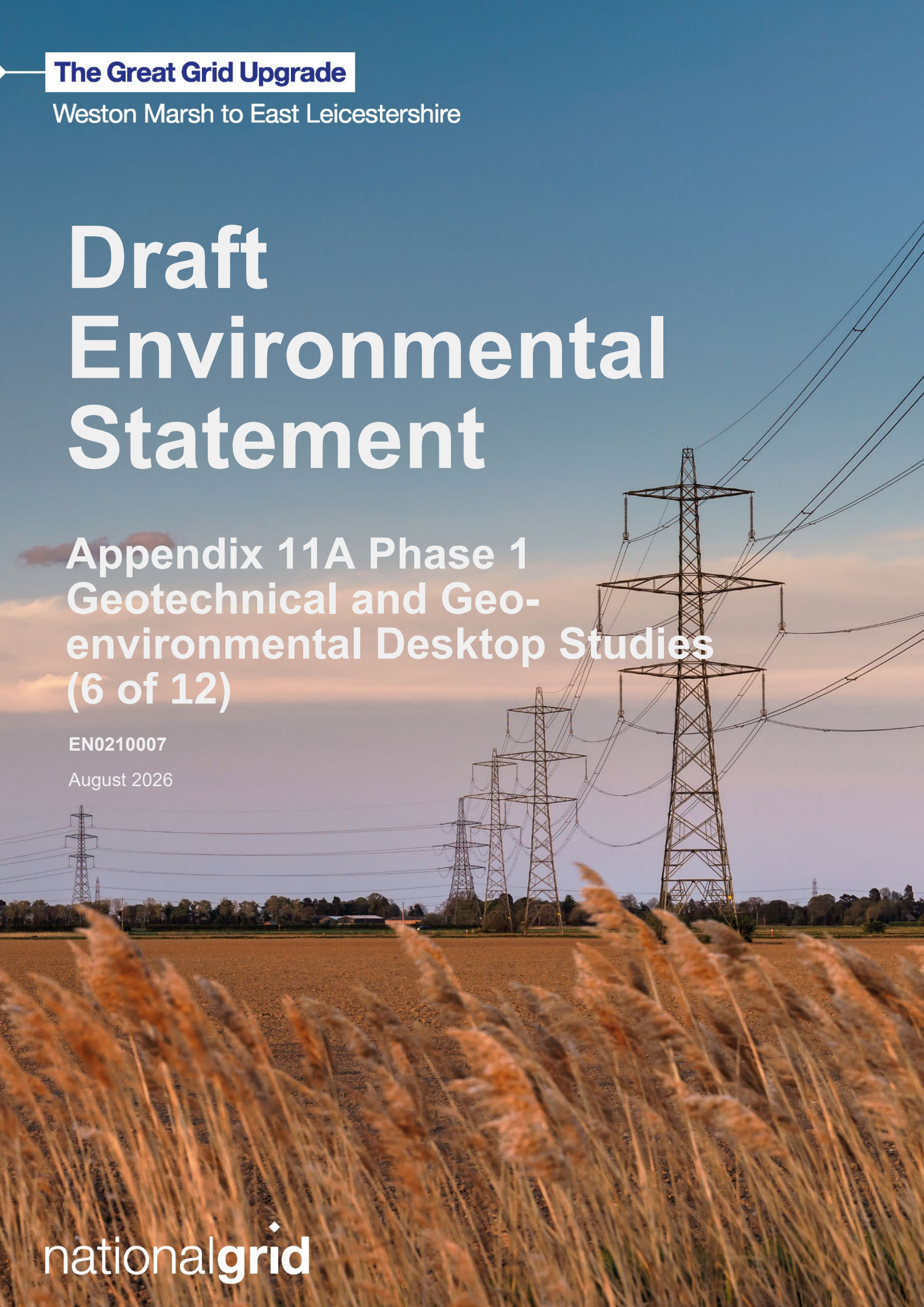




The Great Grid Upgrade

Weston Marsh to East Leicestershire

Draft Environmental Statement

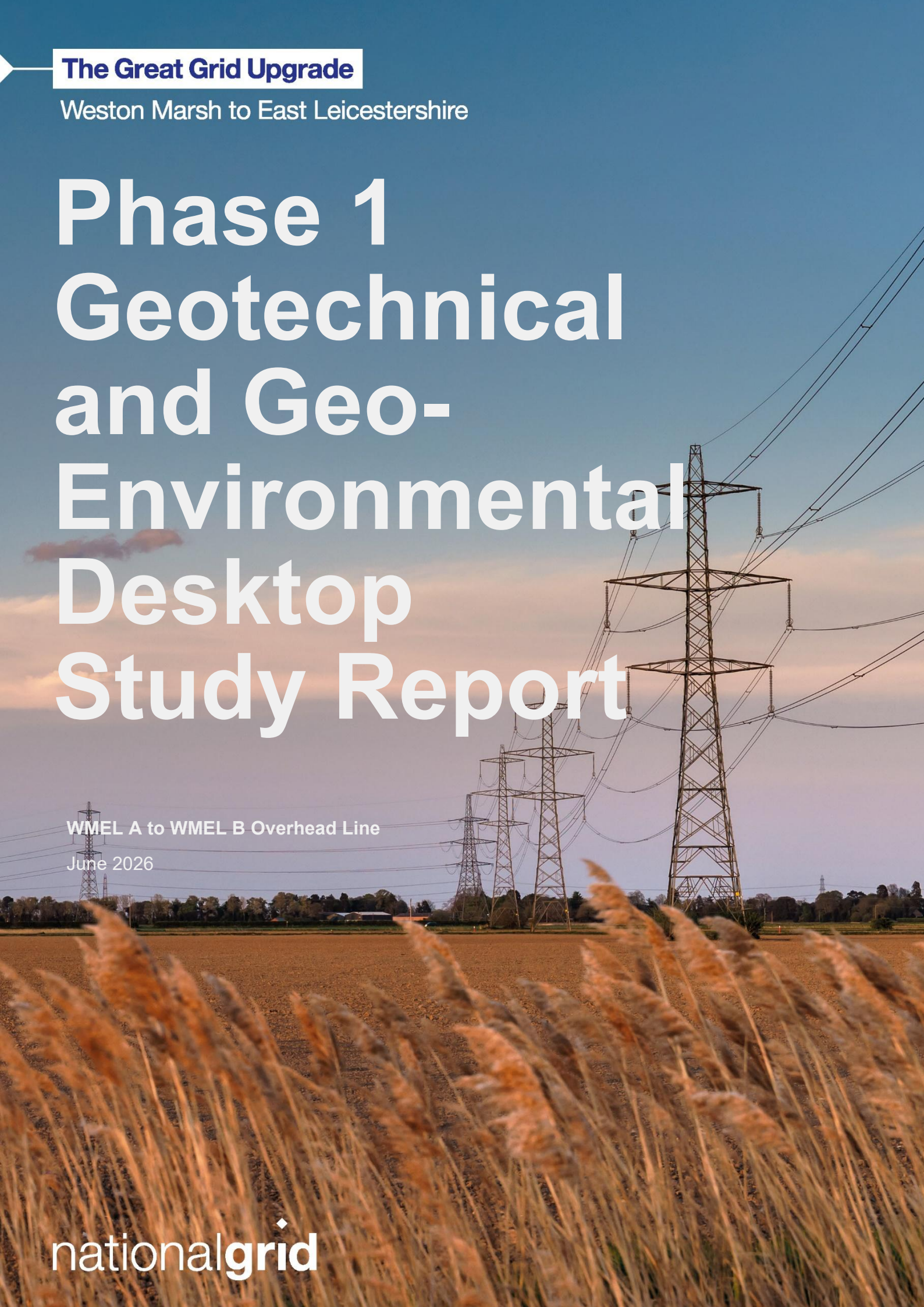
Appendix 11A Phase 1 Geotechnical and Geo- environmental Desktop Studies (6 of 12)

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August 2026

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11A. Phase 1 Geotechnical and Geo- environmental Desktop Studies



The Great Grid Upgrade

Weston Marsh to East Leicestershire

Phase 1 Geotechnical and Geo- Environmental Desktop Study Report

WMEL A to WMEL B Overhead Line

June 2026

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The methodology adopted and the sources of information used by AAJV in providing its services are outlined in this Report. The work described in this Report was undertaken between November 2025 and June 2026 and is based on the conditions encountered and the information available during the said period of time. The scope of this Report and the services are accordingly factually limited by these circumstances. AAJV disclaim any undertaking or obligation to advise any person of any change in any matter affecting the Report, which may come or be brought to AAJV's attention after the date of the Report.

Any risks identified in this Report are perceived risks, based on the information reviewed during the desk study and therefore partially based on conjecture from available information. The study is limited by the non-intrusive nature of the work and actual risks can only be assessed following a physical investigation of the Site.

The opinions expressed in this report and the comments and recommendations given are based on a desk assessment of readily available information. At this stage intrusive investigations have yet to be undertaken at Site to establish actual ground and groundwater conditions.

Reference to historical Ordnance Survey (OS) maps provides invaluable information regarding the land use history of a Site. However, it should be noted that historical evidence will be incomplete for the period pre-dating the first edition and between the release of successive maps.

Executive Summary

On the instruction of National Grid Electricity Transmission (NGET), AECOM Arup Joint Venture (AAJV) has undertaken a Phase 1 Geotechnical and Geo-environmental Desk Study for the WMEL A to WMEL B Overhead Line (OHL) routes to provide baseline ground information in support of the Development Consent Order (DCO) and future ground investigation and design. This Report comprises the Phase 1 Geotechnical and Geo-environmental Desk Study for the OHL route between WMEL A and WMEL B Substation.

The proposed development is understood to comprise the construction of the new OHL route comprising towers, haulage/maintenance roads and drainage, alongside other associated enabling works (including potential cut/fill and drainage). The Site, defined by the Design Freeze (DF) 2 Revision (Rev) B Redline Boundary, is linear in nature, forming a corridor approximately 30km in length through a rural setting predominantly consisting of agricultural fields. The Site extends from the proposed WMEL A Substation in the east (498050 E, 324920 N) to the proposed new WMEL B Substation in the west (469973 E, 322591 N). For the purpose of this Report, the Site is divided into six regions, considering mapped geological conditions.

No up to date/Site specific ground investigation information is available, with information on ground conditions largely limited to published British Geological Survey (BGS) mapping and local historical borehole records in the area with no in-situ testing.

Moving east to west, the published BGS 1:50,000 scale and 1:10,000 scale maps indicate the Site to generally be underlain by Mid Pleistocene Till, then the Oadby Till Member (including Lias-rich parts). Local Alluvium and Head Deposits are also mapped associated with surface water features and sloping topographies.

The bedrock underlying these superficial soils comprises a sedimentary sequence from east to west of the Rutland Formation of the Great Oolite Group (Region 1), into the Lincolnshire Limestone Formation (Upper and Lower Members) of the Inferior Oolite Group (Region 1 and locally Region 2), into the lower parts of the Inferior Oolite Group, the Grantham Formation and the Northampton Sand Formation (locally in Region 1 and 2). This is underlain by the Lias Group formed of the Whitby Mudstone (Region 2 and locally Region 1 and 3) into the Marlstone Rock Formation (locally in Regions 2, 3 and 4) into the Dyrham Formation (Region 5 and locally, Regions 2, 3, 4 and 6) and the Charmouth Mudstone Formation (Regions 3, 4 and 6, locally Region 5).

Locally faults, buried channels/valleys, swallet holes (Region 1) and cambering terrains (Region 2) are also recorded on published mapping, alongside areas of Artificial Ground (Regions 2, 5 and 6) associated with historical developments/works.

Groundwater is anticipated to vary with the geology and topography, including likely being shallow in areas of surface water features. The presence of springs and confined aquifers is also anticipated due to the changes in permeability of stratum through the anticipated geological succession.

The preliminary ground models for the Site anticipate a variable cover of superficial deposits dominated by clay Till, with local areas of Head, Alluvium and likely Worked/Made/Landscaped Ground associated with historical/present day land uses. The underlying bedrock is also anticipated to vary, subject to location on Site, with limestone with associated karst terrains and subsidence features in the east (predominantly in Region 1) giving way to more mudstone dominated geology moving west. The geology includes mineral resources that have been mined/explored in the area, including for ironstone and coal, with evidence of opencast ironstone mining extending onto Site locally, deep coal mining (Asfordby Mine) recorded across parts of Region 6 and possibility for unrecorded mining generally e.g. associated with historical local pits/ponds and small scale unknown features on historical mapping.

The limestone bedrock in the east is associated with a designated Mineral Safeguarding Area therefore consultation with the Mineral Planning Authority is required and potentially a full Minerals Assessment ahead of the works.

The main ground related hazards vary across the Site, directly related to the geological composition and geotechnical properties of the superficial and bedrock materials and groundwater regime. The most significant risks/constraints are currently considered to be subsidence due to karst terrains in limestone bedrock, local potential slope instabilities, cambered geology with potential for fissures/gulls and possibility for unrecorded underground mining voids/features associated with historical ironstone and deep coal extraction.

Notable potential sources of contamination on the Site include localised areas of Made Ground (associated with on and offsite structures and infrastructure, as well as potential fly-tipping), infilled land (associated with infilled pits and ponds), general agricultural land use across the majority of the Site throughout its mapped history, as well as historical railway land, tanks, disused airfield, industrial sites/works, waste site, vehicle repairs site, and sludge storage sites. Risks from these potential contaminant sources have been assessed for three identified receptor groups (Human Health, Controlled Waters and Property). Human health risks are generally considered Low to Moderate, with the highest risk to on Site construction and ground investigation workers from inhalation of ground gas in confined spaces with respect to the offsite sludge storage sites. Controlled waters are the most sensitive receptors due to highly variable superficial geology that may allow contaminant migration, with risks highest where sources coincide with Secondary A or Principal Aquifers and the karst and swallet hole features associated with the Upper and Lower Lincolnshire Limestone, and lower where Made Ground, infilled land or agricultural land is present, or where sources are linked to less vulnerable aquifers (Secondary B or Unproductive). Surface water risk arises from groundwater baseflow permeable units and from surface runoff over impermeable units. Risks to property, including tower foundations, livestock and crops, are considered Very Low to Low due to the relatively mild consequence.

Foundation solutions to the new towers (and any crossing points for haulage/maintenance roads) will need to consider changes in ground conditions and associated risks/constraints across the Site. These will therefore be subject to the final layout of the developments, which should consider the risks/constraints highlighted in this Report. In general, outside of higher risk areas (e.g. associated with recorded or potential voids) shallow foundations should be feasible founded within Till, subject to loading and local changes in ground conditions. Elsewhere, bespoke foundation design/mitigations or remediation will need to be considered to suitably account for specific ground risks/constraints.

The need and extent of earthworks and drainage for haulage/maintenance roads and any laydown/construction areas will depend on the final layout of the development, given the variable topography, access requirements and specific requirements for these roads considering anticipated plant. The design of these earthworks will be subject to changes in ground conditions and associated risks/constraints, with some areas posing a greater risk than others locally e.g. in karst terrains associated with limestones and areas of potential slope instabilities.

A Site-specific ground investigation is recommended to confirm ground conditions and assess risks, informed by the above, and undertaken in accordance with the UK Specification for Ground Investigation 3rd Edition. In brief, the outline scope of works is anticipated to include geophysics (e.g. targeted to areas with void risks), boreholes, trial pitting, in-situ testing (including Standard Penetration Testing, California Bearing Ratio Tests, Cone Penetration Tests, Infiltration Tests, Percolation Tests, and Photo Ionization Detection (headspace) test), sampling of soil, groundwater and surface water, geotechnical and geo-environmental laboratory testing and groundwater, surface water, and gas monitoring. The results of this would then be interpreted as part of a Ground Investigation Report to inform the next stages of design and subsequent construction.

Access for a Site reconnaissance to further profile ground risk was not available prior to the completion of this Report; however, the Site will be revisited by AAJV Geotechnical/Geo-environmental Engineers in advance of any intrusive works. Any additional findings will be incorporated into subsequent reporting, including consideration of a Mining Risk Assessment, and investigation specifications.

1. Introduction

1. Introduction

1.1 Terms of Appointment

- 1.1.1 On the instructions of National Grid Electricity Transmission (NGET), hereafter referred to as ‘the Client’, the AECOM Arup Joint Venture (“AAJV”) has carried out a Phase 1 Geotechnical and Geo-environmental Desktop Study of the Site known as WMEL A to WMEL B Overhead Lines (OHL), associated with the overall Weston Marsh to East Leicestershire (WMEL) project.

1.2 Background and Proposed Development

- 1.2.1 The Report has been produced on the assumption that the Site, defined by the Design Freeze (DF) 2 Revision (Rev) B Redline Boundary, will be redeveloped as a New OHL route with associated haul roads between the new WMEL A and WMEL B Substation (reported on separately in WMEL-AAJ-SS50-ZZZZZZ-RPT-GE-000001 and WMEL-AAJ-SS51-ZZZZZZ-RPT-GE-000001).
- 1.2.2 The haul roads are proposed to enable to the construction of the towers and are assumed to also be permanent locally to provide long term maintenance access. Earthworks (cut and fill), along with localised crossing points to accommodate existing infrastructure and natural features, are proposed to facilitate haul road construction and may also be required for other enabling works e.g. laydown/construction compound areas.
- 1.2.3 It is noted that the development proposals are in development stages and consequently are subject to further change. The findings of this report should be reviewed if changes to the extents of the site Redline Boundary areas are proposed.
- 1.2.4 The development of the Site is anticipated to require the following stages:
- Establishment of Site compounds/laydown areas.
 - Construction of haul roads (including earthworks and crossings).
 - Construction of attenuation ponds and drainage channels.
 - Construction of towers.
- 1.2.5 It is noted that as part of the DF2 Rev B boundary order limits, local detached areas of boundary are present. These are understood to be associated with offsite highway works or works compounds. These detached areas are outside the scope of this Report.
- 1.2.6 For ease of reference, the Site has been split into six regions (Region 1-6) considering mapped ground conditions with these Regions, then further divided into Sub-regions. The Sub-regions are intended to capture particular features and zones of geographic importance in greater detail than the main Regions. The Regions and Sub-region extents are shown in Figure 1 in Appendix A and summarised in Table 1.1.

Table 1.1: Sub-region extents and geographical references

Region	Sub-region	Approximate Extents (from)		Approximate Extents (to)		Sub-region reference
		Easting	Northing	Easting	Northing	
1	1a	497218	324875	496974	323857	North of the A151
	1b	496974	323857	496355	323094	A151
	1c	496355	323094	495709	322425	South of the A151, east of Twyford Wood
	1d	495709	322425	495016	321834	South of Twyford Wood, Honey Pot Lane
	1e	495016	321834	494105	320986	Wooley's Lane
2	2a	494105	320986	493081	320870	A1
	2b	493081	320870	491875	320837	West of A1, South of North Witham
	2c	491875	320837	490678	320792	South of Gunby
	2d	490678	320792	489479	320756	East of The Drift (Road)
	2e	489479	320756	488284	320710	South of Sewstern
	2f	488284	320710	487049	320678	Southeast of Sewstern
3	3a	487049	320678	486074	320645	Northeast of Wymondham

Region	Sub-region	Approximate Extents (from)		Approximate Extents (to)		Sub-region reference
		Easting	Northing	Easting	Northing	
	3b	486074	320645	485318	320890	North of Wymondham
	3c	485318	320890	484526	321346	South of Coston
	3d	484526	321346	483626	321779	River Eye and B676
	3e	483626	321779	482704	321975	North of Garthorpe
	3f	482704	321975	481787	322223	Northwest of Garthorpe, Southwest of Honeypot Plantation
	3g	481787	322223	480798	322538	Southeast of Waltham Pasture Farm
4	4a	480798	322538	480311	322785	Centred west of Waltham Pasture Farm, northeast of Freeby Wood
	4b	480311	322785	479397	322709	North of Freeby Wood, A607
	4c	479397	322709	478373	322568	West of A607
	4d	478373	322568	477779	322440	Northwest of A607, Northeast of Twin Lakes Adventure Park

Region	Sub-region	Approximate Extents (from)		Approximate Extents (to)		Sub-region reference
		Easting	Northing	Easting	Northing	
	4e	477779	322440	477042	322534	North of Twin Lakes Adventure Park, east of Melton Spinney Road
5	5a	477042	322534	476343	322587	Melton Spinney Road
	5b	476343	322587	475605	322380	Scalford Brook
	5c	475605	322380	475066	322236	East of Scalford Road
	5d	475066	322236	474481	322081	Scalford Road
	5e	474481	322081	473937	321860	Northeast of A606
6	6a	473937	321860	473338	321739	A606
	6b	473338	321739	472689	321749	Southeast of A606, north of Asfordby Business Park
	6c	472689	321749	472003	321756	Welby Lane
	6d	472003	321756	471265	321911	Northwest of Welby Brook
	6e	471265	321911	470779	322070	South of Wartnaby

1.3 Report Objectives

- 1.3.1 The primary objective of this Report is to provide baseline information to support the Development Consent Order (DCO) for the scheme and inform the ground investigation scope and specification, alongside subsequent interpretative reporting and design and construction stages of the project.
- 1.3.2 This Report has been authored following the recommended best practice outlined in accordance with Eurocode 7 (BS EN 1997-2:2007; Ref 13.16) and the UK government guidance resource “Land contamination: risk management (LCRM)” (Updated 2025; Ref 13.23) and comprises:
- A description of the Site layout and setting.
 - A review of the Site’s geological, hydrological and hydrogeological setting, and public domain geo-environmental information to build up a more accurate understanding of the Site and surrounding environmental setting/sensitivity.
 - The identification and review of potential geotechnical hazards and constraints, including the production of a preliminary geotechnical risk register, with consideration given to presence of historical mining and underground structures.
 - An appraisal of current and historical development and land use across the Site and in the surrounding area, with a particular emphasis on identifying potential on Site and offsite contamination sources.
 - The production of an initial Conceptual Site Model and Preliminary (Qualitative) Risk Assessment in accordance with the guidance document Environment Agency, Land Contamination: Risk Management 2025 (Ref 13.23).
 - Preliminary recommendations for additional geotechnical and geo-environmental investigation and assessment works required.

1.4 Sources of Information

- 1.4.1 The following sources of information have been considered in the authoring of this Report, either accessed directly or within the project Fuse viewer:
- British Geological Survey (BGS) GeoIndex, Mapping (1:50k and 1:10k scale) and Memoir.
 - Groundsure Insights GIS Dataset, including historical mapping, associated with the DF2 Rev B boundary (included as part of the Project ‘Fuse’ WebGIS and therefore not appended here).
 - Coal Mining/Mineral Extraction records, including Mining Remediation Authority Map viewer.
 - Freely available InSAR data.
 - BGS/ICE seismic hazard assessment for UK.
 - Environment Agency Magic Maps
 - Environmental Agency Catchment Data Explorer

- RadonUK
 - Council Planning Portals
 - LandIS Soilscales
 - Draft LiDAR assessment by Air Photo Services Ltd dated May 2026 for the DF 1.5 boundaries of WMEL A and B Substation sites adjacent to the Site.
 - Fellows International Group Preliminary UXO Risk Assessment from June 2026 (included in Appendix F).
 - Zetica UXO Risk Map. (Ref 13.72).
- 1.4.2 Specific information sources are referenced throughout the document, and a bibliography is included in Report Section 13.
- 1.4.3 It is noted that a Site reconnaissance has not been feasible at the time of reporting and is subject to land access agreements. Once the Site reconnaissance has been completed, this Report should be reviewed and findings incorporated into the ground investigation specification and subsequent Ground Investigation Report.
- 1.4.4 The Detailed Unexploded Ordnance (UXO) Risk Assessment for the Site is also awaited at the time of writing and findings should be reviewed and incorporated into subsequent ground investigation specifications and phases of reporting.
- 1.4.5 Furthermore, non-intrusive or intrusive survey data has not been made available at the time of writing and therefore has also not been considered. This data will be reviewed during the subsequent specification and interpretative reporting stages of the project.

1.5 Draft Order Limits Variations and Report Revisions

- 1.5.1 The following general changes in boundary from the DF 1.5 boundary considered previously are summarised below:
- Adjustments to boundary, including extensions (predominantly northwest and more locally, southwest), between Region 1a and 1c. This includes extension to land north of Long Wood in the east and along existing access routes. Minor reduction in southeast of east of Region 1a, now covered by WMEL A Substation reporting.
 - Adjustment to boundary, including local extensions at Region 1d and to a lesser extent, Region 1e. This includes extensions northwest towards Twyford Woods and Honey Pot Lane and its adjacent developments, alongside along existing access routes.
 - Local extensions to boundary on Region 2a, 2c and 2d, including along existing access routes.
 - Extensions to boundary on central Region 2b (predominantly to the south), around/adjacent to North Witham Road, and more locally along existing access routes.
 - Extensions to boundary in east of Region 2e around The Drift road, and centrally predominately bearing north towards Sewstern.

- Extensions to boundary in Region 2f (mainly to the south, more locally to the north) in areas of/along existing access routes (including towards Buckminster Lodge) and linear surface water feature.
- Extension of boundary in central south of Region 3a, then further afield along existing access route and southwest along/adjacent to linear surface water feature.
- Local extensions to boundaries of Regions 3b and 3c (predominately in the southwest), including along existing access routes.
- Extensions of boundary to the northwest and southeast around the B676 in the west of Region 3d (east of the River Eye).
- General adjustment of the boundary southwest from the west of Region 3d to Region 4a, including locally along existing access routes. This includes extensions across Gipsy Nook Road and associated linear surface water feature, Freeby Brook and land to the south of Waltham Pasture Farm.
- Extensions to boundary in Region 4b and 4c locally, including along access routes, which includes Region 4d. This includes north and south around/across the A607.
- Extensions to boundary in Region 4e and 5a generally, with the former predominately being to the south (including around Thorpe Brook) and the latter to the north and south around Melton Spinney Road and Melton Spinney woods, including along existing access routes.
- General adjustment of boundary southeast from the west of Region 5a to Region 5e, alongside generally along existing access routes.
- Extensions to boundary at Region 6a and Region 6b north to incorporate a semi-circle loop in boundary, with additional crossings to linear surface water feature and the A606. This also includes more general extensions to boundary throughout, including along existing access routes.
- Extensions to boundaries more locally in north and south of Regions 6c to 6e, including along existing access routes and reduction in extent of boundary in the west of Region 6e.

1.5.2 The updates made to this Report post the previous issue are summarised in Table 1.2.

Table 1.2: Summary of Report revisions

Revision	Report Section/Appendix	Details
P03	All Report Sections and Appendices	Update to take into account DF2 Rev B boundary.

2. Site Setting

2. Site Setting

2.1 Location

- 2.1.1 The Site is linear in nature and spans from land between Long Wood and the A151 in the east at the proposed WMEL A Substation (from approximately 497285 Eastings (E), 324234 Northings (N)) to land south of Wartnaby in the west (to approximately 470830 E, 322063 N) at the proposed WMEL B Substation. The Site location plan, including extents of associated Redline boundary, is presented in Figure 1 in Appendix A (WMEL-AAJ-ZZZZ-XXXXXX-DRW-GE-000023).

2.2 Setting and Layout

- 2.2.1 The Site covers an area of approximately circa (c.) 715 hectares over a length of c.30km and is in a predominantly rural setting, generally formed of fields with associated field boundaries and local woodland, surface water features, access roads/paths/tracks, overhead line infrastructure and very locally, existing structures/developments/compounds.
- 2.2.2 Table 2.1 presents a high level description of the Site layout and notable features within or adjacent to its boundary based on background OpenStreetMap (OSM) and satellite mapping presented in the Fuse viewer, alongside freely available OS mapping presented on the associated Site Location drawings (Figure 1 Sheets 1-7) in Appendix A. This summary and the presence of additional details/notable features will be further reviewed through Site reconnaissance and investigation as deemed necessary.

Table 2.1: Site layout and notable adjacent features summary

Region (Figure Ref.)	Layout (moving east to west)	Notable Adjacent Features & potential contamination sources within 250m
1 (Figure 1, Sheet 2 & 3)	The Region generally runs northeast-southwest, predominantly through fields from between Colsterworth Lane/ Long Wood and the A151/Birkholme in the northeast to just east of the A1 in the southwest. The following features are crossed: 1. Colsterworth Lane running northeast-southwest in northwest portion, coordinates: 496909 E, 324806 N (Region 1a). 2. Meandering field boundary bearing northwest-southwest, possibly	• Long Wood adjacent to southeast boundary in Region 1a (497022 E, 324514 N) and A151 adjacent to / encroaching locally on the east (e.g. 497629 E 323750 N) • Farmstead/Corby Birkholme adjacent to southeast boundary near Region 1b (496942 E, 323521 N).

Region (Figure Ref.)	Layout (moving east to west)	Notable Adjacent Features & potential contamination sources within 250m
	associated with surface water feature (Region 1a). 3. Linear alignment of circular darker patches of ground in field on satellite imagery leading up to overgrown oval shaped feature, coordinates: 496608 E, 323747 N (Region 1b). Note, these correlate with depressions in LiDAR data and a deep swallet hole (karst feature) based on published geological mapping. 4. The A151, coordinates: 496584 E, 323355 N (Region 1b). 5. Other field boundaries and locally encroaching on Herricho Wood and 2No. small scale linear surface water features, coordinates: 496598 E, 322884 N (Region 1b/1c). Note, features correlate with local depression based on LiDAR. 6. Local triangular shaped area of assumed woodland, coordinates: 496265 E, 323098 N (Region 1c). 7. Numerous field boundaries, including those locally meandering and possibly associated with surface water features (Region 1c). 8. Local oval shaped overgrown feature on Site, coordinates: 496018 E, 322830 N and nearby linear alignment of trees encroaching on Site, coordinates: 495965 E 322828 N (Region 1c). Note, these correlate with depressions in LiDAR data and a deep swallet hole based on published geological mapping. 9. Local oval shaped overgrown feature on Site indicated to be associated with overhead line tower/pylon, coordinates: 495591 E, 322234 N (Region 1c). 10. Local field boundaries and woodland encroaching on Site seemingly	• Strip of woodland 'Home Spinney' bearing east-west, with indicated paths and local ponds adjacent to east of Region 1b (496786 E, 323555 N). • Farmstead adjacent to Region 1c (496197 E, 322431 N), south of alignment. • Little Osgrove Wood adjacent to of Region 1b (496441 E, 323724 N). • Twyford Woods encroaching on and adjacent to northwest boundary near Region 1d (494914 E, 322835 N). • Honey Pot Industrial Estate adjacent to west boundary near Region 1e/1d (494655 E, 321710 N). • Black Bull Farmhouse / Inn adjacent to local extension of Region 1e (493920 E, 321241 N).

Region (Figure Ref.)	Layout (moving east to west)	Notable Adjacent Features & potential contamination sources within 250m
	associated with Twyford Woods (understood to have been associated with a historical World War II Royal Airforce base), including Honey Pot Lane and associated woodland with linear surface water feature indicated to be culverted as not continuous, coordinates: 495123 E, 322066 N (Region 1d). 11. Local field boundaries/paths/tracks, including Woolley's Lane (and associated footway) bearing east-west, coordinates: 494442 E, 321246 N (Region 1e) and associated linear surface water features indicated locally to be culverted as non-continuous, coordinates: 494843 E, 321455 N. 494159 E, 321014 N. 494229 E, 320722 N.	
2 (Figure 1, Sheet 3 & 4)	The region generally runs east-west predominantly through fields from around the A1/in between North and South Witham in the east to between Buckminster Lodge and Sewstern Grange in the west. The following features are crossed: 1. Local field boundaries and the A1, coordinates: 493783 E, 320913 N (Region 2a). 2. Local triangle shaped area of woodland in the south (Region 2a). Note, correlates with extent of historical pit. 3. River Witham and associated field boundaries and footway, coordinates: 492821 E, 320929 N (Region 2b). 4. North Witham Road, coordinates: 492578 E, 320903 N (Region 2b), including associated bridleway in the south. 5. Existing overhead line infrastructure, including c.7No. utility poles/towers	• c.2-3No. circular features in fields adjacent to linear extension to boundary in Region 2a (e.g. 493512 E 320567 N and 493314 E 320424 N). Note, located south of on Site triangular woodland/historical pit area. • Bulls Lane adjacent to north of linear extension to Region 2a boundary. • Farmstead c.40m north of Site (Region 2a) (493853 E, 321202 N). • Guest Lodge, commercial units (plant hire centre) and communications mast c.90m north of alignment

Region (Figure Ref.)	Layout (moving east to west)	Notable Adjacent Features & potential contamination sources within 250m
	bearing north-south at the following coordinates (Region 2b): 492516 E, 321137 N. 492524 E, 321022 N. 492532 E, 320907 N. 492539 E, 320799 N. 492546 E, 320689 N. 492564 E, 320454 N. 492566 E, 320360 N. 6. 2No. linear surface water features, locally indicated to be culverted beneath North Witham Road, coordinates: 492540 E, 320983 N and 492554 E, 320561 (Region 2b). 7. Further field boundaries, including local circular features assumed to be agricultural stockpile based on satellite imagery and a pond based on Groundsure data, coordinates: 492418 E, 320791 N (Region 2b). Note, other ponds on similar linear alignment adjacent offsite to the west. 8. Field boundaries, linear surface water feature (included indicated local culverted length) and an overgrown oval feature, coordinates: 491815 E, 320888 N (Region 2c). 9. Field boundaries, including linear surface water features assumed to be field drainage with potential culverted crossing points, coordinates: 491578 E, 320869 N (Region 2c). 10. Track/access lane, coordinates: 491402 E, 320821 N (Region 2c). 11. Further field boundaries, alongside associated surface water feature bearing northwest-southeast assumed to be field drainage with indicated culvert at field boundary break, coordinates: 491010 E, 320802 N (Region 2c).	boundary (adjacent North of Woolley's Lane), Region 2a (493885 E, 321244 N). • New Mills Commercial Estate (including timber merchants, Compressed Air Products, and Electrical Installations) c.100m south of Region 2b (492598 E 320203 N). • Apparent agricultural stockpiles/storage adjacent to Site boundary visible on satellite imagery (491322 E 321080 N) (Region 2c). • Glebe Farm, Main Street and other developments adjacent to linear extension to Site boundary in north of Region 2a (491240 E, 321530 N). • Communications mast c.65m north of Site(Region 2e) (488460 E, 320867 N). • Farmstead c.65m southeast of the site boundary (Region 2d) (489611 E 320366 N) • British Model Flying Association (BMFA) Buckminster adjacent to site access road and c.125m north of Site (Region 2f) (487332 E, 320919 N). • Farmstead c.90m southeast of site boundary (Region 2f) (487752 E 320423 N).

Region (Figure Ref.)	Layout (moving east to west)	Notable Adjacent Features & potential contamination sources within 250m
	12. East-west bearing linear surface water feature and associated strip of woodland/planting encroaching locally on south, coordinates: 491122 E, 320558 N (Region 2c). 13. Numerous field boundaries and local triangular shaped area of woodland in the west (Region 2d). 14. The Drift (road), coordinates: 489478 E, 320765 N (Region 2e). 15. Existing overhead line infrastructure, including a number of utility poles/towers, coordinates, 489431 E, 320722 N (Region 2e), including local plot of land with indicated structures/parking in north of alignment. 16. 2No. Linear surface water feature, coordinates: 489239 E, 320752 N and 488962 E, 321392 N (Region 2e). 17. Numerous field boundaries, including associated footways, and local access lanes/tracks (Region 2e/f) e.g. at the following coordinates: 488549 E, 320722 N (Region 2e). 488274 E, 320755 N (Region 2e/f). 487704 E, 320718 N (Region 2f). 18. Local utility poles with overhead lines indicated by satellite imagery around coordinates: 488193 E, 320664 N (Region 2f). 19. Linear surface water feature, including associated track and footway, coordinates: 487677 E, 320710 N (Region 2f). 20. Road, including local access track, coordinates: 487469 E, 320700 N (Region 2f).	• Overgrown circular feature adjacent to south of Region 2f (487256 E, 320509 N).

Region (Figure Ref.)	Layout (moving east to west)	Notable Adjacent Features & potential contamination sources within 250m
3 (Figure 1, Sheet 4 & 5)	The region generally runs southeast-northwest predominantly through fields, between land to the north/west of Buckminster Lodges in the southeast and south of Waltham Pasture Farm in the northwest. The following features are crossed: 1. Numerous field boundaries generally across Site (Region 3a). 2. Track, coordinates: 486914 E, 320683 N (Region 3a). 3. 2No. linear surface water features (Region 3a) at the following coordinates: ○ 486700 E, 320680 N. ○ 486538 E, 320681 N. 4. Site southern boundary extension encompassing continuation of aforementioned linear surface water feature bearing northeast-southwest, and adjoining linear surface water feature, coordinates: 486323 E, 320038 N (Region 3a). 5. 2No. paths/footways, coordinates: 486373 E, 320669 N (Region 3a). 6. Local field boundaries and path/track indicated by satellite imagery through fields (Region 3b), at coordinates: 485365 E, 320869 N. 7. Lane, coordinates: 485643 E, 320646 N (Region 3b). 8. Local field boundaries and northeast extension of Site boundary through path and up to Grange Lane (Region 3c). 9. Linear surface water feature, connecting into the into River Eye offsite, coordinates: 485285 E, 320917 N (Region 3c). 10. Local field boundaries (Region 3d). 11. River Eye, and associated woodland, L-shaped area of vegetation and surface water feature bearing northwest and running	• Apparent sludge stockpile c.50m east of Site Region 3b (485796 E, 320940 N). • 2No. overgrown circular features offsite to the south of Region 3a and north of Region 3b with no apparent associated infrastructure (486189 E 320375 N and 485570 E, 320878 N). • Farmstead adjacent to northeast linear extension to Site on Region 3c (485094 E, 321323 N), including 2No. local irregular shaped vegetated/overgrown features with no apparent associated infrastructure in adjacent fields (485226 E, 321296 N and 485019 E, 321308 N). • ‘Garthorpe Races’ horseracing buildings and associated infrastructure c.120m south of Site (Region 3c and 3d) (484006 E, 321407 N). • Overgrown circular features on linear alignment to on Site feature further afield to Region 3e (e.g. 483276 E 322178 N) • Further overgrown circular/oval features adjacent to southern boundary in Region 3f (482258 E, 321916 N)

Region (Figure Ref.)	Layout (moving east to west)	Notable Adjacent Features & potential contamination sources within 250m
	beneath the B676, coordinates: 484139 E, 321642 N (Region 3d). 12. B676, including local areas of adjacent vegetation/trees, coordinates: 484015 E, 321645 N (Region 3d), including overgrown oval shaped feature at 484210 E, 321803 N. 13. Field boundary leading into rectangular shaped area of vegetated/wooded area, with circular features bearing northeast-southwest across Site seemingly associated with overhead line infrastructure and on Site utility poles/towers based on satellite imagery, coordinates: 483750 E, 321705 N (Region 3d). 14. Local field boundaries and linear Surface water feature, non-continuous indicating local culverting, coordinates: 483435 E, 321815 N (Region 3e). Note, feature also extends to southern extent of Region 3d. 15. Footway and track, including field boundary (Region 3e) at the following coordinates: ○ 483034 E, 321985 N. ○ 482830 E, 322013 N. 16. Overgrown circular feature with no apparent associated infrastructure encroaching on northern boundary, coordinates: 483094 E, 321977 N (Region 3e). Note, similar features on linear alignment bearing northeast-southwest offsite. 17. Linear surface water feature, including culvert beneath Gipsy Nook (lane), running into the Freeby Brook offsite, coordinates: 482224 E, 322089 N (Region 3f). 18. Gipsy Nook (lane), associated tracks and relatively small scale area of	and extension to this and Region 3g's southern extent on a linear alignment (e.g. 482022 E, 321347 N and 481561 E 321978 N).

Region (Figure Ref.)	Layout (moving east to west)	Notable Adjacent Features & potential contamination sources within 250m
	woodland, coordinates: 482237 E, 322093 N (Region 3f). 19.Path, coordinates: 481832 E, 322275 N (Region 3g). 20.Numerous local field boundaries (Region 3g). 21.Freeby Brook and associated footway/path crossings, coordinates: 481353 E, 322339 N (Region 3g). Circular feature associated with overhead line infrastructure on Site identified in northwest; utility poles/towers based on satellite imagery, coordinates:481379 E, 322456 N (Region 3g). 22.Tracks/footways cutting through Site, e.g. at coordinates: 481310 E, 322399 N Region 3g). 23.Footway through Site into strip of woodland encroaching in south of Site, coordinates: 480786 E, 322409 N (Region 3g).	
4 (Figure 1, Sheet 5 & 6)	The region generally runs east-west across predominantly fields, between areas south of Waltham Pasture Farm in the east and land east of Melton Spinney in the west. The following features are crossed: 1. Local field boundaries and circular vegetated feature just east of field boundary with linear surface water feature, coordinates: 480524 E, 322799 N (Region 4a). 2. Field boundary with linear surface water feature, coordinates: 480457 E, 322773 N, (Region 4a). 3. Freeby Lane and associated track in the north bearing southwest across area, coordinates: 480079 E, 322735 N, (Region 4b). 4. Local field boundaries and linear surface water feature, coordinates:	• Research Institute facilities c.105 north of Site (Regions 4a and 4b) (480484 E, 323119 N). • Waltham Thorns Woodland adjacent to southern boundary of Region 4a/4b (480265 E, 322629 N). • Farmstead c.50m east of the site (Region 4b) (479591 E, 323009 N) • Small woodland adjacent to southern boundary near Region 4c (479080 E, 322598 N). • Farmstead adjacent south of alignment Site

Region (Figure Ref.)	Layout (moving east to west)	Notable Adjacent Features & potential contamination sources within 250m
	479869 E, 322688 N (Region 4b), seemingly culverted across area, then Freeby Lane in the southeast, before appearing back onto Site in the south of Region 4b. 5. Local circular features associated with overhead lines and utility poles indicated by satellite imagery on a northeast-southwest bearing, coordinate: 479610 E, 322784 N (Region 4b). 6. Melton Road (A607), coordinates: 479454 E, 322711 N (Region 4b), including footway crossing this in southern extent. 7. Local field boundaries (Region 4c), oval shaped vegetated feature (478561 E, 322641 N), and 3No. linear surface water features including a local break indicating culverting, at the following coordinates: ○ 478784 E, 322825 N. ○ 478650 E, 322589 N. ○ 478392 E, 322665 N. 8. Local central field boundary, coordinates: 478044 E, 322487 N (Region 4d). 9. Bridleway and associated linear surface water feature, coordinates: 477576 E, 322456 N (Region 4e). 10. Field boundary and Thorpe Brook, coordinates: 477353 E, 322495 N (Region 4e). 11. Lane, coordinates: 477210 E, 322552 N (Region 4e).	on Region 4c (479211 E, 322491 N). • Circular features, some overgrown and some with possible infrastructure and on linear alignment to on Site feature further afield (Region 4b and 4c); 3No. overgrown features with no obvious infrastructure e.g. at coordinates: 479298 E, 322839 N (north of 4c), 479683 E, 322200 N (south of 4b) and 480418 E 322114 N (south of 4a). • Pond adjacent to northern boundary near Region 4e associated with Thrope Brook (477372 E, 322617 N).
5 (Figure 1, Sheet 6 & 7)	The region generally runs east-southwest through predominantly fields to the north of the town of Melton Mowbray, from around Melton Spinner Road in the east to land east of Nottingham Road (A606) in the west. The following features are crossed: 1. Local field boundaries generally and extensions of lanes from 4e	• Melton Spinney Woodland adjacent to southern boundary near Region 5a (476677 E, 322412 N). • Remainder of land/structures associated with

(Region 5a), at the following coordinates:

- 476898 E, 322496 N.
 - 476948 E, 322246 N.
 - 2. Local portion of land associated with Hindle Top Farm and Hindles Farm in south, coordinates: 476910 E, 322278 N (Region 5a).
 - 3. 2No. overhead line infrastructure alignments across area including numerous mapped utility poles/towers (albeit not clearly apparent on satellite imagery), intersecting at coordinates: 476984 E, 322410 N (Region 5a).
 - 4. Melton Spinney Road, coordinates: 476773 E, 322587 N, including crossing point of aforementioned overhead lines (Region 5a).
 - 5. Jubilee Way footway to east of Scalford Brook, coordinates: 476227 E, 322553 N (Region 5b).
 - 6. Meandering extent of Scalford Brook, coordinates: 476146 E, 322533 N (Region 5b).
 - 7. Linear surface water feature, including non-continuous sections e.g. beneath dismantled railway adjacent to assumed bridge crossing point, connecting in Scalford Brook, coordinates: 476003 E, 322482 N and 476064 E, 322514 N (Region 5b).
 - 8. Linear alignment of trees, understood to be a dismantled railway with bridge structure evident, on satellite imagery, Coordinates: 476060 E, 322466 N (Region 5b).
 - 9. Wooded/local field boundaries generally (Region 5b/c), including tracks, at the following coordinates:
 - 475722 E, 322396 N.
 - 475479 E, 322354 N.
 - 10. Agricultural/horticultural land seemingly encroaching on north (Region 5c), coordinates:
 - 475217 E, 322231 N.
- farmstead adjacent to the south of Region 5a.
 - Pond adjacent to Scalford Brook adjacent to east of Region 5b (476287 E, 322429 N).
 - Farmstead/agricultural building adjacent to south of Region 5b (475680 E, 322240 N), with associated suspected pond.
 - Residential property and assumed managed agricultural/horticultural facility and with satellite imagery showing land to be under development adjacent to northern boundary near Region 5c (475059 E, 322427 N).
 - Farmstead with associated buildings approximately 150m north of the alignment (Region 5d) (474575 322266).
 - Scalford Gorse woodland adjacent to north of Region 5d (474879 E, 22353 N).
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Region (Figure Ref.)	Layout (moving east to west)	Notable Adjacent Features & potential contamination sources within 250m
	11. Linear surface water feature along field boundary, coordinates: 475225 E, 322197 N (Region 5c), connecting into aforementioned land. 12. Scalford Road, including local parking area, and adjacent mapped overhead line infrastructure and tower/utility pole, coordinates: 475032 E, 322152 N (Region 5d). 13. Farmstead encroaching locally on southernmost linear extension of Site boundary, coordinates: 475306 E, 321918 N (Region 5c). 14. Local field boundaries and footway, coordinates: 474815 E, 322089 N (Region 5d). 15. Gorse Lane, coordinates: 474360 E, 321977 N (Region 5e). 16. Local field boundaries, including trees along extent in the west and associated linear surface water including local break in field boundary and possible culvert, coordinates: 474058 E, 321850 N (Region 5e). 17. Local farm track/footway, coordinates: 473959 E, 321892 N (Region 5e).	
6 (Figure 1, Sheet 6)	The region generally runs east-west predominantly through fields, from land to the east of Potters Hill/A606 in the east to land between Wartnaby and Saxelbye in the west. The following features are crossed: 1. Numerous field boundaries generally (Region 6a). 2. 2No. alignments of existing overhead line infrastructure, including numerous towers/utility poles and local compound (Region 6a), indicated by Groundsure to be a gas valve compound, at the following coordinates:	• Wind turbines located c.50m west and c.60m east of the linear extension south of the Site around Regions 6a (473207 E 321405 N) and 6b (473372 E 321362 N). • Light industrial land use and associated buildings and pond adjacent to southern linear extension to Site south of Region 6b (473050 E, 321101 N).

Region (Figure Ref.)	Layout (moving east to west)	Notable Adjacent Features & potential contamination sources within 250m
	○ 473800 E, 321804 N. ○ 473683 E, 321703 N. ○ 473704 E, 321861 N.	
	3. Dairy farm with associated buildings, coordinates: 473887 E, 321686 N (Region 6a).	• High density agricultural units (poultry units) located c.20m west (472797 E, 322395 N) of the linear extension to Site boundary from the A606 and c.205m north of the Site in Region 6c (472723 E, 322036 N).
	4. A606 (Nottingham Road), including adjacent areas of local woodland: coordinates: 473726 E, 321754 N (Region 6a).	• Oak Plantation and Ash Plantation near northern boundary near Region 6c (472499 E, 321910 N).
	5. Developments adjacent to A606 locally encroaching on Site, including local lanes and footway, in the north associated with Potter Hill and in the south (including silo/tank), indicated to be related to agricultural land uses (Region 6a), e.g. at the following coordinates: ○ 473448 E, 321773 N. ○ 473879 E, 321739 N. ○ 473555 E, 321803 N.	• Assumed inert material storage c.30m south of Site in Region 6b (471856 E, 321563 N). • Farmstead adjacent to the Site (Region 6c) (472380 E 321864 N)
	6. Field boundaries, with two more localised east-west trending linear tree planted features to the north and south (Region 6b), at the following coordinates: ○ 473215 E, 321795 N. ○ 473206 E, 321712 N.	• Solar farm c.100m south linear extension to Site in Region 6c/6d (471880 E, 321328 N). • Remaining extent of Cant's Thorns Woodland adjacent to Region 6c/6d (471831 E, 321890 N).
	7. Linear surface water feature, including local area of woodland encroaching on the north, coordinates: 473104 E, 321745 N (Region 6b) (Note, indicated to be in areas of a historical railway line based on Groundsure data).	• Existing overhead line infrastructure west of westernmost boundary near Region 6e (470448 E, 322147 N).
	8. Local field boundaries, followed by existing overhead line infrastructure, including towers, and local Oak Plantation extent encroaching on the north, coordinates: 472765 E, 321768 N (Region 6b).	• Land parcel with stripped vegetation south of Region 6d. Satellite imagery shows stockpiled material, which may be bulk stockpiled fertiliser destined for use on the surrounding cultivated fields (471863 E 321527N).
	9. Associated with linear, generally semi-circular, extension to Site in north of Region 6b, continuation of	

Region (Figure Ref.)	Layout (moving east to west)	Notable Adjacent Features & potential contamination sources within 250m
	aforementioned linear surface water feature (473257 E, 322498 N) and overgrown historical railway adjacent to the east and footway adjacent to the west. 10. Also associated with above extension, continuation of aforementioned overhead lines and associated towers/pylons, with second crossing of the A606 (473022 E, 322293 N), alongside strip of woodland and linear surface water feature, indicated to be locally culverted (472995 E, 322221N) in Region 6b. 11. Southern linear extensions to Site along tracks/lanes into land associated with Welby Grange, coordinates 473082 E, 321122 N (Region 6a/6b). 12. Numerous field boundaries, including local potential paddocks/plantations followed by Welby Lane and associated footwall and adjacent strip of woodland/vegetation, coordinates: 472314 E, 321771 N (Region 6c). 13. Linear surface water feature, indicated to be culverted in parts and nearby footway, coordinates: 472137 E, 321718 N (Region 6c). 14. Cant's Thorns woodland encroaching on the north, including number of footways/tracks through and to the south of this with further strip of woodland, coordinate: 471669 E, 321800 N (Region 6d, locally 6c). 15. Saxelby Road and adjacent load trees/woodland, coordinates: 471234 E, 321933 N (Region 6e). 16. Field boundaries followed by pond, connecting linear surface water features including non-continuous regions suggesting culverts, and	• Further afield, overgrown circular features to the north and more locally, south (Regions 6c, 6d and 6e) e.g. at coordinates: 472278 E, 321442 N (south of 6c), 472079 E, 322080 N (north of 6c/d), 471654 E, 322176 N (north of 6d) and 470899 E, 322488 N (north of 6e).

Region (Figure Ref.)	Layout (moving east to west)	Notable Adjacent Features & potential contamination sources within 250m
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associated woodland, with footways
west and east of this, coordinates:
470820 E, 322093 N (Region 6e).

Note: Features in **bold** have been discussed further in Report Section 3.0 relative to possible unrecorded karst and historical mining.

2.3 Topography

- 2.3.1 The Site topography based on Environment Agency LiDAR 1m DTM data (Ref 13.24) and estimated and interpolated slope angles from this are summarised in Table 2.2, alongside notable LiDAR features, and presented in Topography and Slope drawings as Figure 2, Sheets 1-7 (WMEL-AAJ-ZZZZ-XXXXXX-DRW-GE-000024) in Appendix A. These features and nature of slope angles will be reviewed further through Site reconnaissance and investigation as deemed necessary. It is noted that this LiDAR data is dated from 2023, consequently, more recent changes in topography may be present that the data does not show.
- 2.3.2 Relative to the draft Air Photo Services Ltd assessment of 'NLP' 1m DTM Lidar from 2020, outside of identified more general farming or wider landform features, a linear alignment of 'microtopographic extraction pits' with adjacent 'microtopographic banks', and local circular feature of the same designation were identified for the WMEL A Substation. The linear alignment correlates with Table 2.2 Region 1 feature number 3., and the localised feature, with an offsite depression also noted in Table 2.2 Region 1. These features are discussed further in Report Sections 3.3 and 3.4.
- 2.3.3 Overall, the Site topographically generally appears to initially cross valleys in the east around Region 1, assumed to be straddling an old tributary of the West Glen River (located to the east of WMEL A), then transitioning into more consistent topographies in Region 2. This (Region 2) and the remaining Regions are interspersed with local valleys (including with associated water courses), which appear to become more frequent/notable in scale from the west end of Region 4 through to the end of Region 6.

Table 2.2: Site topography, LiDAR feature and slope angle summary

Region (Figure Ref.)	General Topographical Description of Site Regions (moving east to west)
1 (Figure 2, Sheet 2/3)	The region generally sits on the across a hillside between c.90m-115m AOD, interspersed with linear depressions/valleys e.g. down to c.85-90m AOD (Region 1a/1b), and generally sloping down to the southeast to an larger scale valley feature, which locally encroaches on the east of the region. The topography in the southwest around Region 1e appear flatter/more consistent and are generally at the higher topographical level. The following notable more extensive changes in topography/slope angles and

Region (Figure Ref.)	General Topographical Description of Site Regions (moving east to west)
	LiDAR features are observed, not including more local ponds/drains/tracks/field boundaries: 1. Slope angles generally around 5.7-15° associated with a linear depression/valley feature in the southeast of Region 1a, coordinates: 497458 E, 323819 N, suspected to be associated with a stream sink (karst feature), continuing offsite onto WMEL A Substation area. 2. Slope angles around 3.5-15° associated with sloping topographies to the northwest into a linear depression/valley feature in the north of Region 1a, coordinates: 496734 E, 324579 N), suspected to be associated with a stream sink. 3. Faint linear depression, connecting into wider more continuous depression to the east (covered in 1.), in Region 1a/b, coordinates: 496924 E, 323767 N and seemingly connecting into a recorded deep swallet hole (based on BGS mapping) and northeast-southwest linear alignment of depressions through Region 1a/b up to coordinate: 496607 E, 323747 N. 4. Linear extents of changes in slope angles of 3.5-15° seemingly associated with aforementioned linear depressions, connecting into wider more continuous depression (covered in 1.) indicated to be associated with a stream sink (Region 1b/c, coordinates: 496465 E, 323181 N). 5. Irregular depressions (c.30-50m in diameter) indicated by slope angle data to connect into aforementioned linear depression on hillside in Region 1b, coordinates: 496422 E, 323271 N. It is noted that these are in a similar area to a swallet hole recorded by BGS mapping. 6. Local depression associated with Herricho Wood and 2No. small scale linear surface water features, coordinates: 496598 E, 322884 N in Region 1b/1c. Note, linear alignment of more prominent depressions present on east side of woodland. 7. Linear extent of changes in slope angles of 3.5-5.7° sloping down to the northwest and connecting into more prominent adjacent linear depression (suspected stream sink) with encroaching local slope angles up to 10-30° associated with a shake hole based on Groundsure data, associated with karst terrains in Region 1c, coordinates: 495961 E, 22830 N. 8. Faint depressions of unknown origin (c.40-50m in length/width) (Region 1d, coordinates: 495564 E, 322288 N and 495466 E, 322271 N) moving west to prominent steep sided depression associated with recorded shake hole/deep swallet hole (c.15-20m in width) based on Groundsure data/BGS mapping, associated with karst terrains (Region 1d, coordinates: 495399 E, 322241 N). 9. Slope angles of 3.5-15° associated with Honey Pot Lane, including irregular depressions associated with recorded 2No. swallet holes (overall c.205m in length) based on BGS mapping, associated with karst terrains (Region 1d, coordinates: 495163 E, 322077 N).

Region (Figure Ref.)	General Topographical Description of Site Regions (moving east to west)
	10. Local slope of generally 5.7-15°, local slope angles of >15° in other Site area around Honey Pot Lane in south of Region 1d e.g. 495789 E, 322222 N. 11. Slope angles of 3.5-5.7°, locally 15° associated with an assumed ditch, in and around a track (Region 1e, coordinates: 494175 E, 321047 N). It is noted here that other LiDAR features are present offsite (in addition to those outlined in points above) that are considered to be/potentially be indicative of karst terrains and associated features e.g. a faint approximately circular depression (c.30m in diameter) east of Region 1a (coordinates: 497177 E, 324214 N), square depression of unknown origin (circa (c.) 15m in width) linking east into irregular depressions and ponds adjacent to Region 1b (coordinates: 496712 E, 323525 N) and suspected dolines (karst features indicated by a clear linear alignments of circular depressions) e.g. c.500m northwest of Region 1c.
2 (Figure 2, Sheet 3/4)	The region initially sits at c.115m AOD around Region 2a, then reduces down to the west into the valley associated with the River Witham (crossing Region 2b) where the topography reduces to c.95m-100m AOD. Topographies then generally increase moving west from the river up to c.145m AOD in Region 2e, and then reduce down to c.130m AOD west through Region 2f. The following notable more extensive changes in topography/slope angles and LiDAR features are observed, not including more local ponds/drains/tracks/field boundaries: 1. Linear changes in topography with slope angles of 3.5-15°, very locally >15°, associated with the A1 and assumed drainage ditches (Region 2a, coordinates: 493755 E, 320783 N) and a faint linear depression of unknown origin in field adjacent to the southeast (Note, mapped location of Gas Valve Compound based on Groundsure data c.200m from the Site to the south). 2. Local irregular depression (c.60m in diameter) mapped to be associated with an unspecified pit based on Groundsure data (Region 2a, coordinates: 493387 E, 320836 N). 3. Slope angles of 3.5-15° associated with the River Witham and very locally >15° associated with adjacent footway (Region 2b, coordinates: 492831 E, 320870 N). 4. Slope angles of 3.5-15° associated with North Witham Road (Region 2b, coordinates: 492578 E, 320901 N), with some general variations in slope angle of 3.5-5.7° in adjacent fields to the east and west, including and adjacent linear depression encroaching on Site to the north of the western field and an irregular depression (c.15m in diameter) indicated by Groundsure data to be a pond on Site (Region 2b, coordinates: 492435 E, 320789 N) (Note, similar pond features are shown on linear alignment with on Site irregular depression feature). 5. Local irregular depression of unknown origin (c.20m in length) (Region 2c, coordinates: 491813 E, 320894 N) (Note, mapped to coincide with historical ironstone surface mineral planning area).

Region (Figure Ref.)	General Topographical Description of Site Regions (moving east to west)
	6. Slope angles of 3.5-15° associated with The Drift road and assumed ditches, including triangular area of uneven ground adjacent associated with woodland (Region 2d/2e, coordinates: 489521 E, 320760 N). 7. Wide depression (c.180m in length) associated with larger scale depression, encroaching on north and correlating with an area of mapped Worked Ground (Artificial Deposits) and partly, a historical mineral planning area for surface extraction of ironstone) (Region 2e, coordinates: 488739 E, 320868 N). 8. Linear extents of slope angles of 3.5-15° associated with tracks (Region 2e/2f, coordinates: 488553 E, 320724 N and 488310 E, 320725 N), alongside local irregular depression on field boundary (c.17m in length, coordinates: 488410 E, 320770 N) in between these of unknown origin (Note, within aforementioned historical mineral planning permission area for ironstone). 9. General variations in slope angles of 3.5-5.7° in fields and locally up to 15° around associated linear surface water feature (Region 2f, coordinates: 487725 E, 320688 N), with faint ridge features adjacent.
3 (Figure 2, Sheet 4/5)	The region generally crosses over rolling hills with associated valleys, the upper topography of which range between c.125m-130m AOD, with the valleys then ranging between c.95m-120m AOD; the most notable being associated with the River Eye (crossing Region 3d). The following notable more extensive changes in topography/slope angles and LiDAR features are observed, not including more local ponds/drains/tracks/field boundaries: 1. Slope angles of 3.5-15°, very locally >15°, associated with fields down to surface water feature (including slightly uneven ground surfacing in northern field), surface water feature itself and connecting drains/field boundaries (Region 3a, coordinates: 486692 E, 320670 N). 2. Irregular depression (c.18m in length) indicated by Groundsure data to be associated with a pond, in north on assumed drain/field boundary with slope angles of 3.5-15°, connecting into an associated lane/associated drain (Region 3a/3b, coordinates: 485822 E, 320686 N) (Note, irregular depression appears to be on northwest-southeast linear alignment with other offsite depressions/historical ponds and BGS boreholes offsite to the north are indicated on occasion to be associated with Stanton Iron Works Company). 3. On eastern side of valley associated with surface water feature, 2No. roughly north-south trending slightly raised linear ridge features, with the southern connecting into an offsite field boundary and the northern one including 2No. offsite irregular surface ground workings indicated by Groundsure to be associated with ponds in its eastern side (Region 3b, coordinates: 485511 E, 320794 N), with similar offsite connecting into an on Site field boundary to the southeast. 4. On western side of valley associated with surface water feature, 1No. Roughly northeast-southwest trending slightly raised linear ridge

Region (Figure Ref.)	General Topographical Description of Site Regions (moving east to west)
	feature (Region 3c, coordinates: 484981 E, 321097 N). - Slight variations in slope angle up to 3.5-5.7° over north and southern areas of western fields (Region 3c), with similar ridge to that noted previously adjacent to the south up to 15°. - Variable slope angles/topographies including ridge feature and step in topography down to lower lying areas associated with the River Eye. Slope angles vary between 3.5-5.7° , with increases to 15° and very locally >15° , the latter being associated with the step in topography (Region 3d, coordinates: 484330 E, 321366 N and 484236 E, 321452 N). - Slope angles of 5.7-15°, very locally >15°, associated with the River Eye and associated connecting surface water features (Region 3d, coordinates: 484223 E, 321525 N). - Slope angles of 3.5-5.7°, locally 5.7-15°, associated with the B676 Coston Road, adjacent triangular shaped piece of ground with irregular surfacing and connecting field boundaries/surface water feature (Region 3d, coordinates: 484019 E, 321641 N). - Areas of variable slope angles of 3.5-15° in the northwest of Region 3d, including around B676 Coston Road and linear surface water feature, including 2No. irregular depressions (c.15-20m in diameter) (coordinates: 484151 E, 321916 N and 484209 E, 321802 N). - Field boundary/ditch connecting into rectangular block of woodland/plantation with mound of unknown origin present (Region 3d, coordinates: 483673 E, 321716 N), including slope angles varying between 3.5-5.7° and locally up to 15°. - Slope angles of 3.5-15° down to a linear surface water feature, with local slope angles of >15° within the water feature itself (Region 3e, coordinates: 483435 E, 321815 N. Western fields generally at lower slope angles of 3.5-5.7°, locally 5.7-15° associated with a connecting field boundary/ditch. - Linear extent of slightly uneven/irregular ground along field boundary, connecting into adjacent depression of unknown origin (c.20m in diameter) encroaching on north (Note, this depression correlates with a very slight ridge-like feature and also sits on a linear northeast-southwest alignment with similar offsite depressions) (Region 3e, coordinates: 483094 E, 321977 N). Linear ridge feature bearing northeast-southwest with connecting northwest-southeast bearing linear depression with slope angles of 5.7-15°, and slope angles of 3.5-15° associated with the surrounding fields, down to a linear break in slope followed by surface water feature, with slope angles generally between 5.7-15° (Region 3f, coordinates: 482373 E, 322055 N and 482251 E, 322103 N). On the west side of the surface water feature, similar slightly undulating topographies are evident, albeit with slopes angles generally remaining between 3.5-5.7° except for locally, including along/around Gipsy Nook Lane, where these increase up

Region (Figure Ref.)	General Topographical Description of Site Regions (moving east to west)
	to 15°. 14. Irregular ground and depressions (up to c.30m) indicated by historical mapping to be associated with structure, pump and pond within wooded parcel to the west of Gipsy Nook Lane (Region 3f, coordinates: 482234 E, 322208 N). 15. Roughly northeast-southwest trending slightly raised linear ridge feature with associated and adjacent scattered slope angles of 3.5-5.7° (Region 3f, coordinates: 481891 E, 322242 N). 16. Slope angles of predominantly 5.7-15° sloping down to Freeby Brook, where slope angles of 5.7° to >15° are evident (Region 3g, coordinates: 481380 E, 322365 N). 17. Scattered changes in slope angles up to 3.5-5.7°, locally up to 15°, around path and in fields to the west of Freeby Brook, including encroaching patch of uneven ground in local copse of trees (Region 3g, coordinates: 481248 E, 322409 N). Local oval depression (c. 17m diameter) in woodland strip encroaching on south of Region 3g (coordinates: 480780 E, 322405 N). It is noted that a number of other oval/circular depression features are evident on LiDAR in the area adjacent to the Site, often correlating with overgrown features identified in Report Section 2.2. In areas, these are on a linear alignment with on Site features and do not appear to be associated with existing infrastructure.
4 (Figure 2, Sheet 5/6)	The region is predominantly situated on the side of rolling hills with upper topography between c.130m-145m AOD, interspersed with local valleys down to c.125m AOD, with the most significant being associated with the surface water features (Thorpe Brook) crossing Region 4e, with a further reduction in levels to between c.95m-100m AOD. The following notable more extensive changes in topography/slope angles and LiDAR features are observed, not including more local ponds/drains/tracks/field boundaries: 1. Local small scale single linear depressions seemingly associated with existing agricultural infrastructure, around adjacent crossroads between tracks/paths/field boundaries (Region 4, e.g. coordinates: 480613 E, 322751 N and 480561 E, 322812 N). 2. Notable circular depression (c.26m in diameter) with local slope angles of >15°, indicated by Groundsure data to be associated with a pond, overgrown on satellite imagery (Region 4a, coordinates: 480524 E, 322799 N) on slopes initially 3.5-5.7° and becoming up to 15° (and very locally >15°) down to a linear surface water feature, with similar slope angles on its western side (Region 4a, coordinates: 480464 E, 322789 N). 3. 3No. slight circular depressions in field and 1No. more prominent oval depression in woodland of unknown origin (c.10-15 in diameter) (Region 4b, coordinates: 480222 E, 322799 N, 480193 E, 322710 N, 480110 E, 322733 N and 480232 E, 322706 N), with similar/elongated depressions also present offsite e.g. in field to south around 480397 E, 322647 N. 4. Extensive area of variations in slope angles, generally 3.5-5.7°, with areas up to 15° associated with an east-west surface water feature in the south,

Region (Figure Ref.)	General Topographical Description of Site Regions (moving east to west)
	Freeby Lane and generally wide undulating topographies with linear depression and field boundaries (Region 4b, coordinates: 479883 E, 322686 N and 480109 E, 322593 N). 5. Linear extents of slope angles of 3.5-15° associated with A607 Melton Road, northwest-southeast bearing linear surface water feature and field boundaries, the water feature connecting into the aforementioned east-west bearing feature (Region 4b, coordinates: 479462 E, 322714 N and 479635 E, 322876 N). 6. Slight linear depression bearing northeast-southwest and connecting into local linear surface water feature encroaching on Site, with associated with slope angles of 3.5-15° (Region 4c, coordinates: 479258 E, 322586 N). 7. Examples of slight depressions (c.8m in diameter) on field boundaries/within fields indicated by Groundsure data to be pond on occasion (Region 4c/d, coordinates: 478560 E, 322639 N and 479001 E, 322750N). Further similar features, including on linear alignment to those on Site present in local area. 8. Irregular/uneven ground along field boundary corridor (Region 4d, coordinates: 478024 E, 322483 N) linking into extensive areas of sloping topographies (with some faint possible linear breaks in slope) down to the south and across the Site sloping down to the north/west to a linear surface water feature which connects into the wider Thorpe Brook (Region 4d/e, coordinates: 477762 E, 322458 N), between 3.5-15° and locally >15° adjacent in area of the linear surface water feature. 9. Slight linear ridge and associated slight depression indicated to be a pond on historical mapping (c.15m in diameter) present in area (Region 4d, coordinates: 477894 E, 322430 N) (Note, areas from this point westwards are associated with a Coal Mining Reporting Area; see Report Section 3.4). 10. Slope angles generally of 3.5-5.7° and locally up to 15° associated with wider hill side, sloping down to the Thorpe Brook, with very local slope angles of >15°. Area of slope angles locally up to 15° are generally associated with slight linear ridge/valley linear features in the field and Melton Spinney Road (Region 4e, coordinates: 477368 E, 322475 N and 477099 E, 322533 N) (Note, historical mapping indicated the realignment of watercourse in this area; valley like features possibly associated with this). 11. Local mound feature (c.8-10m diameter) within field (Region 4e, coordinates: 477238 E, 322311 N). It is noted that a number of other oval/circular depression features are evident on LiDAR in the area adjacent to the Site, often correlating with overgrown features identified in Report Section 2.2. In areas, these are on a linear alignment with on Site features and do not appear to be associated with existing infrastructure.

Region (Figure Ref.)	General Topographical Description of Site Regions (moving east to west)
5 (Figure 2, Sheet 6/7)	The region initially sits across a hillside at c.125m AOD in Region 5a, with levels then reducing moving west down to the Scaford Brook at c.90m AOD (Region 5b). From the brook, moving west, levels then increase up to c.135m AOD on Region 5d, associated with an overall south/southeast sloping hillside. Another general reduction in levels is then present from Region 5d to 5e, to c.125m AOD. The following notable more extensive changes in topography/slope angles and LiDAR features are observed, not including more local ponds/drains/tracks/field boundaries: 1. General areas of variations in slope angles between 3.5-15° associated with wider sloping topographies down to Thorpe Brook, field boundaries/drains and in the south assumed agricultural developments (including local sharp level changes of suspected cutting/retaining features of >15°) to the east of Melton Spinney Road. Including local small-scale mound like features within fields, seemingly associated with existing towers/utility poles (Region 5a, coordinates e.g. 477001 E, 322401 N and 476849 E, 322598 N). 2. Extensive area of slope angles of initially 3.5-5.7°, becoming predominantly 5.7-15°, associated with wider hillside and valley/gulley features down to the Scaford Brook (Region 5a; 476382 E, 322599 N). Including local circular depression indicated to be a pond by historical mapping (c.13m in diameter) seemingly overgrown on satellite imagery, within field atop of the hillside (Region 5a, coordinates: 476514 E, 322604 N). 3. Slope angles of 3.5-5.7° and generally 5.7-15° just to the west of the Scaford Brook and either side of a north-south bearing embankment c.5m high indicated by Groundsure data to be an abandoned railway line with slope angles of >15° locally, including a surface water feature bearing east-west through (including irregular ground in the area of a suspected pond on historical mapping) this in associated valley extending locally across/adjacent to the north with slope angles of between 3.5-15° in (Region 5b: 476061 E, 322517 N and 476048 E, 322368 N). 4. Slope angles of 3.5-15° associated with field boundary/adjacent developments and local areas of irregular raised ground/stockpiles on the field boundaries, including encroaching on / adjacent to the north of Region 5b/c, coordinates e.g. 475480 E, 322312 N, 475386 E, 322366 N and 475312 E, 322384 N. Irregular ground and suspected encroaching pond also present in south associated with an assumed farmstead e.g. coordinates: 475673 E, 322232 N. (Note, these features are assumed to be associated with present day developments/agricultural land uses). 5. Extensive areas of slope angles of 3.5-5.7°, becoming 5.7-15° and very locally >15° associated with a linear surface water feature and adjacent developments with associated assumed raised offsite basin/pond to the north and more locally a pond/basin possibly adjacent to the south (Region 5c, coordinates: 475188 E, 322220 N, 475272 E, 321956 N and 475122 E, 322274 N). Some slope angles up to 15° also present just west associated with Scaford Road.

Region (Figure Ref.)	General Topographical Description of Site Regions (moving east to west)
	- Linear depression/valley feature Site with slopes up to 15° (Region 5d, coordinates: 474762 E, 322096 N) (Note, unspecified heap adjacent to this offsite to the south indicated by Groundsure data). - Slope angles of 3.5-5.7°, locally up to 15° and very locally >15°, associated with a linear surface water feature, bisecting field boundary/drain and slight meandering depression off shooting from the water feature (possible stream/path) (Region 5e; 474100 E, 321924 N).
6 (Figure 2, Sheet 7)	The region is generally situated on rolling hills with upper topographies between c.125-140m AOD, interspersed with local valleys, reducing levels to between c.90-110m AOD, the most significant of which being associated with a linear surface water feature through Region 6b. The following notable more extensive changes in topography/slope angles and LiDAR features are observed, not including more local ponds/drains/tracks/field boundaries: - Variable slope angles and areas of cutting/irregular uneven ground, generally with slope angles between 3.5-15° associated with the A606, adjacent developments (including sharp level changes around footprints) with existing structures, field boundaries/drains, paths and linear surface water feature in the south (Region 6a, coordinates: 473910 E, 321720 N and 473699 E, 321840 N). Including local mound of unknown origin in south of fields (coordinates: 473517 E, 321629 N). - Extensive areas of slope angles between 5.7-15° sloping westwards (with some faint ridge/valley features, including slight linear depressions along planted linear features) down to a linear surface water feature, including associated slopes of >15° with some local semi-circle like features upon western bank (possible signs of slope instability, correlating with faulting, see Report Section 3.3) (Region 6a/6b; coordinates: 473104 E, 321745 N). Embankment/bridge crossing also indicated crossing linear surface water feature locally (473132 E, 321899 N) with adjacent local steps in topography to surface water feature. - Extensive areas of slope angles between 5.7-15° sloping down towards surface water feature on northern semi-circle Site boundary extension, where slope angles increase to >15° (Region 6b; coordinates: 473345 E, 322505 N). Indication through LiDAR data of raised/bunded material on eastern bank of watercourse (shown to be dismantled railway line on historical mapping). - Extensive areas of variable sloping terrains, generally with slope angles between 3.5-15°, locally greater than 15° associated with the A606 and surface water feature crossings on the northern semi-circle Site boundary extension (Region 6b; coordinates: 473091 E, 322229 N and 472775 E, 322312 N). Similar slopes are also present south of this associated with linear extensions to Site, including crossing of linear surface water feature with slope angles of >15°. - Extensive areas of slope angles of generally 3.5-5.7° and locally up to 15° associated with western sloping ground down to the aforementioned linear

Region (Figure Ref.)	General Topographical Description of Site Regions (moving east to west)
	surface water feature, with areas of elevated slope angles up to 15° associated with linear changes in topography along field boundaries/slight linear depressions/ridges (Region 6b/6c, coordinates: 472808 E, 321751 N). Including indicated bund along field boundary and depression of unknown origin (c.13m in length) potentially associated with developments offsite to north (Region 6c, coordinates: 472628 E, 321813 N). 6. Extensive areas of slope angles between 5.7-15° sloping west down to valley/linear surface water feature (very locally >15°), with similar slopes on the west side of this. Including irregular depression (c. 15m in length) indicated by Groundsure data to be a pond atop of the hillside in the east, which appears to be on a linear alignment with offsite features of a similar nature (Region 6c/6d, coordinates: 472310 E, 321705 N and 472137 E, 321718 N) (Note, coal mining features recorded in wider area, see Report Section 3.4). 7. Slope angles of 3.5-15° associated aforementioned valley continuation and field boundaries/paths, including through Cant's Thorns woodland with evidence of irregular/uneven ground within this (Region 6d; 471969 E, 321814 N). 8. Extensive area of variable slope angles, generally of 3.5-15°, with local instances of >15° associated with sloping topography down to a central valley/linear surface water feature and associated Fish Pond (based on Groundsure data), including local ridge and gully like features and possible breaks in slope (Region 6e; 470763 E, 322075 N). Some steeper slopes generally appear to be associated with cuttings to/ adjacent to the aforementioned pond. It is noted that a number of other circular depression features are evident on LiDAR in the area adjacent to the Site, often correlating with overgrown features identified in Report Section 2.2. In areas, these are potentially on a linear alignment across Site and do not appear to be associated with existing infrastructure. Note: Features in bold have been discussed further in Report Section 3 relative to possible association with possible unrecorded karst, historical mining and slope instabilities.

3. Geological and Environmental Setting

3. Geological and Environmental Setting

3.1 Overview

- 3.1.1 The environmental setting, including the topography, geology, hydrogeology and hydrology, are the key factors that influence the nature of ground hazards on Site, the way in which contaminants in the soil or groundwater can be transported on or off Site, and also the way in which contamination can affect applicable receptors including controlled waters and users of the Site.

3.2 Geology

Published Geology & Exploratory Hole Records

- 3.2.1 The published 1:50,000 scale mapping of the Site, alongside available published 1:10,000 scale mapping, produced by the BGS and presented on Fuse indicate the Site to be underlain by the geological successions summarised in Table 3.1 to Table 3.7. This data (generally 1:50,000 scale, including 1:10,000 scale linear features and Artificial ground) is reproduced on Figure 3 for Artificial Ground and Superficial Geology (WMEL-AAJ-ZZZZ-XXXXXX-DRW-GE-000025) and Figure 4 for Bedrock Geology (WMEL-AAJ-ZZZZ-XXXXXX-DRW-GE-000026), presented in Appendix A.
- 3.2.2 The associated available BGS published geological maps and their coverage is summarised below; it is noted that digital 1:10,000 scale map coverage is not available from Region 1 to the eastern half of Region 4b.
- 1:50,000/1:63,360 scale digital Map Sheets:
 - 143 Bourne, separate solid and drift, published 1971 (Ref 13.5) and 1972 (Ref 13.6) respectively: Region 1a to across the majority of 3e.
 - 142 Melton Mowbray published 2002 (Ref 13.11): Remainder of Region 3e to Region 6e.
 - 1:10,000/1:10,560 scale digital Map Sheets:
 - SK92SE (Lincolnshire) published 1969 (Ref 13.4): Region 1a to initial area of Region 1e (Non-digitised map).
 - SK92SW (Lincolnshire) published 1974 (Ref 13.7): Majority of 1e to eastern half of Region 2d (Non-digitised map)
 - SK82SE (Leicestershire-Lincolnshire) published 1968 (Ref 13.3): Western half of 2d to eastern half of Region 3c (Non-digitised map).
 - SK82SW (Waltham) published 2000 (Ref 13.10): Western half of 3c to eastern half of Region 4b (Non-digitised map).
 - SK81NE (Leicestershire) published 1973 (Ref 13.70): Encroaching very locally on southernmost extent of linear extension to Site in Region 3a.

- SK72SE (Scalford) published 2000 (Ref 13.8): Western half of Region 4b to initial part of 5d.
- SK72SW (Ab Kettleby) published 2000 (Ref 13.9): Region 5d to Region 6e.

- 3.2.3 Overall, moving east to west, the superficial geology of the Site generally comprises of Mid Pleistocene Till (Region 1a to 3e), transitioning into the Oadby Till Member (Region 3e to 6e) with local areas of Lias-rich Oadby Till Member (Region 6b to 6d). Alluvium (Region 2 to 6) and Head Deposits (Region 3 to 6) are also locally present associated with surface water features and sloping topographies.
- 3.2.4 The bedrock geology succession of the Site, from east to west, generally comprises of the Rutland Formation of the Great Oolite Group (Region 1), into the Lincolnshire Limestone Formation (Upper and Lower Members) of the Inferior Oolite Group (Region 1 and locally Region 2). This then transitions into the lower parts of the Inferior Oolite Group, the Grantham Formation and the Northampton Sand Formation (locally in Region 1 and 2) underlain by the Lias Group formed of the Whitby Mudstone (Region 2 and locally Region 1 and 3) into the Marlstone Rock Formation (locally in Regions 2, 3 and 4) into the Dyrham Formation (Region 5 and locally, Region 2, 3, 4 and 6) and the Charmouth Mudstone Formation (Region 3, 4 and 6, locally Region 5).
- 3.2.5 Locally faults (Regions 1, 2, 3, 4 and 6), buried channels/basins (Regions 3, 4, 5, and 6) swallet holes (Region 1) and cambering terrains (Region 2) are also recorded on published mapping, alongside local areas of Artificial Ground (Regions 2e, 5b, 6b, 6d and 6e). These are also included on the Figures where on/in the immediate vicinity of the Site.

Table 3.1: Geological succession from published mapping

Geological Stratum (Previous Name)	Geology type	Parent Unit	Age	BGS Lexicon Description	Published Thickness (m)
Landscaped Ground	Artificial	Artificially modified ground	Quaternary Period	Landscaped Ground is an area where the land surface (natural or artificial) has been extensively remodelled, but where it is impracticable or impossible to delineate separate zones of Made Ground, Worked Ground, or Disturbed Ground.	N/R
Infilled Ground	Artificial	Artificially modified ground	Quaternary Period	Infilled Ground is an area where the pre-existing land surface has been excavated (Worked Ground) and subsequently partially or wholly backfilled (Made Ground).	N/R
Made Ground	Artificial	Artificially modified ground	Quaternary Period	Made Ground is an area where the pre-existing (natural or artificial) land surface is raised by artificial deposits.	N/R
Worked Ground	Artificial	Artificially modified ground	Quaternary Period	Worked Ground is an area where the land surface (natural or artificial) has been lowered as a result of man-made excavations.	N/R
Alluvium	Superficial	Fluvial deposits	Quaternary Period	Alluvium is a general term for clay, silt, sand and gravel. It is the unconsolidated detrital material deposited by a river, stream or other body of running water as a sorted or semi-sorted sediment in the bed of the stream or on its floodplain or delta, or as a cone or fan at the base of a mountain slope. Normally soft to firm,	Variable, influenced by topography

Geological Stratum (Previous Name)	Geology type	Parent Unit	Age	BGS Lexicon Description	Published Thickness (m)
				compressible silty clay, but can contain layers of silt, sand, peat and basal gravel. A stronger, desiccated surface zone may be present.	
Head Deposits	Superficial	Mass Movement deposits	Quaternary Period	Head is poorly sorted and poorly stratified, angular rock debris and/or clayey hillwash and soil creep, mantling a hillslope and deposited by solifluction and gelifluction processes. Solifluction is the slow viscous downslope flow of waterlogged soil and other unsorted and unsaturated superficial deposits. The term gelifluction is restricted to the slow flow of fluidized superficial deposits during the thawing of seasonally frozen ground. The flow is initiated by meltwater from thawing ice lenses. Polymict deposit: comprises gravel, sand and clay depending on upslope source and distance from source. Locally with lenses of silt, clay or peat and organic material.	Variable
Oadby Till Member	Superficial	Albion Glaciogenic Group/Wolston Glaciogenic Formation	Quaternary (Mid Pleistocene Epoch, Anglian) 0.423-0.48 Ma	Diamicton, grey, weathering brown, characterised by Cretaceous and Jurassic rock fragments; subordinate lenses of sand and gravel, clay and silt. Clay, brown to grey, and silty clay, with chalk and flint fragments.	Variable up to 20, typically 1 to 7

Geological Stratum (Previous Name)	Geology type	Parent Unit	Age	BGS Lexicon Description	Published Thickness (m)
Oadby Till Member (Lias-rich)	Superficial	Albion Glaciogenic Group/Wolston Glaciogenic Formation/Oadby Till Member	Quaternary (Mid Pleistocene Epoch, Anglian) 0.423-0.48 Ma	Clay, brown to grey, and silty clay, with chalk and flint fragments; rich in 'Lias' rock fragments.	Variable
Till, Mid Pleistocene	Superficial	Glaciogenic deposits	Quaternary (Mid Pleistocene Epoch) 0.78-0.126Ma	Till is unsorted and unstratified drift, generally overconsolidated, deposited directly by and underneath a glacier without subsequent reworking by water from the glacier. It consists of a heterogenous mixture of clay, sand, gravel, and boulders varying widely in size and shape (diamicton).	Variable
Rutland Formation (Upper Estuarine Series)	Bedrock	Great Oolite Group	Jurassic (Bajocian – Bathonian Age) 170.9–165.3 Ma	A succession of up to seven shallowing upward, essentially delta-type rhythms, comprising ideally of a grey marine mudstone passing up into non-marine mudstone and siltstone, with a greenish-grey rootlet bed at the top. Presence of sandstone and mudstone members in areas.	c. 6 to 12 ¹ (Based on thickness of 'Upper Estuarine Series')
Upper Lincolnshire	Bedrock	Inferior Oolite Group/Lincolnshire	Jurassic (Bajocian Age)	Limestone, overwhelmingly dominated by high-energy ooidal and shell fragmental	c. 12 to 21 ¹

Geological Stratum (Previous Name)	Geology type	Parent Unit	Age	BGS Lexicon Description	Published Thickness (m)
Limestone Member		Limestone Formation	170.3–168.3 Ma	grainstones, but includes secondarily recrystallized and micritized lithologies. Upper boundary disconformable, commonly markedly eroded and karstified contact between ooidal and bioclastic grainstone of the Upper Lincolnshire Limestone and the non-calcareous non-marine sandstones, siltstones and mudstones of the overlying Rutland Formation.	
Lower Lincolnshire Limestone Member	Bedrock	Inferior Oolite Group/Lincolnshire Limestone Formation	Jurassic (Bajocian Age) 170.3–168.3 Ma	Limestones, dominated by low-energy calcilutite, and peloidal wackestone and packstone. Commonly includes sandy limestone or calcareous sandstone in basal part and contains substantial units of mudstone. Disconformable, commonly channelled contact between calcilutites, wackestones and packstones below and the high energy ooidal limestones of the overlying Upper Lincolnshire Limestone Member.	c.9 to 15 ¹
Grantham Formation (Lower Estuarine Series)	Bedrock	Inferior Oolite Group	Jurassic (Aalenian Age) 174.1–170.3 Ma	Mudstones, sandy mudstones and argillaceous siltstone-sandstone, which is commonly ferruginous, and containing generally abundant plant debris, interpreted as both non-marine and marine facies, comprising several shallowing-upwards, delta-type rhythms	c.0 to 7.5 ¹

Geological Stratum (Previous Name)	Geology type	Parent Unit	Age	BGS Lexicon Description	Published Thickness (m)
				with typically a tripartite succession comprising: a generally pale, locally carbonate-cemented and commonly ferruginous more or less argillaceous sand or sandstone at the base, which may have a rootleted seatearth at the top, overlain in the type area at least, by a median unit of marine shaly sandy mudstone designated the Stainby Member, which farther to the south is represented by a dark carbonaceous shaly clay, named the "Coaly Bed", which may be equivalent, overlain by an upper, possibly rhythmic succession of alternating sand or sandstone with mudstone or sandy mudstone that may be rootleted in parts.	
Northampton Sand Formation	Bedrock	Inferior Oolite Group	Jurassic (Aalenian Age) 174.1–170.3 Ma	Sandy, berthierine-ooidal and sideritic ironstone, greenish grey where fresh, weathering to brown limonitic sandstone, typically displaying a box-stone structure. The basal part, is commonly muddy and less ferruginous. The uppermost beds are generally more or less ferruginous sandstone. The unit includes lenses of mudstone and limestone in places, and contains a fairly abundant marine fauna of bivalves, brachiopods and ammonites, which are not generally evident in weathered regions.	c.0 to 9 ¹

Geological Stratum (Previous Name)	Geology type	Parent Unit	Age	BGS Lexicon Description	Published Thickness (m)
Whitby Mudstone (Upper Lias Clay)	Bedrock	Lias Group	Jurassic (Toarcian Age) 182.7-174.4 Ma	Medium and dark grey fossiliferous mudstone and siltstone, laminated and bituminous in part, with thin siltstone or silty mudstone beds and rare fine-grained calcareous sandstone beds; dense, smooth argillaceous limestone nodules very common at some horizons; phosphatic nodules at some levels. Nodular and fossiliferous limestones occur at the base in some areas.	c.53 to 76 ¹ to c.55 ² to c.58 ³ to c.30 ⁴
Marlstone Rock Formation (Marlstone Rock Bed)	Bedrock	Lias Group	Jurassic (Pliensbachian -Toarcian Age) 192.9-174.7 Ma	Sandy, shell-fragmental and ooidal ferruginous limestone interbedded with ferruginous calcareous sandstone, and generally subordinate ferruginous mudstone beds. Locally any of these lithologies may pass by increase in iron content into generally ooidal ironstone, and in places any of these may dominate. The iron content (as ooids, altered shell material or in the groundmass) is berthierine (dark green iron-rich layered silicate formed in low-oxygen marine conditions), altering to siderite. Fossil content variable throughout but locally abundant especially in limestone beds.	c.2.5 to 9 ¹ to c.1 to 5 ² to c.5 ³ to c.4 to 6 ⁴
Dyrham Formation	Bedrock	Lias Group	Jurassic (Pliensbachian Age)	Pale to dark grey and greenish grey, silty and sandy mudstone, with interbeds of silt or very fine-grained sand (locally muddy	c. 7 to 18 ¹ to c.15 to 25 ² to c.26 ³

Geological Stratum (Previous Name)	Geology type	Parent Unit	Age	BGS Lexicon Description	Published Thickness (m)
(Middle Lias Silts and Clays)			184.2-192.9 Ma	or silty), weathering yellow. Variably micaceous. Impersistent beds or doggers of ferruginous limestone (some ooidal) and sandstone, which tend to occur at the top of sedimentary cycles. Sporadic large cementstone nodules.	to c.18.5 to 29 ⁴ to c.25 ⁵
Charmouth Mudstone Formation (Lower Lias)	Bedrock	Lias Group	Jurassic (Sinemurian - Pliensbachian Age) 184.2-199.5 Ma	Dark grey laminated shales, and dark, pale and bluish grey mudstones; locally concretionary and tabular limestone beds; abundant argillaceous limestone, phosphatic or ironstone (sideritic mudstone) nodules in some areas; organic-rich paper shales at some levels; finely sandy beds in lower part in some areas.	c.198 ¹ to c.110 to 130 ² to c.129 ³ to c.105 to 125 ^{4,5}

Notes:

Thicknesses of stratum based on the following sources where available and assumed to supersede that provided in BGS Lexicon. When not denoted by the below, thickness is based on BGS Lexicon. N/R = not recorded.

¹ 1:50,000 scale Map Sheet 143 (Bourne) Region 1a to across the majority of 3e.

² 1:50,000 scale Map Sheet 142 (Melton Mowbray) Remainder of Region 3e to Region 6e.

³ 1:10,000 scale Map Sheet SK82SW (Waltham) Western half of 3c to eastern half of Region 4b.

⁴ 1:10,000 scale Map Sheet SK72SE (Scalford) Western half of Region 4b to initial part of 5d.

⁵ 1:10,000 scale Map Sheet SK72SW (Ab Kettleby) Region 5d to Region 6e.

Region 1

3.2.6 The below table summarises the geology mapped underlying the region. It is noted that the geological succession beneath the upper mapped bedrock geology have not been summarised here and that Table 3.1 should be referred to for the underlying succession.

Table 3.2: Geological succession, linear and other geological features and landfill occurrences from published mapping for Region 1

Parent Unit	Geological Stratum	Mapped Coverage	Published Thickness (m)
Till/Glaciogenic deposits	Till, Mid Pleistocene	Locally encroaching on Region 1a and 1b. Generally covering most of Region 1c and 1d. Full coverage of Region 1e.	Assumed Variable
Great Oolite Group	Rutland Formation	Locally encroaching on Region 1d. Across central part of Region 1a and 1b. Generally covering most of Region 1c.	c. 6 to 12
Inferior Oolite Group	Upper Lincolnshire Limestone Member	Generally covering north and south of Region 1a and the majority of Region 1d. Partial coverage in the northeast and southwest of Region 1b and northeast of Region 1c. Locally encroaching on the central part of Region 1e.	c. 12 to 21
Inferior Oolite Group	Lower Lincolnshire Limestone Member	Locally encroaching on east of Region 1a and west/southwest of Region 1d. General coverage of northeast and central parts of Region 1e.	c. 9 to 15
Inferior Oolite Group	Grantham Formation	Locally in east and west of Region 1e.	c. 0 to 7.5
Inferior Oolite Group	Northampton Sand Formation	Locally in the east and west of Region 1e.	c. 0 to 9
Lias Group	Whitby Mudstone Formation	Encroaching on the east and west of Region 1e.	c. 53 to 76

Linear and Other Geological Features

1No. inferred fault mapped crossing Colsterworth Lane in Region 1a, bearing roughly northwest-southeast with the downthrow side to the northeast based on Map Sheet 143 (Bourne), and further adjacent/encroaching observed faulting, associated with Woodlands Fault.

Parent Unit	Geological Stratum	Mapped Coverage	Published Thickness (m)
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1No. inferred fault is mapped around Honey Pot Lane on Region 1d, bearing roughly east-west with the downthrow side to the south based on Map Sheet 143 (Bourne).

Note, the above faulting in limestone is considered to increase risk of karst features (See Report Section 3.3).

Numerous Swallets (also referred to as swallow holes), being vertical steeply sloping holes in the limestone where water disappears underground shown on Map Sheet SK92SE (Lincolnshire). Another feature labelled as 'Compact Oolitic Limestone', but with a circular associated feature is not clearly defined on the map sheet and consequently is also considered to be a possible karst feature. See Report Section 3.3 for further detail on karst features.

Landfill Records

Landfill records are not indicated as per Groundsure data.

2No. landfill waste exemption for sludge storage indicated in field by Groundsure data on Region 1a; point data, therefore presence/extent of any storage unknown.

Note, other landfill exemption point data present in land adjacent to the Site locally; extent unknown due to point data.

Region 2

- 3.2.7 The below table summarises the geology mapped underlying the region. It is noted that the geological succession beneath the upper mapped bedrock geology have not been summarised here and that Table 3.1 should be referred to for the underlying succession.

Table 3.3: Geological succession, linear and other geological features and landfill occurrences for Region 2

Parent Unit	Geological Stratum	Mapped Coverage	Published Thickness (m)
Artificially modified ground	Worked Ground	Encroaching on the north of Region 2e, associated with wider offsite areas of Worked Ground, indicated to be associated with ironstone mining (See Report Section 3.4).	Correlating with indicated reduction in levels relative to adjacent non-worked ground.
Fluvial deposits	Alluvium	Locally mapped in the east of Region 2b associated with the River Witham.	Assumed Variable

Parent Unit	Geological Stratum	Mapped Coverage	Published Thickness (m)
Till/Glaciogenic deposits	Till, Mid Pleistocene	Full coverage of Region 2, except where local Worked Ground and Alluvium is present on 2b and 2e (Note, Till anticipated to underlie Alluvium) and northern extent of linear extension to Site boundary in north of Region 2c.	Assumed Variable
Inferior Oolite Group	Lower Lincolnshire Limestone Member	Locally on linear extensions to Site boundary in north of Regions 2a and 2c.	c. 9 to 15
Inferior Oolite Group	Grantham Formation	Locally encroaching on linear extensions to Site boundary in Regions 2a and 2c and in northwestern part of Region 2e.	c. 0 to 7.5
Inferior Oolite Group	Northampton Sand Formation	Locally encroaching on linear extensions to Site boundary access route in Regions 2a and / 2c General coverage of the western and northern parts of Region 2e.	c. 0 to 9
Lias Group	Whitby Mudstone Formation	Full coverage of Region 2a to 2d (except for outlined local variations of linear extensions to boundary in north). General coverage of the eastern and locally western parts of Region 2e. General coverage of the western and central parts of Region 2f.	c. 53 to 76
Lias Group	Marlstone Rock Formation	Locally in the west of Region 2f.	c. 2.5 to 9
Lias Group	Dyrham Formation	General coverage of the western part of Region 2f.	c. 7 to 18

Linear and Other Geological Features

1No. inferred fault crossing northern extension to Site boundary area in Region 2b, bearing roughly northwest-southeast, with downthrow to the northeast based on Map Sheet 143 (Bourne).

1No. inferred fault crossing linear northern extension to Site in Region 2c, bearing roughly northeast-southwest, with downthrow to the southeast based on Map Sheet 143 (Bourne).

Parent Unit	Geological Stratum	Mapped Coverage	Published Thickness (m)
The above faults appear to be connected and associated with the Stainby Fault based on Map Sheet 143 (Bourne) and are associated with limestone bedrocks. Note, faulting in limestone is considered to increase risk of karst features (See Report Section 3.3). Evidence of ironstone cambering beneath drift labelled on Map Sheet SK82SE (Leicestershire-Lincolnshire) (See Report Section 3.3 for further detail).			
Landfill Records			
Landfill records are not indicated as per Groundsure data. Landfill waste exemption for sludge storage indicated in field by Groundsure data on Region 2f; point data, therefore presence/extent of any storage unknown. Note, other landfill exemption point data present in land adjacent to the Site locally; extent unknown due to point data.			

Region 3

- 3.2.8 The below table summarises the geology mapped underlying the region. It is noted that the geological succession beneath the upper mapped bedrock geology have not been summarised here and that Table 3.1 should be referred to for the underlying succession.

Table 3.4: Geological succession, linear and other geological features and landfill occurrences for Region 3

Parent Unit	Geological Stratum	Mapped Coverage	Published Thickness (m)
Fluvial deposits	Alluvium	Locally in east of Region 3a associated with a linear surface water feature and in the east of Region 3d associated with the River Eye.	Assumed Variable
		Note, local deposits mapped in land adjacent to Region 3g and locally encroaching on extension to Site boundary in the southwest of Region 3d associated with on Site linear surface water features.	

Parent Unit	Geological Stratum	Mapped Coverage	Published Thickness (m)
Mass movement deposits	Head Deposits	Locally present encroaching on Region 3c. Locally mapped across parts of Region 3d, 3e, 3f and 3g. Generally associated with linear valley/depression features.	Assumed Variable
Albion Glaciogenic Group/Wolston Glaciogenic Formation	Oadby Till Member	Partial coverage of western area of Region 3e. General coverage of Region 3f and 3g, except where local occurrences of Head are present (Note, Till anticipated to underlie Alluvium and Head).	Variable up to 20, typically 1 to 7
Till/Glaciogenic deposits	Till, Mid Pleistocene	Full coverage in Region 3b. General coverage in Region 3a, 3c and 3d, except for where local occurrences of Alluvium or Head are present (Note, Till anticipated to underlie Alluvium and Head). General coverage of eastern and central parts of Region 3e.	Assumed Variable
Lias Group	Whitby Mudstone Formation	Locally in the south of Region 3a encroaching on linear extension to Site boundary.	c. 53 to 76
Lias Group	Marlstone Rock Formation	Locally in the south of Region 3a encroaching on linear extension to Site boundary.	c. 2.5 to 9
Lias Group	Dyrham Formation	Locally encroaching on the east and south of Region 3a (including southern linear extension to Site boundary) and in the west of Region 3c, associated with faulting.	c.7 to 26
Lias Group	Charmouth Mudstone Formation	Full coverage in Region 3b, 3d, 3e, 3f and 3g. General coverage in 3a and 3c, except where other aforementioned bedrocks are mapped locally.	c.110 to 198
Linear and Other Geological Features			
2No. inferred faults, intersecting on Region 3c and correlating with an outcrop of the Dyrham Formation within the Charmouth Mudstone. Northern of the two faults bears roughly east-west and southern of the faults bears northeast-southwest. The			

Parent Unit	Geological Stratum	Mapped Coverage	Published Thickness (m)
displacement of the northern fault is unknown, with the southern fault downthrown to the north. The southern of the two faults also appears to pass through a linear southern extension to the Site boundary in Region 3e/f. The northern margin of a wider buried infilled channel or valley is mapped through Region 3g, bearing roughly northeast-southwest, indicating deepening of superficial thicknesses south of this boundary. The southern extent of this feature appears to be present locally bearing east-west on a linear southern extension to Site in Region 3f.			
Landfill Records			
Landfill records are not indicated as per Groundsure data. Landfill exemption for sludge storage indicated in field by Groundsure data on Region 3b; point data, therefore presence/extent of any storage unknown. Note, other landfill exemption point data present in land adjacent to the Site locally; extent unknown due to point data.			

Region 4

- 3.2.9 The below table summarises the geology mapped underlying the region. It is noted that the geological succession beneath the upper mapped bedrock geology have not been summarised here and that Table 3.1 should be referred to for the underlying succession.

Table 3.5: Geological succession, linear and other geological features and landfill occurrences for Region 4

Parent Unit	Geological Stratum	Mapped Coverage	Published Thickness (m)
Fluvial deposits	Alluvium	Locally mapped in central and eastern parts of Region 4e associated with Thorpe Brook and northeast-southwest linear Site boundary extension in the north of Region 4d/locally 4c.	Assumed Variable
Mass movement deposits	Head Deposits	Locally across parts of Region 4a and 4b. Locally encroaching on the south and north of Region 4c and 4e respectively. Generally associated with linear valley/depression features.	Assumed Variable

Parent Unit	Geological Stratum	Mapped Coverage	Published Thickness (m)
Albion Glaciogenic Group/Wolston Glaciogenic Formation	Oadby Till Member	Dominant coverage at surface in Region 4d, except for local Alluvium in linear extensions to Site in north. General coverage of Region 4a, 4b and 4c, except for in areas of local Head. Coverage in eastern, western and central parts of Region 4e outside of Alluvium and Head areas. (Note, Till anticipated to underlie Alluvium and Head).	Variable up to 20, typically 1 to 7
Lias Group	Whitby Mudstone Formation	Locally mapped encroaching on north of Region 4a (associated with linear extensions to Site boundary) and in the northwest/north of Region 4b, correlating with faulting.	c. 30 to 58
Lias Group	Marlstone Rock Formation	Locally mapped encroaching on northwest of Region 4b, correlating with faulting.	c. 1 to 6
Lias Group	Dyrham Formation	Locally encroaching on the northwest of Region 4b and across eastern part of Region 4c, correlating with faulting.	c. 15 to 29
Lias Group	Charmouth Mudstone Formation	Full coverage of Region 4d and 4e and predominant coverage of Region 4a. General coverage of Region 4b and 4c.	c. 105 to 130

Linear and Other Geological Features

1No. inferred fault, downthrown to the north, mapped crossing through the interface between Region 4b and 4c around Waltham Road, bearing roughly northeast-southwest correlating with outcropping of the Dyrham Formation, Marlstone Rock Formation and Whitby Mudstone Formation.

Eastern and western margins of buried, infilled, channels or valleys through central parts of Region 4c, bearing roughly north-south. Note, the eastern margin is an extension of the margin also recorded intersecting Region 3g.

Landfill Records

Landfill records are not indicated as per Groundsure data.

2No. Landfill exemptions for sludge storage indicated in fields by Groundsure data in northeast of Region 4d and south of Region 4e; point data, therefore presence/extent of any storage unknown. Note, other landfill exemption point data present in land

Parent Unit	Geological Stratum	Mapped Coverage	Published Thickness (m)
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adjacent to the Site, including for use of waste in construction and other uses/disposal types adjacent to south of 4e; point data, therefore presence/extent of any use of waste unknown.

Region 5

3.2.10 The below table summarises the geology mapped underlying the region. It is noted that the geological succession beneath the upper mapped bedrock geology have not been summarised here and that Table 3.1 should be referred to for the underlying succession.

Table 3.6: Geological succession, linear and other geological features and landfill occurrences for Region 5

Parent Unit	Geological Stratum	Mapped Coverage	Published Thickness (m)
Artificially modified ground	Made Ground	Locally across Region 5b associated with historical abandoned railway line.	Correlating with railway embankment height
Fluvial deposits	Alluvium	Locally mapped through the east of Region 5b associated with the Scaford Brook.	Assumed Variable
Mass movement deposits	Head Deposits	Locally mapped across all parts of Region 5. Generally associated with linear valley/depression features.	Assumed Variable
Albion Glaciogenic Group/Wolston Glaciogenic Formation	Oadby Till Member	Generally mapped in across all parts of Region 5 (Note, Till anticipated to underlie Alluvium and Head).	Variable up to 20, typically 1 to 7
Lias Group	Dyrham Formation	Full coverage of Region 5a (except very locally in southeast), 5c, 5d and 5e. Partial coverage of the east and general coverage in the west of Region 5b.	c. 15 to 29

Parent Unit	Geological Stratum	Mapped Coverage	Published Thickness (m)
Lias Group	Charmouth Mudstone Formation	Locally encroaching on the southeast of Region 5a. General coverage of central eastern part of Region 5b.	c. 105 to 130

Linear and Other Geological Features

No faults are mapped.

Eastern and western margins of buried, infilled, channels or valleys are mapped through Region 5b (eastern margin locally encroaching on Region 5a), bearing roughly northwest-southeast. Eastern margin connects into wider buried valley/channel extents associated with Region 4c.

Marine Band, fossil horizon, mapped to northwest-southeast through Region 5b, west of the aforementioned buried channel/valley.

Northern margin of buried, infilled, channels or valleys adjacent to south of Region 5e, bearing roughly northwest-southeast and indicating increased thicknesses of superficial deposits to the south of this.

Landfill Records

Landfill records are not indicated as per Groundsure data.

Note, landfill exemption point data present in land adjacent to the Site, including for use of waste in construction and other uses/disposal types adjacent to south of 5a and 5c; point data, therefore presence/extent of any use of waste unknown.

Region 6

- 3.2.11 The below table summarises the geology mapped underlying the region. It is noted that the geological succession beneath the upper mapped bedrock geology have not been summarised here and that Table 3.1 should be referred to for the underlying succession.

Table 3.7: Geological succession, linear and other geological features and landfill occurrences for Region 6

Stratum	Parent Unit	Geological Stratum	Mapped Coverage	Published Thickness (m)
Artificial Ground	Artificially modified ground	Made Ground	Locally encroaching on north of semi-circle linear extension to Site boundary in north and west of Region 6b, assumed to be associated with a historical rail sidings (based on Groundsure data) and existing infrastructure and crossing of linear surface water feature more generally in the area. Locally in south of Region 6b associated with linear extension to Site boundary seemingly associated with linear surface water feature crossing. Locally in the west of Region 6e, correlating with southern end of encroaching Fish Pond. Note, more extensive areas of Made Ground indicated offsite adjacent to the south of linear extensions to the Site on 6b and 6c/d, including in areas associated with historical coal mining spoil heap for Asfordby Mine (See Report Section 3.4) and a landfill/slag hear for Holwell Works (assumed associated with historical ironstone workings in wider area).	Assumed Variable, correlating where visible with bunds/embankments. Correlating with changes in level around Fish Pond.
Artificial Ground	Artificially modified ground	Landscaped Ground	Locally present across linear extension to Site boundary in north of Region 6b, on east side of linear surface water feature. Locally also present on part of southeast bearing linear extension to Site boundary in region 6d, associated with area of bare ground on satellite imagery suspected to be an area of agricultural stockpiling/storage.	Assumed Variable

Stratum	Parent Unit	Geological Stratum	Mapped Coverage	Published Thickness (m)
Superficial Deposits	Fluvial deposits	Alluvium	Locally through Region 6b associated with a linear surface water feature.	Assumed Variable
Superficial Deposits	Mass movement deposits	Head Deposits	Locally mapped across all parts of Region 6. Generally associated with linear valley/depression features.	Assumed Variable
Superficial Deposits	Albion Glaciogenic Group/Wolston Glaciogenic Formation	Oadby Till Member	General coverage across Region 6a, 6c, 6d and 6e. Partial coverage in Region 6b, predominantly in the east (Note, Till anticipated to underlie Alluvium and Head).	Variable up to 20, typically 1 to 7
Superficial Deposits	Albion Glaciogenic Group/Wolston Glaciogenic Formation	Oadby Till Member (Lias-rich)	Partial coverage across parts of Region 6b. Locally encroaching on the Region 6c and 6d to the east of Cant's Thorns woodland and southwest corner of Region 6e (note, Till anticipated to underlie Alluvium and Head).	Assumed Variable
Bedrock	Lias Group	Dyrham Formation	Partial coverage in the north and east of Region 6a and the north of Region 6b, mainly associated with linear semi-circular extension to Site c. 25 boundary. Local coverage in the north of Region 6c.	
Bedrock	Lias Group	Charmouth Mudstone Formation	Full coverage across Region 6, except locally where Dyrham Formation is mapped.	c. 105 to 130

Linear and Other Geological Features

2No. inferred faults, both named Normanton Hills Fault, bearing northwest-southeast through Region 6a, 6b and east-west locally through the north of Region 6e, downthrown to the north/northeast (Note, indicated to be a continuation of faulting mapped to cross Region 4b and 4c).

Northern margin of buried, infilled, channels or valleys crossing Region 6a on a northwest-southeast bearing (connecting into wider margin associated with Region 5e) and also crossing Region 6e on a northeast-southwest bearing. This indicates increased

Stratum	Parent Unit	Geological Stratum	Mapped Coverage	Published Thickness (m)
thicknesses of superficial deposits to the south of this through Region 6. Southern margin locally encroaching on southern linear extensions to Site across Regions 6b and 6c.				
Landfill Records				
Landfill records are not indicated on Site as per Groundsure data, however, extents of Active Recent Landfill associated with Holwell Works, Welby Tip, present across from Welby Lane c.8m from the southern linear extension to Region 6b.				
2No. Landfill exemptions, including for deposit of waste from dredging of inland waters and treating waste (preparatory treatment), in south of 6a; point data, therefore presence/extent of any associated areas unknown. Additional other exemptions also present generally adjacent to Site boundary.				

Published Geological Memoir

- 3.2.12 Based on a review of the BGS geological memoir for Map Sheet 142 (Melton Mowbray) (Ref 13.17 and Ref 13.18) which covers the geology present from Region 3e to Region 6e of the Site, forming central to western areas, Table 3.8 provides a summary of recorded information pertaining to the engineering nature and ground hazards associated with mapped ground conditions. It is noted that a geological memoir is not available for the remaining parts of the Site associated with Map Sheet 143 (Bourne).

Table 3.8: Summary of notable information from BGS geological memoir for Map Sheet 142

Stratum/Topic	Summary of BGS Memoir Commentary and Relevance to Site
Worked ground	Noted to represent areas where material is known to have been removed, for example in unfilled ironstone quarries on the Marlstone Rock outcrop (note, this correlates with area of Worked ground mapped encroaching on the north of Region 2e).
Alluvium	Peaty deposits or lenses of running sand in Alluvium indicated in areas of highly compressible ground. Morphology and thicknesses described as: "Underlies widespread flats along main streams with narrow tracts in tributaries: up to 5m" and "Alluvium of the minor tributary valleys is seldom more than 3 m thick". See groundwater and flooding row.
Head Deposits	See slope stability row. Morphology and thicknesses described as: <i>'In hollows, at base of slopes or on river terraces; variable 0-10m.'</i> <i>'extremely widespread occurrence, can be as much as 3m thick.'</i>
Till, Mid Pleistocene (diamicton)	No relevant commentary identified.
Oadby Till Member	Recorded to include boulder-size fragments of flint, Jurassic limestone, ironstone and rounded quartz pebbles. Morphology and thicknesses described as: <i>'Wide featureless spreads; narrow elongate outcrops in palaeochannel fills, (e.g. the Bytham palaeovalley), where up to 40m recorded; up to 10m elsewhere.'</i> (note, the Bytham palaeovalley may be that which encroaches on Region 5 and 6).
Oadby Till Member (Lias-rich)	Indicated to locally be up to 20m to 30m thick.
Rutland Formation	Outside of Map Sheet, relevant commentary not identified.

Stratum/Topic	Summary of BGS Memoir Commentary and Relevance to Site
Upper and Lower Lincolnshire Limestone Members	Outside of Map Sheet, relevant commentary not identified.
Grantham Formation	Outside of Map Sheet, relevant commentary generally not identified. See groundwater and flooding row.
Northampton Sand Formation	Outside of Map Sheet, relevant commentary generally not identified. See groundwater and flooding row.
Whitby Mudstone Formation	Outside of Map Sheet, relevant commentary generally not identified. Indicated to be of intermediate to high plasticity.
Marlstone Rock Formation	Indicated to be relatively resistant to erosion; see slope stability row. See groundwater and flooding row. Where the formation has a high iron content, much of this outcrop is outlined to have been quarried away or worked underground as a source of ironstone; see historical mining row.
Dyrham Formation	Indicated to outcrop on upper slopes capped by the Marlstone Rock Formation, with its natural exposures mainly of small sections in landslip backscarps; see slope stability row. Indicated to be of intermediate to high plasticity.
Charmouth Mudstone Formation	See slope stability row.
Groundwater and flooding	The district is recorded to receive between 600mm and 700mm of rainfall annually, with surface water conveyed through the large floodplains and tributaries of the River Eye (Region 3) and the off Site River Wreake fed by smaller valleys. These smaller valleys are noted to be moderately incised and that associated streams can be prone to flash flooding. Distribution of Alluvium is indicated to allow tracts of floodable ground to be readily recognised. Springs are recorded to issue mainly from the base of the Lias Group and the Marlstone Rock Formation. The Marlstone Rock and Northampton Sand formations are indicated to have been exploited for water where the aquifer is confined, suggesting potential for artesian waters. The Grantham Formation is noted to act as a lower permeability horizon, separating water in the Lincolnshire Limestone Formation above, from that in the Northampton Sand Formation below.

Stratum/Topic	Summary of BGS Memoir Commentary and Relevance to Site
Mineral Resources	Narrow valleys e.g. around Freeby Lane (Region 4b) are indicated to focus runoff, resulting in flash flooding at times of short-lived and localised, but exceptionally heavy, bursts of rain.
	There are noted to be very considerable potential coal reserves in the district, but no current exploitation is recorded. The economics of deep coal mining in the East Midlands are outlined to have undergone a succession of reviews since the 1950s resulting in progressive closure of older mines. The following mineral resources are noted, with no current mining activity generally indicated: • Building stone from Dyrham Formation, Marlstone Rock and Northampton Sand Formation (Quarries). • Sand and gravel from Alluvium. • Limestone from the Lincolnshire Limestone Formation (Quarries, locally underground in wider area). • Ironstone from the Marlstone Rock Formation (mainly opencast, also underground near Holwell). • Coal e.g. pilot colliery at Asfordby. • Brick clay from Till (Quarries and small pits). The economics of underground mining are indicated to be unlikely to be favourable in the near future, with potential resources being those that could be extracted from surface.
Abandoned mine workings	Coal mining around Asfordby (village south of Region 6) is indicated to be associated with overburden thicknesses in excess of 500m. Principal concerns to ground instability are noted to be caused by collapse of worked-out seams and underground roadways (see Report Section 3.4). The Marlstone Rock Formation is largely indicated to have been quarried out mainly through open-cast mining but also worked underground. Ironstone mining of the Marlstone Rock Formation (mapped very locally as upper bedrock on Regions 2, 3 and 4) is recorded to have occurred immediately east of Brown's Hill Quarry, near Holwell (north of Regions 5 and 6 around coordinate 474500 N, 323500 E), from adits driven at shallow angles from the surface quarries. This mining is indicated to have taken place beneath a minimal overburden, leading to unstable ground and subsequent surface subsidence appearing periodically in the form of crown holes from collapsed pillar and stall workings. The iron ore is noted to have been worked since ancient times. The greatest expansion of the workings around Holwell (village located c.1.5km north of the main areas of Region 6a) are recorded to have commenced in 1875, with those in Wartnaby and (assumed 'Ab') Kettleby (villages located c.800m-1.1km north of the main areas of Region 6) areas following in 1878. The Branston, Eaton and Eastwell works (areas >c.6km northeast of the Site) were noted to have then opened between 1882 and 1891. Most surface workings are indicated to have ceased by the 1930's, with Holwell remaining open till 1963 (note, based on BGS Geoindex viewer (Ref 13.15), extents of Infilled Ground and Mines and Quarries data points are recorded associated with the above

Stratum/Topic	Summary of BGS Memoir Commentary and Relevance to Site
Bedrock solution	aforementioned mines/quarries, none of which are recorded to extend onto the Site). Many quarries are noted to have been backfilled and others, particularly the ironstone workings of the Marlstone Rock Formation, partially filled and degraded. The Northampton Sand Formation is indicated to not have been worked for ironstone in the district, due to comparatively low iron contents (note, this appears to be contrary to Region 2 of the Site where surface ironstone working of the Northampton Sand Formation is evident; this region falls outside this map sheet memoir).
Slope stability	Slope stability is noted to be a potential issue, particularly where building development is extended onto steep valley sides. Many of the land slipped areas that are recorded on map sheets (outside of the Site) are indicated to have potentially formed under wetter freeze-thaw periglacial conditions. These areas, alongside Head deposits (and Slope Terrace Deposits, albeit not indicated to be mapped on Site) are indicated to potentially contain relict shear surfaces, with the potential to be reactivated. More modern slope instability is noted to be developed mainly on Jurassic mudstones. Clays of the Lias and Inferior Oolite groups are noted to be of intermediate to very high plasticity, with strength generally increasing with depth as weathering and stress relief effects decline. Such clays are indicated to have the potential for slope instability. The Dyrham Formation is recorded to outcrop on the upper slopes of escarpment capped by the Marlstone Rock Formation and its natural exposures are recorded to be mainly in small sections in landslide backscarps. Natural land slippage along the Marlstone Rock Formation escarpments in the district is noted to be commonly associated with spring lines in the Dyrham and Marlstone Rock formations. For bedrock lithologies without significant clay, such as the Marlstone Rock Formation, the main modes of slope failure are noted to be by rockfall, slab displacement or undercutting of steep faces.
Aggressive Ground Chemistry	Colliery spoil encountered in the Asfordby area (village south of Region 6) is indicated to potentially contain iron pyrites that are prone to oxidise and produce sulphate-rich, acidic leachates, which could pose a risk to buried concrete/utilities (note, areas of Made /Infilled Ground are mapped adjacent to linear extensions of the Site boundary south of Region 6 associated with Asfordby Mine spoil heap (see Report Section 3.4). In general, mudstones recorded on Site are indicated to pose a risk of sulphate attack to buried concrete.
Radon	Natural radon levels are recorded to be generally low in the district, except over the outcrops of the Lias Group and in particular the Marlstone Rock Formation.

Stratum/Topic	Summary of BGS Memoir Commentary and Relevance to Site
Structures & Earthquakes	The Sileby Fault (note, faulting locally encroaching on Region 3 appears to be associated with the wider Sileby Fault) and Normanton Hill Fault (crossing Region 6) are indicated to be the most significant faults in the district. Faults in the district are recorded to be of ancient origin and indicated to be currently inactive. Alike other parts of Britain, the area is however noted to be affected from time to time by earthquakes. The earthquakes, although of generally small magnitude, are indicated to pose a potential problem in the East Midlands, which is recorded to be one of the more seismically active parts of the UK.
Excavations	Excavations into the Lias and Inferior Oolite groups are indicated to be generally carried out by digging, but ripping is noted to be necessary for sequences with strong limestone beds. Water may flow along joints in limestone beds causing flooding to excavations is also recorded.
Contaminated Land	Potential for Artificial Ground to contain toxic residues directly from sources or indirectly through chemical/biological reactions. The memoir notes the presence of landfills, colliery spoil, railway sidings and sewage works present in the district which would act as significant sources of contamination and thus resulting in leachate migration into the surface waters and groundwater. Groundwater aquifers are particularly susceptible where Principal or Secondary A aquifers are noted, and faulting/karst limestone geologies are present. Whether these are present onsite or within 250m of the Site is included and discussed within Report Section 3.3 and Section 9.2.
Groundwater Vulnerability	The risk of surface and near-surface contamination from poor quality mine water, following further rises in groundwater levels after closure of collieries and consequent cessation of pumping is a potential concern in the district. For the Nottinghamshire coalfield it was suggested by Dumbleton and Glover (Ref 13.21), there are non-pumped, isolated ponds, comprising closed collieries such as Cotgrave [SK 651 363], just to the north of this district. In such situations, which may now include the recently closed Asfordby Colliery adjacent to south of Region 6 linear extension to boundary [SK 725 205], rising mine waters may be generated, which could ingress the Permo-Triassic aquifer. Whether this is of concern to the Site has been included and discussed within Report Section 9.2 and Report Section 9.7.
Ground Gas & Mine Gas	Carbon dioxide and methane are gases which may pose a potential hazard, where gases are able to accumulate to harmful levels in enclosed spaces (buildings or excavations). Landfill gas (methane), formed by the biodegradation of organic matter in landfill sites under anaerobic conditions can migrate from the landfill site through permeable substrates, or along faults and joints, both vertically and laterally. Mine gas, mainly methane, can be generated naturally from the concealed Coal Measures strata.

Notes:

Where Region 1a to across the majority of 3e fall outside of Map Sheet 142, commentary should be taken with caution.

Historical Exploratory Hole Records

- 3.2.13 The BGS maintains an archive of historical exploratory hole records throughout the UK. Those which are considered to provide useful information on the ground profile at the Site and associated hyperlinks to the online record are included in Table 3.9. It is noted that these have generally been selected with focus on main Site areas, and locally, in areas of linear extensions to the Site.

Table 3.9: Summary of BGS boreholes on/near to the Site

Region	BGS Hole ID	Approx. Location	Easting (m)	Northing (m)	Year ¹	Approx. Depth (m) ²	Indicated/Assumed Purpose	Mapped Geology ³	Hyperlink to Borehole Log ⁴
1	SK92SE48	On Site – 1a	497180	324930	N.D.	31.69	Ironstone Exploration	Upper Lincolnshire Limestone	Click Here
	SK92SE91	c. 42m west of 1a	496520	324600	1977	854 (reviewed to c. 108m)	Coal Exploration	At Till (Mid Pleistocene) margin, over Upper Lincolnshire Limestone	Click Here
	SK92SE60	c. 38m northwest of 1a	496520	324680	1963	36.57	Ironstone Exploration	Till (Mid Pleistocene), over Upper Lincolnshire Limestone	Click Here
	SK92SE28	c. 135m south of 1a	497410	323610	1943	31.39	Ironstone Exploration	Upper Lincolnshire Limestone	Click Here
	SK92SE97	c. 20m south of 1b	496830	323590	1941	33.83	Assumed Well	Till (Mid Pleistocene), over Rutland Formation	Click Here
	SK92SE88	c. 20m south of 1b	496840	323590	1921	45.11	Assumed Well		Click Here
	SK92SE27	On Site – 1b	496350	323420	1943	36.88	Ironstone Exploration	Till (Mid Pleistocene), over Upper Lincolnshire Limestone	Click Here
	SK92SE33	On Site -1c	496240	323110	1943	32.30	Ironstone Exploration	Upper Lincolnshire Limestone	Click Here
	SK92SE76	On Site -1c	495990	322830	1943	40.84	Ironstone Exploration	Till (Mid Pleistocene), over	Click Here

Region	BGS Hole ID	Approx. Location	Easting (m)	Northing (m)	Year ¹	Approx. Depth (m) ²	Indicated/Assumed Purpose	Mapped Geology ³	Hyperlink to Borehole Log ⁴
								Upper Lincolnshire Limestone	
	SK92SE89	c.84m west of linear extension to 1c	496110	322290	N.D.	47.24	Well	Upper Lincolnshire Limestone	Click Here
	SK92SE77	Adjacent to southern boundary of 1d	495770	322260	1941	39.62	Ironstone Exploration	Till (Mid Pleistocene), over Upper Lincolnshire Limestone	Click Here
	SK92SE12	On Site - 1d	495800	322220	1941	39.62	Assumed Ironstone Exploration		Click Here
	SK92SE67	c. 72m southwest of 1d	495770	322140	1967	39.32	Ore Exploration	Upper Lincolnshire Limestone	Click Here
	SK92SE66	On Site - 1d	495440	322200	1967	36.88	Ore Exploration	Till (Mid Pleistocene), over Upper Lincolnshire Limestone	Click Here
	SK92SW701	c. 30m west of 1d	494800	322050	1967	46.33	Ore Exploration		Click Here
	SK92SW214	c. 52m west of linear extension to 1e	494690	321930	N.D.	30.48	Ironstone Exploration	Till (Mid Pleistocene), over Grantham Formation/Northampton Sand Formation	Click Here
	SK92SW213	c. 104m west of linear	494640	321920	N.D.	45.41	Ironstone Exploration		Click Here

Region	BGS Hole ID	Approx. Location	Easting (m)	Northing (m)	Year ¹	Approx. Depth (m) ²	Indicated/Assumed Purpose	Mapped Geology ³	Hyperlink to Borehole Log ⁴
2		extension to 1e							
	SK92SE20	c. 300m southeast of 1e	495040	321050	1959	51.20	Ironstone Exploration	Till (Mid Pleistocene), over Lower Lincolnshire Limestone	Click Here
	SK92SW216	Adjacent to northeast of 2a/west of 1e	493950	321060	1959	59.43	Mineral Exploration		Click Here
	SK92SW206	On Site - 2b	492560	320850	N.D.	19.50	Mineral Exploration	Till (Mid Pleistocene), over Whitby Mudstone	Click Here
	SK92SW207	c. 38m east of 2b	492710	320360	N.D.	44.50	Ironstone Exploration		Click Here
	SK92SW428	c.180m northwest of 2b	492000	321125	1960	35.35	Mineral Exploration		Click Here
	SK92SW429		491873	321124	1960	29.26	Ironstone Exploration		Click Here
	SK92SW330	Adjacent to east of northern linear extension to 2c	491331	491331	1958	27.12	Mineral Exploration	Till (Mid Pleistocene), over Lower Lincolnshire Limestone	Click Here
	SK92SW301	c.73m east of northern linear extension to 2c	491321	491321	1958	14.93	Mineral Exploration	Lower Lincolnshire Limestone	Click Here

Region	BGS Hole ID	Approx. Location	Easting (m)	Northing (m)	Year ¹	Approx. Depth (m) ²	Indicated/Assumed Purpose	Mapped Geology ³	Hyperlink to Borehole Log ⁴
	SK92SW674	c.92m north of northern linear extension to 2c	491165	491165	1960	8.52	Mineral Exploration	Northampton Sand Formation	Click Here
	SK92SW205	c. 230m south of 2c	490830	320500	N.D.	54.86	Ironstone Exploration		Click Here
	SK92SW501		490651	321252	1961	37.18	Ironstone Exploration	Till (Mid Pleistocene), over Whitby Mudstone	Click Here
	SK92SW201	c. 410m north of 2d	490580	321240	1942	36.88	Ironstone Exploration		Click Here
	SK92SW495		490500	321228	1961	32.61			Click Here
	SK82SE61	c. 735m west of 2e	488860	321390	N.D.	5.18	Ironstone Exploration	Till (Mid Pleistocene), over Northampton Sand Formation	Click Here
	SK82SE78	c. 38m north of 2e	488660	321060	N.D.	10.05			Click Here
	SK92SW496	c. 360m north of 2d	490257	321198	1961	27.12	Ironstone Exploration	Till (Mid Pleistocene), over Grantham Formation/Northampton Sand Formation	Click Here
	SK82SE81	On Site - 2e	489440	321060	N.D.	13.10	Ironstone Exploration	Till (Mid Pleistocene), over Whitby Mudstone	Click Here
	SK82SE80	c. 112m west of 2e	489310	321170	N.D.	8.0	Ironstone Exploration	Till (Mid Pleistocene), over	Click Here

Region	BGS Hole ID	Approx. Location	Easting (m)	Northing (m)	Year ¹	Approx. Depth (m) ²	Indicated/Assumed Purpose	Mapped Geology ³	Hyperlink to Borehole Log ⁴
	SK82SE79	c. 100m northwest of 2e	489210	321010	N.D.	7.92	Ironstone Exploration	Northampton Sand Formation	Click Here
	SK82SE92	Adjacent to north of 2e	489130	320830	N.D.	9.14	Ironstone Exploration		Click Here
	SK82SE90		488850	320800	N.D.	3.0	Ironstone Exploration		Click Here
	SK82SE88	On Site - 2e	488830	320720	N.D.	10.97	Ironstone Exploration		Click Here
	SK82SE89		488870	320720	N.D.	12.04	Ironstone Exploration		Click Here
	SK82SE93	c. 22m east of 2e	488880	321070	N.D.	7.32	Ironstone Exploration	Worked Ground over Northampton Sand Formation	Click Here
	SK82SE62	c. 160m east of 2e	489130	489130	N.D.	5.79	Ironstone Exploration		Click Here
	SK82SE91	Adjacent to north of 2e	488870	320890	N.D.	6.40	Ironstone Exploration		Click Here
	SK82SE77	On Site – 2e	488640	320930	N.D.	8.83	Ironstone Exploration	Till (Mid Pleistocene), over Grantham Formation/Northampton Sand Formation	Click Here
	SK82SE87	On Site – 2e	488550	320700	N.D.	10.66	Ironstone Exploration	Till (Mid Pleistocene), over Northampton Sand Formation	Click Here
	SK82SE86	c. 70m south of 2e	488510	320570	N.D.	16.76	Ironstone Exploration		Click Here

Region	BGS Hole ID	Approx. Location	Easting (m)	Northing (m)	Year ¹	Approx. Depth (m) ²	Indicated/Assumed Purpose	Mapped Geology ³	Hyperlink to Borehole Log ⁴
	SK82SE76	c. 69m north of 2e	488500	320870	N.D.	14.63	Ironstone Exploration	Till (Mid Pleistocene), over Whitby Mudstone	Click Here
	SK82SE74	c. 228m northeast of 2f	488210	321090	N.D.	20.42	Ironstone Exploration		Click Here
	SK82SE85	c. 78m south of 2f	488130	320560	N.D.	24.99	Ironstone Exploration		Click Here
	SK82SE73	On Site - 2f	487940	321050	N.D.	31.85	Ironstone Exploration		Click Here
3	SK82SE343	c. 32m northeast of linear extension to 3b	485760	320980	N.D.	47.85	Ironstone Exploration	Till (Mid Pleistocene), over Charmouth Mudstone	Click Here
	SK82SE45	Adjacent to linear extension of 3b	485720	320970	1987	47.85	Ironstone Exploration		Click Here
	SK82SW3	c. 92m northeast of 3e	482970	322090	N.D.	67.97	Well	Oadby Till Member, over Charmouth Mudstone Formation	Click Here
3/4	SK82SW2	c. 225m northeast of 3g/4a	481030	322760	1943	53.64	Well		Click Here
5	SK72SE9	On Site - 5a	476754	322556	1976	619.0 (reviewed to c.266)	Coal Exploration	Oadby Till Member, over Dyrham Formation	Click Here

Region	BGS Hole ID	Approx. Location	Easting (m)	Northing (m)	Year ¹	Approx. Depth (m) ²	Indicated/Assumed Purpose	Mapped Geology ³	Hyperlink to Borehole Log ⁴
6	SK72SE16	On Site - 5c	475200	322230	N.D.	128.01	Well	Head/Oadby Till Member, over Dyrham Formation	Click Here
	SK72SW46	c. 173m northwest of 5d	474572	322289	1976	893.56 (reviewed to c.268)	Coal Exploration	Oadby Till Member, over Dyrham Formation	Click Here
	SK72SW86	c. 30m west of 6a	473333	321998	1987 /1988	693.83 (reviewed to c.156)	Prove thickness of igneous rock for Asfordby Mine	Oadby Till Member, over Charmouth Mudstone Formation	Click Here
	SK72SW114	On Site - 6b	473090	321750	1999	42.90	Unknown	Alluvium, Oadby Till (Lias Rich), over Charmouth Mudstone Formation	Click Here
	SK72SW103	c. 169m southeast of 6b	472904	321335	1985	677.27 (reviewed to c.151)	Prove Coal Measure sequence and conduct hydrogeological work	Alluvium, Oadby Till (Lias Rich), over Charmouth Mudstone Formation	Click Here
	SK72SW113	Adjacent to southern linear extension to 6b	472850	321210	1999	23.70	Assumed to inform design of watercourse crossing		Click Here
	SK72SW100	c.190m southwest of southern	472862	472862	1989	574.45 (reviewed to c.183m)	To prove the cover to, and structure of the	Landscaped Ground, Oadby Till Member,	Click Here

Region	BGS Hole ID	Approx. Location	Easting (m)	Northing (m)	Year ¹	Approx. Depth (m) ²	Indicated/Assumed Purpose	Mapped Geology ³	Hyperlink to Borehole Log ⁴
		linear extension to 6b					Coal Measures, for Asfordby Mine	Charmouth Mudstone Formation	
	SK72SW93	c. 225m northwest of 6c	472254	322157	1985	685.49 (reviewed to c.180)	Prove Coal Measure sequence	Oadby Till Member, over Charmouth Mudstone Formation	Click Here
	SK72SW112	c. 143m southwest of 6d	471653	321421	1985	754.74 (reviewed to c.180)	Unknown	Made Ground, Oadby Till Member, over Charmouth Mudstone Formation	Click Here
	SK72SW111	On Site - 6e	471244	322002	1995	515.0 (reviewed to c.195)	Prove base of Permo-Trias to Fourth Waterloo Seam	Oadby Till Member, over Charmouth Mudstone Formation	Click Here
	SK72SW110	c. 43m southwest of 6e	470760	321855	1995	505.0 (reviewed to c.177)			Click Here

Notes:

¹ N.D. = No date available/unclear date.

² Some records are of significant depth, typically associated with deep exploration; the review of such records has been limited as outlined in brackets. It is noted that such deeper records included evidence of deep coal and gypsum occurrences.

³ The ground conditions recorded in some records varied relative to mapped ground conditions; such variations are considered in Table 3.10 to Table 3.26.

⁴ Exploratory hole records referenced in the table are publicly available on the BGS GeoIndex viewer (Ref 13.15).

Region 1

- 3.2.14 The encountered strata from BGS historical exploratory hole records within Region 1 are summarised in Table 3.10 to Table 3.14, subject to mapped geology from surface and encountered ground conditions.

Table 3.10: Mid Pleistocene Till over Rutland Formation encountered geology in historical exploratory holes on/near Region 1

Assumed Stratum	Approximate Depth From (m)	Approximate Depth To (m)	Approximate Thickness (m)	Logged Description Summary
Topsoil	0.00	0.30	0.30	Topsoil
Till, Mid Pleistocene into Rutland Formation	0.00 - 0.30	1.85 - 8.25	1.85 - 7.90	Clay (boundary between Superficial and Bedrock unclear in SK92SE97)
Lincolnshire Limestone Formation	4.90 - 8.25	31.10 - 33.85+	25.60+ - 26.20	Rock, locally with marl bed
Grantham Formation	31.10	32.30	1.20	Clay
Northampton Sand Formation	32.30	36.90	4.60	Sandstone
Whitby Mudstone Formation	36.90	45.10+	8.20+	Clay
Groundwater	c.32m bgl, around boundary between the Lincolnshire Limestone Formation and Grantham Formation in SK92SE88 (dated 1921).			

Notes:

Summary of geological descriptions from BGS historical borehole records SK92SE97 and SK92SE88.

Depths/thicknesses converted from feet to metres.

‘+’ denotes where a thickness/base depth have not been proven.

Table 3.11: Lincolnshire Limestone Formation with no superficial cover geology in historical exploratory holes on/near Region 1

Assumed Stratum	Approximate Depth From (m)	Approximate Depth To (m)	Approximate Thickness (m)	Logged Description Summary
Lincolnshire Limestone Formation	0.00	23.80 - 31.40	23.80 - 31.40	Limestone, locally with clay parting and ragstone bed. On occasion, oolitic with shell fragments.
Grantham Formation	23.80 - 31.40	25.30 - 37.00	1.20 - 6.60	Lower estuarine clay
Northampton Sand Formation	25.30 - 37.00	31.10 - 40.00	2.00 - 7.35	Ironstone/Northampton sands ironstone
Whitby Mudstone Formation	31.10 - 40.00	31.40+ - 101.90	0.30+ - 62.90	Upper Lias/blue clay
Marlstone Rock Formation	101.90	108.20	6.30	Clayey limestone bed
Groundwater	c.27m bgl within the Lincolnshire Limestone Formation in SK92SE89 (No date recorded).			

Notes:

Summary of geological descriptions from BGS historical borehole records SK92SE28, SK92SE33, SK92SE89, SK92SE67, SK92SE48 and SK92SE91.

Depths/thicknesses converted from feet to metres.

'+' denotes where a thickness/base depth have not been proven.

Grantham/Northampton Sand Formation boundary unclear in SK92SE89 and not considered in outlined depths.

Table 3.12: Mid Pleistocene Till over Lincolnshire Limestone Formation geology in historical exploratory holes on/near Region 1

Assumed Stratum	Approximate Depth From (m)	Approximate Depth To (m)	Approximate Thickness (m)	Logged Description Summary
Till, Mid Pleistocene	0.00	0.90 - 31.10	0.90 - 31.10	Boulder clay/chalky boulder clay, including local marlstone boulder

Assumed Stratum	Approximate Depth From (m)	Approximate Depth To (m)	Approximate Thickness (m)	Logged Description Summary
Lincolnshire Limestone Formation	0.90 - 31.10	26.52 - 45.10	8.55 - 31.70	(Oolitic) Limestone, locally with clay parting and ragstone bed. 3m thick fossil bed evident locally at c.32m bgl marking division of Upper and Lower Lincolnshire Limestone.
Grantham Formation	26.52 - 45.10	28.96 - 46.90	0.85 - 2.75	Lower estuarine clay/grey sandstone and clay
Northampton Sand Formation	28.96 - 46.90	34.75 - 50.60	3.70 - 6.70	Ironstone/Northampton sands ironstone, including local ‘very soft and broken’ ironstone, ‘sandy’ / ‘limey’ beds.
Whitby Mudstone Formation	34.75 - 50.60	36.58 - 51.20+	0.30 - 1.83+	Upper Lias/blue clay
Groundwater	c.6m bgl within the Till in SK92SW213, with water loss indicated around encountering the Lincolnshire Limestone Formation (No date recorded). c.32m bgl within the Lincolnshire Limestone Formation in SK92SE20 (dated 1959). c.24m bgl near the base of the Lincolnshire Limestone Formation in SK92SE60 (dated 1963).			
Notes: Summary of geological descriptions from BGS historical borehole records SK92SE27, SK92SE76, SK92SE77, SK92SE12, SK92SE66, SK92SW701, SK92SW213, SK92SE20 and SK92SE60. Depths/thicknesses converted from feet to metres. ‘+’ denotes where a thickness/base depth has not been proven.				

Table 3.13: Mid Pleistocene Till over Northampton Sand Formation geology in historical exploratory holes on/near Region 1

Assumed Stratum	Approximate Depth From (m)	Approximate Depth To (m)	Approximate Thickness (m)	Logged Description Summary
Till, Mid Pleistocene	0.00	24.40	24.40	Boulder clay

Assumed Stratum	Approximate Depth From (m)	Approximate Depth To (m)	Approximate Thickness (m)	Logged Description Summary
Northampton Sand Formation	24.40	30.50	6.10	Reddish sand recorded to fall into excavation, resulting in early termination.
Groundwater	Not recorded.			

Notes:

Summary of geological descriptions from BGS historical borehole records SK92SW214.

Depths/thicknesses converted from feet to metres.

'+' denotes where a thickness/base depth has not been proven.

Table 3.14: Mid Pleistocene Till over Whitby Mudstone Formation geology in historical exploratory holes on/near Region 1

Assumed Stratum	Approximate Depth From (m)	Approximate Depth To (m)	Approximate Thickness (m)	Logged Description
Till, Mid Pleistocene	0.00	59.45+	59.45+	Brown and grey boulder clay
Groundwater	Not recorded.			

Notes:

Summary of geological descriptions from BGS historical borehole records SK92SW216.

Depths/thicknesses converted from feet to metres.

'+' denotes where a thickness/base depth has not been proven.

Bedrock of Whitby Mudstone Formation not encountered; depth of Till not proven.

Region 2

- 3.2.15 The encountered strata from BGS historical exploratory hole records within Region 2 are summarised in Table 3.15 to Table 3.18, subject to mapped geology from surface and encountered ground conditions.

Table 3.15: Mid Pleistocene Till over Whitby Mudstone Formation geology in historical exploratory holes on/near Region 2

Assumed Stratum	Approximate Depth From (m)	Approximate Depth To (m)	Approximate Thickness (m)	Logged Description
Soil	0.00	0.30 - 0.60	0.30 - 0.60	Topsoil

Assumed Stratum	Approximate Depth From (m)	Approximate Depth To (m)	Approximate Thickness (m)	Logged Description
Till, Mid Pleistocene	0.00 - 0.60	13.10 - 59.45+	13.10 - 59.45+	Boulder Clay/chalky boulder clay/brown and grey boulder clay/mixed sand and clay/gravel, clay & limestone chippings
Whitby Mudstone Formation	28.65 - 36.60	29.25 - 37.20+	0.60+	Upper Lias Clay
Groundwater	c.32.7m bgl within layers indicated to be more granular around the base of the Till, nearby boundary with the underlying Whitby Mudstone Formation in SK92SW501 (dated 1961).			
Notes:				
Summary of geological descriptions from BGS historical borehole records SK92SW216, SK92SW206, SK92SW207, SK92SW428, SK92SW429, SK92SW205, SK92SW501, SK92SW201, SK82SE81, SK82SE74, SK82SE85 and SK82SE73.				
Log depths have been converted from feet and inches to metres.				
‘+’ denotes where a thickness/base depth has not been proven.				

Table 3.16: Mid Pleistocene Till over Lower Lincolnshire Limestone geology in historical exploratory holes on/near Region 2

Assumed Stratum	Approximate Depth From (m)	Approximate Depth To (m)	Approximate Thickness (m)	Logged Description Summary
Topsoil	0.00	0.30	0.30	Topsoil
Till, Mid Pleistocene	0.00 - 0.30	3.65 - 14.02	3.65 - 13.72	Boulder Clay
Lower Lincolnshire Limestone	3.65 - 14.02	3.95 - 19.81	0.30 - 5.79	Broken Lincolnshire Limestone / ‘soft rubble’ of limestone
Grantham Formation	3.95 - 19.81	5.20 - 22.25	1.25 - 2.44	Estuarine beds
Northampton Sand Formation	5.20 - 22.25	8.85 - 26.52	3.65 - 4.27	Ironstone, including ‘W’, assumed to mean ‘workable’ thickness.

Assumed Stratum	Approximate Depth From (m)	Approximate Depth To (m)	Approximate Thickness (m)	Logged Description Summary
Whitby Mudstone Formation	8.85 - 26.52	NR - 27.13+	NR - 0.61+	Upper Lias / Lias Clay
Groundwater	c.23-24m bgl strikes, resting at c.21m bgl in the Grantham Formation in SK92SW330 (dated 1958).			

Notes:

Summary of geological descriptions from BGS historical borehole records:

- SK82SE77, which indicated presence of the Lincolnshire Limestone Formation in an area mapped as Till (Mid Pleistocene), over Grantham Formation/Northampton Sand Formation; this could be a limestone boulder or remnants of the upper part of the Lincolnshire Limestone Formation.
- SK92SW330, which is located within Till (Mid Pleistocene) over Lincolnshire Limestone Formation adjacent to east of northern linear extension to Region 2c.

Log depths have been converted from feet and inches to metres.

'+' denotes where a thickness/base depth has not been proven.

NR = not recorded.

Table 3.17. Mid Pleistocene Till over Northampton Sand Formation geology in historical exploratory holes on/near Region 2

Assumed Stratum	Approximate Depth From (m)	Approximate Depth To (m)	Approximate Thickness (m)	Logged Description Summary
Soil	0.00	0.00 - 0.90	0.00 - 0.90	Topsoil
Till, Mid Pleistocene	0.00 - 0.90	0.91 - 27.15	0.91 - 26.50	Boulder Clay/overburden/cover/yellow mixed clay/blue chalky clay/grey mixed clay/blue and white limestone. Locally mixed with underlying ironstone. Assumed to be present where described as 'Boring' only during exploration drilling in SK82SE93 and SK82SE62.
Northampton Sand Formation	0.91 - 27.15	5.79 - 31.70	0.60 - 7.30	Ironstone, including 'W', assumed to mean 'workable' thickness/Northampton sands

Assumed Stratum	Approximate Depth From (m)	Approximate Depth To (m)	Approximate Thickness (m)	Logged Description Summary
				beds/locally potentially 'stone' or sand and gravel.
Whitby Mudstone Formation	5.79 - 31.70	10.06 - 32.60+	0.30 - 2.15+	Upper Lias clay
Groundwater	c.26.7m bgl between the Till and Northampton Sand Formation in SK92SW495 (dated 1961).			

Notes:

Summary of geological descriptions from BGS historical borehole records SK92SW495, SK82SE80, SK82SE79, SK82SE92, SK82SE88, SK82SE90, SK82SE91, SK82SE87, SK82SE86, SK82SE61, SK82SE62, SK82SE78 SK82SE93, and SK82SE76.

SK82SE93, SK82SE62 and SK82SE91 are mapped within an area of Worked Ground associated with opencast ironstone mining (See Report Section 3.4). These have been considered here as are assumed to have been undertaken as part of ironstone exploration prior to removal of Till overburden during extraction.

Log depths have been converted from feet and inches to metres.

'+' denotes where a thickness/base depth has not been proven.

Table 3.18. Mid Pleistocene Till over Grantham Formation geology in historical exploratory holes on/near Region 2

Assumed Stratum	Approximate Depth From (m)	Approximate Depth To (m)	Approximate Thickness (m)	Logged Description Summary
Soil	0.00	0.60	0.60	Topsoil
Till, Mid Pleistocene	0.00 - 0.60	9.75 - 21.35	9.75 – 20.75	Boulder clay, including gravel and limestone chippings locally near base.
Grantham Formation	9.75 - 21.35	10.35 – 23.15	0.60 - 1.85	Lower Estuarine Clay/yellow sandy clay
Northampton Sand Formation	10.35 - 23.15	10.95 - 26.20	0.60 - 3.05	Ironstone/Northampton sand beds
Whitby Mudstone Formation	10.95 - 26.20	13.40 - 27.15+	0.9 - 2.45+	Upper Lias Clay

Assumed Stratum	Approximate Depth From (m)	Approximate Depth To (m)	Approximate Thickness (m)	Logged Description Summary
Groundwater	c.19.8m bgl around the lower more granular portion of the Till, near the boundary with the underlying Grantham Formation in SK92SW496 (1961).			
Notes:				
Summary of geological descriptions from BGS historical borehole records SK92SW496 and SK82SE89.				
Log depths have been converted from feet and inches to metres.				
'+' denotes where a thickness/base depth has not been proven.				

Table 3.19. Lower Lincolnshire Limestone Formation geology in historical exploratory holes on/near Section 2

Assumed Stratum	Approximate Depth From (m)	Approximate Depth To (m)	Approximate Thickness (m)	Logged Description Summary
Topsoil	0.00	0.30	0.30	Topsoil
Lincolnshire Limestone Formation	0.30	5.79	5.49	Rubble limestone and brown clay
Grantham Formation	5.79	7.62	1.83	Estuarine clay
Northampton Sand Formation	7.62	14.33	6.71	Brown sand and ironstone
Whitby Mudstone Formation	14.33	14.94+	0.61+	Lias Clay
Groundwater	Not recorded.			

Notes:				
Summary of geological descriptions from BGS historical borehole record SK92SW301 c.73m east of northern linear extension to Region 2c.				
Log depths have been converted from feet and inches to metres.				
‘+’ denotes where a thickness/base depth has not been proven.				

Table 3.20. Northampton Sand Formation geology in historical exploratory holes on/near Region 2

Assumed Stratum	Approximate Depth From (m)	Approximate Depth To (m)	Approximate Thickness (m)	Logged Description Summary
Topsoil / Completely Weathered Bedrock	0.00	1.22	1.22	Soil
Northampton Sand Formation	1.22	7.92	6.71	Ironstone/
Whitby Mudstone Formation	7.92	8.53+	0.61+	Upper Lias Clay
Groundwater	Not recorded.			

Notes:

Summary of geological descriptions from BGS historical borehole record SK92SW674 c.92m north of northern linear extension to Region 2c.

Log depths have been converted from feet and inches to metres.

'+' denotes where a thickness/base depth has not been proven.

Region 3

- 3.2.16 The encountered strata from BGS historical exploratory hole records within Region 3 are summarised in Table 3.21 and Table 3.22, subject to mapped geology from surface and encountered ground conditions.

Table 3.21: Till (Mid Pleistocene), over Whitby Mudstone Formation in historical boreholes on/near Region 3

Assumed Stratum	Approximate Depth From (m)	Approximate Depth To (m)	Approximate Thickness (m)	Logged Description Summary
Soil	0	0.30	0.30	Topsoil
Till, Mid Pleistocene	0.30	44.80	44.50	Boulder clay
Whitby Mudstone Formation	44.80	46.35 - 46.95	1.50 - 2.15	Upper Lias/sandy clay

Assumed Stratum	Approximate Depth From (m)	Approximate Depth To (m)	Approximate Thickness (m)	Logged Description Summary
Marlstone Rock Formation	46.35 - 46.95	47.85+	0.90 - 1.50+	Marlstone rock/sand
Groundwater	Not recorded.			
Notes: Summary of geological descriptions from BGS historical borehole records SK82SE343 and SK82SE45 Log depths have been converted from feet and inches to metres. Logs indicate 'Upper Lias' suggesting Whitby Mudstone Formation, as opposed to Charmouth Mudstone Formation as per published mapping. '+' denotes where a thickness/base depth has not been proven.				

Table 3.22: Oadby Till Member, over Charmouth Mudstone Formation geology in historical boreholes on/near Region 3

Assumed Stratum	Approximate Depth From (m)	Approximate Depth To (m)	Approximate Thickness (m)	Logged Description Summary
Oadby Till Member	0.00	15.20 - 50.90	15.20 - 50.90	Boulder clay, yellow/blue clay and boulders and locally in SK82SW2 brown silty clay and brown sand; brown sand indicated to be water bearing
Charmouth Mudstone Member	15.20 - 50.90	53.65 – 68.00+	2.75 – 52.75+	Blue Lias clay/clay and sand and clay
Groundwater	Groundwater strike at c.26m within the Oadby Till Member in SK82SW2 (No date recorded). Groundwater indicated to rise c.41m ‘from surface’, assumed to mean from surface at depth within hole, suggesting notable confined aquifer and associated artesian waters in SK82SW3, albeit unclear when this was struck (no date recorded).			
Notes				
Summary of geological descriptions from the BGS historical borehole records SK82SW2 and SK82SW3.				
Log depths have been converted from feet and inches to metres.				
‘+’ denotes where a thickness/base depth has not been proven.				

Region 4

- 3.2.17 The encountered strata from BGS historical exploratory hole records within Region 4 are summarised in Table 3.23, subject to mapped geology from surface and encountered ground conditions.

Table 3.23: Oadby Till Member, over Charmouth Mudstone Formation geology in historical boreholes on/near Region 4

Assumed Stratum	Approximate Depth From (m)	Approximate Depth To (m)	Approximate Thickness (m)	Logged Description Summary
Oadby Till Member	0.00	50.90	50.90	Boulder clay, yellow/blue clay and boulders and brown silty clay and brown sand; brown sand indicated to be water bearing
Charmouth Mudstone Member	50.90	53.65+	2.75+	Blue Lias clay
Groundwater	Groundwater strike at c.26m within the Oadby Till Member (No date recorded).			

Notes:

Summary of geological descriptions from the BGS historical borehole SK82SW2

Log depths have been converted from feet and inches to metres.

‘+’ denotes where a thickness/base depth has not been proven.

Region 5

- 3.2.18 The encountered strata from BGS historical exploratory hole records within Region 5 are summarised in Table 3.24, subject to mapped geology from surface and encountered ground conditions.

Table 3.24: Oadby Till Member over Dyrham Formation geology in historical exploratory holes on/near Region 5

Assumed Stratum	Approximate Depth From (m)	Approximate Depth To (m)	Approximate Thickness (m)	Logged Description Summary
Topsoil	0	0.30	0.30	Soil
Oadby Till Member, potentially locally into	0.00 – 0.30	3.30 – 40.00	N/A	Boulder clay, grey-brown and blue-grey silty clay with abundant chalk and flint fragments and Middle Lias

Assumed Stratum	Approximate Depth From (m)	Approximate Depth To (m)	Approximate Thickness (m)	Logged Description Summary
Dyrham Formation				
Dyrham Formation into Charmouth Mudstone Formation (boundary unclear)	3.30 - 40.00	128.00 – 268.50	N/A	Jurassic Middle/Lower Lias, clay with local 'sandrock' bed/grey marly clay/blue clay/beds of clay and stones/ stone bed / thin beds of stone or grit and blue grey finely laminated mudstone becoming pale grey with depth.
Groundwater	Potentially recorded at c.9m bgl in SK72SE16, although record is unclear.			
Notes:				
Summary of geological descriptions from BGS historical borehole records SK72SE9, SK72SE16 and SK72SW46				
Records are unclear and include contradicting information within the same record; thicknesses have not been incorporated due to uncertainty.				
Log depths have been converted from feet and inches to metres.				
Strata is underlain at depth by the Scunthorpe Mudstone Formation (Logged as Hydraulic Limestone).				
‘+’ denotes where a thickness/base depth has not been proven.				

Region 6

- 3.2.19 The encountered strata from BGS historical exploratory hole records within Region 6 are summarised in Table 3.25 and Table 3.26, subject to mapped geology from surface and encountered ground conditions.

Table 3.25: Alluvium, Oadby Till Member (Lias Rich), over Charmouth Mudstone Formation geology in historical exploratory holes on/near Region 6

Assumed Stratum	Approximate Depth From (m)	Approximate Depth To (m)	Approximate Thickness (m)	Logged Description Summary
Topsoil / Made Ground	0.00	0.30 - 0.80	0.30 - 0.80	Soil / Made Ground
Alluvium	0.30 - 0.80	2.90 – 6.30	2.10 – 6.00	SW114 (shallower) - Firm yellow-brown silty clay with sporadic flint 'pebbles' and organic matter into soft sandy clayey silt.

Assumed Stratum	Approximate Depth From (m)	Approximate Depth To (m)	Approximate Thickness (m)	Logged Description Summary
				SW113 (thicker) - Firm to stiff yellow brown to brownish grey (including greenish reduction streaks), becoming calcareous, clay with angular flint pebbles, claystone, limestone and claystone or stoneless. Slickensides indicated between 2.5-2.9m.
Oadby Till Member (Lias Rich) (potentially into Thrussington Till Member in SW114)	2.90 - 6.30	14.65 - 21.50	18.60	SW114 (thicker) - Firm to stiff 'diamict' with silty clay/silt matrix and abundant angular to rounded 'stones from granules to pebbles', including potential occurrence of Thrussington Till Member at base. SW113 (thinner) - Firm to stiff grey silty slickensided calcareous clay, becoming more variable with granular portions indicated to increase with depth and described as 'diamict', including claystone, phosphatic nodules, sandstone, Bunter pebbles, limestone, mudstone and sandstone.
Baginton Sand and Gravel Formation and / or Bytham Sand and Gravel Formation	14.65 - 22.50	20.50 - 40.80	5.85 - 18.30	SW114 (thicker) - Initial c.1m thickness of lacustrine deposit of firm to stiff reddish brown silty clay into initially 'wet and soft' reddish brown very fine grained sand, becoming locally silt dominant and indicated to be recovered as 'wet slurry/slurry' or locally with no recovery. Sand indicated to become coarser with depth, with evidence of coal grains and Bunter pebbles. SW113 (thinner) – Initial c.0.30m thickness of lacustrine deposits of firm reddish brown clayey, occasionally very

Assumed Stratum	Approximate Depth From (m)	Approximate Depth To (m)	Approximate Thickness (m)	Logged Description Summary
				sandy, silt into 'Bytham Sands Terrace Deposits' formed of very fine clayey sands, recovered as soft / wet slurry, becoming gravelly with depth.
Charmouth Mudstone Formation	40.80	42.90	2.10+	SW114 - Lower Jurassic, dark grey clayey hard to stiff mudstone with phosphatic nodulus and shells. SW113 – Lower Jurassic, grey claystone, noted to be soft brecciated and slickensided over initial thicknesses.
Groundwater	Not recorded, although could be residing in the Baginton Sand and Gravel Formation / Bytham Sand and Gravel Formation where initially recorded to be wet and soft and soft / wet slurry during recovery, respectively.			

Notes:

Summary of geological descriptions from BGS historical borehole records SK72SW114 190m southwest of southern linear extension to Region 6b and SK72SW113 adjacent to southern linear extension to Region 6b.

Log depths have been converted from feet and inches to metres.

'+' denotes where a thickness/base depth has not been proven.

Table 3.26: Oadby Till Member over Charmouth Mudstone Formation geology in historical exploratory holes on/near Region 6

Assumed Stratum	Approximate Depth From (m)	Approximate Depth To (m)	Approximate Thickness (m)	Logged Description Summary
Oadby Till Member or Made Ground (SW100 only)	0.00	4.80 - 51.00	4.80 - 51.00	Boulder clay or brown/grey 'mudstone' with chalk fragments (mudstone assumed to be mislogged) Logged as Made Ground or Boulder Clay for initial 5m thickness of SW100.
Charmouth Mudstone Formation, likely into underlying	4.80 - 51.00	46.80 - 195.00+	4.00+ - 165.80	Jurassic, Lower Jurassic, Lower Lias, blue grey/brown/dark grey, locally laminated, mudstone, occasionally calcareous, and

Assumed Stratum	Approximate Depth From (m)	Approximate Depth To (m)	Approximate Thickness (m)	Logged Description Summary
Scunthorpe Mudstone Formation (unclear boundary)				with thin limestone horizons/bands and local limestone beds with records of ironstone fragments, ammonite fragment and quartz pebbles.
Groundwater	Not recorded.			
Notes:				
Summary of geological descriptions from BGS historical borehole records SK72SW86, SK72SW103, SK72SW93, SK72SW112, SK72SW111, SK72SW110 and SK72SW100.				
SK72SW100 located 190m southwest of southern linear extension to Region 6b, in area of mapped Landscaped Ground and drilled to prove the cover to, and structure of the Coal Measures, for Asfordby Mine. Here drilling fluid was noted to have been lost at c.11m bgl, within the Charmouth Mudstone Formation.				
Log depths have been converted from feet and inches to metres.				
Records are unclear in places; thicknesses have not been incorporated due to uncertainty of lower bedrock boundary.				
Charmouth Mudstone Formation is underlain by the Scunthorpe Mudstone Formation, often initially logged as Hydraulic Limestone.				
SK72SW103 mapped in Alluvium, however, such deposits are not indicated to have been encountered.				
'+' denotes where a thickness/base depth has not been proven.				

Soilscape Classification

- 3.2.20 Information obtained from Soilscales (Ref 13.34) classifies and describes the soils in the vicinity of the Site. A summary of the Soilscales description for each Region onsite of the Site is presented in Table 3.27.

Table 3.27: Soilscales soil descriptions

Region	Subregion	Soilscales ID	Soilscales Name	Summarised Soilscales Description
1	1a – 1e	18	Ragdale	Slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils. Drains to stream network. Main risks are associated with overland flow from compacted or poached fields. Organic slurry, dirty water, fertiliser, pathogens

Region	Subregion	Soilsclapes ID	Soilsclapes Name	Summarised Soilsclapes Description
				and fine sediment can all move in suspension or solution with overland flow or drain water.
	1a – 1d	3	Elmton 3	Shallow lime-rich soils over chalk or limestone Drains to chalk or limestone groundwater. Particularly vulnerable to leaching of nitrate and pesticides to groundwater
2	2a – 2f	18	Ragdale	As above.
	2e	724	Fly Rst Ironstone	Restored Soils mostly from quarry and opencast spoil. Restored ironstone workings. Very variable depending on restoration but mainly fine loamy over clayey often reddish soils. Well drained sandy soils locally.
3	3a – 3g	18	Ragdale	As above.
	3e – 3g	9	Hanslope	Lime-rich loamy and clayey soils with impeded drainage. Drains to stream network. Land is drained and nitrate vulnerable. Potential for rapid pollutant transport. Surface capping can trigger sheet erosion of fine sediment to stream network.
	3d - 3e	3	Beccles 1	Slowly permeable seasonally waterlogged fine loamy over clayey soils, associated with similar clayey soils. Clayey subsoils of Beccles and Ragdale series are relatively impermeable, restricting downward water movement and causing lateral flow at shallow depth in winter

Region	Subregion	Soilsclapes ID	Soilsclapes Name	Summarised Soilsclapes Description
4	4a – 4e	18	Ragdale	As above
	4c - 4e	9	Hanslope	As above.
5	5a, 5c – 5e	18	Ragdale	As above.
	5a – 5c	9	Hanslope	As above
6	6a, 6de, 6e	18	Ragdale	As above
	6a – 6e	9	Hanslope	As above.
	6b - 6e	3	Beccles 1	As Above

Agricultural Land Use Classification

3.2.21 Natural England reports the Agricultural Land Use Classification (Ref 13.40) of the land through which the Site extends, based on the published 1:250,000 scale mapping as follows:

- Grade 1 – Excellent quality agricultural land: no regions of the WMEL A – WMEL B Overhead Line fall within a Grade 1 Agricultural Land Classification.
- Grade 2 – Very good quality agricultural land: Extents of Regions 4d, 4e, 5a,5b, 5c, 6b, and 6c are classified a Very Good Quality Agricultural Land. .
- Grade 3 – Moderate quality agricultural land: The entirety of Regions 1a to 4c, 5d, 5e, 6a, 6d, and 6e, and parts of Regions 3d are wholly classified a Moderately Good Quality Agricultural Land, as well as parts of Region 3d, 4d, 4e, 5a, 5b, 5c, 6a, and 6b.
- Eastern extend of Region 3d is classified as Grade 4 – Poor quality agricultural land.

Soil Chemistry

3.2.22 The BGS Soil Chemistry datasets provide indicative information on regional concentrations of five potentially harmful elements (PHEs): arsenic (As), cadmium (Cd), chromium (Cr), nickel (Ni) and lead (Pb) in soil, as presented within the Groundsure data. Elevated concentrations of these PHEs can exist because of natural geological conditions or possible anthropogenic contamination. The following BGS estimated soil chemistry levels are attributed to the vicinity of the Site based on the geometric mean concentrations of available data (presented in Table 3.28).

Table 3.28: Estimated Soil Chemistry (Site Wide)

Potentially Harmful Element	Estimated geometric mean concentration (mg/kg)
Arsenic	15 to 25
Cadmium	<1.8
Chromium	90 to 120
Nickel	30 to 45
Lead	<100

3.2.23 Table 3.29 presents the estimated soil chemistry levels attributed to Site on a region by region basis.

Table 3.29: Estimated Soil chemistry (by Region)

Potentially harmful element	Estimated geometric mean concentration (mg/kg)					
	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6
Arsenic	15 to 25 ¹	15 to 25 ²	15 to 25 ⁶	15 to 25 ⁷	15 to 25	15 to 25
Cadmium	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8
Chromium	60 to 90 ³	90 to 120 ⁴	90 to 120 ⁸	60 to 90	90 to 120	90 to 120
Nickel	30 to 45	30 to 45 ⁹	30 to 45	30 to 45 ⁵	30 to 45	30 to 45
Lead	< 100	< 100	< 100	< 100	< 100	< 100

Notes:

¹ <15 in Region 1a, 1b, 1c.

² 25 - 35 in Region 1e, 2c, 2e, 2f.

³ 90 – 120 in Region 1d, 1e, 4a, 4b, 4c, 5a.

⁴ 60 – 90 in Region 2b, 2c, 2f, 3a, 3d, 3e, 3f, 3g, 5a, 5b, 6a, 6b, 6c, 6d. 6e.

⁵ 15 – 30 in Region 4c, 4d, 6b.

⁶ 35- 45 in Region 2c

⁷ 60 – 120 in Region 2e.

⁸ 120 – 180 in Region 2e

⁹ 45 – 60 in Region 2e

3.3 Natural Ground Hazards

Groundsure Natural Ground Stability Records

- 3.3.1 Table 3.30 shows the variable hazard potentials for natural ground stability hazards across the Site based on Groundsure data, with Table 3.31 presenting a more detailed breakdown on a Region by Region basis. Note, these do not represent AAJV's risk/hazard ratings for these ground stability matters and further detailed identification and assessment of these is presented in Report Section 11 and associated Preliminary Geotechnical Risk Register.

Table 3.30: Groundsure natural ground stability records hazard potential summary (Site wide)

Natural Hazard Type	Hazard Rating
Collapsible Ground	Negligible (local) to very low (generally)
Compressible Ground	Negligible (generally) to moderate (locally associated with Alluvium deposits)
Ground Dissolution	Negligible to High (associated with the Upper Lincolnshire Limestone Member in the east)
Landslides	Very low to low, very locally moderate
Running Sands	Negligible to low
Shrinking or Swelling Clay	Negligible to low

Table 3.31: Groundsure natural ground stability records per Site region

Natural Hazard Type	Hazard Rating Summary					
	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6
Collapsible Ground	Very low	Generally very low, locally negligible associated with Alluvium deposits.	Generally very low, locally negligible associated with Alluvium deposits.	Generally very low, locally negligible associated with Alluvium deposits.	Generally very low, locally negligible associated with Alluvium deposits.	Generally very low, locally negligible associated with Alluvium deposits.
Compressible Ground	Negligible	Generally negligible with local area of Moderate rating associated with Alluvium deposits around the River Witham and associated tributaries (Region 2b).	Generally negligible with local areas of Moderate rating associated with Alluvium deposits around a linear surface water feature assumed to be a tributary of Langham Brook (Region 3a) and River Eye (Region 3d). Note, Moderate ratings also present associated with adjacent offsite Alluvium deposits e.g. around the Freeby Brook (adjacent to Region 3f and 3g).	Generally negligible with local area of Moderate rating associated with Alluvium deposits around Thorpe Brook and adjoining tributary (Region 4e).	Generally negligible with a local area of Moderate rating associated with Alluvium deposits around the Scalford Brook (Region 5b).	Generally negligible with a local area of Moderate rating associated with Alluvium deposits around a linear surface water feature assumed to be associated with the Welby Brook / tributary of the River Wreake (Region 6b). Note, very low to Moderate ratings are present offsite adjacent to the southern linear extension to Site in Region 6d associated with areas of Made

Natural Hazard Type	Hazard Rating Summary					
	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6
						and Infilled Ground.
Ground Dissolution	Variably negligible to low, with local areas of Moderate rating through Regions 1a and more notably 1b and 1c. Areas of High (alongside local Moderate) rating across 1d, in the west of 1b/1c and adjacent to the west of 1a. The low to high rating is generally associated with bedrock geology of the Upper Lincolnshire Limestone Member.	Generally negligible, albeit with very low to low ratings associated with Lower Lincolnshire Limestone (and local faulting in parts) on linear extensions to Site boundary south of Gunby and around Bull Lane (Regions 2a and 2c). In addition, local area of very low rating associated with the Marlstone Rock Formation in Region 2f.	Negligible, with very local area of very low rating across part of the southern linear extension to Site boundary around Buckminster Lodge associated with the Marlstone Rock Formation (Region 3a)	Negligible	Negligible	Negligible
Landslides	Generally very low with local areas of low to Moderate rating adjacent to/encroaching on in Region 1a	Generally very low, locally negligible.	Generally very low with 3No. very local areas of low ratings generally associated with surface water features in Region	Generally very low with 3No. very local areas of low risk associated with land to the east of Waltham Thorns woods	Generally very low with local areas of low rating associated with sloping topographies east of the Scaford	Generally very low with local areas of low rating, including associated with slopes to the east (and locally west)

Natural Hazard Type	Hazard Rating Summary					
	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6
	around Long Wood and Region 1b around Little Osgrove Wood. Note, obvious sharp level changes not clearly evident on LiDAR.		3d and Region 3g.	and sloping topographies east/southeast of the linear surface water feature on Region 4d/e.	Brook on Region 5a/b.	of the linear surface water feature on Region 6b, slopes to the west of Welby Lane on Region 6c/d and very locally around the pond on Region 6e. Note, local area of Moderate c.50m south of Region 6c.
Running Sands	Negligible to very low.	Generally very low with very local areas of low and negligible.	Generally very low, very locally low.	Generally very low, very locally low.	Generally very low, very locally low.	Generally very low, locally negligible and very locally low.
Shrinking or Swelling Clay Ground	Negligible to low.	Generally low, locally very low or negligible.	Generally low, locally very low.	Generally low, locally very low.	Generally low, locally very low.	Generally low, locally very low.

Ground Dissolution and Karst Risk

- 3.3.2 As outlined in Table 3.2, the Site crosses geology of the Great Oolite Group (Rutland Formation) and Inferior Oolite Group (Upper Lincolnshire Limestone Member, Lower Lincolnshire Limestone Member, Grantham Formation and Northampton Sand Formation). The dominant Jurassic age limestones of the Lincolnshire Limestone Formation are present in Region 1 and very locally also encroach on the linear extensions to the Site boundary in the north of Region 2. A cursory review of publications on karst features has been undertaken and findings summarised below.
- 3.3.3 As per Farrant & Cooper, 2008 (Ref 13.28), *‘Jurassic limestones extend across much of central, southern and eastern England in a belt from Dorset to North Yorkshire.’* and *‘although the karst in these rocks is not as well developed as in the more massive Palaeozoic limestone terrain.’*, karst terrains are highlighted to be *‘well developed in the Lincolnshire Limestone south of Grantham.’*; Grantham is located c.13.2km north of Region 1 of the Site. The BGS, 2022 (Ref 13.14) report supports this, outlining that *‘karst is best documented in the Grantham to Stamford area, associated with the East Glen, West Glen and Witham rivers; but there is evidence for karst throughout the area.’* and that *‘karst is particularly developed in the Lincolnshire Limestone Formation.’*, whilst also adding that *‘there is also evidence of karst in the limestones of the Great Oolite Group.’* This elevated karst risk in the Lincolnshire Limestone Formation correlates with the Groundsure hazard ratings presented for Ground Dissolution in Table 3.31.
- 3.3.4 With regards to issues resulting from karst in the Lincolnshire Limestone Formation, Farrant & Cooper, 2008 (Ref 13.28) states that *‘water supply protection is the main issue, although localised subsidence and areas of irregular rock head are to be expected.’* The BGS, 2022 (Ref 13.14) report further outlines the presence of stream sinks, swallow holes and dissolution pipes/dolines (latter at the boundary between the Great Oolite Group and underlying Lincolnshire Limestone Formation) all being recorded within the Lincolnshire Limestone Formation. As per Report Section 3.2 swallet holes are mapped by the BGS on the Site itself in Region 1, and a linear alignment of depressions is present near to the boundary between the Rutland Formation and limestones in the north of Region 1, suggesting further karstic features.
- 3.3.5 Another example of the above comes in the form of a stream sink feature in the Upper Lincolnshire Limestone near Burton-le-Coggles c.2km from the Site (Ref 13.28). This feature appears to be of a similar nature and matching orientation to the valley present through the WMEL A Site adjacent to the east of Region 1 of the Site. This valley feature and connecting valley features that cross the Site in Region 1 (Table 2.2) are therefore considered likely to be associated with stream sinks and karst terrains. Farrant & Cooper, 2008 (Ref 13.28) also highlights that stream sinks tend to be located on overlying Till near the boundary with bedrock, or near the base of the Rutland or Lincolnshire Limestone Formations.
- 3.3.6 The presence of faulting is understood to increase the risk of karst features, with the BGS, 2022 (Ref 13.14) report highlighting swallow holes correlating with faulting in the Lincolnshire Limestone Formation. Faulting is mapped through limestone geology around Honey Pot Lane on Region 1d (Table 3.2) and appears to correlate with swallet holes recorded by the BGS. Faulting is also present in the north of the linear

Site boundary extension on Region 2c associated with the Lower Lincolnshire Limestone Member south of Gunby.

- 3.3.7 Springs are understood to occur throughout the area inclusive of both the Inferior Oolite Group and the Greater Oolite Group. These are indicated to occur between the Inferior Oolite Group and the Lias Group, alongside between the Rutland Formation and Lincolnshire Limestone and the Kellaways/Oxford Clay Formations and the Great Oolite Group (Ref 13.14). Tracer testing has been carried out in the area as outlined by Atkinson & Farrant (Ref 13.2), confirming hydraulic connection between stream sinks/swallow holes and boreholes, including that at Burton-le-Coggles, which was indicated to link to boreholes further afield to the east in Elsthorpe, which in turn indicated links to a swallow hole at Easton Wood c.1.5km northwest of Region 1. This highlights the potential for contamination pathways through karstic terrains, alongside possibility for springs on Site more generally e.g. associated with identified surface water features.
- 3.3.8 Based on a review of available Groundsure and LiDAR data, alongside published BGS and historical mapping (Report Section 4), recorded/potential karst features on or within the immediate vicinity of the Site in Region 1 and to a lesser extent, Region 2 (very local mapped limestone occurrences), are summarised in Table 3.32 and presented on Figure 10, Appendix A, Sheet 1 and 2 (WMEL-AAJ-ZZZZ-XXXXXX-DRW-GE-000032) in Appendix A.
- 3.3.9 It is noted here that the Groundsure data did not return any natural cavity data points or sinkhole events on Site. It is assumed that such searched databases would include point data for karst features presented in the BGS, 2022 (Ref 13.14) report, however, this may not be the case. Furthermore, due to the large scale nature of the maps presented in the BGS, 2022 (Ref 13.14) report, associated karst features have not been digitised. It should be appreciated that karst records are reflective of where studies have been completed and this, paired with their ongoing natural formation of such features makes associated databases/records inherently incomplete.
- 3.3.10 Overall, karst terrains, including recorded, potential and likely unrecorded features, are considered to pose a significant risk to ground stability, including collapse settlement due to sub-surface voids, in Region 1 of the Site and to a lesser extent Region 2 (due to only minor mapped coverage of limestone geologies in the latter).
- 3.3.11 The features/areas of identified risk covered in this Report Section will be inspected/reviewed further during Site reconnaissance where accessible, including specific targeting of recorded/potential features, and investigation as necessary.

Table 3.32: Summary of recorded and potential karst features in Region 1

Sub-region	Commentary
1a	The following features are indicated: • Suspected stream sink associated with linear depression/valley feature in the southeast (including adjoining smaller similar scale features), coordinates: 497458 E, 323819 N, continuing offsite onto WMEL A Substation area. • Suspected stream sink associated with a linear depression/valley feature in the northeast, coordinates: 496734 E, 324579 N. Including

Sub-region Commentary

circular features on published mapping labelled as 'Compact Oolitic Limestone'; unclear nature of feature based on map legend and possibly associated with a karst feature e.g. swallet hole.

- Linear alignment of circular darker patches in field/depressions (evidence of local pond on historical mapping in Appendix B) on LiDAR bearing northeast-southwest, coordinates 496951 E, 324077 N, leading to mapped deep swallet hole (see Region 1b). These are nearby to the margin of overlying Till, and geological boundary between the overlying Rutland Formation and Upper Lincolnshire Limestone, a contact which is recorded to be karstified. Moderate landslide risk areas are also indicated by Groundsure adjacent to/encroaching locally on the Site around the sides of woodlands which sit next to this linear feature in areas. Subsidence due to karst is suspected along this linear alignment, although potential association with mining (e.g. being pits as indicated by Report Section 2.3) cannot be discounted (as per Report Section 3.4), and has potentially resulted in local oversteepening of slopes also.
- Note, a faint approximately circular depression (c.30m in diameter) at 497177 E, 324214 N, possibly associated with subsidence due to karst, is also noted c.110m east of the Site boundary.

1b The following features are indicated:

- Continuation of linear alignment of circular darker patches in field/depressions (potentially associated with karst subsidence) in LiDAR leading up to overgrown oval shaped feature/depression in LiDAR, coordinates: 496608 E, 323747 N which is mapped as a deep swallet hole based on published geological mapping.
- Suspected stream sink associated with faint linear depression at 496924 E, 323767 N stemming from larger scale feature in Region 1a and potentially also connecting into a recorded deep swallet hole and linear alignment of depressions outlined above.
- Suspected stream sink associated with linear depressions connecting into aforementioned larger scale feature in Region 1a, also encroaching on Region 1c (496465 E, 323181 N and 496307 E, 323373 N).
- Swallet hole from published mapping and irregular depressions (c.30-50m in diameter) (potentially also associated with karst subsidence) indicated by slope angle data to connect into aforementioned linear depression on hillside on Site.
- Note, square depression of unknown origin (15m in width), linking east into irregular depressions, also present offsite adjacent to the south and indicated to be associated with unknown historical industrial land use and ponds based on Groundsure data within wooded areas; possibility that depressions/ponds are associated with subsidence due to karst (496840 E, 323585 N and 496712 E, 323525 N).

1c The following features are indicated:

- Local linear surface water features and depression encroaching (indicated to be a pond on historical mapping in Appendix B) locally with
-

Sub-region Commentary

Herricho Wood, possibly associated with karst terrains, 496603 E, 322873 N. Note, linear alignment of depressions also present offsite on east side of woodland c.75m southeast.

- Sloping ground down to down to the northwest and connecting into more prominent offsite linear depression (suspected stream sink) with recorded shake/deep swallet hole encroaching on the Site based on BGS and Groundsure data, shake/deep swallet hole encroaching at 495965 E 322828 N.
- Ponds indicated by historical mapping (Appendix B), including 3No. within the Site and a number in the local area; possibility that depressions/ponds are associated with subsidence due to karst.
- Evidence of prominent aligned circular depressions in wider area (potential dolines) in LiDAR.

1d	The following features are indicated: • Area of faint irregular depressions c.40-50m in length/width (coordinates: 495564 E, 322288 N and 495466 E, 322271 N) in similar area to a shake hole recorded on historical mapping (Appendix B), moving west to prominent steep sided depression associated with recorded shake hole/deep swallet hole (c.15-20m in width) based on Groundsure data/BGS mapping (495399 E, 322241 N); this area appears to include a number of mapped karst features and areas of associated subsidence, correlating with High ground dissolution natural hazard rating from Groundsure. • Irregular depressions around Honey Pot Lane associated with recorded 2No. swallet holes (c.205m in length) based on BGS mapping, associated with karst terrains (495163 E, 322077 N) and correlating with a recorded fault. • Numerous ponds offsite in the local area, possibly associated with karst features and associated subsidence.
1e	The following features are indicated: • Local pond on Site and numerous ponds offsite in the local area, possibly associated with karst features and associated subsidence.
2a/c (on local northern linear extensions	No obvious features indicated within linear extensions to Site recorded to be underlain by limestone; note, some ponds indicated by historical mapping/surface ground workings (Appendix B) in the area of linear extension to Region 2c where faulting is also indicated through the limestones. These could possibly also be associated with karst features and associated subsidence.

Notes:

This Table is to be read in conjunction with Figure 10 (Appendix A) and should not be considered a complete record of all karst features on Site; the presence of further unrecorded features should be anticipated.

Cambering and Slope Instability

- 3.3.12 As per Table 3.3 evidence of ironstone cambering beneath superficial soils is shown on Map Sheet SK82SE (Ref 13.4) (Leicestershire-Lincolnshire) and is labelled on Figures 3, 4 and 10 in Region 2e. This is associated with geology mapped as Till overlying the Northampton Sand Formation, likely resulting from the associated sandstone being of higher strength relative to the underlying Whitby Mudstone Formation. It is noted that slope angles in this area are relatively low (c.>3.5°-5.7°) and clear evidence of depressions or similar in LiDAR that could indicate the presence of voids such as gulls/fissures in the sandstone caused by cambering are not apparent.
- 3.3.13 This said, considering the recording of cambering here (possibly during adjacent opencast ironstone extraction), the presence of such features is deemed probable and subject to their scale and nature (e.g. infilled/open) pose a risk to ground stability. Furthermore, the potential for un-recorded cambered terrains cannot be discounted elsewhere on Site e.g. where the Northampton Sand Formation is present elsewhere e.g. in the valley through Region 1e.
- 3.3.14 As per the topographical and LiDAR data summarised in Table 2.2, there are several sloping terrains on Site, alongside numerous small scale ditches. The more significant of these terrains tend to be around surface water features/rivers. In general, the presence of slope instabilities on sloping terrains cannot be completely discounted, especially where soils forming these slopes are potentially low strength e.g. Alluvium and Head.
- 3.3.15 As an example to the above, the presence of slickensides very locally on historical BGS borehole record SK72SW113, located adjacent to the southern linear extension to Region 6b (472850 E, 321210 N), indicate potential evidence of relict shear surfaces (planes of weakness). This borehole was undertaken in geology present elsewhere on Site on/near the bank of a surface water feature, as such, similar features cannot be discounted elsewhere e.g. associated with other alluvial channels. Relict shear surfaces pose risk to ground stability e.g. through reactivation when loaded or more generally, due to the presence of associated soils at reduce residual strengths.
- 3.3.16 Locally, LiDAR data indicated the presence of some parallel linear/semi-circular features on slopes that could be associated with slope instabilities and the presence of associated relict shear surfaces; these are summarised in Table 3.31 and labelled on Figure 10 (Appendix A).
- 3.3.17 Groundsure data also locally indicates Moderate landslide hazard rating associated with adjacent/encroaching slopes in Region 1, seemingly in areas of suspected subsidence which has possibly resulted in local oversteepening (See Table 3.2).
- 3.3.18 Overall, the presence of cambering terrains and slope failures are considered to pose a risk to ground stability locally, including the potential for fissures/gulls in cambering terrains, relict shear surface/soils at residual strengths generally in areas of slope failure and possibility for future slope failures posing global slope stability risks.
- 3.3.19 Suspected cambering/slope instabilities areas/features and in general, areas of more significant slope topographies, will be inspected/reviewed during Site reconnaissance where accessible and investigated as deemed necessary. This includes ridge

features summarised in Table 2.2, but these are currently largely assumed to be related to natural changes in geology as opposed to slope failures.

Table 3.33: Summary of potential evidence of slope instabilities from LiDAR (excluding cambering)

Region	LiDAR Feature	Grid Reference	Commentary on geology and slope angles
3	Ridge feature with step, and another more local step in topography down to lower lying areas associated with the River Eye (Region 3d).	484330 E, 321366 N	Geology mapped as Alluvium around the river channel, Mid Pleistocene Till generally, into the Charmouth Mudstone Formation. Slope angles vary between 3.5-5.7°, with increases to 15° and very locally >15°, the latter being associated with the step in topography. Potential indication of slope failure along steps in topography, although lower more local step in topography could also be associated with historical river meander.
4	Faint ridge feature followed by faint possible linear breaks in slope in slopes down to linear surface water feature which connects into the wider Thorpe Brook (Region 4d/e).	477807 E, 322491 N	Geology mapped as the Oadby Till Member underlain by the Charmouth Mudstone Formation. Alluvium mapped away from features associated with watercourse channel. Slope angles generally between 5.7-15° Possible indication of slope failures along linear breaks, albeit very faint and may simply be associated with natural changes in geology.
6	Extensive areas slopes sloping westwards (including some faint ridge/valley features) down to a linear surface water feature, with some local semi-circle like features upon western bank and local steps in topography around embankment/bridge crossing of surface water feature. (Region 6a/b)	473104 E, 321745 N 473132 E, 321899 N	Geology mapped as generally as the Oadby Till Member (Lias Rich on western slopes) with Alluvium locally associated with the channel. Underlying bedrock recorded as the Charmouth Mudstone Formation. Note, historical borehole record SK72SW114 (Table 3.25) indicated to have been undertaken on western slope. Slope angles between 5.7-15° sloping westwards, including associated slopes of >15° around the channel. Potential indication of local slope failures along semi-circles level changes/steps.

Region	LiDAR Feature	Grid Reference	Commentary on geology and slope angles
	Extensive area of variable slope angles down to a central valley/linear surface water feature and associated Fish Pond, including local ridge and gully like features and possible breaks in slope.	470763 E, 322075 N	Geology mapped locally as Head deposits and more generally as the Oadby Till Member. The superficial geology is recorded to be underlain by the Charmouth Mudstone Formation. Slope angles generally of 3.5-15°, with local instances of >15° associated with sloping topography down to a central valley/linear surface water feature. Note, steeper slopes appear to be associated with cuttings to/adjacent to the pond. Possible indication of slope failures along linear breaks in slope, albeit very faint and may simply be associated with natural changes in geology.

Notes:

This Table is to be read in conjunction with Figure 10 (Appendix A) and should not be considered a complete record of all slope instabilities on Site; the presence of further unrecorded features should be anticipated.

InSAR Ground Movements

- 3.3.20 A review of freely available InSAR data from the European Ground Motion Services (EGMS), updated annually from 2016 to present (Ref 13.20), indicates that where locally recorded, settlements associated with infrastructure/developments on/adjacent to the Site appear to be generally low (assumed based on gradated rating provided by the EGMS). It is noted however that the majority of the Site has no data, with some local data points/clusters within fields/local development areas ignored at this time due to their potential for being outliers/not associated with consistent features.
- 3.3.21 Clusters of data points are generally concentrated in/adjacent to the east of the Site (Regions 1 and 2) and locally in the west (Region 6) and are associated with infrastructure i.e. the A1 and A606 or developments associated with the Honey Pot Lane Industrial Estate. A summary of this data nearby to main Site areas is presented in Table 3.34.
- 3.3.22 It is noted that data presented in the EGMS is understood to be updated on an annual basis and therefore may be out of date. Furthermore, the data presented is considered here purely as an indication of signs of ground movement and should be used with caution.

Table 3.34: Summary of evidence of mean settlement velocities from InSAR data

Region	Instances of Ground Movement	Displacement (mm/yr)
Region 1	Adjacent to/Region 1b – Honey Pot Lane Industrial Estate	c. -5.9 - 1.4
Region 2	Region 2a - A1	c. -5.2 - 1.8
Region 6	Region 6a - A606/adjacent Potter Hill developments	c. -7.6 - 0.4

Seismic Hazard

- 3.3.23 In 2020 BGS seismologists completed a seismic hazard assessment for the UK, producing seismic hazard plans for the UK. This was undertaken with support from the Institution of Civil Engineers (ICE), other seismologists and engineers based in the UK and with oversight from the British Standard Institution (BSI) sub-committee B/525/8 for Eurocode 8 (EC8): Earthquake resistant design of structures (Ref 13.66).
- 3.3.24 A review of this plan (available on BGS GeoIndex, Ref 13.15) has shown that the Site is in a low seismicity area with a peak ground acceleration (PGA) with 10% probability in 50 years (475 year return period) at <0.02g, and 2% probability in 50 years (2,500 year return period) at up to 0.02g - 0.04g. These ratings sit within the typically low range of values shown in England.
- 3.3.25 A review of the BGS GeoIndex (Ref 13.15) recorded earthquake maps (Modern and Historical) shows 2No. records of seismic activity in the proximity of the Site, these are summarised below.
- 2.4 on the Richter scale (local magnitude), European Macroseismic Scale (EMS) intensity of 4, in 2019, approximately 650m north of Region 5d near Melton Road (at approximately 474895 E, 323000 N, based on BGS Geoindex). This event is mapped to the south of wider roughly east-west bearing fault networks.
 - 1 on the Richter scale (local magnitude), EMS intensity of 0, in 2015, approximately 450m north of the Region 6c near Welby Lane (at approximately 472201 E, 322282 N, based on BGS Geoindex). This event is mapped to correlate with faulting that crosses Welby Lane.
- 3.3.26 The presence of these events appears to generally agree with the geological memoir, which outlines that earthquakes are generally small magnitude. It is noted however that this memoir also suggests that they can pose a potential problem in the East Midlands generally, and that this part of England is one of the more seismically active parts of the UK.
- 3.3.27 It should be noted that seismicity and event data is limited to the studies undertaken and digitally recorded events at the time of writing. The presence of unrecorded and future events cannot be discounted.

3.4 Mining and Mineral Extraction

Planning Policy for Mineral Use

- 3.4.1 The National Planning Policy Framework (NPPF) for England (2021, Ref 13.65) requires minerals planning authorities to promote sustainable use of mineral resources in their Local Plans. This includes defining mineral safeguard zones to ensure that specific mineral resources of local or national importance are not sterilised by non-mineral development (without assuming that the identified minerals will be worked). If it is necessary for non-mineral development to take place then the local planning authority should set out policies to encourage the prior extraction of minerals, where practicable and environmentally feasible.
- 3.4.2 When determining planning applications local planning authorities must ensure that, amongst other matters, there are no unacceptable impacts on the natural and historic environment, human health or aviation safety (taking into account cumulative effects from multiple sites); unavoidable noise, dust and particle emissions, and vibrations are controlled, mitigated or removed at source; and to not normally permit other developments in mineral safeguard zones.
- 3.4.3 The 1:100,000 BGS Mineral Resources map of Lincolnshire - South (2002; Ref 13.13) and Leicestershire and Rutland (2002; Ref 13.12), alongside BGS GeoIndex record the Site to be underlain by the mineral resources summarised in Table 3.33. Of these minerals, the Lincolnshire Minerals and Waste Local Plan (2016; Ref 13.36) designates the Lincolnshire Limestone Formation extent as a Mineral Safeguarding Area (MSA) and outlines the associated Policy M11. Historical mineral planning permissions for ironstone are also recorded locally encroaching on the Site as outlined in Table 3.35 based on Groundsure data. In relation to ironstone mining and other minerals, the local mineral plans outline the following:
- Lincolnshire Minerals and Waste Local Plan (2016; Ref 13.36):
 - Ironstone: areas with planning permissions for ironstone working are indicated to be dormant and are said to be unlikely to begin works in the foreseeable future. This is attributed to the decline of the steel industry in the UK and the reported low grade quality of the ironstone in Lincolnshire. It is further outlined that it is unlikely for ironstone working to take place in the foreseeable future, other than as a source of building stone.
 - Coal: The coal measures are said to never have been worked. Deep coal reserves are however indicated to have the potential for Coal Bed Methane (CBM) extraction in Lincolnshire, although no subsequent proposals or applications for production of CBM are noted to have come forward. No Underground Coal Gasification (UCG) are noted to be in operation.
 - Leicestershire Minerals and Waste Local Plan (2019; Ref 13.35):
 - Ironstone: alike in Lincolnshire i.e. deposits are also indicated as not being seen to have economic significance and planning permissions as dormant.
 - Coal: plan gives weight to surface coal resources; however, these are not indicated to be mapped on Site as per the Mining Remediation Authority

Map Viewer (Ref 13.38). CBM extraction is indicated to be either be 'very poor' or not a potential.

- 3.4.4 A cursory review of satellite imagery does not indicate current large-scale quarrying/mineral extraction activities in the mapped historical mineral planning permission extents.
- 3.4.5 With regards the use of the Lincolnshire Limestone Formation as a mineral resource, the crushed aggregate is indicated to be of low strength and poor frost resistance therefore only suitable for construction fill or as a sub-base roadstone material. In addition, the variable lithology of the Lincolnshire Limestone Formation is indicated to mean it is unlikely to form a high purity for lime production. These factors are said to reduce its extraction desirability for construction usage (Ref 13.31).
- 3.4.6 Considering the presence of safeguarded limestone mineral resources in the east of the Site, consultation with the Mineral Planning Authority (MPA) is required at the pre-application stage (Ref 13.36). While the proposed development may meet exemption criteria, meaning a full Minerals Assessment (MA) may not be necessary, the exemption reason must be clearly stated in the Planning Statement accompanying the application or referenced in the local plan evidence base supporting the Site allocation. The MPA should be consulted for guidance on these considerations.
- 3.4.7 It should be noted that the mineral resource, safeguarding and planning permission data reviewed is limited to the date in which studies/permissions/policies were undertaken/made and therefore, the potential for unrecorded or future changes to these cannot be discounted.

Table 3.35: Summary of mineral resources, safeguarding and mineral planning permissions

Region	BGS Mineral Resources and Extent	Safeguarded Minerals	Mineral Planning Permissions Extents
1	Limestone: Generally across area. Deep Coal (up to 1200m): locally in Regions 1a to 1c	Limestone	Across the north of Region 1a and more locally, Region 1b (Coordinates: 496713 E, 324146 N): Historical planning permission, Easton Mine, underground working for Ironstone, Status: Valid, granted 11/04/58. 1No. present across parts of Region 1c/d (Coordinates: 495786 E, 322503 N) and 2No. more of same nature encroaching locally on linear extension to Site boundary in south of Region 1c (496190 E, 322278 N) and locally also in the east of Region 1d (494886 E, 322085 N): Historical planning permission, Colsterworth, underground working for Ironstone, Status: Application, grant date N/A. Note, additional similar permissions exist outside of/adjacent to boundary in this area.

Region	BGS Mineral Resources and Extent	Safeguarded Minerals	Mineral Planning Permissions Extents	
2	Limestone: Very locally associated with linear extensions to Site in Regions 2a and 2c.	Local Limestone	Present encroaching on the north of Regions 2b/c (Coordinates: 492525 E, 321076 N, 491851 E, 320895 N and 491298 E, 321279 N): Historical planning permission, Buckminster, surface mineral working for Ironstone, Status: Valid, grant date N/A. 2No. locally encroaching on 2b/c in same area as above and linear extension to Site in north of Region 2a (Coordinates: 493258 E, 321270 N): Historical planning permissions, South and North Witham and Castle Bytham, underground ironstone extraction, Status: Valid (Region 2b/c) and Withdrawn (Region 2a), granted: 31/03/59 (Region 2b/c) and 20/05/75 (Region 2a). Locally encroaching on 2a in same area as above: Historical planning permission, South and North Witham and Castle Bytham, surface mineral working for ironstone, Status: Valid, granted: 31/03/59. Present across part of Regions 2e/f, (Coordinates: 488467 E, 320745 N): Historical planning permission, Buckminster, surface mineral working for Ironstone, Status: Valid, grant date 31/7/54. Note, additional similar permissions exist outside of/adjacent to boundary in this area.	
3	Deep Coal (up to 1200m): Regions 3b to 3g			
4	Deep Coal (up to 1200m): Regions 4a to 4e Coal 2m thick (600-1200m): Region 4e	None recorded	None recorded	
5	Deep Coal (up to 1200m): Regions 5a to 5e Coal 2m thick (600-1200m): Region 5a to 5e			

Region	BGS Mineral Resources and Extent	Safeguarded Minerals	Mineral Planning Permissions Extents
6	Deep Coal (up to 1200m): Regions 6a to 6e Coal 2m thick (600-1200m): Region 6a, 6b and locally/adjacent 6c		

Historical Aggregate/Mineral Mining (Excluding Coal) and Surface Ground Workings

- 3.4.8 The strata underlying the Site comprises resources for mineral extraction, such as aggregates from the Lincolnshire Limestone Formation and metalliferous ore within ironstone from the Marlstone Rock, Northampton Sand and Rutland Formations. These resources are indicated by the geological memoir to have generally been mined via surface quarrying, although some underground operations are also indicated. Other resources are also indicated to have been mined through surface quarrying/pitting, including brick clay from different Tills (which may to have included accumulated ironstone boulders from iron rich bedrocks) and general building stone from rock formations.
- 3.4.9 The following is summarised with regards to ironstone mines in the area, based on a cursory view of recorded and background information:
- Easton Mine:
 - Ironstone mining at Easton Mine, which is indicated to be located around c.3km north of Region 1 based on BGS Geoindex Mines and Quarries points (e.g. around 494000 E, 326600 N), is described as wholly underground. The mineral planning area for Easton Mine (Table 3.35) is shown to encroach on Region 1a/b and is assumed to be associated with planned underground extraction of the Northampton Sand Formation beneath the overlying Lincolnshire Limestone Formation in the area. From available information, it is unclear whether the permission has been acted upon, as Lincolnshire County Council (2016) notes most are now dormant, and where working is still taking place, this is limited to the overlying limestone. The permission is thought to correspond with the transfer of Easton Mine to the United Steel Company who began work on the Easton Mine in 1958, until its closure in 1967 (Ref 13.36). Although associated workings are not recorded on Site, the presence of unrecorded workings cannot be discounted considering the mapped geology.

- A review of the Arup 1991 East Midlands review (Ref 13.1) of mining instability in Great Britain notes two large ironstone mines to be present within South Kesteven of which one was the Easton mine and noted within the county to be extensively worked both by underground and opencast methods. The mining area code reference is 73105 and the Easton mine was noted to be active and outputting ironstone between the 1930s and 1964. Working methods were listed as roadways, pillar and stall whilst access was through adits. It is be noted that an extract of the Ironstone Railways & Tramways of the Midlands by (Ref 13.43) was posted on the Industrial Railway society where commentary states '*The ironstone properties of the Ore Mining Branch of the United Steel Companies Ltd. are confined to Rutland and Lincolnshire and can be conveniently grouped together for study. There have been quite a few changes since 1958, the most important, perhaps, being the opening of a completely fresh mining area.*'; this area may correspond to the aforementioned mineral resource area.
- Colsterworth Ironstone Quarry:
 - Mineral planning areas associated with Colsterworth encroach on Region 1c and 1d of the Site (Table 3.35). In the wider area, it appears as though ironstone was quarried around Colsterworth by the early 20th Century, then understood to have expanded in the 1920s. Initial operations are said to have included No. 1 and No. 2 pits, with a further North Pit opening in 1941 and indicated to cease in the 1970's where land appears to generally to have been returned to agricultural land uses (Ref 13.45). The historical permissions extending onto Region 1c/d, on the contrary to these surface workings, is for underground extraction and it is unclear if the permission has been acted on. Although associated workings are not recorded on Site, the presence of unrecorded workings cannot be discounted considering the mapped geology.
- Buckminster Mine:
 - The Buckminster historical mineral planning permissions for surface extraction of ironstone (Table 3.35) encroach on Regions 2b/c locally and 2e/f and locally correlate with an area of Worked Ground encroaching on Region 2e, evidencing surface mining for ironstone and unfilled/partially filled ground (footprint evident in LiDAR) encroaching on the Site. Based on BGS Geoindex, this quarrying at 2e is associated with the ceased Buckminster No.8 Pit and is assumed to be associated with the quarrying of ironstone from the Northampton Sand Formation. It is noted that extensive areas of Worked Ground and associated Buckminster related pits are present north of this area based on BGS Geoindex; this includes c.100m north of the linear Site extension to Region 2c, associated with Buckminster No. 14 Pit. The presence of similar unrecorded quarrying of the formation where present from shallow depth cannot be discounted, although is considered unlikely to be extensive considering bedrock of the Whitby Mudstone Formation is mapped across the majority of Region 2.
- North and South Witham:

- The mineral planning areas for North and South Witham and Castle Bytham (Table 3.35) locally encroach on Regions 2a/b/2c of the Site, including in the same area as those associated with Buckminster, but for underground workings, and then for underground and surface workings in the other areas. The below is noted relative to associated mines. It is unclear if the permissions have been acted on, unlike where surface workings are clearly evident elsewhere in Region 2e. Although associated workings are not recorded on Site, the presence of unrecorded workings cannot be completely discounted e.g. of the Northampton Sand Formation in the north underlying limestones, or possibly, the Marlstone Rock Formation underlying the Whitby Mudstone Formation, although considering the presence of the Northampton Sand Formation at shallower depths in the area, this is considered less likely.
 - North and South Witham: Associated ironstone extraction, c. 0.7km north and c. 1m south from the Site based on BGS Geoindex associated Mines and Quarries points, is understood to have been both through surface and underground workings. In South Witham, limestone quarrying is indicated to have commenced in the 1890's, with ironstone mining occurring between 1957-1964. The mines are recorded to have extended further south and west, therefore, do not appear have been towards the Site from South Witham. Geological and seepage issues are noted to have led closure of operations by 1964 (Ref 13.33).
 - Castle Bytham: Indicated to be associated with Limestone quarrying, c.4.5km from the Site based on BGS Geoindex associated Mines and Quarries points and therefore not considered relevant here due to distance. BGS Geoindex mines and quarries indicates some local pits named Gunby Dale Stone Pits c. 600m from the north of Region 2b in areas of limestone bedrock, indicating possible surface mining of this. Although associated workings are not recorded on Site, the unrecorded presence of workings in areas of limestone cannot be completely discounted; as part of this, it is assumed that limestone could have been mined above the ironstones of the Northampton Sands Formation.
- Holwell/Brown's Hill Quarry and Holwell Mines:
 - Ironstone mining of the Marlstone Rock Formation (recorded as upper bedrock geology very locally in Region 2, 3 and 4) is recorded in the geological memoir to have occurred immediately east of Brown's Hill Quarry, near Holwell (c. 1-1.4km north of Regions 5 and 6 around coordinate 474500 N, 323500 E) from adits driven at shallow angles from the surface quarries. This mining is indicated to have taken place beneath a minimal overburden, leading to unstable ground and subsequent surface subsidence appearing periodically in the form of crown holes from collapsed pillar and stall workings. Based on BGS Geoindex viewer, extents of Infilled Ground and Mines and Quarries data points are recorded associated with the above aforementioned mines/quarries, none of which are recorded to extend onto the Site. Such are considered less likely to have extended onto Regions 5 and 6 as bedrock geology of the Dyrham

Formation (indicated by mapping to be the siltstone/mudstone dominated occurrence) and Charmouth Mudstone Formation dominate these regions and sit beneath ironstone bearing stratum stratigraphically. It is noted however that unrecorded mining of the Marlstone Rock Formation elsewhere on Site where present in the underlying succession cannot be discounted (e.g. Regions 2, 3 and 4).

- Holwell Mines: According to the geological memoir, the greatest expansion of the workings around Holwell (village located c.1km north of Region 6a) are recorded to have commenced in 1875, with those in Wartnaby and (assumed 'Ab') Kettleby (villages located c. 600m-800m north of Region 6) areas following in 1878. The Branston, Eaton and Eastwell works (areas >c.6km northeast of the Site) were noted to have then opened between 1882 and 1891. Most surface workings are indicated to have ceased by the 1930's, with Holwell remaining open till 1963. As above, based on BGS Geoindex viewer, extents of Infilled Ground and Mines and Quarries data points are recorded associated with this mine/quarry, none of which are recorded to extend onto the Site and such is considered less likely due to the mapped geology.

- 3.4.10 Based on a review of Groundsure data (including BritPits database and surface ground workings), LiDAR, satellite imagery and historical mapping (Appendix B), Table 3.36 and Figure 10 (Appendix A) presents a summary of recorded and suspected/possible mining features on and in the immediate vicinity of the Site. Due to the nature of mining records, alongside potential for ancient mining of ironstone, the presence of further unrecorded mining features on/adjacent to the Site cannot be discounted, especially where similar mining/planning permissions are recorded in the same area/geology.
- 3.4.11 Overall, the presence of recorded and potential for unrecorded mining features, alongside infilled ground more generally associated with surface ground workings (even if not mining related), poses a risk to ground stability e.g. compression of fill or in the case of underground features, potential for more significant ground collapses. The presence of underground mining of non-coal minerals such as limestone and ironstone extensively on Site is however considered relatively unlikely, although in areas e.g. Region 1, and possibly Region 2, or elsewhere where circular/unknown features (or possibly even historical wells/pumps mis-mapped and actually associated with shafts – see Appendix B) from historical mapping are on linear alignments have been identified, such mining/features cannot be discounted, even if for example such are purely associated with exploration shafts as opposed to full extraction (as indicated by some of the historical borehole records in Report Section 3.2). Historical mining matters are discussed further in Report Section 10.3.
- 3.4.12 Suspected/possible mining features and adjacent areas will be inspected/reviewed during Site reconnaissance where accessible and investigations, as deemed necessary, and consideration given to a Mining Risk Assessment. It is also noted that mine plan extents are indicated across the Site based on BGS Geoindex and could be obtained for further risk profiling with regards to mining.

Table 3.36: Recorded and suspected mineral extraction features on and within the immediate vicinity of the Site

Region	Coords.	Sub-region	Name/Descriptor	Operator	Dates	Assumed Status/ Potential Mineral Mined	Commentary on risk
1	On Site - See Table 3.30 and Figure 10 (features in area currently assumed to be more likely karst related generally)		Some ponds/depressions could potentially be mining related as opposed to being associated with karst terrains/subsidence.	N/A	N/A		No historical mining recorded within Region.
							Geology within Region that could have been mined historically.
			This includes the linear alignment of depressions/sloping ground bearing northeast-southwest through Region 1a/1b up to a recorded deep swallet (See Table 3.30), which could also be associated with surface extraction/bell pitting (as also indicated Report Section 2.3), including associated with fireclay and ironstone indicated in this area on 1:10k published mapping.			Ceased, potentially for: Ironstone (surface/underground) Limestone (surface/underground) Clay (surface)	Historical underground mineral planning permissions extending onto the Region as per Table 3.33.
			Evidence of local disused pits in wider local area on historical mapping.				Potential for ponds/depressions to be associated with localised surface mineral extraction, or possibly, underground mining.
							If excavations have been backfilled, there is a risk of compressible fill and sharp changes of ground conditions at pit high walls.

Region	Coords.	Sub-region	Name/Descriptor	Operator	Dates	Assumed Status/ Potential Mineral Mined	Commentary on risk
							If mining is underground, there is a risk of void migration to surface/shaft collapse and subsequent subsidence.
2	493387 E, 320836 N	On Site - Region 2a	Unspecified Pit (Groundsure surface ground workings and historical mapping) Shown as depression in LiDAR, overgrown by trees in satellite imagery.	Unknown	Assumed pre 1887 (earliest available historical mapping)	Ceased, potentially for: Clay.	Generally, no historical mining recorded within Region, except for encroaching extent of Buckminster No. 8 Pit and another smaller scale unspecified pit.
	492435 E, 320789 N	On Site – Region 2b	Irregular depression (c.15m in diameter) indicated by Groundsure data to be a pond and shown to be a circular vegetation feature on satellite imagery. Similar pond features present offsite on linear alignment with the above, adjacent to a track/road associated with linear	Unknown	Assumed pre 1887 (earliest available historical mapping)	Ceased, potentially for: Clay e.g. as borrow pits along track. Possibly ironstone, although considered unlikely based on mapped geology);	Likely presence of quarry highwall associated with these and potential for partial infill. If excavations have been backfilled, there is a risk of compressible fill and obstructed extent of quarry high walls. Other geological formations within Region

Region	Coords.	Sub-region	Name/Descriptor	Operator	Dates	Assumed Status/ Potential Mineral Mined	Commentary on risk
			extension to Site, including on Site historical pump. Stone block structure also present on same alignment on Site, albeit assumed to be a pill box.			could be exploration at depth.	that could have been mined historically and workable thicknesses of ironstone indicated in area based on historical borehole logs (Report Section 3.2).
	491813 E, 320894 N	On Site - Region 2c	Local irregular depression (c.20m in length) of unknown origin adjacent to historical surface ironstone planning permission and shown as circular shaped area of dark/vegetated ground on satellite imagery.	Unknown	N/A	Ceased, potentially for: Clay. Possibly ironstone, although considered unlikely based on mapped geology).	Historical surface and locally, underground mineral planning permissions extending onto the Section as per Table 3.33.
	488684 E, 320777 N	Encroaching on the north of Region 2e	Worked ground correlating with Buckminster No. 8 Pit and historical surface ironstone planning permission, evident by LiDAR depression, shown as fields on present day satellite imagery. Railway sidings (Groundsure data) historical extent indicated associated with worked area, locally encroaching on north linear extension	Assumed Buckminster	Unknown, potentially pre 1884 (earliest available historical mapping)	Ceased, assumed for: Ironstone	Potential for ponds/depressions to be associated with localised surface mineral extraction, or possibly, underground mining, albeit extensive underground mining is considered less likely considering mapped geology.

Region	Coords.	Sub-region	Name/Descriptor	Operator	Dates	Assumed Status/ Potential Mineral Mined	Commentary on risk
			of Site, assumed to be associated with the works. Not clearly evidenced on historical mapping, except for local ponds, rail tracks, and off Site adjacent wells and pumps present. Issues also mapped off Site adjacent to east of workings, with Recent Industrial Land Use data point for Unspecified Mines and Quarries, suggesting association with extraction.				Possibility for historical mining of ironstone inclusions within Till. If excavations have been backfilled, there is a risk of compressible fill and sharp changes of ground conditions at pit high walls. If mining is underground, there is a risk of void migration to surface/shaft collapse and subsequent subsidence.
	488410 E, 320770 N	On Site - Region 2e	Local irregular depression (c.17m in length) on field boundary within historical surface ironstone planning permission, not clearly observable on field boundary in satellite imagery. Shown as a pond on historical mapping. Similar features present along/adjacent to boundaries in wider area on linear alignment.	Assumed Buckmin ster	Unknown, potentially pre 1884 (earliest available historical mapping)	Ceased, assumed for: Ironstone	

Region	Coords.	Sub-region	Name/Descriptor	Operator	Dates	Assumed Status/ Potential Mineral Mined	Commentary on risk
	See Figure 10		Other ponds (from Groundsure surface ground workings or digitised from historical maps) and depressions on the Region, potentially related to mining.	N/A	N/A	Ceased, assumed for: Clay (surface) Possibly locally limestone or ironstone, although generally considered unlikely based on mapped geology	
3 up to 4d	485822 E, 320686 N	On Site - Region 3b	Irregular depression (c.18m in length), indicated by Groundsure and historical mapping to be associated with a pond. Seemingly planted with trees on a field boundary based on satellite imagery. Appears to be on a northwest linear alignment with other depressions and ponds.	Unknown	Unknown, potentially pre 1884 (earliest available historical mapping)	Ceased, potentially for: Clay. Unknown rock/harder occurrence forming ridge features in the geology. Possibly ironstone, although considered unlikely based on mapped geology.	No historical mining recorded within Region. Geology within Region that could have been mined historically. Potential for ponds/depressions/other historical features/structures to be associated with localised surface mineral extraction, or possibly, underground mining,

Region	Coords.	Sub-region	Name/Descriptor	Operator	Dates	Assumed Status/ Potential Mineral Mined	Commentary on risk
	483673 E, 321716 N	On Site – Region 3d	Mound of unknown origin locally within strip of planted ground on satellite imagery.	Unknown	Unknown	Ceased, potentially for: Clay. Possibly ironstone, although considered unlikely based on mapped geology.	albeit extensive underground mining is considered unlikely considering mapped geology.
	484151 E, 321916 N and 484209 E, 321802 N.		No evidence on historical mapping; small scale pit/pond present offsite to the southwest.				Possibility for historical mining of ironstone inclusions/materials forming ridges within Till.
			In fields on Site to northeast, 2No. irregular depressions (c.15-20m in diameter) indicated by historical mapping to be ponds. Overgrown on satellite imagery.				If excavations have been backfilled, there is a risk of compressible fill and sharp changes of ground conditions at pit high walls.
	483094 E, 321977 N	On Site – Region 3e	Linear extent of slightly uneven/irregular ground along field boundary, connecting into adjacent depression (c.20m in diameter) Shown as ponds on historical mapping and overgrown vegetated features on satellite imagery. Depression correlates with a very slight ridge-like feature and also sits on a	Unknown	Unknown, potentially pre 1884 (earliest available historical mapping)	Ceased, potentially for: Clay. Unknown rock/harder occurrence forming ridge features in the geology. Possibly ironstone, although considered	If mining is underground, there is a risk of void migration to surface/shaft collapse and subsequent subsidence.

Region	Coords.	Sub-region	Name/Descriptor	Operator	Dates	Assumed Status/ Potential Mineral Mined	Commentary on risk
			linear northeast-southwest alignment with similar offsite depressions. Other similar features also present adjacent to Site boundary e.g. south of Region 3f.			unlikely based on mapped geology.	
	480785 E, 322408 N	On Site – Region 3g	Irregular depression indicated by Groundsure/historical maps to be associated with a pond. Within strip of vegetated/wooded ground based on satellite imagery. Other similar features on adjacent boundaries.	Unknown	Unknown, potentially pre 1884 (earliest available historical mapping)	Ceased, potentially for: Clay. Possibly ironstone, although considered unlikely based on mapped geology.	
	480524 E, 322799 N	On Site – Region 4a	Notable circular depression (c.26m in diameter) indicated by Groundsure/historical maps to be associated with a pond. Overgrown on satellite imagery	Unknown	Unknown, potentially pre 1884 (earliest available historical mapping)	Ceased, potentially for: Clay. Possibly ironstone, although considered unlikely based on mapped geology.	
	480222 E, 322799 N	On Site – Region 4b	4No. slight circular depressions (c.10-15 in diameter), with	Unknown	Unknown	Ceased, potentially for: Clay.	

Region	Coords.	Sub-region	Name/Descriptor	Operator	Dates	Assumed Status/ Potential Mineral Mined	Commentary on risk
	480193 E, 322710 N 480110 E, 322733 N 480232 E, 322706 N		similar/elongated depressions also present offsite adjacent to the south. No evidence of on Site depressions on historical mapping. Fields, and on 1No. occasion woodland, on satellite imagery.			Possibly ironstone, although considered unlikely based on mapped geology.	
	477894 E, 322430 N	On Site – 4c/d	Example of slight depressions (c.8m in diameter) on field boundaries/within fields indicated by Groundsure data/historical mapping to be ponds. Bare ground in field on satellite imagery.	Unknown	Unknown	Ceased, potentially for: Clay. Possibly ironstone, although considered unlikely based on mapped geology.	
	See Figure 10		Potential for other ponds (from Groundsure surface ground workings or digitised from historical maps) historical features/structures (digitised from historical mapping) and depressions on the Region, potentially related to mining.	N/A	N/A	Ceased, potentially for: Clay. Possibly ironstone, although considered unlikely based on mapped geology.	

Region	Coords.	Sub-region	Name/Descriptor	Operator	Dates	Assumed Status/ Potential Mineral Mined	Commentary on risk
4d to end of Region 6 (within Coal Mining Reporting Area)	See Table 3.36 and Figure 10 (some features in area currently generally assumed to be more likely related to deep coal mining, if mining related)		Potential for other ponds (from Groundsure surface ground workings or digitised from historical maps) historical features/structures (digitised from historical mapping) and depressions on the Region, potentially related to non-coal mining. This includes are of Landscaped Ground and surface ground workings indicated c. 120m southwest of linear extension of Region 6b.	N/A	N/A	Ceased for: Clay (surface) Possibly ironstone (underground), although considered unlikely based on mapped geology)	No historical mining recorded within Region. Geology within Region that could have been mined historically. Underground mining of ironstone in wider area; not anticipated to extent on Site based on mapped geology. Possibility for historical mining of ironstone inclusions/materials forming ridges within Till.
4	477894 E, 322430 N	4d	Slight linear ridge and associated slight depression indicated to be a pond on historical mapping (c.15m in diameter). Field in satellite imagery.	Unknown	Unknown, potentially pre 1884 (earliest available historical mapping)	Ceased for: Clay (surface) Unknown rock/harder occurrence forming ridge/linear features in the geology.	Potential for ponds/depressions/other historical features to be associated with localised surface mineral extraction e.g. of clay.
6	473208 E, 321746 N	6a/b	Slight linear depressions, planted present day with trees, either side of field boundary. No clear evidence on historical mapping.	Unknown			If excavations have been backfilled, there is a risk of compressible fill and sharp changes of ground

Region	Coords.	Sub-region	Name/Descriptor	Operator	Dates	Assumed Status/ Potential Mineral Mined	Commentary on risk
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conditions at pit high walls.

If mining is underground, there is a risk of void migration to surface/shaft collapse and subsequent subsidence.

Notes:

This Table is to be read in conjunction with Figure 10 (Appendix A) and should not be considered a complete record of all mining features on Site; the presence of further unrecorded features should be anticipated.

Historical Coal Mining and Mine Gas

3.4.13 The Mining Remediation Authority Map Viewer (Ref 13.38) identifies the Site to be within the NOTTS Coal Mining Reporting Area from the west of Region 4d to the end of Region 6. No other coal mining related data sets are recorded within the Site by the Mining Remediation Authority, except for Abandoned Mines Catalogue numbers 16889, 16890 and 16909.

3.4.14 The following is highlighted relative to the mine plans associated with the above Abandoned Mines Catalogues:

16889 and 16890 Catalogues

- These are associated with the mining of the Deep Main Seam and Parkgate Seam at Asfordby Mine, the associated plans can be split accordingly:
 - Deep Main Seam only: 436822, 43 7022 and 43 6821.
 - Deep Main Seam and Parkgate Seam: 43 7222, 43 7220, 43 7021, 43 7221 and 43 7020
- The plans show locations of deep coal mining passages e.g. c. 350m-440m below ordnance datum in the area (where preliminarily reviewed), that pass through the WMEL A Substation site in the west, bearing approximately southeast through Region 6, alongside from south/southwest of Region 6 around Saxelbye and Asfordby, north across Region 6. The workings are generally indicated to pass through Regions 6b to 6e when approximately reviewed against the Site boundary.
- 2No. Mine shafts are recorded associated with the above plans, mapping the mines Downcast Shaft (472548 E, 320686 N - north relative to other shaft) and Upcast Shaft (472512 E, 320593 N - south relative to other shaft); these appear to match the records south of the Site summarised in Report Section 3.4.15.
- The shafts were recorded to have internal diameter at surface of c.7.3m, and pass through the Deep Main Seam Level between c.316m and c.337m depth, followed by the Parkgate Seam (c.337m-359m), Inset Level (c.350m-390m i.e. mine tunnel) and Blackshale Seam Level (c.365m-389m), with the base of the shafts at c.397m-425m. Depths are in metres and are relative to depth below ordnance datum.
- The Deep Main Seam is indicated to be approximately 2.32m-2.94m thick, with the Parkgate Seam approximately 22m-27m below this, and Blackshale Seam c.31m below the latter.
- Evidence of waterlogged areas of mine are indicated on some plans.
- Dates of construction of workings were indicated to range from March 1988 to June 1995, with mine abandonment suggested by 18th August 1997.

16909 Catalogue

- Plans are predominantly records associated with Asfordby Mine's spoil heap, correlating with offsite areas of mapped Infilled and Made Ground mapped adjacent to the southeast of the linear extension to Region 6d/c.

- 3.4.15 The 2No. Mine Entries recorded on the Mining Remediation Authority Map Viewer (Ref 13.38) appear to be associated with the Upcast and Downcast Shafts outlined in the above plans, and are presented alongside their localised Zones of Influence and Development High Risk Areas. These are located approximately c.475m southwest of a linear extension to the Site boundary from Region 6b/c and are within the grounds of the present day Asfordby Business Park, just west of the Holwell Works (iron works), north of the village of Asfordby. It is assumed that these shafts were mapped from available mine plans/records and remediated as part of development of the business park.
- 3.4.16 As per the geological memoir, coal mining around Asfordby is indicated to be associated with overburdens in excess of 500m. This generally correlates with the depths indicated on coal exploration borehole records presented in Table 3.9, the coal resource in the area being indicated to be deep as per Table 3.35 and deep extraction depths recorded on the mine plans outlined in Report Section 3.4.14.
- 3.4.17 The memoir does however outline that the principal concerns to ground instability are caused by collapse of worked-out seams and underground roadways in relation to coal mining in the area e.g. Asfordby.
- 3.4.18 A review of historical mapping, LiDAR and satellite imagery has been undertaken for the regions indicated to within the overall Coal Mining Reporting Area and selected possible coal mining features indicated on or of note within the vicinity of the Site are summarised in Table 3.37. Note, this does not include the deep coal mining passages indicated to underlie Regions 6b to 6e or the aforementioned shafts south of Region 6c/d.
- 3.4.19 Overall, although no mine shafts or shallow underground workings are directly recorded on Site by the Mining Remediation Authority, and workings in the area are indicated to be deep, the possible presence of the unrecorded features and the outlined possible features representing unrecorded shafts into deeper workings, or for exploration (as indicated by historical borehole records in Report Section 3.2), cannot be completely discounted. It is however generally deemed unlikely that such would be associated with Asfordby Mine's operations, considering the relatively recent age of this mine and associated record keeping (summarised in Report Section 3.4.14).
- 3.4.20 If present, such features, alongside worked out minerals (which could have instead been non-coal related as per Report Section 3.3) and underground roadways, could pose a risk to ground stability, subject to thicknesses worked/nature of overburden and nature and condition/treatment of shafts. This is discussed further in Report Section 10.3.
- 3.4.21 Suspected/possible mining features and adjacent areas will be inspected/reviewed during Site reconnaissance where accessible, and consideration given to a Mining Risk Assessment, to further profile risk, followed by investigations as deemed necessary.

Table 3.37: Further possible historical coal mining features on or within the vicinity of the Site

Coordinates	Location	Description
477238 E, 322311 N	Region 4e	Local mound feature in LiDAR (c.8m-10m diameter) shown in middle of field based on satellite imagery. Indicated in area of rectangular structure on historical mapping; could be buried remnants of structure, or alternatively, possibly an unrecorded shaft with piled up surrounding material.
476514 E, 322604 N	Region 5a	Circular depression in LiDAR, indicated to be a pond by historical mapping (c.13m in diameter), within a field and seemingly overgrown on satellite imagery. Potential local surface pit e.g. for clay, although possible that circular could be associated with subsidence to a shaft. Similar features on linear alignment in wider area offsite.
474652 E, 321825 N	c.100m from Region 5d	Unspecified heap from Groundsure Surface Ground Workings data; not evident in LiDAR data. Mapped on historical mapping from 1887, then from 1966 mapped as a pond with two adjacent heaps up to most recent mapping from 1994. Slight circular depression just west of digitised extent shown by Groundsure. Heaped material can be associated with spoil piled around a mine shaft and depressions/ponds can be as a result of subsidence to a shaft, indicating potential unrecorded mine shaft in the local area to the Site.
473517 E, 321629 N	Region 6a	Mound/heap on LiDAR in the corner of a field, with evidence of vegetation/potentially exposed piled soils/materials. No evidence on historical mapping. Heaped material can be associated with spoil piled around a mine shaft, although in this instance could simply be associated with modern day agricultural land uses.
472628 E, 321813 N	Region 6c	Depression in LiDAR (c.13m in length), indicated to be a rectangular parcel with surrounding vegetation/trees on field boundary. No evidence on historical mapping. Currently considered more likely to be associated with developments offsite to north, as opposed to mining, however, association with mining cannot be discounted.

Coordinates	Location	Description
472310 E, 321705 N	Region 6c/d	Irregular depression in LiDAR (c. 15m in length) indicated by Groundsure data to be a pond atop of the hillside and apparent as such from earliest historical mapping from 1883 along a path/road. Satellite imagery shows this to be overgrown/planted with tree(s). More obvious circular overgrown features are present in adjacent fields, possible on a linear alignment with this feature and also between themselves, on a linear alignment across the Site. Depressions/ponds can be as a result of subsidence to a shaft, and linear alignment/presence of more pronounced features either side of the Site could indicate underground mining passing through the Site itself.
See Figure 10		Other surface ground workings/ponds/circular depressions/historical features/structures (including wells/pumps) shown could also be associated with unrecorded coal mining; these are noticeably present north and to some extent, south, of Regions 6b/c – i.e. in the same area where Asfordby Mine was operational. These include small scale features and square features of unknown origin digitised from historical mapping e.g. in Region 6d/e, which could for example be associated with unrecorded mine shafts and associated covers to workings at depth.

- 3.4.22 For Region 1a to 4d, as the Site is not within the Mining Reporting Area the risk from mine gas is considered to be negligible without further assessment needed.
- 3.4.23 In October 2021, Contaminated Land Applications in Real Environments (CL:AIRE) published updated guidance on mine gas risk assessment: 'Good Practice for Risk Assessment for Coal Mine Gas Emissions' (Ref 13.67). The site has been characterised for preliminary mine gas risk in accordance with CL:AIRE guidance as part of the site (Region 4d to 6e) is within a Mining Remediation Authority Mining Reporting Area (representing Step 1 in the preliminary mine gas risk flow chart in CL:AIRE Figure 13.1). The following information has been reviewed for the Site to determine the mine gas risk level for the west of Region 4d to 6e.

Table 3.38. Preliminary Mine Gas Risks (Region 4d to 6e)

Step No.	Question	Answer	Discussion
2	Are mine entries >50m from the site boundary?	Yes	No mine entries are recorded within 50 m of the site with the closest recorded

Step No.	Question	Answer	Discussion
3	Are mine workings >150m depth?	Yes	c. 475m southwest of the linear extension of the Site, south of Region 6b/c.
	No faults or other potential pathways connecting surface to deeper unflooded workings?	Yes	Mine workings at depth (c. 350 - 440 m OD) are indicated across Regions 6b - 6e with the date last worked noted as 1995 – 1997. No clear evidence of shallow workings are present on Site or within 1km of Site.
	Outside an area of past or probable shallow workings on Mining Remediation Authority viewer?	Yes	2No. inferred faults are recorded, bearing northwest-southeast through Region 6a, 6b and east-west locally through the north of Region 6e, downthrown to the north/northeast.
	Workings between 30m and 150m but permanently flooded or covered by 10m+ of low permeability superficial deposits	No	Mine workings at depth (c. 350 - 440 m OD).
		Yes	As per the geological memoir, coal mining around Asfordby is indicated to be associated with overburdens in excess of 500m, and has the potential for rising mine waters, thereby saturating seams.
	Mine entries >50m from site boundary		Evidence of waterlogged areas of mine were indicated on some plans . Two entries are recorded c.475m southwest of the linear extension of the Site, south of Region 6b/c.
	Low permeability superficial deposits of sufficient thickness.	Yes	The Site is overlain by superficial deposits of Artificially Modified Ground, Alluvium, Head Deposits, Oadby Till Member, and Lias Rich Oadby Till Member, as detailed in Table 3.7

3.4.24 Based on the above, the risk from mine gas for Region 4d to 6e is considered to be negligible to low.

3.5 Radon

3.5.1 The UK Health Security Agency's UK Radon website (Ref 13.44) was reviewed along with information from the more refined BGS database presented in the Groundsure

GIS data to determine potential radon risks for the Site. Table 3.39 outlines the radon risk on Site.

Table 3.39: Radon percentages

Region	Radon Percentages
Region 1	Generally <1% but with areas of 3-5% in part of Region 1a, 5-10% in part of Regions 1a, 1b, and 1c, and 10-30% in Region 1c and 1d.
Region 2	Generally <1% but with areas of 1-3% locally associated with the River Witham. 1-5% very locally associated with the road “The Drift”. Areas of 5-10% and 10-30% in Region 2c. Areas of 3-5% and 5-10% in Region 2e. An area of 5-10% is located west of the “The Drift”.
Region 3	Generally <1% but with areas of 1-3% and 3-5% very locally associated to all water features. An area of 10-30% very locally associated with Freeby Brook.
Region 4	Generally <1% but with areas of 1-3 % very locally associated with all water features. An area of 10-30% is very locally associated with Melton Road.
Region 5	Generally <1% but with an area of 1-3 % very locally associated with the Scalford Brook.
Region 6	Generally <1% but with an area of 1-3 % very locally associated with a River west of the A606.

- 3.5.2 The estimated properties affected by radon for the majority of the Site, as per the Groundsure GIS data, is at <1% and 1 to 3% in some areas, therefore no radon protection measures are indicated as being required. Where the percentage is recorded as between 3-5% and 5-10%, basic radon protection measures should be implemented. Where the percentage is recorded as the as between 10-30% full radon protection measures are required.

3.6 Hydrogeology

Aquifer Classification

- 3.6.1 Groundwater bodies are classified by the Environment Agency (EA) under the Water Framework Directive (WFD) (Ref 13.46), whereby water bodies in England are classed as High, Good, Moderate, Poor or Bad, defined by chemical status and quantitative status. The chemical status assesses the compliance with environmental quality standards for pollutants (i.e., whether they exceed criteria) whilst quantitative status evaluates whether groundwater affects water levels and dependent ecosystems (i.e., is it sustainable).
- 3.6.2 A search of the EA’s Catchment Data Explorer (Ref 13.25) was conducted regarding the groundwater quality beneath the Site. Details of the WFD Groundwater Bodies beneath the Site and their overall status are included within Table 3.40.

Table 3.40: WFD Groundwater Bodies

Region and NGR	WFD Groundwater Body and ID	Quality Details ¹
Region 1a to 1c 497485 324445 to 495685 322415	Welland Mid Jurassic Unit (GB40501G445300)	Good
Region 1d 495685 322415 to 495006 321807	Welland Limestone Unit A (GB40501G445900)	Poor
Region 1e and Region 1e to 2e 495006 321807 to 494829 321444 and 494277 321107 to 488563 320741	Witham Lias (GB40502G401400)	Good
Region 1e 494829 32144 to 494277 321107	Witham Limestone Unit A (GB40501G444800)	Poor
Region 2e to 6e 488563 320741 to 470412 322247	Soar – Secondary Combined (GB40402G990600)	Good

¹ All status details are taken from Cycle 3 2019 data.

- 3.6.3 According to the Groundsure data the following aquifer designations have been noted along the extent of the Site, outlined in Table 3.41. Where deposits/bedrock geology is sparsely isolated the associated subregion has been defined below. Also note that the location details are for onsite, but aquifers extend offsite within 250 m of these locations.

Table 3.41: Aquifer Designation

Stratum	Aquifer Designation	Location Details
Superficial Deposits		
Alluvium	Secondary A	Regions 2b, 3a, 3d, 4d, 4e, 5b, 6b
Head Deposits	Secondary (undifferentiated)	Regions 3, 4, 5, 6
Till, Mid Pleistocene (diamicton)	Secondary (undifferentiated)	Regions 1, 2, 3
Oadby Till Member (diamicton)	Secondary (undifferentiated)	Regions 3, 4, 5, 6

Stratum	Aquifer Designation	Location Details
Oadby Till Member (Lias-rich)	Secondary (undifferentiated)	Region 6
Bedrock Geology		
Rutland Formation	Secondary B	Region 1a to 1c
Upper Lincolnshire Limestone Member	Principal	Region 1
Lower Lincolnshire Limestone Member	Principal	Region 1, and Region 2a and 2c locally
Grantham Formation	Secondary (undifferentiated)	Regions 1, 2
Northampton Sand Formation	Secondary A	Regions 1, 2
Whitby Mudstone Formation	Unproductive	Regions 1e, 2a - 2f, 3a, 4a and 4b.
Marlstone Rock Formation	Secondary A	Regions 2f, 3a, and 4b.
Dyrham Formation	Secondary (undifferentiated)	Locally, Regions 2f, 3a, 3f, 4b, 4c, 5, 6a, 6b, and 6c
Charmouth Mudstone Formation	Secondary (undifferentiated)	Regions 3, 4, 5a, 5b, and 6

3.6.4 In Region 2f a fracture is noted extending across the site as part of the Marlstone Rock, also present within 250m of Region 3a. Here the permeability is very high and has been classified as within a Secondary A aquifer.

Groundwater Vulnerability

Table 3.42: Groundwater Vulnerability

Stratum	Aquifer Designation	Vulnerability	Location Details
Superficial Deposits			
Alluvium	Secondary A	Medium	Regions 2, 3, 4, 5, 6
Head Deposits	Secondary (undifferentiated)	Medium	Regions 3, 4, 5, 6
Till, Mid Pleistocene (diamicton)	Secondary (undifferentiated)	High	Regions 1, 2, 3

Stratum	Aquifer Designation	Vulnerability	Location Details
Oadby Till Member (diamicton)	Secondary (undifferentiated)	Medium	Regions 3, 4, 5, 6
Oadby Till Member (Lias-rich)	Secondary (undifferentiated)	Medium	Region 6
Bedrock Deposits			
Rutland Formation	Secondary B	Medium	Region 1
Upper Lincolnshire Limestone	Principal	Medium	Region 1
Lower Lincolnshire Limestone	Principal	Low	Region 1
Grantham Formation	Secondary (undifferentiated)	Medium	Regions 1, 2
Northampton Sand Formation	Secondary A	Medium	Regions 1, 2
Whitby Mudstone	Unproductive	Unproductive	Regions 1, 2, 4
Marlstone Rock	Secondary A	Low	Regions 2, 4
Dyrham Formation	Secondary (undifferentiated)	Low	Regions 2, 3, 4, 5
Charmouth Mudstone Formation	Secondary (undifferentiated)	Low	Regions 3, 4, 5, 6

Source Protection Zones

- 3.6.5 In terms of identifying the risk of contamination from potential polluting activities in a given area to groundwater sources (wells, boreholes and springs) used for supplying public drinking water, the Environment Agency identifies Source Protection Zones (SPZ). These show the extent of a groundwater source catchment and are divided into three zones, can be found on the Environment Agency section of the gov.uk website (Ref 13.47) and are outlined below.

- SPZ1 – Defined by a 50-day travel time from any pollution below the water table to the groundwater source, with a minim radius of 50 m. It is the area immediately around an abstraction point for domestic/food supply purposes and is where groundwater is the most vulnerable to pollution.
- SPZ2 – Defined by a 400-day travel time from a point below the water table, with a minim radius of 250 – 500 m, depending on the size of the abstraction.
- SPZ3 – Defined as the area around a groundwater source where all groundwater is presumed to end up at the abstraction point, covering the entire catchment area based on the volume abstracted and effective rainfall.

3.6.6 Region 1 and Region 2a of the Site falls within a SPZ3, with the remainder of the Site falling outside of any SPZ classification.

Licensed Groundwater Abstractions

3.6.7 No Licensed Groundwater Abstractions have been identified on or within 250m of the Site.

Preliminary Hydrogeological Model & Flow Direction

3.6.8 Due to the extent of the Site, the groundwater flow direction within the superficial aquifers will likely be influenced by local topography and watercourses. The topography on the Site varies across each Region between 85m AOD to the east (Region 1) to 145m AOD centrally (Region 4), before reducing again to 90m AOD towards the west (Region 6). The lowest recorded elevations are in areas where valleys/watercourses are noted, with it likely that they influence the direction of groundwater flow in alignment with the surface water flow via baseflow within permeable superficial deposits (hydraulic continuity). It should be noted that this baseflow is likely to be limited laterally within areas where cohesive deposits are noted (Till deposits and clay layers within the head deposits and Alluvium). The presence of the Whitby Mudstone, an unproductive aquifer, recorded onsite may pose some limitations to the baseflow of groundwater.

3.6.9 The BGS Hydrogeological Map for North East Lincolnshire (Region 1a to 3d) and England & Wales (Region 3d to 6e) were reviewed for the Site, showing groundwater contours indicating groundwater flow within the Lincolnshire Limestone and Great Oolite Formation towards the east. None to limited data was provided for the remaining bedrock formations.

3.7 Hydrology

Surface Water Features and Drainage

3.7.1 The Environment Agency Catchment Data Explorer, Groundsure data, and other publicly available sources have been reviewed to identify relevant hydrological features on Site, including rivers, streams and drains, and have been listed below in Table 3.43, along with the associated EA Water Body ID and General Quality Assessment (GQA) status (if valid).

- 3.7.2 It is noted that the presence of further surface water features (linear and ponds) not recorded by Groundsure data should be anticipated, including those drawn to attention/suspected based on a review of mapping/LiDAR data in Report Section 2.2 and 2.3. Of these, it is anticipated that the majority are smaller scale drain features associated with agricultural land uses. In general, considering the agricultural setting of the Site, these and other surface water features are indicated/anticipated to be locally culverted beneath the ground e.g. at crossing points on field boundaries.

Table 3.43: Surface Water Quality

Surface Water Feature ¹ (EA Water Body ID)	GQA Status ² (Chemical ³) (Ecological ⁴)	Distance (m)	NGR Crossing OHL	Details
Region 1				
Unnamed Surface Water Feature	Not Determined	On Site (Region 1d)	495058 E 322057 N	
The Tam (GB10503105065 0)	Chemical: Fail Biological: Poor	On Site (Region 1e)	494151 E 321033 N	
Unnamed Surface Water Feature	Not Determined	On Site (Region 1e)	494833 E 321479 N	
Region 2				
River Witham (GB10503005157 0)	Chemical: Fail Biological: Poor	On Site (Region 2b)	492838 E 320855 N	Witham headwaters to confluence Cringle Brook
Unnamed Surface Water Feature	Not Determined	On Site (Region 2c)	491580 E 320822 N	
Unnamed Surface Water Feature	Not Determined	On Site (Region 2c)	491002 E 320801 N	
Unnamed Surface Water Feature	Not Determined	On Site (Region 2e)	489237 E 320745 N	
Unnamed Surface Water Feature	Not Determined	On Site (Region 2f)	48777877 E 32069241 N	
Region 3				

Surface Water Feature ¹ (EA Water Body ID)	GQA Status ² (Chemical ³) (Ecological ⁴)	Distance (m)	NGR Crossing OHL	Details
Unnamed Surface Water Feature	Not Determined	On Site (Region 3a)	486694 E 320668 N	Tributary of Whisendine Brook to southwest
Unnamed Surface Water Feature	Not Determined	On Site (Region 3a)	486578 320665	Tributary of River Eye to southwest
Unnamed Surface Water Feature	Not Determined	On Site (Region 3c)	485282 E 320908 N	
River Eye (GB104028047610)	Chemical: Fail Biological: Moderate	On Site (Region 3d)	484225 E 321537 N	Eye from Source to Langham Brook
Unnamed Surface Water Feature	Not Determined	On Site (Region 3d)	484160 E 321576 N	
Unnamed Surface Water Feature	Not Determined	On Site (Region 3e)	483435 E 321817 N	
Unnamed Surface Water Feature	Not Determined	On Site (Region 3f)	482393 E 322197 N	Tributary of Freeby Brook to southwest
Freeby Brook	Not Determined	On Site (Region 3g)	48134263 E 322327 N	
Region 4				
Unnamed Surface Water Feature	Not Determined	On Site (Region 4a)	480452 E 322741 N	Tributary of Freeby Brook to southeast
Unnamed Surface Water Feature	Not Determined	On Site (Region 4b)	480099 E 322596 N	Tributary of Freeby Brook to southeast
Unnamed Surface Water Feature	Not Determined	On Site (Region 4c)	478820 E 322703 N m	
Unnamed Surface Water Feature	Not Determined	On Site (Region 4c)	478410 E 322602 N	

Surface Water Feature ¹ (EA Water Body ID)	GQA Status ² (Chemical ³) (Ecological ⁴)	Distance (m)	NGR Crossing OHL	Details
Unnamed Surface Water Feature	Not Determined	On Site (Region 4e)	477597 E 322471 N	
Thorpe Brook Catchment (GB104028047590)	Chemical: Fail Biological: Moderate	On Site (Region 4e)	477353 E 322501 N	Tributary of River Eye
Region 5				
Scalford Brook	Not Determined	On Site (Region 5b)	476230 E 322502 N	
Unnamed Surface Water Feature	Not Determined	On Site (Region 5c)	475218 E 322198 N	Tributary of Scalford Brook to southeast
Unnamed Surface Water Feature	Not Determined	On Site (Region 5e)	474107 E 321913 N	
Region 6				
Unnamed Surface Water Feature	Not Determined	On Site (Region 6b)	473090 E 321716 N	
Unnamed Surface Water Feature	Not Determined	On Site (Region 6c)	472125 E 321725 N	
Unnamed Surface Water Feature	Not Determined	On Site (Region 6e)	470848 E 322050 N	Pond
Unnamed Surface Water Feature	Not Determined	On Site (Region 6e)	470750 E 322089 N	

Notes:

¹ Only Surface Water Features within the Site have been included in this table.

² Data from latest available assessment period used (2022)

³ The classification status for the surface water body against the environmental standards for chemicals that are priority substances and priority hazardous substances. Chemical status is recorded as good or fail. A status of good means that concentrations of priority substances and priority hazardous substances do not exceed environmental quality standards. The

Surface Water Feature ¹ (EA Water Body ID)	GQA Status ² (Chemical ³) (Ecological ⁴)	Distance (m)	NGR Crossing OHL	Details
chemical status classification for the water body, and the confidence in this (high or low), is determined by the worst test result. Chemical status and ecological status together define the overall surface water status of a water body. For groundwater see "Groundwater chemical status".				
⁴ Ecological status applies to surface water bodies and is based on the following quality elements: biological quality, general chemical and physicochemical quality, water quality with respect to specific pollutants (synthetic and non synthetic), and hydromorphological quality. There are five classes of ecological status (high, good, moderate, poor or bad). Ecological status and chemical status together define the overall surface water status of a water body.				

Licensed Surface Water Abstractions

- 3.7.3 No active Licensed Surface Water Abstractions have been identified onsite with one active licensed surface water abstraction identified within 250m of the Site and is included in Table 3.44.
- 3.7.4 The Environment Agency flood risk map for planning and long-term flood risk map (Ref 13.26) was reviewed alongside the Groundsure flood zone data and confirmed that the following flooding risks are recorded for the Site.
- 3.7.5 The majority of the Site is mapped to be within Flood Zone 1, with regards to flooding from rivers. The Groundsure GIS data records the water course trending southwest on the southern border of the site to be associated with flooding from river, locally indicated to be Flood Zone 2 and Flood Zone 3. A Flood Zone 1 is defined as land has a less than 0.1% (1 in 1,000) chance of flooding from rivers or the sea.
- 3.7.6 The Groundsure GIS data records the highest risk of surface water flooding at the site to be 1 in 30 year (3.3%), locally corresponding to the gully features trending north-south across the Site. Extending further from the gulleys, surface water flooding risk lowers to 1 in 100 year. The majority of the Site is indicated to not be at risk of surface water flooding, but is identified as a nitrate vulnerable zone. Potential remanence of the historical Weir and sluices (present up until 1920) is flagged as an abnormal risk.

Table 3.44: Environment Agency Licensed Surface Water Abstractions (within 250m of Site)

National Grid Reference	Distance (m) and Direction	License Number	Use
484046 321298	200m S of Region 3d	03/28/54/0042	Spray Irrigation - Direct

4. Historical Land Use

4. Historical Land Use

4.1 Introduction

- 4.1.1 Historical Ordnance Survey (OS) maps of the Site and the wider environments were provided by Groundsure (scales 1:2,500, 1:10,560 and 1:10,000) and these, alongside publicly accessible historical aerial photography from Google Earth Pro (Ref 13.29), have been reviewed and summarised here, with a tabulated summary presented in Appendix B.
- 4.1.2 The tabulated summary in Appendix B outlines the on Site features and those considered to be of consequence within the 250m of the Site boundary. The summary does not include all historical features, only those considered to be relevant to the scheme from a geo-environmental and geotechnical perspective.
- 4.1.3 It is noted that the historical OS maps obtained from Groundsure date between 1883 and 1994, with aerial photography from Google Earth Pro date from 1999 to 2024. Where dates are stated, these refer to the dates of maps on which the features are present, have changed use or are no longer annotated, and do not necessarily refer to the exact dates of existence of a particular feature. Development that may have occurred between map editions is recorded as occurring on the later published map, hence there are some limitations to the accuracy to the date of development unless supplementary evidence is available.

4.2 Summary of Site and Surrounding Area History

- 4.2.1 The Site is predominantly occupied by agricultural fields both in its present-day use and historically based on the review of historical mapping and satellite imagery. These fields, alike present day, are seen to have been interspersed or have adjacent associated local farms, hamlets, woodlands, ponds, drainage channels, wells/pumps, paths/tracks and roads, alongside rivers/streams (including local indicated realignment of such) and historical (now abandoned) railway lines.
- 4.2.2 Railway lines were in-use on Site in Region 2d between 1902 and 1982, Region 5b between 1884 and 2006 and Region 6b between 1884 and 1994. Railway sidings marginally encroached onto the Site of Region 2e during 1950. The tracks relating to these railway lines have been removed, with the configuration of the railway crossing Region 5b still present through the alignment of trees/vegetation, however from 2006 aerial photography the tracks have been removed.
- 4.2.3 The railway sidings encroaching on Region 2e are assumed to be associated with historical surface ironstone extraction on Site outlined in Report Section 3.4; clear evidence of this mining is not evidenced on historical mapping, although wells/pumps/pits and issues are indicated in the local/immediate area of this which could be associated with the works. It is noted that small scale more local disused pits/quarries are indicated in the wider area by historical mapping, and very locally on Site in Region 2a as per Report Section 3.4.
- 4.2.4 With regards to ponds, a number of these are noted across the Site, some of which disappear from later mapping and have potentially been infilled where footprints are

no longer evident in LiDAR. Figure 10 (Appendix A) includes digitised ponds from historical mapping where not already shown by the Surface Ground Workings data set, including indication of where these have been infilled based on a review of the associated LiDAR footprint. It is noted that some ponds associated with the Surface Ground Workings data set may also have been infilled. It is considered likely that infill to ponds was un-engineered Made Ground.

- 4.2.5 As per Report Sections 3.3 and 3.4, these ponds may locally be associated with karst or mining features, whilst other historically mapped features e.g. 'Shake holes' in Region 1 provide confirmed evidence historically of karst features being recorded on Site.
- 4.2.6 A number of local historical features of unknown origin, possibly structures or other features of possible geotechnical/geo-environmental consequence have also been identified and digitised as per Figure 10, and could be, as per Report Section 3.3 and 3.4, related to karst or historical mining or simply associated with historical land uses (likely mainly agricultural). This includes historical development footprints and likely associated local Made Ground and possible obstructions e.g. associated with relict foundations, pumps, wells etc. The presence of further features of consequence, including those in adjacent Site areas that have not been digitised, cannot be completely discounted.
- 4.2.7 Historical deep coal mining associated with the Deep Main Seam and Parkgate Seam respectively associated with Asfordby Mine is evidenced by mine plans available through the Mining Remediation Authority in Region 6 and is detailed in Report Section 3.4. Clear evidence from historical mapping and satellite imagery of these works is limited to Asfordby Mine's spoil heap (shown as 'slag heap' on historical maps) adjacent to the southwest of a linear extension of the Site boundary on Region 6c/d. The heap correlates with offsite areas of mapped Infilled and Made Ground mapped adjacent to the southeast of the linear extension to Region 6d/c.
- 4.2.8 Potentially more contaminative sources are noted on Site and within 250m including tanks (on and offsite of Regions 1b, 1d, 6a, 6d and 6e), dis-used airfield (offsite of Region 1d/1e, albeit encroaching onto Site in Region 1d and 1e), unspecified depots/warehouses part of Honeypot Lane Industrial Estate (offsite of Region 1d/1e) and an electricity substation present from 1982 to present day on Site of Region 1e. The airfield in the vicinity of Twyford Woods, noted as potentially present on 1958 mapping and visibly present on aerial photography from 1999, is the Royal Air Force (RAF) North Witham airfield. The airfield was active between 1943 and 1956 assisting in World War 2 (WII) activities.
- 4.2.9 An 'Active Recent Landfill' site is recorded adjacent to the south of the linear extension of the Site of Region 6b (c.10m from Site boundary), with historical mapping from 1950 - 1994 showing a 'slag heap' (likely at least initially associated with historical ironstone mining at Holwell/Brown's Hill to the north of the Site outlined in Report Section 3.4, and access via historical railway lines bearing north). Satellite imagery shows continued landfilling activity (waste type unspecified) from 1999 to 2025. The landfill appears to form part of a waste management facility, operating under license EPR/JP3434RS.
- 4.2.10 Those features identified from a geo-environmental perspective have been listed in Report Section 4.3 below. Features of identified and potential geotechnical/geo-

environmental consequence will be inspected/reviewed where accessible during Site reconnaissance and investigated as deemed necessary.

4.3 Summary of Potential Historical Contaminative Sources

4.3.1 This Report Section summarises sources of contamination on Site and, in the vicinity, associated with historical features identified in Report Section 4.2 inclusive of the Contaminants of Potential Concern (CoPC). These include:

On Site

- Potential/suspected infilled ground (all regions) and landscaped ground (Region 6b; which has potential for infilled ground) – associated with former ponds and disused pit (most regions Region 1c) and suspected realignment of Thorpe Brook (Region 4e) infilled with unknown materials. Surface workings associated with local historical pit (Region 2a) and more extensive Worked Ground (with potential for partial infilling) associated with historical ironstone mining (Region 2e) and potential unrecorded surface mining locally elsewhere as per Report Section 3.4. Landscaped ground/infilled ground associated with historical/present day developments, including potential for infilling of historical structure footprints (most regions locally, including published extents on Region 6b/d). CoPC include: metals and metalloids, Polycyclic Aromatic Hydrocarbons (PAH), Semi-volatile Organic Compounds (SVOCs), pH, Asbestos Containing Materials (ACM)/asbestos and ground gas (methane and carbon dioxide. Hydrogen sulphide (H₂S) may be locally associated with ironstone mining where workings are exposed to groundwater.
- Made Ground (all regions) – associated with infrastructure such as roads and embankments crossing the Site, local buildings/structures, the disused airfield encroaching onto Site in Regions 1d and 1e and the gas valve compound located in Region 6a. CoPC include: metals and metalloids, cyanides (total, free), SVOCs, Volatile Organic Compounds (VOCs), TPH, PAH, pH, ACM/asbestos, per- and polyfluoroalkyl (PFAS) substances, and ground gas (methane and carbon dioxide).
- Underground deep coal mining (Region 6 and assumed low possibility for unrecorded underground deep workings between Region 4d and end of Region 6 which is covered by Coal Mining Reporting Area). CoPC include: Metals and metalloids, Cyanides (total, free), SVOCs, VOCs, PAH Sulphate, Sulphide, Free sulphur, pH, ACM asbestos, Ammoniacal nitrogen, thiocyanate, Thallium, Ground Gas (CH₄, CO₂), TPH, PCBs.
- Historical Railway land (Regions 2e, 5b and 6b) crossing Site at 490037 E 320777 N, 476056 E 322425 N and 473104 E 321717 N. CoPC include: metals and metalloids, SVOCs, VOCs, PAH, TPH, Polychlorinated Biphenyls (PCBs), sulphate, ACM/asbestos, herbicides and glyphols.
- Agricultural Land (all regions) – CoPC include: TPH (anticipated to be minimal), ammoniacal nitrogen, herbicides and pesticides.
- Tanks (Regions 1b, 6a and 6e) - CoPC include: PAH, TPH and asbestos.

Offsite

- Infilled Ground (all regions) – associated with former ponds and quarries/pits infilled with unknown materials. See CoPC listed above for potential on Site source.
- Made Ground (all regions) – associated with infrastructure such as roads, embankments, buildings etc., and the dis-used airfield adjacent to the Site along Regions 1c – 1e. See CoPC listed above for potential on Site source.
- Historical Railway Land (Region 2d, 2e, 5b and 6b) – railway land (railway line and railway siding) extending offsite from crossings detailed above, and historical railway features south of Region 6b. See CoPC listed above for potential on Site source.
- Agricultural Land including farms (all regions) – see CoPC listed above for on Site source.
- Tanks (Regions 1b, 1d and 6d) - see CoPC listed above for on Site source.
- Electricity Substation (Region 1e) – noted at 494781 E 321719 N, and Region 6c. CoPC include: TPH and PCBs.
- Underground deep coal mining (e.g. South and west of Region 6 associated with Asfordby Mine), as well as some assumed low possibility for unrecorded underground workings adjacent to other regions. CoPC include: Metals and metalloids, Cyanides (total, free), SVOCs, VOCs, PAH Sulphate, Sulphide, Free sulphur, pH, ACM asbestos, Ammoniacal nitrogen, thiocyanate, Thallium, Ground Gas (CH₄, CO₂), TPH, PCBs.
- Waste Sites on Regions 1e, 5a and 6b. Licencing related to farm waste at Honey Pot Estate 265m north of Region 1e, and household/commercial/industrial waste 225m northeast of Region 5a, as well as the recent Active Landfill adjacent to the linear extension south of Region 6b (marked as slag heap in historical mapping). Slag/spoil heap associated with the historical Asfordby Deep coal mine (south of Region 6c/d). Unrecorded spoil heaps associated with ironstone extraction on Region 2e. Metals and metalloids, SVOCs, VOCs, TPH, PAH, PCBs, Dioxins & furans, Sulphide, pH, ACM/asbestos and Ammoniacal nitrogen, sulphate and ground gas (carbon dioxide, methane, and hydrogen sulphide).

4.4 Unexploded Ordnance Risk

- 4.4.1 The regional UXO mapping published by Zetica (accessed 24/06/2026; Ref 13.72) shows that the Site to lie within a zone that experiences a low risk of Unexploded Bombs (UXB). This is defined by Zetica as “an area indicated as having 15 bombs per 1000 acres or less.” It is noted that these maps only include information on potential for bombing to have occurred in the area and do not include all potential sources of UXO, such as historical land use.
- 4.4.2 A Preliminary UXO Risk Assessment has been undertaken for the Site by Fellows International Group (FIG) (Ref 13.71). FIG’s assessment includes research and review of satellite and aerial photography, historical mapping, archival material and First and Second World War UK bombing data within a 5 km radius of the Site. The assessment aims to identify military or potential UXO related activities that raises the

risk of encountering a UXO during intrusive activities (e.g. below-ground construction, ground investigation).

- 4.4.3 FIG's Preliminary UXO Risk Assessment has identified potential sources of UXO risk on or within 5 km of the Site as listed in Table 4.1.

Table 4.1: Sources of potential UXO identified by Preliminary Assessment

Potential UXO Source	Description of source
WW2 Aerial Bombing	Bombing activity gives rise to the potential existence of undiscovered unexploded bombs. Initial research has identified five areas of WW2 bombing in proximity to the Site.
Military Airfields	Military airfields were sometimes subjected to attack and are also related to military activity. This can result in potential encounter with UXO in areas located in proximity to an airfield site. Two military airfields have been identified in proximity to the Site.
Bombing Decoy Sites	RAF and Royal Navy decoy sites were constructed in the vicinity of legitimate targets to deceive and decoy enemy bombers. For obvious reasons, such sites were often built in remote and uninhabited areas. Some were more successful than others and received relatively high bombing rates. One decoy site has been identified in proximity to the Site.
Explosive Ordnance Clearance (EOC) Tasks & Reports	EOC tasks are potential indicators of the existence of legacy munitions. There is a record of three post-war explosive ordnance clearance tasks in proximity to the Site.
Ordnance Factory/Ordnance Storage Facilities	Ordnance factories were responsible for the manufacture of arms and ammunition, and ordnance storage facilities were used for storing of live munitions. An ordnance factory and an ordnance storage facility have been identified in proximity to the Site.

- 4.4.4 Given the potential sources of UXO identified, it is recommended that a Detailed UXO Risk Assessment is carried out. Detailed assessment has been commissioned and is in production at the time of this Report issue. This assessment should be reviewed and findings incorporated into subsequent ground investigation specifications and any intrusive construction works.

5. Review of Historical Site Investigation

5. Review of Historical Site Investigation

- 5.1.1 AAJV has undertaken a high-level review of a list of historical ground investigation reports noted to be on the National Grid Enterprise Content Management (ECM) and have found that based on the limited location information provided none of the historical ground investigation reports related to the Site at the time of writing. If relevant historical reports become available, these should be considered in subsequent specification/reporting.

6. Regulated Activities and Statutory Consultation

6. Regulated Activities and Statutory Consultation

6.1 Introduction

- 6.1.1 The key relevant features that characterise the Site and surrounding area are summarised in this Report Section, along with an indication of the risk to the land quality of the Site. Generally, any regulated activities within 250 m of the Site could, depending upon their nature, represent potential offsite sources of contamination.

6.2 Regulatory Database Review

- 6.2.1 Table 6.1 summarises information on regulated processes contained in the Groundsure Report. The Report collates data from a variety of sources including the Environment Agency (EA) and the British Geological Survey (BGS). All data suppliers are referenced in the Report.

Table 6.1: Summary of Regulated Activities

Subject	Region	Number present		Details
		On site	0–250 m	
Regulatory Processes				
Discharge Consents	Region 1	1	3	1No. entry ~35m east (Region 1c, 496200 E 322400 N) for unspecified effluent (historical). 1No. entry onsite northwest (Region 1d, 494899 E 322973 N) for trade discharges (process effluent) with status of consent revoked – discharge ceased. 1No. entry ~15m northwest (Region 1d, 494889 E 322119 N) for sewage discharges – final/treated effluent (historic). 1No. entry ~5m southwest (Region 1e, 494794 E 321713 N) for sewage discharges – final/treated effluent (new consent).
	Region 2	0	3	2No. entries ~85m north (Region 2b, 490999 E 321002 N) for unspecified effluent (historical). 1No. entry ~115m north (Region 2c, 490996 E 320999 N) for unspecified effluent (historic).
	Region 3	0	0	No entries within 250m of the Site boundary.
	Region 4	0	0	
	Region 5	0	1	1No. entry 190m northeast (Region 5a, 477181 E 322981 N) for sewage discharges – final/treated effluent.
	Region 6	0	0	No entries within 250m of the Site boundary.
Pollution Incidents	Region 1	1	0	1No. entry onsite (Region 1d, 495180 E 322121 N) for agricultural materials and waste. Impacts to air and land listed as Category 4 (minor) and impacts to water listed as Category 3 (minor).
	Region 2	0	0	No entries within 250m of the Site boundary.

Subject	Region	Number present		Details
		On site	0–250 m	
	Region 3	0	0	
	Region 4	0	0	
	Region 5	0	0	
	Region 6	0	0	
Pollution Inventory – Substances & waste	Region 1	0	0	No entries within 250m of the Site boundary.
	Region 2	0	0	
	Region 3	0	0	
	Region 4	0	0	
	Region 5	0	0	
	Region 6	0	4	3No. listings ~55m northwest (Region 6b, 472859 E 322170 N) for intensive farming (substances). 1No. listing ~55m northwest (Region 6b, 472859 E 322170 N) for intensive farming operated by Sunrise Poultry Farms Limited (waste).
<u>Licensed Waste Management Facilities and Industrial Land Uses</u>				
Authorised and Historic Landfills	Region 1	0	0	No entries within 250m of the Site boundary.
	Region 2	0	0	
	Region 3	0	0	
	Region 4	0	0	
	Region 5	0	0	
	Region 6	0	0	

Subject	Region	Number present		Details
		On site	0–250 m	
Licensed Waste Sites	Region 1	0	2	1No. entry (Region 1e, ~190m north) for on-farm anaerobic digestion – farm wastes only, surrendered on 26/07/2024 with a range of >=25000 to <75000 tonnes (ID: 629461) at 494559 E 321562 N. 1No. entry (Region 1e, ~185m north) for on-farm anaerobic digestion – farm waste only, issued on 15/07/2015 with a range of <25000 tonnes (ID: ADJ002) at 494560 E 321561 N.
	Region 2	0	0	No entries within 250m of the Site boundary.
	Region 3	0	0	
	Region 4	0	0	
	Region 5	0	3	3No. entries (Region 5a, ~115 m northeast) for household, commercial and industrial waste T Stn, one with status: issued (ID: KEN002), one with status: transferred (ID:LAM003) and one with status: surrendered (ID: 651725). All with range of <25,000 tonnes of waste, 476764 E 323054 N
	Region 6	0	1	1 No. entry for an Active Recent Landfill, Holwell Works, Welby Tip, EPR/JP3434RS, for waste landfilling (>10T/D with capacity >25,000T, Excluding inert waste.
Landfill waste exemptions	Region 1	0	5	WEX185552 for the spreading of waste on non-agricultural land to confer benefit – ~100m southwest (Region 1b, 496914 E 323480 N) WEX026643 (2No. entries) for burning waste in the open and disposal by incineration – ~105m southwest (Region 1b, 496994 E 323392 N) WEX266180 and WEX393692 (2No. entries each) for use of waste for a specified purpose and use of waste in construction – ~85m northwest (Region 1d, 494757 E 322089 N)

Subject	Region	Number present		Details
		On site	0–250 m	
	Region 2	1	51	WEX227580 for storage of sludge – onsite (Region 2f, 487499 E 320650 N) WEX415779 for use of waste in construction – ~130m north (Region 2a, 493870 E 321275 N) WEX001021 for storage of sludge – ~45m southwest (Region 2e, 489381 E 320211 N) EPR/YF0935NS/A001 and EPR/DF0635NQ/A001 (5No. entries each) for use of waste for a specified purpose, use of baled end-of-life tyres in construction, deposit of waste from dredging of inland waters and burning waste in the open and spreading waste on agricultural land to confer benefit – ~40m northwest (Region 2f, 487337 E 320963 N) EPR/MF0034LV/A001 (36No. entries) for use of waste derived biodiesel as fuel, burning of waste as a fuel in a small appliance, spreading waste on non-agricultural land to confer benefit, mechanical treatment of end-of-life tyres, treatment of waste wood and waste plant matter by chipping, shredding, cutting or pulverising, preparatory treatments (baling, sorting, shredding etc), cleaning, washing, spraying or coating relevant waste, deposit of waste from a portable sanitary convenience, deposit of waste from dredging of inland waters, aerobic composting and associated prior treatment, use of mulch, spreading of waste on agricultural land to confer benefit, recovery of scrap metal, screening and blending of waste, treatment of non-hazardous pesticide washings by carbon filtration for disposal, treatment of waste food, sorting mixed waste, burning waste in the open, disposal by incineration, deposit of agricultural waste consisting of plant tissue under a Plant Health Notice, use of waste to manufacture finished goods, storage of waste in secure containers, storage of waste in a secure place, crushing waste fluorescent tubes, use of waste for a specified purpose, treatment of waste in a biobed or biofilter, treatment of sheep dip for disposal, anaerobic digestion at premises used for agriculture and burning of resultant biogas,

Subject	Region	Number present On site 0–250 m	Details
			treatment of waste aerosol cans, crushing and emptying waste vehicle oil filters, anaerobic digestion at premises not used for agriculture and burning of resultant biogas, use of baled end-of-life tyres in construction, pig and poultry ash, incorporation of ash into soil, spreading of plant matter to confer benefit and use of waste in construction – ~150m southeast (Region 2f, 487781 E 320389 N). WEX236155 for the spreading waste on non-agricultural land to confer benefit and cleaning, washing, spraying or coating relevant waste, spreading of plant matter to confer benefit, use of waste to manufacture finished goods, treatment of non-hazardous pesticide washings by carbon filtration for disposal, spreading waste on agricultural land to confer benefit, use of mulch, screening and blending of waste, recovery of scrap metal, sorting mixed waste, treatment of waste food, treating waste exemption, treatment of waste aerosol cans, anaerobic digestion at premises used for agriculture and burning of resultant biogas, treatment if sheep dip for disposal, burning of waste as a fuel in a small appliance, treatment of waste in a biobed or biofilter, deposit of agricultural waste consisting of plant tissue under a Plant Health notice, disposal by incineration, burning waste in the open, use of waste in construction, incorporation of ash into soil, use of waste for a specified purpose, pig and poultry ash, use of waste derived biodiesel as fuel, use of baled end-of-life tyres in construction, aerobic composting and associated prior treatment, anaerobic digestion at premises not used for agriculture and burning of resultant biogas, deposit of waste from dredging of inland waters, deposit of waste from a portable sanitary convenience, storage of waste in secure containers, storage of waste in a secure place, preparatory treatments (baling, sorting, shredding etc), treatment of waste wood and waste plant matter for chipping, shredding, cutting and pulverising, mechanical treatment of end-of-life tyres, crushing waste fluorescent tubes – ~130m southeast (Region 2f, 487752 E 320381 N)

Subject	Region	Number present On site 0–250 m	Details
			WEX405049 for burning waste in the open, deposit of waste from dredging of inland waters, storage of waste in a secure place, storage of waste in secure containers, crushing and emptying waste vehicle oil filters, use of waste for a specified purpose, use of waste in construction, treatment of waste wood and waste plant matter for chipping, shredding, cutting or pulverising, spreading waste on agricultural land to confer benefit – ~130m southeast (Region 2f, 487752 E 320381 N) WEX086085 for deposit of waste from a portable sanitary convenience, use of waste in construction, cleaning, washing, spraying or coating relevant waste, aerobic composting and associated prior treatment, preparatory treatments (baling, sorting, shredding etc), spreading of plant matter to confer benefit, incorporation of ash into soil, pig and poultry ash, use of waste derived biodiesel as fuel, use of waste for a specified purpose, crushing waste fluorescent tubes, deposit of waste from dredging of inland waters, storage of waste in secure containers, storage of waste in a secure place, anaerobic digestion at premises not used for agriculture and burning of resultant biogas, treatment of waste wood and waste plant matter by chipping, shredding, cutting or pulverising, mechanical treatment of end-of-life tyres, spreading waste on non-agricultural land to confer benefit, use of baled end-of-life tyres in construction, burning of waste as a fuel in a small appliance, deposit of agricultural waste consisting of plant tissue under a Plant Health notice, screening and blending of waste, use of mulch, disposal by incineration, burning waste in the open, sorting mixed waste, treatment of waste food, treatment of waste aerosol cans, anaerobic digestion at premises used for agriculture and burning of resultant biogas, treatment of sheep dip for disposal, treatment of non-hazardous pesticide washings by carbon filtration for disposal, treatment of waste in a biobed or biofilter, recovery of scrap metal, crushing and emptying waste vehicle oil filters, use of waste to

Subject	Region	Number present		Details
		On site	0–250 m	
				manufacture finished goods and spreading waste on agricultural land to confer benefit – ~130m southeast (Region 2f, 487752 E 320381 N)
	Region 3	1	23	WEX450164 for storage of sludge – onsite (Region 3b, 485588 E 320569 N). WEX395727 and WEX394027 for storage of sludge – ~20m east (Region 3b, 485760 E 320959 N). WEX326756, WEX053754 and WEX201657 for deposit of waste from dredging of inland waters, burning waste in the open, use of waste for a specified purpose, treatment of waste wood and waste plant matter by chipping, shredding, cutting or pulverising, burning of waste as a fuel in a small appliance – ~40m west (Region 3c, 485051 E 321278 N) WEX379124 for burning of waste in the open – ~40m west (Region 3c, 485051 E 321278 N) EPR/NF0231LE/A001 for treatment of waste wood and waste plant matter by chipping, shredding, cutting or pulverising, deposit of waste from dredging of inland waters, burning of waste as a fuel in a small appliance, use of waste for a specified purpose and burning waste in the open – ~ 5m east (Region 3c, 485135 E 321340 N).
	Region 4	2	6	WEX195344 and WEX184543 for storage of sludge – onsite (Region 4d, 478199 E 322570 N). WEX099671 for storage of sludge – ~110m south (Region 4c, 478698 E 322459 N) WEX326796 for storage of sludge – ~60m north (Region 4d, 478031 E 322626 N) WEX454810 for storage of sludge – ~20m northeast (Region 4d, 477989 E 322661 N)

Subject	Region	Number present		Details
		On site	0–250 m	
				WEX099615 for storage of sludge – ~135m south (Region 4d, 477779 E 322220 N) WEX380473 for storage of sludge – onsite (Region 4e, 477517 E 322359 N) EPR/LF0901XC/A001 for use of waste in construction and storage of waste in a secure place - ~20m south (Region 4e, 476994 E 322220 N) WEX099681 for storage of sludge – ~220m south (Region 4e, 477171 E 322032 N)
	Region 5	0	9	EPR/RF0032GC/A001 for use of waste in construction, deposit of waste from dredging of inland waters, cleaning, washing, spraying or coating relevant waste, aerobic composting and associated prior treatment, spreading waste on agricultural land to confer benefit, incorporation of ash into soil, use of waste for a specified purpose, disposal by incineration, burning waste in the open – ~10 m south (Region 5a, 476886 E 322232 N) WEX454812 for storage of sludge – 226 southeast (region 5a, 477018 E 321989 N) WEX330349, WEX197842 and WEX043207 for burning waste in the open, use of waste in construction and spreading waste on agricultural land to confer benefit – ~20m southeast (Region 5c, 475324 E 321984 N)
	Region 6	5	18	EPR/PH0972JE/A001 for deposit of waste from dredging of inland waters and burning waste in the open – onsite (Region 6a, 473886 E 321676 N) WEX054926 for deposit of waste from dredging of inland waters, preparatory treatments (baling, sorting, shredding etc) and burning waste in the open – onsite (Region 6a, 473904 E 321648 N)

Subject	Region	Number present		Details
		On site	0–250 m	
Historical Industrial Land Uses				WEX335734 and WEX211941 for deposit of waste from dredging of inland waters, preparatory treatments (baling, sorting, shredding etc), use of waste for a specified purpose, use of waste in construction, burning waste in the open and spreading waste on agricultural land to confer benefit – ~15m north (Region 6a, 473989 E 321596 N) WEX467120 for deposit of waste from dredging of inland waters, spreading waste on agricultural land to confer benefit, burning waste in the open, use of waste for a specified purpose and use of waste in construction – ~10m west (Region 6a, 473884 E 321503 N) WEX426782 for mechanical treatment of end-of-life tyres ~10m west (Region 6a, 473884 E 321503 N) WEX387165 for spreading waste on agricultural land to confer benefit and anaerobic digestion at premises used for agriculture and burning of resultant biogas – ~40m north (Region 6c, 472447 E 321861 N)
	Region 1	1	5	2No. unspecified tanks, one located ~10m south and one located 5m west of Region 1b. Disused airfield spanning Regions 1c, 1d and 1e, largely offsite, albeit historical boundaries encroaching onsite on Region 1d and 1e. Unspecified disused pit ~100m east spanning 1c and 1d Shake hole onsite in Region 1d. Unspecified warehouse, 2No. unspecified disused pits ~70m northwest in Region 1d.
	Region 2	0	5	Unspecified pit, and ground workings 32m south of OHL in Region 2a Unspecified heap ~160m southeast in Region 2b. Unspecified pit and ground workings ~20m east in Region 2b.
	Region 3	0	0	No entries within 250m of the Site boundary.
	Region 4	0	2	Unspecified tank ~95m northeast at 480535 E 323086 N in Region 4a.

Subject	Region	Number present		Details
		On site	0–250 m	
				Unspecified tank ~10m south at 476978 E 322229 N in Region 4e.
	Region 5	0	1	Unspecified heap ~105m south in Region 5d.
	Region 6	0	5	Railway sidings ~30m west between 473062 E 322076 N and 473109 E 322232 N in Region 6b. Unspecified ground workings ~25m west in Region 6b. Cuttings onsite to ~125m west in Region 6a-6b.
Tanks (current/recent)	Region 1	0	1	Roofed storage tank located 190m northwest (Region 1e, 494548 E 321584 N), commercial activity: distribution or storage.
	Region 2	0	0	No entries within 250m of the Site boundary.
	Region 3	0	0	
	Region 4	0	0	
	Region 5	0	0	
	Region 6	1	0	Open storage tank located onsite (Region 6a, 473911 E 321699 N), commercial activity: distribution and storage.
Historical Tanks	Region 1	0	4	Three unspecified tanks located ~145m west (Region 1d, 495219 E 321788 N), ~95m northwest (494819 E 322219 N) and 120m northwest (495089 E 322349 N), all dated 1978. One tank located ~155m south (Region 1d, 494750 E 322182 N) dated 1978.
	Region 2	0	0	No entries within 250m of the Site boundary.
	Region 3	0	0	
	Region 4	0	1	One unspecified tank located ~375m northeast (Region 4a, 481062 E 322898 N) dated 1975.

Subject	Region	Number present		Details
		On site	0–250 m	
Recent Industrial Land Uses	Region 5	0	0	No entries within 250m of the Site boundary.
	Region 6	1	5	One unspecified tank located onsite (Region 6a, 473908 E 321700 N) dated 1991. Three unspecified tanks located ~10m west (Region 6b, 473079 E 322098 N) and ~5m west (Region 6b, 473071 E 322122 N) dated 1993 and 1991, respectively. Three entries for tanks ~15m northeast (Region 6b, 473109 E 322122 N) dated 1968, 1986 and 1991
	Region 1	0	2	Specialist Vehicles Traders (construction plant) ~135m northwest (Region 1d, 494772 E 322208 N) Electricity substation ~20m west (Region 1e, 494777 E 321721 N)
	Region 2	0	5	Radio mast located ~165m north (Region 2a, 493908 E 321311 N) Gas valve compound ~240m south (Region 2a, 493807 E 320407 N) Disused workings (unspecified quarries or mines) ~85m northeast (Region 2d, 489548 E 321241 N) Radio mast located ~50m north (Region 2e, 488456 E 320854 N) Pylon located ~65m north (Region 2e, 488460 E 320868 N)
	Region 3	0	2	2No. Silos ~10m west (Region 3c, 485119 E 321350 N) and Region 3c, 485125 E 321361 N)
	Region 4	0	2	Unspecified works or factory ~120m northeast (Region 4b, NGR 479643 323009) Pylon ~165m south (Region 4e, 477226 E 322099 N).
	Region 5	3	0	3No. Pylons located onsite (Region 5a, 476998 E 322398 N), (Region 5a, 476847 E 322595 N) and (Region 5a, 476686 E 322813 N).
	Region 6	8	5	Mast (telecommunications) onsite (Region 6a, 473703 E 321776 N)

Subject	Region	Number present		Details
		On site	0–250 m	
				Gas valve compound onsite (Region 6a, 473700 E 321850 N) Wind turbine ~70m southeast (Region 6a, 473390 E 321360) N Welby Grange Farm Turbine ~75m southeast (Region 6a, 473390 E 321355 N) Farmstead (farming) onsite (Region 6a, 473903 E 321650 N) Pylon 162m northeast (Region 6b, 472987 E 322214 N) 3No. Pylons onsite (Region 6b, NGR 472830 321919), (Region 6b, NGR 472705 321686) and (Region 6b, NGR 472576 321447). Solar panels ~35m north (Region 6c, 472409 E 321857 N) Wind turbine ~50m southwest (Region 6d, 471181 E 321728 N) Pylon onsite (Region 6e, 470464 E 322245 N) Pylon onsite (Region 6e, 470415 E 321907 N)
Licensed Industrial Activities	Region 1	0	0	No entries within 250m of the Site boundary.
	Region 2	0	0	
	Region 3	0	0	
	Region 4	0	0	
	Region 5	0	0	
	Region 6	0	1	1No. entry for Poultry Production (Permit ID: CP3203BA) for intensive farming; > 40,000 poultry, issued 11/02/2020 at 472859 E 322170 N.
Historical Railway OSM	Region 1	0	0	No entries within 250m of the Site boundary.
	Region 2	1	0	Abandoned railway line/Historical OSM crossing Site at 490036 E 320776 N.
	Region 3	0	0	No entries within 250m of the Site boundary.

Subject	Region	Number present		Details
		On site	0–250 m	
	Region 4	0	0	
	Region 5	1	0	Abandoned railway line/historical OSM crossing OHL 476061 E 322507 N.
	Region 6	1	1	Dismantled/historical OSM/abandoned railway line crossing OHL at 473107 E 321724 N. Railway sidings listed in 1916 and 1950 between 473108 E 322232 N (Nottingham Road) and 473061 E 322075 N. Historical railway tracks located ~220m south of the linear extension south of Region 6b, 472850 E 320732 N.
Historical Energy Features	Region 1	0	<u>1</u>	An electricity substation dated 1989 located ~10m west (Region 1e, 494785 E 321722 N). <i>[Listed as 115m west under Recent Land Uses]</i> .
	Region 2	0	<u>0</u>	No entries within 250m of the Site boundary.
	Region 3	0	<u>0</u>	
	Region 4	0	<u>0</u>	
	Region 5	0	<u>0</u>	
	Region 6	0	<u>0</u>	
<u>Sensitive Land Uses</u>				
Listed Buildings	Region 1	0	1	1No. entry for a milestone (Grade II) located ~110m southwest in Region 1b, 496979 E 323411 N.
	Region 2	0	1	1No. entry for the Old Black Bull (Grade II) located ~125m north in Region 2a, 493818 E 321269 N.
	Region 3	0	0	No entries within 250m of the Site boundary.
	Region 4	0	0	

Subject	Region	Number present		Details
		On site	0–250 m	
	Region 5	0	0	
	Region 6	0	1	1No. entry for Potter Hill Farmhouse (Grade II) located ~20m east in Region 6b, 473099 E 322162 N.
Ancient Woodland	Region 1	2	5	2No. entries for Great Osgrove Wood located ~5m east, in Region 1a, centred on 497036 E 324398 N. 1No. entry for Little Osgrove Wood located onsite to ~5m north, in Region 1b, centred on 496474 E 323744 N 1No. entry for Herricho Wood located onsite in Region 1b, centred on 496597 E 322894 N 1No. entry for Beaumont Wood located ~150m southeast, in Region 1d, centred on 495269 E 321715 N. 1No. entry for Twyford Forest located ~180m northwest, in Region 1d, centred on 494756 E 322291 N. 1No. entry for Mickley Wood located ~125m southeast, in Region 1e, centred on 494737 E 321050 N.
	Region 2	0	0	No entries within 250m of the Site boundary.
	Region 3	0	0	
	Region 4	0	1	1No. entry for Freeby Wood located ~50m south, in Region 4b, centred on 480116 E 322467 N.
	Region 5	0	0	No entries within 250m of the Site boundary
	Region 6	0	0	No entries within 250m of the Site boundary
List 2 Dangerous Substances	Region 6b	0	1	1No. entry for Boron, Chromium, Copper, Lead, Nickel, pH, and Zince, associated with the Welby Tip, 472931 E 320641 N
List 1 Dangerous Substances	Region 6b	0	1	1No. entry for Cadmium, associated with the Welby Tip, 472931 E 320641 N

Subject	Region	Number present		Details
		On site	0–250 m	
Scheduled Monuments	Region 1	0	0	No entries within 250m of the Site boundary.
	Region 2	0	1	1No. entry for the Remains of Knights Templar preceptory, watermill and fishponds located ~5m east, in Region 2b, centred on 492820 E 320599 N.
	Region 3	0	0	No entries within 250m of the Site boundary.
	Region 4	0	0	
	Region 5	0	0	
	Region 6	0	0	

- 6.2.2 No entries were recorded for the following: Control of Major Accident Hazards (COMAH), historical or active petrol stations, historical or active garages, historical or active military land, explosive sites, Licensed Industrial Activities Part A1, waste sites, hazardous substance storage, or pollution inventories. Aspects related to Ramsar sites, Special Areas of Conservation (SAC), Special Protection Areas (SPA), National or Local Nature Reserves, Green Belts, Nitrate Sensitive Areas, world heritage sites, National parks, and Areas of Outstanding Natural Beauty are not included within this Report.
- 6.2.3 In summary, several possibly contaminative sources have been recorded along the extent of the Site. Namely the electricity substations, tanks and historical railway sidings. There is a limited number of sources which could have the potential to generate ground gas including the on Site infilled land associated with the numerous historical ponds present, alongside potentially historical surface mineral workings e.g. if partial infilling of areas of Worked Ground associated with ironstone workings has been undertaken encroaching on Region 2e. There are very few environmental designations within 250 m of the Site which may pose as sensitive receptors, however the general risk to controlled waters and human health still remains.

6.3 Regulatory Consultation

Planning Information

- 6.3.1 The council web-based planning portals that were identified within the extent of the Site were reviewed to identify whether there are existing planning conditions which relate to the area. The following councils have been reviewed and summarised within Table 6.2 below. A review of all relevant planning application data is outside of the scope of this Report.

Table 6.2: Summary of Planning Information

Planning Council	Regions Covered	Findings
South Kesteven District Council (2026; Ref 13.42)	1a to 2d	Land At Woolleys Lane Lobthorpe Lincolnshire NG33 5LL located 75m north of Region 2a (ID: S25/1431) for 'To upgrade existing equipment at Woolleys Lane, Farmhouse, North Witham, South Kesteven, NG33 5LL', status: No Objections Made.
Melton Borough Council (2026; Ref 13.37)	2e to 6e	Framlands Farm located 250m southeast of Region 5c (ID: 25/00946/FUL for 'Erection of replacement dwelling in the countryside (self-build)', status: unknown. Waltham Centre for Pet Nutrition located 160m north of Region 4a (ID: 26/00011/OUT) for 'Outline planning application with all matters reserved except access; for the demolition of existing Class E(g)(ii) Research and Development buildings, and the erection of up to

Planning Council	Regions Covered	Findings
		9,000m² of Class E(g)(ii) Research and Development buildings, including associated support buildings.', status: unknown. Private Track OS 486467 321256 Coston Road Buckminster located within Region 3a (ID: 25/00790/CL) for 'Re-surfacing of internal grass tracks to a depth of 150mm, overlaying with geotextile membrane and backfilling with aggregate and topping off with finer aggregate to reduce soil compaction and erosion, surface runoff and the subsequent risk of pollution and soil entering watercourses and provide safer access to the fields/across the holding and for feeding and moving livestock', status: Unknown.

6.4 Environment Agency Flooding Data

- 6.4.1 The Environment Agency map for planning and long-term flood risk map were accessed (Ref 13.26), alongside the Groundsure flood zone data and confirmed that the below flooding risks are recorded for the Site.

Flooding from Rivers

- 6.4.2 Flooding from rivers varies between a there being no chance and a High chance along the extent of Site, as detailed below:
- No Chance – majority of the site
 - Low Chance – Region 2b, 2c, 3a, 3c, 3d, 3f, 4e, 5b and 6b
 - Medium Chance – Region 2b, 2c, 3a, 3c, 3d, 3f, 3g, and 4e, 5b, and 6b
 - High Chance – Region 2b, 2c, 3a, 3c, 3d, 3f, 3g, 4e, 5b and 6b
- 6.4.3 The yearly chance of flooding is defined as the following: low is between 0.1% and 1% chance each year, medium is between 1% and 3.3% chance each year and high is more than a 3.3% chance each year.
- 6.4.4 It should be noted that where the chance of river flooding is highest is concentrated along the alignment of the major rivers/drains including the River Witham (Region 2b), tributaries of the Whisendine Brook (Region 3a and 3c), River Eye (Region 3d), Freddy Brook (Region 3f and 3g), Thorpe Brook (Region 4e) and unnamed watercourses (Region 5b and 6b).
- 6.4.5 It should be noted that the above watercourses sit within a Flood Zone 3, with a Flood Zone 2 outlining the perimeter.

Surface Water Flooding

- 6.4.6 The surface water (i.e. fluvial) flooding risk is typically Very Low. Areas where the topography is low-lying such as around various drainage networks and/or watercourses are susceptible to higher levels of risk. There are various isolated areas of Low to High risk of surface water flooding chances recorded along the entirety of the Site extent which have not been individually listed here due to the large number of features.
- 6.4.7 The Environment Agency flood risk map for planning and long-term flood risk map (Ref 13.27) were accessed, alongside the Groundsure flood zone data and confirmed that the following flooding risks are recorded for the Site:

Table 6.3: EA Flood Zones

National Grid Reference	Distance (m) and Direction	Flood Zone	Associated Surface Water Feature
492852 320811	Onsite, Region 2b	Zone 2 ¹ & 3	Witham - headwaters to confluence of Cringle Brook
486677 320634	Onsite, Region 3a	Zone 2 & 3	Unnamed Surface Water Feature
485282 320901	Onsite, Region 3c	Zone 2 & 3	Unnamed Surface Water Feature
484209 321505	Onsite, Region 3d	Zone 2 & 3	Eye from Source to Langham Brook
482437 322251	Onsite, Region 3f	Zone 2 & 3	Unnamed Surface Water Feature
481528 322564	Onsite, Region 3g	Zone 2 & 3	Unnamed Surface Water Feature
477359 322490	Onsite, Region 4e	Zone 2 & 3	Thorpe Brook Catchment (tributary of Eye)
476150 322527	Onsite, Region 5b	Zone 2 & 3	Scalford Brook Catchment (tributary of Wreake)
473099 321729	Onsite, Region 6b	Zone 2 & 3	Unnamed Surface Water Feature

Notes:

¹ Areas of land at risk of flooding, when the presence of flood defences are ignored. Covering land between Flood Zone 3 and the extent of the flooding from rivers or the sea with a 1 in 1000 (0.1%) chance of flooding each year.

Groundwater Flooding

- 6.4.8 The following is drawn to attention relative to Report Section 3.2 and anticipated ground conditions and association with flooding:
- Alluvium is indicated to allow tracts of floodable ground to be readily recognised.
 - Springs, including stream sinks in limestone associated with karst terrains, are anticipated between/within a range of geology which can lead to groundwater flows becoming surface waters and resultant flooding.

6.4.9 A formal flood risk assessment is outside the scope of this Report.

7. Site Reconnaissance

7. Site Reconnaissance

- 7.1.1 This Report has been prepared to support the Development Consent Order (DCO) scoping and preliminary assessment stages. Access for a Site reconnaissance (walkover) was not available prior to the completion of this Report.
- 7.1.2 An external inspection of the Site will be undertaken by a suitably qualified and experienced AAJV Engineer's prior to intrusive investigations.
- 7.1.3 The aim of the visit will be to:
- Identify the range of activities carried out on the Site.
 - Identify any obvious potential sources of ground contamination (e.g., visual evidence of spills, asbestos, stressed vegetation) or geotechnical issues (e.g., karst depressions, slope instability, mining etc).
 - Validate the provisional risk ratings presented in this Report.
- 7.1.4 Accordingly, all risk ratings presented herein are provisional and based on a precautionary assessment of available desktop data. These will be reviewed and updated within the final Environmental Statement (ES) following the completion of the walkover and intrusive investigations.
- 7.1.5 The Site will be revisited ahead of any intrusive works by AAJV Geotechnical/Geo-environmental Engineers to inform future works. Any findings additional to those outlined in this Report will be accounted for in subsequent reporting and specifications.

8. Preliminary Anticipated Ground Models

8. Preliminary Anticipated Ground Models

8.1 Overview

8.1.1 Based on the review of published geological and hydrogeological information, historical mapping and a selection of historical borehole records, the ground conditions within the Site are generally anticipated to comprise the overall succession outlined in Table 3.1, with dominant superficial Till deposits, locally interspersed with Head and Alluvium, overlaying bedrock geology formed of the Great Oolite Group locally and Inferior Oolite Group in the east, then Lias Group moving west across the majority of the Site. Variations and complexities in these successions are anticipated in areas e.g. due to solution of limestone bedrock forming karst features, mining of ironstone and potentially coal, faulting, cambering/slope instabilities and other more localised developments historically and present day, including associated with occurrences of Artificial Ground.

8.2 Preliminary Anticipated Ground Models

8.2.1 Summaries of the preliminary anticipated ground models split by Site regions are presented in Table 8.1 to Table 8.6, alongside a breakdown of anticipated features that could impact the outlined succession/have the potential to cause abnormal ground conditions based on reviewed information. These outline ground models will be reviewed post Site reconnaissance and confirmation through Site specific intrusive ground investigations to inform the design and construction of the proposed developments. As part of this an assessment of the risk posed by the preliminary geotechnical hazards/constraints (as per Report Section 11) will also be required.

8.2.2 Groundwater levels/observations relate to the time that the measurement was recorded and may not indicate current groundwater levels which will need to be verified by Site specific ground investigation.

Table 8.1: Preliminary anticipated ground model for Region 1

Stratum	Anticipated Occurrence	Generalised Description	Approximate anticipated thickness (m)
Topsoil	Generally Region wide (except local present day and historical development areas).	Topsoil.	Nominal thickness e.g. c.0.1m-0.4m, potentially greater due to agricultural activities.
Local Made Ground	Locally associated with areas of present day and historical developments/feat	Variable granular and cohesive materials with anthropogenic inclusions, and some possibility of local obstructions e.g. well.	Generally anticipated to be of relatively minor thickness i.e. <1m, although could

Stratum	Anticipated Occurrence	Generalised Description	Approximate anticipated thickness (m)
	ures e.g. roads/lanes, agricultural land uses (e.g. possible sludge storage), historical Twyford Lodge, nearby tank, well, ponds (including locally infilled) etc.	Potential for 'sludge' locally associated with waste exemption in field on Region 1a.	locally be deeper e.g. infilling historical ponds.
Local Alluvium	Some possibility locally around existing surface water features, including area of historical 'spreads'.	Soft to firm unconsolidated, compressible silty clay, potentially with layers of silt, sand, peat and basal gravel. Potential for a desiccated surface zone.	Variable
Till, Mid Pleistocene	Generally across Regions 1c to 1e, locally 1a and 1b, including potentially underling possible local Alluvium deposits.	Overconsolidated clay, with presence of boulders and with chalk constituents, including potential for more variable heterogenous mixtures of clay, sand and gravel.	Highly variable, c. 1 to 60, likely to include more significant local variations where overlying top of limestone formations.
Rutland Formation	Generally across Region 1c, centrals parts of 1a and 1b and locally encroaching on 1d.	Grey mudstone into mudstone and siltstone, with a greenish-grey rootlet bed at the top. Potential for sandstone and mudstone members. Assumed weathering profile predominantly of clay transitioning into mudstone.	c.6 to 12

Stratum	Anticipated Occurrence	Generalised Description	Approximate anticipated thickness (m)
Upper Lincolnshire Limestone Member	Present across north and south of Region 1a and majority of 1d. Partial coverage of 1b and 1c and locally encroaching on 1e, alongside underlying the Rutland Formation.	Limestone, with disconformable, commonly markedly eroded and karstified contact with the overlying Rutland Formation. Evidence of oolitic nature with shell fragments. Assumed granular weathering profile.	c. 12 to 21
Lower Lincolnshire Limestone Member	Generally coverage of Region 1e, locally encroaching on 1a and 1d, alongside underlying the Upper Lincolnshire Limestone Member.	Limestone, with units of mudstones, potentially with sandy limestone or calcareous sandstone. Disconformable, potentially channelled contact with the overlying Upper Lincolnshire Limestone Member. Evidence of 3m thick fossil marker bed marking change from Upper to Lower Lincolnshire Limestone at top of member. Assumed granular weathering profile.	c. 9 to 15
Grantham Formation	Locally in Region 1e, and underlying the Lincolnshire Limestone Formation.	Mudstones, sandy mudstones and argillaceous siltstone-sandstone, commonly ferruginous, becoming pale argillaceous sand or sandstone at the base. Assumed weathering profile predominantly of clay transitioning into mudstone.	c. 0.5 to 7.5

Stratum	Anticipated Occurrence	Generalised Description	Approximate anticipated thickness (m)
Northampton Sand Formation	Locally in Region 1e, and underlying the Grantham Formation.	Sandy ironstone, greenish grey where fresh, weathering to brown limonitic sandstone, typically displaying a box-stone structure. Basal parts potentially muddy and less ferruginous, with upper beds generally ferruginous sandstone. Potential for lenses of mudstone and limestone in places. Assumed weathering profile of reddish sand, with evidence of being unstable in excavations based on historical logs, with 'soft/broken' components to the weathering ironstone also indicated by historical borehole records. Assumed granular (likely sand dominated) weathering profile.	c. 2 to 9
Whitby Mudstone Formation	Locally in east and west of Region 1e, underlying the Northampton Sand Formation.	Medium and dark grey mudstone and siltstone, laminated and bituminous in part, with thin siltstone or silty mudstone beds and rare fine-grained calcareous sandstone beds. Potential for limestone nodules in some horizons and nodular limestones at the base. Assumed weathering profile predominantly of clay transitioning into mudstone. Anticipated to be underlain at depth by the Marlstone Rock Formation.	Up to 120m
Groundwater: Potential for presence of springs and confined groundwater anticipated, associated with changes in permeability between varying geological units e.g. sandstone/sands of the Northampton Sand Formation creating a confined aquifer, and springs between the Inferior Oolite Group and the Lias Group,			

Stratum	Anticipated Occurrence	Generalised Description	Approximate anticipated thickness (m)
		also between the Rutland Formation and Lincolnshire Limestone Formation, and evidenced by stream sinks associated with karstic terrains in the limestones. Indicated to be between 6m to 32m bgl in historical logs locally both within the Till and the Lincolnshire Limestone Formation but anticipated to be shallow in areas of lower lying topographies/surface water features.	

Anticipated features impacting succession/presence of abnormal ground conditions

Recorded and suspected karst features and associated subsidence risk as per Report Section 3.3 and Figure 10.

Presence of faulted rock mapped around Colsterworth Lane in northeast of Region 1a and around Honey Pot Lane on Region 1d; considered to also increase the risk of karst features.

Some potential for historical mining, including underground, e.g. for limestone and ironstone as per Report Section 3.4.

Potential for Made Ground locally e.g. associated with present day and historical developments and ponds (anticipated to be locally infilled).

Table 8.2: Preliminary Anticipated Ground Model for Region 2

Stratum	Anticipated Occurrence	Generalised Description	Approximate anticipated thickness (m)
Topsoil	Generally Region wide (except local present day and historical development areas).	Topsoil.	Nominal thickness e.g. c.0.1m-0.4m, potentially greater due to agricultural activities e.g. evidenced by soil to c.1m on historical logs in area.
Local Made Ground	Locally associated with areas of present day and historical development/features e.g. roads, agricultural land uses (e.g. possible sludge storage), historical structure, ponds (including locally infilled) etc.	Variable granular and cohesive materials with anthropogenic inclusions, and some possibility of local obstructions e.g. pump, well etc. Potential for 'sludge' locally associated with waste exemption in field on Region 2f.	Generally anticipated to be of relatively minor thickness i.e. <1m, although could locally be deeper e.g. infilling historical ponds.

Stratum	Anticipated Occurrence	Generalised Description	Approximate anticipated thickness (m)
Local Worked Ground	Encroaching on the north of Region 2e, associated with wider offsite areas of Worked Ground, associated with surface ironstone mining, and associated with small scale unspecified pit on Region 2a, including evidence of wells and pumps in local area, alongside possible unrecorded drainage runs.	Excavation, removing overlying ironstone of Northampton Sand Formation, lowering ground level and some potential for partial backfill with un-engineered materials e.g. variable granular and cohesive materials with anthropogenic inclusions, and some possibility of local obstructions.	Variable
Local Alluvium	Locally mapped in the east of Region 2b associated with the River Witham. Some possibility for more localised/thinner deposits around other existing surface water features.	Soft to firm unconsolidated, compressible silty clay, potentially with layers of silt, sand, peat and basal gravel. Potential for a desiccated surface zone.	Variable, likely increasing in thickness towards the central valley associated with the River Witham.
Till, Mid Pleistocene	Generally Region wide, except in local area of mapped Worked Ground and north part of linear extension to Site boundary of Region 2c. Anticipated to underly local Alluvium.	Overconsolidated clay, with presence of boulders and with chalk and limestone constituents, including more variable heterogenous mixtures of clay, sand and gravel.	Highly variable, c.1 to 60; likely relatively shallow in areas near to recorded surface workings for ironstone.
Local Lower Lincolnshire Limestone Member	Very locally on linear extensions to Site boundary in north of Regions 2a and 2c and northwest of Region 2e	Limestone, with units of mudstones, potentially with sandy limestone or calcareous sandstone.	c. 5.5 to 15

Stratum	Anticipated Occurrence	Generalised Description	Approximate anticipated thickness (m)
		Disconformable, potentially channelled contact with the overlying Upper Lincolnshire Limestone Member. Evidence of 3m thick fossil marker bed marking change from Upper to Lower Lincolnshire Limestone at top of member. Assumed granular weathering profile.	
Grantham Formation	Locally encroaching on linear extensions to Site boundary in Regions 2a and 2c and in northwest of Region 2e, including underlying Lower Lincolnshire Limestone.	Mudstones, sandy mudstones and argillaceous siltstone-sandstone, commonly ferruginous, becoming pale argillaceous sand or sandstone at the base. Assumed weathering profile predominantly of clay transitioning into mudstone.	0.5 to 7.5
Northampton Sand Formation	Locally encroaching on linear extensions to Site boundary in Regions 2a and 2c and general coverage of the western and northern part of Region 2e, including underlying the Grantham Formation.	Sandy ironstone, greenish grey where fresh, weathering to brown limonitic sandstone, typically displaying a box-stone structure. Basal parts potentially muddy and less ferruginous, with upper beds generally ferruginous sandstone. Potential for lenses of mudstone and limestone in places. Assumed weathering profile of reddish sand, with evidence of being unstable in excavations based on historical logs in wider area, with 'soft/broken' components to the weathering ironstone also indicated by historical borehole records.	c. 0.5 to 9

Stratum	Anticipated Occurrence	Generalised Description	Approximate anticipated thickness (m)
		Workable thicknesses of ironstone indicated by historical logs.	
		Assumed granular (likely sand dominated) weathering profile.	
Whitby Mudstone Formation	Present across Region 2a to 2d (except for local variations outlined above), and generally present across parts of 2e and 2f, including underlying the Northampton Sand Formation.	Medium and dark grey mudstone and siltstone, laminated and bituminous in part, with thin siltstone or silty mudstone beds and rare fine-grained calcareous sandstone beds. Potential for limestone nodules in some horizons and nodular limestones at the base. Assumed weathering profile predominantly of clay transitioning into mudstone.	c. 53 to 76
Marlstone Rock Formation	Locally present in the west of Region 2f and underlying the Whitby Mudstone Formation.	Sandy, ferruginous limestone interbedded with ferruginous calcareous sandstone, and subordinate ferruginous mudstone beds. Assumed granular weathering profile.	c. 2.5 to 9
Dyrham Formation	General coverage of the western part of Region 2f and underlying the Marlstone Rock Formation.	Pale to dark grey and greenish grey, silty and sandy mudstone, with interbeds of silt or very fine-grained sand (locally muddy or silty), weathering yellow. Impersistent beds or doggers of ferruginous limestone and sandstone, occurring in upper part of sedimentary cycles. Potential for local large cementstone nodules.	c. 7 to 18

Stratum	Anticipated Occurrence	Generalised Description	Approximate anticipated thickness (m)
		Assumed weathering profile predominantly of clay transitioning into mudstone.	
Groundwater:	Potential for presence of springs and confined groundwater anticipated, associated with changes in permeability between varying geological units e.g. sandstone/sands of the Northampton Sand Formation and Marlstone Rock Formation creating confined aquifers, and springs between the Inferior Oolite Group and the Lias Group, also between the Rutland Formation and Lincolnshire Limestone Formation, and evidenced by stream sinks associated with karstic terrains in the limestones in the wider area (e.g. Region 1). Indicated to be between 20m to 33m bgl in historical logs locally, within lower parts of Till indicated to be more granular, around the contact between Till and Northampton Sand Formation or within the Grantham Formation, but anticipated to be shallow in areas of lower lying topographies/surface water features e.g. around the River Witham.		
Anticipated features impacting succession/presence of abnormal ground conditions			
Some potential for karst features locally in areas of northern extensions to Site boundary as per Report Section 3.3 and Figure 10.			
Presence of faulted rock in areas of local limestone in the north; considered to also increase the risk of karst features.			
Evidence of cambering based on 1:10,000 scale Map Sheet SK82SE as presented in Report Section 3.3 associated with the Northampton Sand Formation.			
Recorded extent of Worked Ground, including evidence of reduced level footprint, associated with wider area of ironstone extraction encroaching on the north of Region 2e and local area of unspecified pitting in 2a, as recorded in Report Section 3.4, with potential for associated partial un-engineered fill and associated buried high walls.			
Some potential for unrecorded historical mining, including underground, e.g. for ironstone as per Report Section 3.4.			
Potential for Made Ground locally associated with present day and historical developments/features and ponds (anticipated to be locally infilled).			
Possibility for further unrecorded extents of Lincolnshire Limestone Formation extending onto Site, including associated karst risk, based on historical borehole record, although such could be associated with a limestone boulder within Till.			
Some potential for karst features as per Report Section 3.3.			

Table 8.3: Preliminary anticipated ground model for Region 3

Stratum	Anticipated Occurrence	Generalised Description	Approximate anticipated thickness (m)
Topsoil	Generally Region wide (except local present day and historical development areas).	Topsoil.	Nominal thickness e.g. c.0.1-0.4m, potentially greater due to agricultural activities.
Local Made Ground	Locally associated with areas of present day and historical development/features e.g. roads/lanes, historical structure with pump, around the existing Waltham Pasture Farm, ponds (including locally infilled) etc.	Variable granular and cohesive materials with anthropogenic inclusions, and some possibility of local obstructions e.g. pump. Potential for 'sludge' locally associated with waste exemption in field on Region 3b.	Generally anticipated to be of relatively minor thickness i.e. <1m, although could locally be deeper e.g. infilling historical ponds.
Local Alluvium	Locally in east of Region 3a associated with a linear surface water feature and in the east of Region 3d associated with the River Eye. Some possibility for more localised/thinner deposits around other existing surface water features.	Soft to firm unconsolidated, compressible silty clay, potentially with layers of silt, sand, peat and basal gravel. Potential for a desiccated surface zone.	Variable likely increasing in thickness towards the central valley associated with the River Eye.
Local Head Deposits	Associated locally with linear valley/depression features, e.g. in Region 3c to 3g.	Poorly sorted and poorly stratified gravel, sand and clay (subject to upslope source), potentially locally with lenses of silt, clay or peat and organic material.	Variable.
Oadby Till Member	General coverage of Region 3f and 3g and local coverage of Region 3e, including underlying	Overconsolidated brown to grey, and silty clay, with boulders and subordinate lenses of sand and gravel, clay and silt. Constituents of Cretaceous and Jurassic rock, including chalk and flint fragments.	Variable, c. 15 to 60, possibly less i.e. up to 20 and mis-logged on historical records

Stratum	Anticipated Occurrence	Generalised Description	Approximate anticipated thickness (m)
	Head/Alluvium deposits.		
Till, Mid Pleistocene	General coverage in Region 3a, 3c and 3d, and full coverage of 3b, including underlying Head/Alluvium deposits.	Overconsolidated clay, with presence of boulders and with chalk constituents, including potential for more variable heterogenous mixtures of clay, sand and gravel.	Variable, including notable thicknesses e.g. c. 44.5
Local Whitby Mudstone Formation	Locally in south of Region 3a encroaching on linear extension to Site boundary.	Medium and dark grey mudstone and siltstone, laminated and bituminous in part, with thin siltstone or silty mudstone beds and rare fine-grained calcareous sandstone beds. Potential for limestone nodules in some horizons and nodular limestones at the base. Assumed weathering profile predominantly of clay transitioning into mudstone.	c. 53 to 76
Local Marlstone Rock Formation	Locally in south of Region 3a encroaching on linear extension to Site boundary, and underlying Whitby Mudstone Formation.	Sandy, ferruginous limestone interbedded with ferruginous calcareous sandstone, and subordinate ferruginous mudstone beds. Assumed granular weathering profile.	c. 1 to 9
Local Dyrham Formation	Locally encroaching on Regions 3a and 3c associated with faulting, and underlying Marlstone Rock Formation.	Pale to dark grey and greenish grey, silty and sandy mudstone, with interbeds of silt or very fine-grained sand (locally muddy or silty), weathering yellow. Impersistent beds or doggers of ferruginous limestone and	c. 7 to 26

Stratum	Anticipated Occurrence	Generalised Description	Approximate anticipated thickness (m)
		sandstone, occurring in upper part of sedimentary cycles. Potential for local large cementstone nodules. Assumed weathering profile predominantly of clay transitioning into mudstone.	
Charmouth Mudstone Formation	Generally full coverage of Region, including underlying local occurrences of the Dyrham Formation.	Dark grey laminated shales, and dark, pale and bluish grey mudstones. Potential for local concretionary and tabular limestone beds, abundant argillaceous limestone and phosphatic or ironstone nodules in some areas. Further potential for organic-rich shales at some levels and finely sandy beds in lower part in some areas. Assumed weathering profile predominantly of clay transitioning into mudstone.	c. 110 to 198
Groundwater: Indicated to be c. 26m bgl within Till in local historical borehole record, with another suggesting a c.40m rise in water from surface (assumed to be at depth in borehole) during drilling suggesting potential for presence of confined groundwater. Groundwater anticipated to be shallow in areas of lower lying topographies/surface water features, including the River Eye.			
Anticipated features impacting succession/presence of abnormal ground conditions			
Presence of 2No. inferred faults, correlating with an outcrop of the Dyrham Formation within the Charmouth Mudstone. Presence of the northern margin of a wider buried infilled channel/valley through Region 3g, bearing roughly northeast-southwest, indicating deepening of superficial Till thicknesses south of this boundary. The southern extent of this appears to be present bearing east-west across the linear southern extension to the Site in Region 3f.			

Stratum	Anticipated Occurrence	Generalised Description	Approximate anticipated thickness (m)
		Potential evidence of slope instability on valley associated with the River Eye as per Report Section 3.3.	
		Some potential for unrecorded historical mining as per Report Section 3.4.	
		Potential for Made Ground locally associated with present day and historical developments/features and ponds (anticipated to be locally infilled).	
		Possibility for unrecorded extents of the Whitby Mudstone Formation and underlying Marlstone Rock Formation based on historical borehole record, although could have been mis-logged and be the Charmouth Mudstone Formation.	

Table 8.4: Preliminary anticipated ground model for Region 4

Stratum	Anticipated Occurrence	Generalised Description	Approximate anticipated thickness (m)
Topsoil	Generally Site wide (except local present day and historical development areas).	Topsoil.	Nominal thickness e.g. c.0.1m-0.4m, potentially greater due to agricultural activities.
Local Made Ground	Locally associated with areas of present day and historical development/features e.g. roads/lanes, realignment of Thorpe Brook, agricultural land uses (e.g. possible sludge storage and potential culvert), ponds (including locally infilled), local structures etc.	Variable granular and cohesive materials with anthropogenic inclusions, and some possibility of local obstructions e.g. well. Potential for 'sludge' and 'use of waste in construction' locally associated with waste exemptions in field and area of present day developments on Regions 4d and adjacent to 4e.	Generally anticipated to be of relatively minor thickness i.e. <1m, although could locally be deeper e.g. infilling historical ponds and realignment of the Thorpe Brook.
Local Alluvium	Locally mapped in central and eastern parts of Region 4e and on northeastern linear Site boundary	Soft to firm unconsolidated, compressible silty clay, potentially with layers of silt, sand, peat and basal gravel.	Variable, likely increasing in thickness towards the central valley

Stratum	Anticipated Occurrence	Generalised Description	Approximate anticipated thickness (m)
	extension in Region 4d/c, associated with the Thorpe Brook and an adjoining tributary, including associated with historical meandering extent. Some possibility for more localised/thinner deposits around other existing surface water features.	Potential for a desiccated surface zone.	associated with the Thorpe Brook.
Local Head Deposits	Associated locally with linear valley/depression features, e.g. in Region 4a, 4b, 4c and 4e.	Poorly sorted and poorly stratified gravel, sand and clay (subject to upslope source), potentially locally with lenses of silt, clay or peat and organic material.	Variable.
Oadby Till Member	General coverage across Region, including underlying Head/Alluvium deposits.	Overconsolidated brown to grey, and silty clay, with boulders and subordinate lenses of sand and gravel, clay and silt. Constituents of Cretaceous and Jurassic rock, including chalk and flint fragments.	Variable, including up to 51m, possibly less i.e. up to 20m and mis-logged on historical records.
Local Whitby Mudstone Formation	Very locally encroaching on Region 4b, correlating with faulting and in the north of Region 4a associated with a local linear extension to the Site boundary.	Medium and dark grey mudstone and siltstone, laminated and bituminous in part, with thin siltstone or silty mudstone beds and rare fine-grained calcareous sandstone beds. Potential for limestone nodules in some horizons and nodular limestones at the base. Assumed weathering profile predominantly of clay transitioning into mudstone.	c. 30 to 58

Stratum	Anticipated Occurrence	Generalised Description	Approximate anticipated thickness (m)
Local Marlstone Rock Formation	Very locally encroaching on Region 4b, correlating with faulting, and underlying Whitby Mudstone Formation.	Sandy, ferruginous limestone interbedded with ferruginous calcareous sandstone, and subordinate ferruginous mudstone beds. Assumed granular weathering profile.	c. 1 to 6
Local Dyrham Formation	Locally encroaching on east of Region 4c, and very locally correlating with faulting on Region 4b. Underlying Marlstone Rock Formation generally.	Pale to dark grey and greenish grey, silty and sandy mudstone, with interbeds of silt or very fine-grained sand (locally muddy or silty), weathering yellow. Impersistent beds or doggers of ferruginous limestone and sandstone, occurring in upper part of sedimentary cycles. Potential for local large cementstone nodules. Assumed weathering profile predominantly of clay transitioning into mudstone.	c. 15 to 29
Charmouth Mudstone Formation	Generally full coverage of Region, including underlying local occurrences of the Dyrham Formation.	Dark grey laminated shales, and dark, pale and bluish grey mudstones. Potential for local concretionary and tabular limestone beds, abundant argillaceous limestone and phosphatic or ironstone nodules in some areas. Further potential for organic-rich shales at some levels and finely sandy beds in lower part in some areas.	c. 105 to 130

Stratum	Anticipated Occurrence	Generalised Description	Approximate anticipated thickness (m)
		Assumed weathering profile predominantly of clay transitioning into mudstone.	
Groundwater: Indicated to be at c. 26 m bgl on a local historical borehole record within the Till. Groundwater anticipated to be shallow in areas of lower lying topographies/surface water features e.g. around the Thorpe Brook. Potential for presence of springs and confined groundwater locally associated with changes in permeability between varying geology e.g. sandstone/sands of the Marlstone Rock Formation creating confined aquifer.			
Anticipated features impacting succession/presence of abnormal ground conditions Presence of 1No. inferred fault, downthrown to the north, mapped crossing through the interface between Region 4b and 4c around Waltham Road, bearing roughly northeast-southwest correlating with outcropping of the Dyrham Formation, Marlstone Rock Formation and Whitby Mudstone Formation. Presence of eastern and western margins of buried, infilled, channel/valley through central parts of Region 4c, bearing roughly north-south. Possible evidence of slope instability on valley associated with the Thorpe Brook as described in Report Section 3.3. Some potential for unrecorded historical mining as per Report Section 3.4 including partially within a Coal Mining Reporting Area with associated deep coal from Region 4d. Potential for Made Ground locally associated with present day and historical developments/features and ponds (anticipated to be locally infilled) and realignment of the Thorpe Brook.			

Table 8.5: Preliminary anticipated ground model for Region 5

Stratum	Anticipated Occurrence	Generalised Description	Approximate anticipated thickness (m)
Topsoil	Generally Region wide (except local present day and historical development areas).	Topsoil.	Nominal thickness e.g. c.0.1m-0.4m, potentially greater due to agricultural activities.
Local Made Ground	Locally mapped associated with	Fill associated with historical railway embankment likely formed	Correlating with height of historical rail embankment.

Stratum	Anticipated Occurrence	Generalised Description	Approximate anticipated thickness (m)
	historical rail embankment.	of ballast, possibly covering a clay embankment.	Elsewhere, generally anticipated to be of relatively minor thickness i.e. <1m, although could locally be deeper e.g. infilling historical ponds.
	Potential elsewhere associated with areas of present day and historical development/features e.g. roads, adjacent developments (e.g. Hindle Top Farm, agricultural facility and suspected drainage basin/pond, towers etc), irregular ground/mounds/stoc k piles, ponds (possibly locally infilled), local structures etc.	Elsewhere, variable granular and cohesive materials with anthropogenic inclusions, and some possibility of local obstructions e.g. well. Potential for 'use of waste in construction' locally associated with waste exemptions in area of present day developments adjacent to south of Region 5a/c.	
Local Alluvium	Locally mapped through the east of Region 5b associated with the Scalford Brook. Some possibility for more localised/thinner deposits around other existing surface water features.	Soft to firm unconsolidated, compressible silty clay, potentially with layers of silt, sand, peat and basal gravel. Potential for a desiccated surface zone.	Variable, likely increasing in thickness towards the central valley associated with Scalford Brook.
Local Head Deposits	Associated locally with linear valley/depression features across Region.	Poorly sorted and poorly stratified gravel, sand and clay (subject to upslope source), potentially locally with lenses of silt, clay or peat and organic material.	Variable.
Oadby Till Member	Generally mapped across Region, including underlying	Overconsolidated brown to grey, and silty clay, with boulders and subordinate lenses of sand and gravel, clay and silt. Constituents of	Variable, c. 3.50 to 31, possibly less i.e. up to 20 and

Stratum	Anticipated Occurrence	Generalised Description	Approximate anticipated thickness (m)
	Head/Alluvium deposits.	Cretaceous and Jurassic rock, including chalk and flint fragments.	mis-logged on historical records.
Dyrham Formation	Generally Region wide, albeit with partial coverage in Region 5b.	Pale to dark grey and greenish grey, silty and sandy mudstone, with interbeds of silt or very fine-grained sand (locally muddy or silty), weathering yellow. Impersistent beds or doggers of ferruginous limestone and sandstone, occurring in upper part of sedimentary cycles. Potential for local large cementstone nodules. Assumed weathering profile predominantly of clay transitioning into mudstone.	c. 15 to 29
Charmouth Mudstone Formation	General coverage of central eastern part of Region 5b and locally encroaching on 5a, including underlying the Dyrham Formation generally.	Dark grey laminated shales, and dark, pale and bluish grey mudstones. Potential for local concretionary and tabular limestone beds, abundant argillaceous limestone and phosphatic or ironstone nodules in some areas. Further potential for organic-rich shales at some levels and finely sandy beds in lower part in some areas. Assumed weathering profile predominantly of clay transitioning into mudstone.	c. 105 to 130, possibly greater
Groundwater: Indicated to potentially be around c.10m bgl on a local historical borehole log, albeit record appears unclear and anticipated to be shallow in areas of lower lying topographies/surface water features e.g. Thorpe Brook.			
Anticipated features impacting succession/presence of abnormal ground conditions			

Stratum	Anticipated Occurrence	Generalised Description	Approximate anticipated thickness (m)
		Presence of eastern and western margins of buried, infilled, channel /valley through Region 5b (eastern margin locally encroaching on Region 5a), bearing roughly northwest-southeast.	
		Northern margin of buried, infilled, channel/valleys adjacent to the south of Region 5e, bearing roughly northwest-southeast and indicating increased thicknesses of superficial deposits to the south of this.	
		Some potential for unrecorded historical mining as per Report Section 3.4, including being within a Coal Mining Reporting Area with associated deep coal.	
		Potential for Made Ground locally associated with present day and historical developments/features, historical railway embankment, adjacent developments, mounds/stockpiles, adjacent basin/pond and ponds (possibly locally infilled).	

Table 8.6: Preliminary anticipated ground model for Region 6

Stratum	Anticipated Occurrence	Generalised Description	Approximate anticipated thickness (m)
Topsoil	Generally Region wide (except local present day and historical development areas).	Topsoil.	Nominal thickness e.g. c.0.1m-0.4m, potentially greater due to agricultural activities.
Local Made / Landscaped Ground	Locally mapped adjacent to existing Fish Pond in Region 6e and on northern and southern linear extension to Region 6b associated with historical railway siding and existing infrastructure/watercourse crossings. Locally in area of bare ground on satellite imagery across linear southeast extension to Region 6d.	Variable granular and cohesive materials with anthropogenic inclusions, and some possibility of local obstructions e.g. well. In areas, materials associated with embankments/historical rail lines. Potential for 'waste from dredging of inland waters and treating waste' adjacent to the south of Region 6a. In adjacent areas, heaped or landfilled material associated with coal mining at Asfordby and Holwell Works respectively; albeit assumed to not extent onto Site.	Generally anticipated to be of relatively minor thickness i.e. <1m, although could locally be deeper e.g. adjacent to Fish Pond/infilling historical ponds. In areas of raised ground around/associated with historical railways/existing infrastructure, correlating with height of associated embankments/bunds.

Stratum	Anticipated Occurrence	Generalised Description	Approximate anticipated thickness (m)
	Potential elsewhere associated with areas of present day and historical development/features e.g. roads/lanes, existing structures and tank adjacent to 5a, historical Fish Pond House, existing Gas Valve Compound, towers, ponds (including potentially infilled) etc. Note, more extensive areas indicated adjacent to south of 6b/c/d associated with landfill and coal mining spoil heap.		
Local Alluvium	Locally through Region 6b associated with a linear surface water feature. Some possibility for more localised/thinner deposits around other existing surface water features.	Soft to firm unconsolidated, compressible silty clay, potentially with layers of silt, sand, peat and basal gravel. Potential for a desiccated surface zone.	Variable, likely increasing in thickness towards the central valley associated surface water feature.
Local Head Deposits	Associated locally with linear valley/depression features across Region.	Poorly sorted and poorly stratified gravel, sand and clay (subject to upslope source), potentially locally with lenses of silt, clay or peat and organic material.	Variable.
Oadby Till Member	General coverage of Region 6a and 6c to	Overconsolidated brown to grey, and silty clay, with boulders and	Variable, c. 5 to 51, possibly less i.e. up

Stratum	Anticipated Occurrence	Generalised Description	Approximate anticipated thickness (m)
	6e, partial coverage of 6b, and underlying Head/Alluvium deposits.	subordinate lenses of sand and gravel, clay and silt. Constituents of Cretaceous and Jurassic rock, including chalk and mudstone fragments.	to 20 and mis-logged on historical records.
Local Oadby Till Member (Lias-rich)	Partial coverage across parts of Region 6b, locally encroaching on 6c, 6d and 6e, and underlying Head/Alluvium deposits.	Overconsolidated clay, brown to grey, and silty clay, with chalk and flint fragments; rich in 'Lias' rock fragments. Possibility for Thrussington Till Member and Baginton Sand and Gravel Formation / Bytham Sand and Gravel Formation at base, including evidence wet/low strength deposits as per Table 3.25 of relatively notable thicknesses.	
Dyrham Formation	Partial coverage in north and east of Region 6a and north of Region 6b, predominantly associated with semi-circle linear extension to Site boundary. Local coverage in north of Region 6c.	Pale to dark grey and greenish grey, silty and sandy mudstone, with interbeds of silt or very fine-grained sand (locally muddy or silty), weathering yellow. Impersistent beds or doggers of ferruginous limestone and sandstone, occurring in upper part of sedimentary cycles. Potential for local large cementstone nodules. Assumed weathering profile predominantly of clay transitioning into mudstone.	c. 25
Charmouth Mudstone Formation	Generally Region wide, including underlying Dyrham Formation.	Dark grey laminated shales, and dark, pale and bluish grey mudstones. Potential for local concretionary and tabular limestone beds, abundant argillaceous limestone	c.105 to 130, possibly greater

Stratum	Anticipated Occurrence	Generalised Description	Approximate anticipated thickness (m)
		and phosphatic or ironstone nodules in some areas.	
		Further potential for organic-rich shales at some levels and finely sandy beds in lower part in some areas.	
		Assumed weathering profile predominantly of clay transitioning into mudstone.	
		Evidence of loss of drilling fluid on historical record, suggesting open fractured nature potentially in areas.	

Groundwater: Anticipated to be relatively deep in upper topography, then relatively shallow in areas of lower lying topography/surface water features.

Anticipated features impacting succession/presence of abnormal ground conditions

Potential evidence of slope instability around the surface water feature with mapped Alluvium and possibly around the Fish Pond as per Report Section 3.3, alongside other evidence of slickensides on historical borehole log further south.

Presence of 2No. inferred faults, bearing northwest-southeast through Regions 6a and 6b and east-west locally through the north of Region 6e, downthrown to the north/northeast.

Presence of northern margin of buried, infilled, channel/valley crossing Region 6a on a northwest-southeast bearing also crossing Region 6e on a northeast-southwest bearing. This indicates increased thicknesses of superficial deposits to the south of this through Region 6, with the southern boundary evident encroaching on southern linear extension to Site across Regions 6b and 6c

Evidence of deep historical coal mining associated with Asfordby Mine, indicated across Regions 6b to 6e and some potential for further unrecorded historical mining features as per Report Section 3.4 . This correlates with being within a Coal Mining Reporting Area with associated deep coal.

Potential for Made Ground locally associated with present day and historical developments/features, including e.g. Fish Pond, existing structures and tank (e.g. adjacent to/encroaching on 6a), historical Fish Pond House, existing Gas Valve Compound, towers and ponds (including potentially infilled), historical rail lines etc.

Areas of landfill and coal mine tip/heap adjacent to south.

9. Initial Conceptual Site Model

9. Conceptual Site Model & Risk Assessment

9.1 Introduction

- 9.1.1 The preliminary CSM has been developed to identify potentially complete contaminant linkages that may require further investigation to assess their existence and/ or potential significance. The potential sources of contamination on or in the vicinity of the Site, receptors on or near the Site, and pathways on or near the Site are discussed within the following paragraphs.
- 9.1.2 A summary of the applicable legislative and planning framework, and AAJV's approach to assessment used in the following paragraphs is presented in Appendix D.

9.2 Potential Sources of Contamination

- 9.2.1 Based on the Site setting, history and land uses described in preceding Report Sections, the following potential sources of contamination and CoPC listed in Report Section 4.3 have been identified and are presented in Table 9.1. Note that distances for the same feature identified on historical mapping and regulatory consultation data may vary slightly. All features are identified as current unless stated as historical.
- 9.2.2 The CoPC are based on information provided in the Department of Environment Industry Profiles (Ref 13.49) and AAJV's industry experience.

Table 9.1: Summary of potential sources of contamination

Source	Region(s)	Description	CoPC
On Site and Offsite Existing Underground Fuel Line	1a	Existing underground fuel line running in a north-south orientation through the eastern corner of Region 1a.	Total Petroleum Hydrocarbons (TPH), Polyaromatic Hydrocarbons (PAHs), Semi-Volatile Organic Compounds (SVOCs)
On Site and Offsite Gas Pipelines	2b, 2e, 2f, 3a, 3b, 5e, 6a	Existing gas supply pipelines crossing the OHL alignment	Methane, Carbon Dioxide
On Site Pill Box	2b	Stone block feature (historical military feature) located on Region 2b. Made Ground may be associated with construction of the feature.	Metals and metalloids, asbestos/ACM

Source	Region(s)	Description	CoPC
On Site and Offsite Infilled Land	All	Various ponds have been noted on and within 250 m of the Site (all regions) from earliest mapping, which have since mostly been assumed to have been infilled. The nature of the infill material is unknown. Similar infilling may have also been undertaken during realignment of the Thorpe Brook. Ponds may be associated with former surface working associated with mining on and within 250m of the Site, or with karst features in Region 1.	Metals and metalloids, Polyaromatic Hydrocarbons (PAHs), Semi-Volatile Organic Compounds (SVOCs), pH, ground gas (carbon dioxide, methane and hydrogen sulphide) and asbestos containing materials (ACM)/asbestos.
On Site and Offsite Made Ground	All	Due to the presence of various roads, historical railways, structures, disused airfield and infilled ponds, Made Ground is anticipated across all regions. The nature of the infill material is unknown.	Metals and metalloids, PAHs, SVOCs, pH, cyanides, ground gas (carbon dioxide and methane) and asbestos containing materials (ACM)/asbestos.
On Site and Offsite Railway Land	2e, 5b and 6b	A number of historical railway lines were noted to cross the Site in Region 2e (at 490036 E 320776 N), Region 5b (at 476061 E 322507 N), and Region 6b (at 473107 E 321724 N) extending offsite. From recent aerial photography the tracks related with these are no longer present, with the most recent removed by 2006. Historical railway sidings were also noted crossing the access route in north Region 6b and adjacent the access route south of Region 6b.	Metals and metalloids, SVOCs, Volatile Organic Compounds (VOCs), Total Petroleum Hydrocarbons (TPH), PAH, Polychlorinated Biphenyls (PCBs), sulphate, asbestos containing materials (ACM), herbicides and glycols.
On Site and Offsite Agricultural Land	All	Agricultural land is noted along the entire extent of the Site and in the surrounding area – including use of chemicals on crops (diffuse application), agricultural machinery and tanks/sheep dips (classed as	Metals and metalloids, TPH (anticipated to be minimal), ammoniacal nitrogen, herbicides and pesticides. <i>Contaminants in highest concentration/significance</i>

Source	Region(s)	Description	CoPC
		point sources). Silos have been noted ~10m west (of the access route) of Region 3c.	<i>likely to be present where specific point sources are recorded.</i>
On Site and Offsite Tanks	1b, 1e, 1d, 4a, 4e, 6a, 6b, 6d and 6e	A number of historical and current tanks have been noted along the extent of the Site. Known current tanks have been noted ~190m northwest of Region 1e and onsite on Region 6a. All other listed tanks (Report Section 4.3) are recorded as historical, and range from ~5m – 155m from Site.	PAH, asbestos and TPH
Onsite and Offsite Airfield (disused)	1c, 1d and 1e	The RAF North Witham disused airfield located in Twyford Wood has been noted to span from onsite of Region 1c to 1e, extending offsite. Visually the airfield appears offsite, however database information records it as onsite. The airfield is noted to have been active between 1943 and 1956. Present day aerial (2024) shows the alignment of the runways still present with vegetation across the hardstanding.	Metals and metalloids, Cyanides (total, free), SVOCs, VOCs, TPH, PCBs, pH, ACM/asbestos, per- and polyfluoroalkyl substances (PFAS) and Glycols
Onsite and Offsite Sludge Storage	2e, 2f, 3b, 4c, 4d, 4e and 5a	Licence for storage of sludge onsite of Region 2f, 4d. Recorded offsite 220m southwest of Region 2e, 20m and 105m south/southwest of Region 3b, 7No. entries ~20m to ~220m of Region 4c to 4e and ~220m southeast of 5a.	Metals and metalloids, Cyanides (total, free), SVOCs, VOCs, TPH, PCBs, Nitrate, Sulphate, Sulphide, pH, ACM/asbestos and Ammoniacal nitrogen
Onsite and Offsite Surface Workings & Underground Mining	2a, 4e 5a, 5d, 6a, 6c, 6d and 6e	Recorded and potential/possible mining has been noted across the Site in various areas as per Report Section 3.4. Deep underground coal mining is recorded across parts of Region 6 associated with Asfordby Mine, with the risk	Metals and metalloids, pH, sulphate, Methane, carbon dioxide, and hydrogen sulphide.

Source	Region(s)	Description	CoPC
		from mine gas outlined in Report Section 3.4. Surface workings for ironstone are recorded in Region 2e, with a more local pit recorded in Region 2a. Potential for unrecorded spoil heaps associated with the surface and underground workings, as well as the landfill and spoil heap recorded, adjacent to south of Region 6 understood to have associations with the Holwell Works and Asfordby Mine respectively. Some potential for other unrecorded workings elsewhere, including associated with mapped ponds, as per Report Section 3.4	
Offsite Industrial Site	1d, 1e, and 6b	Honey Pot Lane Industrial Estate adjacent to northwest the site, and Asfordby Industrial Estate south of the linear extension of the Site.	Metals and metalloids, Cyanides (total, free), SVOCs, VOCs, TPH, PCBs, pH, ACM/asbestos.
Offsite Electricity Substations	1e, and 6c	Electricity substations recorded ~10m west (historical) of Region 1e (from the access road), ~170m northwest of Region 1e from historical mapping, and ~130m south of the linear extension south of Region 6c.	TPH and PCBs.
Offsite Gas Valve Compound	2a and 6a	Gas valve compounds are noted ~240m south of 2a and on Site on Region 6a.	Metals and metalloids and TPH.
Offsite Animal Management Sites	6b	Licencing for substances and waste relating to the Poultry Farm 95m northwest of Region 6b.	Metals and metalloids, SVOCs, PAH, Organochlorine Pesticides, Sulphate, Sulphide and Ammoniacal nitrogen

Source	Region(s)	Description	CoPC
Offsite Waste Sites	1e, d 5a, and 6b	Licencing related to farm waste at Honeypot Estate 265m north of Region 1e, and household/commercial/industrial waste 225m northeast of Region 5a, as well as the recent Active Landfill adjacent to the linear extension south of Region 6b (marked as slag Heap in historical drawings).	Metals and metalloids, SVOCs, VOCs, TPH, PAH, PCBs, Dioxins & furans, Sulphide, pH, ACM/asbestos and Ammoniacal nitrogen
Offsite Vehicle Repair Site	1d	Vehicle Repairs recorded ~135m northwest of Region 1d.	Metals and metalloids, SVOCs, VOCs, TPH, PAH, PCBs, Organolead compounds, pH and ACM/asbestos
Offsite Unspecified Works/Factory	4b	Works/factory of unknown use recorded 205m north of Region 4b.	Metals and metalloids, SVOCs, VOCs, PAH, Nitrate, Sulphate, pH and ACM/asbestos

9.3 Ground Gas Sources

9.3.1 The identified sources of ground gas within the above table have been further characterised in Table 9.2 using BS 8576:2013 “Guidance on investigations for ground gas – Permanent gases and Volatile Organic Compounds (VOCs)” (Ref 13.48) – Figure 6 to determine the ground gas generation potential of the sources.

Table 9.2: Potential Sources of Ground Gas Generation

Source	BS 8576 Ground Gas Generation Potential	Justification
Made Ground	Very Low	Due to the nature of the features onsite and offsite which are likely to lead to the presence of Made Ground (roads, railway, buildings with limited contamination risk) the risk from ground gas generation is considered to be Very Low in accordance with BS 8576, as it is likely that the Made Ground present is of low biodegradable organic content (<5% organic matter).
Infilled ponds	Very Low to Low	Numerous ponds, pits and quarries were assumed to be infilled from their disappearance on historical OS mapping. These features are noted both onsite and within 250m along the extent of the alignment. BS 8576 states infilled ponds less than 15m diameter and infilled before the 1930s

Source	BS 8576 Ground Gas Generation Potential	Justification
		to 1940s are of Very Low risk. Where these are infilled at a later date than this, the risk is slightly increased to Low.
Peat	Very Low	Localised areas of peat have been noted as layers within the Alluvium and Head Deposits across the deposits present from Region 1 to 6. While peat is anticipated to be present on the Site, it is classified as having a Very Low ground gas generation potential by BS 8576 due to its low degradable organic content and is therefore unlikely to represent a significant source of ground gas generation.
Animal waste	Low	A licencing entry with respect to farm waste is noted ~190m north of Region 1e and ~40m north of Region 6c. The site is considered out of influencing distance with respect to ground gas. Gas generation potential from the waste following anaerobic digestion is also considered to be low. Although BS 8576 doesn't explicitly state animal waste as a source of ground gas generation, anaerobic degradation processes create carbon dioxide and methane. BS 8576 states that natural soils with a high degradable organic content may have a Low ground gas generation potential.
Sludge storage	Moderate	The storage of sludge is noted onsite of Region 2f and 3b, and offsite of Region 2e, 3b, 4c to 4e and 5a. From the landfill waste exemption entries, it is unknown the details of the sludge, whether it is of sewage origin or not, albeit reasonably assumed to be animal waste. In accordance with BS5876 the presence of sewage sludge results in a Moderate ground gas generation potential.
Underground Coal Mining & Shallow Ground Workings	Very Low	Underground mining has been recorded across Region 6 of the Site, with the depth of workings at c. -350 - 440m OD and last worked in 1995-1997. Former deep workings are likely to be saturated by groundwater in the absence of active pumping. Two faults are known to be present in this area. Based on this and in line with BS 8576 (and CL:AIRE, 2021), it is unlikely that mine gas poses a risk to the Site, with a very low gas generation potential considered appropriate, and an absence of confined spaces where gases may accumulate. For surface workings, these have been identified as close as onsite e.g. on Region 2e (albeit ironstone mining).
Leaks from Existing Gas Mains	Very Low	Existing gas mains have been identified crossing the OHL in Regions 2b, 2e, 2f, 3a, 3b, 5e, 6a. Although stated by BS 8576 that methane and carbon dioxide may be generated by leaks in gas mains, it is considered

Source	BS 8576 Ground Gas Generation Potential	Justification
		reasonable that gas generation potential from existing mains is very low due to modern construction, maintenance programs, and surveillance of the mains.

9.4 Potential Receptors

9.4.1 Potential receptors associated with the proposed development are shown in Table 9.3.

Table 9.3 Potential Receptors

Receptor group	Receptor	Description
Human Health	Construction and Ground Investigation Workers	Workers involved in the GI and construction phases.
	Maintenance Workers	Maintenance workers of the pylons and OH cables.
	Trespassers/General Public	Areas where pylons/OHL are located are within open fields which are accessible to users of public footpaths or trespassers.
	Site Users	Site users include owners and users of the various land uses crossed by the OHL alignment including farmland with crops and livestock and solar farms.
	Adjacent Site Users	Residential housing, commercial properties and farms present within 250 m of the alignment.
Controlled Waters	Unproductive Aquifers	Whitby Mudstone.
	Secondary Undifferentiated Aquifers	Head Deposits, Till (Mid Pleistocene, Diamicton), Oadby Till Member (Diamicton), Oadby Till Member (Lias-rich), Grantham Formation, Charmouth Mudstone Formation, Dyrham Formation
	Secondary B Aquifers	Rutland Formation
	Secondary A Aquifers	Alluvium, Northampton Sand Formation, Marlstone Rock
	Principal Aquifers	Upper Lincolnshire Limestone and Lower Lincolnshire Limestone, and the Karst features associated with these Formations.

Receptor group	Receptor	Description
	Surface Waters ¹	Major watercourses inclusive of rivers, streams and drains as described in Report Section 3.7 and those connecting to them.
Property	Buildings & Infrastructure – Concrete	Concrete foundations associated with the pylons.
	Buildings & Infrastructure – Structures with Enclosed Spaces	Buildings adjacent to the <u>Site</u> inclusive of housing, commercial units, substations etc.
	Buildings & Infrastructure – Services	Underground services passing beneath the <u>Site</u> associated with the surrounding land uses.
	Livestock	Livestock and crops in fields beneath the OHL alignment, adjacent to the pylon towers and surrounding land.
	Crops	

Notes:

¹ A comprehensive assessment on surface water quality and impact, and sensitive site use will be undertaken by the environment team

9.5 Potential Pathways

9.5.1 Potential pathways associated with the proposed development are shown in Table 9.4.

Table 9.4: Potential Pathways

Pathway Group	Pathway
Human Health	Ingestion of soil, dust, and groundwater
	Inhalation of dust – indoor and outdoor
	Dermal contact – indoor and outdoor
	Vapour intrusion and inhalation – indoor and outdoor
	Gas ingress – explosive atmosphere
	Gas ingress – inhalation
Controlled Waters	Leaching and vertical migration through unsaturated zone
	Lateral migration in groundwater
	Vertical migration in groundwater

Pathway Group	Pathway
Property	Direct run-off
	Baseflow from groundwater to surface water
	Migration via preferential pathways – underground services, pipes and granular material
	Gas intrusion – explosion
	Direct contact – corrosion
Property	Direct contact – permeation of water pipe
	Plants via root uptake/Direct Uptake
	Dermal contact/inhalation of dust/ingestion

9.6 Discounted Sources/Pathways/Receptors

9.6.1 The following sources, pathways and receptors shown in Table 9.5 are discounted from the conceptual site model with the justification presented.

Table 9.5: Discounted Sources/Pathways/Receptors

Group	Discounted Item	Justification
Source	Existing Underground Fuel Line	No construction information on the fuel line is available. Assuming the fuel line is critical infrastructure, the construction thereof, and modern day operating procedures, is considered to be unlikely to result in minor continuous leaks/spills.
	Existing Gas Mains	Unlikely that the standard operation of the gas main is a source of contamination. It is considered reasonable that gas generation potential from existing mains is very low due to modern operational procedures. Mitigation measures implemented prior to ground investigation and construction works, included utility surveys, aim to prevent potential damage to existing utilities. Risk to construction works from potential gas accumulation will be covered under Risk Assessments and Method Statements, required under the CDM regulations. It is expected that any potential gas generated will dissipate into the open air.
	Stone block feature (historical military feature, Pill Box)	Unlikely to be a source of contamination due to its size, intended use (short term human occupancy and defence), and time elapsed since use.

Group	Discounted Item	Justification
	Animal Management Site	The animal management site is unlikely to be a viable source of contamination affecting the Site as no processing operations are taking place. These sites are only to raise/keep the animals.
	Gas Valve Compound	Listed as a recent industrial land use, with it unlikely that present-day activities are to cause significant risk to receptors in comparison to historical processes. The compound is isolated and likely to be on hardstanding.
	Waste Site – Honeypot Estate	The waste site at Honeypot Estate can be discounted due to its distance from the site boundary (>250m).
	Gas generation from Surface Workings (offsite) & Underground Coal Mining	Due to the lateral distance from site, offsite surface workings are not considered to be of risk to the receptors. Similarly, due to the depth at which the underground workings are present onsite the risk from mine gas is negligible to very low (as defined in Report Section 3.4).
Pathways	Preferential pathways – service ducts	Due to the extent of the Site, its rural setting and the localised construction/GI works taking place in the vicinity of the pylons, services are unlikely to pass close to the towers themselves. Therefore, the pathway is considered very unlikely to be present.
	Direct contact – permeation of water pipe	Pylons are likely to be positioned away from current water supply pipes.
	Gas Ingress – explosion for Very Low to Low sources	In line with BS 8576 where ground gas sources are of Very Low to Low risk (Made Ground, infilled land, animal waste, underground coal mining and shallow workings). With this in mind the likelihood of it generating gas to a high enough concentration to cause explosion (particularly as the site is in an open-air environment) is negligible. The pathway remains present within 250m of where sludge storage sites are noted.
Receptors	Maintenance Workers	Maintenance workers will be attending to the transmission towers and overhead cables above ground and will be unlikely to be in contact with the ground for extended periods of time. The risk to them is considered low enough that it can be discounted at this stage.
	Buildings & infrastructure – services	Due to the extent of the Site, its rural setting and the localised construction/GI works taking place in the vicinity of the pylon towers, services are unlikely to pass close by to the towers themselves.

9.7 Preliminary Risk Assessment

- 9.7.1 AAJV's approach to the preliminary risk assessment follows the guidance outlined in CIRIA C552 (2001) (Ref 13.50) and is described in further detail in Appendix D.
- 9.7.2 The qualitative preliminary risk assessment of the possible linkages of the above sources, exposure and transport pathways and receptors is provided in detail in Appendix E. The majority of the Site is deemed as low risk due to the low-level contaminative sources or where a credible pathway isn't present between the source and receptor.
- 9.7.3 A summary of the risk assessment in has been included in Table 9.6.

Table 9.6: Summary of Moderate/Low to Moderate risks

Pathway Group	Pathway	Risk Rating
Human Health		
Dermal contact and ingestion (GI and Construction Workers)	<u>Onsite only:</u> Railway Land and Disused Airfield – Regions 1c to 1e, 2e, 5b and 6b	Moderate/Low
Human Health		
Inhalation of dust & asbestos (GI and Construction Workers)	<u>Onsite:</u> Railway Land and Disused Airfield – Regions 1c to 1e, 2e, 5b and 6b <u>Offsite:</u> Made Ground, Railway Land, Industrial Estate, Sludge Storage and Disused Airfield – All Regions	Moderate/Low
Human Health		
Inhalation of vapours (GI and construction workers)	<u>Offsite only:</u> Railway land, Disused Airfield, Industrial Site, Waste Sites, Sludge Storage, Vehicle Repair Site and Unspecified Works – 1c, 1d, 1e, 2e, 2f, 3b, 4b, 5a, 5b and 6b	Moderate/Low
Human Health		
Ground gas inhalation & explosion	<u>Onsite:</u> Sludge Storage Site, historical deep coal mining – Region 2f and 6e <u>Offsite:</u> Sludge Storage Sites – Regions 2e, 3b, 4c, 4d, 4e and 5a	Moderate/Low to Moderate
Controlled Waters		
Leaching into Principal & Secondary A Aquifers	<u>Onsite & Offsite:</u> Made Ground, Infilled Land, Agricultural Land (All Regions)	Moderate/Low
	<u>Onsite & Offsite:</u>	Moderate

Pathway Group	Pathway	Risk Rating
	Made Ground, Infilled Land, Agricultural Land (All Regions)	
	<u>Onsite:</u> Railway Land, Disused Airfield and Tanks – Regions 1b to 1d, 2e, 5b and 6b	
	<u>Offsite:</u> Tanks, Electricity Substation, Disused Airfield, Sludge Sites, Vehicle Repair Site, Waste Sites, and historical deep coal mine – Regions 1e, 1d, 2f, 5a, and 6b.	
Controlled Waters Run-off/baseflow into Surface Waters	<u>Onsite</u> Run-off in areas of impermeable soils Baseflow in areas of permeable soils <u>Offsite:</u> Tank, Railway Land, and slag heap – Region 5b and 6	Moderate/Low

9.8 Discussion of Acute Risk to Future Construction Workers & Offsite Receptors.

- 9.8.1 AAJV understands that the proposed development works will be undertaken in compliance with Construction Design and Management (CDM) 2015 regulations (Ref 13.52).
- 9.8.2 Prior to work commencing, a health and safety risk assessment should be carried out by the appointed Principal Contractor/developed in accordance with current health and safety regulations. This assessment should cover potential risks to construction staff, permanent Site staff and the local population. Based on the findings of this risk assessment, appropriate mitigation measures should be implemented during the construction period.
- 9.8.3 The greatest potential for generation of dust will be during the Site works and therefore dust generation should be kept to a minimum in accordance with general best practice, as outlined in, for example, 'Environmental Good Practice on Site', CIRIA Publication C692 (Ref 13.68) to reduce this risk.
- 9.8.4 The risk to construction workers during the excavation and construction phases in terms of potential exposure to high concentrations of contaminants is currently considered to be low given the historical and current land uses identified at the Site. Should gross contamination be identified during the ground investigation and/or construction phase, then this may pose a potential acute risk to construction works. It is likely to be able to be effectively managed through good health and safety practices and protocols. Adoption of appropriate dust suppression techniques would also mitigate the degree of potential particulate migration offsite.

10. Review of Geotechnical Risk and Preliminary Engineering Assessment

10. Review of Geotechnical Risk and Preliminary Engineering Assessment

10.1 Preliminary Geotechnical Risk Register

- 10.1.1 A preliminary geotechnical risk register is presented in Appendix C which describes the main ground related hazards/constraints on the Site (excluding ground contamination) and mitigation measures which may be implemented to eliminate or reduce the risk either through further investigation or during the design phase. The following risks/constraints are currently anticipated associated with the Site:
- Generally unknown ground conditions (including groundwater) due to the absence of ground investigation information across the Site, increasing likelihood for unexpected ground conditions.
 - Presence of recorded karstic terrains and associated subsidence features and likely additional unrecorded/associated features, including swallet/sink/shake holes and stream sinks as per Report Section 3.3.
 - Lateral and vertical changes in ground conditions and ground engineering properties, including geological boundaries, faulting and buried channels/valleys, resulting in sudden changes in natural geology.
 - Aggressive ground chemistry, anticipated to be most prevalent in mudstone bedrock formations (e.g. Charmouth Mudstone) and potentially Tills (e.g. where Lias rich), subject to constituents.
 - Local natural compressible deposits such as Alluvium, including potential areas of unrecorded deposits around other surface water features and wider extents due to altered river channels e.g. around the surface water course in Region 4e.
 - Potential for slope instability issues, including relict shear surfaces and soils at residual strengths, with mapped cambering terrains (with possibility for fissures/gulls) and potential signs of local slope instabilities/over steepened slopes in existing sloping topographies as per Report Section 3.3 (including risk of scour in watercourses).
 - Local Head deposits with potential for poor load bearing characteristics associated with valley/depression topographies.
 - Sloping topographies requiring earthworks/retaining walls to manage level changes as part of enabling works.
 - Potential for shallow groundwater in lower lying topographies/surface water features, alongside potential for confined aquifers, including evidence of springs and artesian groundwater.

- Potential for excavation/cutting instabilities, including possibility for running sand conditions associated with water bearing granular soils e.g. weathering from the Northampton Sand Formation.
- Potential for shallow bedrock/natural obstructions (including boulders in Tills and possible harder rock beds within 'softer' rock stratum) and potentially locally, anthropogenic obstructions associated with historical/present day developments including historical structures, rail, wells and pumps.
- Presence of existing utilities (buried and overhead), including existing overhead lines, culverts and increasing in likelihood in areas of existing developments, tanks and Gas Valve Compound.
- Potential for damage to existing developments/infrastructure if not suitably considered, including existing tower foundations, buildings and assumed drainage ponds/basins, and associated access constraints generally.
- Surface mineral extraction as per Report Section 3.4, including area of opencast ironstone worked ground and local recorded/suspected pits, with associated buried high walls and infill (including local infilled ponds and historical development footprints).
- Historical deep underground coal mining recorded in Region 6, alongside some potential for other unrecorded coal mining features within wider Coal Mining Reporting Area and some potential for historical underground non-coal mining in other regions as per Report Section 3.4 e.g. of ironstone and associated features.
- Possibility for constraints associated with developments within safeguarded limestone mineral resources.
- Likely clay dominated shallow soils with shrink-swell risk, exacerbated by the presence of trees.
- Potential for shallow soils prone to frost heave e.g. associated with fine/variable Till.
- Ground conditions likely generally unsuitable for infiltration drainage due to shallow soils generally being anticipated to be clay dominated with overall low permeability, and subsidence risk of using such drainage in areas with karst features.
- Potential UXO risk identified by preliminary assessment, with further detailed assessment required to further inform risk and subsequent mitigation.

10.1.2 Further details on the Site's geotechnical risks/constraints are contained in the preliminary geotechnical risk register in Appendix C and local risks/constraints presented on Figure 10 in Appendix A. This risk register is a live document and will be reviewed, alongside Figure 10, following Site reconnaissance and ground investigations, then developed and refined as the geotechnical design and assessment progresses such that the register will allow management of the geotechnical risks. As part of risk refinement and assessment, Site specific ground investigations are required to identify underlying ground conditions and assess ground related risks.

10.2 Preliminary Engineering Assessment

- 10.2.1 This preliminary engineering assessment is based on the proposed development as outlined in Report Section 1. No Site specific intrusive ground investigations have been completed to support ground engineering assessments at the time of writing, therefore the high-level commentary and preliminary outline recommendations only are presented herein and are reliant on limited publicly available desk-based sources as referenced throughout this Report. Ground investigations and subsequent interpretive reporting are required to confirm the ground and groundwater conditions, further assess identified risks/constraints, and enable design development and inform construction.

Structural Foundations

- 10.2.2 Structural foundations will be required for proposed towers along the new OHL route. Structural foundations are also anticipated to potentially be required for enabling works/haul roads, e.g. if bridged crossings are required such as over water features that are present locally crossing the Site.
- 10.2.3 The type and geometry of these foundations will be dependent on the associated structural loads and ground conditions, including associated hazards/constraints, present beneath/adjacent to the development footprint of the structure.
- 10.2.4 In general, Made Ground/Worked Ground/Landscaped Ground, and superficial Head and Alluvium deposits are not considered suitable founding stratum due to their likely variability and/or low strength characteristics.
- 10.2.5 Glacial Tills (which are anticipated to dominate shallow soils on Site) and bedrock geology are typically anticipated to be suitable founding stratum, subject to their variability, lateral/vertical consistency, presence of boulders creating hard spots/risks of differential settlement, slope instabilities/cambering terrains, presence of natural voids within limestones, and possibly, mining voids associated with ironstone or coal mining in other bedrock geology.
- 10.2.6 Where high structural loads are imparted by proposed developments, the need for deeper foundation solutions over traditional shallow foundations increases in likelihood. Likewise, where unfavourable shallow ground conditions are present e.g. deep Artificial Ground, soft Alluvium or loose/variable Head (including with potential for relict shear surfaces) and voids/karstic terrain, deep foundations will likely be required to transmit loads to underlying deeper competent bearing stratum, unless other suitable remedial/mitigation measures can be put in place to enable use of shallow foundations.
- 10.2.7 Shallow soils are anticipated to be clay dominated associated with Tills, alongside the upper weathered profile of mudstone bedrock. Clays are prone to shrink-swell on changes in moisture content, and consequently, heave will likely need to be taken into account in foundation design, including accounting for the presence of trees/shrubs e.g. through ensuring suitable foundation depths and incorporation of heave protection or excavation and replacement with granular engineered fill.
- 10.2.8 Where there is potential for local variations in the nature of shallow soils and bedrock (including interbedded softened soils), alongside local areas of Made Ground/Worked

Ground/Landscaped Ground or weathered bedrock horizons with boulders (more likely in limestone/sandstone areas), associated bearing and settlement risks would also require consideration to manage differential settlement risks e.g. through deepening of foundations to a competent homogenous bearing stratum.

- 10.2.9 It is noted that if foundations are constructed atop of existing slopes or adjacent to existing infrastructure, due consideration will need to be given to loading interactions and undermining, including accounting for requirements of specific asset owners.

Haul Road/Pavement Foundations

- 10.2.10 In general, haul roads/pavements (except where constructed atop of any designed embankments) are anticipated to be predominantly formed on natural clay subgrade associated with the Tills. Assuming the subgrade is formed of clay soils, relatively low long term equilibrium design CBR/subgrade modulus values may be present, subject to the plasticity index of the clays and depth of groundwater.
- 10.2.11 Assuming the above, incorporation of ground improvement (informed by a specialist ground improvement contractor) or geo-grid layer may require consideration in haul road design, alongside a separation geotextile to manage migration of fines into capping layers.
- 10.2.12 Consideration of shrink-swell of clay soils generally and indirect and direct root action from existing, proposed or to be removed trees should also be considered subject to the confirmed plasticity of on Site soils and movement tolerances / maintenance requirements. This may potentially be done through methods such as increasing pavement foundation thickness and excavation and replacement of desiccated soils at formation level to an engineering specification. There is also considered to be a potential for fine/variable soils prone to frost heave, which could also be mitigated by deepening pavement foundation thicknesses.
- 10.2.13 The presence of hard spots formed by boulders in Tills is considered likely (alongside in areas of weathered limestone/sandstone bedrock), which poses a risk of differential settlement beneath haul roads/pavement areas. Hard spots could be managed through breaking these out and backfilling to an engineering specification.
- 10.2.14 Where haul roads/pavements are formed on engineered fill i.e. where embankments are required, the design CBR/subgrade modulus value would be subject to the type and as-built quality of the earthwork.

Earthworks

- 10.2.15 Earthworks are anticipated to be required to form haul roads, and potentially laydown/construction areas. All earthworks will require undertaking in accordance with an engineering specification and where possible, cut/fill balance should be aimed for and material re-use considered.
- 10.2.16 Ground investigation and subsequent earthworks classification testing will be required to assess suitability of the Site won materials for re-use. In general, where excavations in rock are made, it is anticipated that a greater degree of processing will likely be required to enable re-use as engineered fill e.g. crushing of boulder/cobble sized clasts. The crushed aggregate from Lincolnshire Limestone Formation is noted to be of low strength and poor frost resistance (Ref 13.31) therefore may only be

suitable for construction fill or as a sub-base, as opposed to structural fill. Re-use of Site won materials derived from sandstones as aggregate for higher quality/structural fill may be more feasible but would require further investigation and testing.

- 10.2.17 Site won material from Till and mudstones could be considered as general fill, however, their use as structural fill is not anticipated to be feasible due to likely shrink-swell and aggressive ground characteristics.
- 10.2.18 Site won materials derived of Made Ground/Worked Ground/Landscaped Ground or Alluvium deposits are not anticipated to be suitable for re-use as engineered fill due to their typical variable/low strength/organic characteristics, with such potentially being more feasible for re-use as fill to landscape areas, subject to settlement tolerances within these.
- 10.2.19 Alike with foundations, fill works will require consideration of loading interactions with underlying and adjacent ground, including loading atop of existing slopes/near existing infrastructure and undermining, including accounting for requirements of specific asset owners.

Excavations

- 10.2.20 Excavations within shallow soils, generally anticipated to be clay Tills, should be feasible with conventional excavation plant. However, where boulders are present or intact bedrock is encountered, which is considered to increase in likelihood with the scale of any cuttings, the ease of excavation will vary depending on the weathering profile/strength of the bedrock and nature of the associated discontinuities. In general, it is recommended to avoid significant magnitudes of cuttings in bedrock which could risk needing more significant excavation techniques e.g. ripping or even in extreme cases, blasting.
- 10.2.21 Safe working slope angles for cuttings will be subject to the associated soil/bedrock conditions, groundwater regime and loading interactions. The presence of clay soils, discontinuities in rock dipping unfavourably to the cutting face, shallow groundwater/springs, water bearing sands (e.g. weathered from the Northampton Sand Formation) and relict shear surfaces/soils at residual strengths are examples of ground conditions that could result in relatively shallow safe slope angles being needed. Alternatively, engineering measures can be put in place to enable steeper angles e.g. soil nails, rock bolts and mesh, retaining structures etc.
- 10.2.22 The potential presence of loose soils associated with the upper weathered profile of sandstone/limestone bedrock may result in instability in excavations which cannot be discounted and will need to be taken into account in any design of the earthworks. The potential for running sand conditions e.g. forming water bearing granular soils locally such as from alluvial soils or weathered sandstone bedrock may also require consideration locally.
- 10.2.23 Close or continuous support will be required for any personnel-entry into excavations. Excavation angles should be adjusted according to the anticipated strata and groundwater levels encountered.
- 10.2.24 Considering the presence of springs and potential for shallow groundwater e.g. in lower lying areas around surface water features, the incorporation of adequate drainage during design and construction will be required. Furthermore, if piling is

required, avoidance of penetrating confined aquifers/artesian waters is recommended.

- 10.2.25 All excavations should be planned, and due consideration be given to providing temporary support or suitable battering. Excavations should also be regularly inspected by a competent person to ensure continued safety. Further advice on the safety of excavations is given in Health and Safety in Construction (Ref 13.32).
- 10.2.26 Support or battering of the excavation faces to a safe angle of repose will be required for all excavations where personnel entry is necessary, the nature and extent of which will need to be evaluated under CDM regulations. Inspections should be carried out regularly and by a competent person. No operative should enter unshored or otherwise unprotected excavations. A Site specific risk assessment should be carried out where personnel-entry into excavations is required.
- 10.2.27 UXO risk will require assessment prior to breaking ground to inform risk management/mitigation measures.
- 10.2.28 Utility surveys will be required to inform constraints posed by utilities prior to breaking ground or passing under or working adjacent to overhead utilities. It is recommended that these are undertaken in accordance with PAS 128.

Infiltration Drainage

- 10.2.29 Based on the anticipated ground models, the feasibility of shallow infiltration drainage (soakaways) is generally considered negligible to low across the majority of the route, based on the below:
- Infiltration generally (Till) may be unsuitable due to the dominance of cohesive soils (clays) which exhibit negligible permeability, although could potentially be feasible subject to magnitudes of granular occurrences/constituents increasing permeability.
 - Limited infiltration potential may exist within localised outcrops of bedrock. However, this is subject to fracture flow characteristics and introduces significant geotechnical risks, specifically slope instability (if discharging near valley crests), solution features (Karst) in soluble carbonate rocks and possibility for underground mining and risks around promoting subsidence.
- 10.2.30 The use of infiltration drainage in lower lying areas associated with surface water features is considered unlikely to be feasible due to the anticipated presence of shallow groundwater.

Geo-environmental Constraints & Groundwater Protection

- 10.2.31 In accordance with CIRIA C753 (The SuDS Manual) (Ref 13.19) and the Environment Agency's 'Groundwater Protection: Principles and Practice (GP3)' (Ref 13.22) the following constraints apply to any proposed infiltration features:
- 10.2.32 Discharge of surface water into the ground within Source Protection Zone 3 (Region 1 and locally, Region 2) is generally accepted, however the EA still requires designs to demonstrate that they will not create pathways for pollutants to reach groundwater.

- 1) Infiltration is prohibited in areas where soil contamination has been identified, as this may mobilise pollutants into the underlying aquifer. Based on the Historical Review, infiltration is not suitable at identified 'Hotspots' including the Former Railway Lines and areas with storage tanks;
- 2) Outside of identified hotspots, the risk from diffuse agricultural pollution is considered sufficiently low to permit infiltration, provided adequate pre-treatment (catch pits/filter drains) is incorporated to manage suspended solids.

Aggressive Ground Chemistry

- 10.2.33 The presence of aggressive ground conditions is anticipated, associated primarily with mudstone bedrocks (e.g. the Charmouth Mudstone) and potential Tills and alluvium, subject to rocks the associated soil and rock clasts were eroded from (e.g. Lias rich member). These conditions, alongside the potential aggressivity of other stratum and groundwater will require confirmation through testing and concrete mixes designed in accordance with BRE SD1 (Ref 13.69).
- 10.2.34 It is noted that the presence of elevated sulphate /sulphide levels could preclude the use of some forms of ground improvement e.g. lime stabilisation.

10.3 Abnormal Ground Conditions

- 10.3.1 The above Report sub-sections include high level commentary considering general ground conditions, however, the presence of some areas of significant abnormal ground conditions are anticipated on Site i.e. karst areas, local areas of potential slope instabilities/cambering terrains, deep coal mining and possibility for other unrecorded underground mining extents/features.
- 10.3.2 Where confirmed to be present in this Report, or where identified through further assessment/ground investigation, such ground conditions would likely have a significant impact on design and construction on Site, including the above preliminary design advice.
- 10.3.3 Of these, karst features are recorded on in Region 1, and possibly very locally in north of Region 2, as per Report Section 3.3 and are considered to pose an immediate and long-term risk to ground stability, which will require consideration throughout investigation, design, construction and future risk management/maintenance. The incorporation of remedial schemes, designing shallow foundations to span voids/ignoring base resistance in pile design, avoiding/offsetting infiltration drainage/avoiding any concentrated water flows, inspections of cuttings/formations etc are examples of some of the measures that should be considered going forwards as part of a risk based approach that will need to be taken in the management and mitigation of subsidence risks associated with karst.
- 10.3.4 If the potential landslips/cambering terrains as per Report Section 3.3 are confirmed to be present, including relict shear surfaces, such soils are unlikely to stand up even at relatively shallow angles in cuttings/excavations and are likely be poor from a load bearing perspective due to the variability and presence of soils at residual strengths. This includes the potential for open fissures/gulls associated with cambered rock, and difficulties founding in such conditions. Alongside this, the wider scale risk of re-

activating slip surfaces by loading with earthwork embankments would require consideration. Avoiding developments in these areas could be considered, or incorporation of slope stability measures and inclusion of deep foundations to transmit loads down to deeper competent stratum.

- 10.3.5 Deep coal mining is evident based on mine plans for Asfordby Mine across Region 6, as per Report Section 3.4. The deep depth of this mining reduces the risk of void propagation causing subsidence at surface on Site and known shafts and associated development high risk areas are off Site to the south. The potential presence of unrecorded shafts or access points from the surface into the mine, from or adjacent to the Site (e.g. those associated with unknown features identified on historical mapping/satellite imagery) is also considered to be relatively low, considering the relatively modern nature of the mine and assumed quality/completeness of record keeping, although cannot be completely discounted e.g. associated with earlier exploration.
- 10.3.6 Considering the mapped geology and recorded extensive mining in the wider local area, the presence of other extensive areas of unrecorded coal or non-coal mining underlying the Site (including for ironstone and limestone) is considered unlikely. However, the presence of further local unrecorded mining, as mentioned in Report Section 3.4, cannot be discounted.
- 10.3.7 If underground mine extents and/or possible underground mining features, as discussed in Report Section 3.4, are confirmed present and found to pose risk to ground stability on Site, remedial measures may be required subject to the nature and condition of the feature, paired with its proximity and depth relative to the proposed developments. As part of this, avoidance of developments in proximity to such features could be considered where risk is localised.
- 10.3.8 It is also noted that the presence of faulting, Worked Ground associated with ironstone extraction at surface, infilled channels/valleys and other more local features e.g. infilled pits/ponds/demolished structures, realigned water course, wells/pumps etc also have the potential to cause abnormal/sudden changes in ground conditions, which will also require consideration as the project progresses.
- 10.3.9 Further investigation and assessment is required to confirm the risk posed by the above aspects and inform developments further, including review during the Site reconnaissance, and if deemed necessary, a Mining Risk Assessment.

10.4 Preliminary Geotechnical Complexity Class

- 10.4.1 The geotechnical works relate to the construction of a new OHL towers and haul roads (including associated earthworks and crossing points), alongside construction/laydown areas and drainage.
- 10.4.2 The existing ground investigation information available for the Site is limited/largely absent, consequently there is uncertainty in the lateral variations in the contents of superficial soils, the depth of bedrock and the groundwater regime across the Site. Furthermore, there are recorded karst features, potential slope instability/cambered terrains and possible unrecorded underground mining which, alongside other features, will impact the geotechnical complexity of the Site.

- 10.4.3 A Geotechnical Complexity Class (GCC) of GCC2 is preliminarily applied for this Site in accordance with EC7 (Ref 13.16). This classification can be reviewed once further assessment, including Site reconnaissance, is undertaken and then once ground investigations are completed.

10.5 Preliminary Geotechnical Category

- 10.5.1 Geotechnical structures are classified into a Geotechnical Category that combines the uncertainty and complexity of the ground and ground-structure interaction with the consequence of failure of the structure.
- 10.5.2 The project is preliminarily classified as Geotechnical Category (GC) 2 as defined in EC7 (Ref 13.16) based on the proposals stated in Report Section 1, assuming the preliminary GCC2 classification and an assumed Consequence Class of CC2 (Normal). This will be reviewed as the project progresses.

11. Conclusions

11. Conclusions

11.1 Geotechnical Conclusions

- 11.1.1 The preliminary anticipated ground models for the Site suggest that ground conditions will generally comprise dominant superficial Till deposits, locally interspersed with Head and Alluvium, overlaying bedrock geology formed of the Great Oolite Group locally and Inferior Oolite Group in the east, then Lias Group moving west across the majority of the Site. Variations and complexities in these successions are anticipated in areas e.g. due to solution of limestone bedrock forming karst features, mining of coal, ironstone and potentially other minerals, faulting, cambering/slope instabilities and other more localised developments historically and present day, including infilled pits/ponds and demolished historical structures.
- 11.1.2 The changes in ground conditions and topography moving across the Site will result in different engineering characteristics and ground hazards/constraints as outlined in the preliminary geotechnical risk register, requiring consideration in design, construction and future maintenance. The most significant of these ground hazards is currently anticipated to be the presence of karst features and resulting significant subsidence risk predominantly on Region 1, although due consideration will need to be given to all identified hazards/constraints on Site.
- 11.1.3 Further assessments and investigations are required to confirm ground conditions, investigate hazards and inform design development; recommendations for such are outlined in Report Section 12. It should be appreciated however that due to the nature of some of the ground risks on Site, mainly associated with solution of limestone bedrock and formation of karst features, complete risk mitigation will likely not be possible, with residual risks requiring ongoing management anticipated to remain.

11.2 Geo-Environmental Conclusions

- 11.2.1 Potential sources of contamination have been identified on and within 250m of the Site to various historical and current potentially contaminative activities. Isolated areas of Made Ground and infilled land are considered likely to be present relating to the historical and current land use at the Site. Additionally, Site-wide historical and current agricultural land use also represents a source of contamination. These sources are considered as being associated with relatively low levels of contamination. Sources of higher-level contamination are also present both onsite and within 250m of the Site buffer, including a disused airfield, historical railway land, farm tanks, industrial sites, works, waste sites, vehicle repairs site, sludge storage sites, spoil heaps associated with coal and aggregate mining, and an electricity substation.
- 11.2.2 With regard to human health the risks are generally considered to be **Low to Moderate**, with the greatest risk present to workers onsite during construction and GI phases with respect to construction/GI workers for the risk of inhalation of ground gas from the onsite and offsite (within 250m) sludge storage where a 'moderate' potential

of ground gas generation in accordance with BS 8576 (Ref 13.48) was identified. Here this risk is highest where GI/construction workers may enter confined spaces where gases accumulate. A **Moderate/Low** risk is given for the inhalation of dust fibres, in particular asbestos fibres. Where certain sources (onsite or offsite) have asbestos as a CoPC the risk in the vicinity of these is elevated, particularly for GI/construction workers where material is more likely to be disturbed. A **Moderate/Low** risk is also given for vapours where volatile organic compounds are noted and could be disturbed during works. All other risks are deemed as **Low** for human health.

- 11.2.3 Controlled waters are considered to be the most sensitive receptors, with the superficial geology onsite noted to be highly variable potentially enabling migration of contamination (if present). The risk to controlled waters is greatest where sources are present within the vicinity of a Secondary A or Principal Aquifer, particularly where there are karst features and swallet holes associated with the bedrock geology, reducing in risk where 'lower risk' sources such as Made Ground, infilled land and agricultural land are present or where less vulnerable aquifers such as Secondary B or Unproductive Aquifers are recorded. The risk to surface waters is present through baseflow groundwater movements, as well as surface runoff where impermeable soils such as clay layers within the Till deposits are present resulting in runoff.
- 11.2.4 The risks to property inclusive of pylon foundations, livestock and crops are considered to be **Very Low** to **Low**, primarily due to the 'mild' consequence given.
- 11.2.5 Based on the available desk study information and the proposed development, the Site is classified overall as having a **Very Low** to **Moderate** risk with respect to contaminated land, predominantly driven by risks to controlled waters and human health through ground gas inhalation. Where risks are noted above Low, the associated sources have been summarised below in Table 11.1 with respect to their risk rating (C552) and a discussion of the risk.

Table 11.1: Summary of risks above low risk rating

Receptor & linkage	Source (risk within 250m of feature)	Risk Rating	Discussion
Human Health Dermal contact and ingestion (GI and Construction Workers)	<u>Onsite only:</u> Railway Land and Disused Airfield – Regions 1c to 1e, 2d, 5b and 6b	Moderate/Low	Direct exposure pathways can be mitigated using cover systems.
Human Health Inhalation of dust & asbestos (GI and Construction Workers)	<u>Onsite:</u> Railway Land and Disused Airfield – Regions 1c to 1e, 2d, 5b and 6b <u>Offsite:</u> Made Ground, Railway Land, Industrial Estate, Sludge Storage and Disused Airfield – All Regions	Moderate/Low	During onsite construction/GI activities it is assumed that workers will adhere to all site rules and wear appropriate PPE to mitigate risks (i.e., face masks and gloves, if required).

Receptor & linkage	Source (risk within 250m of feature)	Risk Rating	Discussion
Human Health Inhalation of vapours (GI and construction workers)	<u>Offsite only:</u> Railway land. Disused Airfield, Industrial Site, Waste Site, Sludge Storage, Vehicle Repair Site and Unspecified Works – 1c, 1d, 1e, 2e, 2f, 3b, 4b, 5a, 5b and 6b	Moderate/Low	Where the risk is higher for construction workers, it is assumed that workers will adhere to all site rules and wear appropriate PPE to mitigate risks (i.e., face masks and gloves, if required).
Human Health Ground gas inhalation & explosion	<u>Onsite:</u> Sludge Storage Site – Region 2f <u>Offsite:</u> Sludge Storage Sites – Regions 2e, 3b, 4c, 4d, 4e and 5a	Moderate/Low to Moderate	Where the risk is higher for construction workers (Moderate), it is assumed that workers will incorporate mitigating strategies when entering confined spaces (i.e., gas monitors).
Controlled Waters Leaching into Principal & Secondary A Aquifers	<u>Onsite & Offsite:</u> Made Ground, Infilled Land, Agricultural Land (All Regions) <u>Onsite:</u> Railway Land, Disused Airfield and Tanks – Regions 1b to 1d, 5b and 6b <u>Offsite:</u> Tanks, Electricity Substation, Disused Airfield, Sludge Sites and Vehicle Repair Site – Regions 1e, 1d and 2f	Moderate/Low Moderate	Potential contaminants may enter groundwater and/or surface water onsite. The absence of data confirming the presence/absence of a cohesive layer acting as a barrier makes it possible that contaminants may migrate into groundwater below. Where swallet holes are noted use of doubled-up spill protection is required – spill kits and drip trays.
Controlled Waters Run-off/baseflow into Surface Waters	<u>Onsite</u> Run-off in areas of impermeable soils Baseflow in areas of permeable soils <u>Offsite:</u> Tank and Railway Land – Region 5b and 6b	Moderate/Low	Agricultural land limits the amount of surface runoff, however drainage channels onsite and high permeability soils in areas equally increase the risk to controlled waters. However, the distance to the nearest major surface

Receptor & linkage	Source (risk within 250m of feature)	Risk Rating	Discussion
			watercourse limits this risk.

12. Recommendations

12. Preliminary Recommendations

Summary of Recommendations

- 12.1.1 Further assessment and investigation are required to confirm the ground conditions, groundwater regime, investigate hazards/constraints and inform the design and construction of the proposed development. The below is an outline of recommended further works to further update and refine the risk to the proposed development as part of desk-based reporting updates:
- General: Site reconnaissance, comprising inspection of the Site by a suitably qualified and experienced engineering geologist/geotechnical engineer and geo-environmental engineer/scientist to identify any signs of instability/subsidence and contamination (including potential sources, pathways and risks), with specific focus on karst, mining, slope instability/cambering features, alongside features of unknown origin, as summarised in Figure 10 (Appendix A), Report Section 3.3-3.4. This would also provide an opportunity to identify additional features of note, not identified in this Report.
 - Historical mining risk: Inspect possible mining features during the above, and subject to findings of this, consider obtaining a Consultants Coal Mining Report, purchasing and digitising mine catalogue records and undertake a Mining Risk Assessment (e.g. for coal and/or ironstone mining) to assess the legacy mining risk further.
 - UXO risk: Review awaited Detailed UXO Risk Assessment.
 - Mineral Safeguarding constraints (Lincolnshire Limestone Formation): Consultation with the MPA at the pre-application stage to inform a mineral assessment requirement (including need to incorporate ground investigations to inform this).
- 12.1.2 The following geotechnical and geo-environmental works are recommended:
- Preparation of a Ground Investigation Specification and schedule, outlining the proposed ground investigation methodologies, including non-intrusive surveying, intrusive exploratory test hole drilling, pitting, probing, sampling, laboratory and in-situ testing, installations and monitoring activities.
 - Site specific ground investigation and subsequent interpretative Ground Investigation Report to confirm the ground and groundwater conditions on the site, investigate and assess anticipated risks, and inform designs and construction. Further outline recommendations for ground investigations works are outlined in Report Section 12.2.
 - Minerals Assessment relating to safeguarded limestone mineral resource, subject to confirmed requirements of the MPA.
 - Post ground investigation, subsequent interpretative Ground Investigation Report, Geotechnical Design Report and design specifications e.g. earthworks, subject to defined nature of proposed developments.

- 12.1.3 By undertaking an intrusive ground investigation, an assessment of the ground and groundwater profiles may be carried out along with an assessment of the geotechnical and geo-environmental risks associated with the Site. This will allow a refined risk assessment and conceptual site model (CSM) to be developed in accordance with Land Contamination Risk Management (LCRM) methodology (Ref 13.23). The ground investigation will allow a quantitative assessment as to whether any of the potential risks identified in this study are present and are of material concern to the development.
- 12.1.4 Other recommended survey works, if not already considered/planned to date, include:
- Topographical survey to inform earthwork design.
 - Arboricultural survey to inform heave/shrink risk.
 - If deemed required by environmental teams, other environmental surveys e.g. associated with ecological and archaeological matters, to inform associated constraints to works (including ground investigations).
 - PAS128 Type D, C and B Utility Surveys to inform utility constraints and breaking ground.
 - Geophysical surveys to inform geotechnical risk profiling and design.
 - Detailed UXO Risk Assessment, to further inform UXO risk and mitigation.
- 12.1.5 Further recommendations for ground investigation works are outlined below.

12.2 Outline Recommendations for Ground Investigation

- 12.2.1 The geotechnical elements of the investigation should be designed with consideration to BS EN 1997-1:2004, BS EN 1997-2:2024 (Eurocode 7: Geotechnical Design- Parts 1 and 2 (Ref 13.16), and BS 5930:2015+A1:2020 (Ref 13.51).
- 12.2.2 The geo-environmental elements of the investigation should be designed with due consideration of the requirements of BS 10175:2011+A2:2017 (Ref 13.60).
- 12.2.3 In summary, the key objectives to be addressed by the investigation in order to inform the design and construction of the proposed development include exploratory holes at a suitable depth and spacing to enable:
- Confirmation ground and groundwater conditions, including seasonal variations in the latter.
 - Confirmation of the chemical status of soil for the purpose of risk assessment to human health, groundwater and for preliminary waste classification to inform disposal/storage and chemical status of groundwater and surface water in order to determine risks to controlled waters.
 - Investigation and verification of geotechnical hazards/constraints, including focus on:
 - Karst features.

- Legacy mining features (subject to further risk refinement).
- Potential slope instabilities/cambering terrains.
- Areas of infilled ground e.g. associated with historical ponds/pits if present below development areas.
- Identification of geotechnical design parameters and ground models.
- Confirmation of permeability/infiltration characteristics.
- Confirmation of excavatability of bedrock.
- Assessment of material re-use as part of earthworks and if required, to inform minerals assessment.
- Ground gas assessment following BS 8485:2015+A1:2019 (Code of practice for the design of protective measures for methane and carbon dioxide). Supported by CL:AIRE RB17 to determine the potential risks to the proposed development, surrounding properties, and construction site workers.

12.2.4 It is recommended that the ground investigation be undertaken in accordance with the UK Specification for Ground Investigation 3rd Edition. In brief, the scope of works is generally anticipated to include:

- Geophysical survey in advance of intrusive works targeting areas where sub-surface voids are suspected e.g. associated with karst features (including around faulting in limestone bedrock), areas of cambering terrains, and recorded/possible legacy underground mining. Note, this could also be used to assist with tracing bedrock depth between the confirmed locations provided by the intrusive locations.
- Boreholes sunk by cable percussive or dynamic sampling and rotary coring techniques, including in-situ Standard Penetration Testing (SPT)
- Trial pitting, including excavation in layers with toothless buckets to help identify relict shear surfaces.
- Cone Penetration Testing (CPT), specifically to delineate changes in thickness of soft soils e.g. across alluvial channels and infilled pits/ponds.
- Geotechnical and geo-environmental soil, rock and groundwater sampling.
- Plate load/in-situ CBR/ subgrade modulus testing to inform pavement foundation design and bearing capacities of shallow soils.
- Infiltration and percolation testing to inform drainage.
- Installation monitoring wells and programme of monitoring.
- Geotechnical and geo-environmental laboratory testing.

12.2.5 Liaison with the existing stakeholders, asset owners, landowners etc. should be undertaken to confirm their requirements and expectations with regard to the proposed works and developments, alongside any constraints. Liaison with the Environment Agency and other relevant bodies, concerning the need for permits to carry out ground investigation, should be undertaken to confirm their requirements

and expectations with regard to the proposed works and developments, alongside any constraints.

- 12.2.6 PAS128 Type D, C and B (and A as required) surveys should be undertaken (prior to intrusive investigations), and ground penetrating radar (GPR) and cable avoidance tools (CAT) used prior to breaking ground. It should be ensured that any existing utilities are identified and fully traced prior to the commencement of intrusive investigations and construction works if near proposed exploratory hole locations. A hand dug inspection pit will be required, dug to at least 1.20m bgl using insulated hand tools, with CAT scanning periodically. Only after this process should mechanical intrusive investigation commence. Procedures are to be adopted in the event underground utilities are encountered and these must be detailed in the Risk Assessments and Method Statements (RAMS) for the intrusive investigation works.
- 12.2.7 At the time of writing AAJV is awaiting further Detailed UXO Risk Assessment information for the Site. AAJV recommends that this assessment is undertaken prior to the commencement of any intrusive investigation; this recommendation will be reviewed once the further UXO information has been obtained.

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Appendix A

Figures

Appendix A Figures

Figure 1. Site Location

Figure 2. Topography and Slope

Figure 3. Superficial Geology and Artificial Ground

Figure 4. Bedrock Geology and Artificial Ground

Figure 5. Hydrogeology

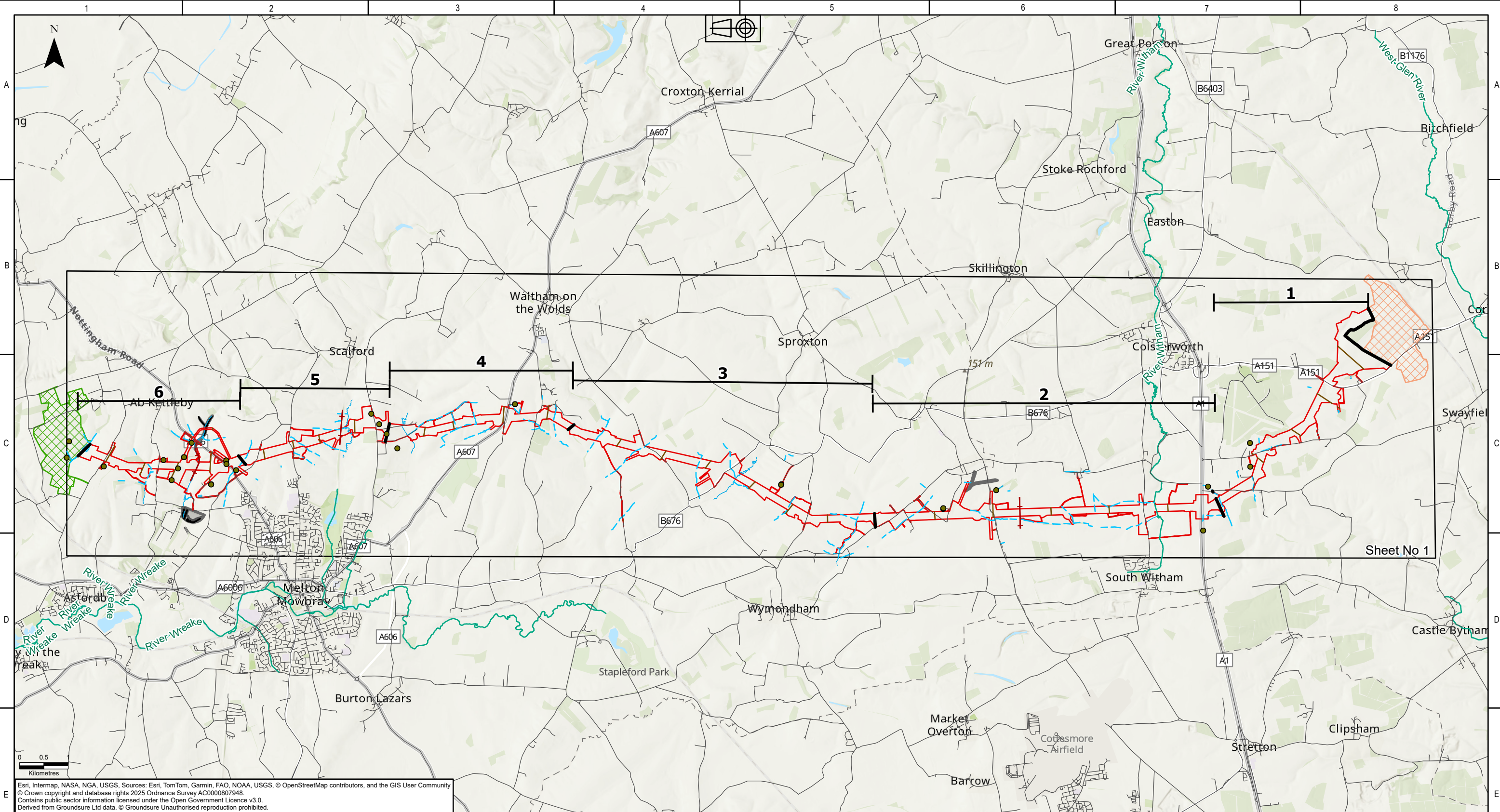
Figure 6. Hydrogeology - Aquifers

Figure 7. Hydrology and Risk of Flooding

Figure 8. Hydrology and Flooding

Figure 9. Licenced waste and industrial land use and hazardous substances

Figure 10. Geotechnical Hazard and Constraints



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- WMEL-B
- Regions
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- OS Surface Water Features - Areas
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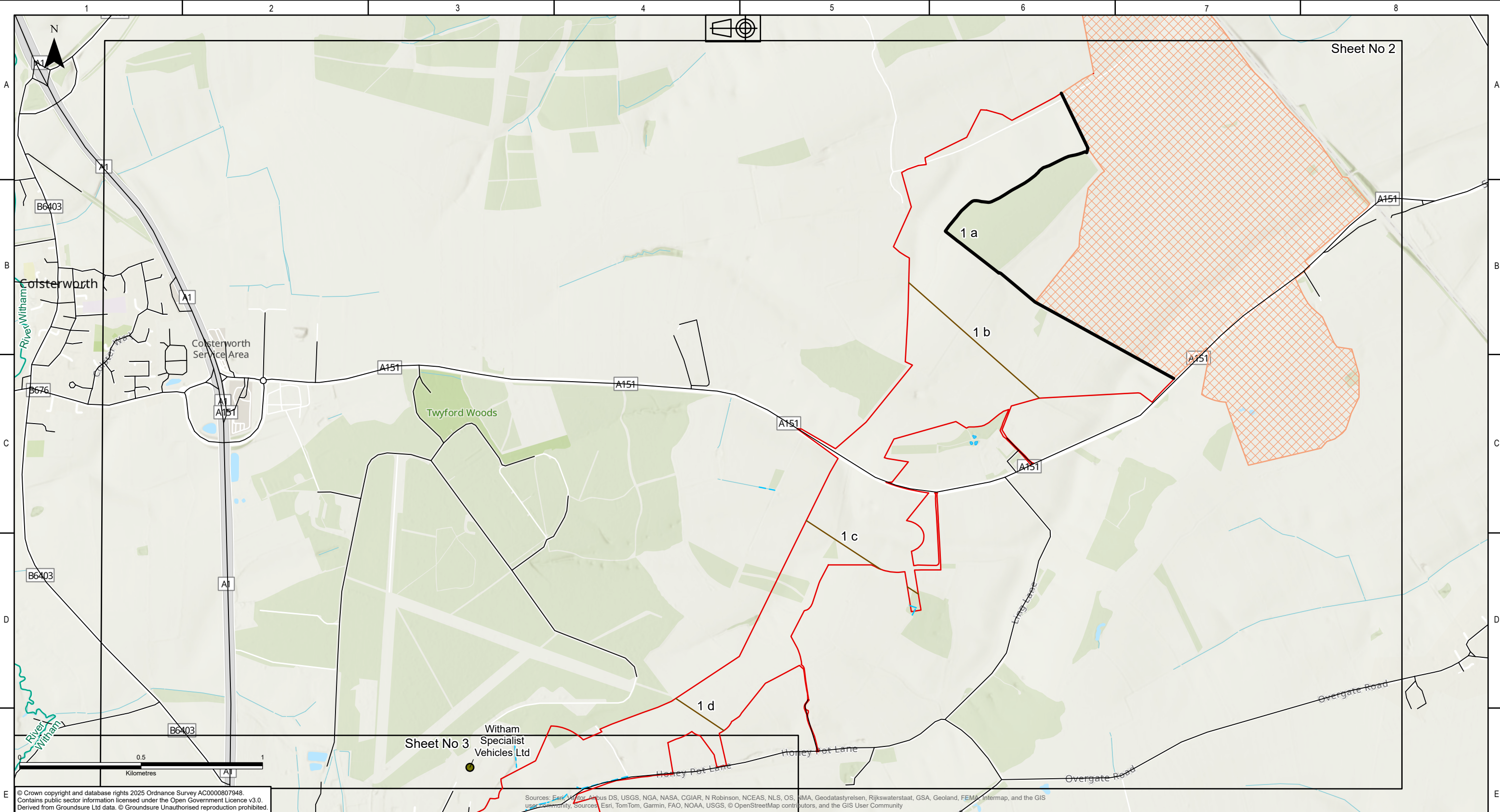
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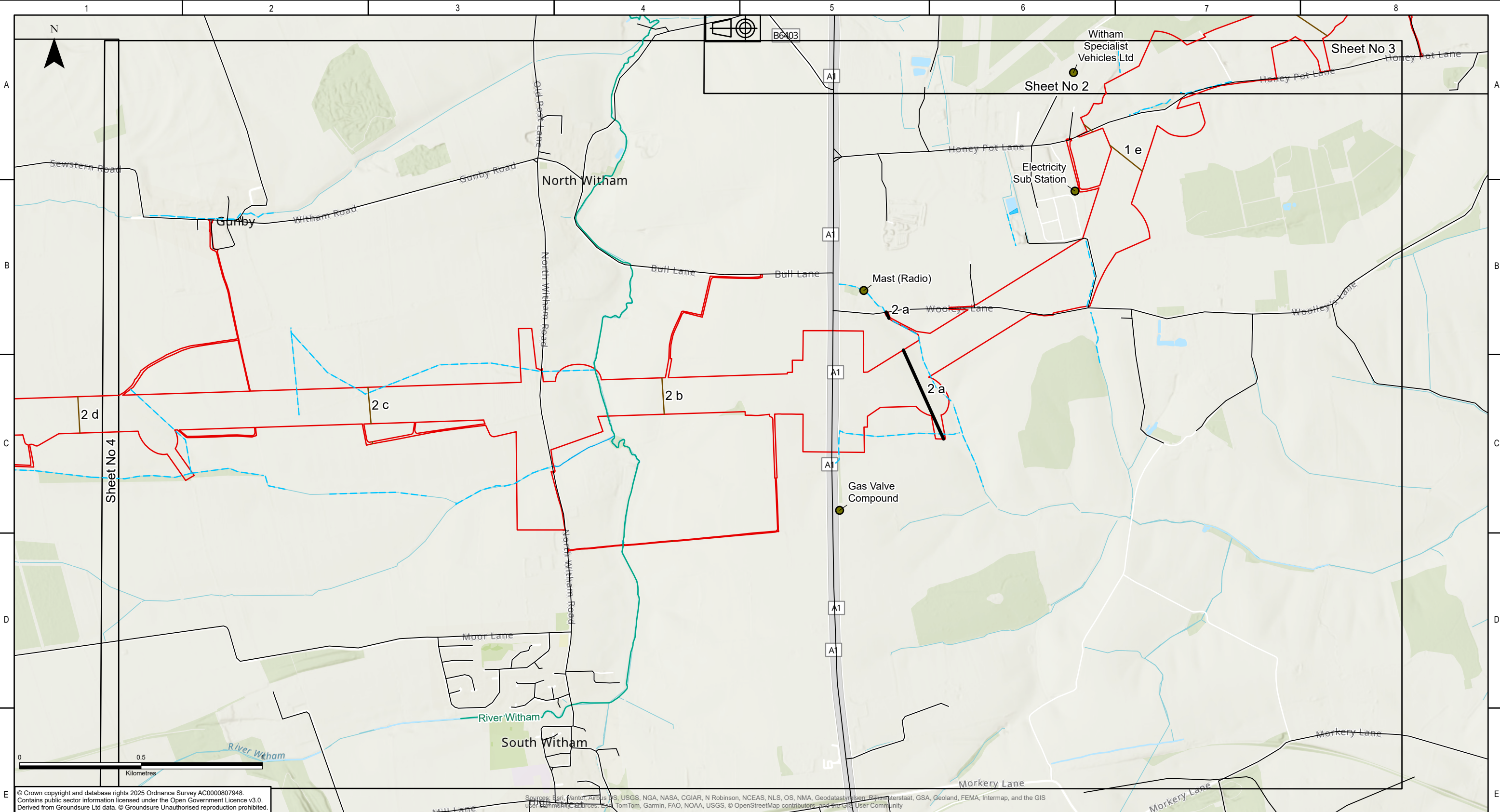
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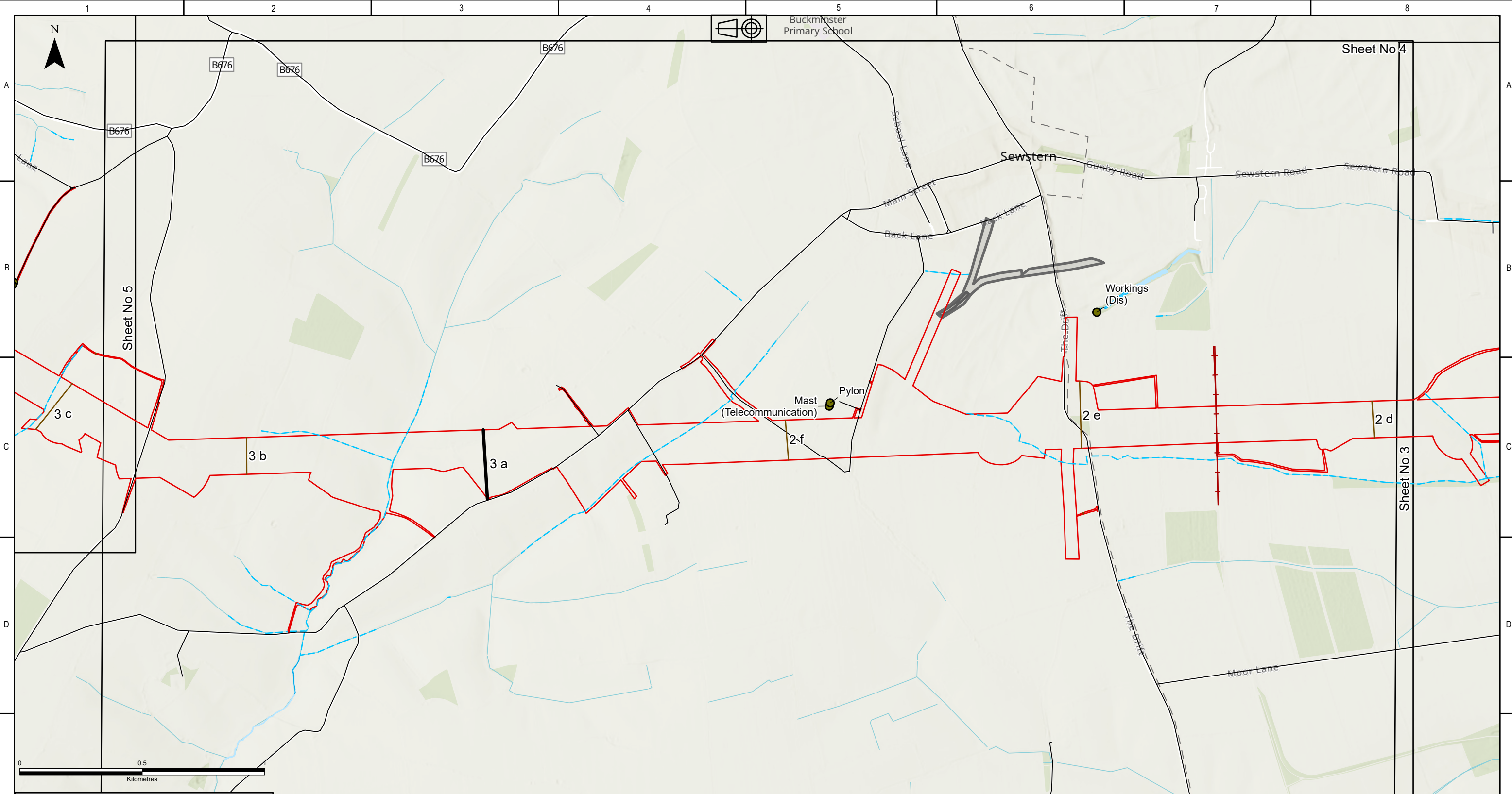
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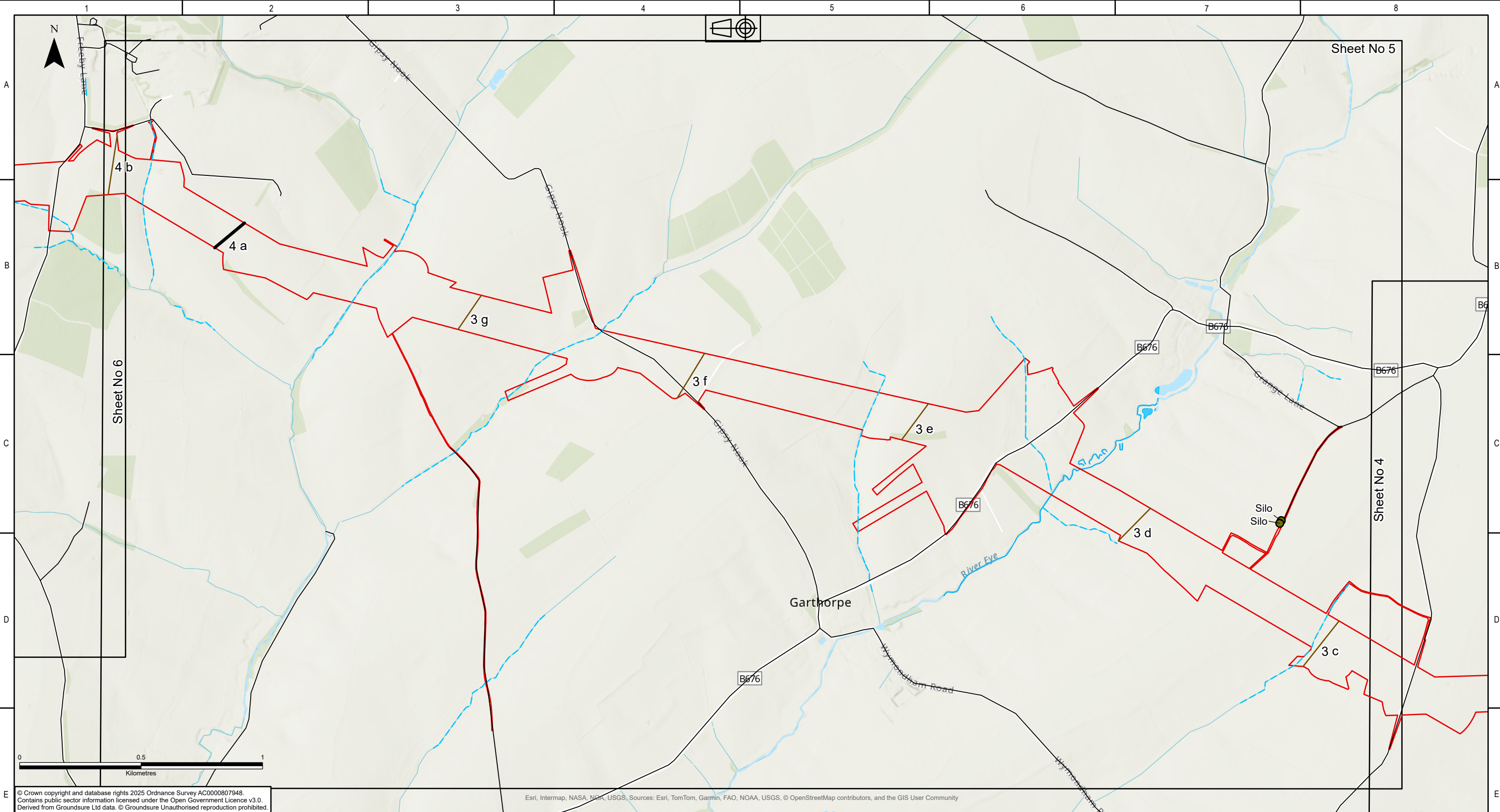
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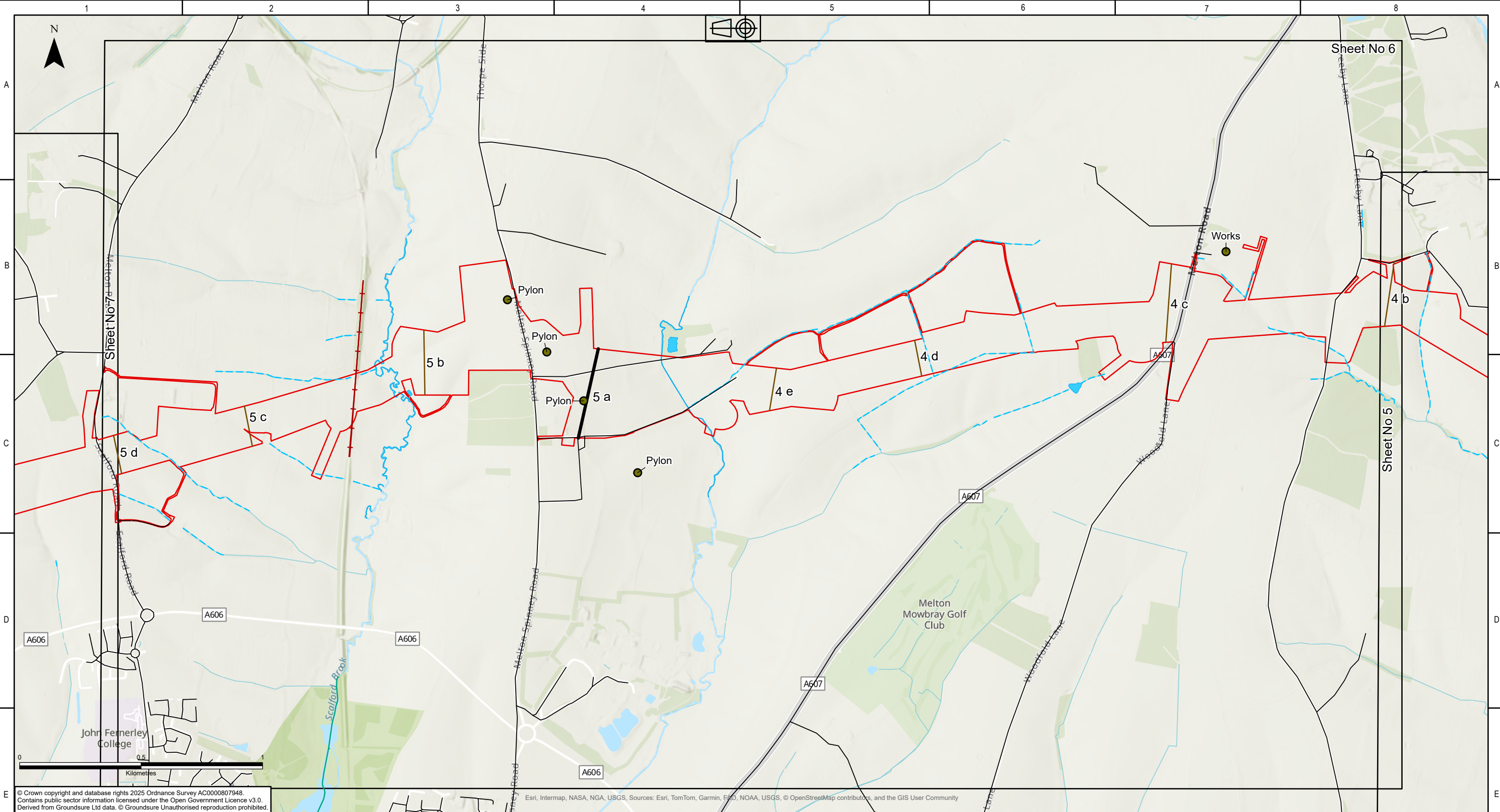
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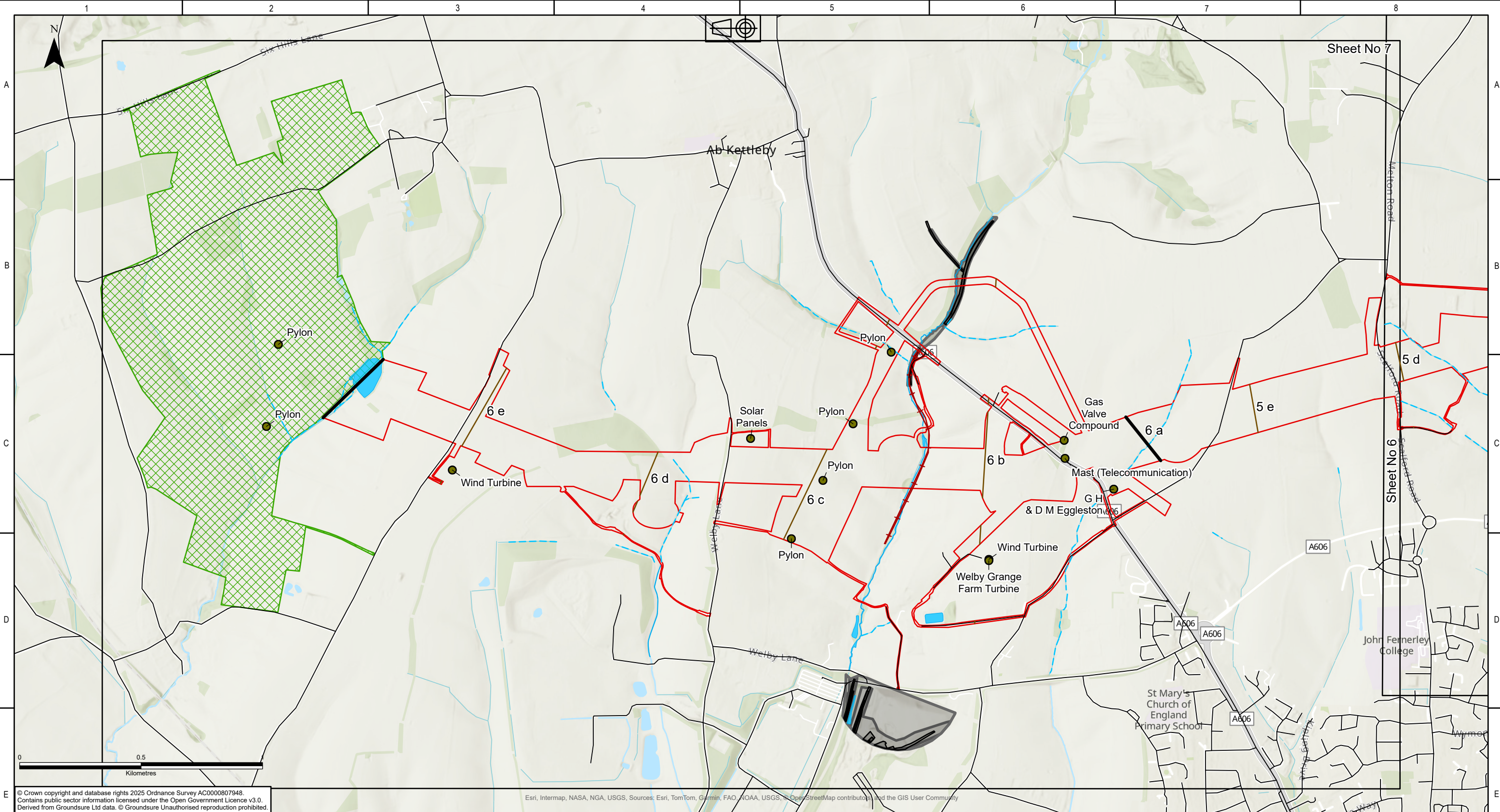
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KEY PLAN

Legend

- DF2 Rev B Boundary - Overhead Line from Substation WMEL-A to Substation WMEL-B
- WMEL-B
- Regions
- Sub Regions
- Recent Industrial Land Uses
- OS Open Roads
- OS Surface Water Features - Lines
- OS Surface Water Features - Areas
- OSM Historical Railway
- Historical Railway Feature LD
- Historical Railway Feature HD

NATIONAL GRID INVESTMENT NUMBER: 101746-203470

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P03	25/06/2026	Third issue		AK	SL	TT	JC
P02	28/04/2026	Second issue		DM	SL	TT	JC
P01	19/01/2026	First issue		DM	SL	TT	JC
Rev.	Date	Comment	Drw by	Check	Rev by	Appr.	

nationalgrid

National Grid plc, Warwick Technology Park, Gallows Hill, Warwick, CV34 6DA

Contractor

AECOM

ARUP

Drawn

A.KARRAN

Checked

S.LUMACA

Site

Weston Marsh to East Leicestershire

Title

WMEL-A to WMEL-B Overhead Line
Phase 1 Geotechnical and Geo-environmental Desk Study:
Figure 1
Site Location Plan

Purpose of issue

For Information

Status

S3

Contractor Drawing No.

WMEL-AAJ-ZZZZ-XXXXXX-DRW-GE-000023

Revision

P03

Customer Drawing No.

N/A

Sheet 7 of 7

Issue

A

Reviewed

T.TAVENDALE

Approved

J.CHASTNEY

Date

26/06/2026

Scale

1:15,000

Size

A3

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