource with a medium quality and rarity at a regional or national scale.	Secondary aquifer providing potable water to a small population. An aquifer or surface water body providing abstraction water for agricultural or industrial use. A local nature reserve dependent on groundwater.
Low	Water resource with a low quality and rarity at a local scale.	A non 'main' river or stream or another waterbody without significant ecological habitat.

Gypsy Race is the nearest surface water feature to the Site and is down-gradient of the development area. The 'Gypsy Race Operational Catchment' is noted to have a 'bad' ecological status, although the ephemeral nature of the stream at this location will limit its ecological potential. The Site is in a Nitrate Vulnerable Zone (NVZ) but is not within a Nutrient Neutrality Catchment.

The Flamborough Chalk Formation is a Principal Aquifer which is assessed as having a very high sensitivity due to numerous abstractions in the area and its significance for potable drinking water supplies.

There are limited superficial deposits present in the area, and where mapped these are typically head deposits of clay, silt, sand and gravel in valley floors. These are classified as a 'Secondary Undifferentiated' aquifer and are assessed as having a medium sensitivity, albeit water bearing is seasonal and due to seasonal increases in chalk groundwater to surface elevations.

The deeper Middle / Lower Jurassic secondary aquifers and the deep Sherwood Sandstone Principal Aquifer are assessed as having a low sensitivity due to their depth with a significant thickness of low-permeability clay (such as the Speeton Clay, Kimmeridge Clay and Oxford Clay) likely to limit vertical migration, and natural mineralisation effects.

[4.7] Magnitude of Impact

The magnitude of impact is based upon the methodology outlined in Table 11.

Table 11 Magnitude of Impact

Magnitude of Impact	Criteria	Examples
High	Results in a shift in a water body's potential attributes	Loss of EU-designated Salmonid fishery Change in WFD classification of a water body Compromise employment source Loss of flood storage / increased flood risk Pollution of potable source of abstraction
Medium	Results in impact on integrity of attribute or loss of part of attribute	Loss / gain in productivity of a fishery Contribution / reduction of a significant proportion of the effluent in a receiving river, but insufficient to change its WFD classification Reduction / increase in the economic value of the feature
Low	Results in minor impact on water body's attribute	Measurable changes in attribute but of limited size and / or proportion
Very Low	Results in an impact on attribute but of significant magnitude to affect the use / integrity	Physical impact to a water resource but no significant reduction / increase in quality, productivity or biodiversity No significant impact on the economic value of the feature No increase in flood risk

The magnitude of impact is relative to the nature and extent of the proposed development. Impacts can be beneficial or adverse. The derivation of magnitude is independent of the importance of the water resource.

Should the Gypsy Race, Flamborough Chalk Principal Aquifer or Superficial Secondary Aquifer be impacted by contamination from the proposed development, there would be a major change to water quality which would create a 'high' magnitude of impact.

The magnitude of impact on deeper formations (such as the Middle or Lower Jurassic Secondary Aquifers) would be lower due to the potential for lower quality water within these formations, which is of limited resource value.

The Sherwood Sandstone is the target for the exploration investigations to test the quality and flow of gas. This unit is classified as a Principal Aquifer which is highly productive at outcrop or near surface. However, due to its depth and downgradient continuity, it is unlikely to act as an economic water source in the area. Potential contamination of this aquifer would have a limited impact upon its usefulness as a geothermal resource.

[4.8] Significance of Effect

The significance of effect is based upon the matrix detailed in Table 12. This is the significance of a hazard occurring before the likelihood is taken into account.

Table 12 Potential Significance of Effect

Receptor Sensitivity	Magnitude of Impact			
	High	Medium	Low	Very Low
Very High	Major	Major / Moderate	Moderate	Moderate / Minor
High	Major	Moderate	Moderate / Minor	Minor
Medium	Moderate	Moderate / Minor	Minor	Negligible
Low	Moderate	Minor	Negligible	Negligible

The proposed development has the potential to lead to:

- Major effects to the Flamborough Chalk Principal Aquifer and the Superficial Deposits Secondary Aquifers likely to be in continuity with the Chalk;
- Moderate effects to the Upper Jurassic Principal Aquifers; and
- Minor effects to the Middle / Lower Jurassic Secondary Aquifers and the Sherwood Sandstone Principal Aquifer.

[4.9] Likelihood of Occurrence

The likelihood of a hazard occurring is based upon the matrix detailed in Table 13. The proposed development features a high degree of embedded mitigation, intended to prevent harmful effects in order to minimise or prevent the majority of hazards that could occur.

Table 13 Likelihood of Occurrence

Likelihood	Description	Examples
Very Likely	High probability of occurrence	Spillage at a poorly maintained or operated facility Uncontrolled activity in or above an aquifer, close to surface water Uncontrolled and known discharge
Likely	Could occur	Controlled, unmitigated activity Complex process where failure of a part could lead to release of substances
Moderate	Equally likely / unlikely	Unmitigated but low risk Controllable activity Contained site
Unlikely	Unlikely to occur	Mitigated but higher risk Controllable activity Low-permeability strata Contained site
Very Unlikely	Very low probability of occurrence	Negligible risk Extreme set of circumstances required to generate low probability Fully mitigated low or medium risk

[4.10] Risk Assessment

The risk assessment in Table 15 has been evaluated using the relationships mapped out in Table 14.

Table 14 Qualitative Risk Assessment Matrix

Qualitative Likelihood	Significance of Effect			
	Major	Moderate	Minor	Negligible
Highly Likely	Very High	High	Medium	Low
Likely	High	Medium	Low	Very Low
Moderately Likely	Medium	Low	Very Low	Negligible
Unlikely	Low	Very Low	Negligible	Negligible
Very Unlikely	Very Low	Negligible	Negligible	Negligible

Table 15 Hydrogeological Risk Assessment Summary

Activity (Phase)	Source(s)	Pathway	Receptor	Receptor Sensitivity	Magnitude of Impact	Significance	Mitigation or Justification	Likelihood	Risk after mitigation
Site and Access Construction Drilling Testing Restore site	Potentially contaminated soils from fuels and chemicals associated with plant, machinery and vehicles	Surface runoff and overland flow to Gypsey Race	Surface Water Drainage System	High	High	Major	Site is located on undeveloped agricultural land. Excavation operations to avoid periods of heavy rain or ground saturation that could lead to silt mobilisation. Perimeter containment ditch (see Section 6.2.2) to be constructed, along with soil berm with impermeable anchor trench along the downhill south-eastern, southern and south-western boundaries. In event of failure case, soils to be tested for contamination prior to decommissioning of site, and contaminated material removed.	Unlikely	Low
			Gypsey Race	High	High	Major		Unlikely	Low
		Vertical pathways into underlying aquifers inc. fissures within the Chalk and potential for drilling at depth to create preferential vertical pathways through otherwise isolated hydraulic layers	Superficial Head Deposits (Secondary Undifferentiated aquifer)	Medium	High	Moderate	Drilling will utilise water-based non-hazardous fluids through the aquifer units. Use of Dura-Base 102 mm thick HDPE interlocking matting for wellsite working surface overlaid on impermeable membrane and protection geotextiles to reduce quantity of any mobilised potential contamination. Tertiary containment system to be constructed in accordance with Environment Agency-approved Construction Quality Assurance (CQA) Plan.	Very Unlikely	Negligible
			Private Water Supply boreholes	High	High	Major	The well will be constructed in accordance with EA-approved CQA Plan, with a series of cemented steel casings from the surface to the top of the Sherwood Sandstone to provide isolation and testing barriers and prevent a vertical pathway from being established. Design to be approved by EA and HSE to ensure well integrity and prevent unplanned releases of reservoir fluids. Use of Loss Control Materials to manage any sub-surface losses during drilling. Control mechanisms to be put in place to ensure no excessive overpressure which could cause surface pollution event or transmission between geological units.	Unlikely	Low
			Flamborough Chalk (Principal Aquifer)	Very High	High	Major		Unlikely	Low

Activity (Phase)	Source(s)	Pathway	Receptor	Receptor Sensitivity	Magnitude of Impact	Significance	Mitigation or Justification	Likelihood	Risk after mitigation
			Upper Jurassic Principal Aquifers	Medium	High	Moderate	As above, with additional protection afforded by low permeability clay of the Speeton Clay and Kimmeridge Clay.	Very Unlikely	Negligible
			Middle / Lower Jurassic Secondary Aquifers	Medium	Low	Minor	Aquifers located at depth and separated from surface operations by a significant thickness of low permeability clay (Speeton Clay, Kimmeridge Clay, Oxford Clay etc.)	Very Unlikely	Negligible
			Sherwood Sandstone Principal Aquifer	Medium	Low	Minor		Very Unlikely	Negligible
Drilling	Loss of drilling fluids, chemicals and additives used in the well construction phase	Surface runoff and overland flow to Gypsey Race	Surface Water Drainage System	High	High	Major	Site is located on undeveloped agricultural land. Excavation operations to avoid periods of heavy rain or ground saturation that could lead to silt mobilisation. Perimeter containment ditch (see Section 6.2.2) to be constructed, along with soil berm with impermeable anchor trench along the downhill south-eastern, southern and south-western boundaries. In event of failure case, soils to be tested for contamination prior to decommissioning of site, and contaminated material removed.	Unlikely	Low
			Gypsey Race	High	High	Major		Unlikely	Low
		Vertical pathways into underlying aquifers inc. fissures within the Chalk and potential for drilling at depth to create preferential vertical pathways through otherwise isolated hydraulic layers	Superficial Head Deposits (Secondary Undifferentiated aquifer)	Medium	High	Moderate	Drilling will utilise water-based non-hazardous fluids through the aquifer units. Use of Dura-Base 102 mm thick HDPE interlocking matting for wellsite working surface overlaid on impermeable membrane and protection geotextiles to reduce quantity of any mobilised potential contamination. Tertiary containment system to be constructed in accordance with Environment Agency-approved Construction Quality Assurance (CQA) Plan. The well will be constructed in accordance with EA-approved CQA Plan, with a series of cemented steel casings from the surface to the top of the Sherwood Sandstone to provide isolation and testing barriers and prevent a vertical pathway from being established. Design to be approved by EA and HSE to ensure well integrity and prevent unplanned releases of reservoir fluids. Use of Loss Control Materials to manage any sub-surface losses during drilling. Control mechanisms to be put in place to ensure	Very Unlikely	Negligible
			Private Water Supply boreholes	High	High	Major		Unlikely	Low
			Flamborough Chalk (Principal Aquifer)	Very High	High	Major		Unlikely	Low

Activity (Phase)	Source(s)	Pathway	Receptor	Receptor Sensitivity	Magnitude of Impact	Significance	Mitigation or Justification	Likelihood	Risk after mitigation
							no excessive overpressure which could cause surface pollution event or transmission between geological units.		
			Upper Jurassic Principal Aquifers	Medium	High	Moderate	As above, with additional protection afforded by low permeability clay of the Speeton Clay and Kimmeridge Clay.	Very Unlikely	Negligible
			Middle / Lower Jurassic Secondary Aquifers	Medium	Low	Minor	Aquifers located at depth and separated from surface operations by a significant thickness of low permeability clay (Speeton Clay, Kimmeridge Clay, Oxford Clay etc.)	Very Unlikely	Negligible
			Sherwood Sandstone Principal Aquifer	Medium	Low	Minor		Very Unlikely	Negligible
Drilling Testing	On-site storage tanks and chemical storage	Surface runoff and overland flow to Gypsey Race	Surface Water Drainage System	High	High	Major	Site is located on undeveloped agricultural land. Excavation operations to avoid periods of heavy rain or ground saturation. Perimeter containment ditch (see Section 6.2.2) to be constructed, along with soil berm with impermeable anchor trench along south-eastern and southern boundaries. In event of failure case, soils to be tested for contamination prior to decommissioning of site, and contaminated material removed.	Unlikely	Low
			Gypsey Race	High	High	Major		Unlikely	Low
		Vertical pathways into underlying aquifers and potential creation of preferential vertical pathways through otherwise isolated hydraulic layers Fractures within the Chalk	Superficial Head Deposits (Secondary Undifferentiated aquifer)	Medium	High	Moderate	Drilling will utilise water-based non-hazardous fluids through the aquifer units. Use of Dura-Base 102 mm thick HDPE interlocking matting for wellsite working surface overlaid on impermeable membrane and protection geotextiles to reduce quantity of any mobilised potential contamination. Tertiary containment system to be constructed in accordance with Environment Agency-approved Construction Quality Assurance (CQA) Plan. The well will be constructed with a series of cemented steel casings from the surface to the top of the Sherwood Sandstone to provide isolation and testing barriers and prevent a vertical pathway from being established. Design to be approved by EA and HSE to ensure well integrity and prevent unplanned releases of reservoir fluids. Use of Loss Control Materials to manage any sub-surface losses during drilling. Control mechanisms to be put in place to ensure no excessive overpressure which could	Very Unlikely	Negligible
			Private Water Supply boreholes	High	High	Major		Unlikely	Low
			Flamborough Chalk (Principal Aquifer)	Very High	High	Major		Unlikely	Low

Activity (Phase)	Source(s)	Pathway	Receptor	Receptor Sensitivity	Magnitude of Impact	Significance	Mitigation or Justification	Likelihood	Risk after mitigation
Testing	Produced hydrocarbons, waters or chemicals present in the well, well cellar and storage tanks	Surface runoff and overland flow to Gypsey Race					cause surface pollution event or transmission between geological units.		
			Upper Jurassic Principal Aquifers	Medium	High	Moderate	As above, with additional protection afforded by low permeability clay of the Speeton Clay and Kimmeridge Clay.	Very Unlikely	Negligible
			Middle / Lower Jurassic Secondary Aquifers	Medium	Low	Minor	Aquifers located at depth and separated from surface operations by a significant thickness of low permeability clay (Speeton Clay, Kimmeridge Clay, Oxford Clay etc.)	Very Unlikely	Negligible
			Sherwood Sandstone Principal Aquifer	Medium	Low	Minor		Very Unlikely	Negligible
		Vertical pathways into underlying aquifers and potential creation of preferential vertical pathways through otherwise isolated hydraulic layers Fractures within the Chalk	Surface Water Drainage System	High	High	Major	Site is located on undeveloped agricultural land. Excavation operations to avoid periods of heavy rain or ground saturation. Perimeter containment ditch (see Section 6.2.2) to be constructed, along with soil berm with impermeable anchor trench along south-eastern and southern boundaries. In event of failure case, soils to be tested for contamination prior to decommissioning of site, and contaminated material removed. Minimise storage of liquids and carry out regular transport of waste from the Site	Unlikely	Low
			Gypsey Race	High	High	Major		Unlikely	Low
			Superficial Head Deposits (Secondary Undifferentiated aquifer)	Medium	High	Moderate	Drilling will utilise water-based non-hazardous fluids through the aquifer units. Use of Dura-Base 102 mm thick HDPE interlocking matting for wellsite working surface overlaid on impermeable membrane and protection geotextiles to reduce quantity of any spilled potential contamination. Tertiary containment system to be constructed in accordance with Environment Agency-approved Construction Quality Assurance (CQA) Plan. The well will be constructed with a series of cemented steel casings from the surface to the top of the Sherwood Sandstone to provide isolation and testing barriers and prevent a vertical pathway from being established. Design to be approved by EA and HSE to ensure well integrity and prevent unplanned releases of reservoir fluids. Use of Loss Control Materials to manage any sub-surface losses during drilling. Control	Very Unlikely	Negligible
			Private Water Supply boreholes	High	High	Major		Unlikely	Low
			Flamborough Chalk (Principal Aquifer)	Very High	High	Major		Unlikely	Low

Activity (Phase)	Source(s)	Pathway	Receptor	Receptor Sensitivity	Magnitude of Impact	Significance	Mitigation or Justification	Likelihood	Risk after mitigation
							mechanisms to be put in place to ensure no excessive overpressure which could cause surface pollution event or transmission between geological units.		
			Upper Jurassic Principal Aquifers	Medium	High	Moderate	As above, with additional protection afforded by low permeability clay of the Speeton Clay and Kimmeridge Clay.	Very Unlikely	Negligible
			Middle / Lower Jurassic Secondary Aquifers	Medium	Low	Minor	Aquifers located at depth and separated from surface operations by a significant thickness of low permeability clay (Speeton Clay, Kimmeridge Clay, Oxford Clay etc.)	Very Unlikely	Negligible
			Sherwood Sandstone Principal Aquifer	Medium	Low	Minor		Very Unlikely	Negligible
Restore Site	Contaminants within site surface hardcore accumulated during drilling / testing activities	Leaching from hardcore / construction materials onto surfaces after removal of impermeable membrane	Superficial Head Deposits (Secondary Undifferentiated aquifer)	Medium	High	Moderate	Removal of all potentially contaminated material from the Site prior to removal of the impermeable membrane. Soils to be tested for contamination following decommissioning of site.	Very Unlikely	Negligible
			Private Water Supply boreholes	High	High	Major		Unlikely	Low
			Flamborough Chalk (Principal Aquifer)	Very High	High	Major		Unlikely	Low
			Upper Jurassic Principal Aquifers	Medium	High	Moderate	As above, with additional protection afforded by low permeability clay of the Speeton Clay and Kimmeridge Clay.	Very Unlikely	Negligible
			Middle / Lower Jurassic Secondary Aquifers	Medium	Low	Minor	Aquifers located at depth and separated from surface operations by a significant thickness of low permeability clay (Speeton Clay, Kimmeridge Clay, Oxford Clay etc.)	Very Unlikely	Negligible
			Sherwood Sandstone Principal Aquifer	Medium	Low	Minor		Very Unlikely	Negligible

The most significant risks are to Gypsy Race, the associated shallow superficial deposits and groundwater contained within, and to groundwater within the Flamborough Chalk Principal Aquifer directly beneath the Site, which supports a number of local private water abstractions. However, risk mitigation measures proposed for the Site significantly reduce the risk to such receptors, such that the overall risk to these is either 'low' or 'negligible' (no risks are classified as 'very low' according to the likelihood-significance matrix presented in Table 14).

[5] Flood Risk Assessment

[5.1] Introduction and Data Sources

The risk of flooding to the Proposed Development has been assessed using information from currently available Environment Agency flood risk data and the North Yorkshire Council Strategic Flood Risk Assessment (SFRA)¹.

The objectives of this FRA are to demonstrate that the Proposed Development:

- is located in a suitable location with regards to flood risk;
- results in no net loss of floodplain storage;
- will not impede water flows; and,
- will not increase the risk of flooding at the Site or elsewhere.

This FRA has been prepared in accordance with the National Planning Policy Framework (NPPF)²² and Planning Practice Guidance (PPG): Flood Risk and Coastal Change²³.

[5.2] Potential Sources of Flood Risk

[5.2.1] Risk of flooding from the rivers and sea

The EA's flood risk for planning data is shown in Figure 22 and definitions of each Flood Zone are included in Table 16.

The Site is situated entirely within Flood Zone 1 and is therefore at a 'Very Low' risk of flooding from rivers and sea. There is an area of elevated fluvial flood risk on the far side of Butt Lane, associated with the Gypsy Lane watercourse.

Neither the SFRA (NYCC, 2016) nor the EA database of historical flooding contains any evidence of fluvial flooding having occurred in this area or its vicinity.

²² Ministry of Housing, Communities & Local Government, 2023. National Planning Practice Guidance.

²³ Ministry of Housing, Communities & Local Government, 2022. Flood risk and coastal change. Retrieved from Gov.uk: <https://www.gov.uk/guidance/flood-risk-and-coastal-change>.

Hydrogeological and Flood Risk Assessment and Surface Water Drainage Strategy



Hydrogeological and Flood Risk Assessment and Surface Water Drainage Strategy

Hydrogeological and Flood Risk Assessment and Surface Water Drainage Strategy

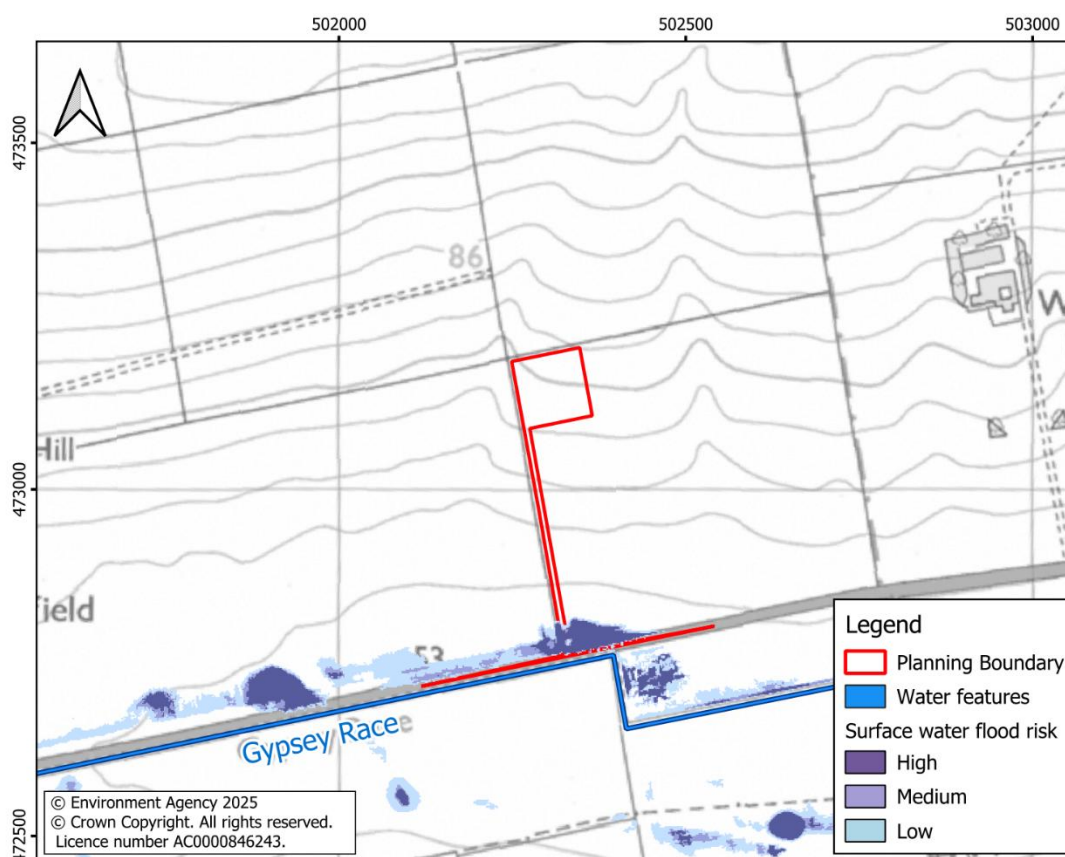
[5.2.2] Risk of flooding from surface water

A map of EA's Risk of Flooding from Surface Water (RoFSW) data is shown in Figure 23 and the risk of surface water flooding reaching or exceeding a depth of 0.3 m is shown in Figure 24. This data includes the 'Central' climate change allowance for the 2050s epoch (2040-2060). The EA classifies the risk from surface water flooding using the following four categories:

- High – Greater than a 3.3% probability of occurrence in any given year;
- Medium – Between a 1%-3.3% probability of occurrence in any given year;
- Low – Between a 0.1%-1% probability of occurrence in any given year; and
- Very Low – Less than a 0.1% probability of occurrence in any given year.

Most of the Site, including all of the working area at the northern section of the Site, has a 'Very Low' risk of surface water flooding. The only exception is a small area where the access road joins Butt Lane, which has a 'High' surface water flood risk, with a 'Low' risk of reaching or exceeding flood depths of 0.3 m. A depth of <0.30 m is unlikely to present a significant hazard to site staff, and will be the same risk as road users on the Butt Lane.

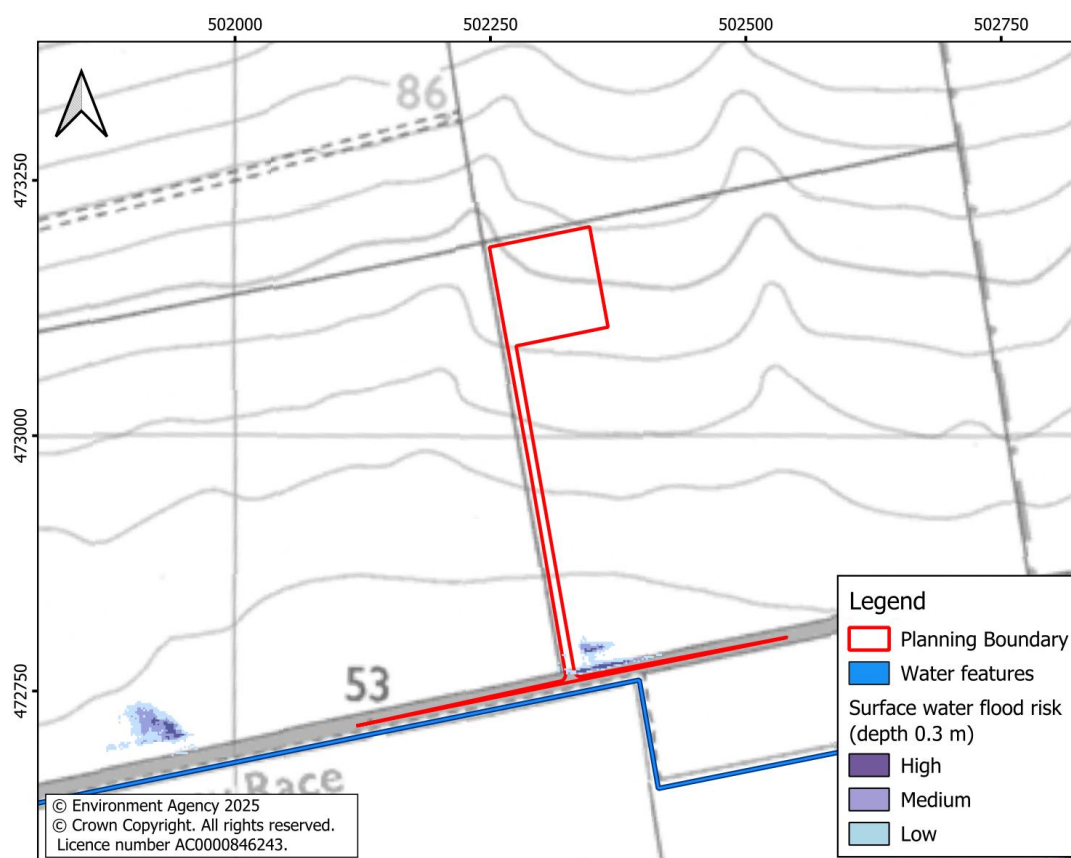
Figure 23 EA Flood Risk from Surface Water (with climate change allowance)



The SFRA¹ does not confirm the locations of Critical Drainage Areas (CDA). However, given the Site's topographically elevated location, the generally very low risks of flooding, and no evidence of historical flooding, it is assumed the Site is not located within a CDA.

Following the implementation of the water drainage strategy (see Section 6), the overall risk of off-site surface water flooding from the Site will be low.

Figure 24 Environment Agency Surface Water Flood Depth Risk (0.3 m; with climate change allowance)



[5.2.3] Risk of flooding from groundwater

Groundwater flooding is caused by the natural emergence of water at surface level originating from underlying permeable sediments or rocks (aquifers). The groundwater may emerge as one or more-point discharges (springs) or as diffuse upwelling of water over an extended area. Groundwater flooding tends to be more persistent than other sources of flooding, typically lasting for weeks or months rather than hours or days.

The North Yorkshire Council SFRA data indicates that the Site is in an area with a 'Very Low' susceptibility of groundwater flooding.

[5.2.4] Risk of flooding from reservoirs

The risk of reservoir flooding is related to the failure of a large water storage reservoir. The risk of failure is considered to be extremely low²⁴. The Site is not at risk of flooding in the event of reservoir failure, and the nearest reservoir posing a risk in the event of failure is located in a separate

²⁴ DEFRA, 2010. Press release on reservoir flood map release for public use. Available online at <https://www.gov.uk/government/news/reservoir-flood-maps-published>

catchment c. 22 km south of the Site. There are no other large water bearing features in the area of interest which may impact flood risk at the Site.

Therefore, there risk of flooding from reservoirs is considered 'Very Low'.

[5.2.5] Risk of flooding from sewers

Sewer flooding can occur during periods of intense rainfall and/or if a sewer becomes blocked with debris.

There are no proposed connections from the Proposed Development to a public sewer.

The North Yorkshire Council SFRA does not provide assessment of flood risks from sewers. However, based on the rural location of the Site, it is understood that there are no public or private sewers in the vicinity. The overall risk of flooding to and from public sewers is therefore considered 'Very Low'.

[5.2.6] Risk of flooding post-development

The Site's condition post-development will vary depending on the outcome of the exploratory borehole's investigation results (see Section 2.4).

In the Success Case, the Site's working area will be reduced and maintained while a new planning application is produced and submitted. The flood risks at the Site in this instance are expected to remain the same as during the development phase.

In the Failure Case (or failure to gain regulatory approvals after Success Case), the Site will be dismantled and returned to its pre-development (agricultural) condition. In this instance, the risk of flooding post-restoration of the Site will be the same as pre-development i.e. 'Very Low'.

[5.3] Flood Risk Vulnerability Classification

The Sequential Test, outlined in the PPG, identifies that developments should be directed to areas at the lowest probability of flooding.

The Proposed Development is classified as 'Less Vulnerable' with its activities focused on the production of oil and associated infrastructure and facilities. According to the NPPF and PPG (see Table 17), "Less Vulnerable" site uses are considered appropriate within Flood Zones 1 and an Exception Test is not required.

Therefore, the Sequential Test is considered passed in this instance.

Table 17 Flood risk vulnerability and flood zone compatibility

Flood risk vulnerability classification	Essential infrastructure	Water compatible	Highly vulnerable	More vulnerable	Less vulnerable
Zone 1 (low probability)	✓	✓	✓	✓	✓
Zone 2 (medium probability)	✓	✓	Exception Test required	✓	✓
Zone 3a (high probability)	Exception Test required	✓	x	Exception Test required	✓
Zone 3b (functional floodplain)	Exception Test required	✓	x	x	x

✓ Development is appropriate.

x Development should not be permitted.

[5.4] Risk of flooding from the Proposed Development

To reduce the risk of flooding from the Proposed Development, the Site has been designed to be fully sealed through the construction of the tertiary containment system and which contains incident rainfall and releases it to the environment if it is safe to do so. The design in effect acts as a Sustainable Urban Drainage Systems (SuDS) system. All new developments mitigate the risk of increasing flooding using SuDS systems, these systems work by storing rainfall runoff and releasing them slowly into the ground or to local water courses. This should act as a proxy for a natural system.

As such, the Site does not increase the risk of off-site flooding and if necessary, can hold and slowly release the volumes of water generated from an extreme storm.

[5.5] Risk Summary

An FRA has been carried out in accordance with the National Planning Policy Framework (NPPF) and Planning Practice Guidance (PPG): Flood Risk and Coastal Change.

A summary of the potential sources of flood risk to the Proposed Development is provided in Table 18.

Table 18 Flood Risk Summary

Potential Flood Source	Risk of Flooding			
	Very Low	Low	Medium	High
River and Sea	✓			
Surface Water *	✓			✓
Groundwater	✓			
Reservoirs	✓			
Sewers	✓			
Post-Restoration	✓			

* Area of high surface water flood risk at site entrance only. Will be localised and shallow.

The risk of flooding can be summarised as follows:

- The Proposed Development is wholly located within the Environment Agency Flood Zone 1 (Very Low risk of flooding from fluvial and tidal sources);
- The Proposed Development is an acceptable development type in Flood Zone 1 in accordance with the NPPF and PPG;
- The risk of surface water flooding to the Proposed Development is 'Very Low', with a localised, shallow ponding possible at the site entrance during a storm event;
- Surface runoff over the proposed extension will be managed in accordance with the proposed perimeter containment ditch which will ensure that there is 'Very Low' risk of surface flooding off-site.
- Flooding from groundwater, reservoirs and public sewers poses 'Very Low' risk to the Site;
- The risk of flooding post-restoration will be the same as that pre-development i.e. 'Very Low'.

This FRA demonstrates that the Proposed Development is sited in a suitable location, will result in no net loss of floodplain storage, will not impede water flows and will not increase the risk of flooding at the Site or elsewhere.

[6] Surface Water Management

[6.1] Existing Drainage scheme

There is currently no drainage system / infrastructure in place. The Site is a greenfield area (a field) which slopes southwards. Runoff flows southwards, crossing Butt Lane to the Gypsy Race watercourse.

Point descriptors for the site are included in Table 19. The BFI value for the area is high and indicates a permeable catchment.

Table 19 Hydrological point descriptors (CEH, 2023)

Descriptor	Value
NGR	TA 01918 73201
BFIHOST19	0.924
PROPWET	0.3
SAAR 61-90	716 mm

Post-development, all runoff will be either discharged to ground or tankered off site (depending on the phase of development, as described below). The greenfield runoff rates and volumes have been calculated below for completeness. The RefH2 method in the ‘Pre-development discharge’ calculator within Causeway Flow was utilised to estimate the greenfield runoff rates for the existing Site. The “Positively Drained Area” used in this instance was the total site area – 1.274 ha. The ‘QBAR’ (i.e. 1 in 2.3-year return period) greenfield runoff rate for the existing Site was thus determined along with runoff rates for other relevant return period storms (see Table 20).

In addition to the greenfield runoff rates, the greenfield runoff volumes were also calculated using the RefH2 methodology through the Source Control rural runoff calculator module. These volumes are also included in Table 20.

Table 20 Greenfield runoff

Return period (yrs.)	Runoff rate (l/s)	Runoff volume (m3/s)
1	0.6	8
2.3 (QBAR)*	0.8	11
30	1.7	21
100	2.2	27

The greenfield QBAR runoff rate or 2 l/s/ha (whichever is greater) is generally set as the ‘permissible discharge rate’ for new developments. 2 l/s/ha. results in a total flow rate of 2.55 l/s (1.274 ha * 2l/s/ha.) for the Site. As such, a 2.55 l/s ‘permissible discharge’ rate may be assumed.

[6.2] Proposed Drainage Scheme

It is proposed to manage surface runoff water during the retention phase of operations using a Class 1 Full Retention oil-water separator, Hydro-Brake® and soakaway. The proposed site drainage layout is illustrated within Appendix B. Water management over the construction phase is included in discussed in Section [6.2.2].

The operational area will be covered with a permeable gravel pad, underlain with an impermeable liner – forming a sealed drainage system. Perimeter ditches around the edge of the pad will collect infiltrating water (above the impermeable liner) and convey this to an outfall in the southwestern corner. Pipework (Ø150 mm) will convey water to the soakaway via the separator. This pipework will include a penstock to contain water within the pad in the event of a spillage/leak of potentially contaminating liquid.

The access track leading into the proposed extension area will be laid using permeable material as part of the development works to support the load of HGV vehicles visiting the Site.

Site derived soils will be stored on-site for the restoration phase. Storage bunds will be bounded by shallow trenches to allow attenuation of runoff and infiltration to ground. The trenches will include regular check dams to maximise the storage capacity provided by the features over the sloping terrain.

[6.2.1] Drainage calculations

Stormwater storage calculations have been undertaken for the site using Causeway Flow+ drainage modelling software. Appendix C contains the model setup details as well as the results.

Simulations were run for storm duration of between 15 minutes and 10,080 minutes (7 days), using the FEH-22 rainfall simulation model. A 35% and 40% allowance for climate change was applied to the model simulations for the 1 in-30 year and 1 in-100-year scenarios (recommended allowances for the Hull and East Riding Management Catchment for the 2050s and 2070s epochs).

The permeable pad was represented as a permeable car park feature within the drainage design software, with a depth of 0.30 m, an area of 1,773 m², and a porosity of 0.30 m, yielding a maximum capacity of 159.57 m³.

The perimeter drains were included as square sided, gravel filled trenches with a depth of 0.30 – 0.40 m, a width of 0.30 m and a porosity of 0.30, with a permeable pipe at the base.

The soakaway included in the current design is a square, 2 m by 2 m cellular storage structure, with a depth of 2 m. An infiltration rate of 1 m/hr has been utilised for the calculations for now, which will be updated following completion of on-site BRE365 infiltration testing (at which point the soakaway can be resized if required). It is noted that, based on the literature values summarised in Section [3.7.3], the Chalk in this area of the Great Wold valley is likely to have very high transmissivity values, potentially supporting significant infiltration.

The drainage simulations demonstrate that the extended wellsite platform can contain in excess of a critical 7 day, 1 in 100-year event plus 40% climate change storm event while discharging to the soakaway. The peak water level during the critical 1 in 100-year event plus 40% storm event (1440 minutes), is calculated to be 75.67 mAOD (0.13 m below the surface of the permeable pad). The water depth in the soakaway under this event is 1.74 m (freeboard depth remaining: 0.26 m).

[6.2.2] Management of rainfall runoff

The separator and the soakaway system will be installed following the drilling and testing phase of operations – it is not viable to install before this infrastructure before this time as a concurrent discharge to ground in the vicinity is not compatible with the drilling and testing operations and is scheduled to be implemented during the retention phase.

During workover and other operational phases (well operations), rainfall runoff will be stored and contained within the perimeter bund and ditch system and a wellsite platform (up to the height of the perimeter bund) and tankered off-site to an Environment Agency approved waste disposal / treatment facility. The operational procedure is to keep the containment ditch and platform empty (dry).

The perimeter trenches would provide a storage volume of 72.64 m³ assuming a depth of 1.00 m, a width of 0.45 m and a porosity of 0.35. Under a 1-in-100-year storm event with a conservative climate change allowance of 40%, the total rainfall depth (77.46 mm for a 6-hour event) would exceed the

capacity of the trenches and flood the operational pad to a depth of 0.066 m (6.6 cm). This would be safely contained within the perimeter bunds (which have a height of c. 400 mm).

The Site will be manned and controlled 24 hours a day, 7 days a week during drilling operations. A contracted drainage management company will have tankers on standby and available to remove water from the well pad containment drain, during the consented operational hours.

The water level in the containment ditch will be monitored via the drain sumps on a daily basis and after a rainfall event by a designated member(s) of Egdon site personnel. Periods of saturation will not occur as water levels will be monitored continually and water will be tankered from the wellsite platform as required. The operational procedure is to keep the platform dry. Additional storage (a mobile tank) could be installed on-site to assist in maintaining dry working conditions, if needed.

[6.3] Maintenance

A maintenance plan for the surface water drainage scheme at the Site will be drawn up and carried out by the Site operators or nominated third party. The plan shall include daily and weekly inspections of all drainage elements. This shall include the removal of any obstructions and silt build-up where necessary and checks on the physical structure of the drainage elements.

[6.4] Foul Water

The Site office and welfare facilities will discharge into a sealed foul water/sewage tank. The tank will be sealed with no outfall to the environment and foul water/sewage will be emptied regularly by tanker and disposed of at an approved treatment facility

[7] Conclusions

A Hydrogeological Risk Assessment and Flood Risk Assessment has been undertaken for the development of a proposed conventional hydrocarbon (natural gas) exploration borehole near Weaverthorpe in North Yorkshire to identify if it is likely to have significant effects on nearby water features and groundwater receptors.

The most significant receptors are to Gypsey Race, which is in hydraulic continuity with surrounding superficial head deposits, and groundwater within the Flamborough Chalk Principal Aquifer directly beneath the Site. The latter supports several private water abstractions and seasonally may contribute baseflow in Gypsey Race. However, risk mitigation measures proposed significantly reduce the potential risk to receptors, such that the overall risk to these is either 'low' or 'negligible'.

The main risks to groundwater relate to the accidental release of contaminants introduced during the drilling process and the possible creation of preferential vertical pathways through the multi-layered aquifer units. The uppermost aquifer, the Chalk, is the most significant in terms of receptors, as it is a highly productive unit which supports several nearby abstractions. The Chalk aquifer will be screened off during the first stage of drilling, when the risks to it are greatest. The risks to the Chalk are mitigated by the site construction approach, including the installation of impermeable membrane and protection geotextiles placed at surface and the well cellar, the use of only water based drilling fluids when drilling through the formation, and by casing off the formation once the well reaches its base at a predicted depth of 280 m bgl, up to the surface. The well design ensures that when completed, three separate well casing strings will provide protection to the Chalk from both drilling fluid and formation fluids from underlying strata.

The potential risks to groundwater from the above-surface activities are likely to be low due to the passive managed protective mitigation measures proposed. These include maintaining the integrity of the surface impermeable membrane and protection geotextiles, maintenance of the perimeter containment ditch and soil berm with impermeable anchor trench as well as the controlled removal of water and other chemicals to prevent their accumulation in excessive quantities. In addition, as the well is a gas exploration borehole, there will be no production or storage of hydrocarbons on-Site, further limiting the potential for pollution event at the Site.

The Site should be operated and maintained in accordance with the most up-to-date management, health and safety and environmental standards in place at the time of site activities taking place, and in accordance with an established Environmental Management System (EMS) that is a requirement of the Environmental Permitting mechanism.

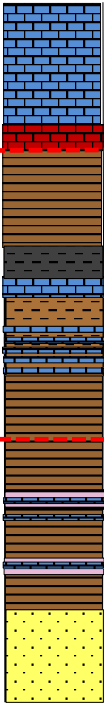
Embedded mitigation measures significantly reduce the risk to the identified receptors, reducing the risk of contamination entering or moving between different hydrological units. The Site therefore presents a negligible to low risk to the Chalk aquifer, Gypsey Race watercourse and the associated superficial deposits aquifer. The proposed development satisfies policies M17, D02 and D09 of the Minerals and Waste Joint Plan (2022) and complies with the relevant policy SP17 on protecting the water environment (land resources, flood risk and water resources) within the Ryedale Local Plan (2013)²⁵ which is also included within Appendix D.

The Flood Risk Assessment has been carried out in accordance with the National Planning Policy Framework and Planning Practice Guidance: Flood Risk and Coastal Change, demonstrating that the Proposed Development is sited in a suitable location, will result in no net loss of floodplain

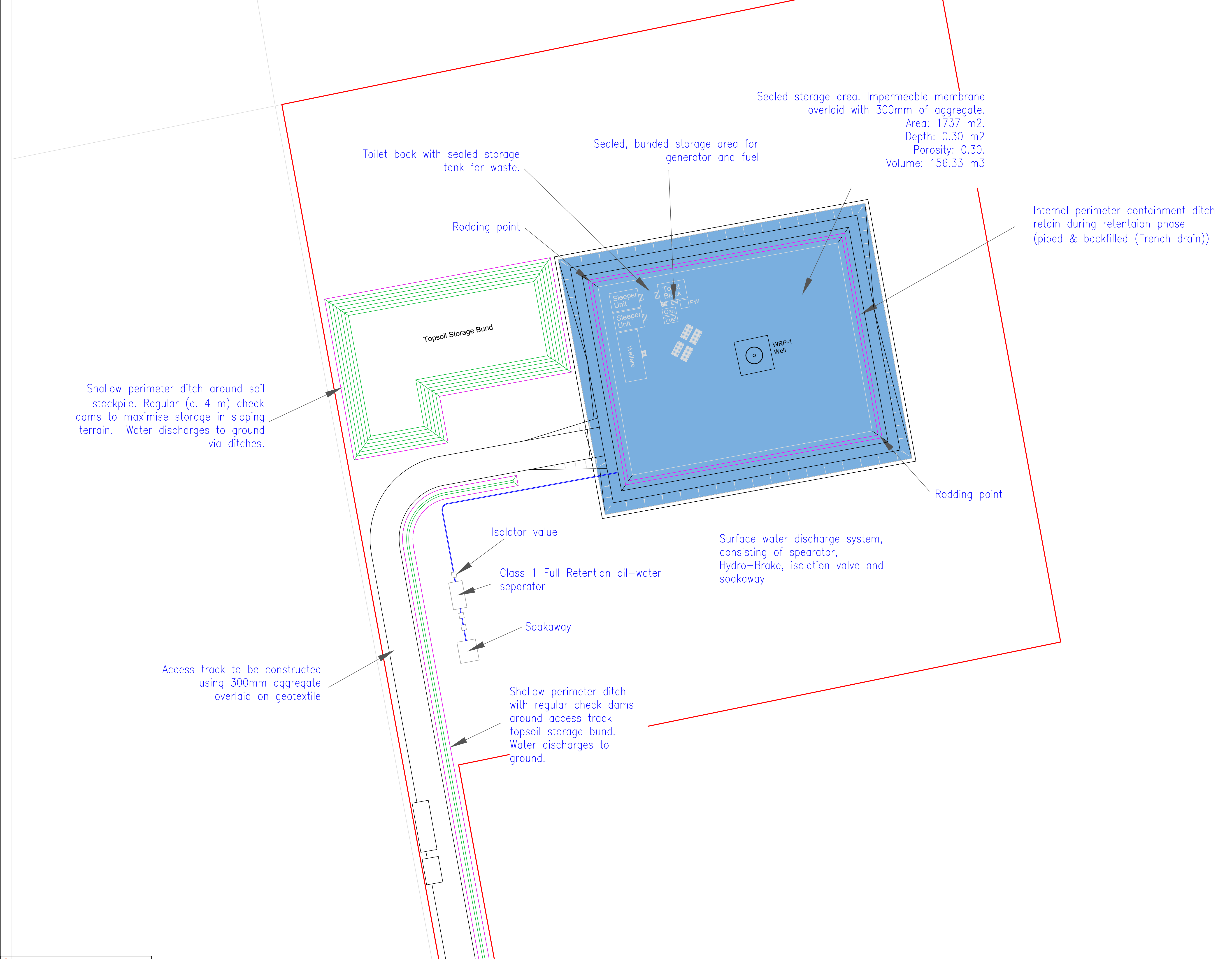
²⁵ Ryedale District Council, 2013. The Ryedale Local Plan Strategy.

storage, will not impede surface water flows and will not increase the risk of flooding at the Site or elsewhere.

Appendix A – Well Design Schematic for ‘Weaverthorpe’

Well Design Schematic for 'Weaverthorpe 1'							Option1: "Slant well" 29-Nov-2024			
Operator:		Egdon Resources U.K. Limited					Surface Locations (BNG OSGB1936) & Elevations (m) (all provisional)			
Well Name:		Weaverthorpe 1 (L41/28- 2 provisional)								
County, Country:		North Yorkshire, onshore UK					Surface Location: E: 502370.00 , N: 473150.00			
Licence:		PEDL347					Bottom Hole Location: E: 502230.55 , N: 473452.33			
Well Type:		Deviated Exploration Well for gas in Triassic aged Sherwood Sandstone					Elevations: Ground level at c.75m above Mean Sea Level (MSL), Rig-18's RKB at nominally 5m (ref Rig-18) above Ground Level (GL), c.80m above MSL			
Drilling Unit:		to be confirmed								
Prognosed Total Depth:		±1,130m.RKB (approx. -970m TVDSS, c.50m below anticipated GWC)								
Measured Depth (m.RKB)	Formation Names	Prognosed Lithology	Fault cuts	Objective	Hole & Casing sizes, setting depths (all RKB unless noted)	Anticipated bit (IADC code)	Drilling Fluid, Type and Density	Casing (provisional)		
				• oil ⚙ gas				Casing	Interval (m)	Casing Specification
0	Cretaceous Chalk Group		Fault		16" hole set at approx. 0-15m RKB into superficial deposits and Chalk	4-3-7 tricone or similar	Air Water	13-3/8" conductor casing	±15m to surface	TBD
250	Hunstanton Fm Speeton Clay				12-1/4" hole 15-280m	4-3-7 tricone or similar	Bentonite	9-5/8" to surface	From 280m to surface	TBD
500	Kimmeridge Clay Corallian Group Oxford Clay Estuarine Group				8-1/2" hole section drilled 280m to approx. 780m	PDC bit	KCI Polymer	7" intermediate casing to surface	From 780m to surface	TBD
750	Lower Lias Mercia Mudstone Muschelkalk		Fault							
1,000	Sherwood Sandstone			⚙	6" hole 780 - 1,130m TD; ~50m below GWC	PDC bit	KCI Polymer	4-1/2" (or 5") production liner (success case), to surface	From plugged back depth (above GWC) or TD to surface	TBD
1,125	TD									

Appendix B – Site Drainage Layout



GENERAL NOTES

- Drawing based on:
 - Topographical data provided by Client and LIDAR data.
 - Site layout drawing provided by Client.
- All cover levels shown are indicative only, actual level to be used on site (some work on the site has already been undertaken which will affect the topography to some degree). Additional protection may be required for shallower pipes.
- All private drainage is to be constructed in accordance with the Building Regulations as current at construction.
- Side connections to SW to be 100Ø @1/100 gradient unless stated otherwise.
- All private drainage pipes to be constructed of suitable materials as defined in the Building Regulations Document H. All systems to be installed in accordance with manufacturers recommendations and with appropriate bed and surround. All pipe systems must have appropriate levels of ring stiffness- typically 8kN/m² and jetting pressure resistance of 2600 psi without damage as per the 'Sewer Jetting Code of Practice 2nd Edition (2005-2006).Additional concrete protection must be provided where side support may be lost in the future due to parallel trench excavation e.g. for services or drain repair/replacement.
- All pipes to enter manhole with soffits level.
- All drainage is to be tested for water tightness in accordance with the Building Regulations Document H.
- All proposals to be reviewed upon completion of final site layout and the onsite topographical survey.
- All building drainage works shall be carried out in accordance with the current British/European standards, the current building regulations and the local authority building control specifications and requirements.
- Contractor to verify locations of all existing services prior to commencement and arrange for any necessary protection, diversion or lowering works as required.
- Proposed finished levels to be designed by others. as a result all proposed finished levels shown are to be review in line with the proposed external works plan produced by others.
- This drawing is intended to assist with discharging planning conditions only, the contractor is to review all design proposals and make any required changes to ensure all proposals are coordinated and there is no conflicting information.

KEY

- PROPOSED DRAINAGE CHANNELS
- PROPOSED PIPES
- SOIL BUNDS
- PROPOSED PERMEABLE PAD (WITH IMPERMEABLE LINER BENEATH)

Rev	Date	Description	By	Chk	App
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CLIENT
Egdon
Blackstable House Longridge,
Gloucestershire, England, GL6 7QX

PROJECT
Weaverthorpe

DRAWING TITLE
Drainage Strategy

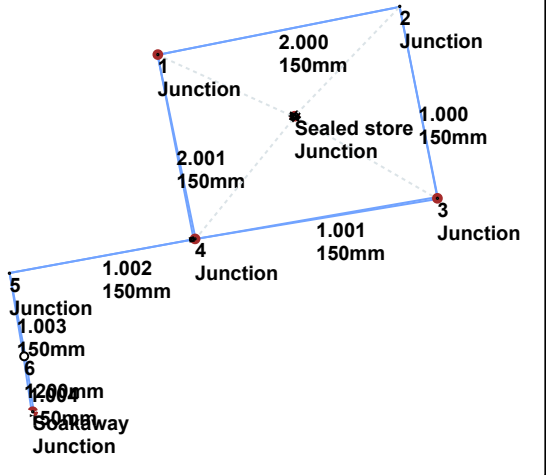
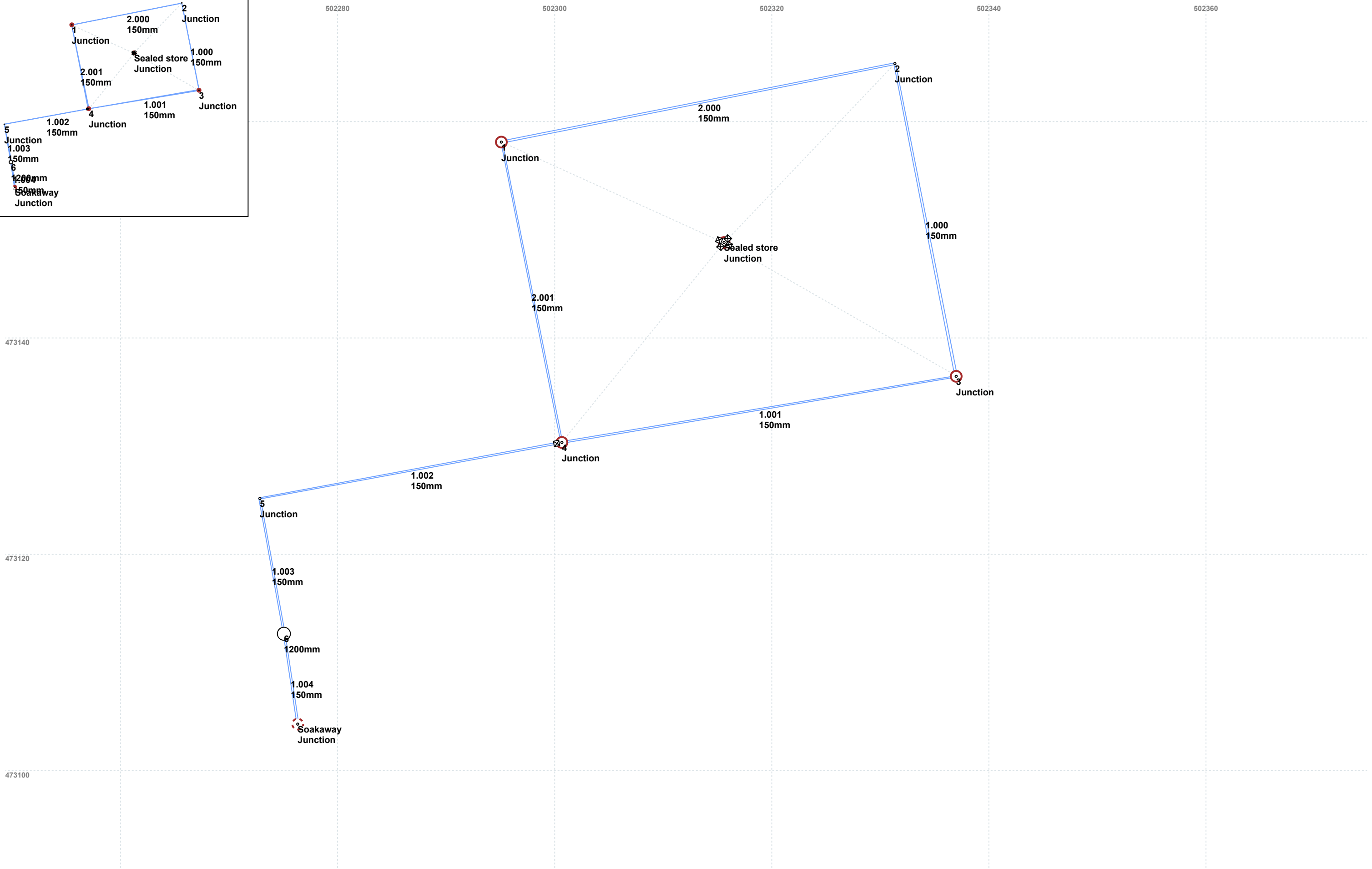
STATUS
Draft

SUITABILITY
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Date: 17/04/25 Scale: 1:250 Drawn: HJK Title: AIA App: AIA

Project No: 2055 Drg. No: 101 Rev: 00

Appendix C – Drainage Model Setup and Results



Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	100	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	0.750	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	x
Maximum Rainfall (mm/hr)	50.0		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Node Type	Diameter (mm)	Depth (m)
Sealed store	0.177	3.00	75.800	Junction		0.300
✓ 2		5.00	75.800	Junction		0.300
✓ 3			75.800	Junction		0.350
✓ 4			75.800	Junction		0.400
✓ 1			75.800	Junction		0.350
✓ 5			73.600	Manhole	1200	1.000
✓ 6			72.250	Manhole	1200	1.000
✓ Soakaway			71.600	Junction		2.000

Links (Results)

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Minimum Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	0.407	7.2	0.0	0.150	0.200	0.150	0.000	0.0	0	0.000
1.001	0.363	6.4	0.0	0.200	0.250	0.200	0.000	0.0	0	0.000
2.001	0.415	7.3	0.0	0.200	0.250	0.200	0.000	0.0	0	0.000
2.000	0.362	6.4	0.0	0.150	0.200	0.150	0.000	0.0	0	0.000
1.002	3.187	56.3	0.0	0.250	0.850	0.250	0.000	0.0	0	0.000
1.003	3.304	58.4	0.0	0.850	0.850	0.850	0.000	0.0	0	0.000
1.004	4.483	79.2	0.0	0.850	1.850	0.850	0.000	0.0	0	0.000

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Normal	Starting Level (m)	
Rainfall Events	Singular	Skip Steady State	x	Check Discharge Rate(s)	x
Summer CV	0.750	Drain Down Time (mins)	240	Check Discharge Volume	x
Winter CV	0.840	Additional Storage (m³/ha)	20.0		

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	0	0
30	35	0	0
100	40	0	0

Node Sealed store Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	75.500
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.30	Time to half empty (mins)	

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	1773.0	1773.0	0.300	1773.0	1817.8

Node Soakaway Soakaway Storage Structure

Base Inf Coefficient (m/hr)	1.00000	Invert Level (m)	69.600	Depth (m)	2.000
Side Inf Coefficient (m/hr)	1.00000	Time to half empty (mins)	38	Inf Depth (m)	
Safety Factor	2.0	Pit Width (m)	2.000	Number Required	1
Porosity	1.00	Pit Length (m)	2.000		

Node 1 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Link	2.000
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	75.450	Surround Shape	(Trench)
Safety Factor	2.0	Time to half empty (mins)		Diameter (mm)	300

Node 4 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Link	1.001
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	75.400	Surround Shape	(Trench)
Safety Factor	2.0	Time to half empty (mins)		Diameter (mm)	300

Node 3 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Link	1.000
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	75.450	Surround Shape	(Trench)
Safety Factor	2.0	Time to half empty (mins)		Diameter (mm)	300

Node 4 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Link	2.001
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	75.400	Surround Shape	(Trench)
Safety Factor	2.0	Time to half empty (mins)		Diameter (mm)	300

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
1 year 15 minute summer	63.839	18.064
1 year 15 minute winter	44.800	18.064
1 year 30 minute summer	41.815	11.832
1 year 30 minute winter	29.344	11.832
1 year 60 minute summer	28.441	7.516
1 year 60 minute winter	18.895	7.516
1 year 120 minute summer	21.271	5.621
1 year 120 minute winter	14.132	5.621
1 year 180 minute summer	17.933	4.615
1 year 180 minute winter	11.657	4.615
1 year 240 minute summer	15.026	3.971

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
1 year 240 minute winter	9.983	3.971
1 year 360 minute summer	12.302	3.166
1 year 360 minute winter	7.996	3.166
1 year 480 minute summer	10.099	2.669
1 year 480 minute winter	6.709	2.669
1 year 600 minute summer	8.499	2.325
1 year 600 minute winter	5.807	2.325
1 year 720 minute summer	7.723	2.070
1 year 720 minute winter	5.190	2.070
1 year 960 minute summer	6.501	1.712
1 year 960 minute winter	4.306	1.712
1 year 1440 minute summer	4.830	1.294
1 year 1440 minute winter	3.246	1.294
1 year 2160 minute summer	3.502	0.968
1 year 2160 minute winter	2.413	0.968
1 year 2880 minute summer	2.934	0.786
1 year 2880 minute winter	1.972	0.786
1 year 4320 minute summer	2.253	0.589
1 year 4320 minute winter	1.483	0.589
1 year 5760 minute summer	1.884	0.482
1 year 5760 minute winter	1.220	0.482
1 year 7200 minute summer	1.631	0.416
1 year 7200 minute winter	1.052	0.416
1 year 8640 minute summer	1.451	0.370
1 year 8640 minute winter	0.937	0.370
1 year 10080 minute summer	1.320	0.337
1 year 10080 minute winter	0.852	0.337
30 year +35% CC 15 minute summer	311.330	88.096
30 year +35% CC 15 minute winter	218.477	88.096
30 year +35% CC 30 minute summer	207.161	58.619
30 year +35% CC 30 minute winter	145.376	58.619
30 year +35% CC 60 minute summer	140.894	37.234
30 year +35% CC 60 minute winter	93.607	37.234
30 year +35% CC 120 minute summer	85.204	22.517
30 year +35% CC 120 minute winter	56.607	22.517
30 year +35% CC 180 minute summer	65.219	16.783
30 year +35% CC 180 minute winter	42.394	16.783
30 year +35% CC 240 minute summer	51.546	13.622
30 year +35% CC 240 minute winter	34.246	13.622
30 year +35% CC 360 minute summer	39.407	10.141
30 year +35% CC 360 minute winter	25.615	10.141
30 year +35% CC 480 minute summer	31.098	8.218
30 year +35% CC 480 minute winter	20.661	8.218
30 year +35% CC 600 minute summer	25.522	6.981
30 year +35% CC 600 minute winter	17.438	6.981
30 year +35% CC 720 minute summer	22.796	6.110
30 year +35% CC 720 minute winter	15.320	6.110
30 year +35% CC 960 minute summer	18.804	4.951
30 year +35% CC 960 minute winter	12.456	4.951
30 year +35% CC 1440 minute summer	13.786	3.695
30 year +35% CC 1440 minute winter	9.265	3.695

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
30 year +35% CC 2160 minute summer	10.038	2.774
30 year +35% CC 2160 minute winter	6.917	2.774
30 year +35% CC 2880 minute summer	8.466	2.269
30 year +35% CC 2880 minute winter	5.690	2.269
30 year +35% CC 4320 minute summer	6.554	1.714
30 year +35% CC 4320 minute winter	4.316	1.714
30 year +35% CC 5760 minute summer	5.485	1.404
30 year +35% CC 5760 minute winter	3.550	1.404
30 year +35% CC 7200 minute summer	4.701	1.199
30 year +35% CC 7200 minute winter	3.034	1.199
30 year +35% CC 8640 minute summer	4.134	1.055
30 year +35% CC 8640 minute winter	2.668	1.055
30 year +35% CC 10080 minute summer	3.709	0.946
30 year +35% CC 10080 minute winter	2.394	0.946
100 year +40% CC 15 minute summer	406.232	114.950
100 year +40% CC 15 minute winter	285.075	114.950
100 year +40% CC 30 minute summer	272.057	76.983
100 year +40% CC 30 minute winter	190.918	76.983
100 year +40% CC 60 minute summer	186.973	49.411
100 year +40% CC 60 minute winter	124.220	49.411
100 year +40% CC 120 minute summer	110.661	29.244
100 year +40% CC 120 minute winter	73.521	29.244
100 year +40% CC 180 minute summer	83.900	21.590
100 year +40% CC 180 minute winter	54.537	21.590
100 year +40% CC 240 minute summer	65.958	17.431
100 year +40% CC 240 minute winter	43.821	17.431
100 year +40% CC 360 minute summer	50.156	12.907
100 year +40% CC 360 minute winter	32.603	12.907
100 year +40% CC 480 minute summer	39.546	10.451
100 year +40% CC 480 minute winter	26.273	10.451
100 year +40% CC 600 minute summer	32.504	8.891
100 year +40% CC 600 minute winter	22.209	8.891
100 year +40% CC 720 minute summer	29.115	7.803
100 year +40% CC 720 minute winter	19.567	7.803
100 year +40% CC 960 minute summer	24.229	6.380
100 year +40% CC 960 minute winter	16.049	6.380
100 year +40% CC 1440 minute summer	18.043	4.836
100 year +40% CC 1440 minute winter	12.126	4.836
100 year +40% CC 2160 minute summer	13.382	3.698
100 year +40% CC 2160 minute winter	9.221	3.698
100 year +40% CC 2880 minute summer	11.391	3.053
100 year +40% CC 2880 minute winter	7.655	3.053
100 year +40% CC 4320 minute summer	8.830	2.309
100 year +40% CC 4320 minute winter	5.815	2.309
100 year +40% CC 5760 minute summer	7.343	1.880
100 year +40% CC 5760 minute winter	4.753	1.880
100 year +40% CC 7200 minute summer	6.240	1.592
100 year +40% CC 7200 minute winter	4.027	1.592
100 year +40% CC 8640 minute summer	5.435	1.387
100 year +40% CC 8640 minute winter	3.508	1.387
100 year +40% CC 10080 minute summer	4.830	1.232

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
100 year +40% CC 10080 minute winter	3.118	1.232

Results for 1 year Critical Storm Duration. Lowest mass balance: 99.73%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
960 minute winter	Sealed store	690	75.552	0.052	1.8	28.2910	0.0000	OK
960 minute winter	2	690	75.510	0.010	0.1	0.0000	0.0000	OK
960 minute winter	3	705	75.468	0.018	0.2	0.0234	0.0000	OK
960 minute winter	4	705	75.431	0.031	0.6	0.1350	0.0000	OK
960 minute winter	1	705	75.467	0.017	0.2	0.0256	0.0000	OK
960 minute winter	5	705	72.611	0.011	0.6	0.0124	0.0000	OK
960 minute winter	6	705	71.259	0.009	0.6	0.0103	0.0000	OK
960 minute winter	Soakaway	720	69.646	0.046	0.6	0.1849	0.0000	OK

US Node	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
Sealed store	2	0.1				4.3
Sealed store	3	0.2				5.9
Sealed store	4	0.2				5.9
Sealed store	1	0.2				5.9
2	3	0.1	0.073	0.008	0.0254	
2	1	0.1	0.070	0.008	0.0294	
3	4	0.2	0.111	0.033	0.0712	
4	5	0.6				
1	4	0.2	0.112	0.028	0.0528	
5	6	0.6	1.134	0.010	0.0064	
6	Soakaway	0.6	0.526	0.007	0.0213	
Soakaway		0.6				

Results for 30 year +35% CC Critical Storm Duration. Lowest mass balance: 99.73%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
720 minute winter	Sealed store	540	75.638	0.138	6.3	75.1115	0.0000	OK
720 minute winter	2	540	75.517	0.017	0.4	0.0000	0.0000	OK
720 minute winter	3	540	75.482	0.032	0.7	0.0657	0.0000	OK
720 minute winter	4	540	75.466	0.066	1.8	0.5344	0.0000	OK
720 minute winter	1	540	75.480	0.030	0.6	0.0708	0.0000	OK
720 minute winter	5	540	72.619	0.019	1.8	0.0212	0.0000	OK
720 minute winter	6	540	71.266	0.016	1.8	0.0176	0.0000	OK
960 minute winter	Soakaway	780	70.641	1.041	1.8	4.1633	0.0000	OK

US Node	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
Sealed store	2	0.4				13.0
Sealed store	3	0.5				15.4
Sealed store	4	0.5				15.4
Sealed store	1	0.5				15.4
2	3	0.2	0.109	0.029	0.0577	
2	1	0.2	0.105	0.029	0.0667	
3	4	0.7	0.132	0.104	0.1896	
4	5	1.8				
1	4	0.6	0.133	0.088	0.1414	
5	6	1.8	1.594	0.030	0.0141	
6	Soakaway	1.8	0.571	0.022	0.0784	
Soakaway		1.7				

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.73%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
960 minute winter	Sealed store	675	75.673	0.173	6.6	93.8560	0.0000	OK
960 minute winter	2	675	75.520	0.020	0.5	0.0000	0.0000	OK
960 minute winter	3	690	75.504	0.054	1.0	0.1656	0.0000	OK
960 minute winter	4	690	75.501	0.101	2.6	0.8990	0.0000	OK
960 minute winter	1	690	75.503	0.053	1.0	0.2009	0.0000	OK
960 minute winter	5	690	72.623	0.023	2.6	0.0257	0.0000	OK
960 minute winter	6	780	71.341	0.091	2.6	0.1030	0.0000	OK
960 minute winter	Soakaway	780	71.340	1.740	2.6	6.9602	0.0000	OK

US Node	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
Sealed store	2	0.5				20.4
Sealed store	3	0.7				25.4
Sealed store	4	0.7				25.5
Sealed store	1	0.7				25.4
2	3	0.3	0.113	0.039	0.1038	
2	1	0.2	0.109	0.039	0.1277	
3	4	1.0	0.136	0.150	0.3358	
4	5	2.6				
1	4	0.9	0.137	0.128	0.2562	
5	6	2.6	1.790	0.045	0.0806	
6	Soakaway	2.6	0.565	0.033	0.1216	
Soakaway		2.5				

Appendix D – Review of Relevant Planning Policies

The Site is located within the Ryedale District of North Yorkshire. The last Local Plan Strategy was published in 2013, and the relevant local policies outlined below have been reviewed. Ryedale became part of the new unitary authority of North Yorkshire Council in April 2023 when the districts of Craven, Hambleton, Richmondshire, Ryedale, Scarborough, and Selby merged with North Yorkshire Council.

Ryedale Local Plan 2013

Policy SP17 – Managing Air Quality, Land and Water Resources

Land resources will be protected and improved by:

- Supporting new uses for land which is contaminated or degraded where an appropriate scheme of remediation and restoration is agreed and in place.
- Prioritising the use of previously developed land and protecting the best and most versatile agricultural land from irreversible loss. New land allocations will be planned to avoid and minimise the loss of the Best and Most Versatile Agricultural Land. Proposals for major development coming forward on sites that are not allocated for development which would result in the loss of the Best and Most Versatile Agricultural Land will be resisted unless it can be demonstrated that the use proposed cannot be located elsewhere and that the need for the development outweighs the loss of the resource.

Flood risk will be managed by:

- Requiring the use of sustainable drainage systems and techniques, where technically feasible, to promote groundwater recharge and reduce flood risk. Development proposals will be expected to attenuate surface water run off to the rates recommended in the Strategic Flood Risk Assessment. In addition, major development proposals within areas highlighted as having critical drainage problems in the North East Yorkshire Strategic Flood Risk Assessment (or future updates) as Critical Drainage Areas may, if appropriate, be required to demonstrate that the development will not exacerbate existing problems by modelling impact on the wider drainage system.
- Ensuring new development does not prevent access to water courses for the maintenance of flood defences.
- Undertaking a risk based sequential approach to the allocation of land for new development and in the consideration of development proposals in order to guide new development to areas with the lowest probability of flooding, whilst taking account of the need to regenerate vacant and previously developed sites within the towns. In considering development proposals or the allocation of land, full account will be taken of the flood risk vulnerability of proposed uses and the national 'Exception Test' will be applied if required.

Water resources will be managed by:

- Supporting the water efficient design of new development and requiring developers to demonstrate how development proposals will seek to minimise water consumption.
- Ensuring applications for new development assess impacts on water quality and propose mitigation measures to reduce the risk of pollution and a deterioration of water quality.
- Protecting surface and groundwater from potentially polluting development and activity. Sources of groundwater protection within and adjacent to the District will be protected using the Source Protection Zones (SPZs) identified by the Environment Agency. Within SPZ1 the

following types of development will not be permitted unless adequate safeguards against possible contamination can be agreed:

- Septic tanks, wastewater treatment works, storage tanks containing hydrocarbons or any chemicals or underground storage tanks;
 - Sustainable drainage systems with infiltration to ground
 - Oil pipelines
 - Storm water overflows and below ground attenuation tanks
 - Activities which involve the disposal of liquid waste to land
 - Graveyards and cemeteries
 - Other specific types of development identified within the Environment Agency's Groundwater Protection Policy
- Within Source Protection Zones 2 and 3 a risk-based approach will be applied to the consideration of development proposals with the exception of development involving deep soakaways, sewerage, trade and storm effluent to ground which will not be permitted unless it can be demonstrated that these are necessary, are the only option available and where adequate safeguards against possible contamination can be agreed.
 - Within Source Protection Zones developers will be expected to provide full details of the proposed construction of new buildings and construction techniques, including foundation design as part of their proposals.
 - Ensuring that necessary sewerage and water treatment infrastructure improvements are provided in tandem with new development and that scale, type, location and phasing of new development or land-based activity can be accommodated without an unacceptable impact on water supply.

As of April 2025, a new North Yorkshire Local Plan is under development, which is expected to be published in 2027 and adopted by late 2029.

Minerals and Waste Joint Plan 2022

The following Policies have been considered from the Minerals and Waste Joint Plan 2022:

Policy M17: Other spatial and locational criteria applying to hydrocarbon development

1. Accessibility and transport
 - i) Hydrocarbon development will be permitted in locations with suitable direct or indirect access to classified A or B roads and where it can be demonstrated through a Transport Assessment that:
 - a) There is capacity within the road network for the level of traffic proposed and the nature, volume and routing of traffic generated by the development would not give rise to unacceptable impact on local communities¹⁶, businesses or other users of the highway or, where necessary, any such impacts can be appropriately mitigated for example by traffic controls, highway improvements and/or traffic routing arrangements; and
 - b) Access arrangements to the site are appropriate to the volume and nature of any road traffic generated and safe and suitable access can be achieved

for all users of the site, including the needs of nonmotorised users where relevant; and

- c) There are suitable arrangements in place for on-site manoeuvring, parking and loading/unloading.
- ii) Where access infrastructure improvements are needed to ensure that the requirements of i) a) and b) above can be complied with, information on the nature, timing and delivery of these should be included within the proposals.
- iii) Where produced gas needs to be transported to facilities or infrastructure not located at the point of production, including to any remote processing facility or the gas transmission system, this should be via underground pipeline where practicable, with the routing of pipelines selected to have the least practicable environmental or amenity impact.
- iv) Where hydraulic fracturing is proposed, proposals, where practicable, should also be located where an adequate water supply can be made available without the need for bulk road transport of water.

2. Cumulative impact

- i) Hydrocarbon development will be permitted in locations where it would not give rise to unacceptable cumulative impact, as a result of a combination of individual impacts from the same development and/or through combinations of impacts in conjunction with other existing, planned or unrestored hydrocarbons development. Applications for appraisal and production activities should specifically address the potential for cumulative impacts of development upon climate change and where appropriate, propose such mitigation and adaptation measures as may be available and are consistent with Policy D11 and the requirements of other relevant regulators.
- ii) Well pad density and/or the number of individual wells within a PEDL area will be limited to ensure that unacceptable cumulative impact does not arise. Assessment of the contribution to cumulative impact arising from a proposal for hydrocarbon development will include (but not necessarily be limited to) consideration of:
 - a) The proximity of a proposed new well pad site to other existing, permitted or unrestored well pads, and the extent to which any combined effects would lead to unacceptable impacts on the environment or local communities, including as a result of any associated transport impacts;
 - b) The duration over which hydrocarbon development activity has taken place in the locality and the extent to which any adverse impacts on the environment or local communities would be expected to continue if the development were to be permitted;
 - c) The sensitivity of the receiving environment, taking into account the nature and distribution of any environmental constraints, proximity to local communities, the availability of adequate access links to the highway network and the need to ensure a high standard of protection in line with other relevant policies in the Plan.

Where results from any earlier exploration and/or appraisal activity are available, proposals for production of unconventional hydrocarbons should

include information on how the proposal is intended to fit within an overall scheme of production development within the PEDL area and should ensure as far as practicable that production sites are located in the least environmentally sensitive areas of the resource.

- iii) In order to reduce the potential for adverse cumulative impact, proposals for production of hydrocarbons will be supported in locations where beneficial use can be made of existing or planned supporting infrastructure including, where relevant, pipelines for transport of gas and/or water, facilities for the processing or generation of energy from extracted gas and overhead or underground power lines and grid connections which could serve the development.
- iv) Where development of new processing, power or pipeline infrastructure is required, consideration should be given to how the location and design of the development could facilitate its use for multiple well pads in order to reduce adverse cumulative impact. The Minerals Planning Authority will support co-ordination between operators and the development of shared infrastructure where this will help reduce overall adverse impacts from hydrocarbon development.
- v) New processing or energy generation infrastructure for hydrocarbons should, as a first priority, be sited on brownfield, industrial or employment land. Where it can be demonstrated that development of agricultural land is required, and subject first to other locational requirements in Policies M16 and M17, proposals should seek to utilise land of lower quality in preference to higher quality.

3. Local economy

Hydrocarbon development will be permitted in locations where a high standard of protection can be provided to environmental, recreational, cultural, heritage or business assets important to the local economy including, where relevant, important visitor attractions. The timing of short term development activity likely to generate high levels of noise or other disturbance, or which would give rise to high volumes of heavy vehicle movements, should be planned to avoid or, where this is not practicable minimise, impacts and take into account seasonal variations and peaks in traffic movements.

4. Specific local amenity considerations relevant to hydrocarbon development

- i) Hydrocarbon development will be permitted in locations where it would not give rise to unacceptable impact on local communities or public health. Adequate separation distances should be maintained between hydrocarbon development and residential buildings and other sensitive receptors in order to protect against unacceptable adverse individual and cumulative impacts on amenity and public health, in line with the requirements of Policy D02. Proposals for surface hydrocarbon development, particularly those involving hydraulic fracturing, within 500m of residential buildings and other sensitive receptors, will only be permitted in following the particularly careful scrutiny of supporting information which robustly demonstrates how in site specific circumstances an unacceptable degree of adverse impact can be avoided.
- ii) Proposals should refer to any relevant data from baseline monitoring and other available information to ensure that a robust assessment of potential impacts is undertaken, and that comprehensive mitigation measures are proposed where necessary.

- iii) Proposals involving hydraulic fracturing should be accompanied by an air quality monitoring plan and Health Impact Assessment.
- iv) Proposals should include measures appropriate and proportionate to the development to manage waste gas emissions, including the capture and use of the gas where practicable, to ensure there is not an unacceptable impact on local communities or public health and to make practical use of any waste gas available.

Policy D02: Local amenity and cumulative impacts

1. Proposals for minerals and waste development, including ancillary development and minerals and waste transport infrastructure, will be permitted where it can be demonstrated that there will be no unacceptable impacts on the amenity of local communities and residents, local businesses and users of the public rights of way network and public open space including as a result of:
 - noise,
 - dust,
 - vibration,
 - odour,
 - emissions to air, land or water
 - visual intrusion,
 - site lighting
 - vermin, birds and litter
 - subsidence and land instability
 - public health and safety
 - disruption to the public rights of way network
 - the effect of the development on opportunities for enjoyment and
 - understanding of the special qualities of the National Park
 - cumulative effects arising from one or more of the above at a single site
 - and/or as a result of a number of sites operating in the locality

Proposals will be expected as a first priority to prevent adverse impacts through avoidance, with the use of robust mitigation measures where avoidance is not practicable.

2. Applicants are encouraged to conduct early and meaningful engagement with local communities in line with Statements of Community Involvement prior to submission of an application and to reflect the outcome of those discussions in the design of proposals as far as practicable.

Policy D09: Water environment

1. Proposals for minerals and waste development will be permitted where it can be demonstrated that no unacceptable impacts will arise, taking into account any proposed mitigation, on surface or groundwater quality and/or surface or groundwater supplies and flows.
2. In relation to surface and groundwater quality and flows, a very high level of protection will be applied to principal aquifers and groundwater Source Protection Zones. Development which would lead to an unacceptable risk of pollution, or harmful disturbance to groundwater flow, will not be permitted.

3. Permission for minerals and waste development on sites not allocated in the Joint Plan will, where relevant, be determined in accordance with the Sequential Test and Exception Test for flood risk set out in national policy. Development which would lead to an unacceptable risk of, or be at an unacceptable risk from, all sources of flooding (i.e. surface and groundwater flooding and flooding from rivers and coastal waters) will not be permitted.
4. Proposals for minerals and waste development should, where necessary or practicable taking into account the scale, nature and location of the development proposed, include measures to contribute to flood alleviation and other climate change mitigation and adaptation measures including use of sustainable drainage systems.