10.5 Baseline Environment

The following section provides a summary of existing ground conditions within the study area. The information obtained is based on the sources of information identified in Section 10.3.3.1 and from field surveys. For ease of reporting, the study area is split into four sections, detailed in **Chapter 3: Description of the English Onshore Scheme** and in Section 10.4, above.

10.5.1 Section 1 – Landfall to Bainton

This section describes the baseline environment within the study area between landfall at Fraisthorpe Beach and Bainton.

10.5.1.1 Geology

Published geological maps acquired from Groundsure GIS (Ref 10-4) and from the GIS data sourced from the British Geological Survey (BGS) (Ref 10-5 & Ref. 10-6) indicate that the study area is underlain by the geological succession summarised below in **Table 10-8**. Geological mapping is shown on **Figure 10-2** and **Appendix 10A Figure 10-2 (Sheet 1)** (superficial geology) and **Figure 10-3** and **Appendix 10A Figure 10-3 (Sheet 1)** (bedrock geology).

Table 10-8: Summary of Geology from BGS 1:50,000 Mapping

Stratum Type	Description
Made Ground	Although not mapped, it is likely that Made Ground deposits are present within the planning application boundary, associated with infrastructure and developments including major roads and various on-shore wind turbines between the A165 and landfall.
Superficial	The majority of the study area is shown to be underlain by Devensian Glacial Till, comprising *'unsorted drift deposits of clay, sand, gravel and boulders varying widely in shape and size'*. Some deposits of Glaciofluvial Sand and Gravel are present within the eastern part of this section of the study area. Alluvium, consisting of clay, silt and sand as bands, is present, typically following water courses such as the Kelk Beck to the southeast of Lowthorpe and the River Hull to the southwest of Wansford. River Terrace Deposits formed of sand and gravel occur in one instance south of Nafferton, associated with Nafferton Beck.
Bedrock	The majority of the study area is underlain by the Flamborough Chalk Formation of the White Chalk Subgroup. A small portion of this section near Fraisthorpe, towards the eastern end of the route, is underlain by Rowe Chalk Formation of the White Chalk Subgroup.
Faults	No geological faults are present within the study area.
Source: BGS Map Fifth Edition. 1:50,000 Sheets 55 & 65 (Solid alongside Drift, 1986) and 64 (Solid and Drift, 2003). Groundsure GIS.	

10.5.1.2 Previous Ground Investigation

BGS Geo-Index online resources (Ref. 10-7) recorded ground investigation data from three boreholes drilled within the study area. The strata encountered in these exploratory locations generally correlate with information obtained from BGS mapping data. Strata encountered are summarised in **Table 10-9**.

Table 10-9 Summary of BGS Geo-Index Boreholes

Stratum Type	Description
Topsoil	Topsoil was recorded at the centre of this section at a maximum thickness of 0.50 m.
Made Ground	No reference to the presence of Made Ground was found within the borehole logs reviewed. Borehole logs may pre-date land development, when Made Ground may have been placed.
Superficial	Layers of 'clay', 'clay and stone' and alternating sand and clay, inferred to represent Glacial Till, were recorded to depths of between approximately 4 m and 31 m below ground level (bgl) between Fraisthorpe and Skerne, generally decreasing towards the west.

Stratum Type	Description
Bedrock	Chalk bedrock was encountered underlying the superficial deposits in all three boreholes. The chalk was recorded as being weathered between 4 m and 6.7 m bgl near Skerne.
Source: BGS Borehole Refs. TA16SW9, TA05NE24 and TA05NW308	

10.5.1.3 Geological Site of Special Scientific Interest and Regionally Important Geological Sites

A review of available information from the East Yorkshire RIGS Group (Ref 10-8) indicated that there is one Regionally Important Geological Site (RIGS) within this section, as summarised in **Table 10-10**.

Table 10-10 Regionally Important Geological Sites

RIGS Name	Location / Description
Gransmoor Quarry	NGR 511100, 459600, to the west of Gransmoor (adjacent to the north of the planning application boundary). Devensian mere deposits filling a kettle hole.

The location of the RIGS is shown on **Figure 10-3** and **Appendix 10A Figure 10-3 (Sheet 1)**.

There are no geological SSSIs within the study area.

10.5.1.4 Coal Mining and Shallow Mining

Coal Authority mapping (Ref 10-9) indicates that this section of the study area does not lie within a designated Coal Mining Reporting Area.

No other non-coal mining activities were reported within this section of the study.

Mining activities are shown on **Figure 10-4**.

10.5.1.5 Natural Ground Subsidence

A review of natural ground subsidence features from Groundsure GIS (Ref 10-4) relating to Section 1 of the study area is presented in **Table 10-11**. Unless stated otherwise, all features documented in the table are present within the planning application boundary.

Natural ground subsidence features are shown on **Figure 10-5** to **Figure 10-7.** Features that have the potential to result in adverse impacts to Section 1 of the scheme are shown on **Appendix 10A Figure 10-5 (Sheet 1)** (compressible deposits) and **Appendix 10A Figure 10-7 (Sheet 1)** (running sand).

Table 10-11 Summary of Natural Ground Subsidence

Geotechnical Features	Definition	Location
Collapsible Deposits	*'Deposits with potential to collapse when loaded and saturated are believed not to be present'*	Areas where superficial deposits of Alluvium are present, including a small pocket south of Wilsthorpe and sporadic locations from Fraisthorpe to west of Wansford at the River Hull.
	'Deposits with potential to collapse when loaded and saturated are unlikely to be present'	Predominant classification present within Section 1.
Compressible Deposits	*'Compressible strata are not thought to occur'*	Predominant classification within Section 1.
	'Compressibility and uneven settlement hazards are probably present. Land use should consider specifically the compressibility and variability of the site'	Areas where superficial deposits of Alluvium are present, including a small pocket south of Wilsthorpe and sporadic locations from Fraisthorpe to west of Wansford at the River Hull.

Geotechnical Features	Definition	Location
Ground Dissolution of Soluble Rocks	*'Soluble rocks are present within the ground. Few dissolution features are likely to be present. Potential for difficult ground conditions or localised subsidence are at a level where they need not be considered.'*	Sporadic in distribution. Areas where soluble rocks are identified are located at: • Landfall at Fraisthorpe Beach; • Southwest of Nafferton; • Land along the B1249 to the west of Wansford; • Land adjacent to the River Hull; • Large portion of land extending from the west of Skerne to the north of Hutton; and • Land to the west of Hutton Cranswick extending to the end of this section, east of Bainton. • No soluble rock classification is given to strata elsewhere within this section.
Landslides	*'Slope instability problems are not likely to occur but consideration to potential problems of adjacent areas impacting on the site should always be considered'*	Entirety of planning application boundary within Section 1.
Running Sand	*'Running sand conditions are unlikely. No identified constraints on land use due to running conditions unless water table rises rapidly'*	Predominant classification within Section 1.
	'Running sand conditions may be present. Constraints may apply to land uses involving excavation or the addition or removal of water'	Areas where superficial deposits of Alluvium are present, including a small pocket south of Wilsthorpe and sporadic locations from Fraisthorpe to west of Wansford at the River Hull.
Shrink Swell Clays	*'Ground conditions predominately non-plastic'*	Areas of superficial deposits containing sand and gravels, including Devenisan Glaciofluvial Deposits, River Terrace Deposits and Sand and Gravel.
	'Ground Conditions predominately low plasticity'	Predominant classification within Section 1. Situated where superficial deposits are formed with a portion of clay, including Devensian Glacial Till and Alluvium.

10.5.1.6 Mineral Sites and Designations

Information obtained from ERYC's 'East Riding Local Plan' (adopted 2016) (Ref 10-10) indicates that a large portion of this section of the study area is safeguarded under Policy EC6: 'Protecting Mineral Resources', made up of numerous smaller areas. The Mineral Safeguarding Areas recorded in the East Riding Local Plan are for sand and gravel, crushed rock, limestone, industrial chalk, clay and silica sand.

10.5.1.7 Hydrogeology

10.5.1.7.1 Aquifer Classifications

Aquifer classifications in Section 1 of the study area, as shown on Defra's 'MAGIC' mapping portal (Ref 10-11) and Groundsure GIS (Ref 10-4), are presented in **Table 10-12**. Aquifer classifications are shown on **Figure 10-8** and **Appendix 10A Figure 10-8 (Sheet 1)** (superficial aquifers) and **Figure 10-9** and **Appendix 10A Figure 10-9 (Sheet 1)** (bedrock aquifers).

Table 10-12 Summary of Aquifer Classifications

Stratum Type	Aquifer Classification	Definition (Environment Agency)	Location
Superficial	Secondary A Aquifer	*'permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers'*	Landfall to Skerne (interchanging between Secondary A and Secondary Undifferentiated) Associated with Alluvium, River Terrace Deposits, Devensian Glacifluvial Deposits, Sand and Gravel.
	Secondary Undifferentiated	*'it has not been possible to attribute either category A or B to a rock type/ superficial. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type'*	Landfall to Bainton (interchanging between Secondary A and Secondary Undifferentiated between Landfall and Skerne). Associated with Devensian Glacial Till.
Bedrock	Principal Aquifer	*'layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale'*	Landfall to Bainton (entirety of Section 1). Associated with Chalk.

10.5.1.7.2 Water Framework Directive Groundwater Bodies

One Water Framework Directive (WFD) groundwater body has been identified within Section 1 of the study area:

- White Chalk Subgroup – a highly productive aquifer, up to 450m thick and locally yielding 50 to 100 L/s of hard to very hard, good quality water.

10.5.1.7.3 Other Hydrogeological Classifications and Features

The following additional hydrogeological classifications and features have been identified within the Section 1 study area:

- Groundwater vulnerability across this section is classified as predominately 'Medium'. A classification of 'High' in an area where Sand and Gravel superficial deposits are present located to the southwest of Fraisthorpe within the planning application boundary;
- The majority of this section is not located in a Source Protection Zone (SPZ). However, to the west of Hutton, a SPZ1 (inner), SPZ2 (outer) and SPZ3 (total catchment) are identified within the study area. The SPZ2 and SPZ3 are located within the planning application boundary. The SPZ 1 is located approximately 60 m north of the planning application boundary at its closest point;
- A portion of this section of the application boundary is classified as a Drinking Water Safeguard Zone for groundwater resources, between 260 m west of Hutton and the western end of this section at Bainton. For surface water resources, a Drinking Water Safeguard Zone is present for the majority of the application boundary within this section, with the exception of the area between landfall and the A615; and
- The entirety of this section, with the exception of a small portion of land near the landfall at Fraisthorpe Beach, is located within a Nitrate Vulnerable Zone (NVZ) in relation to surface water and located within the study area. For Groundwater, a NVZ is present adjacent to the west of Kelk Beck to the western end of this section at Bainton, within the study area.

A request for information (30th June 2021) relating to private water supplies was addressed by ERYC (18th October 2021). It was stated that two private water supplies are located in or within 250 m of the planning application boundary, as follows:

- Field House Farm, Skerne. Approximately 130 m north of the planning application boundary (NGR 503572, 455571). Main Supply - Commercial production. Less than 10 cubic metres daily abstraction. Source type: borehole water; and
- Conyers House, Skerne. Approximately 185 m east of the planning application boundary (NGR 504142, 455384). Single Dwelling - Domestic production. Single Dwelling. Volume/rate not stated. Source type: borehole water.

Source Protection Zones, Drinking Water Safeguard Zones and private water supplies in this section are presented on **Figure 10-10** and **Appendix 10A Figure 10-10 (Sheet 1)**.

10.5.1.8 Current and Historic Potentially Contaminative Land Uses

10.5.1.8.1 Current

Current land use for the majority of this section is predominately agricultural. The section crosses the A165 and A164 trunk roads. According to ERYC's 'East Riding Brownfield Register' (Ref 10-12), there are no registered brownfield sites within Section 1 of the study area. According to ERYC's 'Contaminated Land – Public Register' (Ref 10-13) there are no sites determined as Contaminated Land under Part 2A of the Environmental Protection Act 1990 within Section 1 of the study area.

Four locations within Section 1 were visited by AECOM during a site walkover on 7th December 2021. No visible signs of contamination were reported at any of the locations.

10.5.1.8.2 Historic

From searches of Groundsure GIS (Ref 10-4), the following historic potentially contaminative land uses were identified within Section 1. These are presented in **Table 10-13** and shown on **Figure 10-11** and **Appendix 10A Figure 10-11 (Sheet 1)**. Selected locations were visited during the walkover survey completed by AECOM on 7th December 2021 and observations are described in **Table 10-13**.

Table 10-13 Summary of Historic Potentially Contaminative Land Uses

Reference on Figure 10-11	Feature	Year	Location	Distance and Orientation from Planning Application Boundary	Any Evidence of Contamination Observed during Walkover?
73	Unspecified Heap	1909	Fraisthorpe beach	110 m south	Not visited
205	Unspecified (Sand) Pits	1852 – 1952	Adjacent to (east of) A615 to the north of Fraisthorpe	100 m north	No evidence of former pits observed (currently arable farmland).
284	Old gravel pits	1952 - 1977	East of A165, south of Fraisthorpe	100 m and 230 m south	Not visited
259	Unspecified Ground Workings	1909 - 1946	West of Gransmoor village	60 m southeast	Not visited
123 / 311	Quarry/ Disused Pits	1909 - present	Gransmoor Quarry	Immediately north of planning application boundary	Open quarry still present
South of 311	Unspecified Sand Pits	1909 - 1952	South of Gransmoor Quarry	Immediately south of planning application boundary	Not visited
237	Historic Canal	1952 - present	West of Wansford	Within planning	River Hull / Driffied Canal still present

Reference on Figure 10-11	Feature	Year	Location	Distance and Orientation from Planning Application Boundary	Any Evidence of Contamination Observed during Walkover?
				application boundary	
211	Unspecified Tank and Smithy	1984	Associated with farm buildings north of main street in Skerne	250 m south	Not visited
122	Old Chalk Pit	1911 - 1981	West of Hutton	190 m east	Not visited
239	Old Chalk Pit	1851 – 1950	West of Burn Butts Lane	20 m south	No evidence of contamination observed (chalk pit still present).
112	Railway Cuttings and Former Railway	1890 – 1977	Former Market Weighton and Driffield Railway. West of Burnbutts Lane, east of Bainton.	Within planning application boundary	Route for former railway discernible by a linear depression in the landscape. No evidence of contamination observed (currently arable farmland).

10.5.1.8.3 Environment Agency Environmental Pollution Incidents Register

A review of the EA Environmental Pollution Incidents Register (Ref 10-4 & Ref 10-14) did not identify any recorded pollution incidents that have occurred within Section 1 of the study area.

10.5.1.8.4 Current and Historic Landfills

Recorded current and historic landfills (Ref 10-4 & 10-16) identified within Section 1 of the study area are summarised in **Table 10-14** and shown on **Figure 10-11** and **Appendix 10A Figure 10-11 (Sheet 1)**.

Table 10-14 Summary of Current and Historic Landfills

Landfill Type	Description
EA Historic Landfill	Site name: 'Dismantled Railway Cutting, Neswick Farm' (site ref: 2000/A659, 55/19/0659). Located 110 m north of planning application boundary. Status: Closed (1989). Formerly taking inert, commercial and household waste.
EA Active or Recent Landfill	None recorded.
EA Licensed Waste Sites	None recorded.

10.5.1.9 Ground Gas

Ground gas including methane and carbon dioxide may be present associated with the natural strata and Made Ground deposits, where present, throughout this section of the study area. Ground gas may also be associated with recorded landfills as well as infilled land (e.g. backfilled former sand and chalk pits).

No records of ground gas investigation data were available for review.

10.5.1.10 Radon

Published radon data from Groundsure GIS and UKRadon (Ref 10-4 & Ref 10-16) indicate that this section of the study area is located within an area with a maximum radon potential of 'Less than 1%' meaning no radon protection measures are required.

Radon potential is shown on **Figure 10-12**.

10.5.1.11 Unexploded Ordnance Potential

Online Zetica Unexploded Ordnance (UXO) mapping (Ref 10-17) shows a 'Low Risk' from UXO (15 bombs per 1000 acres, or less) for the entirety of this section. A single bombing 'Decoy Site' was recorded to the west of Skerne within the planning application boundary.

10.5.2 Section 2 – Bainton to Market Weighton

This section describes the baseline environment within the study area between Bainton and Market Weighton.

10.5.2.1 Geology

Published geological maps acquired from Groundsure GIS (Ref 10-4) and from the GIS data sourced from the BGS (Ref 10-5, Ref 10-6 & Ref 10-7) indicate that the study area is underlain by the geological succession summarised below in **Table 10-15**. Geological mapping is shown on **Figure 10-2** and **Appendix 10A Figure 10-2 (Sheet 2)** (superficial geology) and **Figure 10-3** and **Appendix 10A Figure 10-3 (Sheet 2)** (bedrock geology).

Table 10-15 Summary of Geology from BGS 1:50,000 Mapping

Stratum Type	Description
Made Ground	Although not mapped, it is likely that Made Ground deposits are present within this section of the study area in small pockets associated with various farm buildings within the planning application boundary. In addition, Made Ground deposits will be present associated with the railway near Kiplingcoates, within the planning application boundary.
Superficial	No superficial deposits are recorded beneath the majority of Section 2 at this mapping scale. Where superficial deposits do occur, the majority comprise Devensian Glacial Till, extending for a distance of approximately 5.2 km from the start of Section 2 near Bainton. Towards the center of the section, various bands of Head deposits (formed of clay, silt, sand and gravel) are present, as well as one pocket of Glaciofluvial Sand and Gravel). Towards the west of the section, south of Market Weighton, small pockets of sand (Sutton Sand Formation) and clayey sand (Bielby Sand Member) are present.
Bedrock	Bedrock underlying Section 2 comprises, from east to west: • Flamborough Chalk Formation (start of Section 2 to the B1248 , northeast of Middleton on the Wolds); • Burnham Chalk Formation (B1248 to Kiplingcotes); • Welton Chalk Formation (Kiplingcotes to the A1034, east of Market Weighton); • Ferriby Chalk Formation (to the southeast of Market Weighton); • Hunstanton Formation (Chalk) (to the southeast of Market Weighton); • Lincolnshire Limestone – Upper Lincolnshire Limestone and Raventhorpe Beds • Lias Group - Whitby Mudstone, Marlstone Rock, Charmouth Mudstone and Scunthorpe Mudstone Formations
Faults	No geological faults are present within this section of the study area.
Source: BGS Map Fifth Edition. Sheet 1:50,000 55 & 56 Bedrock and Superficial, 64 Bedrock and Superficial, 72 Bedrock and Superficial. Groundsure GIS.	

10.5.2.2 Previous Ground Investigation

BGS Geo-Index online resources (Ref 10-8) recorded ground investigation data from ten boreholes drilled within Section 2 of the study area. The strata encountered in these exploratory locations generally correlate with information obtained from BGS mapping data. Strata encountered are summarised in **Table 10-16**.

Table 10-16 Summary of BGS Geo-Index Boreholes

Stratum Type	Description
Topsoil	Various topsoil deposits ranging from 0.15 m to 0.4 m in thickness were recorded across the study area.
Made Ground	Made Ground deposits 0.2 m in thickness were recorded towards the east of Section 2, associated with the former Kiplingcotes railway station.
Superficial	Superficial deposits were either not recorded or were found to comprise 'thin drift', with no measurement on thickness given. In the vicinity of Market Weighton, 'drift', including sand, was recorded up to 3.6m in thickness.
Bedrock	Bedrock encountered within the majority of the section was recorded as chalk, immediately underlying the topsoil. Towards the far west of Section 2 near Market Weighton, the bedrock encountered comprised Lias Blue Clay, present from a depth of approximately 1.8 m bgl.
Source: BGS Borehole Refs. SE94NW21, SE94SW10, SE94SW26, SE94SW14, SE94SW9, SE94SW33, SE94SW17, SE83SE9/A, SE84SE5, SE84SE4,	

10.5.2.3 Geological Site of Special Scientific Interest and Regionally Important Geological Sites

A review of available information from the East Yorkshire RIGS Group (Ref 10-9) indicated that there are five RIGS within this section, as presented in **Table 10-17**.

Table 10-17 Regionally Important Geological Sites

Section	Regionally Important Geological Site
Bracken Quarry	NGR 497300, 451200, near Bainton (55 m east of the planning application boundary). Base of the Flamborough Chalk Formation.
Arras Road Chalk Pit	NGR 492800, 443300, south of Kiplingcotes (180 m south of the planning application boundary). Turonian Coniacian Chalk; Kiplingcotes Marls, Arras Flint and Enthorpe Marls.
Kiplingcotes Nature Reserve	NGR 491500, 443400, near Kiplingcotes (located within planning application boundary) Turonian Chalk; Deepdale Marls. See Photos 1 and 2 (**Appendix 10B**), 7th December 2021.
Kiplingcotes Station Quarry	NGR 493200, 443800, Kiplingcotes (located within planning application boundary). Turonian Chalk; type section of Kiplingcotes Flints and Marls; site of large ammonites found by C W & E V Wright; former SSSI.

The locations of the RIGS are shown on **Figure 10-3** and **Appendix 10A Figure 10-3 (Sheet 2)**.

There are no geological SSSIs identified within the study area.

10.5.2.4 Coal Mining and Shallow Mining

Coal Authority mapping (Ref 10-10) indicates that this section of the study area does not lie within a designated Coal Mining Reporting Area.

A portion of land associated with '*non-coal mining related mining and ground workings*' is present to the southeast of Market Weighton and transects the Working Width (**Figure 10-9**). This area is approximately 900 m in length and described in BGS records (Ref 10-4) as '*sporadic underground mining of restricted extent may have occurred. Potential for difficult ground conditions are unlikely and localised and are at a level where they need not be considered*'.

Mining activities are shown on **Figure 10-4** and **Appendix 10A Figure 10-4 (Sheet 2)**.

10.5.2.5 Natural Ground Subsidence

A review of natural ground subsidence features from Groundsure GIS (Ref 10-4) relating to Section 2 of the study area is presented in **Table 10-18**. Unless stated otherwise, all features documented in the table are present within the planning application boundary.

Natural ground subsidence features are shown on **Figure 10-5** to **Figure 10-7.** Features that have the potential to result in adverse impacts to Section 2 of the scheme are shown on **Appendix 10A Figure 10-6 (Sheet 2)** (landslides) and **Appendix 10A Figure 10-7 (Sheet 2)** (running sand).

Table 10-18 Summary of Natural Ground Subsidence Features

Geotechnical Features	Definition	Location
Collapsible Deposits	*'Deposits with potential to collapse when loaded and saturated are believed not to be present'*	A relatively small area straddling the A1034 to the southeast of Market Weighton.
	'Deposits with potential to collapse when loaded and saturated are unlikely to be present'	Remainder of planning application boundary within Section 2.
Compressible Deposits	*'Compressible strata are not thought to occur'*	Entirety of planning application boundary within Section 2.
Ground Dissolution of Soluble Rocks	*'Soluble rocks are present within the ground. Few dissolution features are likely to be present. Potential for difficult ground conditions or localised subsidence are at a level where they need not be considered.'*	Entirety of planning application boundary within Section 2.
Landslides	*'Slope instability problems are not likely to occur but consideration to potential problems of adjacent areas impacting on the site should always be considered'*	Predominant classification from Bainton to Market Weighton.
	'Slope instability problems may be present or anticipated. Site investigation should consider specifically the slope stability of the site'	Land associated with an old chalk pit adjacent to the east of the planning application boundary to the east of the B1248. A small area within the planning application boundary to the north of Kiplingcotes. A small area 200 m from the planning application boundary to the northwest of Kiplingcotes.
	'Slope instability problems are probably present or have occurred in the past. Land use should consider specifically the stability of the site'	Land associated with an old chalk pit, 20 m from the planning application boundary the east of the B1248. This is an extension to the above classification and relates to the same old chalk pit.
	'Not classified'	Large portion of land within this section not mapped with any landslide classifications, associated with areas where superficial deposits are absent.
Running Sand	*'Running sand conditions are not thought to occur whatever the position of the water table. No identified constraints on lands use due to running conditions'*	Predominant classification within Section 2 of the study area, present from south of Middleton on the Wolds to south of Market Weighton.
	'Running sand conditions are unlikely. No identified constraints on land use due to running conditions unless water table rises rapidly'	Generally associated with superficial deposits (clay, silt sand and gravel of Head deposits), present from Bainton to the south of Middleton on the Wolds and sporadically from east of Market Weighton to the western end of this section.
	'Running sand conditions may be present. Constraints may apply to land uses involving excavation or the addition or removal of water'	Associated with sandy superficial deposits (Sutton Sand Formation and the Bielby Sand Member), present only in small areas to the southeast and south of Market Weighton.

Geotechnical Features	Definition	Location
Shrink Swell Clays	*'Ground conditions predominately non-plastic'*	Predominantly present in locations where no superficial deposits are recorded. The remainder are associated with more sandy superficial deposits (Sutton Sand Member Formation and the Bielby Sand Member).
	'Ground Conditions predominately low plasticity'	Generally associated with locations of superficial deposits of Glacial Till and Alluvium.
	'Ground conditions predominantly medium plasticity'	Associated with shallow bedrock deposits of the Whitby Mudstone Formation, the Charnmouth Mudstone Formation and Scunthorpe Mudstone Formation, located to the south of Market Weighton only.

10.5.2.6 Mineral Sites and Designations

Information obtained from ERYC's 'East Riding Local Plan' (adopted 2016) (Ref 10-11) indicates that the majority of this section of the study area is safeguarded under Policy EC6: 'Protecting Mineral Resources'. The Mineral Safeguarding Areas recorded in the East Riding Local Plan are for sand and gravel, crushed rock, limestone, industrial chalk, clay and silica sand.

10.5.2.7 Hydrogeology

10.5.2.7.1 Aquifer Classifications

Aquifer classifications in Section 2 of the study area, as shown on Defra's 'MAGIC' mapping portal (Ref 10-12) and Groundsure GIS (Ref 10-4) are presented in **Table 10-19**. Aquifer classifications are shown on **Figure 10-8** and **Appendix 10A Figure 10-8 (Sheet 2)** (superficial aquifers) and **Figure 10-9** and **Appendix 10A Figure 10-9 (Sheet 2)** (bedrock aquifers).

Table 10-19 Summary of Aquifer Classifications

Stratum Type	Aquifer Classification	Definition (Environment Agency)	Location
Superficial	Secondary A Aquifer	*'permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers'*	Associated with Alluvium, Glaciofluvial Deposits, Sutton Sand Formation and Bielby Sand Member.
	Secondary Undifferentiated	*'it has not been possible to attribute either category A or B to a rock type/ superficial. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type'*	Associated with Glacial Till and Head deposits, from Bainton to the west of Lund then sporadic to the east of Market Weighton.
Bedrock	Principal Aquifer	*'layers of rock or drift deposits that have high intergranular and/or fracture permeability – meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale'*	Predominant classification for Section 2, associated with chalk and limestone bedrock strata, present between Bainton to the southeast of Market Weighton.
	Secondary A Aquifer	*'permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers'*	Associated with Marlstone Rock Formation, to the southeast of Market Weighton.
	Secondary B Aquifer	*'Aquifers with predominately lower permeability layers which may store and yield limited amounts of groundwater due*	Associated with Charnmouth Mudstone Formation and Scunthorpe

Stratum Type	Aquifer Classification	Definition (Environment Agency)	Location
		to localized features such as fissures, thin permeable horizons and weathering'	Mudstone Formation bedrock, to the south of Market Weighton.
	Unproductive Strata	*'rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow'*	Associated with Whitby Mudstone Formation to the southeast of Market Weighton.

10.5.2.7.2 Water Framework Directive Groundwater Bodies

Four WFD groundwater bodies have been identified within Section 2 of the study area, as follows:

- White Chalk Subgroup – a highly productive aquifer, up to 450 m thick and locally yielding 50 to 100 L/s of hard to very hard, good quality water;
- Grey Chalk Subgroup – a highly productive aquifer, thickness unknown, locally yielding 5 L/s of groundwater;
- Lias Group – local aquifers yielding small supplies only; and
- Undifferentiated Triassic Rocks – a low productive aquifer, yielding less than 0.5 L/s of water which can be highly mineralised.

10.5.2.7.3 Other Hydrogeological Classifications and Features

The following additional hydrogeological classifications and features have been identified within the study area of Section 2:

- Groundwater vulnerability across this section is classified as 'Low', 'Medium' and 'High'. The predominant classification is 'High', associated with areas where no superficial deposits are present;
- The majority of this section is identified as having soluble rock risk;
- Three SPZ1 (inner catchment) features are located within the study area of Section 2:
    - To the west of Dalton Park at Kiplingcotes), approximately 250 m from the planning application boundary; and
    - To the north and south of the A1079east of Market Weighton), approximately 200 m and 170 m from the planning application boundary, respectively.

An SPZ2 (outer catchment) features is transected by the English Onshore Scheme, to the southeast of Bainton. In addition, a short section of a proposed haul road transects a second SPZ2 located to the southeast of Kiplingcotes. A third SPZ2 feature is located approximately 140 m from the planning application boundary at Kiplingcotes (associated with the SPZ1, above). The remainder of the route between the start of Section 2 at Bainton and the A1079 east of Market Weighton is located within an SPZ3 (total catchment);

- The majority of this section is classified as a Drinking Water Safeguard Zone for groundwater resources between the beginning of Section 2, south of Bainton and extending down to the A1079 to the east of Market Weighton. For surface water resources, a smaller Drinking Water Safeguard Zone is present at the beginning of Section 2 adjacent to the west of the B1248 south of Bainton; and
- The entirety of this section is located within a NVZ for both groundwater and surface water. In addition, a portion of land is identified to be located within a Nitrate Sensitive Area, located to the east of Market Weighton.

A request of information (30th June 2021) relating to private water supplies was addressed by ERYC (18th October 2021). It was stated that four private water supplies are located in or within 250 m of the planning application boundary, as follows:

- Carr House Farm, Nafferton. Approximately 70 m east of the planning application boundary (NGR 507598, 457957). Single Dwelling - Domestic production. Single Dwelling. Volume/rate not stated. Source type: borehole water;

- Goodmanham Lodge Farm, Goodmanham. Approximately 150 m north of the planning application boundary (NGR 492229, 443438). Single Dwelling - Domestic production. Single Dwelling. Volume/rate not stated. Source type: borehole water;
- Weighton Wold Farm, Market Weighton. Approximately 170 m north of the planning application boundary (NGR 490119, 441506). Single Dwelling - Domestic production. Single Dwelling. Volume/rate not stated. Source type: borehole water; and
- Middle Dale Farm, Market Weighton. Approximately 170 m north of the planning application boundary (NGR 489703, 441201). Unused - Domestic production. Volume/rate not stated. Unused. No information on source type.

Source Protection Zones, Drinking Water Safeguard Zones and private water supplies in this section are presented on **Figure 10-10 and Appendix 10A Figure 10-10 (Sheet 2)**.

10.5.2.8 Current and Historic Potentially Contaminative Land Uses

10.5.2.8.1 Current

Current land use for the majority of this section is predominately agricultural. According to ERYC's 'East Riding Brownfield Register' (Ref 10-13), there are no registered brownfield sites within Section 2 of the study area. According to ERYC's 'Contaminated Land – Public Register' (Ref 10-14) there are no sites determined as Contaminated Land under Part 2A of the Environmental Protection Act 1990 within Section 2 of the study area.

During a site walkover undertaken on 7th December 2021, suspected fuel storage tanks were observed within Kiplingcotes Nature Reserve, with a hydrocarbon odour noted to originate from the tanks (Photos 3 and 4 in **Appendix 10B**). This was located approximately 65 m north of the planning application boundary. There were however no visible signs of contamination or impacts to the exposed soils beneath the tanks during the walkover. Also within the nature reserve was the presence of building materials and two cans of liquid petroleum gas laid on their side on exposed ground (Photo 5 in **Appendix 10B**). No visible signs of contamination to the ground were reported.

10.5.2.8.2 Historic

From searches of Groundsure GIS (Ref 10-4), the following historic potentially contaminative land uses were identified within Section 2. These are presented in Table 10-20Table 10-13 and shown on Figure 10-11 and **Appendix 10A Figure 10-11 (Sheet 2).** Selected locations were visited during the walkover survey completed by AECOM on 7th December 2021 and observations are described in Table 10-20.

Table 10-20 Summary of Historic Potentially Contaminative Land Uses

Reference on Figure 10-11	Feature	Year	Location	Distance and Orientation from Planning Application Boundary	Any Evidence of Contamination Observed during Walkover?
154	Old Chalk Pits / Unspecified Pits	1890 – 1994	South of Bainton to the east of the B1248.	55 m east	Location of chalk quarry confirmed during walkover - no visible evidence of contamination reported (see Photo 6 in **Appendix 10B**)
72		1911 - 1977	South of Bainton to the east of the B1248.	160 m east	Not visited
189		1911 - 1977	Dalton Holme, north of Kiplingcotes	200 m east	Not visited

Reference on Figure 10-11	Feature	Year	Location	Distance and Orientation from Planning Application Boundary	Any Evidence of Contamination Observed during Walkover?
271		1911 - 1977	North of former Kiplingcotes Station	200 m west	Not visited
146		1890 - 1994	East of former Kiplingcotes Station	80 m east	Not visited
78		1891 – 1994	South of former Kiplingcotes Station. Adjacent to the east of Kiplingcotes Lane.	220 m south	Not visited
13		1855 – 1994	South of Goodmanham Fold. Southwest of Kiplingcotes.	200 m north	Not visited
152		1855 – 1950	Adjacent to the north of the A1079.	Within planning application boundary	Not visited
171		1890 - 1994	North of Wold Road	200 m north	Not visited
21	Former Railway Sidings, Cuttings, Buildings	1911- 1950	South of Bainton to the east of B1248.	Sidings within application boundary; railway buildings/ station/ pit 130m west	Not visited
60		1911 - 1950	Former Kiplingcotes railway/ buildings/ station	Within planning application boundary	Some station buildings remain, as well as the former station platform. The line of the former rail tracks was also evident during the walkover. No visible evidence of contamination was reported (see Photos 7 – 9 in **Appendix 10B**)
272	Pump House	1977	North of former Kiplincotes railway station	220 m west	Not visited
-	Unspecified tanks	1890 – 1950	Mount Pleasant Farm	145 m west	Not visited

Reference on Figure 10-11	Feature	Year	Location	Distance and Orientation from Planning Application Boundary	Any Evidence of Contamination Observed during Walkover?
286		1950	Dalton Holme, North of Kiplingcotes	200 m west	Not visited
79		1855 – 1977	Goodmanham Lodge. Southwest of Kiplingcotes.	90 m north	Not visited
195		1950	South of Goodmanham Fold. Southwest of Kiplingcotes.	200 m north	Not visited
51				180 m northwest	Not visited
296	Land associated with Former Wireless Transmitter Station	1950	West of Lund	Within planning application boundary	Not visited
252	Old Sand Pits	1850 – 1950	South of Market Weighton. West of the A1034.	60 m north	Not visited
164		1850 – 1950	South of Market Weighton. East of Cliffe Road.	65 m south	Not visited

10.5.2.8.3 Environment Agency Environmental Pollution Incidents Register

A review of the EA's Environmental Pollution Incidents Register (Ref 10-3 and Ref 10-16) did not identify any recorded pollution incidents within Section 2 of the study area.

10.5.2.8.4 Current and Historic Landfills

No recorded current and historic landfills (Ref 10-4 & 10-16) were identified within Section 2 of the study area.

10.5.2.9 Ground Gas

Ground gas including methane and carbon dioxide may be present associated with the natural strata and Made Ground deposits, where present, throughout this section of the study area. Ground gas may also be associated with recorded landfills as well as infilled land (e.g. backfilled former sand and chalk pits).

No records of ground gas investigation data were available for review.

10.5.2.10 Radon

Published radon data from UKRadon and Groundsure (Ref 10-4 & Ref 10-17) indicate that the majority of this section of the study area is located within an area with a maximum radon potential of 'Less than 1%' meaning no radon protection measures are required.

The exceptions are within the planning application boundary to the southeast of Market Weighton and within the study area to the east of Market Weighton, where a maximum radon potential ranging

between '1 and 3%' is recorded, meaning 1-3% of homes and properties within this area is estimated to be at or above defined action levels.

Radon potential is shown on **Figure 10-12**.

10.5.2.11 Unexploded Ordnance Potential

Online Zetica UXO mapping (Ref 10-18) shows a 'Low Risk' from UXO (15 bombs per 1000 acres, or less) for the entirety of this section.

10.5.3 Section 3 – Market Weighton to River Ouse

This section describes the baseline environment within the study area between Market Weighton and the River Ouse.

10.5.3.1 Geology

Published geological maps acquired from Groundsure GIS (Ref 10-4) and from the GIS data sourced from the BGS (Ref 10-7, Ref 10-19 & Ref 10-20) indicate that the study area is underlain by the geological succession summarised below in **Table 10-21**. Geological mapping is shown on **Figure 10-2** and **Appendix 10A Figure 10-2 (Sheet 3)** (superficial geology) and **Figure 10-3** and **Appendix 10A Figure 10-3 (Sheet 3)** (bedrock geology).

Table 10-21 Summary of Geology from BGS 1:50,000 Mapping

Stratum Type	Description
Made Ground	An area of Made Ground has been mapped within the planning application boundary associated with the railway line at North Howden as 'Made Ground (Undivided)'. Although not mapped, it is likely that Made Ground deposits are also present within this section of the study area, including around major roads and other developments.
Superficial	The majority of Section 3 is shown to be underlain by the Bielby Sand Member, comprising clayey sand (northeast and towards the centre of the section) and Hemingbrough Glaciolacustrine Formation, comprising silty clay (centre towards the east of the A63 south of Newsholme). Two small pockets of peat and an area of Alluvium (consisting of clay, peat and silt) are mapped near to the River Foulness. West of the A63, the superficial deposits variably comprise Breighton Sand Formation, 'Warp' (clay and silt) and Alluvium (clay, silt, sand and gravel, associated with tributaries of the River Derwent and the River Ouse).
Bedrock	The majority of this section is underlain by mudstone bedrock of the Mercia Mudstone Group. At the far northern end of the section, Sculthorpe Member and Penarth Group mudstones are mapped. From the west of North Howden to the western end of Section 3 at the River Ouse, bedrock is mapped as Sherwood Sandstone Group.
Faults	Two geological faults are mapped within the planning application boundary: - Close to the Back Delfin and Egremore Drain; normal fault, trending east-northeast to west-southwest; and - Close to the A614 crossing, north of Featherbed Drain; normal fault, trending east-northeast to west-southwest.
Source: Scale BGS Map Fifth Edition. Sheet 1:50,000 72 Bedrock and Superficial, Sheet 79 Bedrock and Superficial	

10.5.3.2 Previous Ground Investigation

BGS Geo-Index online resources (Ref 10-8) recorded ground investigation data from three boreholes drilled within Section 3 of the study area. The strata encountered in these exploratory locations generally correlate with information obtained from BGS mapping data. Strata encountered are summarised below in **Table 10-22**.

Table 10-22 Summary of BGs Geo-Index Boreholes

Stratum Type	Description
Topsoil	Topsoil was noted to be present in the referenced logs to a depth of approximately 0.3 m.
Made Ground	No reference to the presence of Made Ground was found within the borehole logs reviewed. Borehole logs may pre-date land development, when Made Ground may be placed.
Superficial	Based on the reviewed borehole logs, variable sand, peat, silt and clay superficial deposits are present towards the southwest of the section, with a maximum recorded thickness of approximately 16 m.
Bedrock	Weathered sandstone bedrock was recorded at depth of 14.5 m to 18.0 m bgl
Coal	In the western part of this section, borehole SE72NW14 was drilled to more than 1,000 m bgl for coal exploration. Coal seams up to 0.9 m in thickness were reportedly encountered between approximately 514 m bgl and 1,054 m bgl.
Source: BGS Borehole Refs. SE72NW14, SE62NE134, SE62NE133	

10.5.3.3 Geological Site of Special Scientific Interest and Regionally Important Geological Sites

A review of available information from the East Yorkshire RIGS Group (Ref 10-9) indicated that there are no geological SSSIs or RIGS within this section.

10.5.3.4 Coal Mining and Shallow Mining

Coal Authority mapping (Ref 10-9) indicates that a very small part of the study area within Section 3 (approximately 0.02 km^2 within the planning application boundary between Barmby on the Marsh and Asselby) is located within a Coal Mining Reporting Area. The location is outside of coal mining licencing areas, and no development high risk areas or mine entries were identified. Due to the very small area affected, and the low likelihood of potentially significant coal mining features based on online mapping, a Consultants Coal Mining Report was not obtained for environmental assessment.

No other non-coal mining activities were reported within this section of the study area.

Mining activities are shown on **Figure 10-4** and **Appendix 10A Figure 10-4 (Sheet 3)**.

10.5.3.5 Natural Ground Subsidence

A review of Natural Ground Subsidence features from Groundsure GIS (Ref 10-4) relating to Section 3 of the study area is presented in **Table 10-23**. Unless stated otherwise, all features documented in the table are present within the planning application boundary.

Natural ground subsidence features are shown on **Figure 10-5** to **Figure 10-7.** Features that have the potential to result in adverse impacts to Section 3 of the scheme are shown on **Appendix 10A Figure 10-5 (Sheet 3)** (compressible deposits) and **Appendix 10A Figure 10-7 (Sheet 3)** (running sand).

Table 10-23 Summary of Natural Ground Subsidence Features

Geotechnical Features	Definition	Location
Collapsible Deposits	*'Deposits with potential to collapse when loaded and saturated are believed not to be present'*	One small section of land in and surrounding the River Foulness. Larger portions of land with this feature are present to the north and west of Asselby.
	'Deposits with potential to collapse when loaded and saturated are unlikely to be present'	Predominant feature from Market Weighton to the River Ouse.
Compressible Deposits	*'Compressible strata are not thought to occur'*	Predominant feature from Market Weight to the east of the River Foulness.

Geotechnical Features	Definition	Location
	'Compressibility and uneven settlement hazards are probably present. Land use should consider specifically the compressibility and variability of the site'	Predominant feature from the River Foulness to the River Ouse. Largely associated with superficial deposits that include Hemingbrough Glaciolacustrine Formation, Warp and Alluvium.
Ground Dissolution of Soluble Rocks	None identified	
Landslides	*'Slope instability problems are not likely to occur but consideration to potential problems of adjacent areas impacting on the site should always be considered'*	Predominant feature from Market Weighton to the River Ouse.
Running Sand	*'Running sand conditions are not thought to occur whatever the position of the water table. No identified constraints on lands use due to running conditions'*	Present and sporadic in distribution from the northwest of Holme Industrial Estate to the River Foulness. Predominately present from the River Foulness to east of the A63 at Newsholme. Associated with superficial deposits of the Hemingbrough Glaciolacustrine Formation and Warp.
	'Running sand conditions are unlikely. No identified constraints on land use due to running conditions unless water table rises rapidly'	To two patches of land, 180 m to the north and 45 m to the southeast of the planning application boundary are identified with this feature, located to the east and north of the River Foulness. Additional patch of land, 115 m to the northeast of a proposed construction compound south of the A614 is identified with this feature. An additional small area of land to the east of the A614 is identified to have this feature. These are associated with superficial deposits of Peat and Breighton Sand Formation.
	'Running sand conditions may be present. Constraints may apply to land uses involving excavation or the addition or removal of water'	Predominant feature from Market Weighton to the northeast of Holme Industrial Estate. Sporadic in area from the northeast of Home industrial estate to the River Foulness. Present again adjacent to and surrounding the A63 and to the north and west of Asselby. Associated with superficial deposits of Bielby Sand Member, Breighton Sand Formation and Alluvium.
Shrink Swell Clays	*'Ground conditions predominately non-plastic'*	Relatively small areas of land identified with this feature, including the east of the A614, the west of North Howden, adjacent to and surrounding the A63 with a larger area of land identified to the west of Asselby. These features are associated with superficial deposits lacking in clay content, including Peat and Breighton Sand Formation.
	'Ground Conditions predominately low plasticity'	Present from the southwest of Market Weighton to the northwest of Holme Industrial Estate. Then sporadic in distribution to the River Foulness. Present again to the north and the southwest of Asselby. Associated with superficial deposits formed with a portion of clay and include the Bielby Sand Member, Warp and Alluvium.
	'Ground conditions predominantly medium plasticity'	Present at the beginning of this section, southwest of Market Weighton. Then sporadic in distribution from the west of Holme Industrial Estate to the River Foulness. Then the most predominate feature from the River Foulness to the east of the A63. Associated with superficial deposits with greater clay content including Bielby Sand Member and Hemingbrough Glaciolacustrine Formation.

10.5.3.6 Mineral Sites and Designations

Information obtained from ERYC's 'East Riding Local Plan' (adopted 2016) (Ref 10-11) indicates that the majority of this section of the study area is safeguarded, under Policy EC6: 'Protecting Mineral Resources'. The Mineral Safeguarding Areas recorded in the East Riding Local Plan are for sand and gravel, crushed rock, limestone, industrial chalk, clay and silica sand. The area between North Howden and Spaldington is not safeguarded.

10.5.3.7 Hydrogeology

10.5.3.7.1 Aquifer Classifications

Aquifer classifications in Section 3 of the study area, as shown on Defra's 'MAGIC' mapping portal (Ref 10-12) and Groundsure GIS (Ref 10-4) are presented in **Table 10-24**. Aquifer classifications are shown on **Figure 10-8** and **Appendix 10A Figure 10-8 (Sheet 3)**(superficial aquifers) and **Figure 10-9** and **Appendix 10A Figure 10-9 (Sheet 3)** (bedrock aquifers).

Table 10-24 Summary of Aquifer Classifications

Stratum Type	Aquifer Classification	Definition (Environment Agency)	Location
Superficial	Secondary A Aquifer	*'permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers'*	Associated with Bielby Sand Member from the south of Market Weighton to Back Drain; Alluvium and Breighton Sand Formation from west and southwest of North Howden; and Bielby Sand Member, Breighton Sand Formation, Warp and Alluvium from the A63 crossing to the River Ouse.
	Secondary Undifferentiated	*'it has not been possible to attribute either category A or B to a rock type/ superficial. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type'*	Associated with Bielby Sand Member from the west of Back Drain to east of the River Foulness. Interchanging between Secondary Undifferentiated and Unproductive Strata from Drain Lane to west of the River Foulness (associated with Bielby Sand Member and Alluvium).
	Unproductive Strata	*'rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow'*	Small portion to the west of Back Drain associated with Hemingbrough Glaciolacustrine Formation. Interchanging between Secondary Undifferentiated and Unproductive Strata from Drain Lane to east of the River Foulness, associated with Hemingbrough Glaciolacustrine Formation. Predominately unproductive strata from the west of the River Foulness to the east of the A63 (associated with Hemingbrough Glaciolacustrine Formation and Peat deposits).
Bedrock	Principal Aquifer	*'layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale'*	Associated with Sherwood Sandstone bedrock towards the western end of Section 3, from the west of North Howden to the River Ouse.

Stratum Type	Aquifer Classification	Definition (Environment Agency)	Location
	Secondary B Aquifer	*'Aquifers with predominately lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering'*	Majority of Section 3, from the south of Market Weighton to the west of North Howden (associated with Mercia Mudstone Group bedrock).

10.5.3.7.2 Water Framework Directive Groundwater Bodies

Five WFD groundwater bodies have been identified within Section 3 of the study area, as follows:

- White Chalk Subgroup – a highly productive aquifer, up to 450 m thick and locally yielding 50 to 100 L/s of hard to very hard, good quality water;
- Grey Chalk Subgroup – a highly productive aquifer, thickness unknown, locally yielding 5 L/s of groundwater;
- Lias Group – local aquifers yielding small supplies only;
- Undifferentiated Triassic Rocks – a low productive aquifer, yielding less than 0.5 L/s of water which can be highly mineralised; and
- Undifferentiated Triassic Rocks – a highly productive aquifer, up to 600 m thick and locally yielding up to 125 L/s of good quality but hard groundwater.

10.5.3.7.3 Other Hydrogeological Classifications and Features

The following additional hydrogeological classifications and features have been identified in Section 3 of the study area:

- Groundwater vulnerability across this section is classified 'Low', 'Medium' and 'High'. High relating to specific areas with sandy superficial deposits such as areas of Bielby Sand Member and Breighton Sand Formation. Other high vulnerability areas relating to deposits of more granular strata such as Alluvium;
- No soluble rock risk has been identified within this section;
- A small area at the western end of Section 3 is located in an SPZ3 (total catchment) and encompasses the Scheme. No other SPZs are present within this section;
- No Drinking Water Safeguard Zones, protective of groundwater resources, are present within Section 3. A Drinking Water Safeguard Zone for surface water resources covers a small portion of the study area, including the planning application boundary, between Asselby and Barmby on the Marsh; and
- From the beginning of this section to the north of Featherbed drain, east of the A614, the study area is identified to be located within a Nitrate Vulnerable Zone, for surface water resources; and

A request of information (30th June 2021) relating to private water supplies was addressed by ERYC (18th October 2021). It was stated that no private water supplies are located in the study area.

Source Protection Zones and Drinking Water Safeguard Zones in this section are presented on **Figure 10-10** and **Appendix 10A Figure 10-8 (Sheet 3)**.

10.5.3.8 Current and Historic Potentially Contaminative Land Uses

10.5.3.8.1 Current

Current land use for the majority of this section is predominately agricultural. According to ERYC's 'East Riding Brownfield Register' (Ref 10-13) there are no registered brownfield sites within Section 3 of the study area. According to ERYC's 'Contaminated Land – Public Register' (Ref 10-14) there are no sites determined as Contaminated Land under Part 2A of the Environmental Protection Act 1990 within Section 3 of the study area.

A site walkover was carried out by AECOM on the 8th December 2021. The walkover targeted the identified unspecified heap feature located adjacent to the River Foulness within the planning application boundary, where a HDD crossing is proposed. Various mounds of fill material were observed, apparently formed of old building materials (bricks and concrete), textiles, possible asbestos containing materials and possible animal pelts (Photos 10 and 11 in **Appendix 10B**). A separate pile of possible asbestos containing material, in the form of corrugated roof sheets, was present in the same area (Photo 12 in **Appendix 10B**).

10.5.3.8.2 Historic

From searches of Groundsure GIS (Ref 10-4), the following historic potentially contaminative land uses were identified within Section 3. These are presented in **Table 10-25**Table 10-13 and shown on **Figure 10-11** and **Appendix 10A Figure 10-11 (Sheet 3)**. Selected locations were visited during the walkover survey completed by AECOM on 8th December 2021 and observations are described in **Table 10-20**.

Table 10-25 Summary of Historic Potentially Contaminative Land Uses

Reference on Figure 10-11	Feature	Year	Location	Distance and Orientation from Planning Application Boundary	Any Evidence of Contamination Observed during Walkover?
-	Unspecified Tanks	1971 - 1997	Common Farm, south of Long Lane	210 m north	Not visited
-		1970 – 1995	East of Bursea Lane	70 m north	Not visited
24	Old Marl Pits	1890 – 1950	South of Bells Beck	80 m southeast	Not visited
97		1910 - 1957		250 m southeast	Not visited
4		1910 - 1950	Skiff Farm, north of Skiff Lane	70 m north	Not visited
144		1890 - 1958	North of Skiff Lane	Within planning application boundary and 10 m south	Not visited
159	Disused Canal	1855 – 1950	Egremont Drain, south of Sand Lane	Within planning application boundary	Drain still present, but canal inferred to have been infilled
187	Disused Brick and Tile Works	1855 – 1958	North of Lock Lane, west of Egremont Drain.	60 m south	Not visited
94		1910 - 1957	East of Wood Lane, North Howden	200 m north	Not visited
263	Airfield (former RAF Holme-on-Spalding Moor)	1950 - 1971	Northwest of Holme Industrial Estate	Within planning application boundary	No evidence of contamination reported during the walkover from use as a former airfield (currently arable farmland).
12	Unspecified Disused Pit	1890 – 1971	Northeast of Drain Lane	20 m north	Not visited

Reference on Figure 10-11	Feature	Year	Location	Distance and Orientation from Planning Application Boundary	Any Evidence of Contamination Observed during Walkover?
179	Unspecified Heaps	1891 – 1957	Adjacent to the east and west of the River Foulness	40 m southeast	Mounds of fill material observed during walkover (see above, and Photos 10 – 12 in **Appendix 10B**). Unclear if current heaps are the same as historical features.
204		1958	North of the River Ouse	230 m south	Not visited
1	Former Filling Station	1972 – 1995	Adjacent to the north of the A614	40 m north	No evidence of the former filling station was observed.
307	Railway Sidings/ Buildings	1854 – present	North Howden Railway Station	Sidings within planning application boundary; buildings 100 – 250 m east	Not visited
n/a	Historic Railways	1890 – 1958 (based on publicly available online resources)	Northwest of Asselby	Within planning application boundary	The route of the former railway is discernible by shallow depressions in the landscape (currently roughly vegetated field boundaries).

10.5.3.8.3 Environment Agency Environmental Pollution Incidents Register

A review of the EA's Environmental Pollution Incidents Register (Ref 10-4 and Ref 10-15) identified the following recorded pollution incident within Section 3 of the study area:

- Immediately east of the A614 (140 m north of the planning application boundary). Environmental Pollution Incident: 194947, occurred 10/08/2003, classified as Category 3 (minor) impact to land, involving Inorganic Chemicals/Products.

10.5.3.8.4 Current and Historic Landfills

Recorded current and historic landfills (Ref 10-4 and Ref 10-16) identified within Section 3 of the study area are summarised below in **Table 10-26** and shown on **Figure 10-11** and **Appendix 10A Figure 10-11 (Sheet 3)**.

Table 10-26 Summary of Current and Historic Landfills

Landfill Type	Description
EA Historic Landfill	Site Name:' Asselby, East Riding of Yorkshire (site ref: A673). Located 45 m east of the planning application boundary. Status: Closed (1980) formerly taking inert waste.
EA Active or Recent Landfill	None recorded.

Landfill Type	Description
EA Licensed Waste Sites	None recorded.

10.5.3.9 Ground Gas

Ground gas including methane and carbon dioxide may be present associated with the natural strata and Made Ground deposits, where present, throughout this section of the study area. Ground gas may also be associated with recorded landfills as well as infilled land (e.g. various old marl pits, a former canal and unspecified heaps andpits).

No records of ground gas investigation data were available for review.

10.5.3.10 Radon

Published radon data from Groundsure GIS and UKRadon (Ref 10-4 & Ref 10-17) indicate that this section of the study area is located within an area with a maximum radon potential of 'Less than 1%' meaning no radon protection measures are required.

Radon potential is shown on **Figure 10-12**.

10.5.3.11 Unexploded Ordnance Potential

Online Zetica UXO mapping (Ref 10-18) shows a 'Low Risk' from UXO (15 bombs per 1000 acres, or less) for the entirety of this section.

10.5.4 Section 4 – River Ouse to Drax Substation

This section describes the baseline environment within the study area between the River Ouse and Drax Substation.

10.5.4.1 Geology

Published geological maps acquired from Groundsure GIS (Ref 10-4) and from the GIS data sourced from the British Geological Survey (BGS) (Ref 10-19 & Ref 10-20) indicate that the study area is underlain by the geological succession summarised below in **Table 10-27**. Geological mapping is shown on **Figure 10-2** and **Appendix 10A Figure 10-2 (Sheet 3)** (superficial geology) and **Figure 10-3** and **Appendix 10A Figure 10-3 (Sheet 3)** (bedrock geology).

Table 10-27 Summary of Geology from BGS 1:50,000 Mapping

Stratum Type	Description
Made Ground	Although not mapped, it is highly likely that Made Ground deposits are present within the study area, including within the current footprint of the Drax Power Station facility and relating to an historic railway line to the east of Drax Power Station.
Superficial	The superficial deposits underlying the eastern side of this section comprise Warp (clay and silt) and Alluvium (clay, silt, sand and gravel), associated with the River Ouse. Variable deposits of Breighton Sand and Hemingbrough Glaciolacustrine Formation (silty clay) are recorded at the centre and west of Section 4..
Bedrock	The entirety of Section 4 is underlain by Sherwood Sandstone Group bedrock.
Faults	No geological faults are present within the Study Area.
Source: BGS Map Fifth Edition. Sheet 1:50,000 79 Bedrock and Superficial. Groundsure GIS.	

10.5.4.2 Previous Ground Investigation

BGS Geo-Index online resources (Ref 10-8) record ground investigation data from ten boreholes drilled within the study area. The strata encountered in these exploratory locations generally correlate with information obtained from BGS mapping data. Strata encountered are summarised in **Table 10-28**.

Table 10-28 Summary of BGS Geo-Index Boreholes

Stratum Type	Description
Topsoil	Topsoil was recorded to a maximum depth of 0.6 m bgl to the south of Redhouse Lane close to the River Ouse,.
Made Ground	Made Ground was recorded in one location at Drax Power Station to a depth of 0.75m bgl. Made Ground may be present in other developed areas where borehole logs may pre-date land development, when Made Ground may be placed.
Superficial	Variable sand and clay superficial deposits were recorded within the boreholes reviewed, between approximately 11 m and 27 m in thickness.
Bedrock	The bedrock encountered in the borehole logs for this section was Sherwood Sandstone Formation, primarily recovered as sandstone but with occasional marl, recorded as being weathered towards the top of the unit.
Coal	One borehole within the planning application boundary located to the west of the River Ouse was progressed to 984 m bgl for coal exploration. The borehole encountered coal seams between 514 m bgl and 908 m bgl. The greatest thickness of coal was recorded to be 92 cm (Kent's Thick seam), at a depth of approximately 697 m bgl.
Source: BGS Borehole Refs. SE62NE16, SE62NE22, SE62NE231, SE62NE2, SE62NE92, SE62NE91, SE62NE128, SE62NE90, SE62NE127, SE62NE49	

10.5.4.3 Geological Sites of Special Scientific Interest and Regionally Important Geological Sites

A review of currently available information from the East Yorkshire RIGS Group (Ref 10-9) indicates that there are no geological SSSIs or RIGS within the planning application boundary or within the study area.

10.5.4.4 Coal Mining and Shallow Mining

Coal Authority mapping (Ref 10-10) indicates that this section of the study area does not lie within a designated Coal Mining Reporting Area.

No other non-coal mining activities were reported within this section of the study area.

Mining activities are shown on **Figure 10-4** and **Appendix 10A Figure 10-4 (Sheet 3)**.

10.5.4.5 Natural Ground Subsidence

A review of natural ground subsidence features from Groundsure GIS (Ref 10-4) relating to ground conditions within the study area is presented in **Table 10-29**. Unless stated otherwise, all features documented in the table are present within the planning application boundary.

Natural ground subsidence features are shown on **Figure 10-5** to **Figure 10-7.** Features that have the potential to result in adverse impacts to Section 4 of the scheme are shown on **Appendix 10A Figure 10-5 (Sheet 3)** (compressible deposits) and **Appendix 10A Figure 10-7 (Sheet 3)** (running sand).

Table 10-29 Summary of Natural Ground Subsidence Features

Geotechnical Features	Definition	Location
Collapsible Deposits	*'Deposits with potential to collapse when loaded and saturated are believed not to be present'*	Identified to be present adjacent to the River Ouse, extending to the east of Main Road.
	'Deposits with potential to collapse when loaded and saturated are unlikely to be present'	Present from the east of Main Road to the end of this section at Drax Power Station.
Compressible Deposits	*'Compressible strata are not thought to occur'*	Sporadic in distribution and present from the Read School to Wren Hall Lane with smaller patches present to the north of Carr Lane and south Redhouse Lane, 150 m south of the planning application boundary. Associated with

Geotechnical Features	Definition	Location
		superficial deposits of Breighton Sand Formation.
	'Compressibility and uneven settlement hazards are probably present. Land use should consider specifically the compressibility and variability of the site'	Predominant feature for the majority of this section and associated with superficial deposits of Warp, Alluvium and Hemingbrough Glaciolacustrine Formation.
Ground Dissolution of Soluble Rocks	None identified	
Landslides	*'Slope instability problems are not likely to occur but consideration to potential problems of adjacent areas impacting on the site should always be considered'*	Predominant feature from the River Ouse to Drax Power Station.
Running Sand	*'Running sand conditions are not thought to occur whatever the position of the water table. No identified constraints on lands use due to running conditions'*	Predominant feature within this section from the River Ouse to Drax Substation. Associated with superficial deposits of the Hemingbrough Glaciolacustrine Formation and Warp.
	'Running sand conditions may be present. Constraints may apply to land uses involving excavation or the addition or removal of water'	Sporadic in distribution and present from the River Ouse to Wren Hall Lane. Associated with superficial deposits of Breighton Sand Formation and Alluvium.
Shrink Swell Clays	*'Ground conditions predominately non-plastic'*	Sporadic in distribution and present from the Read School to Wren Hall Lane with smaller patches present to the north of Carr Lane and south Redhouse Lane, 150 m south of the planning application boundary. Associated with superficial deposits of Breighton Sand Formation.
	'Ground Conditions predominately low plasticity'	Identified to be present from the River Ouse to the east of Main Road. Associated with superficial deposits formed with a portion of clay and include Warp and Alluvium.
	'Ground conditions predominantly medium plasticity'	Predominant feature identified within this section, present from the east of Main Road to Drax Substation. Associated with superficial deposits with greater clay content including the Hemingbrough Glaciolacustrine Formation.

10.5.4.6 Mineral Sites and Designations

Information obtained from North Yorkshire County Council's Local Plan (Ref 10-21) indicates that this section of the study area is safeguarded under Policy S01 'Safeguarding mineral resources' being identified as a Brick and Clay Safeguarded Area.

10.5.4.7 Hydrogeology

10.5.4.7.1 Aquifer Classifications

Aquifer classifications in Section 4 of the study area, as shown on Defra's 'MAGIC' mapping portal (Ref 10-12) and Groundsure GIS (Ref 10-4) are presented in **Table 10-30**. Aquifer classifications are shown on **Figure 10-8** and **Appendix 10A Figure 10-8 (Sheet 3)** (superficial aquifers) and **Figure 10-9 Appendix 10A Figure 10-2 (Sheet 3)** (bedrock aquifers).

Table 10-30 Summary of Aquifer Classifications

Stratum Type	Aquifer Classification	Definition (Environment Agency)	Location
Superficial	Secondary A Aquifer	*'permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers'*	Approximately half of this section, extending from the River Ouse to north of the Read School (associated with superficial deposits of Warp, Alluvium and Breighton Sand Formation). In addition, pockets further west within areas Unproductive Strata associated with Breighton Sand Formation.
	Unproductive Strata	*'rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow'*	Approximately half of this section of the study area is mapped as unproductive strata, from the centre of this section extending north to Redhouse Lane and extending west to the end of this section at Drax Power Station. Associated with Hemingbrough Glaciolacustrine Formation deposits.
Bedrock	Principal Aquifer	*'layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale'*	River Ouse to Drax Power Station (entirety of Section 4), associated with Sherwood Sandstone.

10.5.4.7.2 Water Framework Directive Groundwater Bodies

One WFD groundwater body has been identified within Section 4 of the study area:

- Undifferentiated Triassic Rocks – a highly productive aquifer, up to 600 m thick and locally yielding up to 125 L/s of good quality but hard groundwater.

10.5.4.7.3 Other Hydrogeological Classifications and Features

The following additional hydrogeological classifications and features have been identified in Section 4 of the study area:

- Groundwater vulnerability across this section is classified 'Low', 'Medium' and 'High'. Areas classified as 'High' vulnerability associated with superficial deposits of Warp, Breighton Sand Formation and Alluvium;
- No soluble rock risk has been identified within the entirety of this section;
- An SPZ3 (total catchment) is identified for the entirety of the English Onshore Scheme within this section. No other SPZs are present within this section;
- No Drinking Water Safeguard Zones for protective of both groundwater or surface water resources are present within the entirety of this section; and
- There are no NVZs identified within the entirety of this section.

A request of information (30th July 2021) relating to private water supplies was addressed by SDC (6th August 2021). It was stated that no private water supplies are located in the study area.

Source Protection Zones in this section are presented on **Figure 10-10**.

10.5.4.8 Current and Historic Potentially Contaminative Lane Uses

10.5.4.8.1 Current

Current land use for the majority of this section is predominately agricultural. Off-site industrial land use is present adjacent to the east of this site relating to power generation activities at Drax Power Station (ref. 169 on **Figure 10-11** and **Appendix 10A Figure 10-11 (Sheet 3)**.

According to SDC's 'Brownfield Register' (Ref 10-22) there are no registered brownfield sites within Section 4 of the study area. According to SDC's 'Contaminated Land Public Register' (Ref 10-23) there are no sites determined as Contaminated Land under Part 2A of the Environmental Protection Act 1990 within Section 4 of the study area.

The western part of this section is within the boundary of the Drax Power Station facility, which is classified as a Lower Tier Control of Major Accidents Hazards (COMAH) site.

Two locations within Section 4 were visited by AECOM during a site walkover on 8th of December 2021, including the proposed converter station location. No visible signs of contamination were reported at any of the locations.

10.5.4.8.2 Historic

From searches of Groundsure GIS (Ref 10-4), the following historic potentially contaminative land uses were identified within Section 4. These are presented in **Table 10-31**Table 10-13 and shown on **Figure 10-11** and **Appendix 10A Figure 10-11 (Sheet 3)**. Selected locations were visited during the walkover survey completed by AECOM on 8th December 2021 and observations are described in **Table 10-31**.

Table 10-31 Historic Potentially Contaminative Land Uses

Reference on Figure 10-11	Feature	Year	Location	Distance and Orientation from Planning Application Boundary	Any Evidence of Contamination Observed during Walkover?
7	Former Pump House	1974 – 1994	Adjacent to west of the River Ouse.	115 m north	Not visited
n/a	Former Railway	1891 – 1972 (based on publicly available online resources)	East of Wren Hall Lane.	Within planning application boundary	Route of the historical railway is discernible by a shallow depression across arable farmland and lines of trees/vegetation. No evidence of contamination was observed.

10.5.4.8.3 Environment Agency Environmental Pollution Incidents Register

A review of the Groundsure GIS and the EA's Environmental Pollution Incidents Register (Ref 10-4 & Ref 10-15) did not identify any recorded pollution incidents within Section 4 of the study area.

10.5.4.8.4 Current and Historic Landfills

No recorded current and historic landfills (Ref 10-4 & Ref 10-16) were identified within the study area of Section 4.

10.5.4.9 Ground Gas

Ground gas including methane and carbon dioxide may be present associated within the natural strata and Made Ground deposits, where present, throughout this section of the study area.

No ground gas investigation data was available for review.

10.5.4.10 Radon

Published radon data from Groundsure GIS and UKRadon (Ref 10-1 & Ref 10-17) indicate that this section of the study area is located within an area with a maximum radon potential of 'Less than 1%' meaning no radon protection measures are required.

Radon potential is shown on **Figure 10-12**.

10.5.4.11 Unexploded Ordnance Potential

Online Zetica UXO mapping (Ref 10-18) shows a 'Low Risk' from UXO (15 bombs per 1000 acres, or less) for the entirety of this section.

10.6 Potential Impacts

10.6.1 Introduction

This section presents an assessment of how the English Onshore Scheme may result in impacts to geology and hydrogeology receptors during the construction and operational stages, as well as how the existing geology and hydrogeology may impact upon the English Onshore Scheme.
Potential receptors in the context of the geology and hydrogeology assessment are considered to be groundwater resources, (uncontaminated) soils, geological strata and end users of the English Onshore Scheme (including construction and maintenance workers), i.e. human health.

Groundwater underlying the majority of the English Onshore Scheme is classified as a Principal Aquifer. The proposed DC cable route passes through SPZ2 and SPZ3 designations. Although the WFD classification is 'poor', groundwater vulnerability is classified as 'medium' to 'high'. As a result the overall sensitivity of the groundwater receptor has been assessed as medium. A preliminary hydrogeological risk assessment (HyRA) has been undertaken for the works proposed at Hutton that are within close proximity to the SPZ1 of the Hutton Cranswick-Bainton SPZ, this is set out in **Appendix 10C**.

In relation to geology, five Regionally Important Geological Sites (RIGS) have been identified within the study area (Sections 1 and 2) of which two are within planning application boundary. The overall sensitivity of geological receptors (uncontaminated soil and bedrock) has been assessed to be low.

Pathways by which the identified geological and hydrogeological receptors have the potential to be impacted by the English Onshore Scheme during the construction and operational phases include direct release of substances to ground (e.g. fuel spills), creation of pathways to deeper groundwater as a result of groundworks (e.g. foundations/piling), adverse effects on groundwater quality or quantity due to construction activities (e.g. dewatering of excavations) and reduction in soil quality (e.g. due to heavy trafficking or handling).

Localised sources of potential contamination, including quarries and pits, railways and historical landfills have been identified along the English Onshore Scheme, as well as Drax Power Station adjacent to the western end of Section 4, result in the potential for contaminated soil and/or groundwater to be present. However, along the majority of the route, few potentially significant sources of ground contamination have been identified. During construction, workers may be exposed to potentially contaminated soil and/or groundwater, if present. During the operational phase, no viable human health receptors are likely, with the exception of potential workers at the converter station and during occasional maintenance activities. The sensitivity with respect to human health has been assessed to be low.

10.6.2 Mitigation by Design

Where possible embedded mitigation measures, or mitigation by design, have been incorporated into the English Onshore Scheme such that they inform its design and/or how it shall be constructed. Through iterative assessment, potential impacts have been predicted and opportunities to mitigate them identified with the aim of preventing or reducing impacts as much as possible.

Mitigation measures have been taken into account through English Onshore Scheme design changes and route amendments during the initial design process to avoid potential sensitive receptors (e.g. important geological sites or groundwater Source Protection Zone 1) and reduce potential impacts by

construction methodologies where they cannot be avoided (e.g. HDD installation to avoid surface disturbance). This approach has reduced potential impacts from the outset.

An Outline Construction Environmental Management Plan (CEMP) is included in the ES (**Chapter 18: Outline Construction Environmental Management Plan**) and will be developed further by the Contractor prior to construction. General mitigation measures detailed in the CEMP that are relevant to geology and hydrogeology, including ground contamination, are summarised in **Table 10-32**.

Table 10-32: General Construction Phase Mitigation Measures included in the CEMP

CEMP Section Ref.	Description	Benefit
18.4	Inductions and Training: All construction personnel to receive site-specific induction including environmental information. All personnel will be suitably trained on emergency procedures, including the use of spill kits.	Reduces potential impacts to human health and the environment from poor environmental management
18.4	Environmental Monitoring: Regular monitoring, auditing and reporting to ensure effective implementation of mitigation measures and environmental performance. A designated Site Environmental Manager will conduct regular checks of works areas, record environmental incidents and corrective measures, and monthly audits recording compliance with the CEMP and relevant environmental legislation.	
18.5	Pollution Prevention: storage of potentially polluting materials will be at least 10m from any watercourse. Location-specific risk assessments to be undertaken where water crossings are required along the cable route. Spill kits, including sorbent pads and granules and booms, to be readily available and checked weekly.	Reduces potential impacts to soils, geology and Controlled Waters from contamination/ release of chemicals to ground
18.5	Storage and Handling: Oil/ diesel storage (including fixed tanks, IBCs, mobile bowsers and generators) will be placed be at least 10m from any watercourse and 50 m from any borehole/ well. Spill kits and drip trays will be provided for all equipment with liquid storage. Drip trays will be checked and emptied daily and will retain at least 10% of the volume being handled. Daily inspections will be undertaken of plant using hydraulic oils. Storage containers will be correctly labelled. Storage areas will be kept secure to prevent acts of vandalism which may result in leaks/ spills.	
18.5	Spill Response: Spill kits will be available, and personnel will be trained in their use. In the event of a spill/leak the flow of pollution will be stopped (if safe to do so) using spill kits or other means to prevent the spill reaching watercourses. Spill kit contents will be checked weekly, and their contents replaced if used. Contaminated materials from spill kits will be disposed according to the Site Waste Management Plan (SWMP). The cause of any spill/ leak/ incident will be investigated and reported to prevent recurrence.	
18.5	Fuel Storage and Refuelling: All fuel will be stored within double-skinned bowsers, kept in a secure building. Refuelling areas will be on hardstanding to prevent infiltration to ground. Each refuelling area will have a designated spill kit. Refuelling lines will be fitted with automatic shutoffs. Only vehicles which do not regularly use public roads will be refuelled on site. Refuelling will only be undertaken by suitably trained personnel within designated areas. Plant nappies will be kept beneath stationary mechanical plant. Regular inspections will be undertaken, and plant removed offsite where maintenance is required. Non-fuel items, e.g., hydraulic oil, will be stored in appropriate labelled containers/bunded areas. Where possible, biodegradable oils will be used when working over watercourses.	
18.5	Site Wastewater: Site effluent will be retained on site in an IBC or holding tank before being disposed offsite. No discharge of wastewater to ground will occur.	

Specific mitigation measures outlined in the CEMP relevant to geology and hydrogeology, including ground contamination, are presented in Section 18.6.4.

Ground investigation data, including geological, hydrogeological and contamination data, is not currently available for the English Onshore Scheme. This will be obtained prior to commencement of construction and appropriate measures required as a result of the findings of the ground investigation and associated risk assessments will be incorporated into the CEMP.

10.6.2.1 Geology/ Soils

The main mitigation measure to prevent adverse effects on soils is to ensure good site practice and management. The following measures will be employed during construction:

- Topsoil will only be handled in suitable conditions when they are not excessively wet to prevent loss of structure and fertility;
- Topsoil storage bunds will be restricted to a maximum height of 4 m to minimise risk of compaction and development of adverse conditions within the topsoil heap that may affect structure and fertility;
- Soil will be stripped using appropriate machinery (to prevent compaction) and stored in bunds adjacent to the area stripped to ensure the soil is returned to the same area during reinstatement;
- Protective bog mats or temporary roads will be used, where required, to prevent compaction of subsoil from construction traffic in soft or wet ground;
- Ripping of the subsoil will be undertaken to alleviate compaction prior to topsoil replacement; and
- Excavated material will be stored separately to prevent mixing of topsoil and subsoil during construction.

In addition, a detailed Soil Management Plan will be in place. The importance of soil care and the implementation of good agricultural practice for the protection of soils is discussed in more detail in **Chapter 12: Soils and Agriculture**.

10.6.2.2 Groundwater

Ground investigation surveys will be undertaken to inform the design of the proposed converter station and cable route. During surveys, groundwater levels will be monitored to allow groundwater profiles to be derived. From this, the requirements for dewatering (if any) will be identified. Specific potential mitigation relating to dewatering is discussed in Section 10.7.1.

10.6.2.3 Ground Contamination

To accurately mitigate risks from the potential presence of ground contamination, the actual nature, extent and magnitude of any significant potential contamination needs to be assessed through ground investigation.

An appropriate intrusive ground investigation will be undertaken in accordance with all relevant guidance and legislation including BS 10175:2011 and Environment Agency guidance (Land Contamination Risk Management, Ref 10-5). The ground investigation will be undertaken to achieve the following objectives:

- Determine the ground conditions to allow design of foundations and structures;
- Assess the nature, extent and magnitude of any soil and groundwater contamination present;
- Assess the risks (if any) from potential contaminants to human health and Controlled Waters; and
- Assess the ground gas regime.

As an additional precaution a watching brief will be maintained during construction works to confirm the absence of potential sources of contamination such as Made Ground, visual or olfactory evidence of hydrocarbons etc. These areas of potentially contaminated ground and/ or water will be sampled and undergo appropriate sampling and laboratory analysis.

Subsequently a risk assessment will be undertaken in accordance with LCRM guidance (Ref 10-5) to identify if these areas of potential contaminants pose a risk to construction workers and/or groundwater. A remediation strategy will be devised and agreed with the regulatory authorities prior to any remedial works, if required. The determination of the risks through ground investigation and risk assessment,

and the potential remediation of areas may result in the reduction of the significance, or even removal, of some of the potential effects identified.

Measures to prevent the creation of contaminant linkages include:

- Risk assessments in accordance with the Health and Safety at Work Act to restrict exposure to potentially harmful substances to a safe level for construction workers. Construction Design and Management practices will be applied;
- Dust suppression measures to reduce the generation of dust from excavated contaminated soils, for example impermeable covers spread over mounds of bare contaminated soil. Implementation of these simple measures can reduce the risk of effects to construction workers and adjacent site users from potentially contaminated dusts;
- A road sweeper will be deployed to prevent spreading of contamination onto off-site roads. Vehicles carrying contaminated soils off-site will only to be loaded up to appropriate levels and be covered to prevent contaminated materials dropping onto roads; and,
- Where piled foundations are used, they will be designed in accordance with the EA guidance document 'Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination: Guidance on Pollution Prevention' (Ref 10-24).

Site cabins/ offices will be suitably ventilated and/ or have a suitable void beneath in accordance with BRE FB41 'Radon in the Workplace, A guide for building owners and managers' (Ref 10-25), in order to prevent exposure to radon above workplace limits.

Any material imported to site, such stone access roads/ foundations will be natural quarried stone or, if recycled, the material will undergo chemical testing. The suite of contaminants and site use criteria will be agreed with regulatory authorities, in order to demonstrate that the material is suitable for use on site and does not pose a risk to construction workers, convertor station workers, new structures or the environment.

Should contaminated material be identified that requires removal it will be disposed of appropriately. Material to be disposed offsite will be analysed to determine the appropriate waste classification and disposal location.

Waste management is discussed in more detail in **Chapter 16: Waste and Materials**.

10.6.3 Assessment of Potential Impacts: Construction Phase

The construction phase of the English Onshore Scheme will comprise the use of construction equipment, construction of temporary haul roads and site compounds, excavation of the cable route, placement and backfilling of the cable route. In addition, in Section 4, cut-fill earthworks (e.g. to create a suitable building platform for the converter station) and potential piling of the converter station may occur.

Pathways by which the identified geological and hydrogeological receptors have the potential to be impacted by the English Onshore Scheme during the construction phase include:

- Release of substances to ground (e.g. fuel spills) resulting in contamination of (uncontaminated) underlying receptors;
- Reduction in soil quality by heavy trafficking or handling/storage;
- Disturbance and handling of potentially contaminated soils, or importation of contaminated construction materials, resulting in contamination of underlying receptors and/or risk to human health;
- Dewatering of excavations resulting in reduced groundwater flow to abstractions of surface water bodies; and
- Creation of preferential contaminant migration pathways to deeper groundwater as a result of groundworks (e.g. foundations/piling).

Identified potential impacts during the construction phase are described in **Table 10-33**, along with an assessment of the potential significance of the impact on the identified receptors, assuming no mitigation measures (other than mitigation by design and adherence to the CEMP) are implemented.

Significance of effects categorised as 'negligible' or 'minor' are considered '**not significant**'. Significance categorised as 'moderate' or 'major' are considered potentially '**significant'**. Those effects considered potentially '**significant**' are considered in the context of proposed mitigation measures and re-assessed in Section 10.8.

Table 10-33: Assessment of Potential Impacts: Construction Phase (Sections 1 - 4)

Potential Impact	Description	Receptor	Assessment of Significance		
			Magnitude	Sensitivity	Significance
Groundwater and ground pollution due to chemical spillages and leaks.	Potential for plant to leak or spill oil and/ or fuel. Leaks and spillages could occur in any area of the working width and construction compounds in which plant is operated or stored, including refuelling. Additionally, the potential exists for spills and drips to occur associated with stored fuels and chemicals brought onto the site to facilitate construction. There is potential that such spillages could enter the underlying uncontaminated strata and contaminate shallow groundwater, as well as presenting a risk to human health. However, mitigation measures are included in the CEMP (see Chapter 18 and Table 10-32), including training, pollution prevention measures, responsible storage and handling and spill response measures etc., which would reduce the likelihood of, and the likely magnitude of the effect of, any spill/leak.	Geology/soils	Negligible	Low	Negligible (Not Significant)
		Groundwater (Secondary A superficial aquifer; Principal bedrock aquifer)	Low	Medium	Minor (Not Significant)
		Human Health (Construction Workers)	Negligible	Low	Negligible (Not Significant)
Reduction of soil quality during handling and storage.	During the excavation and temporary storage of soils, minor changes to soil characteristics, such as soil hydrology and soil structure, could occur due to handling and storage of topsoil and subsoil in inappropriate conditions. Soils stored in bunds are also susceptible to erosion from run-off during heavy rainfall or wind erosion during dry periods. The reduction in the quality of the soils could lead to the loss or alteration to one or more key important features. However, mitigation measures are included in the CEMP (see Chapter 18 and Section 10.6.2.1), including only handling soil in suitable conditions, maximum height of temporary storage bunds and use of appropriate machinery etc., which would reduce the likely magnitude of the effect. In addition, soil will be handled in accordance with a detailed Soil Management Plan.	Geology/soils	Low	Low	Negligible (Not Significant)
Reduction of soil quality due to construction traffic.	The tracking of heavy plant across the site during construction could compact the ground surface causing degradation of soil quality. In addition, compaction could lead to a decrease in infiltration and, therefore, potential water logging and increase of surface water runoff, and a reduction of local groundwater levels. However, mitigation measures are included in the CEMP (see Chapter 18 and Section 10.6.2.1), including use of protective mats for temporary haul roads etc., which would reduce the likely magnitude of the effect. In addition, soil will be handled in accordance with a detailed Soil Management Plan.	Geology/soils	Low	Low	Negligible (Not Significant)
		Groundwater (Secondary A superficial aquifer; Principal bedrock aquifer)	Negligible	Medium	Negligible (Not Significant)
Disturbance of potentially contaminated soils, sediments and	Most of the land is farmland. A number of historical railway lines transect the Scheme. Infilled ground (pits, former railway cuttings, canals etc.) may be present. In Section 3, heaps of material apparently comprising building rubble, including possible asbestos-containing materials, and animal pelts, were	Geology/soils	Negligible	Low	Negligible (Not Significant)
		Groundwater	Low	Medium	Minor (Not Significant)

Potential Impact	Description	Receptor	Assessment of Significance		
			Magnitude	Sensitivity	Significance
waters posing a risk to construction workers, groundwater, soils and geology.	observed at the proposed HDD crossing of the River Foulness during the walkover in December 2021. Drax Power station is located adjacent to the converter station in Section 4. The potential presence of contaminated soils encountered during construction could lead to adverse impacts associated with contaminated soils: • Vehicles tracking over potentially contaminated soils have the potential to spread contamination and carry it off-site; • Construction workers may be exposed during the excavation of material to potentially harmful contaminants and ground gases; • Disturbance of soils may alter the chemical conditions within the site soils resulting in mobilisation of potential contaminants; • The surfaces of contaminated material may be exposed in excavations, which could cause dissolution and/ or mobilisation of contaminants by percolating rainwater; and • Arisings from the excavation of soil could potentially result in the stockpiling of contaminated soils on the site and reuse on-site. The exposed soils could lead to increased migration of potential contaminants both on-site and off the site through dust generation and to underlying soils and Controlled Waters through leaching and surface water runoff. However, mitigation measures are included in the CEMP (see Chapter 18 and Section 10.6.2.3), including investigation and risk assessment in line with LCRM guidance (Ref 10-5), employing CDM practices, undertaking risk assessments, dust suppression and design in accordance with relevant guidance etc., which would reduce the likely magnitude of the effect of any disturbance of contaminated soils, sediments or waters.	(Secondary A superficial aquifer; Principal bedrock aquifer)			
		Human Health (Construction Workers)	Low	Low	Negligible (Not Significant)
Importation of potentially contaminated construction materials posing a potential risk to human health and underlying soils and geology.	Without controls in place, imported construction materials, including natural or recycled stone to create building platforms, access tracks and other working areas or Cement Bound Sand (CBS) (or similar thermostable material) materials for backfilling of the cable trench, could be contaminated and present a potential a risk to construction workers underlying uncontaminated strata and groundwater. It is anticipated that significant amounts of construction material will be required at the converter station (Section 4) to create a building platform, potentially 2m above existing ground level.	Geology/soils	Negligible	Negligible	Negligible (Not Significant)
		Groundwater (Secondary A superficial aquifer; Principal bedrock aquifer)	Low	Medium	Minor (Not Significant)
		Human Health (Construction Workers)	Low	Low	Negligible (Not Significant)

Potential Impact	Description	Receptor	Assessment of Significance		
			Magnitude	Sensitivity	Significance
	However, mitigation measures are included in the CEMP (see Chapter 18 and Section 10.6.2.3), including suitable chemical testing of any imported material, which would reduce the likely magnitude of the effect.				
Requirement for dewatering, reducing flow to groundwater abstractions and surface water bodies and changes to soil hydrology.	During construction, there may be a requirement to excavate below the water table (e.g. in HDD locations, foundations for the converter station). If this is the case, dewatering may be required. Groundwater would likely be extracted from sumps within the excavation and discharged to surrounding ground. Groundwater levels could be locally affected. A reduction in groundwater levels may lead to reduced baseflow to watercourses and to groundwater abstraction points. In addition, the quality of surrounding soils may be affected through a reduction of soil water changing the soil structure. Mitigation measures are included in the CEMP (see Chapter 18 and Section 10.6.2.2), including monitoring of groundwater levels to assess groundwater profiles and inform dewatering requirements, which would reduce the likely magnitude of the effect of dewatering.	Geology/soils	Low	Low	Negligible (Not Significant)
		Groundwater (Secondary A superficial aquifer; Principal bedrock aquifer)	Medium	Medium	Moderate (Significant)
Requirement to remove spoil from construction posing a potential risk to human health and the environment.	Potential contaminated spoil arising from construction of building platforms and/or cable route excavations may be generated. This may be reused elsewhere within the English Onshore Scheme, potentially impacting the geology/soils and/or groundwater in the receiving location or require removal from the site. Handling of potentially contaminated soils may be required by construction workers. In Section 3, heaps of material apparently comprising building rubble, including possible asbestos-containing materials, and animal pelts, were observed at the proposed HDD crossing of the River Foulness during the walkover in December 2021. However, mitigation measures are included in the CEMP (see Chapter 18 and Section 10.6.2.3), including investigation and risk assessment in line with LCRM guidance (Ref 10-5), employment of CDM practices, risk assessments and dust suppression measures, which would reduce the likely magnitude of the effect of handling of potentially contaminated spoil.	Geology/soils	Negligible	Low	Negligible (Not Significant)
		Groundwater (Secondary A superficial aquifer; Principal bedrock aquifer)	Low	Medium	Minor (Not Significant)
		Human Health (Construction workers)	Low	Low	Negligible (Not Significant)
Foundations creating a preferential pathway for contaminants to migrate ***[Section 4 only]***	The presence of up to approximately 20 m of superficial deposits in Section 4 would typically reduce the potential for vertical migration between shallow groundwater and the bedrock (Principal) aquifer. However, the superficial aquifer is itself classified as a Secondary A Aquifer. If penetrated by piling (or other construction activities), which is likely to be the case at the converter station, there is the potential for vertical migration pathways to be created	Geology/soils	Negligible	Low	Negligible (Not Significant)
		Groundwater (Secondary A superficial aquifer; Principal bedrock aquifer)	Medium	Medium	Moderate (Significant)

Potential Impact	Description	Receptor	Assessment of Significance		
			Magnitude	Sensitivity	Significance
	between shallow Made Ground/ contaminated shallow groundwater/ drilling fluids to deeper uncontaminated strata and groundwater. Mitigation measures are included in the CEMP (see Chapter 18 and Section 10.6.2.3), including investigation and risk assessment in line with LCRM guidance (Ref 10-5) and adherence to specific guidance for piling on land affected by contamination, which would reduce the likely magnitude of the effect. However, in the absence of ground investigation data, the potential for significant contamination to be present cannot be ruled out.				
Potential adverse effect on geological designations ***[Sections 1 and 2 only]***	Regionally Important Geological Sites (RIGS) were identified within planning application boundary in Section 2 (Kiplingcotes Nature Reserve and Kiplingcotes Station Quarry) and adjacent to the northern edge of the planning application boundary in Section 1 (Gransmoor Quarry). A further two RIGS were identified within the study area (Bracken Quarry 50 m east of the planning application boundary at the Section 1-2 boundary) and Arras Road Chalk Quarry (180 m of the application boundary in Section 2). None of the RIGS are anticipated to be affected by the English Onshore Scheme as the quarry faces / geological outcrops will not be intersected by the cable route or any ancillary development.	Geology/soils	Negligible	Low	Negligible (Not Significant)

10.6.4 Assessment of Potential Impacts: Operational Phase

The operational phase of the English Onshore Scheme will comprise limited activities in relation to geological and hydrological impacts, other than the physical presence of the newly constructed structures (i.e. the proposed converter station and cable route) and potential workers occupying the converter station. Occasional maintenance activities are also considered in this assessment.

Potential impacts have been identified for Section 4 of the English Onshore Scheme only, where the converter station, and associated infrastructure (e.g. permanent attenuation ponds, piles penetrating deeper groundwater bodies and the permeant presence of above-ground infrastructure) will be located. Potential impacts relate to long-term pathways which may be present, include:

- The presence of piled foundations (or other below-ground structures) creating preferential vertical pathways for contaminants, if present, to migrate downwards, presenting a risk to deeper (uncontaminated) strata and aquifers, or upwards (e.g. vapours) into buildings presenting a risk to human health of site users;
- Potential equipment failure, or spills during maintenance or refuelling, of diesel-powered infrastructure (e.g. back-up generators), resulting in direct loss of contaminants to ground; and
- Impacts on the groundwater regime from permanent drainage systems.

No operational phase impacts have been identified for Sections 1 to 3 of the English Onshore Scheme, which comprise the cable route only.

Identified impacts during the operational phase are described in **Table 10-34**, along with an assessment of the potential significance of the impact on the identified receptors, assuming no mitigation measures (other than mitigation by design and measures implemented during construction in line with the CEMP which reduce potential impacts during the operational phase, as described in Section 10.6.2) are implemented.

Significance of effects categorised as ‘negligible’ or ‘minor’ are considered ‘**not significant**’. Significance categorised as ‘moderate’ or ‘major’ are considered potentially ‘**significant’**. Those effects considered potentially ‘**significant**’ are considered in the context of proposed mitigation measures and re-assessed in Section 10.8.

10.6.5 Assessment of Potential Impacts: Decommissioning Phase

The scale and nature of activities undertaken during decommissioning would be similar to those described previously for construction, and they would be temporary during the period of decommissioning activities on site. Following the removal of the structures and the reinstatement of the land there would be no further potential effects on geological and hydrogeological receptors. The potential effects from decommissioning should therefore be regarded as the same as construction as described in greater detail below.

Table 10-34: Assessment of Potential Impacts: Operational Phase (Section 4 only)

Potential Effect	Description	Receptor	Assessment of Significance		
			Magnitude	Sensitivity	Significance
Presence of foundations creating a preferential pathway for contaminant migration	If strata are penetrated by piling (or other construction activities), there is the potential for long-term vertical migration pathways to be created between shallow Made Ground/ contaminated shallow groundwater to deeper uncontaminated strata and groundwater. Although up to 20 m of superficial deposits are inferred to underly Section 4 of the English Onshore Scheme and may afford some protection to the bedrock (Principal) aquifer, the proposed depth of piles may exceed this, and the superficial deposits themselves are classified as a Secondary A Aquifer. Furthermore, the presence of piles or other below-ground structures, may create a potential pathway for migration of ground gases and/ or soil vapours to workers in the newly-constructed converter station. Mitigation by design measures will be incorporated during the construction phase. Mitigation measures are included in the CEMP (see Chapter 18 and Section 10.6.2.3), including investigation and risk assessment in line with LCRM guidance (Ref 10-5) and adherence to specific guidance for piling on land affected by contamination, which would reduce the likely magnitude of the effect.	Geology/soils	Negligible	Low	Negligible (Not Significant)
		Groundwater (Secondary A superficial aquifer; Principal bedrock aquifer)	Medium	Medium	Moderate (Significant)
		Human Health (Future Site Workers)	Medium	Low	Minor (Not Significant)
Presence of contaminated soils/groundwater causing adverse impact on human health	If the converter station is manned by regular workers, or during occasional maintenance activities, there is a potential adverse impact on human health from contaminated soils/groundwater, e.g. by direct contact with soil/shallow groundwater during maintenance activities, or from inhalation of soil vapour and/or ground gas inhalation by workers inside the building. Mitigation measures are included in the CEMP (see Chapter 18 and Section 10.6.2.3), including investigation and risk assessment in accordance with LCRM guidance (Ref 10-5), which would reduce the likely magnitude of the effect of contaminated soil/groundwater. However, depending on the findings of ground investigations prior to construction, additional measures may be required to address site-specific potential risks associated with the English Onshore Scheme.	Human Health (Future Site Workers)	Medium	Low	Minor (Not Significant)

Potential Effect	Description	Receptor	Assessment of Significance		
			Magnitude	Sensitivity	Significance
Storage and use of chemicals / substances	During the operational phase of the English Onshore Scheme back-up diesel generators will be present at the converter station, likely with an associated fuel storage tank. In addition, fluids (oils) may be used in the switchgears and a pumping station will likely be associated with drainage requirements which will require a fuel source. There is potential for a release to ground to occur due to equipment failure, during refuelling of diesel generators/storage tanks or during maintenance activities, followed by vertical migration to underlying soils and groundwater. Should diesel impacted groundwater be present then there is a potential risk of vapour intrusion into the converter station building from the vapour source. However, protection measures will be incorporated to mitigate against any potential release during the operational phase. Mitigation measures for the storage and use of fuels will be in accordance with The Control of Pollution (Oil Storage) (England) Regulations 2001 (Ref 10-26). Fuel and other potentially polluting chemicals will be stored at a minimum of 30 m away from watercourses (unless it is demonstrated that there is no pathway for migration of pollution), in an impermeable and bunded tank, with the bund capacity being 110% of the total tank volume. The back-up diesel generator will be located within an impermeable, bunded area in case of release during operation. Should any drains be present nearby, oil-water interceptors will be installed to prevent migration of fuels along the drains. When storing and handling fuels on site, appropriate spill control measures will be employed including appropriate training of personnel, spill kits available and regular inspections/maintenance of equipment.	Geology/ soils	Negligible	Low	Negligible (Not Significant)
		Groundwater (Secondary A superficial aquifer; Principal bedrock aquifer)	Low	Medium	Minor (Not Significant)
		Human Health (Future Site Workers)	Negligible	Low	Negligible (Not Significant)
Impact on groundwater from drainage	Attenuation ponds are proposed to be present during the operational phase of the Scheme at the converter station. Should potentially contaminated water enter the attenuation ponds and then be discharged to ground and/ or pumped to nearby water courses/land drains, impacted water may ultimately migrate to shallow groundwater receptors. However, mitigation by design includes a Surface Water Management Plan (SWMP) which will be in place during the operational phase to ensure surface water runoff quality and quantity is managed effectively. In addition, the converter station design includes SuDS system to manage surface water runoff and storage (see **Chapter 11: Hydrology and Land Drainage**).	Groundwater (Secondary A superficial aquifer; Principal bedrock aquifer)	Low	Medium	Minor (Not Significant)

10.7 Project Specific Mitigation

10.7.1 Construction Phase Mitigation

The potential impacts and assigned significances associated with the construction phase (as described in Section 10.6.3 are an assumed worst-case scenario based on the baseline data and assuming no mitigation measures are in place, other than mitigation by design, including adherence to the CEMP.

Additional specific measures relevant to geology and hydrogeology, including ground contamination, over and above the mitigation measures outlined in Section 10.6.2, are presented below.

Ground investigation data, including geological, hydrogeological and contamination data, is not currently available for the English Onshore Scheme. This will be obtained prior to commencement of construction and appropriate measures required as a result of the findings of the ground investigation and associated risk assessments will be incorporated into the final CEMP.

10.7.1.1 Geology/Soils

As shown in **Table 10-33** and **Table 10-34**, all potential impacts were assessed as **not significant** with respect to geology/ soils. Therefore, no project-specific mitigation is proposed with respect to geology/ soils.

10.7.1.2 Groundwater

Ground investigation surveys will be undertaken to inform the design of the proposed converter station and cable route. During surveys, groundwater levels will be monitored to allow groundwater profiles to be derived. From this, the requirements for de-watering will be identified.

If required, a detailed dewatering scheme will be developed prior to construction to manage the water arising from dewatering operations and treat the water prior to controlled discharge. This may include the construction of raised lagoons for the storage of water and to allow the settlement of any sediment prior to discharge. Consideration will be given to the potential effects of dewatering on adjacent water features and groundwater abstraction points, both from drawdown during dewatering and subsequent discharge, and mitigation applied, such as use of cessation rings around HDD launch pits etc.

In addition, a HyRA will be undertaken where the cable route passes through SPZ2 designations. The HyRA will consider potential effects on the groundwater regime (levels, flow regime and supply to abstractions) as well as potential pollution risk from the construction activities. This will expand upon the preliminary HyRA presented in Appendix 10-C and will be informed by the results of the ground investigation and final Contractor design. Mitigation measures will be implemented to reduce the potential risk to acceptable levels.

Water storage and flood risk is discussed in more detail in **Chapter 11: Hydrology and Land Drainage**.

Mitigation measures associated with the potential contamination of groundwater during construction are discussed in Section 10.7.1.3, below.

10.7.1.3 Ground Contamination

The majority of the potential effects are associated with an assumed worst case relating to potential soil and groundwater contamination for the English Onshore Scheme, which have been derived by qualitative assessment based on available desk-based baseline data. In order to accurately mitigate the potential contaminants, the actual nature, extent and magnitude of any significant potential contamination needs to be assessed through ground investigation.

In addition to the mitigation by design measures, including those in the CEMP (see Section 10.6.2.3 and Chapter 18), additional project specific measures may be required where the ground investigation indicates significant potential for contamination exists. The scope of the additional mitigation measures is dependent on the findings of the ground investigation, but may include:

- Ground Gas Risk Assessment: If the ground investigation identifies significant thicknesses of Made Ground (>3m) in the vicinity of manned buildings (i.e. the converter station), a Ground Gas Risk Assessment (GGRA) will be undertaken in accordance with CIRIA guidance document

'Assessing Risks Posed by Hazardous Ground Gases to Buildings' (C665), to further assess potential risks from ground gas; and

- Piling Risk Assessment: Where piled foundations are proposed (i.e. the converter station), they will be designed in accordance with the EA guidance document 'Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination: Guidance on Pollution Prevention' (Ref 10-24) to prevent piles acting as preferential pathways for vertical migration of contaminants to groundwater;
- Generic Quantitative Risk Assessment: A Generic Quantitative Risk Assessment (GQRA) will be undertaken in line with LCRM guidance (Ref 10-5) to identify potential risks to identified human health and groundwater receptors from soil, soil vapour and groundwater contamination. Although the CEMP assumes a GQRA will be undertaken in line with LCRM, this is particularly pertinent at the proposed converter station where permanent above-ground, potentially manned buildings will be present. A remediation strategy will be devised and agreed with the regulatory authorities prior to any remedial works, if required. The determination of the risks through ground investigation and risk assessment, and the potential remediation of areas may result in the reduction of the significance, or even removal, of some of the potential effects identified; and
- Additional assessment may also be required in relation to handling of potentially significant volumes of potentially contaminated spoil, for example at the HDD launch pit in the vicinity of heaps of spoil at the River Foulness crossing in Section 3. Depending on the findings of such an assessment, this may also entail the preparation of Materials Management Plan, including additional measures to reduce the potential risk to construction workers and groundwater (e.g. segregation of materials, validation testing and additional personal protective equipment), over and above the standard 'best practice' measures included in the CEMP for the rest of the English Onshore Scheme. If areas of the proposed redevelopment are shown to pose a risk, any remedial measures required will be implemented. If handling of contaminated soils is required, risk assessments will be in place in accordance with the Health and Safety at Work Act to restrict exposure to potentially harmful substances to a safe level for construction workers.

10.7.2 Operational Phase Mitigation

The potential impacts and assigned significance associated with the operational phase (as described in Section 10.6.5) are an assumed worst-case scenario based on the baseline data and assuming no mitigation measures are in place, other than mitigation by design, including measures implemented during construction in line with the CEMP which reduce potential impacts during the operational phase, as described in Section 10.6.2) are implemented.

Where possible, measures will be put in place during the construction phase which will mitigate against the identified potential operational impacts, largely based on the findings of any ground investigation and risk assessments carried out. Potential impacts during the operational phase for which mitigation may be implemented at construction phase will include, as required:

- Potential impact on human health from contaminated soils – should the ground investigation data and subsequent GQRA indicate that contaminants in soil, soil vapour and/ or groundwater are present at concentrations which may present a risk to identified human health or groundwater receptors, mitigation measures to remove the contaminants sources or break contaminant linkages will be implemented (e.g. removal of shallow soils and replacement with clean imported materials, construction of soil vapour barriers/venting systems on buildings). If required, the remediation strategy will be devised and agreed with the regulatory authorities prior to any remedial works being undertaken;
- Potential impact of ground gases – should ground gas investigations and the GGRA determine that the site is at risk of a hazardous ground gas regime then there may be a requirement for ground gas protection measures for any manned building, such as the converter station. Ground gas protection measures will be in line with British Standard 8485:2015+A1:2019 - Code of Practice for the Design of Protective Measures for Methane and Carbon Dioxide Ground Gases for New Buildings (Ref 10-27); and
- Potential impact on groundwater from piling - should ground investigations indicate that piled foundations are required, piles will be designed in accordance with the Environment Agency guidance document 'Piling and Penetrative Ground Improvement Methods on Land Affected by

Contamination: Guidance on Pollution Prevention' (Ref 10-24) to prevent piles acting as preferential pathways for vertical migration of contaminants to groundwater in the long term.

10.8 Residual Effects

The potentially significant impacts identified in Section 10.6.4 (**Table 10-33** (construction phase) and **Table 10-34** (operational phase)) have been reconsidered in light of the proposed project-specific mitigation measures detailed in Section 10.7.

Implementation of the project specific mitigation measures will reduce the magnitude of the potential effects by removing potential pathways by which the identified receptors may be impacted, for example:

- Development of detailed dewatering schemes, based on ground investigation data, to reduce impact on groundwater levels/flow, manage the water arising from dewatering operations and treat the water prior to controlled discharge; and
- Appropriate pile design, in accordance with relevant guidance, to prevent the creation of vertical pathways, both during construction and long-term.

The following sections outline the assessment of residual effects, taking into account the proposed mitigation, for the construction (Section 10.8.1) and operational (Section 10.8.2) of the English Onshore Scheme.

10.8.1 Assessment of Residual Effects: Construction Phase

The project-specific mitigation measures during the construction phase, as outlined in Section 10.7.1, will reduce the magnitude of the potential impacts identified in Section 10.6.3 by:

- Ensuring no significant effect on identified groundwater or surface water receptors (including SPZs and groundwater-fed watercourses) by undertaking detailed dewatering design and hydrogeological risk assessment prior to commencement of construction; and
- Depending on the findings of ground investigations and preliminary risk assessments, undertaking ground gas risk assessment (GGRA), piling risk assessment (PRA) and/ or additional GQRA to ensure adequate mitigation measures are in place in relation to potential ground contamination.

An assessment of residual effects for the construction phase of the English Onshore Scheme, after implementation of project-specific mitigation measures, is presented in **Table 10-35**.

Table 10-35: Assessment of Residual Effects: Construction Phase (Sections 1 – 4)

Receptor Description	Value/ Sensitivity	Description of Potential Impact	Magnitude	Significance	Mitigation Measure(s)	Residual Effect	
						Magnitude	Significance
Geology/ soils	Low	Groundwater and ground pollution due to chemical spillages and leaks (see details in **Table 10-33**).	Negligible	Negligible (not significant)	**Mitigation by Design**: Mitigation measures are included in the CEMP, including training, pollution prevention measures, responsible storage and handling and spill response measures etc., which would reduce the likelihood of, and the likely magnitude of the effect of, any spill/leak. **Project Specific Mitigation**: None	Negligible	Negligible (not significant)
	Low	Reduction of soil quality during handling and storage (see details in **Table 10-33**).	Low	Negligible (Not Significant)	**Mitigation by Design**: Mitigation measures are included in the CEMP, including only handling soil in suitable conditions, maximum height of temporary storage bunds and use of appropriate machinery etc., which would reduce the likely magnitude of the effect. In addition, soil will be handled in accordance with a detailed Soil Management Plan. **Project Specific Mitigation**: None	Negligible	Negligible (not significant)
	Low	Reduction of soil quality due to construction traffic (see details in **Table 10-33**).	Low	Negligible (Not Significant)	**Mitigation by Design**: Mitigation measures are included in the CEMP, including use of protective mats for temporary haul roads etc., which would reduce the likely magnitude of the effect. In addition, soil will be handled in accordance with a detailed Soil Management Plan. **Project Specific Mitigation**: None.	Negligible	Negligible (not significant)
	Low	Disturbance of potentially contaminated soils, sediments and waters posing a risk to soils and geology (see details in **Table 10-33**).	Negligible	Negligible (Not Significant)	**Mitigation by Design**: Mitigation measures are included in the CEMP, including employing CDM practices, undertaking risk assessments, dust suppression and design in accordance with relevant guidance etc., which would reduce the likely magnitude of the effect of any disturbance of contaminated soils, sediments or waters. **Project Specific Mitigation**: None	Negligible	Negligible (Not Significant)

Receptor Description	Value/ Sensitivity	Description of Potential Impact	Magnitude	Significance	Mitigation Measure(s)	Residual Effect	
						Magnitude	Significance
	Low	Importation of potentially contaminated construction materials posing a potential risk to underlying soils and geology (see details in **Table 10-33**).	Negligible	Negligible (Not Significant)	**Mitigation by Design**: Mitigation measures are included in the CEMP, including suitable chemical testing of any imported material, which would reduce the likely magnitude of the effect. **Project Specific Mitigation**: None	Negligible	Negligible (Not Significant)
	Low	Requirement for dewatering, resulting in potential changes to soil hydrology (see details in **Table 10-33**).	Low	Negligible (Not Significant)	**Mitigation by Design**: Mitigation measures are included in the CEMP, including monitoring of groundwater levels to assess groundwater profiles and inform dewatering requirements, which would reduce the likely magnitude of the effect of dewatering. **Project Specific Mitigation**: If required, a detailed dewatering scheme will be developed prior to construction to manage the water arising from dewatering operations. This may include the construction of raised lagoons for the storage of water and to allow the settlement of any sediment prior to discharge.	Negligible	Negligible (Not Significant)
	Low	Requirement to remove spoil from construction posing a potential risk to the environment (see details in **Table 10-33**).	Negligible	Negligible (Not Significant)	**Mitigation by Design**: Mitigation measures are included in the CEMP, including employment of CDM practices, risk assessments and dust suppression measures, which would reduce the likely magnitude of the effects from potentially contaminated spoil. **Project Specific Mitigation**: None	Negligible	Negligible (Not Significant)
	Low	***[Sections 1 and 2 only]*** Potential adverse effect on geological designations (see details in **Table 10-33**).	Low	Negligible (Not Significant)	**Mitigation by Design**: The route alignment has bene amended during the design process such that none of the RIGS are anticipated to be affected by the English Onshore Scheme. Quarry faces / geological outcrops will not be intersected by the cable route or any ancillary development. **Project Specific Mitigation**: None	Low	Negligible (Not Significant)
	Low	***[Section 4 only]*** Foundations creating a preferential pathway for	Negligible	Negligible (Not Significant)	**Mitigation by Design**: Mitigation measures are included in the CEMP, including adherence to specific guidance for piling on land affected	Negligible	Negligible (Not Significant)

Receptor Description	Value/ Sensitivity	Description of Potential Impact	Magnitude	Significance	Mitigation Measure(s)	Residual Effect	
						Magnitude	Significance
		contaminants to migrate (see details in **Table 10-33**).			by contamination, which would reduce the likely magnitude of the effect. **Project Specific Mitigation**: Depending on the findings of ground investigation and preliminary risk assessment, piling risk assessment may be required. Piles will be designed in accordance with EA guidance document 'Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination: Guidance on Pollution Prevention' (Ref 10-24) to prevent piles acting as preferential pathways for vertical migration of contaminants.		
Ground-water (Secondary A superficial aquifers; Principal bedrock aquifers)	Medium	Groundwater and ground pollution due to chemical spillages and leaks (see details in **Table 10-33**).	Low	Minor (Not Significant)	**Mitigation by Design**: Mitigation measures are included in the CEMP, including training, pollution prevention measures, responsible storage and handling and spill response measures etc., which would reduce the likelihood of, and the likely magnitude of the effect of, any spill/leak. **Project Specific Mitigation**: A hydrogeological risk assessment (HRA) will be undertaken where the cable route passes through SPZ2 designations (Sections 1 and 2 only), including assessment of potential pollution risk from the construction activities. Mitigation measures will be implemented to reduce the potential risk to acceptable levels.	Low	Minor Adverse (Not Significant)
	Medium	Reduction of soil quality due to construction traffic, including waterlogging and impacts on shallow groundwater (see details in **Table 10-33**).	Negligible	Negligible (Not Significant)	**Mitigation by Design**: Mitigation measures are included in the CEMP, including use of protective mats for temporary haul roads etc., which would reduce the likely magnitude of the effect. **Project Specific Mitigation**: None	Negligible	Negligible (Not Significant)
	Medium	• Disturbance of potentially contaminated soils, sediments and waters	Low	Minor (Not Significant)	**Mitigation by Design**: Mitigation measures are included in the CEMP, including employing CDM practices, undertaking risk assessments, dust suppression and design in accordance	Low	Minor Adverse (Not Significant)

Receptor Description	Value/ Sensitivity	Description of Potential Impact	Magnitude	Significance	Mitigation Measure(s)	Residual Effect	
						Magnitude	Significance
		posing a risk to groundwater (see details in **Table 10-33**).			with relevant guidance etc., which would reduce the likely magnitude of the effect of any disturbance of contaminated soils, sediments or waters. **Project Specific Mitigation:** Depending on the outcome of the ground investigation and preliminary risk assessment, additional assessment may be required in relation to handling of potentially significant volumes of potentially contaminated spoil. Depending on the findings of such an assessment, this may also entail the preparation of Materials Management Plan, including additional measures to reduce the potential risk to groundwater (e.g. segregation of materials, validation testing), over and above the standard 'best practice' measures included in the CEMP for the rest of the English Onshore Scheme. If areas of the proposed redevelopment are shown to pose a risk, any remedial measures required will be implemented.		
	Medium	Importation of potentially contaminated construction materials posing a potential risk underlying groundwater (see details in **Table 10-33**).	Low	Minor (Not Significant)	**Mitigation by Design**: mitigation measures are included in the CEMP, including suitable chemical testing of any imported material, which would reduce the likely magnitude of the effect. **Project Specific Mitigation:** None	Low	Minor Adverse (Not Significant)
	Medium	Requirement for dewatering, reducing flow to groundwater abstractions and surface water bodies (see details in **Table 10-33**).	Medium	**Moderate (Significant)**	**Mitigation by Design**: Mitigation measures are included in the CEMP, including monitoring of groundwater levels to assess groundwater profiles and inform dewatering requirements, which would reduce the likely magnitude of the effect of dewatering. **Project Specific Mitigation:** If required, a detailed dewatering scheme will be developed prior to construction to manage the water arising from dewatering operations and treat the water prior to controlled discharge.	Low	Minor (Not Significant)

Receptor Description	Value/ Sensitivity	Description of Potential Impact	Magnitude	Significance	Mitigation Measure(s)	Residual Effect	
						Magnitude	Significance
					Consideration will be given to the potential effects of dewatering on adjacent water features and groundwater abstraction points, both from drawdown during dewatering and subsequent discharge, and mitigation applied, such as use of cessation rings around HDD launch pits etc. In addition, HRA will be undertaken where the cable route passes through SPZ2 designations (Sections 1 and 2 only). The HRA will consider potential effects on the groundwater regime (levels, flow regime and supply to abstractions). Mitigation measures will be implemented to reduce the potential effects to acceptable levels.		
	Medium	Requirement to remove spoil from construction posing a potential risk to the environment (see details in **Table 10-33**).	Low	Minor (Not significant)	**Mitigation by Design**: Mitigation measures are included in the CEMP, including investigation and risk assessment in line with LCRM guidance (Ref 10-5), employment of CDM practices, risk assessments and dust suppression measures, which would reduce the likely magnitude of the effect on groundwater by handling of potentially contaminated spoil. **Project Specific Mitigation:** Depending on the outcome of the ground investigation and preliminary risk assessment, additional assessment may also be required in relation to handling of potentially significant volumes of potentially contaminated spoil. Depending on the findings of such an assessment, this may also entail the preparation of Materials Management Plan, including additional measures to reduce the potential risk to groundwater (e.g. segregation of materials, validation testing), over and above the standard 'best practice' measures included in the CEMP for the rest of the English Onshore Scheme. If areas of the proposed	Low	Minor Adverse (Not significant)

Receptor Description	Value/ Sensitivity	Description of Potential Impact	Magnitude	Significance	Mitigation Measure(s)	Residual Effect	
						Magnitude	Significance
					redevelopment are shown to pose a risk, any remedial measures required will be implemented.		
	Medium	***[Section 4 only]*** Foundations creating a preferential pathway for contaminants to migrate - (see details in **Table 10-33**).	Medium	**Moderate (Significant)**	**Mitigation by Design:** Mitigation measures are included in the CEMP, including investigation and risk assessment in line with LCRM guidance (Ref 10-5) and adherence to specific guidance for piling on land affected by contamination, which would reduce the likely magnitude of the effect. However, in the absence of ground investigation data, the potential for significant contamination to be present cannot be ruled out. **Project Specific Mitigation:** Depending on the findings of ground investigation and preliminary risk assessment, piling risk assessment may be required. Piles will be designed in accordance with EA guidance document 'Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination: Guidance on Pollution Prevention' (Ref 10-24) to prevent piles acting as preferential pathways for vertical migration of contaminants to groundwater.	Low	Minor Adverse (Not significant)
Human Health (Construction Workers)	Low	Groundwater and ground pollution due to chemical spillages and leaks (see details in **Table 10-33**).	Negligible	Negligible (Not Significant)	**Mitigation by Design:** Mitigation measures are included in the CEMP, including training, pollution prevention measures, responsible storage and handling and spill response measures etc., which would reduce the likelihood of, and the likely magnitude of the effect of, any spill/leak. **Project Specific Mitigation:** None	Negligible	Negligible (Not Significant)
	Low	Disturbance of potentially contaminated soils, sediments and waters posing a risk to construction workers (see details in **Table 10-33**).	Low	Negligible (Not Significant)	**Mitigation by Design**: Mitigation measures are included in the CEMP, including investigation and risk assessment in line with LCRM guidance (Ref 10-5), employing CDM practices, undertaking risk assessments, dust suppression and design in accordance with	Low	Negligible (Not Significant)

Receptor Description	Value/ Sensitivity	Description of Potential Impact	Magnitude	Significance	Mitigation Measure(s)	Residual Effect	
						Magnitude	Significance
					relevant guidance etc., which would reduce the likely magnitude of the effect of any disturbance of contaminated soils, sediments or waters. **Project Specific Mitigation**: Depending on the outcome of the ground investigation and preliminary risk assessment, additional assessment may be required in relation to handling of potentially significant volumes of potentially contaminated spoil. Depending on the findings of such an assessment, this may also entail the preparation of Materials Management Plan, including additional measures to reduce the potential risk to construction workers (e.g. segregation of materials, validation testing and additional personal protective equipment), over and above the standard 'best practice' measures included in the CEMP for the rest of the English Onshore Scheme. If handling of contaminated soils is required, risk assessments will be in place in accordance with the Health and Safety at Work Act to restrict exposure to potentially harmful substances to a safe level for construction workers.		
	Low	Importation of potentially contaminated construction materials posing a potential risk to human health (see details in **Table 10-33**).	Low	Negligible (Not Significant)	**Mitigation by Design:** Mitigation measures are included in the CEMP, including suitable chemical testing of any imported material, which would reduce the likely magnitude of the effect. **Project Specific Mitigation:** None	Low	Negligible (Not Significant)
	Low	Requirement to remove spoil from construction posing a potential risk to human health (see details in **Table 10-33**).	Low	Negligible (Not Significant)	**Mitigation by Design:** Mitigation measures are included in the CEMP, including investigation and risk assessment in line with LCRM guidance (Ref 10-5), employment of CDM practices, risk assessments and dust suppression measures, which would reduce	Low	Negligible (Not Significant)

Receptor Description	Value/ Sensitivity	Description of Potential Impact	Magnitude	Significance	Mitigation Measure(s)	Residual Effect	
						Magnitude	Significance
					the likely magnitude of the effect of handling of potentially contaminated spoil. **Project Specific Mitigation:** Depending on the findings of ground investigation and preliminary risk assessment, additional assessment may also be required in relation to handling of potentially significant volumes of potentially contaminated spoil. Depending on the findings of such an assessment, this may also entail the preparation of Materials Management Plan, including additional measures to reduce the potential risk to construction workers (e.g. segregation of materials, validation testing and additional personal protective equipment), over and above the standard 'best practice' measures included in the CEMP for the rest of the English Onshore Scheme. If handling of contaminated soils is required, risk assessments will be in place in accordance with the Health and Safety at Work Act to restrict exposure to potentially harmful substances to a safe level for construction workers.		

10.8.2 Assessment of Residual Effects: Operational Phase

As described in Section 10.7.2, many of the potential impacts during the operational phase identified in Section 10.6.4 by will be addressed via project-specific mitigation measures implemented during the construction phase. Depending on the findings of ground investigations and risk assessments prior to construction, this may include:

- Removal of contaminants source or breaking of contaminant linkages (should the GQRA indicate that contaminants in soil, soil vapour and/ or groundwater are present at concentrations which may present a risk to identified human health or groundwater receptors);
- Installation of ground gas protection measures in manned buildings (should ground gas investigations / GGRA determine that the site is at risk of a hazardous ground gas regime); and
- Design of piles in accordance with the Environment Agency guidance document 'Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination: Guidance on Pollution Prevention' (Ref 10-24) (should ground investigations indicate that piled foundations are required).

As above, this applies to Section 4 of the English Onshore Scheme only (including the converter station, and associated infrastructure). No potential operational impacts were identified for Sections 1 – 3 (cable route only).

An assessment of residual effects for the operational phase of the English Onshore Scheme, after implementation of mitigation measures, is presented in **Table 10-36**.

Table 10-36: Assessment of Residual Effects: Operational Phase (Section 4 only)

Receptor Description	Value/ Sensitivity	Description of Potential Impact	Magnitude	Significance	Mitigation Measure(s)	Residual Effect	
						Magnitude	Significance
Geology/ soils	Low	Presence of foundations creating a preferential pathway for contaminant migration (see details in **Table 10-34**).	Negligible	Negligible (Not Significant)	**Mitigation by Design**: Mitigation measures are included in the CEMP, including adherence to specific guidance for piling on land affected by contamination, which would reduce the likely magnitude of the effect. **Project Specific Mitigation**: Depending on the findings of ground investigations and risk assessment prior to construction, additional assessment may be required, such as a piling risk assessment (PRA) and design of piles in accordance with EA guidance document 'Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination: Guidance on Pollution Prevention' (Ref 10-24) to prevent piles acting as preferential pathways for vertical migration of contaminants (should the ground investigation indicate that piling of the converter station is required).	Negligible	Negligible (Not Significant)
	Low	Storage and use of chemicals/ substances (see details in **Table 10-34**).	Negligible	Negligible (Not Significant)	**Mitigation by Design**: Protection measures will be incorporated to mitigate against any potential release during the operational phase. Mitigation measures for the storage and use of fuels will be in accordance with The Control of Pollution (Oil Storage) (England) Regulations 2001 (Ref 10-26). Fuel and other potentially polluting chemicals will be stored at a minimum of 30 m away from watercourses (unless it is demonstrated that there is no pathway for migration of pollution), in an impermeable and bunded tank, with the bund capacity being 110% of the total tank volume. The back-up diesel generator will be located within an impermeable, bunded area in case of release during operation. Should any drains be present nearby, oil-water interceptors will be installed to prevent migration of fuels along the drains. When storing and handling fuels on site, appropriate spill control measures will be employed including appropriate training of personnel, spill kits available and regular inspections/maintenance of equipment. **Project Specific Mitigation:** None	Negligible	Negligible (Not Significant)

Receptor Description	Value/ Sensitivity	Description of Potential Impact	Magnitude	Significance	Mitigation Measure(s)	Residual Effect	
						Magnitude	Significance
Groundwater (Secondary A superficial aquifer; Principal bedrock aquifer)	Medium	Presence of foundations creating a preferential pathway for contaminant migration (see details in **Table 10-34**).	Medium	**Moderate (Significant)**	**Mitigation by Design**: Mitigation measures are included in the CEMP, including adherence to specific guidance for piling on land affected by contamination, which would reduce the likely magnitude of the effect. **Project Specific Mitigation**: Depending on the findings of ground investigations and risk assessment prior to construction, additional assessment may be required, such as a PRA and design of piles in accordance with EA guidance document 'Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination: Guidance on Pollution Prevention' (Ref 10-24) to prevent piles acting as preferential pathways for vertical migration of contaminants (should the ground investigation indicate that piling of the converter station is required).	Low	Minor Adverse (Not Significant)
	Medium	Storage and use of chemicals/ substances (see details in **Table 10-34**).	Low	Minor (Not Significant)	**Mitigation by Design**: Protection measures will be incorporated to mitigate against any potential release during the operational phase. Mitigation measures for the storage and use of fuels will be in accordance with The Control of Pollution (Oil Storage) (England) Regulations 2001 (Ref 10-26). Fuel and other potentially polluting chemicals will be stored at a minimum of 30 m away from watercourses (unless it is demonstrated that there is no pathway for migration of pollution), in an impermeable and bunded tank, with the bund capacity being 110% of the total tank volume. The back-up diesel generator will be located within an impermeable, bunded area in case of release during operation. Should any drains be present nearby, oil-water interceptors will be installed to prevent migration of fuels along the drains. When storing and handling fuels on site, appropriate spill control measures will be employed including appropriate training of personnel, spill kits available and regular inspections/maintenance of equipment. **Project Specific Mitigation:** None	Low	Minor Adverse (Not Significant)
	Medium	Impact on groundwater from drainage - (see	Low	Minor (Not Significant)	**Mitigation by Design**: A Surface Water Management Plan (SWMP) will be in place during the operational phase to ensure surface water runoff quality and quantity is managed	Low	Minor Adverse (Not Significant)

Receptor Description	Value/ Sensitivity	Description of Potential Impact	Magnitude	Significance	Mitigation Measure(s)	Residual Effect	
						Magnitude	Significance
		details in **Table 10-34**).			effectively. In addition, the converter station design includes SuDS system to manage surface water runoff and storage (see Chapter 11: Hydrology and Land Drainage). **Project Specific Mitigation**: None.		
Human Health (Construction Workers)	Low	Presence of foundations creating a preferential pathway for contaminant migration (see details in **Table 10-34**).	Low	Minor (Not Significant)	**Mitigation be Design**: Mitigation measures are included in the CEMP, including investigation and risk assessment in accordance with LCRM guidance (Ref 10-5) and adherence to specific guidance for piling on land affected by contamination, which would reduce the likely magnitude of the effect. **Project Specific Mitigation:** Depending on the findings of ground investigations and risk assessment prior to construction, additional assessment may be required, including: • Ground gas risk assessment (GGRA), in accordance with CIRIA guidance document 'Assessing Risks Posed by Hazardous Ground Gases to Buildings' (C665), to further assess potential risks from ground gas (should the ground investigation identify significant thicknesses of Made Ground (>3m) in the vicinity the converter station); • Piling risk assessment (PRA) and design of piles in accordance with EA guidance document 'Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination: Guidance on Pollution Prevention' (Ref 10-24) to prevent piles acting as preferential pathways for vertical migration of contaminants (should the ground investigation indicate that piling of the converter station is required); and • Generic Quantitative Risk Assessment (GQRA), in line with LCRM guidance (Ref 10-5), to identify potential risks to identified human health receptors from soil, soil vapour and groundwater contamination. Although the CEMP assumes a GQRA will be undertaken in line with LCRM, this is particularly pertinent at the proposed converter station where permanent above-ground, potentially manned buildings will be present. A remediation strategy will subsequently be devised and agreed with the	Low	Minor (Not Significant)

Receptor Description	Value/ Sensitivity	Description of Potential Impact	Magnitude	Significance	Mitigation Measure(s)	Residual Effect	
						Magnitude	Significance
					regulatory authorities prior to any remedial works, if required.		
	Low	Presence of contaminated soils/groundwater causing adverse impact on human health - (see details in **Table 10-34**).	Low	Minor (Not Significant)	**Mitigation by Design:** Mitigation measures are included in the CEMP, including investigation and risk assessment in accordance with LCRM guidance (Ref 10-5), which would reduce the likely magnitude of the effect of contaminated soil/groundwater on human health receptors. **Project Specific Mitigation:** Depending on the findings of ground investigations and risk assessment prior to construction, additional assessment may be required, including: • GGRA, in accordance with CIRIA guidance document 'Assessing Risks Posed by Hazardous Ground Gases to Buildings' (C665), to further assess potential risks from ground gas (should the ground investigation identify significant thicknesses of Made Ground (>3m) in the vicinity the converter station); and • GQRA, in line with LCRM guidance (Ref 10-5), to identify potential risks to identified human health receptors from soil, soil vapour and groundwater contamination. Although the CEMP assumes a GQRA will be undertaken in line with LCRM, this is particularly pertinent at the proposed converter station where permanent above-ground, potentially manned buildings will be present. A remediation strategy will subsequently be devised and agreed with the regulatory authorities prior to any remedial works, if required.	Low	Minor Adverse (Not Significant)
	Low	Storage and use of chemicals / substances (see details in **Table 10-34**).	Negligible	Negligible (Not Significant)	**Mitigation by Design:** Protection measures will be incorporated to mitigate against any potential release during the operational phase. Mitigation measures for the storage and use of fuels will be in accordance with The Control of Pollution (Oil Storage) (England) Regulations 2001 (Ref 10-26). When storing and handling fuels on site, appropriate spill control measures will be employed including appropriate training of personnel, spill kits available and regular inspections/maintenance of equipment. **Project Specific Mitigation:** None	Negligible	Negligible (Not Significant)

10.9 Cumulative Effects

This section reports the findings of an assessment of potential intra-project and inter-project cumulative and effects associated with the English Onshore Scheme with a focus on how these effects may impact upon geology and hydrogeology.

Intra-project cumulative effects have the potential to arise where two or more developments are proposed within close enough proximity that lead to effects on the same receptor.

Inter-project cumulative effects from the English Onshore Scheme may arise where several different types of effect resulting from the English Onshore Scheme have the potential to affect a single receptor. Inter-project effects are taken into consideration during the construction phase and operational phase.

The methodology for this assessment can be found in **Chapter 17: Cumulative Effects**.

10.9.1 Assessment of Intra-project Cumulative Effects

As outlined in **Chapter 1: Introduction**, the English Onshore Scheme forms one element of the wider Project, along with the Marine Scheme and Scottish Onshore Scheme. Due to the distances of separation between the English Onshore Scheme and the Scottish Onshore Scheme, intra-Project cumulative effects to individual receptors will not occur, for example no property or ecological site would experience effects from both the English Onshore Scheme and Scottish Onshore Scheme. Similarly, although there is a slight overlap of the English Onshore Scheme and Marine Scheme in the intertidal area between Mean High Water Springs and Mean Low Water Springs (as shown in Figure 1-2), as the HVDC cable reaches the landfall site (part of the English Onshore Scheme) via HDD, the works which could give rise to environmental impacts are physically separated and hence no significant intra-Project cumulative effects to individual receptors are predicted to occur.

The separate EIA/EA reports produced for the English Onshore Scheme, Marine Scheme and Scottish Onshore Scheme provide an environmental assessment of each topic area for which potential environmental effects could arise from that element. Once the assessment of the other elements of the Project is complete, a Bridging Document will be prepared which summarises the main interactions of these three individual environmental assessments. The Bridging Document will be made available as soon as it is available, but as highlighted above, there are no significant in-combination impacts between the English Onshore Scheme, Marine Scheme or Scottish Onshore Scheme. This section, therefore, provides an assessment of the combined and cumulative effects relating to the English Onshore Scheme only. For full definitions of terminology and details of other projects considered in this assessment see **Chapter 17: Cumulative Assessment**.

10.9.2 Assessment of Inter-project Cumulative Effects

Overall cumulative effects for the English Onshore Scheme are considered within **Chapter 17: Cumulative Effects**. For geology and hydrogeology, no significant inter-project cumulative effects are considered to result in adverse effects from the English Onshore Scheme and other proposed/ committed developments within its immediate area.

Effects from the English Onshore Scheme would be limited to within the confines of the working width, and off-site developments are not considered likely to lead to effects on geology, groundwater quality or human health within the English Onshore Scheme, as any such development would be constructed and operated in accordance with planning laws and current good practice. There is some limited potential for groundwater to be affected by off-site activities through dewatering during construction creating a short-term reduction of groundwater levels, which could combine with similar effects from the English Onshore Scheme. However, due to the short term minor effects identified for the English Onshore Scheme and the nature of the off-site developments, it is considered unlikely that effects on shared receptors would be significant.

10.10 Summary of Assessment

This chapter has assessed the potential effects of the English Onshore Scheme on the geology and hydrogeology within the study area. The potential for effects of ground and groundwater contamination materials on human health has also been considered.

The assessment has shown that the geology underlying the English Onshore Scheme comprises variable Glacial Till, alluvium, warp, glaciolacustrine and glaciofluvial deposits. Superficial deposits are shown on published mapping to be absent beneath the majority of Section 2. Bedrock underlying the superficial deposits consists of chalk at the east, Lia Group and Mercia Mudstone in the central part and Sherwood Sandstone at the west. Although not mapped, areas of Made ground are likely to be present associated with developed land, including in the vicinity of Drax Power Station and various current and historical railways.

Five Regionally Important Geological Sites (RIGS) were identified within Sections 1 and 2. Mineral safeguarding areas, in relation to sand and gravel, limestone, clay, chalk and silica sand, were also identified at various locations along the entire length of the route.

In relation to hydrogeology, the superficial deposits are classified as Unproductive Strata to Secondary A Aquifers (corresponding to alluvium and glacial sands and gravels). The chalk and Sherwood Sandstone bedrock strata at either end of the English Onshore Scheme are classified as Principal Aquifers. Groundwater vulnerability is generally classified as medium to high. The route intersects Source Protection Zones (SPZ) 2 (Section 1 and 2) and 3 (all Sections) and passes within approximately 140 m of a SPZ1 at Hutton (Section 1). Six groundwater abstractions, including five for domestic supply, were identified within Sections 1 and 2.

Sites of potentially contaminative current and/or historic land uses have been identified within the study area including quarries and pits, railways and nearby industrial development associated with Drax Power Station. The majority of land within the planning application boundary is used for agriculture.

The identified potential impacts which may occur during the construction phase are primarily associated with spillages and leaks of fuel/oil associated with plant/machinery, disturbance of contaminated soils and potential degradation of soil quality during handling and movement of soil or tracking of heavy plant, as well as the potential for dewatering to locally affect groundwater levels. In addition, there may be the potential for creation of pathways between shallow soils, drilling fluids and/or contaminated groundwater (if present) and deeper (uncontaminated) strata and groundwater, depending on the construction techniques employed. However, all of these effects can be controlled through good practice and standard mitigation measures outlined in the CEMP (Chapter 18) and the residual effects are considered to be of **Negligible** to **Minor Adverse** (**Not significant**).

During the operational phase, identified potential impacts are limited to effects resulting from potential land contamination on site users and groundwater receptors within Section 4 of the route only (at the converter station). Mitigation of the potential impacts will be put in place at construction phase which would also aid in the reduction of operational effects. Required mitigation will be confirmed by means of risk assessments based on ground investigation data (when available) and may include removal of contaminant sources and installation of gas protection measures on the buildings (i.e. the converter station). As such, the significance of residual effects has been assessed as **Negligible** to **Minor Adverse (Not Significant)**.

Overall, the mitigation required to address the potential impacts is standard practice. As a result, the overall assessment of effects of the English Onshore Scheme in relation to geology and hydrogeology is predicted to be of **Negligible (Not Significant)** significance with respect to geology, human health and infrastructure, and **Minor (Not Significant)** significance with respect to groundwater.

10.11 References

Ref 10-1 Land Contamination Risk Management (LCRM), Environment Agency - https://www.gov.uk/government/publications/land-contamination-risk-management-lcrm

Ref 10-2 Design Manual for Roads and Bridges (DMRB), LA 109 Geology and Soils; Highways England, July 2019

Ref 10-3 Design Manual for Roads and Bridges (DMRB), LA 113 Road drainage and the Water Environment; Highways England, March 2020

Ref 10-4 Groundsure GIS – Enviro, Geo and Map Insight (GSIP-2021-11001-5939, GSIP-2021-1101-5940, GSIP-2021-11001-5938)

Ref 10-5 British Geological Survey Map Sheet No. 55 and 65 Flamborough & Bridlington, Solid Alongside Drift 1:50,000 Scale;
https://largeimages.bgs.ac.uk/iip/mapsportal.html?id=1001536

Ref 10-6 British Geological Survey Map Sheet No. 64 Great Driffield, Solid and Drift 1:50,000 Scale;
https://webapps.bgs.ac.uk/data/maps/maps.cfc?method=viewRecord&mapId=9197

Ref 10-7 British Geological Survey Map Sheet No. 72 Beverley, Solid and Drift 1:50,000 Scale
https://webapps.bgs.ac.uk/data/maps/maps.cfc?method=viewRecord&mapId=9374

Ref 10-8 British Geological Survey Geoindex -
https://mapapps2.bgs.ac.uk/geoindex/home.html?_ga=2.139948279.53941229.1614087105-556125256.1573056023

Ref 10-9 Hull Geological Society and the East Yorkshire RIGS Group –
http://www.hullgeolsoc.co.uk/RIGSlist.html

Ref 10-10 Coal Authority – Coal Mining Reporting Areas:
https://mapapps2.bgs.ac.uk/coalauthority/home.html

Ref 10-11 East Riding of Yorkshire Council Local Plan – Polices Map 2016 –
https://www.eastriding.gov.uk/planning-permission-and-building-control/planning-policy-and-the-local-plan/policies-map/

Ref 10-12 Multi-Agency Geographic Information for the Countryside (MAGIC) website -
https://magic.defra.gov.uk/

Ref 10-13 East Riding of Yorkshire Council – East Riding Brownfield Register. 2018 –
https://www.eastriding.gov.uk/planning-permission-and-building-control/planning-policy-and-the-local-plan/housing-monitoring/

Ref 10-14 East Riding of Yorkshire Council – East Riding Contaminated Land Public Register.
https://www.eastriding.gov.uk/business/licences-and-registrations/public-registers/other/contaminated-land/

Ref 10-15 Environment Agency Environmental Pollution Incidents Register
https://data.gov.uk/dataset/c8625e18-c329-4032-b4c7-444b33af6780/environmental-pollution-incidents-category-1-and-2

Ref 10-16 EA landfill site data -
https://hubaecomnatgrid.hub.arcgis.com/app/e547fd498e0641659ca199963f5e3c77

Ref 10-17 Radon Potential Map - https://www.ukradon.org/information/ukmaps

Ref 10-18 Zetica Unexploded Ordnance Regional Risk Maps – https://zeticauxo.com/downloads-and-resources/risk-maps/

Ref 10-19 British Geological Survey Map Sheet No. 79 Goole, Solid 1:50,000 Scale
https://webapps.bgs.ac.uk/data/maps/maps.cfc?method=viewRecord&mapId=9423

Ref 10-20 British Geological Survey Map Sheet No. 79 Goole, Drift 1:50,000 Scale
https://webapps.bgs.ac.uk/data/maps/maps.cfc?method=viewRecord&mapId=9422

Ref 10-21 North Yorkshire County Council Policies Map –
https://maps.northyorks.gov.uk/connect/analyst/mobile/#/main?mapcfg=mwjp

Ref 10-22 Selby District Council – Brownfield Register Mapbook. 2018 –
https://www.selby.gov.uk/sites/default/files/Brownfield_Register%20_Mapbook_reduced.pdf

Ref 10-23 Selby District Council – Contaminated Land Public Register
https://www.selby.gov.uk/public-registers

Ref 10-24 Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination: Guidance on Pollution Prevention, Environment Agency, REP NC/99/73, 2001.

Ref 10-25 BRE FB41 Radon in the Workplace, A guide for building owners and managers. October 2011.

Ref 10-26 The Control of Pollution (Oil Storage) (England) Regulations 2001.

Ref 10-27 British Standard 8485:2015+A1:2019 - Code of Practice for the Design of Protective Measures for Methane and Carbon Dioxide Ground Gases for New Buildings.