



Hornsea Project Four: Environmental Statement (ES)

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Volume A6, Annex 1.1: Land Quality Preliminary Risk Assessment

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Glossary

Term	Definition
Development Consent Order (DCO)	An order made under the Planning Act 2008 granting development consent for one or more Nationally Significant Infrastructure Projects (NSIP).
Effect	Term used to express the consequence of an impact. The significance of an effect is determined by correlating the magnitude of the impact with the importance, or sensitivity, of the receptor or resource in accordance with defined significance criteria.
EIA Regulations	The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017
Energy Balancing Infrastructure (EBI)	Energy Balancing Infrastructure is used for importing, storing and exporting energy in order to meet the needs of the National Grid and improve stability and reliability.
Export cable corridor (ECC)	The specific corridor of seabed (seaward of Mean High Water Springs (MHWS)) and land (landward of MHWS) from the Hornsea Project Four array area to the Creyke Beck National Grid substation, within which the export cables will be located.
High Voltage Alternating Current (HVAC)	High voltage alternating current is the bulk transmission of electricity by alternating current (AC), whereby the flow of electric charge periodically reverses direction.
High Voltage Direct Current (HVDC)	High voltage direct current is the bulk transmission of electricity by direct current (DC), whereby the flow of electric charge is in one direction.
Hornsea Project Four Offshore Wind Farm	The term covers all elements of the project (i.e. both the offshore and onshore). Hornsea Four infrastructure will include offshore generating stations (wind turbines), electrical export cables to landfall, and connection to the electricity transmission network. Hereafter referred to as Hornsea Four.
Landfall	The generic term applied to the entire landfall area between Mean Low Water Spring (MLWS) tide and the Transition Joint Bay (TJB) inclusive of all construction works, including the offshore and onshore ECC, intertidal working area and landfall compound. Where the offshore cables come ashore east of Fraisthorpe.
Local Authority	The Local Authority is a body empowered by law to exercise various statutory functions for a particular area of the United Kingdom. This includes County Councils, District Councils and the Broads Authority, as set out in Section 43 of the Planning Act 2008. East Riding of Yorkshire Council (ERYC) is the Local Authority for the entirety of the onshore project footprint.
National Grid Electricity Transmission (NGET) substation	The grid connection location for Hornsea Four at Creyke Beck.
Onshore export cables	Cables connecting the landfall first to the onshore substation and then on to the NGET substation at Creyke Beck.
Onshore substation (OnSS)	Comprises a compound containing the electrical components for transforming the power supplied from Hornsea Project Four to 400 kV and to adjust the power quality and power factor, as required to meet the UK Grid Code for supply to the National Grid. If a HVDC system is used the OnSS will also house equipment to convert the power from HVDC to HVAC.
Order Limits	The limits within which Hornsea Project Four (the 'authorised project') may be carried out.

Term	Definition
Orsted Hornsea Project Four Ltd.	The Applicant for the proposed Hornsea Project Four Offshore Wind Farm Development Consent Order (DCO).
Transition Joint Bay (TJBs)	TJBs are pits dug and lined with concrete, in which the jointing of the offshore and onshore export cables takes place.
Trenchless Techniques	Also referred to as trenchless crossing techniques or trenchless methods. These techniques include HDD, thrust boring, auger boring, and pipe ramming, which allow ducts to be installed under an obstruction without breaking open the ground and digging a trench.

Acronyms

Acronym	Definition
BCS	British Geological Survey
DCO	Development Consent Order
DEFRA	Department of Environment, Food and Rural Affairs
DoE	Department of Environment
EBI	Energy Balancing Infrastructure
ECC	Export Cable Corridor
EIA	Environmental Impact Assessment
ES	Environmental Statement
NGET	National Grid Electricity Transmission
NVZ	Nitrate Vulnerable Zones
OnSS	Onshore substation
PCB	Polychlorinated biphenyls
PCOC	Potential contaminant of concern
PCSM	Preliminary Conceptual Site Model
PEIR	Preliminary Environmental Information Report
PRA	Preliminary Risk Assessment
QRA	Qualitative Risk Assessment
SPZ	Source Protection Zone
SSSI	Site of Special Scientific Interest
WFD	Water Framework Directive

Units

Unit	Definition
kV	Kilovolt (electrical potential)
m	metre

1 Introduction

1.1 Project Background

1.1.1.1 Orsted Hornsea Project Four Limited (the 'Applicant') is proposing to develop Hornsea Project Four offshore wind farm (hereafter 'Hornsea Four'). Hornsea Four will be located approximately 69 km offshore the East Riding of Yorkshire in the Southern North Sea and will be the fourth project to be developed in the former Hornsea Zone. Hornsea Four will include both offshore and onshore infrastructure including an offshore generating station (wind farm), export cables to landfall, and on to an onshore substation (OnSS) with energy balancing infrastructure (EBI), and connection to the electricity transmission network. The location of Hornsea Four is illustrated on [Figure 1](#).

1.1.1.2 Royal HaskoningDHV was commissioned to undertake a Phase 1 Land Quality Preliminary Risk Assessment (PRA) within and around the Hornsea Four Order Limits (i.e. the landfall search area, onshore ECC, the OnSS including EBI), and 400 kV National Grid Electricity Transmission (NGET) connection area. This technical annex has been produced to characterise the baseline environment to inform and support the Environmental Statement for Geology and Ground Conditions ([Volume A3, Chapter 1: Geology and Ground Conditions](#)).

1.2 Objectives

1.2.1.1 The key objective of this PRA is to develop a Preliminary Conceptual Site Model (PCSM) which provides the initial steps in the identification of any potential pollutant linkages and potentially unacceptable risks to sensitive receptors (e.g. human health and environmental receptors) associated with Hornsea Four. The PCSM draws conclusions from historical data available. These are then used to inform decisions with regards to whether further investigation or assessment (i.e. a Generic Quantitative Risk Assessment) is needed to understand and mitigate potential impacts.

1.2.1.2 The purpose of this report is to provide the findings of the PRA in support of [Volume A3, Chapter 1: Geology and Ground Conditions](#) which presents the assessments of any likely significant effects on geology and conditions, because of the development of the Hornsea Four project. This PRA is the first stage of an evolving risk assessment process that has been updated as the Environmental Impact Assessment (EIA) process, data gathering, and project design process develops through to the Development Consent Order (DCO) submission.

1.3 Report Structure

1.3.1.1 This report comprises the following principal sections:

- [Section 1](#) – Introduction and Methodology;
- [Section 2](#) – Site Location and Description;
- [Section 3](#) – Environmental Setting;
- [Section 4](#) – Regulatory Information;
- [Section 5](#) – Preliminary Conceptual Site Model and Qualitative Assessment; and

- [Section 6](#) – Conclusions and Recommendations.

1.4 Methodology

- 1.4.1.1 This PRA has been completed in accordance with the recommended approach in the Environment Agency Land Contamination: Risk Management ((Environment Agency 2019) (formerly - Contaminated Land Report 1.1 (DEFRA and Environment Agency 2004.)).
- 1.4.1.2 This PRA is based solely on a desktop review of available information (e.g. historical maps and regulatory information). In the absence of site-specific ground investigation data, the assessments and conclusions drawn adopt a precautionary approach i.e. if a potential pollutant linkage (a source, pathway and receptor must be present for a potential pollutant linkage to exist, refer to [Section 5](#) for full details) has been identified it is assumed to be present until further site-specific information is available to clarify whether the linkage actually exists.
- 1.4.1.3 This PRA forms the initial step in the assessment of potentially contaminated land. It precedes, if required, intrusive investigations, risk assessments, options appraisals, remedial designs, implementation planning and completion reporting.
- 1.4.1.4 The following desk-based information sources have been reviewed and have informed this report:
- Envirocheck Report (Ref 201127462_1_1, 201127557_1_, 201127555_1_1, 201127465_1_1 and 201127560_1_1.) comprising historical maps, environmental sensitivity data and regulatory records (see [Volume A6, Annex 1.2: Envirocheck Report](#));
 - British Geological Survey (BGS) online geology viewer;
 - The Coal Authority interactive online viewer;
 - UK Radon Website (Public Health England);
 - Environmental data available on the data.gov.uk website (DEFRA); and
 - Publicly available aerial imagery (Google Earth).

1.5 Study Area

- 1.5.1.1 Due to the size of the onshore elements of Hornsea Four, some sections within this PRA have been divided into the following composite areas which together comprise the Hornsea Four Order Limits, as referred to within this PRA ([Figure 1](#)).
- Landfall – where the offshore export cables will connect to the onshore export cables. This area will include transition joint bay, cable laydown area, and temporary access tracks. These components are located near Fraisthorpe;
 - Onshore ECC - is the proposed route the onshore export cables will take between landfall and the OnSS; and
 - OnSS – located to the west of the Creyke Beck NGET substation, Hornsea Four's proposed grid connection point. A further section of the onshore export cables (within

the 400 kV connection area) is then required to connect the OnSS to the Creyke Beck NGET substation. EBI will be housed within the footprint of the OnSS and will be comprised of energy storage technology (e.g. batteries, energy conversion technology) with the exact configuration to be determined post-consent.

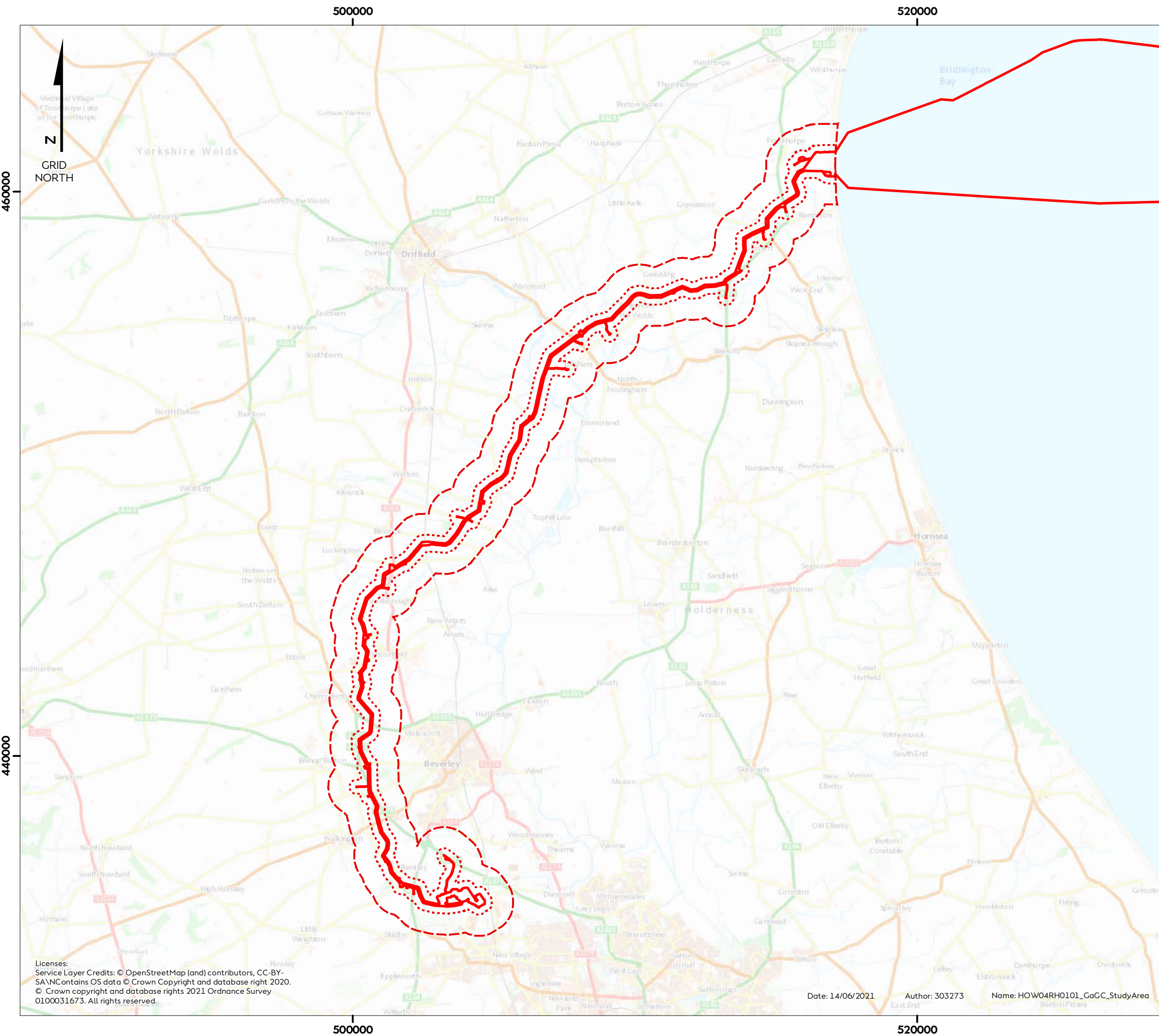
1.5.1.2 The Hornsea Four land quality PRA study area includes a buffer zone of up to 1 km that surrounds the Hornsea Four Order Limits. The buffer zones used within this study area are broken down further, as follows:

- A 250 m study area around the Hornsea Four Order Limits - for potential sources of contamination, including discharge consents, pollution incidents, landfills, and contemporary trade entries (see [Table 11](#)) that may indirectly impact areas within the Hornsea Four Order Limits. With regards to potential sources of contamination, sources at distances greater than 250 m have not been considered as it is anticipated that with increasing distance the risk from these potential sources to the Hornsea Four Order Limits diminishes due to an absence of viable pathways. For this reason, designated sites (e.g. Sites of Special Scientific Interest (SSSIs)) and surface water features, for example, have also been considered to a maximum distance of 250 m; and
- A 1 km study area around the Hornsea Four Order Limits – within which historical maps have been reviewed to provide a clear picture of the surrounding area. Both surface and groundwater water abstraction points, have been considered to a distance of 1 km as these are considered to be sensitive receptors that may be impacted by development. Within this distance there is a potential for contaminants to travel greater distances via surface and groundwater, where a pathway exists.

1.6 Data Limitations

1.6.1.1 Following the production of the initial PRA, which was included as part of the Hornsea Four Preliminary Environmental Information Report (PEIR) (Orsted 2019)), ongoing route and site selection refinement has taken place, as detailed in [Volume A1, Chapter 3: Site Selection and Consideration of Alternatives](#). This PRA, produced to support the Geology and Ground Conditions ES chapter ([Volume A3, Chapter 1](#)), has been updated to incorporate all changes to the Hornsea Four Order Limits between PEIR and DCO submission.




1.6.1.2 As such this technical report has been updated to account for any changes to the Hornsea Four Order Limits and subsequently the 250 m and 1 km Hornsea Four land quality PRA study area surrounding the Hornsea Four Order Limits (see [Section 1.5](#)). All such changes to the Hornsea Four Order Limits since the submission of the PEIR are located within the pre-DCO boundary (submitted at PEIR) land quality PRA 250 m study area. As such the changes which have taken place between the pre-DCO boundary (submitted at PEIR) and the Order Limit are not considered to have had an impact of the baseline environment established. In addition to this, the changes to the 250 m and 1 km Hornsea Four land quality PRA study area are also not considered to have had an impact on the baseline environment previously established at PEIR.



Hornsea Four


Figure 1

Hornsea Four Land Quality PRA Study Area

-  Order Limits
-  250 m Study Area
-  1 km Study Area



Coordinate system: British National Grid
 Scale@A3: 1:130,000



REV	REMARK	DATE
	First Issue for PEIR	21/06/2019
A	Updated following PEIR consultations, for DCO	14/06/2021

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2 Site Location and Description

2.1 Current Land Use

2.1.1.1 Hornsea Four is located within the East Riding of Yorkshire (ERY), landfall is approximately centred at National Grid Reference 516669, 461044, Onshore ECC is approximately centred at 501645, 446780 and the OnSS is approximately centred at 503826, 434933.

2.1.1.2 The landfall is located to the east of Fraisthorpe and comprises agricultural land and beach. From the landfall, the onshore ECC crosses predominantly open agricultural land avoiding the towns and villages of Lissett, Leconfield (and Leconfield airfield), Cherry Burton and Beverley, prior to reaching the OnSS before connecting to the Creyke Beck NGET substation, near Cottingham ([Figure 1](#)).

2.2 Historical Information

2.2.1.1 A review of historical maps contained within the 2019 Envirocheck Report obtained has been undertaken to identify key on-site and off-site features that may have contributed to land contamination. The key features identified are summarised below in [Table 1](#) and [Table 2](#) and the historical maps are included for reference in [Volume A6, Annex 1.2: Envirocheck Report](#).

Table 1: Historical Information (within the Hornsea Four Order Limits).

Map Dates	On-Site Features
<i>Landfall</i>	
1854 - 2019	Agricultural land with a small number of buildings and road.
<i>OnSS</i>	
1855	Agricultural land with a series of small buildings recorded.
1952 - 1953	Electricity pylons recorded traversing the southern part of the OnSS.
1963 - 1988	Creyke Beck electricity substation recorded.
<i>Onshore ECC</i>	
1854 - 1855	<ul style="list-style-type: none"> Gravel and sand pits recorded throughout the onshore ECC. Agricultural land. Railway line recorded near Lockington; and The River Hull bisects the onshore ECC.
1891 - 1892	York, Markey Weighton and Beverley railway bisects onshore ECC.
1938 - 1951	Electricity pylons recorded.
1970 – 1975	York, Markey Weighton and Beverley railway recorded as dismantled railway.
1981	A1079 and A1035 bisects onshore ECC.
2019	No significant change.

Table 2 : Historical Information (within the 1 km Hornsea Four land quality PRA study area, exclusive of the Hornsea Four Order Limits).

Map Dates	Off-Site Features	Distance from Hornsea Four Order Limits (m)	Direction in relation to the Hornsea Four Order Limits
<i>Landfall</i>			
1888 - 2019	Marr Plantation.	0	North
<i>OnSS</i>			
1854 - 1855	Railway line (Hull and Scarborough).	0	North, east and south
	York and North railway line recorded	>100	East
1891 - 1894	Hull Water Works.	>250	South-east
1954 - 1969	Nurseries and tanks recorded adjacent to Park Lane	>250	South
	Unspecified 'works' and builder's yard recorded adjacent to railway.	>250	South-east
1963 - 1979	Electricity pylons recorded adjacent to the southern boundary.	0	South
	Shafts recorded.	>10	South
	Substation recorded adjacent to the Hull Water Works (now recorded as a pumping station).	>250	South-east
1986 - 1988	Footprint of 'works' has increased, builder's yard no longer recorded.	>250	South-east
1994 - 1995	A disused tip is recorded adjacent to a traveller's caravan site.	>400	South
1999	Landfill site recorded adjacent to a golf course and traveller's caravan site.	>400	South
<i>Onshore ECC</i>			
1854 - 1855	Lockington Railway Station.	500	South east
	Railway line (Hull and Scarborough).	0	North, east and south
1891 - 1894	East Riding Lunatic Asylum and hospital recorded.	600	East
	Artesian well.	500	East
	Old gravel pit	450	West
	Cherry Burton Station.	800	West
1910 - 1911	Gas works, and sewage works recorded adjacent to the lunatic asylum.	600	East

Map Dates	Off-Site Features	Distance from Hornsea Four Order Limits (m)	Direction in relation to the Hornsea Four Order Limits
1928	Gas works, and sewage works no longer recorded adjacent to the lunatic asylum.	600	East
1951	Beeswick Brick and Tile Works.	500	North west
1954 - 1969	Expansion of sand pits recorded.	>50	East
	Sewage works (Beverley Corporation).	0	East.
1963 - 1979	Cherry Burton Station no longer recorded.	800	West
	Increase in number of buildings, thought to be residential properties, recorded within Leconfield.	500	East
	Cherry Burton Nurseries and Raventhorpe Nursery recorded.	>250	West
	Shooting ground and gun club recorded in Bygot Wood.	>250	West
1982 - 1984	Poultry houses recorded adjacent to Killingwoldgraves Lane.	250	West
	Unspecified depot and 'works' recorded adjacent to the railway line.	100	East
	Sand Pits recorded as disused. Brigham Quarry recorded.	>50	East
	Trout farm recorded	1000	North west
1993	Sewage works (Beverley Corporation) recorded as disused.	0	East
	Former lunatic asylum no longer recorded.	600	East
1999	Fish Farm recorded.	>450	West

Features common across the 1 km Hornsea Four land quality PRA study area

1854 - 1855	Agricultural land.	0	North, east, south and west
	Chalk, sand and gravel pits recorded along onshore ECC.	>100	North, east, south and west.
1893	York, Markey Weighton and Beverley railway branches off Hull and Scarborough railway.	0	East and west.
1963 - 1979	York, Markey Weighton and Beverley railway recorded as dismantled.	0	East and west.

3 Environmental Setting

3.1 Ground Conditions

3.1.1.1 Information on geological conditions within the Hornsea Four Order Limits has been collated from British Geological Survey (BGS) datasets including 1: 50,000 scale geological mapping. The anticipated geological sequence, as shown on the BGS online viewer, is outlined in [Table 3](#). [Figure 2](#) to [Figure 6](#) illustrate the BGS geological sequence within the 1 km Hornsea Four land quality PRA study area.

Table 3: Geology within the Hornsea Four Order Limits (see Figure 2 to Figure 6).

Stratum	Unit	Description
Superficial Deposits	Till (Onshore ECC and OnSS).	No description given.
	Glaciofluvial Deposits (Landfall and onshore ECC).	Sand and gravel.
	Alluvium (Landfall and onshore ECC).	Normally soft to firm consolidated, compressible silty clay, but can contain layers of silt, sand, peat and basal gravel. A stronger desiccated surface zone may be present.
Bedrock	Rowe Chalk Formation (Landfall and onshore ECC).	White, flint-bearing chalk with sporadic marl bands.
	Flamborough Chalk Formation (Landfall, onshore ECC and OnSS).	White, well-bedded, flint free chalk with common marl seams (typically about one per metre). Common stylolitic surfaces and pyrite nodules.
	Burnham Chalk Formation (onshore ECC and OnSS).	White, thinly-bedded chalk with common tabular and discontinuous flint bands; sporadic marl seams. Formal subdivision: none as defined here (BGS Lexicon), but there are many named marl and flint bands throughout the succession that are used to divide the formation. They are all of bed status.

3.1.1.2 Historical borehole records were also accessed via the BGS GeoIndex online viewer (British Geological Survey, Undated), a summary of the ground conditions encountered can be found in [Table 4](#).

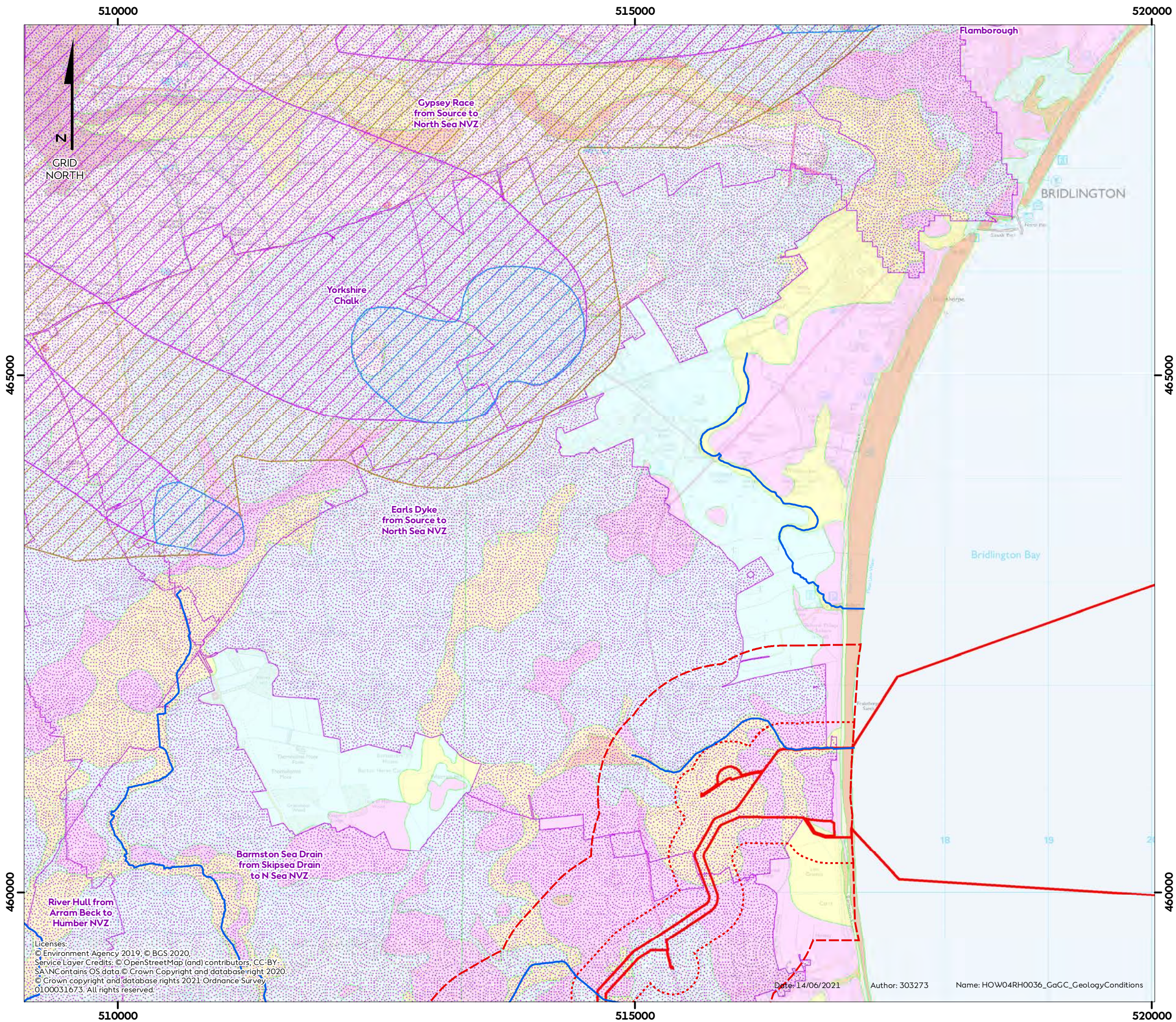
Table 4: Summary of BGS borehole records within the Hornsea Four Order Limits (see Figure 2 to Figure 6).

Borehole reference	Strata	Thickness (m)	Description
<i>Onshore ECC</i>			
TAO4NW24	Superficial deposits	0.3	Soil.
		3.96	Gravel.
		4.27	Clay.
		3.66	Gravel.
	Bedrock	11.28 (base of borehole)	Chalk.

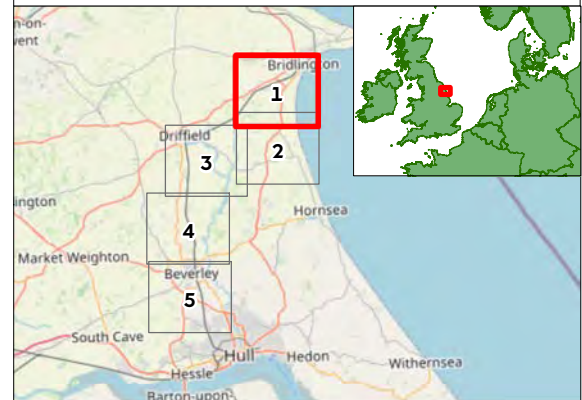
Hornsea Four

Figure 2

Geology and Ground Conditions within the Landfall area of the Hornsea Four Land Quality PRA Study Area - Sheet 1 of 5



- Order Limits
- 250 m study area
- 1 km Study Area
- WFD water body
- Nitrate Vulnerable Zones - 2017 Designation
- Aquifer Designations - Secondary A**
- Alluvium Sediment
- Aquifer Designation - Unproductive
- Sand and Gravel
- Lacustrine Deposits
- Source Protection Zones**
- 1
- 2
- 3



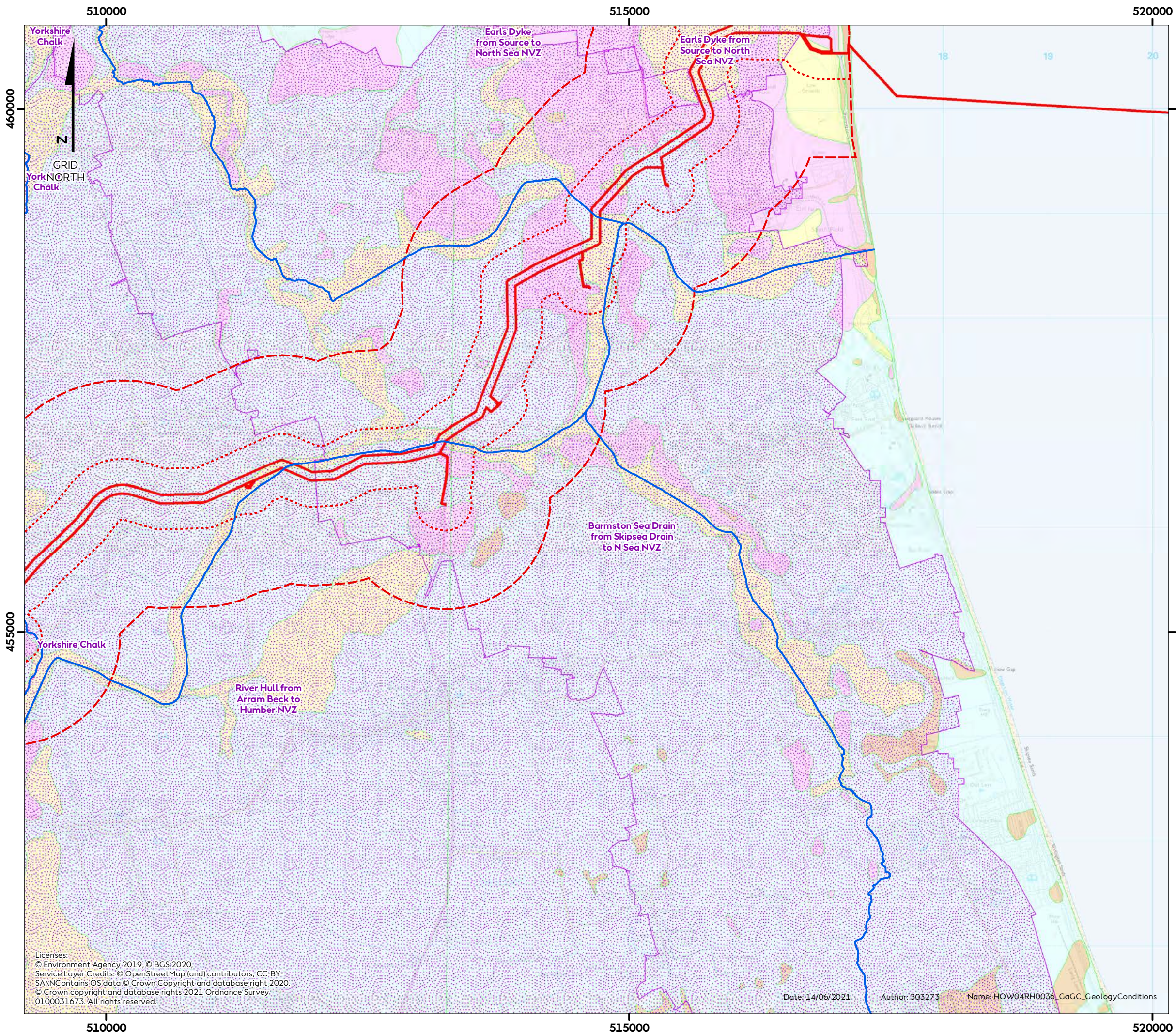
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A	Updated following PEIR consultations, for DCO	14/06/2021

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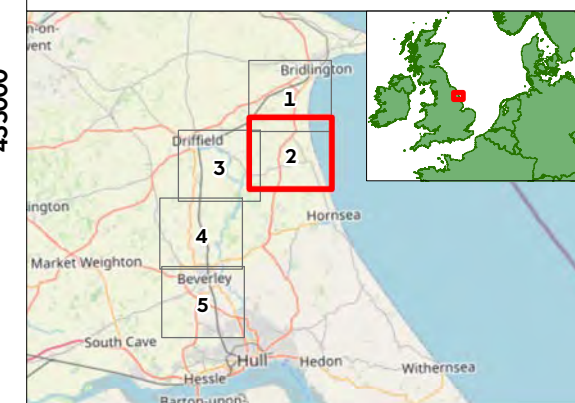


Hornsea Four

Figure 3

Geology and Ground Conditions within the Onshore ECC #1 of the Hornsea Four Land Quality PRA Study Area - Sheet 2 of 5

- Order Limits
- 250 m study area
- 1 km Study Area
- WFD water body
- Nitrate Vulnerable Zones - 2017 Designation
- Aquifer Designations - Secondary A**
 - Alluvium Sediment
 - Aquifer Designation - Unproductive
 - Sand and Gravel
 - Lacustrine Deposits



Coordinate system: British National Grid
 Scale@A3: 1:35,000

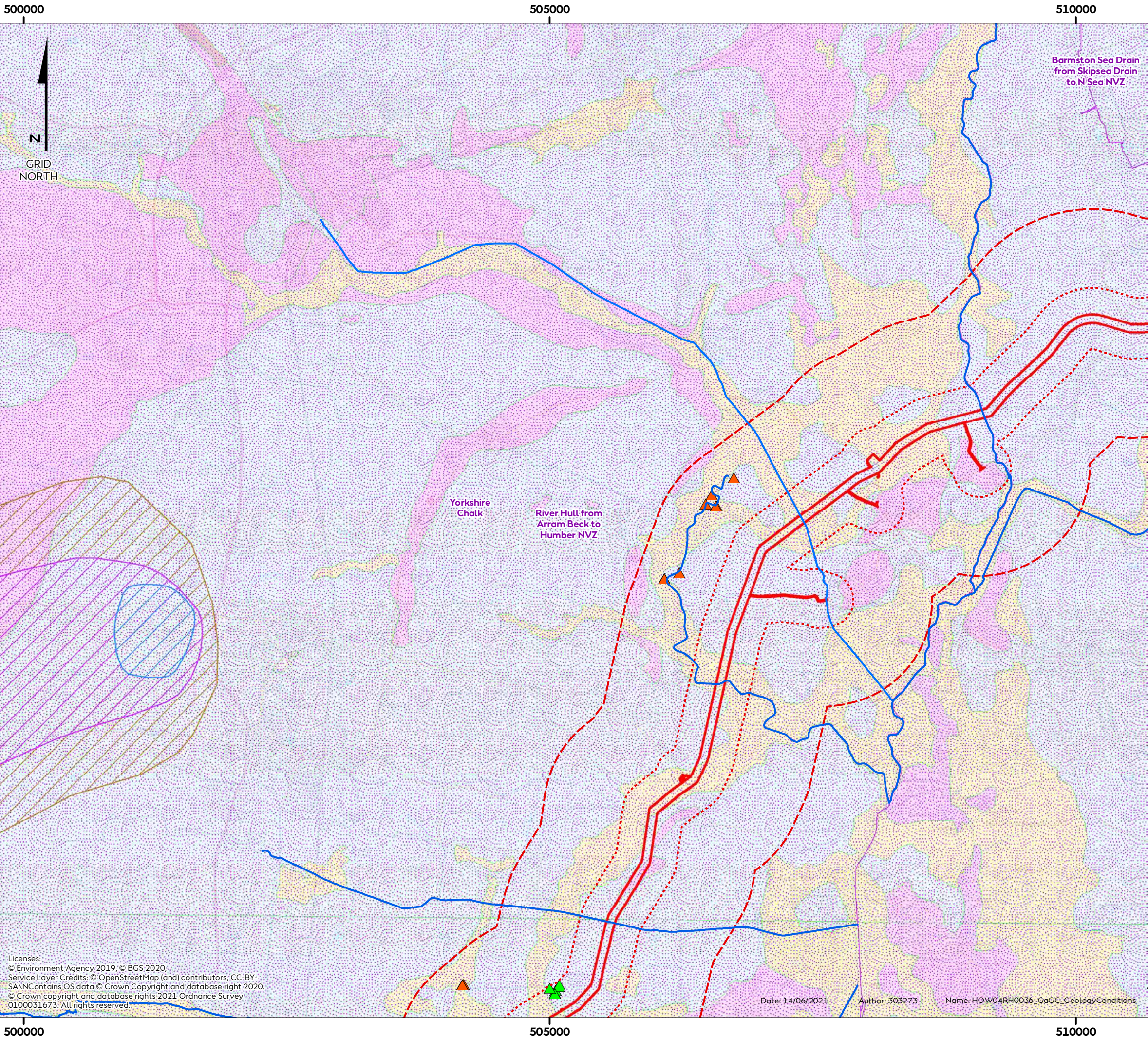
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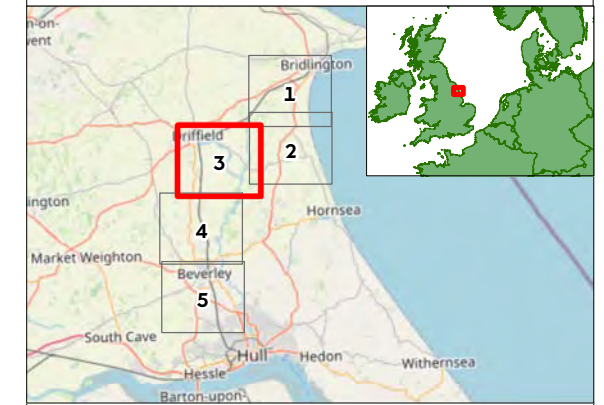


Hornsea Four

Figure 4

Geology and Ground Conditions within the Onshore ECC #2 of the Hornsea Four Land Quality PRA Study Area - Sheet 3 of 5

- Order Limits
- 250 m study area
- 1 km Study Area
- WFD water body
- Nitrate Vulnerable Zones - 2017 Designation
- ▲ Abstraction Point - Groundwater
- ▲ Abstraction Point - Surface
- Aquifer Designations - Secondary A**
- Alluvium Sediment
- Aquifer Designation - Unproductive
- Sand and Gravel
- Lacustrine Deposits
- Source Protection Zones**
- 1
- 2
- 3



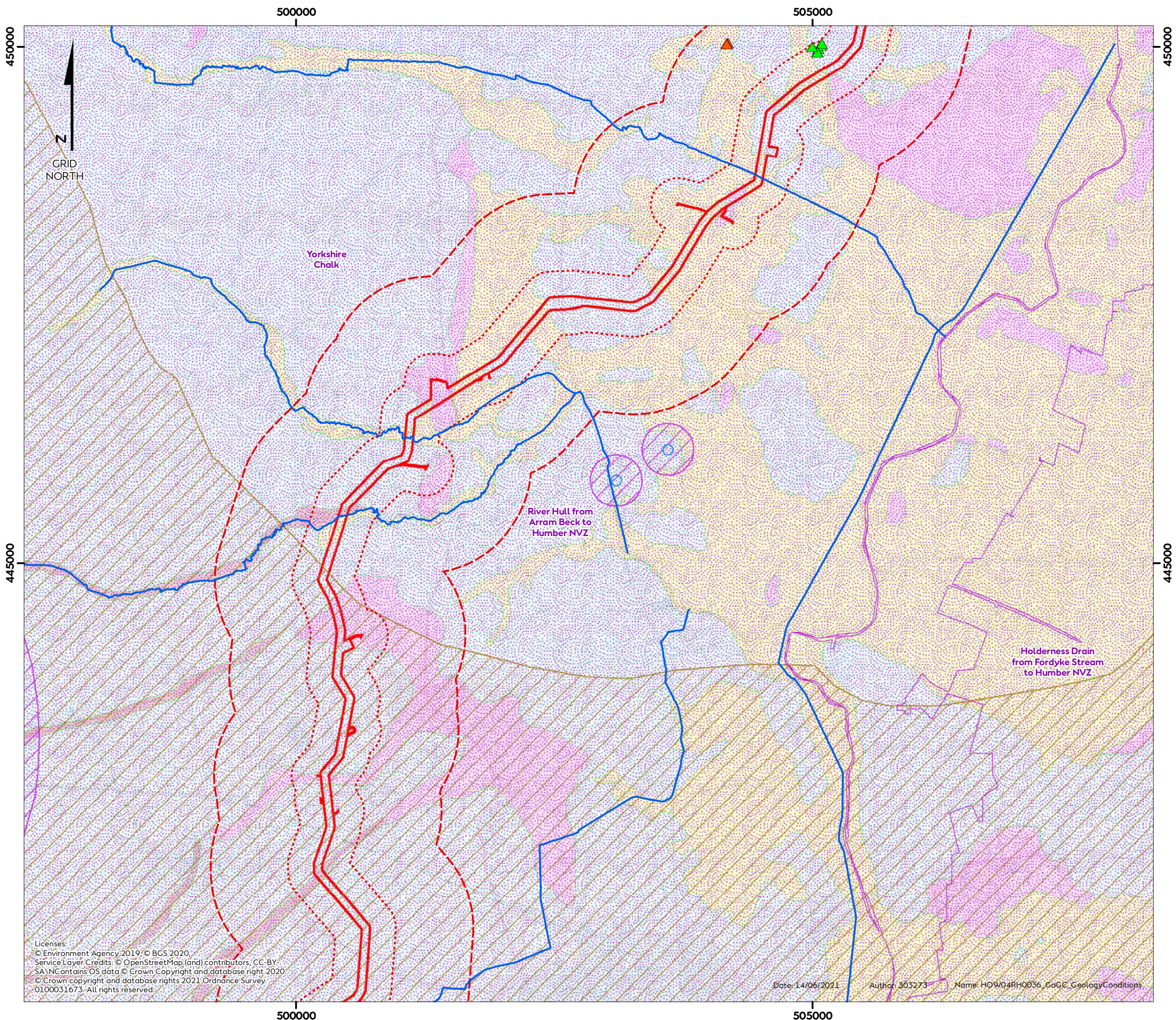
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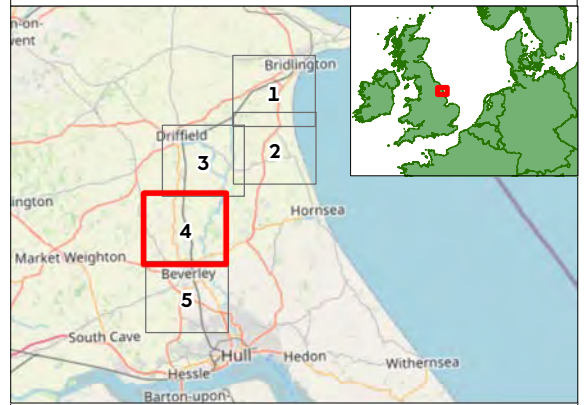
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Hornsea Four

Figure 5
 Geology and Ground Conditions
 within the Onshore ECC #3 of the
 Hornsea Four Land Quality PRA
 Study Area - Sheet 4 of 5

- Order Limits
- 250 m study area
- 1 km Study Area
- WFD water body
- Nitrate Vulnerable Zones - 2017 Designation
- ▲ Abstraction Point - Groundwater
- ▲ Abstraction Point - Surface
- Aquifer Designations - Secondary A**
- Alluvium Sediment
- Aquifer Designation - Unproductive
- Sand and Gravel
- Lacustrine Deposits
- Source Protection Zones**
- 1
- 2
- 3

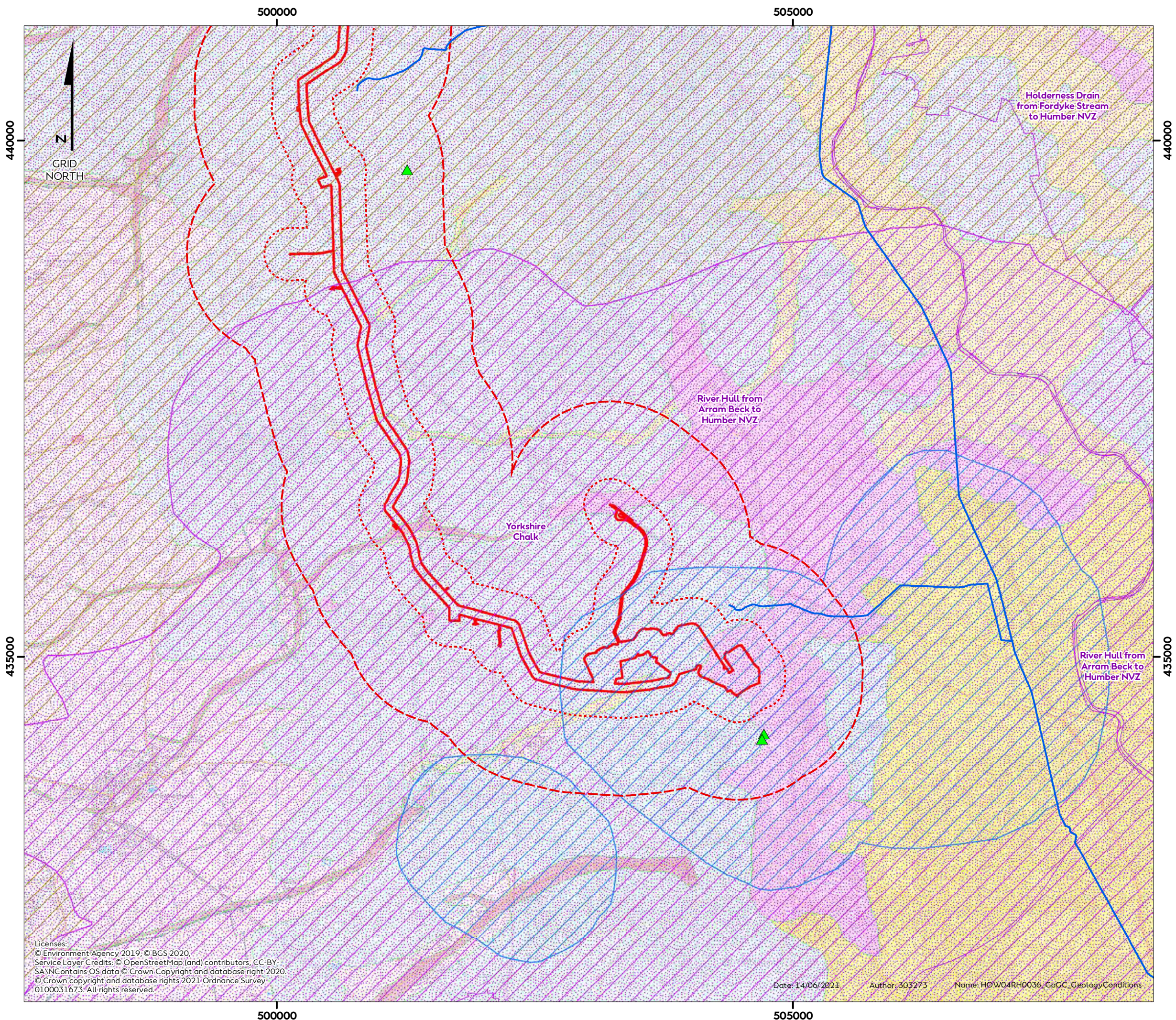


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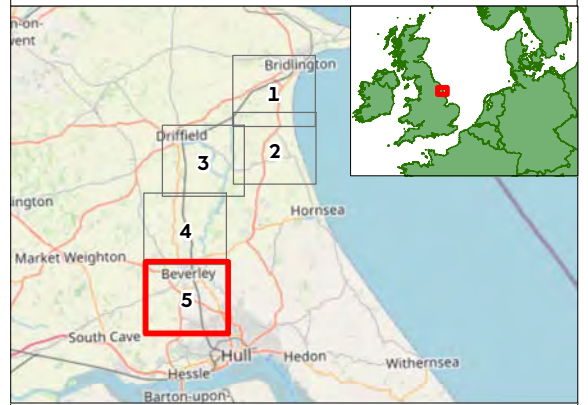


Hornsea Four

Figure 6

Geology and Ground Conditions within the OnSS of the Hornsea Four Land Quality PRA Study Area - Sheet 5 of 5

- Order Limits
 - 250 m study area
 - 1 km Study Area
 - WFD water body
 - Nitrate Vulnerable Zones - 2017 Designation
 - Abstraction Point - Groundwater
- Aquifer Designations - Secondary A**
- Alluvium Sediment
 - Aquifer Designation - Unproductive
 - Sand and Gravel
 - Lacustrine Deposits
- Source Protection Zones**
- 1
 - 2
 - 3



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3.1.2 Mining and Mineral Extraction

3.1.2.1 Information presented on the Coal Authority Interactive Map indicates that Hornsea Four is not located within a coal mining reporting area or in a high-risk development area. Information contained within [Volume A6, Annex 1.2: Envirocheck Report](#) indicates that there are several BGS Recorded Mineral Sites recorded both within the Hornsea Four Order Limits ([Table 5](#)) and within the 250 m Hornsea Four land quality PRA study area ([Table 6](#)).

Table 5: BGS Recorded Mineral Sites within the Hornsea Four Order Limits.

Site Name	Coordinates	Element of Hornsea Four	Commodity	Status
Cottage Pasture Gravel and Sand Pits	501392, 446614	Onshore ECC	Sand and gravel	Ceased
Cottage Pasture Gravel and Sand Pits	501454, 446660	Onshore ECC	Sand and gravel	Ceased
Wilfholme Bridge Gravel Pit	504297, 448606	Onshore ECC	Sand and gravel	Ceased
Gill's Charity	500248, 442822	Onshore ECC	Chalk	Ceased
Bently	501265, 436121	Onshore ECC	Chalk	Ceased

Table 6: BGS Recorded Mineral Sites within the 250 m Hornsea Four land quality PRA study area, exclusive of the Hornsea Four Order Limits.

Site Name	Coordinates	Distance from Hornsea Four Order Limits (m)	Commodity	Status
Bently	501208, 436106	53 m (west of onshore ECC)	Chalk	Ceased
Gill's Charity	500388, 442836	58 m (east of onshore ECC)	Sand and gravel	Ceased
Burn Park Chalk Pit	503625, 434794	25 m (north of onshore ECC)	Chalk	Ceased
Cottage Pasture Gravel and Sand Pits	501435, 446574	1 m (south-east of onshore ECC)	Sand and gravel	Ceased
Cottage Pasture Gravel and Sand Pits	501484, 446570	30 m (south-east of onshore ECC)	Sand and gravel	Ceased
Broadgate Farm	500996, 437894	102 m (east of onshore ECC)	Chalk	Ceased
Burn Park Gravel Pit	503654, 434849	77 m (north of onshore ECC, 95m west of OnSS)	Sand and gravel	Ceased
Pillwoods Farm Gravel Pit	504703, 434626	123 m (south east of OnSS)	Sand and gravel	Ceased
Lockington Gravel Pit	501324, 446861	86 m (north of onshore ECC)	Sand and gravel	Ceased
Gill's Charity	500111, 442857	122 m (west of onshore ECC)	Sand and gravel	Ceased

Site Name	Coordinates	Distance from Hornsea Four Order Limits (m)	Commodity	Status
High Ings Gravel Pit	506462, 451846	124 m (east of onshore ECC)	Sand and gravel	Ceased
Gill's Charity	500451, 442839	121 m (east of onshore ECC)	Sand and gravel	Ceased
Broadgate Farm	500698, 438167	112 m (west of onshore ECC)	Chalk	Ceased
Broadgate Farm	501081, 437950	198 m (east of onshore ECC)	Chalk	Ceased
Gill's Charity	500521, 442871	194 m (east of onshore ECC)	Sand and gravel	Ceased
Fishpond Wood Sand Pit	501463, 435358	208 m (west of onshore ECC)	Sand	Ceased
Tinker's Nook Sand Pit	508331, 454788	215 m (south-east of onshore ECC)	Sand	Ceased

3.1.3 Radon Gas

3.1.3.1 Information presented within [Volume A6, Annex 1.2: Envirocheck Report](#) indicates that Hornsea Four is located within an area where less than 1% of properties are above the action level. As such no radon protection measures are considered necessary within structures constructed within the Hornsea Four Order Limits, including at the OnSS.

3.2 Hydrogeology and Groundwater Vulnerability

3.2.1.1 The superficial Alluvium and Glaciofluvial Deposits within the Hornsea Four Order Limits are classified as Secondary A aquifers and Secondary B aquifers (illustrated on [Figure 2](#) to [Figure 6](#)). Secondary A aquifers are composed of permeable strata capable of supporting water supplies at a local rather than strategic scale, and in some cases form an important source of base flow to rivers. A Secondary B aquifer comprises predominantly lower permeability strata which may, in part, have the ability to store and yield limited amounts of groundwater by virtue of localised features such as fissures, thin permeable horizons and weathering.

3.2.1.2 The Superficial Till Deposits within the Hornsea Four Order Limits are classified as a Secondary Undifferentiated aquifer. Aquifers are given this classification when it has not been possible to attribute either category A or B to a rock type.

3.2.1.3 The Rowe Chalk Formation, Flamborough Chalk Formation and Burnham Chalk Formation within the Hornsea Four Order Limits are classified as Principal aquifers. Aquifers within this classification are composed of geology that exhibits high permeability and/or provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale.

3.2.1.4 **Volume A6, Annex 1.2: Envirocheck Report** indicates that the area within the Hornsea Four Order Limits has been assigned a medium to high groundwater vulnerability risk for the Superficial aquifers and low to high for Principal aquifers. A high groundwater vulnerability designation indicates that the soil is easily able to transmit pollution to groundwater, which is characterised by high leaching potential in soils and the absence of low permeability superficial deposits.

3.2.2 Groundwater Source Protection Zones

3.2.2.1 Groundwater Source Protection Zones (SPZs) are defined around abstraction boreholes used for potable water supply. They delineate the area where the release of a contaminant into the aquifer could impact on the abstraction. There are three types of SPZ:

- The Inner Zone (Zone 1) is the most sensitive and certain activities with potential to pollute groundwater are restricted in this area;
- The Outer Zone (Zone 2) is less sensitive, and there are fewer restrictions; and
- Total Catchment (Zone 3) is outside of Zone 2 and indicates the recharge area that contributes to that water supply.

3.2.2.2 Information presented in **Volume A6, Annex 1.2: Envirocheck Report** indicates that areas of the onshore ECC and OnSS are within Zone 1, Zone 2 and Zone 3 SPZs, as illustrated on **Figure 2** to **Figure 6**).

3.2.3 Groundwater Abstractions

3.2.3.1 There is one record of groundwater abstractions identified within the Hornsea Four Order Limits. Details of the record are provided below:

- J Thompson – groundwater abstraction from the chalk aquifer for the purposes of general farming and domestic. The permit was issued 17th March 1966 for a yearly extraction of 3273 m³ (502800, 447500).

3.2.3.2 A total of 109 groundwater abstractions were identified in the information reviewed within the 1 km Hornsea Four land quality PRA study area (exclusive of the Hornsea Four Order Limits). The majority of the abstractions are associated with general agriculture and domestic uses. **Table 7** summarises both potable groundwater records and other sensitive abstractions within this area (as illustrated on **Figure 2** to **Figure 6**).

Table 7: Groundwater Abstractions within the 1 km Hornsea Four land quality PRA study area, exclusive of the Hornsea Four Order Limits (see Figure 2 to Figure 6).

Permit Holder	Coordinates	Distance from Hornsea Four Order Limits (m)	Abstraction Details
Yorkshire Water Services Ltd.	504720, 434250; and 504700, 434200	447 m and 478 m south east of onshore ECC	Pumping shaft (chalk), daily abstraction rate 68182 m ³ per day, permit issued 27/6/1973 and 2/2/2005, no end date in information available. Groundwater abstracted for public water supply: potable water supply.
J Marr Ltd	505050, 449950; 505057, 449982; 505084, 450015; and 505090, 450030	161 m; 189 m; 208 m; and 218 m north west of onshore ECC	Borehole (chalk), daily abstraction rate not supplied in information received, permit issued 7/8/2003, 1/4/2008, 1/4/2013 and 1/4/2016, no end date in information available. Groundwater abstracted for food and drink: water bottling.
Blue Keld Springs Ltd.	505050, 449950 and 505000, 450000	161 m and 228 m north west of onshore ECC	Borehole (chalk), daily abstraction rate not supplied in information received, permit issued 27/11/2002 and 12/5/2003, no end date in information available. Groundwater abstracted for food and drink: water bottling.

3.3 Hydrology

- 3.3.1.1 Information provided in [Volume A6, Annex 1.2: Envirocheck Report](#) indicates that there are 53 records of water bodies within the Hornsea Four Order Limits. Of these, 50 are recorded as rivers present at the surface and 3 are rivers recorded as underground. The water bodies identified are comprised of both small streams and drainage ditches as well as larger water bodies over 1 km in length.
- 3.3.1.2 A total of 359 water bodies are recorded within the 250 m Hornsea Four land quality PRA study area (exclusive of the Hornsea Four Order Limits). This include 13 lakes and 346 inland rivers, of which 30 are recorded as underground rivers.
- 3.3.1.3 The Environment Agency's Water Framework Directive (WFD) water quality data for all surface waters in the Hornsea Four Order Limits, as presented on the Catchment Data Explorer (last updated January 2019) (Environment Agency, 2019) demonstrates that the water quality does not generally meet the required standards under the WFD and is under pressure from point source pollution from sewage and industrial discharges, and diffuse pollution from agriculture. As a result, concentrations of nutrients such as phosphate, ammonia, and contaminants such as metals are elevated within a large portion of the watercourses within the 250 m Hornsea Four land quality PRA study area (see [Figure 2 to Figure 6](#) for WFD waterbodies).

3.3.2 Surface Water Abstractions

3.3.2.1 There are no records of surface water abstraction identified within the Hornsea Four Order Limits.

3.3.2.2 There are 86 records of surface water abstraction points recorded within the 1 km Hornsea Four land quality PRA study area (exclusive of the Hornsea Four Order Limits). The majority of the abstractions are associated with general agriculture and domestic uses. **Table 8** summarises surface water abstraction points that are deemed to be the most sensitive within this area (see **Figure 2** to **Figure 6**).

Table 8: Surface Water Abstractions within the 1 km Hornsea Four land quality PRA study area, exclusive of the Hornsea Four Order Limits.

Permit Holder	Coordinates	Distance from Hornsea Four Order Limits (m)	Abstraction Details
Yorkshire Wildlife Trust	506588, 454580; 506091, 453895; and 506233, 453951	554 m; 735 m and 621 m north west of onshore ECC	Surface water abstracted (West Beck) for aquaculture. The daily abstraction rate is not provided within the information received. Permit issued 5/9/2012 and 20/1/2014, no end date is provided in the information received.
Yorkshire Wildlife Trust	506750, 454850	662 m north west of onshore ECC	Surface water abstracted (West Beck) for aquaculture. The daily abstraction rate is not provided within the information received. Permit issued 5/9/2012 and 14/3/2016 no end date is provided in the information received.
Mr K Ryder	506580, 454580 and 506090, 453890	559 m and 735 m north west of onshore ECC	Surface water abstracted (West Beck) for aquaculture. The daily abstraction rate is not provided within the information received. Permit issued 13/3/1975, 1/4/2008 and 14/3/2016, no end date is provided in the information received.
Rainbow Springs Fish Farm	506480, 454600 and 506540, 454690	649 m and 665m north west of onshore ECC	Surface water abstracted (West Beck) for aquaculture. The daily abstraction rate is 60 000 m ³ per day. Permit issued 13/10/2006, no end date is provided in the information received.
J Marr Ltd	504182, 450035 and 504170, 450030	743 m and 747 m north west of onshore ECC	Surface water abstracted (spring – Blue Kell) for food and drink: water bottling. The daily abstraction rate is not provided in the information received. Permit issued 1/4/2013, no end date available in information received.
Blue Keld Springs Ltd	504170, 450030	747 m north west of onshore ECC	Surface water abstracted (spring – Blue Kell) for food and drink: water bottling. The daily abstraction rate is not provided in the information received. Permit issued 30/7/2003, no end date available in information received.

3.4 Sensitive Land Use

3.4.1.1 Information provided in [Volume A6, Annex 1.2: Envirocheck Report](#) indicates that there are sensitive land uses recorded within the Hornsea Four Order Limits, details of which are provided below in [Table 9](#) and [Figure 7](#) to [Figure 11](#). Details of sensitive land uses within the 250 m Hornsea Four land quality PRA study area (exclusive of the Hornsea Four Order Limits) are provided in [Table 10](#). These sites are considered, by statutory agencies, to be of special importance due to their intrinsic qualities which are unique to those areas. Thus, they are regarded to be sensitive land uses due to the importance attached to them.

Table 9: Sensitive Land Uses Within the Hornsea Four Order Limits.

Designation	Name of Site	Coordinates	Element of Hornsea Order Limits
SSSI	River Hull Headwaters	507043, 452467 and 509147, 455457	Onshore ECC

Table 10: Sensitive Land Uses Within the 250 m Hornsea Four land quality PRA study area, exclusive of the Hornsea Four Order Limits.

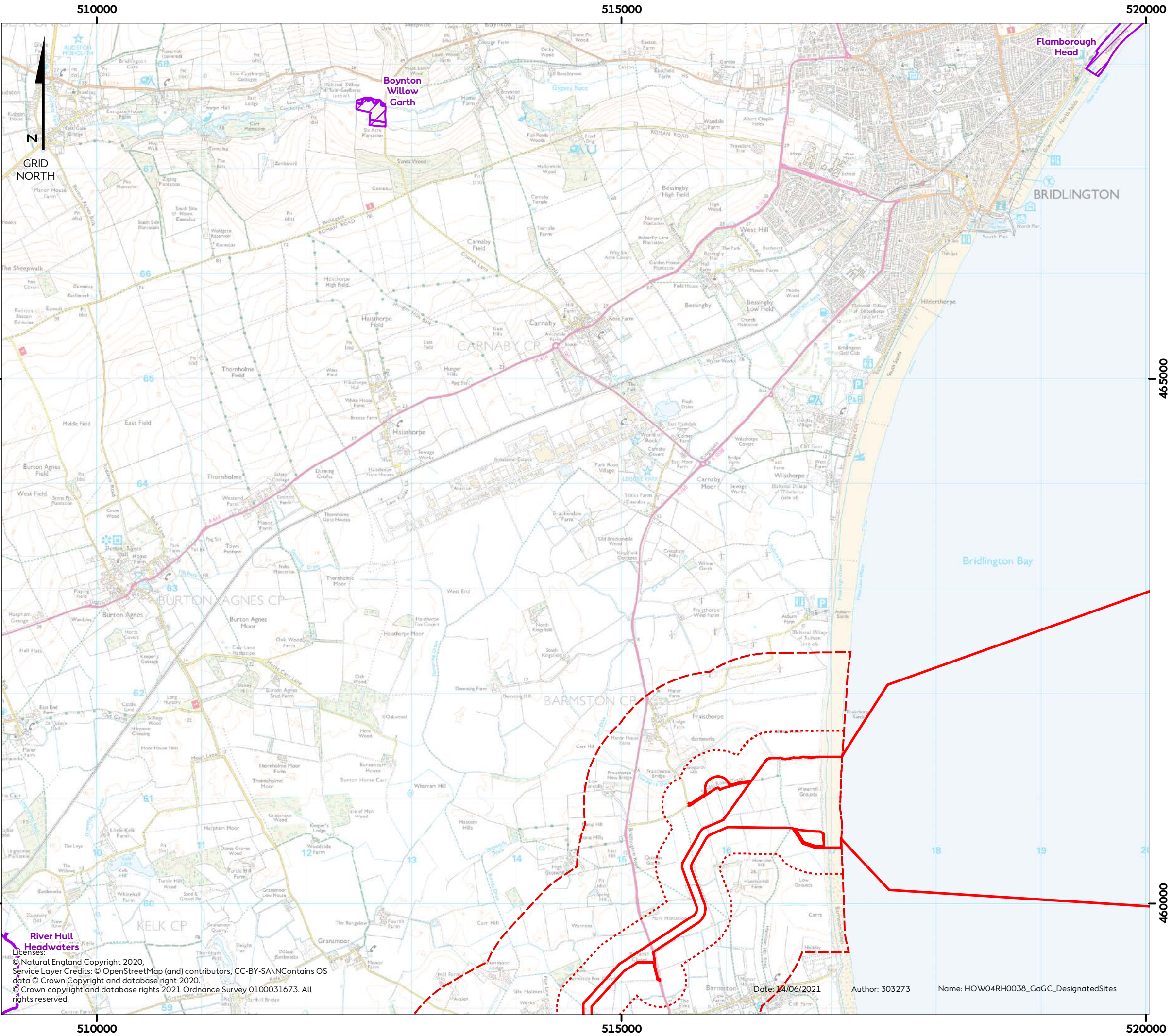
Designation	Name of Site	Distance (m)	Coordinates
SSSI	Bryan Mills Field	120 m (north east of onshore ECC access track)	501338, 446049
		165 m (east of onshore ECC)	501295, 446149

3.4.1.2 The River Hull Headwaters is designated as a SSSI ([Table 9](#)) as the headwaters are nationally important as the most northerly chalk stream system in Britain. The SSSI is currently undergoing river restoration works as 65% of this SSSI were assessed as being in an unfavourable condition by Natural England in 2003.

3.4.1.3 Bryan Mills Field is a SSSI ([Table 10](#)) that comprises a tall fen community which occupies the centre of a small ungrazed field, the surrounding drier areas of which have been planted with trees.

3.4.1.4 Parts of the Hornsea Four Order Limits are located within the following Nitrate Vulnerable Zones (NVZ), as shown in [Figure 2](#) to [Figure 6](#):





- River Hull from Arram Bank to Humber NVZ (surface water);
- Yorkshire Chalk NVZ (groundwater);
- Barmston Sea Drain from Skipsea Drain to North Sea NVZ (surface water); and
- Earls Dyke from source to North Sea NVZ (surface water).

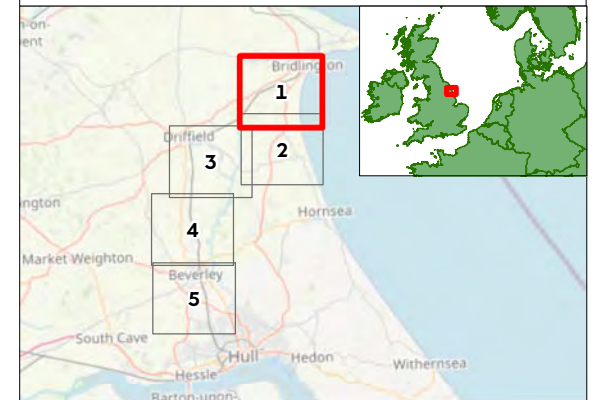


Hornsea Four

Figure 7

Designated Sites in relation to the Hornsea Four Land Quality PRA Study Area (Landfall area) - Sheet 1 of 5

-  Order Limits
-  250 m study area
-  1 km study area
-  Sites of Special Scientific Interest (SSSI)



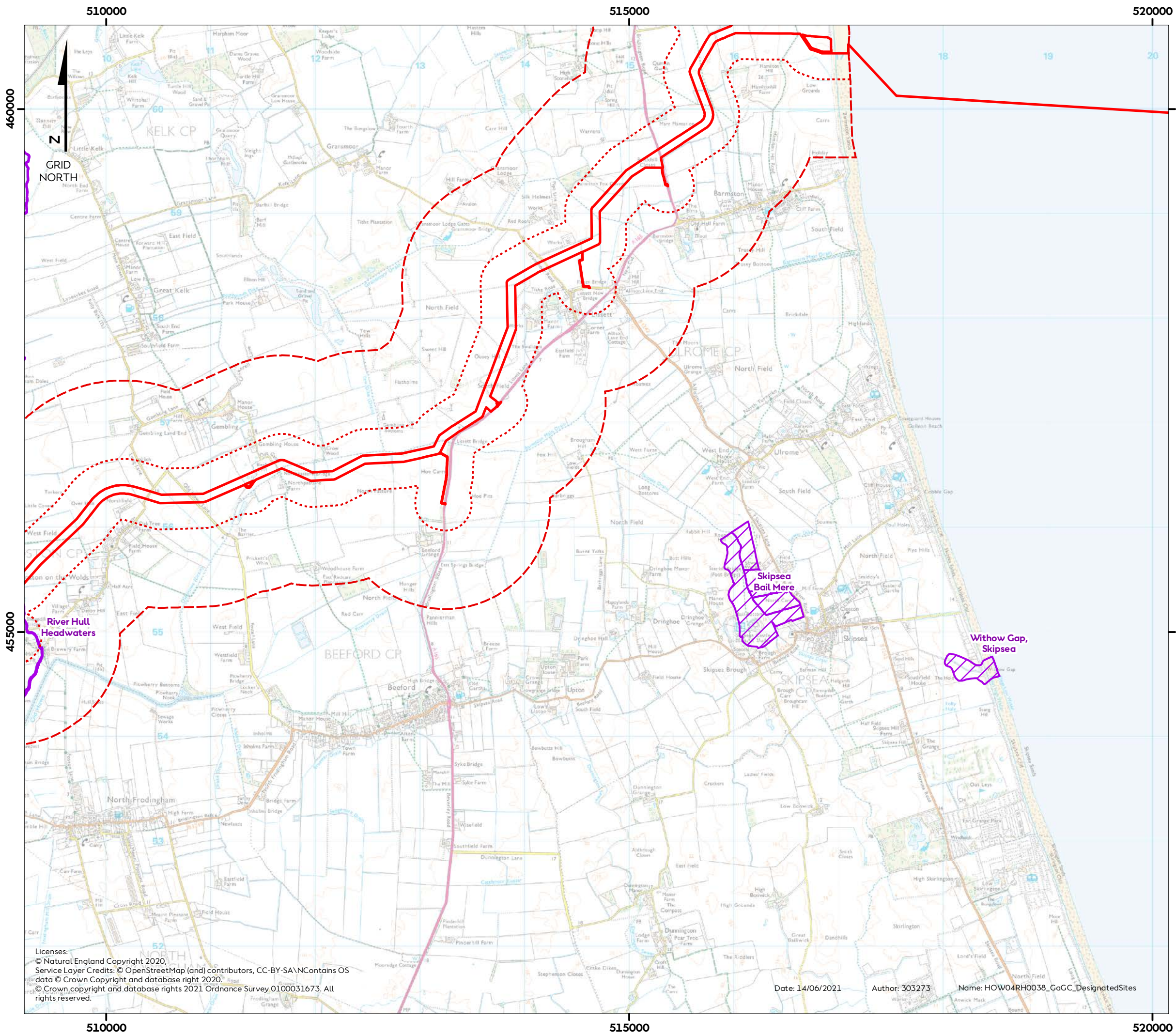
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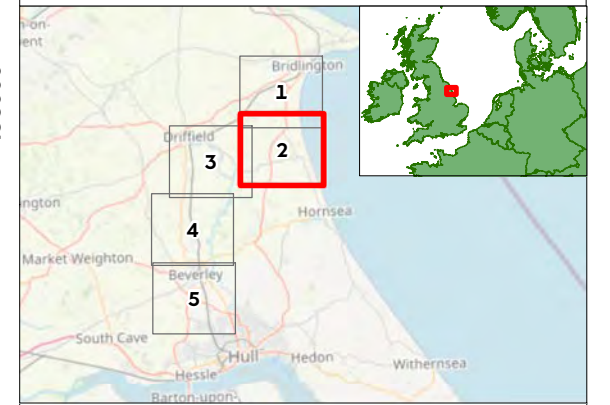


Hornsea Four

Figure 8

Designated Sites in relation to the Hornsea Four Land Quality PRA Study Area (Onshore ECC #1) - Sheet 2 of 5

-  Order Limits
-  250 m study area
-  1 km study area
-  Sites of Special Scientific Interest (SSSI)



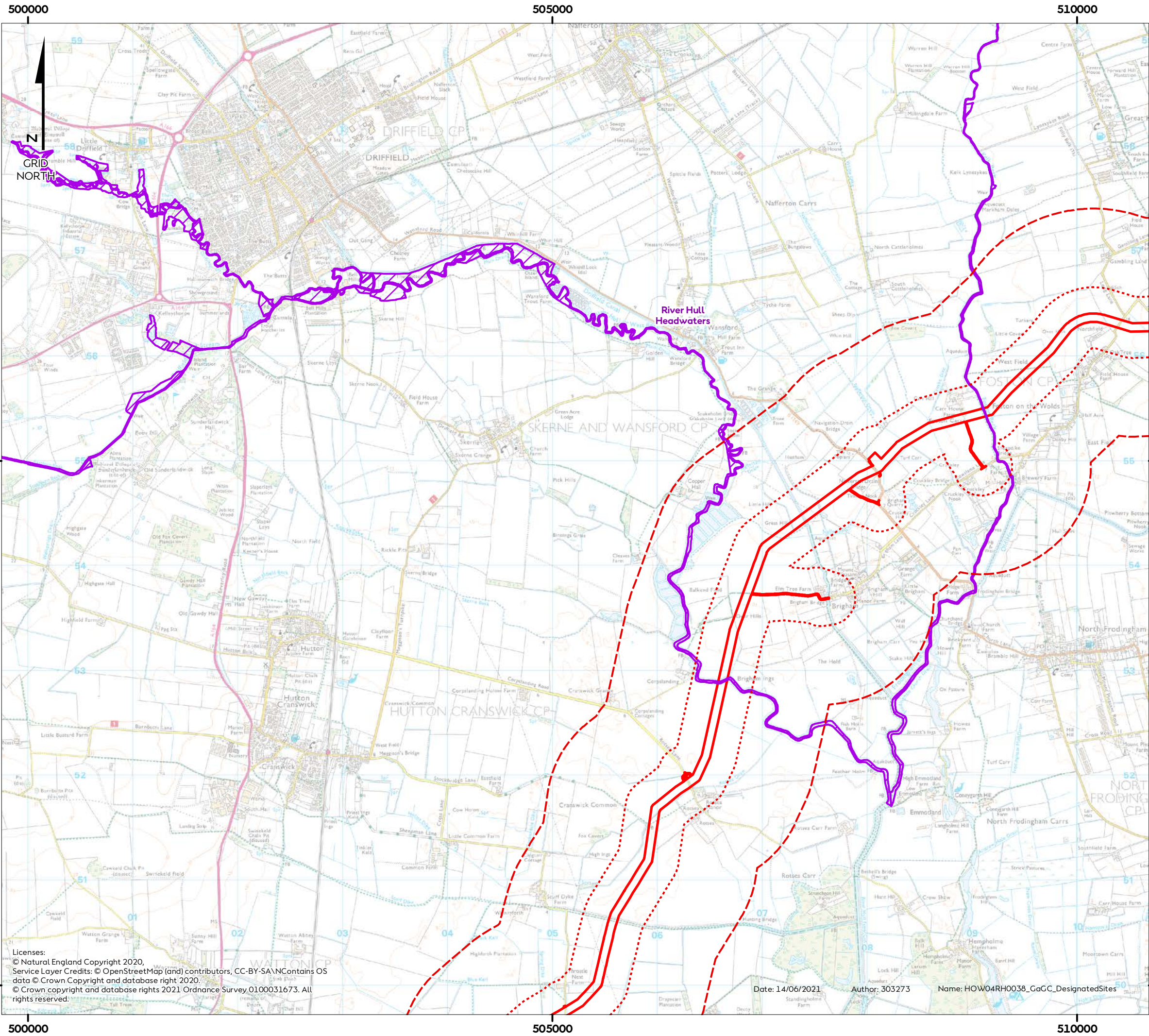
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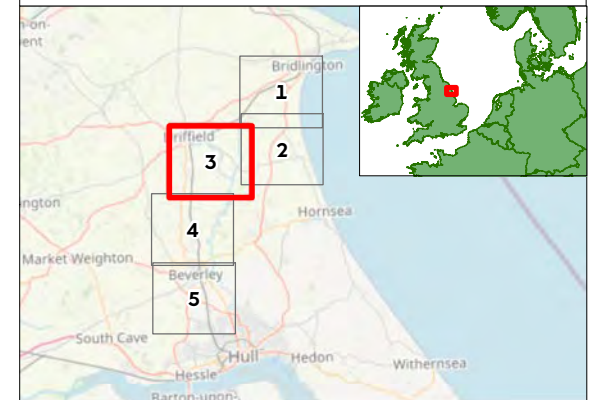


Hornsea Four

Figure 9

Designated Sites in relation to the Hornsea Four Land Quality PRA Study Area (Onshore ECC #2) - Sheet 3 of 5

-  Order Limits
-  250 m study area
-  1 km study area
-  Sites of Special Scientific Interest (SSSI)



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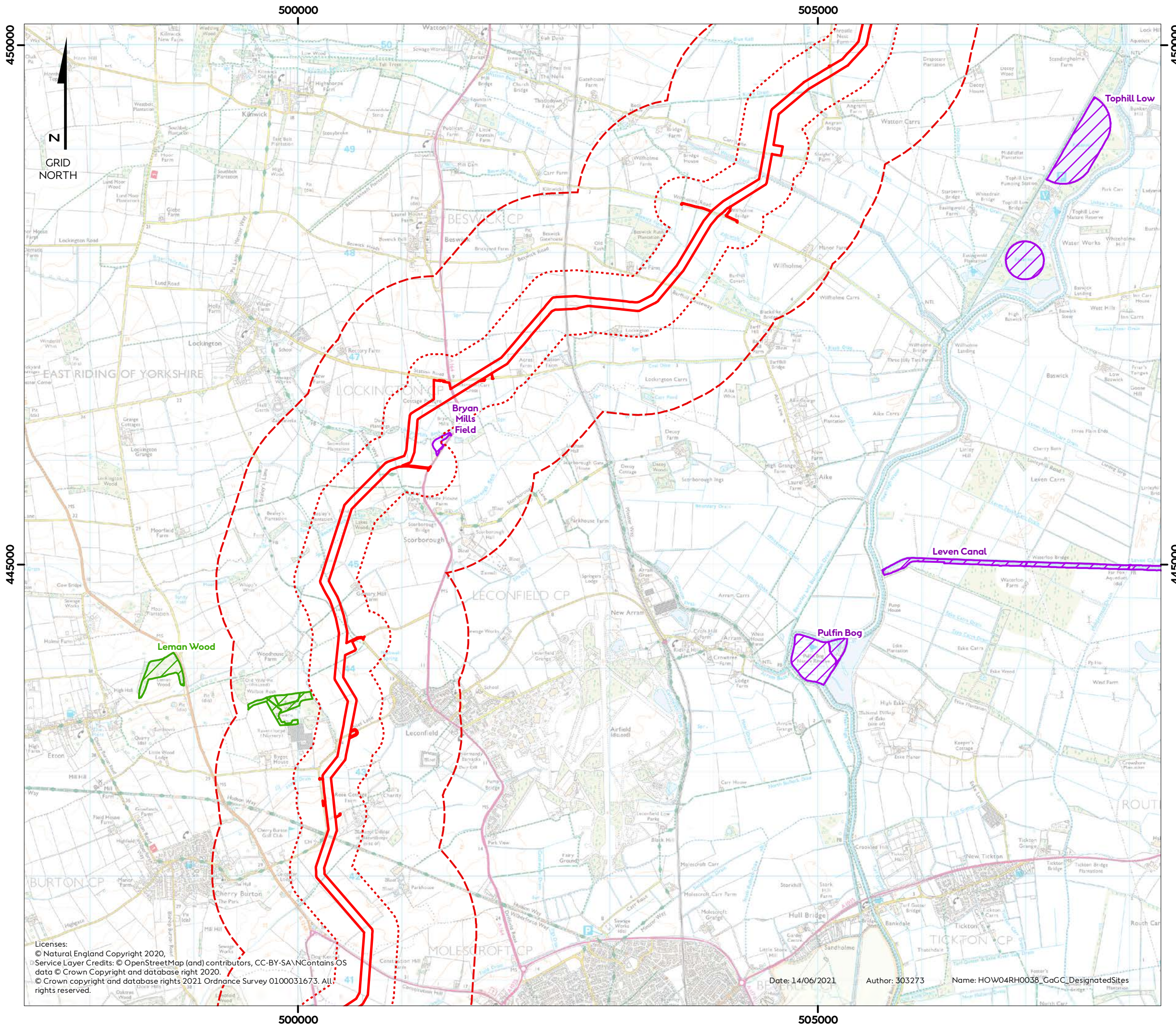
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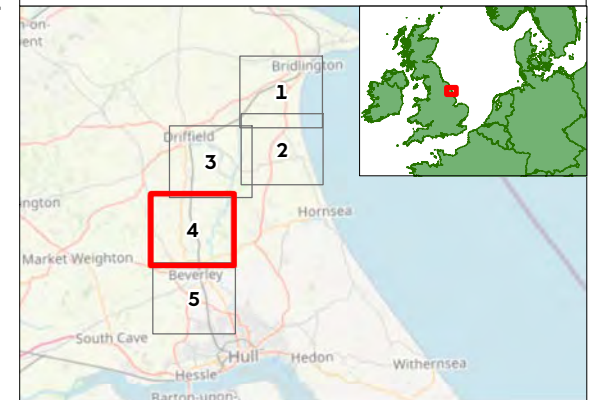


Hornsea Four

Figure 10

Designated Sites in relation to the Hornsea Four Land Quality PRA Study Area (Onshore ECC #3) - Sheet 4 of 5

-  Order Limits
-  250 m study area
-  1 km study area
-  Sites of Special Scientific Interest (SSSI)
-  Ancient Woodland Inventory



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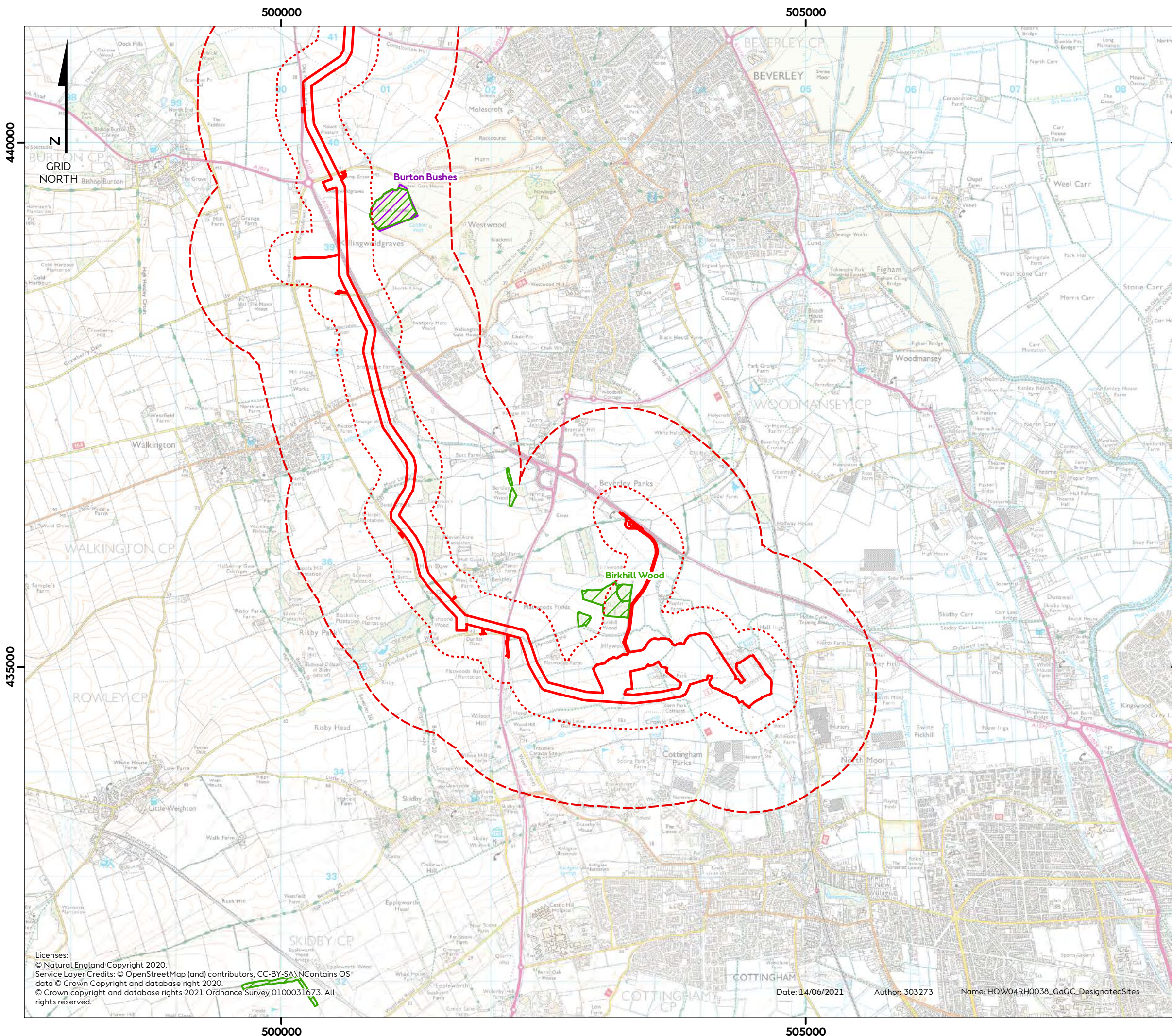
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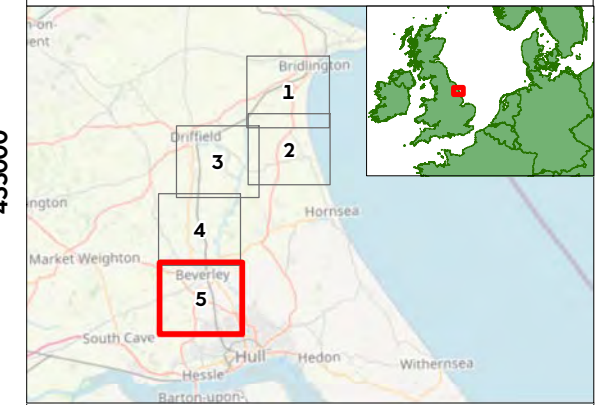


Hornsea Four

Figure 11

Designated Sites in relation to the Hornsea Four Land Quality PRA Study Area (OnSS) - Sheet 5 of 5


-  Order Limits
-  250 m study area
-  1 km study area
-  Sites of Special Scientific Interest (SSSI)
-  Ancient Woodland Inventory



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4 Regulatory Information

- 4.1.1.1 Regulatory information relating to potentially contaminative activities in the vicinity of the Hornsea Four Order Limits has been summarised in [Table 11](#). Further details are provided in [Volume A6, Annex 1.2: Envirocheck Report](#).

Table 11: Regulatory Information (as reported in Volume A6, Annex 1.2: Envirocheck report).

Environmental Records	Number of records within Hornsea Four Order Limits	Number of records within the 250 m Hornsea Four Land Quality PRA Study Area, exclusive of the Hornsea Four Order Limits	Description
Discharge Consents	4	5	<p>The four discharge consents located within the Hornsea Four Order Limits are outlined below:</p> <ul style="list-style-type: none"> • National Grid Transco Plc - trade discharge (site drainage) to a tributary of Creyke Beck. The permit was issued 27 March 2004 and is recorded as revoked in March 2011. (504170, 434970 - OnSS); • National Grid Electricity Transmission Plc - trade discharge (contaminated surface water) to a tributary of Creyke Beck. The permit was issued 1 August 2006, no end date is provided in the information received. (504680, 434850 - OnSS); • David Michaels – discharge of sewage effluent to an unnamed inland water body. The dates of permit issue and end date are not provided within the information received. (501150, 436650 – onshore ECC); and • Stephen Andrew Burley (sewage discharge -final/treated effluent) (501490, 446550 – onshore ECC). <p>The five discharge consents present within the 250 m Hornsea Four land quality PRA study are registered to:</p> <ul style="list-style-type: none"> • National Grid Company Plc - sewage discharge (final/treated effluent) to a tributary of Creyke Beck. The permit was issued 24 September 1997, no end date is provided in the information received. 96 m east (504700, 435000 - OnSS); • Ashfield Farm (sewage discharge -final/treated effluent), 184 m south west (500200, 440800 – of onshore ECC); • East Riding of Yorkshire Council (sewage discharge -final/treated effluent) 241 m west (510400, 456600 – of onshore ECC);

Environmental Records	Number of records within Hornsea Four Order Limits	Number of records within the 250 m Hornsea Four Land Quality PRA Study Area, exclusive of the Hornsea Four Order Limits	Description
			<ul style="list-style-type: none"> Mr Stephen Holtby (sewage discharge -final/treated effluent) 189 m east (501089, 437861 – of onshore ECC); and W H Woods - sewage discharge (treated effluent) to an unnamed water body. The permit was issued 10 January 1986, no end date is provided in the information received. 226m north west (514500, 459200 – of onshore ECC).
Pollution Incidents to Controlled Waters	3	3	<p>Three pollution incidents to controlled waters recorded within the Hornsea Four Order Limits, details of which are provided below:</p> <ul style="list-style-type: none"> Farm: the incident occurred in December 1992 with the pollutant recorded as heating oil. The incident is recorded as a Category 3 – minor incident, the receiving water is reported as Cottingham Drain. (504001, 435001 - OnSS); Farm: the incident occurred in December 1992 with the pollutant recorded as heating oil. The incident is recorded as a Category 3 – minor incident, the receiving water is reported as Cottingham Drain. (504001, 434996 - OnSS); and Farm: the incident occurred in December 1992 with the pollutant recorded as heating oil. The incident is recorded as a Category 3 – minor incident, the receiving water is reported as Cottingham Drain. (504006, 434996 - OnSS). <p>Three pollution incidents to controlled waters have been recorded within the 250 m Hornsea Four land quality PRA study area, details of which are provided below:</p> <ul style="list-style-type: none"> Farm: the incident occurred in February 1991 with the pollutant recorded as heating oil. The incident is recorded as a Category 2 – significant incident, the receiving water was Wanlass Beck and Creyke Beck (confluence of the two). The incident occurred 122 m south of Hornsea Four Order Limits (504500, 434500 of OnSS); Water Company Sewage (foul sewer): the incident occurred in February 1990 with the pollutant involved recorded as crude sewage. The incident is recorded as a Category 3 – minor incident, the receiving water was not reported in the information provided. The incident occurred 142 m south of Hornsea Four Order Limits (509200, 454900 – of Onshore ECC); and Water Company Sewage (sewage treatment works): the incident occurred in October 1994 with the pollutant recorded as sewage (treated effluent). The incident is recorded as a

Environmental Records	Number of records within Hornsea Four Order Limits	Number of records within the 250 m Hornsea Four Land Quality PRA Study Area, exclusive of the Hornsea Four Order Limits	Description
			Category 3 – minor incident, the receiving water was Driffield Canal. The incident occurred 187 m north west of Hornsea Four Order Limits (505101, 450001 of Onshore ECC).
Substantiated Pollution Incidents	1	0	<p>There is one recorded substantiated pollution incident within the Hornsea Four Order Limits, details of which are provided below:</p> <ul style="list-style-type: none"> A Category 2 significant incident (water) occurred in July 2006, the type of pollutant is recorded as general biodegradable materials and wastes (food & drink). (516773, 461397 - landfall).
Registered Landfill, Historic Landfill or other Waste Disposal Sites	N/A – no records of landfills in information available	N/A – no records of landfills in information available	N/A
Local Authority Pollution Prevention and Control Authorisations	N/A – no records of local authority pollution prevention control authorisations in information available	N/A – no records of local authority pollution prevention control authorisations in information available	N/A
Fuel Sites	N/A – no records of fuel sites in information available	N/A – no records of fuel sites in information available	N/A
Contemporary Trade Directory Records (active and former)	0	5	<p>Active entries within the 250 m Hornsea Four land quality PRA study area include the following:</p> <ul style="list-style-type: none"> Food products (manufacturers) – 124 m north (508843, 455569 of onshore ECC). <p>Inactive entries within the 250 m Hornsea Four land quality PRA study area include the following:</p> <ul style="list-style-type: none"> Shredding equipment and services – 230 m north (511399, 456767 – of onshore ECC); Road haulage services – 245 m north west (507836, 455080 – onshore ECC);

Hornsea 4



Environmental Records	Number of records within Hornsea Four Order Limits	Number of records within the 250 m Hornsea Four Land Quality PRA Study Area, exclusive of the Hornsea Four Order Limits	Description
			<ul style="list-style-type: none">• Agricultural engineers – 233 m north west (500202, 440846 of onshore ECC); and• Agricultural machinery sales and service – 233 m north west (500202, 440846 – of onshore ECC).

5 Preliminary Conceptual Site Model and Qualitative Assessment

5.1 Preliminary Conceptual Site Model

5.1.1.1 Current guidance recommends that a Conceptual Site Model (CSM) is formulated based on the information available (Environment Agency Land Contamination: Risk Management (Environment Agency, 2019). As more information becomes available the CSM may be updated.

5.1.1.2 The CSM is based on the identification and assessment of potential sources, potential receptors, and the anticipated pathways to those receptors, identified as a result of desk-based research. For contamination within soil and water to pose a risk, a feasible pollutant linkage must be established.

5.1.1.3 A pollutant linkage consists of three parts, and where all three of these are present, a feasible pollutant linkage exists:

- A source of contamination in or on the land;
- A viable pathway by which the contaminant is able to cause harm (or which presents a significant possibility of such harm being caused); and
- A receptor which is sensitive to impact from the contamination.

5.2 Potential Sources

5.2.1.1 Potential sources of contamination within the Hornsea Four Order Limits are presented in **Table 12** and illustrated in **Figure 12** to **Figure 18**.

Table 12: Potential Sources of Contamination within the Hornsea Four Order Limits (see Figure 12 to Figure 18).

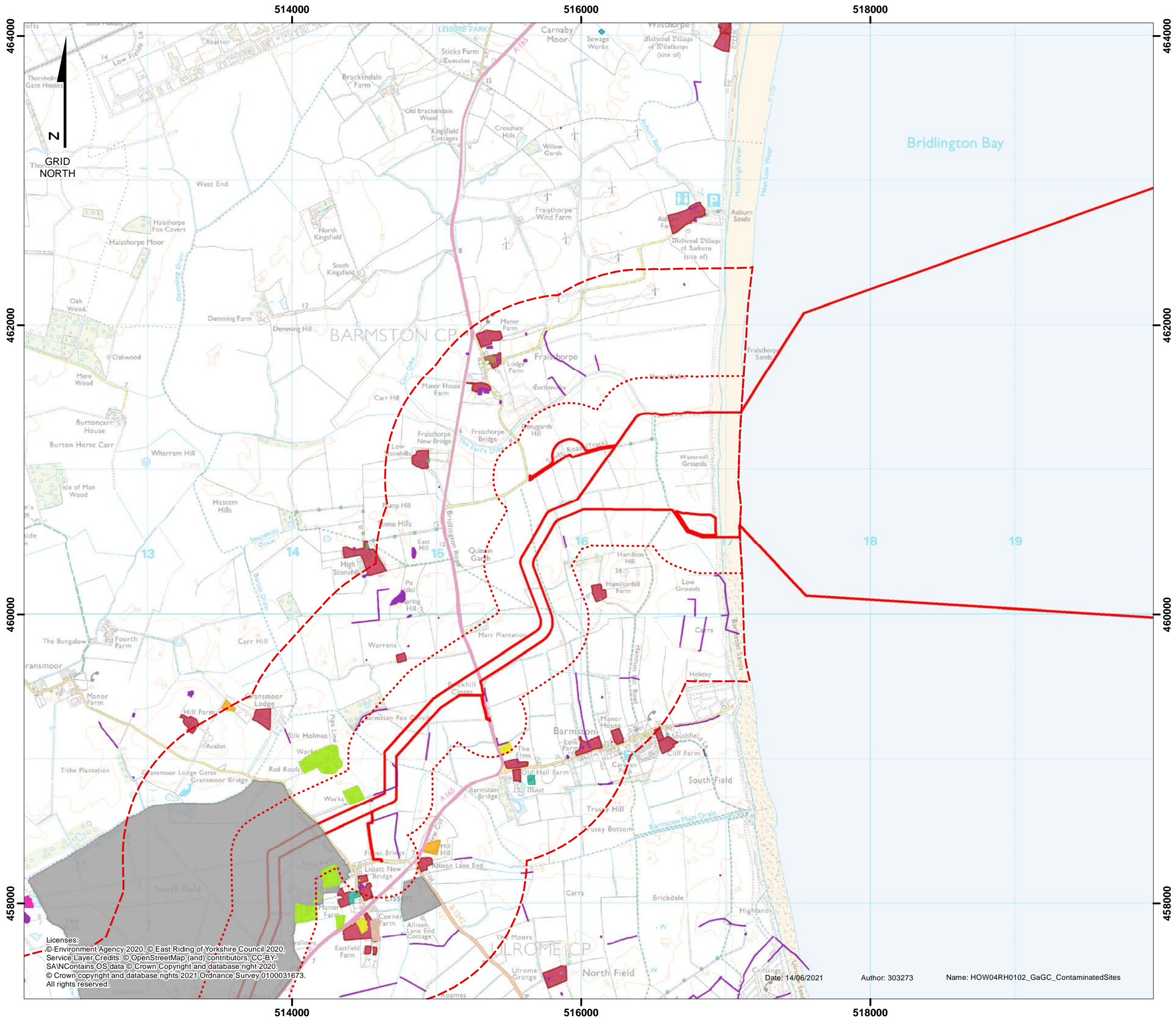
Potential Source	Potential Contaminants of Concern (PCOC)
Gravel, sand and chalk pits (backfilled)	The contaminants of concern (including asbestos) associated with the backfilling of the pits are dependent on the age of emplacement and materials used. With increasing age of emplacement, the risks posed by PCOC may have decreased. It is not known from the information received how many of the pits have been backfilled and whether any of the pits were officially utilised as landfills. There is the potential for ground gases to be present within backfilled pits, again this is dependent on the materials used.
Agricultural land use	In addition to herbicides and pesticides it is not uncommon for discarded material to be buried on farm land such as demolition rubble associated with remodelling works and can include asbestos sheeting and old farm machinery.
Railway and sidings	Active and historical railway activity is a potential source of contamination. These activities are historically associated with herbicides, metals, hydrocarbons and sulphates (Department of Environment – Industry Profiles). A range of PCOC, including asbestos, can also be associated with the materials used within the track bedding material and fill used in the formation of embankments.

Potential Source	Potential Contaminants of Concern (PCOC)
Electricity substations and pylons	Potential sources of PCBs and oils associated with possible electrical equipment, plant, interceptors and oil storage tanks.
Unspecified works	A number of unspecified works have been recorded within the Hornsea Four Order Limits, therefore a range of PCOC may be associated with these areas.
Unspecified tanks	A number of unspecified tanks have been recorded within the Hornsea Four Order Limits, therefore a range of PCOC may be associated with these areas.
Landfill	It is not known from the information received whether former gravel/sand/chalk pits were utilised as either official or unofficial landfill sites, therefore a range of PCOC may be associated with these areas.

5.2.1.2 Several current and historical activities undertaken within 250 m Hornsea Four land quality PRA study area (exclusive of the Hornsea Four Order Limits) also have the potential to release contaminants into the ground, which may have subsequently migrated to the site in groundwater. These are identified in **Table 13** and illustrated in **Figure 12** to **Figure 18**.

Table 13: Potential Sources of Contamination within the 250 m Hornsea Four Land Quality PRA Study Area, exclusive of the Hornsea Four Order Limits.

Potential Source	Potential Contaminations of Concern (PCOC)
Railway line and stations	Active and historical railway activity is a potential source of contamination. These activities are historically associated with herbicides, metals, hydrocarbons and sulphates (Department of Environment – Industry Profiles).
Gravel, sand and chalk pits (backfilled)	The contaminants of concern (including asbestos) associated with the backfilling of the pits are dependent on the age of emplacement and materials used. With increasing age of emplacement, the risks posed by PCOC may have decreased. It is not known from the information received how many of the pits have been backfilled and whether any of the pits were officially utilised as landfills. There is the potential for ground gases to be present within backfilled pits, again this is dependent on the materials used.
Sewage works	A sewage works, to the immediate east of the onshore ECC, has been recorded within the Hornsea Four land quality PRA study area (250 m buffer) The processing of sewage could have led to a wide range of contaminants being present at these locations, depending on the site’s full operational histories and usage. The Department of Environment (DoE) Industry Profile for sewage works and sewage farms indicated that the PCOCs likely to be present include metals, metalloids and their compounds, organic and inorganic PCOC, acids and asbestos.
Unspecified works	A number of unspecified works have been recorded within 250 m of Hornsea Four land quality PRA study area, therefore a range of PCOC may be associated with these areas.
Electricity substations and pylons	Potential sources of PCBs and oils associated with possible electrical equipment, plant, interceptors and oil storage tanks.
Tip and landfill	It is not known from the information received whether former gravel/sand/chalk pits were utilised as either official or unofficial landfill sites, therefore a range of PCOC may be associated with these areas.

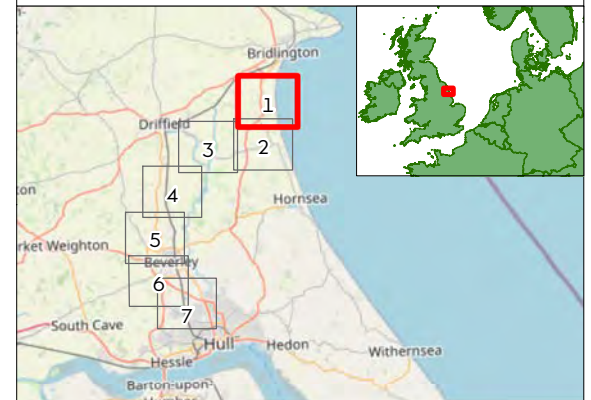


Hornsea Four

Figure 12

Potential Sources of Contamination within the Hornsea Four Order Limit and Hornsea Four Land Quality PRA Study Area (Landfall) - Sheet 1 of 7

- Order Limits
 - 250 m Study Area
 - 1 km Study Area
 - Authorised Landfill Site
- Potentially Contaminated Land**
- Cemetery
 - Part B Installation
 - Depot
 - Petroleum
 - Electricity Sub Station
 - Possible Landfill
 - Farm - Out Buildings
 - Sewage
 - General Works
 - Sheep Dips
 - Historic Landfill Site
 - Tank
 - MoD Land
 - Timber Saw Mills

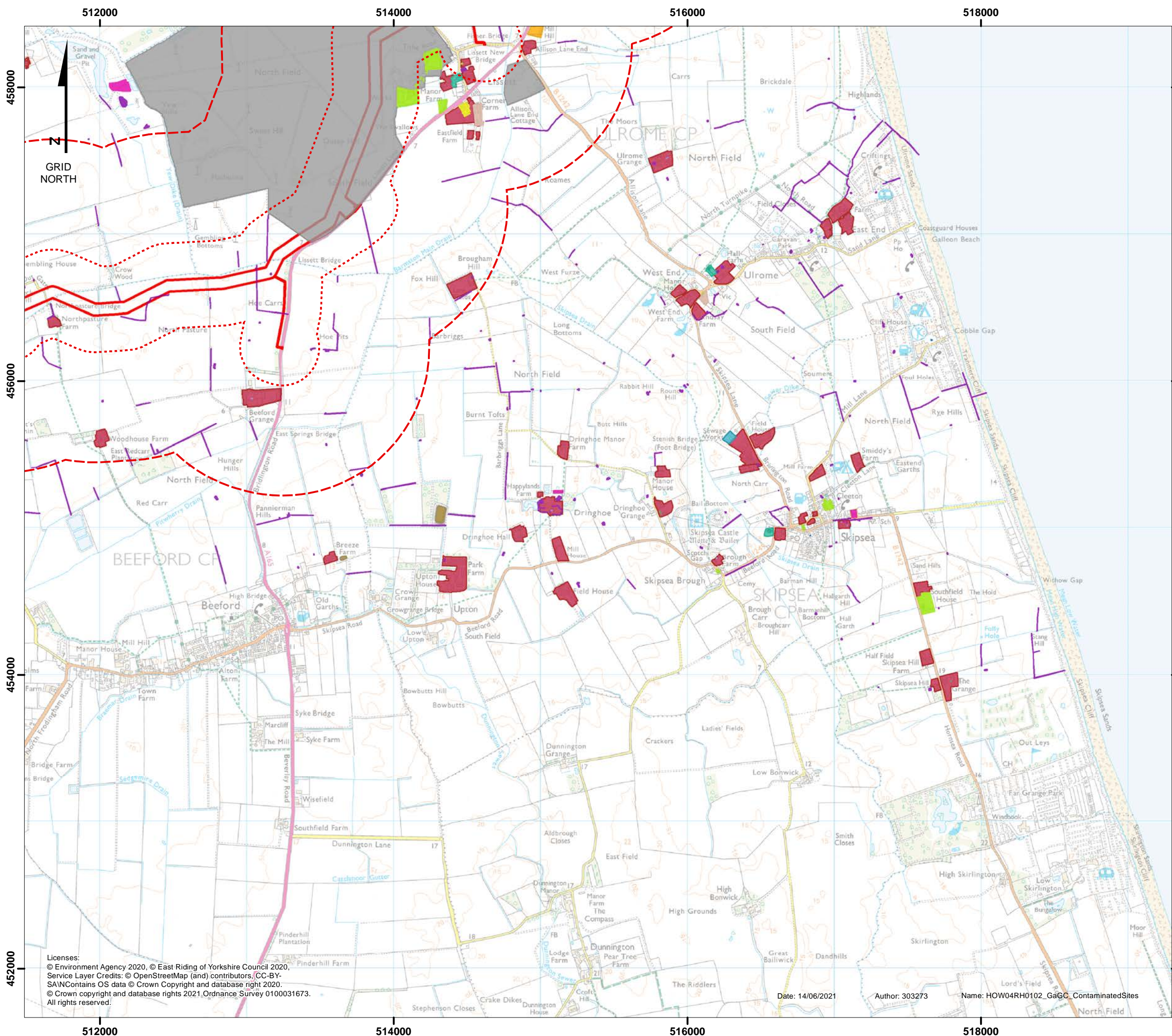


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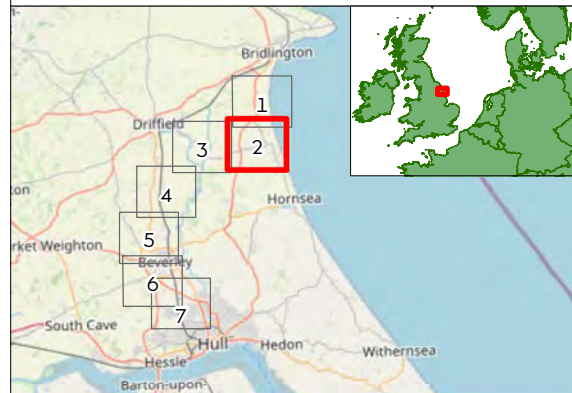


Hornsea Four

Figure 13

Potential Sources of Contamination within the Hornsea Four Order Limit and Hornsea Four Land Quality PRA Study Area (ECC #1) - Sheet 2 of 7

- Order Limits
 - 250 m Study Area
 - 1 km Study Area
 - Authorised Landfill Site
- Potentially Contaminated Land**
- | | |
|---|---|
| Cemetery | Part B Installation |
| Chemical Works | Petroleum |
| Depot | Possible Landfill |
| Electricity Sub Station | Sewage |
| Farm - Out Buildings | Sheep Dips |
| General Works | Slurry Ponds |
| Historic Landfill Site | Tank |
| MoD Land | Timber Saw Mills |



Coordinate system: British National Grid
 Scale@A3: 1:25,000
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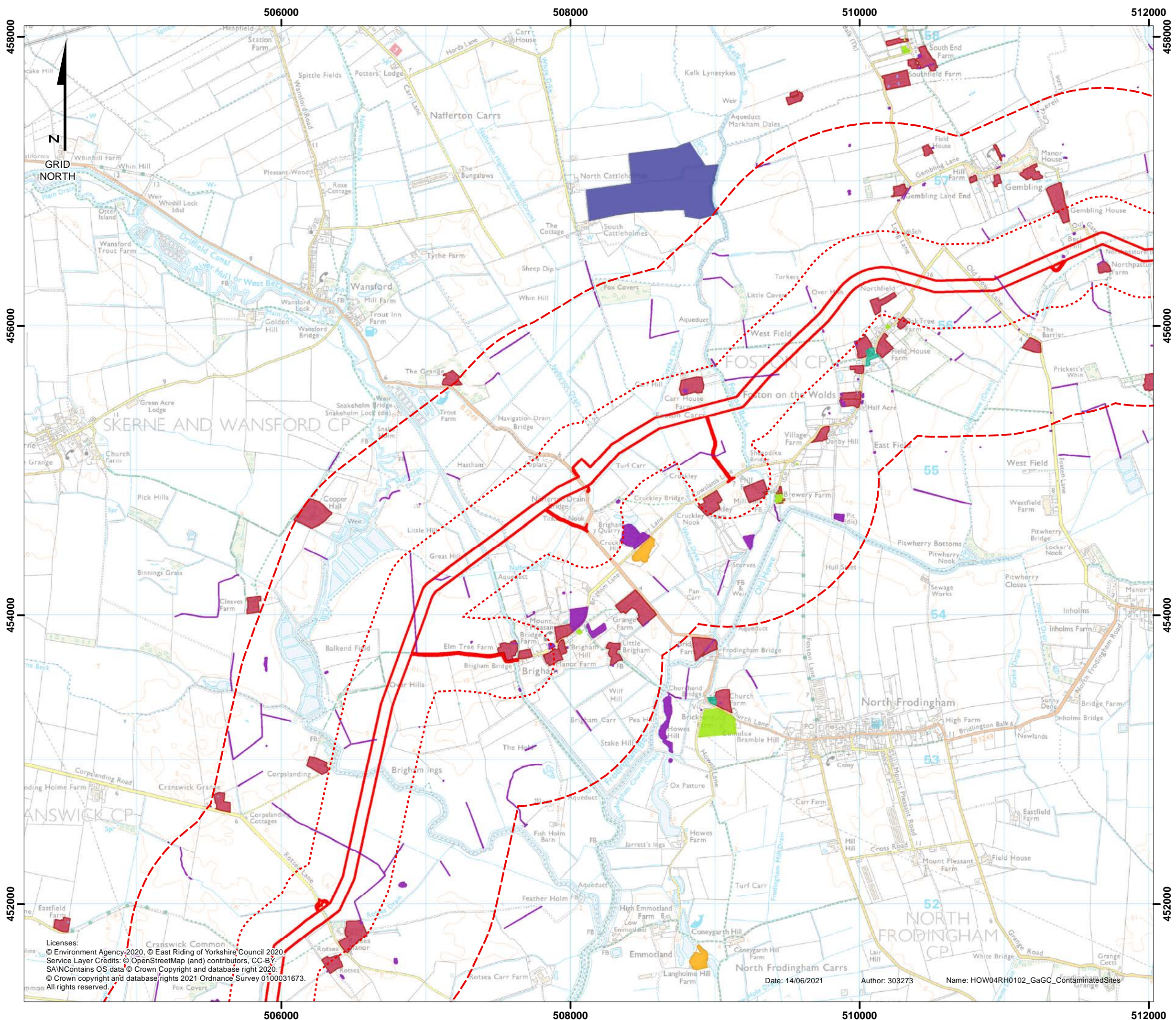
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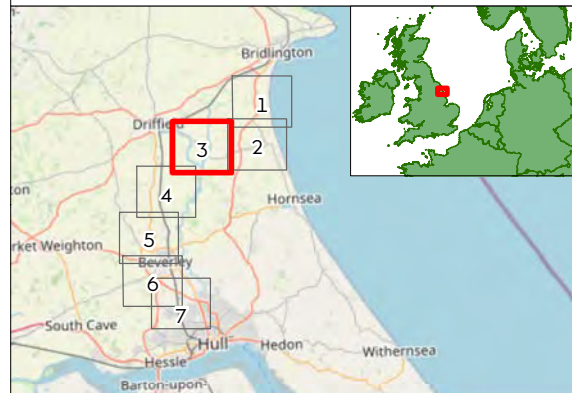


Hornsea Four

Figure 14

Potential Sources of Contamination within the Hornsea Four Order Limit and Hornsea Four Land Quality PRA Study Area (ECC #2) - Sheet 3 of 7

- Order Limits
 - 250 m Study Area
 - 1 km Study Area
 - Authorised Landfill Site
- Potentially Contaminated Land**
- Cemetery
 - Farm - Out Buildings
 - General Works
 - Historic Landfill Site
 - Possible Landfill
 - Sewage Sludge Disposal
 - Tank
 - Tannery

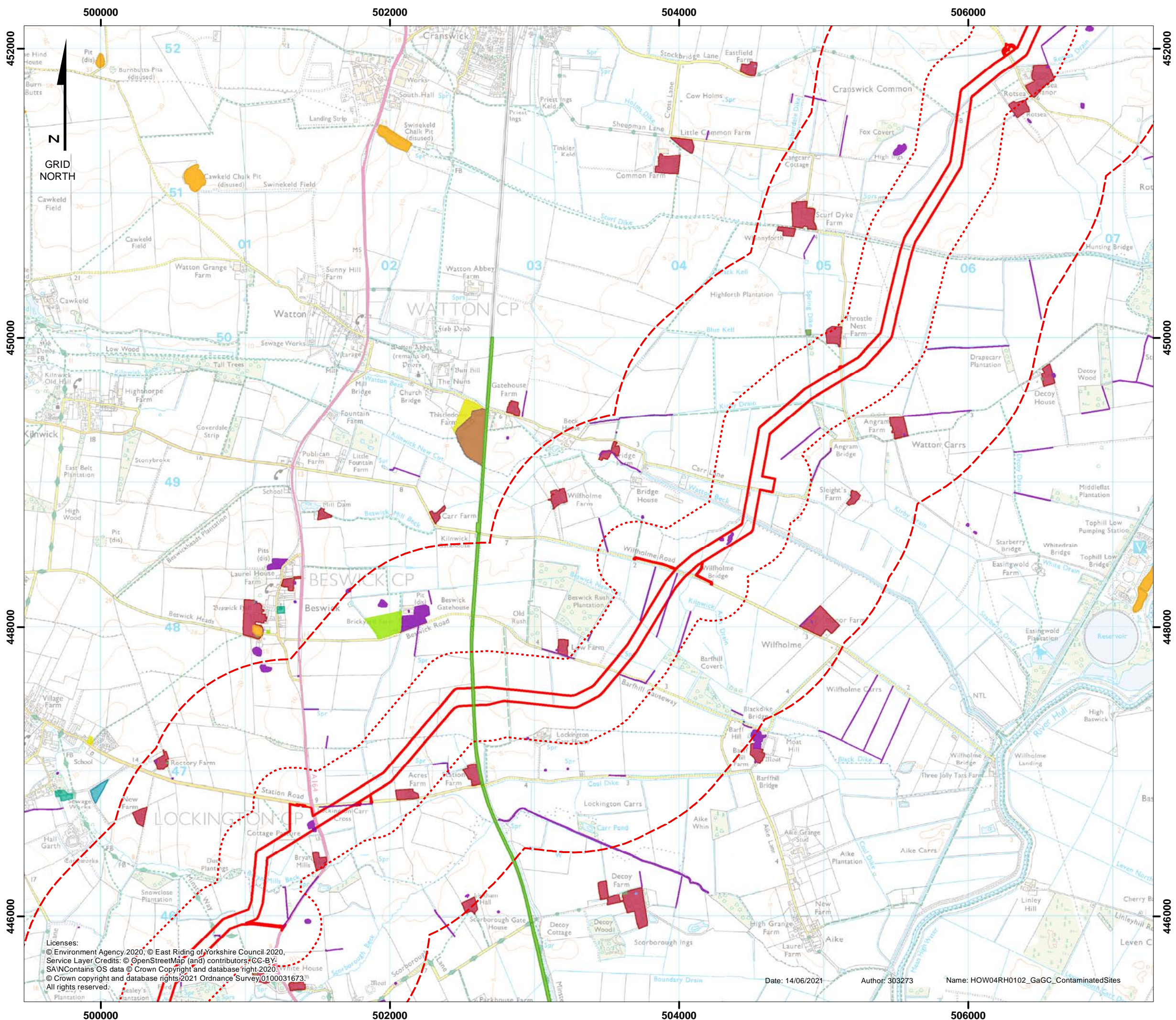


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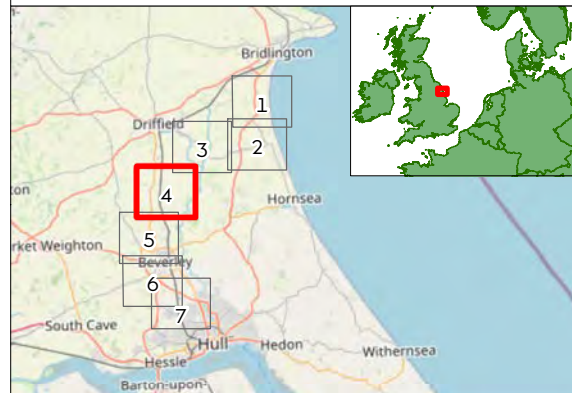


Hornsea Four

Figure 15

Potential Sources of Contamination within the Hornsea Four Order Limit and Hornsea Four Land Quality PRA Study Area (ECC #3) - Sheet 4 of 7

- Order Limits
 - 250 m Study Area
 - 1 km Study Area
 - Authorised Landfill Site
- Potentially Contaminated Land**
- Cemetery
 - Historic Landfill Site
 - Depot
 - Petroleum
 - Electricity Sub Station
 - Possible Landfill
 - Existing Railway
 - Sewage
 - Farm - Out Buildings
 - Sheep Dips
 - General Works
 - Slurry Ponds
 - Tank



Coordinate system: British National Grid
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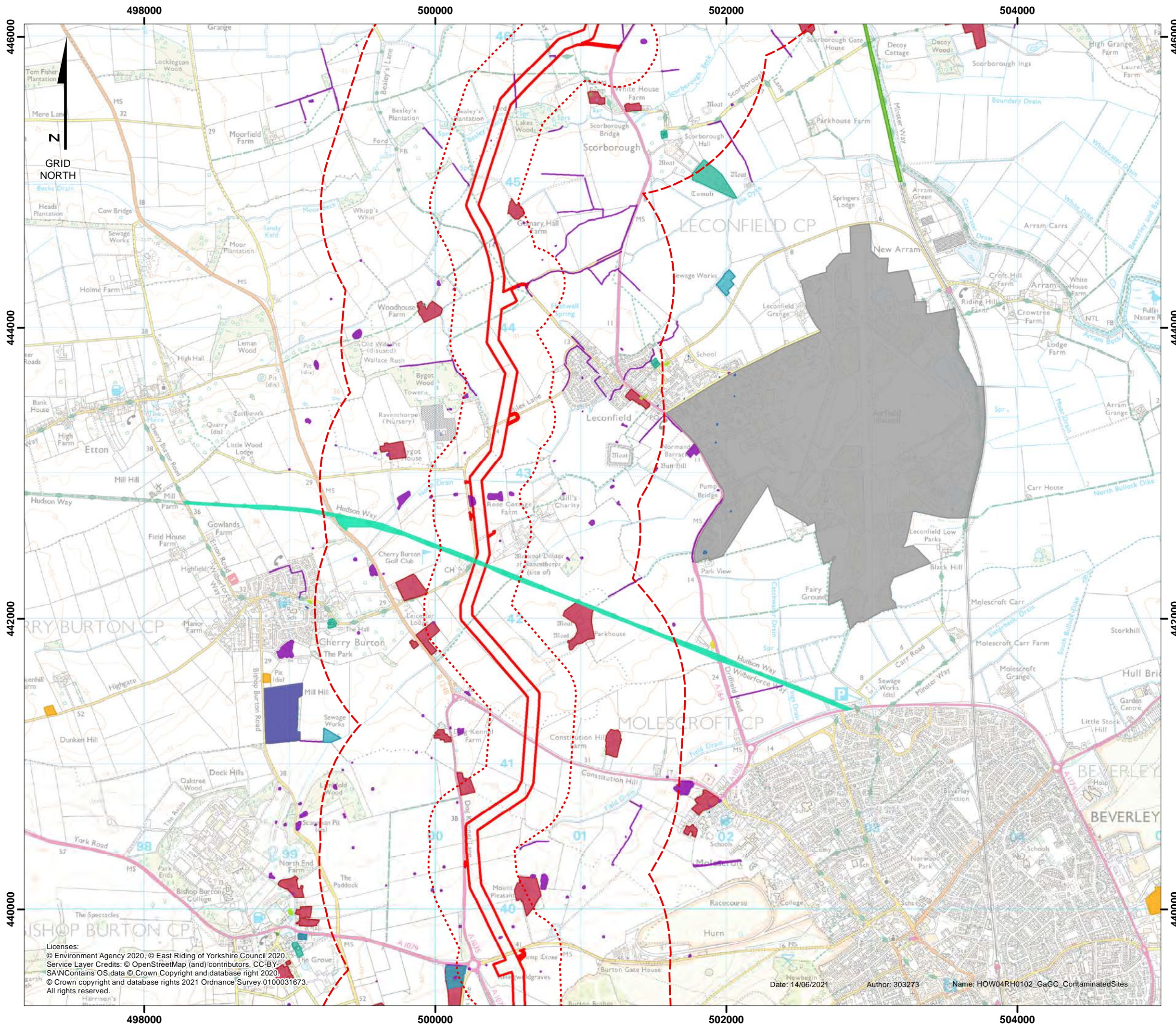
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Hornsea Four

Figure 16

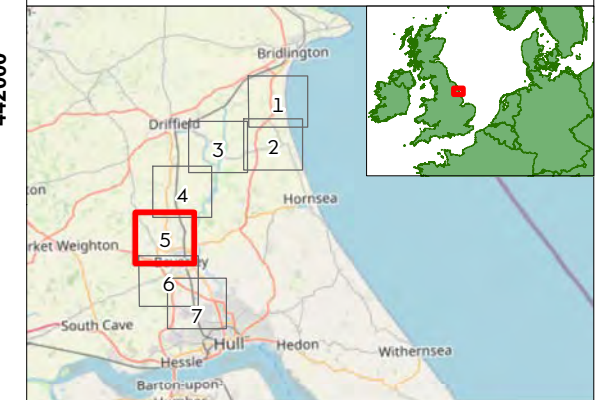
Potential Sources of Contamination within the Hornsea Four Order Limit and Hornsea Four Land Quality PRA Study Area (ECC #4) - Sheet 5 of 7

Order Limits

- Order Limits (Red solid line)
- 250 m Study Area (Red dashed line)
- 1 km Study Area (Red dotted line)
- Authorised Landfill Site (Pink polygon)

Potentially Contaminated Land

- Cemetery (Light green)
- Old/Disused Railways (Light blue)
- Depot (Brown)
- Petroleum (Yellow)
- Electricity Sub Station (Blue)
- Possible Landfill (Purple)
- Existing Railway (Green)
- Sewage (Light blue)
- Farm - Out Buildings (Red)
- Sewage Sludge Disposal (Dark blue)
- General Works (Light green)
- Sheep Dips (Dark green)
- Hospital (Blue)
- Slurry Ponds (Brown)
- Historic Landfill Site (Orange)
- Tank (Light blue)
- MoD Land (Grey)



Coordinate system: British National Grid
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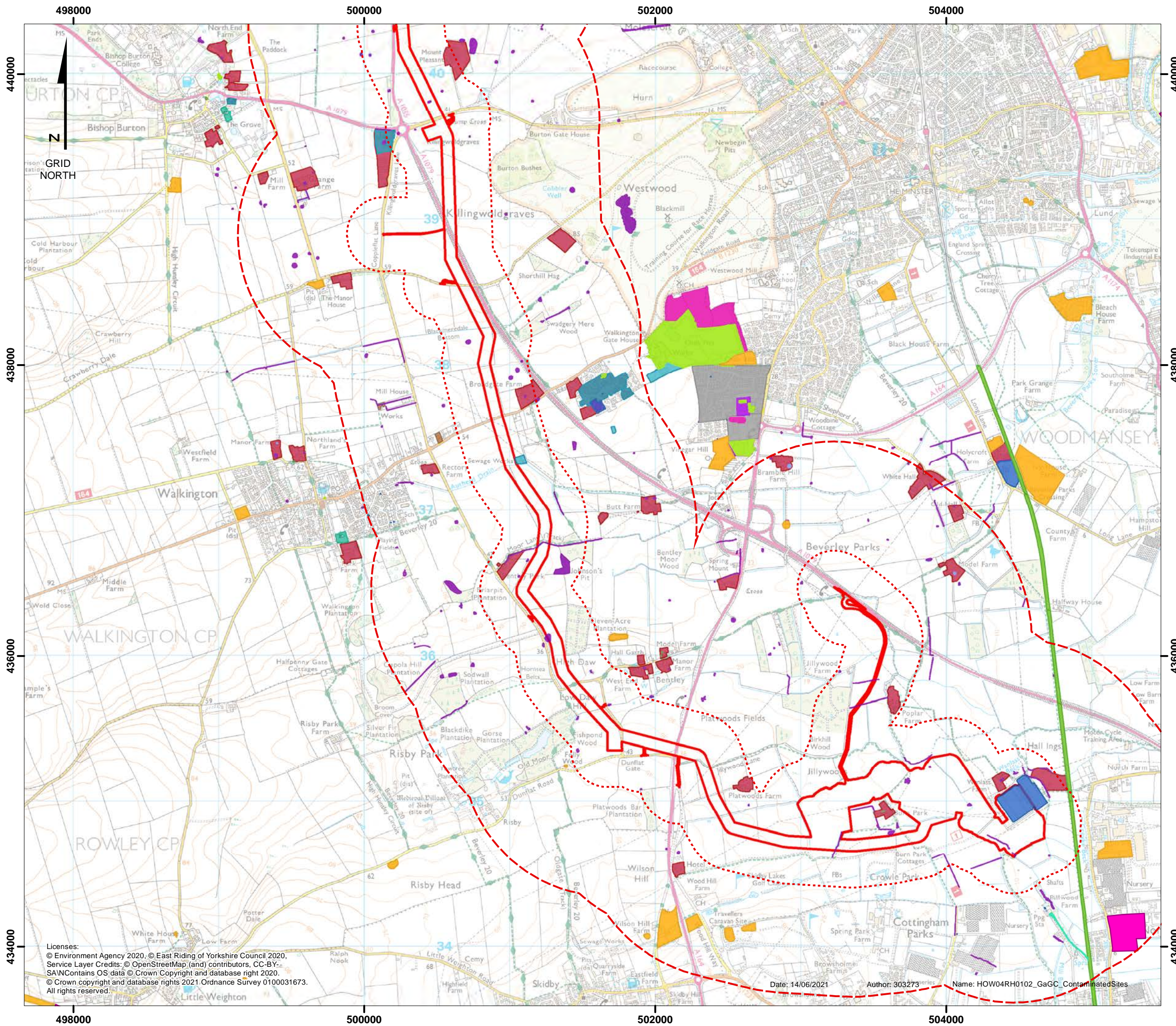
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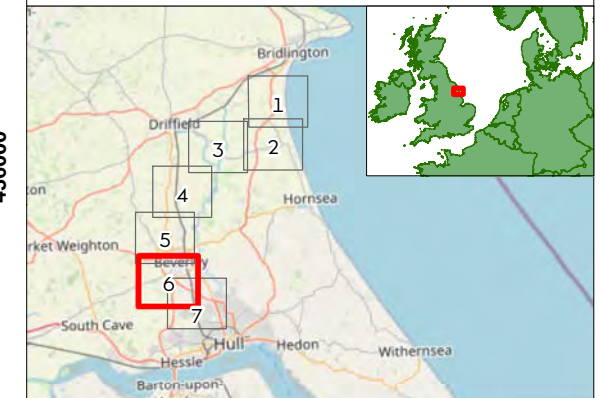


Hornsea Four

Figure 17

Potential Sources of Contamination within the Hornsea Four Order Limit and Hornsea Four Land Quality PRA Study Area (OnSS #1) - Sheet 6 of 7

- Order Limits
 - 250 m Study Area
 - 1 km Study Area
 - Authorised Landfill Site
- Potentially Contaminated Land**
- | | |
|---|--|
| Cemetery | MoD Land |
| Depot | Old/Disused Railways |
| Electricity Sub Station | Part B Installation |
| Existing Railway | Petroleum |
| Farm - Out Buildings | Possible Landfill |
| Gas Works | Sewage |
| General Works | Sheep Dips |
| Hospital | Tank |
| Industrial Estate | Timber Saw Mills |
| Historic Landfill Site | |



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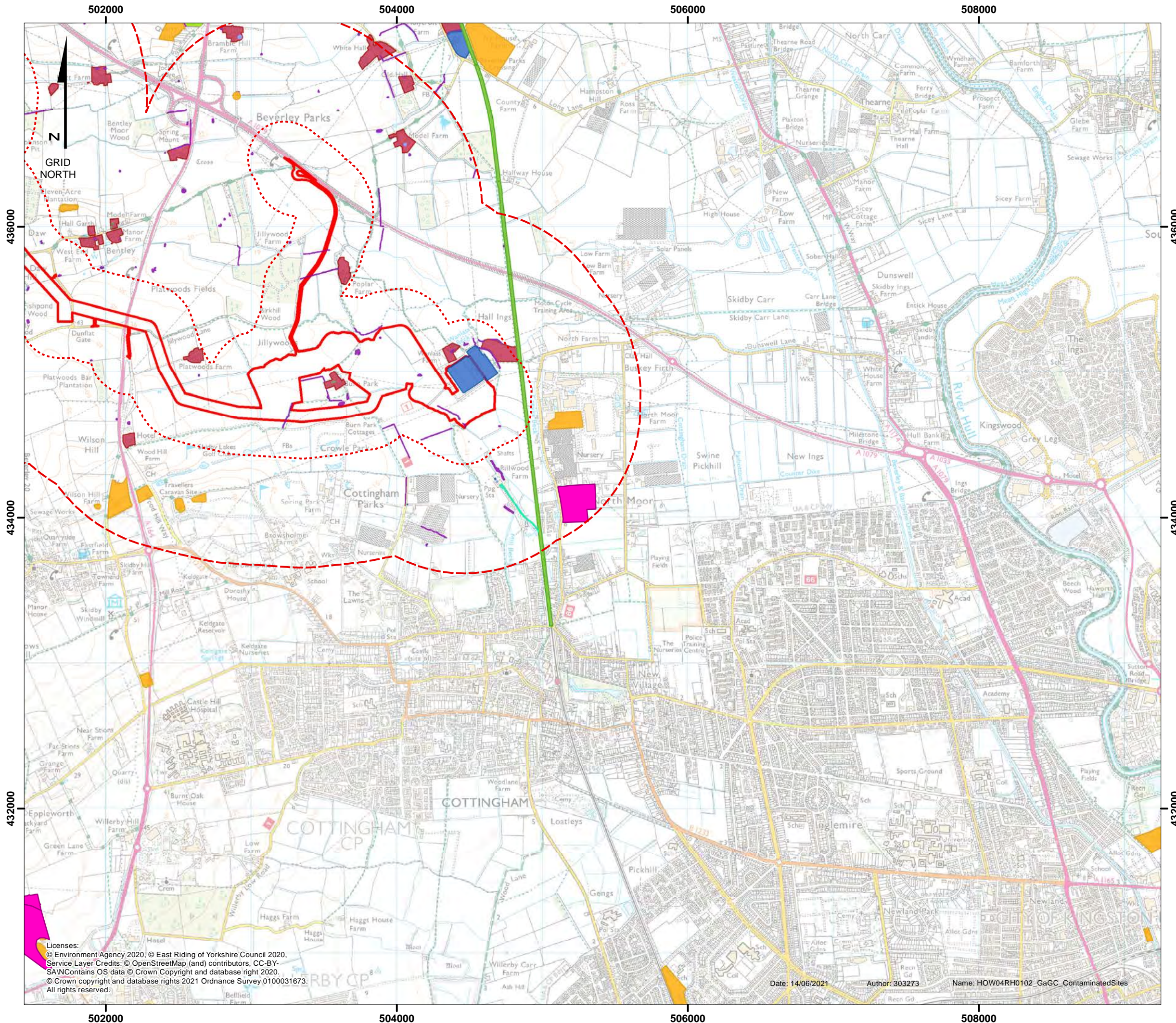
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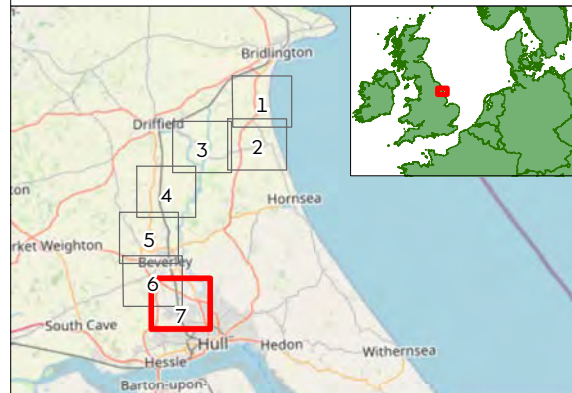
Hornsea Four

Figure 18

Potential Sources of Contamination within the Hornsea Four Order Limit and Hornsea Four Land Quality PRA Study Area (OnSS #2) - Sheet 7 of 7



- Order Limits
 - 250 m Study Area
 - 1 km Study Area
 - Authorized Landfill Site
- Potentially Contaminated Land**
- Electricity Sub Station
 - Historic Landfill Site
 - Existing Railway
 - Old/Disused Railways
 - Farm - Out Buildings
 - Possible Landfill
 - General Works
 - Sheep Dips
 - Industrial Estate
 - Tank



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5.3 Qualitative Risk Assessment

5.3.1.1 This Qualitative Risk Assessment (QRA) follows the relevant guidance (Environment Agency, 2019). The QRA considers the PCOC, site setting, and proposed site use to establish whether a feasible pollutant linkage is likely to exist. If a feasible pollutant linkage is identified this is then assessed to determine whether it could represent an unacceptable risk to human health or controlled waters. It should be noted that the assessment is based on historical information only and has not yet been informed by ground investigation, therefore the assessment has taken a precautionary approach. As such if a potential pollutant linkage has been identified it is assumed to be present until further site-specific information is available to clarify whether the linkage exists, for the purpose of the QRA. The Preliminary CSM (PCSM) and QRA are presented in [Table 14](#).

Table 14: Preliminary Conceptual Site Model and Qualitative Risk Assessment.

Source	Pathway	Receptor	Qualitative Assessment
Potential on-site and off-site sources of soil and groundwater contamination.	Dermal contact, ingestion and inhalation.	Construction workers.	<p>Construction workers have the potential to be exposed to contaminants if any are present. The PCSM is based on historical information and has not been informed by ground investigation, therefore a precautionary approach (i.e. if a potential pollutant linkage has been identified it is assumed to be present until further site-specific information is available to clarify whether the linkage actually exists) has been adopted.</p> <p>It should be noted that the proposed development is located in an undeveloped area, predominantly utilised for agricultural purposes. Furthermore, Hornsea Four is committed to ensuring potential linkages are appropriately investigated, assessed and mitigated. Further information in relation to these is provided in Volume A3, Chapter 1: Geology and Ground Conditions.</p>
	Dermal contact, ingestion and inhalation.	Site operatives.	<p>During the operational phase of the project, site operatives have the potential to be exposed to contaminants, if present, during maintenance works. This is a precautionary conclusion (i.e. if a potential pollutant linkage has been identified it is assumed to be present until further site-specific information is available to clarify whether the linkage is present) in the absence of ground investigation information.</p> <p>Furthermore, Hornsea Four is committed to ensuring potential linkages are appropriately investigated, assessed and mitigated. Further information in relation to these is provided in Volume A3, Chapter 1: Geology and Ground Conditions.</p>

Source	Pathway	Receptor	Qualitative Assessment
Contaminant migration via leaching and groundwater transport.	<p>Superficial Secondary A Aquifer, Secondary B Aquifer and Secondary Undifferentiated Aquifer.</p> <p>Principal Aquifer(bedrock).</p> <p>Surface water bodies.</p> <p>Groundwater and surface water abstractions.</p>	<p>Superficial Secondary A Aquifer, Secondary B Aquifer and Secondary Undifferentiated Aquifer.</p> <p>Principal Aquifer(bedrock).</p> <p>Surface water bodies.</p> <p>Groundwater and surface water abstractions.</p>	<p>Sensitive water resources have been identified as part of the PRA and the ground conditions are such that they could permit the migration of contaminants if present. Potential isolated sources have been identified although as indicated in Section 3. This is based on a precautionary approach in the absence of ground investigation information (i.e. if a potential pollutant linkage has been identified it is assumed to be present until further site-specific information is available to clarify whether the linkage actually exists).</p> <p>Construction activities associated with the proposed development include trenching, horizontal directional drilling and piling (if required) have the potential to disturb existing contamination and/or create preferential pathways which could result in contaminant migration to sensitive water resources. However, Hornsea Four is committed to ensuring potential linkages are appropriately investigated, assessed and mitigated. Further information in relation to these is provided in Volume A3, Chapter 1: Geology and Ground Conditions.</p>
Contaminant migration via leaching and groundwater transport and physical transport by surface runoff due to erosion.		Designated sites.	<p>Designated sites are present within the Hornsea Four preliminary land quality risk assessment study area and the ground conditions are such that they could permit the migration of contaminants if present.</p> <p>Construction activities could disturb contamination if present which could result in the migration of contamination via leaching, groundwater transport and physical transport by surface runoff, particularly in the areas surrounding the SSSI which is designated due to its ecological sensitivities. However, Hornsea Four is committed to ensuring that potential linkages are appropriately investigated, assessed and mitigated. Further information in relation to these is provided in Volume A3, Chapter 1: Geology and Ground Conditions.</p>
Physical transport by surface runoff due to erosion.		Surface water bodies.	<p>In areas in close proximity to surface waters there is the risk that during construction works runoff from exposed contaminated soils may occur which could transport contaminated sediments or dissolved contaminants to nearby surface waters. Hornsea Four is committed to ensuring that potential pollutant linkages are appropriately investigated, assessed and mitigated. Further information in relation to these is provided in Volume A3, Chapter 1: Geology and Ground Conditions.</p>

Source	Pathway	Receptor	Qualitative Assessment
Ground gases and vapours.	Gas generation and transport.	Construction workers, future site operatives and future infrastructure.	Landfills and areas of Made Ground may exist within isolated areas of the Hornsea Four Order Limits. Unrecorded landfill sites may be present and if these are encountered during construction works Hornsea Four is committed to conducting an appropriate risk assessment and if necessary, removing the contaminated material / treating it and / or installing appropriate mitigation measures. Further information in relation to these is provided in Volume A3, Chapter 1: Geology and Ground Conditions .

5.4 Uncertainties in the Conceptual Site Model

5.4.1.1 The PCSM and QRA has been developed based on a desk-based review of available information, and in the absence of site-specific ground investigation data. For this reason, they adopt a precautionary approach, assuming that if a potential pollutant linkage has been identified, it is present, until further site-specific information is available to clarify whether the linkage actually exists. Without further site-specific data potential pollutant linkages cannot be ruled out. However, it should be noted that Hornsea Four will be largely located in an undeveloped area, and the potential pollutant linkages identified in the PCSM are only associated with a comparatively small number of isolated areas.

5.5 Summary of Proposed Mitigation

5.5.1.1 The proposed mitigation measures and commitments to be adopted by Hornsea Four are described and evaluated in [Volume A3, Chapter 1: Geology and Ground Conditions](#) to which this document forms an annex. A list of all commitments for Hornsea Four can be found in [Volume A4, Annex 5.2: Commitments Register](#).

6 Conclusions and Recommendations

6.1.1.1 The key objective of the PRA was to develop a PCSM to aid in the identification of any potential pollutant linkages and potentially unacceptable risks to sensitive receptors associated with development of Hornsea Four, so that appropriate mitigation measures can be adopted to ensure the proposed scheme is delivered without risk to sensitive receptors. These are then used to inform decisions with regards to whether further investigation or assessment is needed (i.e. a Generic Quantitative Risk Assessment) to understand and mitigate potential impacts.

6.1.1.2 The PRA has identified a limited number of plausible pollutant sources and linkages in isolated areas within the Hornsea Four Order Limits. However, it should be noted that the PRA has been developed based on a desk-based review of available information, and in the absence of ground investigation data, and the PCSM adopts a precautionary approach.

- 6.1.1.3 It should be noted that whilst potential pollutant linkages have been identified as a result of the precautionary approach taken, this should be considered in the context that the proposed scheme will largely be located in an undeveloped (predominantly agricultural) area. Furthermore, the potential pollutant linkages identified in the PCSM are only associated with isolated locations (see [Figure 12](#) to [Figure 18](#)).
- 6.1.1.4 The Applicant is committed to a range of actions to ensure potential linkages are investigated and mitigated. Such commitments can be found in [Volume A3, Chapter 1: Geology and Ground Conditions](#) and [Volume A4, Annex 5.2: Commitments Register](#).

7 References

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