

The Keadby 3 Low Carbon Gas Power Station Project

PINS Ref: EN010114

The Keadby 3 Low-Carbon Gas Power Station Order

Land at and in the vicinity of the Keadby Power Station site, Trentside, Keadby, North Lincolnshire

Preliminary Environmental Information (PEI) Report Volume II - Appendix 13A: Phase 1 Desk Based Assessment

The Planning Act 2008

The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017

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1.0 INTRODUCTION

1.1 Overview

- 1.1.1 This Appendix supplements **Chapter 13**: Geology, Hydrogeology and Land Contamination (PEI Report Volume I) and presents the phase 1 desk-based geoenvironmental assessment for the Proposed Development.
- 1.1.2 The Proposed Development is for a Low Carbon Combined Cycle Gas Turbine (CCGT) Generating Station on land at, and in the vicinity of, the existing Keadby Power Station.
- 1.1.3 The Proposed Development Site is located to the west of Trent Side Road (B1392), to the west of the village of Keadby, near Scunthorpe. The town of Scunthorpe is located approximately 5km to the east. The Proposed Development Site is centred on approximate National Grid Reference SE828116. The site location plan is presented as Figure 13A.1 (PEI Report Volume III) and a site layout plan is presented as Figure 13A.2, in Annex A of this report.
- 1.1.4 For the purposes of this report, the Proposed Development Site consists of a number of areas corresponding with the different parts of the Proposed Development. These are outlined below and illustrated on **Figure 13A.3**, in **Annex A**:
 - Proposed Power Station and Carbon Capture Site (Proposed PCC Site);
 - Electrical Connection Area to National Grid 400 kilovolt (kV) Substation;
 - Emergency Vehicle Access Road and Potential Electrical Connection to 132kV Substation;
 - Land within the Keadby Power Station site for the purposes of facilitating connections to the Proposed Development for natural gas supply, and other necessary infrastructure (including 'Gas Connection Corridor');
 - Water Connection Corridors (River Water Abstraction Option; Canal Water Abstraction Option and Water Discharge Corridor);
 - Waterborne Transport Offloading Area;
 - Additional Abnormal Indivisible Load Route;
 - Indicative Construction Laydown Areas; and
 - Construction and Operational Access Route and Gatehouse.

1.2 Report Objectives

- 1.2.1 This report will be used to establish the baseline conditions at the Proposed Development Site; it is also a necessary precursor to any ground investigation that may be required to support the Environmental Impact Assessment (EIA), preliminary design and Development Consent Order (DCO) application submission.
- 1.2.2 Current industry guidance supports the preparation of a development-specific desk study as a necessary precursor to any intrusive works for new development. The





desk study defines the plausible risks that may be present on a site, and hence the need for any further remediation or investigation. By undertaking a desk study first, this ensures that subsequent intrusive works (if required) are proportionate, cost effective and designed specifically for the ground conditions expected.

- 1.2.3 The scope of this Appendix is to:
 - review the Proposed Development Site's geological, hydrological and hydrogeological setting, and other geo-environmental information obtained from the Landmark Information Group (April 2020) to build up an understanding of the environmental setting and sensitivity;
 - review the historical development and land use at the Proposed Development Site and in the surrounding area, with an emphasis on identifying potential on-site and off-site contamination sources;
 - carry out a site inspection to identify any current potential contamination sources as well as possible indicators of contamination;
 - review any previous investigation reports or studies;
 - review any geo-hazards or outline geotechnical constraints;
 - develop an initial Conceptual Site Model (CSM) describing significant sourcepathway-receptor linkages followed by a preliminary risk assessment; and
 - outline the scope of any further investigation or remediation, as required.

1.3 Sources of Information

- 1.3.1 This Appendix draws on information from a combination of the following sources:
 - historical mapping included as part of a professional Envirocheck Report provided by the Landmark Information Group (April 2020) presented in Annex B;
 - standard Envirocheck data and site sensitivity information provided by the Landmark Information Group (in GIS data format – April 2020);
 - British Geological Survey (BGS) Geological Mapping and Memoirs https://www.bgs.ac.uk/data/maps/maps.cfc?method=listResults&MapName=&seri es=E50k&scale=&pageSize=100&getLatest=Y;
 - Environment Agency website;
 - BGS Geoindex website https://www.bgs.ac.uk/geoindex/;
 - Cranfield Soil and AgriFood Institute (CSAI) Soilscapes website http://www.landis.org.uk/soilscapes/;
 - stakeholder consultation;
 - URS. Design of a Site Protection and Monitoring Programme for Keadby Generation Ltd, Keadby Power Station (2018);
 - Structural Soils. Keadby Power Station, Geo-environmental Report (2017);





- Environmental Resources Management. Phase II Baseline Investigation Keadby (2017);
- Environmental Resources Management. Project Keadby Power Station: Phase 1 Desk Study Report (2017);
- Environmental Resources Management. Keadby 2 Power Station Environmental Statement (2016);
- Structural Soils. Interpretive Geotechnical Assessment on Ground Investigation (2016);
- Structural Soils. Additional Geotechnical Reports (2016);
- RSK. Keadby Power Station, Preliminary Risk Assessment (2016);
- URS. SSE Keadby, High pH (Alkaline) Drainage Water Options Appraisal (2012);
- URS. Environmental Site Assessment (2010);
- Exploration Associates. Settlement Monitoring: Keadby Power Station (2002);
- SSE. Keadby Power Station, Permitted Preliminary Works and Access Road, Discovery of Asbestos 11 September 1998 – Close Out Report (1999);
- Mouchel. Geotechnical Interpretative Report (1992);
- Mott MacDonald. Report on Pile Testing and Concrete Coring/Laboratory Testing (1991);
- Mott MacDonald. Project Phoenix, Proposed Groundwater Abstraction (1991);
- Department for Environment Food and Rural Affairs (DEFRA) Magic website https://magic.defra.gov.uk/;
- UK radon website provided by Public Health England https://www.ukradon.org/information/ukmaps;
- Zetica website for preliminary information on unexploded ordnance (UXO) https://zeticauxo.com/downloads-and-resources/risk-maps/; and
- 6 Alpha Associates Preliminary UXO Threat Assessment

1.4 Study Area

1.4.1 For the purposes of determining the local baseline conditions with respect to geology and land contamination, a study area that extends 250m from the boundary of the Proposed Development Site is adopted (see **Figure 13A.2** in **Annex A**). This is extended for hydrogeology to 1km from the boundary of the Proposed Development Site. This is appropriate to assess the local geological and hydrogeological setting, and any influence that potential contaminated land might have on the Proposed Development or local receptors. However, the baseline conditions in terms of soil chemical quality, where available, will be based on information directly within the Proposed Development Site only.





2.0 SITE DESCRIPTION AND SETTING

2.1 Site Setting and Surrounding Land Use

- 2.1.1 The Proposed Development Site covers an area of approximately 72.7 hectares (ha). and is currently occupied by the following:
 - Keadby Power Station, including numerous above ground tanks in the central/ eastern area;
 - a large 400kV electricity substation operated by National Grid in the northern area;
 - predominantly open land in the west (Keadby Common) including areas of former agricultural land¹ (used by the Keadby 2 Power Station construction project as lay-down and temporary spoil storage) with further open land on the eastern spurs (proposed Water Connection Corridor); and
 - a pumping station and residential housing are located on the eastern-most extent of the eastern spur and a pumping station is also located on the north-eastern spur.
- 2.1.2 A further 38.2ha of land is currently under evaluation to determine the suitability for potential construction laydown, although this land will not all be required and will be refined through ongoing studies and assessment.
- 2.1.3 Land within and surrounding the Proposed Development Site is generally low lying at elevations below 10m Above Ordnance Datum (mAOD) and with very shallow gradients. According to the Environment Agency Digital Terrain Model, the ground level varies from a low point of approximately 0m AOD, to a high point of 4m AOD within the Proposed PCC Site. The majority of the Proposed Development Site lies between 0 and 2m AOD, including the Proposed PCC Site.
- 2.1.4 A notable steep ridge is present immediately to the west of the Proposed PCC Site (outside the Proposed Development Site boundary) where land associated with the former Ash Tip is in excess of 19m AOD.
- 2.1.5 Levels on the Keadby 1 and Keadby 2 Power Station sites are slightly elevated compared to the surrounding land within the Proposed Development Site, with levels typically between 1 and 3m AOD. Levels within the construction laydown areas (farmland) under consideration are typically circa 1m AOD.
- 2.1.6 Relevant features immediately surrounding the Proposed Development Site (within the study area) are summarised in Table 1.



¹ The part of Keadby Common on which the Proposed PCC Site is to be located was previously occupied by a tenant farmer and used for agricultural purposes. The Applicant released the land from the tenancy in 2018 and it is therefore now back under the Applicant's full control.



Table 1: Features surrounding the Proposed Development Site

Direction	Summary
North	Keadby Wind Farm, additional areas of Keadby Common, agricultural land and watercourses (see Section 7.1 for further details).
South	Scunthorpe to Doncaster passenger railway line adjacent to the south-west and central-southern part of the Proposed Development Site. Sheffield and South Yorkshire Navigation (canal), Stainforth and Keadby Canal and other watercourses (see Section 7.1 for further details) and agricultural land.
East	Keadby village, Trent Side Road (B1392), River Trent, PD Ports (Marina) and wharf, pumping stations, electricity substations, a depot.
West	Open land (Keadby Common and agricultural land).





3.0 SITE INSPECTION

3.1 Overview

- 3.1.1 An external inspection of the Proposed Development Site was completed by a suitably qualified and experienced AECOM Engineer on 16 July 2020. The aim of the visit was to identify the range of activities carried out at the Proposed Development Site and to note any visible potential sources of ground contamination or geotechnical issues.
- 3.1.2 During the site visit, the AECOM Engineer was accompanied by representatives of the Applicant who provided a tour of the operational parts of the Keadby 1 Power Station site. Areas excluded from the walkover due to safety constraints included the Keadby 2 construction site and the Keadby 2 Laydown Area.
- 3.1.3 **Figure 4** (**Annex A**) identifies the principal observations made during the visit and a summary is provided below. A photographic record of the visit is included as **Annex B**.

3.2 Proposed PCC Site (Area to accommodate CCGT and CO₂ Capture Plant)

- 3.2.1 The Proposed PCC Site on which both the CCGT and Carbon Capture Plant (CCP) are situated is occupied by former agricultural land associated with Keadby Common and lies north and north-west of the Keadby 2 Laydown Area.
- 3.2.2 During the walkover, it was noted that the southern portion of this area has been converted to temporary spoil storage whereas the northern portion has been left untouched.
- 3.2.3 The spoil storage was noted to be formed of mounds and excavations; deeper excavations were found to exist to the west of the area compared to the east. The highest mounds were also recorded to the west of the area compared to the east.
- 3.2.4 A watercourse was noted to span the southern and western perimeter of both areas. On the spoil heap, a blue pipe was noted to be present that was positioned in the spoil heap and in the adjacent watercourse. Although unconfirmed by site representatives, it appeared to potentially be related to dewatering the spoil storage area.
- 3.2.5 On the spoil heap, surface erosion was recorded in the form of rills. No gullies were noted to be present.

3.3 Keadby 1 Power Station Site

- 3.3.1 Entrance to the Keadby 1 Power Station was via the gate house located to the northeast of the Proposed Development Site off Trent Road.
- 3.3.2 To the south-east of this area, a waste oil and gas cylinder storage area was noted to be present along with a water treatment works. Three cages of propane and butane gas cylinders were recorded with a waste oil area positioned adjacent. Contents of





the waste oil area included one bunded waste oil container, two 1000 litre waste oil containers, intermediate bulk containers (IBC), thirteen 250 litre barrels of insulating oil that were stood upright and placed on top of pallets directly onto the concrete beneath and various smaller containers of waste lubricating oil that were also placed directly onto the concrete. The condition of the concrete in the waste oil area was noted to be in good condition with no cracks present nor was there any evidence of surface staining. However, cracks in the hardstanding adjacent to the waste oil area were noted.

- 3.3.3 The area of the Water Treatment Works was found to contain five above ground storage tanks (AST). Two of the tanks were labelled as containing sodium hypochlorite, however these were reported to be empty by the site representative. A third tank contained caustic soda, the fourth contained sulphuric acid and the fifth contained alum for use in waste purification. All the tanks were contained within a concrete bund.
- 3.3.4 Further east, a scaffold storage area was noted together with a cage of gas cylinders stored in this area. A fabrication workshop was also noted adjacent to the scaffold area.
- 3.3.5 Running along the southern perimeter of Keadby 1 Power Station site are four large AST for the storage of demineralised water.
- 3.3.6 To the south of the Keadby Power Station site a fire fighting pump house was noted, which contained two pumps, each of which had diesel tanks positioned on top of each pump. The tanks appeared to be in good order and no surface staining of fuel was noted on the ground. It was reported by site representatives that fire-fighting exercises are carried out at Keadby 1 Power Station; however, the site representative informed AECOM that the use of fire-fighting foams e.g. Aqueous Film Forming Foams (AFFF) are not used during the exercises. Quantities of AFFF are stored at the Keadby Power Station site, however the location and quantities stored were not reported during the walkover.
- 3.3.7 Two gas heaters were located to the south west of the Keadby 1 Power Station site.
- 3.3.8 In the western part of the Keadby 1 Power Station site is the auxiliary boiler house, adjacent to which four AST were noted. Two were for the storage of waste lubricating oil, with the remaining two for the storage of clean lubricating oil. All four AST were located inside a concrete bund.
- 3.3.9 The western perimeter of the Keadby 1 Power Station site was fenced off with herras fencing demarking the boundary between Keadby 1 Power Station and the current boundary of the Keadby 2 Power Station construction site. Observations were made from Keadby 1 Power Station site towards Keadby 2 Power Station construction site and noted a single large AST to the south-west of Keadby 1 Power Station and three large AST grouped together to the west. The contents of the AST are unknown. As this part of the Keadby 2 construction site could not be accessed, during the site inspection, the state and condition of these AST and bunding is not known.
- 3.3.10 In the north-west of the Keadby 1 Power Station, a fenced off compound is present for the storage of multiple hydrogen cylinders and an AST of liquid carbon dioxide.





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- 3.3.11 To the north of the Keadby 1 Power Station site, 400kV transformers were noted for the distribution of electricity off-site. The transformers were reportedly built in the early 1990's and therefore, present a low risk for containing polychlorinated biphenyls (PCB). East of the transformers was an open area where a network of closed cycle cooling water pipes exists.
- 3.3.12 To the centre of the Keadby 1 Power Station site was the main boiler house. The main boiler house was not entered during the site inspection. Adjacent to the main boiler house to the east were two buildings housing emergency diesel generators. Access to the diesel generators was not conducted during the site inspection. An additional waste area was present at the centre of the Keadby 1 Power Station site and contained non-hazardous general waste, plastic recycling, a small battery waste container, a large battery waste container, a cabinet containing empty chemical drums, a cabinet containing Waste Electrical and Electronic Equipment (WEEE) and a container for hazardous fluorescent tubes. Hazardous lamps storage and aerosol containers (some spent) were also present. The condition of the hardstanding in this area was noted to be in a good condition with no cracks present. A building housing a hot works area was also present. A small area of ponded water was present at the centre of the Keadby 1 Power Station site; however, this was noted to be due to a rise in elevation of the roadway.
- 3.3.13 To the north-east of the Keadby 1 Power Station site, a large AST containing distillate fuel oil was present for use in gas turbine 3 to the west. The AST is contained in a large concrete bund. Adjacent to the AST is an additional waste oil storage area. The waste oil areas contained three 1000 litre capacity IBC and a 1000 litre capacity IBC containing glycol. The IBC were not bunded, however the hardstanding was observed to be in good condition and no staining on the ground was observed.
- 3.3.14 No constraints for any potential ground investigation were recorded for Keadby 1 Power Station, however considerations must be taken to ensure services are cleared prior to the progression of exploratory locations. A discharge point was also recorded off site north-east of the gate house, approximately 25m from the Proposed Development Site boundary that discharges to the drainage ditches that extend off site within agricultural fields. Access to the discharge point could not be granted at the time of the site inspection.

3.4 Electrical Connection Area

3.4.1 The majority of this area is occupied by road/ track and open land. In the eastern extent is a large corrugated metal and brick building with adjacent car park and metal fencing around, including warning signs for electric shock risk. Approximately 60m to the west of this building is a disused farm (adjacent to the Proposed Development Site boundary).





4.0 ENVIRONMENTAL SETTING

4.1 Introduction

- 4.1.1 The environmental setting including the topography, geology, hydrogeology and hydrology are the key factors that influence the way in which contaminants in the soil or groundwater can be transported on or off site, and the way in which contamination can affect users of the Proposed Development Site.
- 4.1.2 The environmental setting of the Proposed Development Site has been assessed by making reference to the information sources detailed in Section 1.4.

4.2 Soils Classification

- 4.2.1 Information obtained from Cranfield Soil and AgriFood Institute (CSAI) Soilscapes website (CSAI 2020) describes the soils on the Proposed Development Site to be loamy and clayey soils of coastal flats with naturally high groundwater (Soilscape identification description number 21). Land within this soil type is described as generally draining to local groundwater and mostly drained. Shallow groundwater and marginal ditches to most fields mean that the water resource is vulnerable to pollution from nutrients, pesticides and wastes that may be applied to the land.
- 4.2.2 According to the Landmark Information Group GIS data, Natural England reports the Agricultural Land Classification (ALC) to be Grade 2 for the Proposed Development Site. This is classed as soil of '*very good quality*'. This land is further described as having only minor limitations which affect crop yield, cultivations or harvesting. It can support a wide range of agricultural and horticultural crops but there can be some reduced flexibility on land within the grade, which causes difficulty in the production of more demanding crops e.g. winter harvested vegetables and arable root crops.

4.3 Geology

4.3.1 The BGS Geoindex website and published 1:50,000 scale geological maps of the area (Sheet 88, Doncaster and Sheet 79, Goole) have been reviewed, alongside the historical borehole records available from the Proposed PCC Site. The historical ground investigations are described in greater detail in Section 7.0. These records indicate that the Proposed Development Site is underlain by the geological succession summarised in Table 2.

Geology	Expected Location	Anticipated thickness	British Geological Survey (BGS) lithological description
Made Ground	Although not mapped at the site, Made Ground is expected across the Proposed Development Site given the historical site use.	Up to 2m	Artificial deposits on the natural ground's surface.

Table 2: Geological succession from published mapping and historical borehole logs





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Geology	Expected Location	Anticipated thickness	British Geological Survey (BGS) lithological description
Warp (artificially induced Alluvium)	Across the majority of the Proposed Development Site and the study area.		Clay and silt.
Cohesive Alluvium	Eastern extent of the Proposed Development Site and study area.	12 – 17m	Normally soft to firm consolidated, compressible silty clay, but can contain layers of silt, sand, peat and basal gravel.
Granular Alluvium	Beneath the Cohesive Alluvium.		Sands, silts and clays, with occasional peat layers (peat layers recorded between 0.45m and 1.6m thickness). Sands sometimes described as ' <i>blown</i> <i>sands</i> ' ¹ .
Mercia Mudstone Group (bedrock)	Across the Proposed Development Site and study area, beneath the superficial deposits.	Up to 200m	Dominantly red, less commonly green-grey, mudstones and subordinate siltstones with thick halite-bearing units in some basinal areas. Thin beds of gypsum/ anhydrite widespread; sandstones are also present.

¹ Blown sand; defined by BGS as sand that has been transported by wind, or sand consisting predominantly of wind-borne particles

4.3.2 No faults have been identified in the vicinity of the Proposed Development Site.

4.4 Soil Chemistry

4.4.1 BGS Soil Chemistry datasets detail the topsoil concentrations of five potentially harmful elements (PHE): arsenic (As), cadmium (Cd), copper (Cu), nickel (Ni) and lead (Pb). Elevated concentrations of these PHE can exist because of natural geological conditions or possible anthropogenic sources. The estimated soil chemistry levels attributed to the Proposed Development Site are set out in Table 3.





Table 3: Estimated soil chemistry

Potentially Harmful Element	Estimated geometric mean concentration range within the Proposed Development Site boundary (mg/kg)
Arsenic	14.1 – 18.9
Cadmium	South-western area of the site $-0.49 - 0.85$ Remainder of the site $-<0.33$
Copper	15.4 – 35.0
Lead	47.1 – 242
Nickel	23.5 – 31.9

4.5 Hydrogeology

Aquifer Classification

- 4.5.1 The Environment Agency's Groundwater Protection Policy (Environment Agency, 2018) adopts aquifer designations that are consistent with the Water Framework Directive (Water Framework Directive 2000/60/EC).
- 4.5.2 The superficial geology (Alluvium/ Warp) is classified as a Secondary A aquifer. These are permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers.
- 4.5.3 The bedrock geology (Mercia Mudstone Formation) is classified as a Secondary B aquifer. These are predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering. These are generally the water-bearing parts of the former non-aquifers.

Groundwater Vulnerability

4.5.4 The Environment Agency's simplified Groundwater Vulnerability Map (Environment Agency 2017) shows that the Proposed Development Site is located in an area where the groundwater vulnerability to pollution is classified as medium-high. These are high priority groundwater resources that have limited natural protection. These areas are likely to be characterised by generally high leaching soils. This results in a medium-high overall pollution risk to groundwater from surface activities. Activities in these areas may require additional measures over and above good practice to ensure they do not cause groundwater pollution.

Groundwater Source Protection Zones

4.5.5 The Proposed Development Site does not lie within a Source Protection Zone (SPZ). There are no SPZ within 1km of the Proposed Development Site.





Groundwater Abstractions

- 4.5.6 According to the Envirocheck report, there is one licenced groundwater abstraction recorded within the Proposed Development Site and none within the extended 1km study area for groundwater abstractions. This single entry is indicated to be within the footprint of the existing Keadby Power Station (National Grid Reference 482619, 411656) and licensed to 'Siemens Public Limited Company' (Md/028/0083/040). The abstraction is listed as being for 'industrial/ commercial/ public services/ dewatering'.
- 4.5.7 Engagement is ongoing with relevant stakeholders principally the Environment Agency and local authority to obtain records of any further private abstractions within a 1km radius of the Proposed Development Site; this is discussed further in Chapter 12: Water Resources and Flood Risk (PEI Report Volume I). A contemporaneous review of private abstractions will be provided in the Environmental Statement.

Groundwater Levels

4.5.8 Groundwater levels within the historical borehole records indicate generally shallow groundwater levels within the superficial geology of between 0.9m - 3.0m below ground level (bgl). Occasionally, deeper groundwater strikes were recorded between 5.4m - 6.9m bgl. There is insufficient information to conclude at this stage whether these levels are representative of true groundwater levels across the wider area.

4.6 Hydrology

Surface Watercourses and Drainage

4.6.1 There are numerous surface water features located within the Proposed Development Site and wider study area. These are detailed, along with river quality information (where available) in Table 4.

Surface water feature name	Location	River Quality Information
Various unnamed drains	Located on-site and within the study area; various directions	Not available
River Trent (tidal river)	Overlaps slightly onto the eastern spurs of the Proposed Development Site; north-south direction	Reach: A631 Gainsborough To Keadby River Quality C Flow greater than 80 cumecs Year: 2000
Eastoft Moors (Warping) Drain (inland river)	Overlaps slightly onto the north-eastern spur of the Proposed Development Site; west-east direction	Reach: Track Bridge to Confluence of River Trent River Quality D Flow less than 0.31 cumecs Year: 2000

Table 4: Surface water features





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Surface water feature name	Location	River Quality Information
Sewer Drain (drain)	Overlaps slightly onto the north-eastern spur of the Proposed Development Site; west-east direction	Not available
North Soak Drain (inland river)	Overlaps slightly onto the southern boundary of the Proposed Development Site; west-east direction	Reach: Medge Hall To Confluence of South Soak Drain River Quality E Flow less than 0.31 cumecs Year: 2000
Sheffield and South Yorkshire Navigation/ Stainforth and Keadby Canal	Overlaps slightly onto the southern boundary of the Proposed Development Site; west-east direction	Reach: Thorne Lock to Trent River Quality C Flow greater than 80 cumecs Year: 2000
(canal)		Reach: River Don Navigation to Thorne Lock River Quality Chemistry General Quality Assessment (GQA) Grade A - Very Good Year: 2009
		Reach: Thorne Lock to Trent River Quality Chemistry GQA Grade A - Very Good Year: 2009
South Soak Drain (inland river)	25m south of the Proposed Development Site at its closest point; west-east direction	Reach: Moors Bridge to Confluence of Three Rivers River Quality D Flow less than 0.31 cumecs Year: 2000
Three Rivers (inland river)	100m south of the Proposed Development Site at its closest point; south-west to north-east direction	Reach: Pilfrey Bridge to Keadby Pumping Station River Quality C Flow less than 1.25 cumecs Year: 2000
		Reach: Pilfrey Bridge to Keadby Pumping Station River Quality Chemistry GQA Grade D - Fair Year: 2009





4.6.2 Further information on the quality and status of relevant watercourses can be found in Chapter 12: Water Resources and Flood Risk (PEI Report Volume I) and Appendix 12B: Water Framework Directive Screening Assessment (PEI Report Volume II).

Surface Water Abstractions

4.6.3 Seven surface water abstractions have been identified within 250m of the Proposed Development Site. These are listed in Table 5.

National Grid Reference	Approximate distance	Licence number and operator	Use
483540, 411640	On the Proposed Development Site, located on the eastern extent of the eastern spur	03/28/85/0007 Keadby Generation Ltd	Production of energy: boiler feed; and Amenity: spray irrigation – direct
481780, 412230	23m north-west	03/28/84/0008 Mr W Foster-Thornton	General agriculture: spray irrigation - direct
482790, 411490	10m south	03/28/83/0171 Canal and River Trust/ British Waterways	Production of energy: boiler feed
482790, 411490	10m south	Md/028/0083/014 Canal and River Trust	Mechanical non- electrical; evaporative cooling
481800, 411400	160m south	03/28/83/0094 J A Chapman Farms	General agriculture: spray irrigation - direct
483700, 411795	190m east	03/28/85/0006/1 Holly Hall Farms Ltd	Spray irrigation
483700, 411795	190m east	03/28/85/0010 T F Belton Limited	General agriculture: spray irrigation - direct
483171, 412204	230m north	Md/028/0084/005 RJ & AE Godfrey	General agriculture: spray irrigation - direct

Table 5: Environment Agency licensed surface water abstractions

Permit end dates for these abstractions are specified as 'not supplied', and therefore all are assumed to be active abstractions.

Nitrate Vulnerable Zones

4.6.4 The Proposed Development Site and the study area are located within a nitrate vulnerable zone – surface water. Designations of nitrate vulnerable zones occur





where land drains contribute to nitrate concentrations found in polluted water. Polluted waters include:

- surface waters that contain at least 50mg/l of nitrate;
- surface waters that are likely to contain at least 50mg/l of nitrate if no action is taken; and
- waters which are eutrophic, or are likely to become eutrophic, if no action is taken.

Drinking Water Protected Areas

4.6.5 The Proposed Development Site and the study area are not located within a Drinking Water Protected Area (surface water).

4.7 Minerals Safeguarding and Mineral Extraction

- 4.7.1 The National Planning Policy Framework (NPPF) (Ministry of Housing, Planning & Local Government, 2019) for England requires minerals planning authorities to promote sustainable use of mineral resources in their Local Plans. North Lincolnshire Council is the local authority responsible for minerals planning in Keadby.
- 4.7.2 The adopted 2003 Local North Lincolnshire Plan does not refer to any minerals safeguarding or consultation areas in the study area. The 2003 Local North Lincolnshire Plan is due to be replaced by the North Lincolnshire Local Plan which will run to 2037. This is currently at Preferred Options Consultation stage.
- 4.7.3 Based on available data and local authority consultation carried out there are no records of aggregate/ mineral quarrying or mining, non-coal mining or coal mining within 500m of the study area of the Proposed Development Site.
- 4.7.4 As such, the risk from quarrying and mining can be considered negligible.

4.8 Radon

- 4.8.1 The Envirocheck report and the Public Health England (PHE) Radon UK map indicate that the Proposed Development Site is within an area where the risk from radon is generally considered to be low. Less than 1% of homes are above the UK 'Action Level'.
- 4.8.2 No radon protective measures are necessary (applicable in the construction of new dwellings or extensions.)

4.9 Unexploded Ordnance

- 4.9.1 According to the Zetica website, the Proposed Development Site lies within a zone that experiences a low risk of UXO.
- 4.9.2 The Preliminary UXO Threat Assessment provided by 6 Alpha Associates indicates that the potential for encountering UXO at the site is 'unlikely'. This report is presented in **Annex C**.





4.10 Utilities

4.10.1 Utility plans are included in **Annex D**. The confirmed utilities at the location of the Proposed Development Site are summarised in Table 6 below.

Utility Type	Utility Company	Location
Telecoms	Open Reach	Open Reach line and boxes to the east of the site. Open Reach line also runs parallel to the track to the south of the site.
Power	Northern Power Grid	Underground conductor runs east-west along the boundary separating the northern and southern sections of the site. Overhead conductor runs parallel to the track to the south of the site. Underground conductor cuts across and runs parallel to the track to the south of the site.
Water	Yorkshire Water	None shown within the site.
Gas	Cadent	Gas pipe cuts across and runs parallel to the track to the south of the site.

 Table 6: Summary of indicated services.





5.0 REGULATED ACTIVITIES

5.1 Introduction

- 5.1.1 The key relevant features that characterise the Proposed Development Site and surrounding area are summarised in this section, along with an indication of the risk to land quality of the Proposed Development Site. Information detailed in the following section has been taken from the Landmark Information Group Envirocheck Report obtained for the Proposed Development Site.
- 5.1.2 Information on groundwater and surface water abstractions is detailed in Section 4.5 and 4.6 and is not repeated here.
- 5.1.3 Generally, any regulated processes, registered radioactive substances, licensed waste management facilities and landfills, hazardous substances, fuel station entries and any other contemporary trade directory entries within 250m of the Proposed Development Site could, depending upon the nature of their activities represent potential sources of contamination.

5.2 Regulated Processes

5.2.1 Table 7 summarises information on regulated processes which has been collated from Environment Agency and Local Authority datasets presented within the Landmark Information Group GIS data.

Consent	Number present in relation to Proposed Development Site		Details
	On-site	0-250m	
Discharge Consents	9	14	<u>On-site:</u> Various locations, concerning sewage/ trade effluent/ trade discharge (process water) to underground strata/ surface water/ unknown (receiving water not supplied)
			<u>Off-site:</u> Various locations, concerning sewage/ trade effluent/ contaminated water/ trade discharge (process water and cooling water) to underground strata/ surface water/ unknown (receiving water not supplied)

Table 7: Summary of regulatory information – industrial processes





Consent	Number present in relation to Proposed Development Site		Details
Integrated Pollution Controls	12	0	<u>On-site</u> : All located within the footprint of the current Keadby Power Station. One located within the footprint of the Additional Abnormal Indivisible Load Route. Name: Keadby Generation Limited Concerning combustion processes within the Fuel & Power Industry Status: Authorisation superseded by a substantial or non substantial variation (11 no.) and revoked (1 no.)
Integrated Pollution Prevention and Control	13	0	<u>On-site:</u> All located within the footprint of the current Keadby 1 Power Station. Name: Keadby Generation Limited Concerns combustion; any fuel greater or equal to 50Mw and gasification, liquefaction and refining; odorising natural gas/ LPG Status: Valid (2 no.), superseded by variation (7 no.), effective (1 no.) Name: National Grid Gas plc Concerns gasification, liquefaction and refining; odorising natural gas/ LPG Status: Valid (2 no.), effective (1 no.)
Local Authority Pollution Prevention and Controls	1	3	On-site:Located within the footprint of the current Keadby1 Power StationType: air pollution controlProcess: PG1/15 Odourising natural gas andliquified petroleum gasStatus: authorisedOff-site:30m south-west of the Waterborne Transport Off-Loading AreaType: air pollution controlProcess: PG3/5 Coal, coke and coal productprocessesStatus: authorised





Consent	Number present in relation to Proposed Development Site		Details
			30m south of the Additional Abnormal Indivisible Load Route
			Type: Local Authority Pollution Prevention and Control
			Process: PG3/5 Coal, coke and coal product processes
			Status: permitted
			215m south-east of the Waterborne Transport Off- Loading Area
			Type: air pollution control
			Process: PG3/5 Coal, coke and coal product
			processes
			Status: authorised

5.3 Waste Management Facilities

5.3.1 Table 8 summarises information on licensed and historical waste management facilities collated from the Environment Agency and Local Authority datasets presented within the Landmark Information Group GIS data.

 Table 8: Summary of regulatory information – waste management processes

Subject	Number present in relation to Proposed Development Site		Details
	On- site	0- 250m	
Landfill Sites	6	2	<u>On-site:</u> <i>Historical landfill site;</i> Keadby Power Landfill located in the central part of the Proposed Development Site and licensed between 1992 and 2000. Reported to have received inert and industrial waste.
			<i>Historical landfill site;</i> Keadby Central Electricity Generating Board located adjacent to the southern and western boundary of the Proposed Development Site, and licensed





Subject	Number present in relation to Proposed Development Site		Details
			between 1977 and 1990, but with the first recorded input to have been in 1958 and last input in 1990. This landfill is indicated to have received inert, commercial, industrial and household waste.
			Licensed waste management facility and historical landfill site: Keadby Power Station landfill located adjacent to the southern and western boundary of the Proposed Development Site and licensed in 1992. First recorded input in 1992 and last recorded input in 1993. This landfill is indicated to have received inert, commercial and household waste. Operated by Keadby Power Ltd. Maximum input: Medium (equal to or greater than 25,000 and less than 75,000 tonnes per year). Status: inactive.
			Licensed waste management facility and historical landfill site: John Brown Engineering landfill located adjacent to the southern and western boundary of the Proposed Development Site, in a cluster with the previous two entries. Licensed between 1994 and 2000, but with the first input in 1994 and the last input recorded in 1995. This landfill is indicated to have received inert, industrial and liquid sludge waste. Operated by J Brown Engineering Ltd. Maximum input: Large (equal to or greater than 75,000 tonnes per year). Status: inactive.
			Registered landfill site and historical landfill site; Transtore Industries/ Former Keadby Power Station landfill located in the west of the Proposed Development Site. Operated by the Central Electricity Generating Board, licensed from 1987 but received date of waste was from 1981. No indicated surrender dates. This landfill is indicated to have received inert, industrial, commercial, household and special waste. Maximum input: Very Small (less than 10,000 tonnes per year). Status: licence cancelled.





Subject	Number present in relation to Proposed Development Site	Details
		BGS recorded landfill site and historical landfill site; Keadby Power Station landfill located in the northern area of the Proposed Development Site and extends beyond the Proposed Development Site boundary to the west. Operated by the Central Electricity Generating Board with the first waste input recorded in 1958. Identified as having received inert and industrial waste.
		Off-site: Historical landfill site; Keadby Power Station landfill located to the west of the Pulverised Fuel Ash (PFA) settlement lagoon and 15m west of the Proposed Development Site at its closest point. Operated by the John Brown Engineering. No licence or waste details indicated.
		Historical landfill site; PFA Settlement Lagoon, Keadby Power Station, located to the east of the Keadby Power Station landfill and 25m west of the Proposed Development Site at its closest point. Operated by the Central Electricity Generating Board with no recorded licence details.

5.4 Hazardous Substances

- 5.4.1 There is one Planning Hazardous Substances Consent located within the study area. This is located 55m west of the Additional Abnormal Indivisible Load Route and it concerns ammonium nitrate-based fertilisers which conforms to the Fertilisers Regulations 1991(a) and composite fertilisers containing phosphate and/or potash. However, its status is indicated to have been withdrawn.
- 5.4.2 There are no Registered Radioactive Substances listed on the Proposed Development Site or in the study area.
- 5.4.3 There are no records of COMAH (Control of Major Accidents Hazards) sites or licenses present on the Proposed Development Site or within the study area.
- 5.4.4 There are four historical tanks indicated on available plans within the Proposed Development Site; three above ground oil storage tanks located within the footprint of the existing Keady Power Station (which currently forms part of the Keadby 2 Power





Station construction site) and one located on the eastern spur (the Water Connection Corridor) which is assumed to be associated with the pumping station. There is one historical tank located 220m south of the Abnormal Indivisible Load Route.

5.5 **Contemporary Trade Directory Entries**

5.5.1 There is one contemporary trade directory entry located on the Proposed Development Site for the Applicant and electricity generation. There are two further trade directory entries within the study area; one active entry located 55m west of the Additional Abnormal Indivisible Load Route for PD Ports and one inactive entry located 200m north and south-east of the Water Connection Corridor for SL Cleaning Services.

5.6 Pollution Incidents

- 5.6.1 There is one recorded pollution incident to controlled waters (Category 3) listed for the Proposed Development Site. This is indicated to have been at the eastern extent of the Water Connection Corridor and concerned raw sewage in filter pipes which impacted an abstraction. The receiving water was identified as a saline estuary (River Trent) and the incident occurred in 1999.
- 5.6.2 There are a further four Category 3 pollution incidents to controlled waters within the study area. The closest of these was 10m north of the Waterborne Transport Off-Loading Area and concerned oil pollutants to an unknown receiving water in 1996. Of the remaining three incidents, these are either older than 30 years or in excess of 100m from the Proposed Development Site.

5.7 Sensitive Land Uses

5.7.1 Sensitive land uses on the Proposed Development Site and within the study area are summarised in Table 9.

Sensitive land use	Distance and direction from the Proposed Development Site	Details
Ramsar Site – Humber Estuary		Status: listed
Site of Special Scientific Interest (SSSI) – Humber Estuary	On-site (eastern extent of the proposed Water Connection Corridors) and beyond the Proposed Development Site	Status: notified
Special Area of Conservation (SAC) – Humber Estuary	boundary to the east	Status: designated
LWS – Keadby Boundary Drain	Adjacent to the north-west boundary of the Proposed Development Site	Type: non-statutory Status: selected LWS

Table 9: Summary of sensitive land uses





Sensitive land use	Distance and direction from the Proposed Development Site	Details
LWS – Stainforth and Keadby Canal Corridor	On-site (very slight overlap onto southern boundary (Potential Abstraction Option) and beyond the Proposed Development Site boundary to the south	Type: non-statutory Status: selected LWS
LWS – South Soak Drain, Keadby	25m south of the Proposed Development Site	Type: non-statutory Status: selected LWS
LWS – Keadby Wetland	25m south of the Proposed Development Site	Type: non-statutory Status: selected LWS
LWS – Keadby Wet Grassland	50m south of the Proposed Development Site	Type: non-statutory Status: selected LWS
LWS – Three Rivers	100m south of the Proposed Development Site	Type: non-statutory Status: selected LWS
Local Wildlife Site (LWS) – Keadby Warping Drain	On-site (north-eastern spur of Water Connection Corridor) and beyond the Proposed Development Site boundary to the north	Type: non-statutory Status: selected LWS





6.0 HISTORICAL DEVELOPMENT

6.1 Introduction

6.1.1 Historical mapping has been reviewed to evaluate the potential for past activities, both on and adjacent to the Proposed Development Site, to have impacted upon the its environmental and land quality. Historical Ordnance Survey (OS) maps of the Proposed Development Site were obtained from the Landmark Information Group and are presented in Annex B. The available mapping dates were between 1885 - 2020. Where dates are given in the text, these refer to dates of maps on which the features appear, and do not necessarily refer to exact dates of construction, or operation of any particular facility.

6.2 **Proposed Development Site**

- 6.2.1 Circa 1885 1886, the Proposed Development Site is shown to be largely undeveloped with predominantly open fields, forming Keadby Common at the centre. Properties are present on the eastern-most spur of the Proposed Development Site, near to the western banks of the River Trent. A railway passes just over the southern boundary near to Keadby Junction. This railway runs broadly parallel adjacent to the south of the Proposed Development Site in a west-east direction.
- 6.2.2 No notable changes occurred until around 1967 1969 when a power station is shown to have been developed in the central/ eastern area. The mapping shows electricity transmission cables and pylons originating from the power station and spanning across the centre. Railway lines, orientated in a west-east direction, occupy the south-western area which lead to, and terminate, at the power station. Adjacent to the north of the railway lines is a conveyor system, presumably used for the transport of materials and fuels, such as coal, from trains to the power station. An area of marshland is present in the south-west along with a small refuse heap, with tracks leading from this to the power station and also extending beyond the site boundaries. Three mixed circular and rectangular tanks of unknown contents are present south and east of the power station. Keadby Common Farm is also present at the centre along with a wider network of drains. To the east, an increase in properties is noted. A pond and a tank are also present on the eastern-most spur of the Proposed Development Site.
- 6.2.3 By 1978 1982, circa seven mixed circular and rectangular tanks are shown to occupy the land directly south of the main power station building.
- 6.2.4 No notable changes occur until 1991 1994, at which time the power station is labelled as disused. Contained within the Proposed Development Site boundary in the east are jetties present on the River Trent, with a pumping station located inland where the pond and tanks are located. Keadby Common Farm is no longer shown.
- 6.2.5 From 1995 onwards, the disused power station has become an electric generation station and a change in site layout is observed. The railway and conveyor system that was previously present terminating at the power station is now absent from the landscape. A set of small tanks and a single tank is located to the west; five tanks





run parallel to the south, and an additional set of tanks is located east of the electric generation station. Further west from the electric generation station, towards the centre of the Proposed Development Site, are three large tanks. The refuse heap and area of marshland to the south-west of the Proposed Development Site are now indicated to be absent. A large electric substation is now present in the north of the Proposed Development Site with electricity transmission cables and pylons connected to the electric generation station, with overhead cables leading off-site to the north, south and west. A building and mast are present to the north of the electric generation station.

6.2.6 Aerial imagery from 2003, 2008 and 2015 demonstrate no notable changes.

6.3 Study Area

- 6.3.1 From 1886, a railway line runs parallel and adjacent to the south of the Proposed Development Site with areas of marshland beyond this approximately 50m away from the boundary. Towards the River Trent, to the south of the Proposed Development Site boundary, is a gasometer approximately 60m away, which is absent from mapping in 1907. Occasional farms and farmland are located within the study area.
- 6.3.2 No additional notable features with a potential to have resulted in land contamination are noted until around 1966 1969. At this time and 220m west of the Proposed Development Site, a large slag heap with two sludge beds and a pond are indicated. A drain is also present adjacent to the slag heap and pond, which appears to be connected to one of the sludge beds and indicated to run onto the Proposed Development Site, passing through the centre. An additional drain is also present north of the slag heap that passes past the northern boundary of the Proposed Development Site, with a drain adjacent to the south of the slag heap which runs onto the Proposed Development Site. To the east, adjacent to the Proposed Development Site, a coal wharf is present on the banks of the River Trent, with a loading bay on train tracks further inland approximately 30m from the Proposed Development Site. An electrical substation is present in the loading bay. A pond is located adjacent to the south of the loading bay. Further south and to the east is a depot approximately 120m south, along with a set of tanks present approximately 220m from the Proposed Development Site.
- 6.3.3 Mapping from 1994 shows that the loading bay and associated railway previously mentioned to the south-east of the Proposed Development Site are now absent from the landscape, with the pond now assumed to have been infilled. A warehouse is now also present in the location of the former loading bay approximately 20m from the Proposed Development Site.
- 6.3.4 Historical maps from 1995 show the slag heap to the west of the Proposed Development Site as a disused spoil heap. The two sludge beds, pond and drains associated with this area are no longer apparent and are assumed to have been infilled.
- 6.3.5 No other notable off site historical contaminative features are evident from recent mapping and aerial imagery.





7.0 PREVIOUS GROUND INVESTIGATIONS

7.1 Introduction

7.1.1 This section summarises a number of previous reports that have been made available to AECOM, relating to the Proposed Development Site. These have been summarised in chronological order (from the most recent to the oldest).

7.2 URS (2018) Design of a Site Protection and Monitoring Programme for Keadby Generation Ltd, Keadby Power Station

Introduction

7.2.1 This report represented the Site Protection and Monitoring Programme (SPMP) for Keadby Power Station submitted to the Environment Agency in pursuance of Condition 2.8.1 of the Permit No. (YP3133LL), authorising the operation of the Keadby Power Station Installation. The SPMP was a revised and updated version of the original SPMP that was submitted in 2007 incorporating identified changes to the infrastructure monitoring protocols and any potential polluting events that had occurred on the site.

Summary of Key Information

- 7.2.2 An issue regarding the integrity of drainage in the south eastern corner of the site was raised in an Application Site Report (ASR) submitted as part of the IPPC application. Due to subsidence, the drains in the area had been inspected by a third party and damage to the drains had been identified. As stated in the ASR the drainage system in this area had been dug out and a new drainage system had been laid. These improvements were made in March 2006, prior to issue of the PPC permit. The survey report from work carried out in 2006 was forwarded to the Environment Agency. A formal programme of ongoing, three yearly integrity inspections of the drainage system across the whole of the site had been implemented.
- 7.2.3 An extensive programme of drain cleaning and camera inspections of site drainage was carried out in 2017. Some minor repairs were conducted. Further inspections were carried out in 2018.
- 7.2.4 On 16th October 2007, the Environment Agency were notified of gas oil that was identified during an excavation on the distillate oil tank farm. The Environment Agency subsequently acknowledged that the oil spill was of a low level and had occurred historically. The Environment Agency deemed that this historic oil spill was not relevant to the operation of the site at the time and should be referenced in, but not monitored through, the SPMP.
- 7.2.5 Following the oil spill identification, several monitoring points were installed, and monitoring was conducted, to further assess the historical oil spill. Following discussions with URS, it was identified that new monitoring boreholes should be installed to provide a greater representation of conditions at the site. Free product was not identified in any of the monitoring wells during a groundwater monitoring event in January 2013.





7.2.6 The SPMP did not cover environmental monitoring or the collection of reference data, as this was determined as unnecessary through the assessment of the Keadby Power Station installation and its activities using the Environment Agency's H7 Guidance document. For all relevant activities at the installation it was considered that there was little likelihood that land pollution or leaks to the land would occur during the future life of the installation. It was stated that monitoring of the historical gas oil spill would continue with results reported to the Environment Agency but outside of the scope of the SPMP.

Reports Contained within the Appendices of the SPMP

- 7.2.7 Previous reports were included within the appendices of the SPMP; however, these did not appear to be summarised in the main report. These included;
 - Exploration Associates Ltd 1992. Keadby Power Station: Site Contamination Assessment;
 - Exploration Associates Ltd 1992. Keadby Power Station, Factual Report on Ground Investigation;
 - Environmental Resources Management 2017. Project Keadby Power Station: Phase 1 Desk Study Report; and
 - Environmental Resources Management 2017. Phase II Baseline Investigation Keadby
- 7.2.8 The Exploration Associates Ltd reports above were summarised in the Environmental Resources Management (ERM) 2016 Environmental Statement (see Section 7.6) and therefore are not discussed further in this section.
- 7.2.9 The ERM 2017 reports are summarised in Sections 7.4 and 7.5.

7.3 Structural Soils (2017) Keadby Power Station, Geo-environmental Report

Introduction

7.3.1 The purpose of this report was to investigate ground conditions and provide information on land contamination, both to assess risks to human health and groundwater, prior to construction of Keadby 2 Power Station (adjacent to Keadby 1).

Risks to Human Health

- 7.3.2 With the exception of the presence of asbestos, the Structural Soils assessment indicated contaminant concentrations in the soil were below the RSK assessment criteria used (commercial end use). Therefore, Structural Soils concluded that the risks to site users (other than from asbestos) was low to very low.
- 7.3.3 It was concluded that the presence of asbestos would lead to a moderate to low risk during the construction phase, but that this risk could be managed.





Risks to Groundwater

7.3.4 The Structural Soils investigation identified marginally elevated levels of contaminants in two of the leachate samples which they stated may pose a risk to the underlying Secondary A aquifer. Also, elevated total petroleum hydrocarbons (TPH) was recorded in the water sample taken whilst drilling from one exploratory hole. However, no corresponding elevated concentrations were recorded in the groundwater samples obtained from the wells following purging and as such, Structural Soils presumed that there was no pathway and that increased hard standing would limit the pathway further.

Remediation

- 7.3.5 The minimum remediation required for the site was assumed to be the removal of the buried foundations and other areas of hardstanding. Due to the presence of asbestos within the soil, although low, asbestos management would be required during the construction works.
- 7.3.6 Structural Soils also conclude that localised areas of contamination are likely to be at the site given the history of the site and existence of Made Ground, Structural Soils recommended to maintain vigilance during site clearance and construction, in case any further areas of suspected contamination were encountered. It was recommended that if further areas of contamination were encountered, then a suitably qualified person should undertake appropriate sampling, testing and further risk assessment.

Ground Gas

7.3.7 Following gas monitoring on three occasions, a Gas Characteristic Situation 1 (very low hazard potential) was defined.

7.4 Environmental Resources Management (2017) Project Keadby Power Station: Phase 1 Desk Study Report

Introduction

- 7.4.1 ERM was commissioned by Scottish and Southern Electricity (SSE) ('the client') to undertake a Phase I Environmental Site Assessment (ESA) of the Proposed Development (Keadby 2), Trentside, Keadby, Scunthorpe DN17 3EF.
- 7.4.2 A number of previous reports (approximately 20) had been made available to ERM and had been reviewed and summarised in the report. This included site investigation data dating from 1991 to 2016 and were used by ERM to provide details on the potential sources of contamination at the Proposed Development Site. ERM provided an overall summary of the findings of these 20 documents. This is provided in this section, below. However, a more detailed review of some of these reports (those that have been made available to AECOM) has been provided in Sections 7.7 to 7.11, and 7.14.





Summary of Potential Current On-site and Off-site Sources of Impact

- 7.4.3 The large areas to the north-west of Keadby 2 were identified to be dominated by landfills of various compositions and were considered to be a potential significant source of contamination. The nature of the wastes are likely to comprise ashes, sludges and builders wastes. Therefore, it was considered that the potential for the generation of large volumes of ground gas and leachate are likely to be limited.
- 7.4.4 Made Ground, including PFA and Blast Furnace Slag (BFS) were reported to cover much of Keadby 2 and a large area to the west of Keadby 2. The PFA and BFS were reported to be associated with high concentrations of sodium, sulphate and boron as well as potentially having a high alkalinity (frequently demonstrated to be above pH 10). The previous site investigations reviewed by ERM had mentioned the presence of asbestos in the Made Ground, although ERM indicated that only low concentrations were present.
- 7.4.5 The tanks associated with the current Keadby Power Station were considered potential sources of hydrocarbon impact. ERM indicated that some contamination was noted in a URS 2012 report and anecdotal evidence indicated that some floating product was present on the perched groundwater, although the lateral extent was limited. This is discussed further in Section 7.10.
- 7.4.6 The potential source of PCB associated with the electricity substation to the north of Keadby 2 was considered to be a source of potential impact due to its size. Analysis of PCB was completed by Exploration Associates in 1992, but significant concentrations of PCB in soils were not detected. Many of the samples were taken across the site with some more targeted in close proximity to the electrical substation.
- 7.4.7 The historical coal power station and its associated railway sidings were considered to be potential sources of contamination. The presence of heavy metals and phenols are associated with clinker, coal slag and coal tars as well as with areas of coal storage. Some isolated hotspots of heavy metals and some hydrocarbons had been detected in close proximity to the footprint of the former coal fired power station.

Summary of Recommendations Made

- 7.4.8 The following recommendations were made:
 - Undertake a site investigation specifically focussing on the potential for contamination in the shallow soils and groundwater. It was recommended that this would comprise the use of boreholes to depths of 5m bgl and monitoring of these and the existing monitoring wells on site;
 - Adopt field screening using a photo-ionisation detector to discount the potential for volatile organic compounds (VOC) contamination;
 - Delineate areas of potential concern such as areas of known hydrocarbon impact to determine options for treatment of the groundwater, if required, but also removal/ disposal/ remediation of any soil hotspots which could be excavated;
 - Undertake an investigation of the areas containing slag and the high pH in groundwater. This could be a combination of shallow boreholes and hand





excavated pits to depths of 1.5m bgl. The aim of this assessment would be to consider options to treat groundwater during the temporary works/ enabling works, but also to assess options to retain and reuse the slag on site or characterise the materials for offsite disposal; and

• Complete shallow ground gas monitoring to assess the requirement for impermeable ground gas membranes beneath the building footprint.

7.5 Environmental Resources Management (2017) Phase II Baseline Investigation Keadby

Summary of Phase 2 Investigation

- 7.5.1 The Phase 1 study summarised in Section 7.4, identified several potential data gaps, following a review of available site investigation information. A Phase 2 site investigation was therefore commissioned within the Keadby 2 area, to address the data gaps.
- 7.5.2 The Phase 2 site investigation was undertaken between 31st July and 3rd August 2017. The investigation comprised the advancement of seven windowless sample boreholes, hand digging of four soil bores, the collection of soil and groundwater samples for chemical analysis and completion of two rounds of soil gas monitoring. The boreholes reached maximum depths of 2.0m bgl.
- 7.5.3 Some visual or olfactory evidence of contamination was observed in the soil during the fieldwork activities; white precipitate was observed in four locations within the Made Ground between depths of 0.4 and 1.15m bgl and natural black staining was observed in two locations within clay between depths of 1.2 and 1.3m bgl.
- 7.5.4 Limited visual or olfactory evidence of contamination was observed in the groundwater during fieldwork activities. A yellow green 'scummy' film was observed on the surface of a grab sample in one location, where groundwater had collected above the refusal depth.

Ground Conditions

7.5.5 The shallow ground investigation encountered Made Ground, which was mainly composed of clinker or BFS. This was underlain by soft to firm clay. Additionally, fibrous peat was encountered to the west of the site. The clay was underlain by a well sorted sand in the east.

Human Health Risk Assessment

7.5.6 In terms of human health impacts from the soils, the ERM assessment recorded no exceedances of the GAC under a commercial land use scenario. Based on this, ERM stated that no risks were predicted to human health, assuming ongoing commercial use of the site and appropriate precautionary measures such as Personal Protective Equipment (PPE) to be adopted during construction.





Asbestos Assessment

- 7.5.7 Asbestos was detected in five of seven soil samples analysed, from locations distributed across the site, all within a depth of between 0.1 and 0.4m bgl. Quantification analysis was completed, the results of which identified that asbestos was present at concentrations less than <0.001%. The concentrations were detected below the method detection limits and whilst a positive result was returned in the screening exercise, the quantification had returned results that were not considered by ERM to pose a potential risk to human health. Therefore, no special precautions were considered to be required during the earthworks.
- 7.5.8 However, the potential for asbestos to be encountered during excavation works could not be discounted and it was therefore recommended that a watching brief should be adopted during construction works. It was also recommended that the Contractor develop an asbestos management plan in the event that hotspots of suspected ACM were encountered.

Controlled Waters Risk Assessment

- 7.5.9 The River Trent (775m east of the Keadby 2 site) had been identified as a controlled waters receptor and considered in the generic risk assessment. Therefore, groundwater results were compared against Fresh Water Environmental Quality Standards (EQS).
- 7.5.10 Groundwater was present within each of the seven monitoring wells and a groundwater sample was obtained from each location. The depth to groundwater was measured, which identified potential groundwater flow towards the north. It was indicated that the groundwater encountered during the investigation works was perched groundwater present within the sand lenses of the underlying clay and upper Made Ground layer. Further evidence that the shallow groundwater encountered was perched and not a continuous water body was that during the monitoring works the wells were purged with little recharge being observed.
- 7.5.11 Comparing the results from the groundwater analysis with the Freshwater EQS assessment criteria, ERM concluded that barium and boron were the only criteria which were exceeded within all of the seven groundwater samples. This was considered by ERM as potentially representative of natural background concentrations. Elevated sulphate concentrations were recorded within all but one of the samples analysed, which was attributed to the former use of the site and widespread deposition of PFA. Overall, ERM suggested that the shallow groundwater test results indicated the risks to the controlled water receptor associated with a potential groundwater source were low.

Soil Gas Risk Assessment

7.5.12 Based on the available monitoring results, it was considered by ERM that the risk to the on-site and off-site receptors via gas migration pathways from the Keadby 2 site was very low.




Waste Classification

- 7.5.13 ERM completed a waste classification assessment based on five soil samples recovered from five boreholes across the Keadby 2 site. Each of the five samples were classified by ERM as non-hazardous. It was further concluded that whilst the soil concentrations were low, given that the material was Made Ground, it was considered unlikely that the material could be classified as Inert.
- 7.5.14 The interpretation presented in the report offered a steer in relation to the proposed construction works and was based on a limited number of samples. It was considered possible that hotspots of material may be present at the Keadby 2 site that could be classified as hazardous waste if excavated with an intention to discard. Therefore, recommended that a watching brief be adopted during the construction works to allow for the segregation of those materials that could be considered to be hazardous. It was recommended that method statements in relation to this process should be presented in a Materials Management Plan.

7.6 Environmental Resources Management (2016) Keadby 2 Power Station Environmental Statement

Introduction

- 7.6.1 An Environmental Statement (ES) was prepared in 2016 by ERM for the Keadby 2 Power Station, which is located approximately in the centre of the Proposed Development Site (see **Figure 13A.3** - Proposed Development Layout).
- 7.6.2 Previous intrusive site investigations of the Keadby 1 and Keadby 2 Power Station areas (as part of the pre-construction activity for Keadby 2 Power Station) were summarised in the ERM Keadby 2 ES. These included:
 - Wimtec Environmental Ltd 1998. Scottish Hydro Electric Plc, Keadby 2 CCGT Development, Report on Ground Investigation (reference 1);
 - Exploration Associates Ltd 1992. Keadby Power Station: Site Contamination Assessment (reference 2);
 - Exploration Associates Ltd 1992. Keadby Power Station, Factual Report on Ground Investigation (reference 3); and
 - Mott MacDonald 1991. Project Phoenix, Keadby Power Station, Phase 1 Site Investigation Interpretative Report (reference 4).
- 7.6.3 These four reports summarised as part of the ERM Keadby 2 ES report are therefore not included as independent reviews but do form part of this ERM Keadby 2 ES report review detailed below.

Summary of Ground Conditions Encountered

7.6.4 The previous intrusive investigations characterised the geology underlying the eastern and western sections of the Keadby 2 Power Station; indicating Made Ground overlying Alluvium, which in turn overlies bedrock comprising Mercia Mudstone.





- 7.6.5 The Made Ground was described as compact to very compact, stratified sand and silt, PFA with occasional concrete rubble, coarse gravel, cobbles of brick, steel fragments, timber, glass, slag and furnace clinker (foundry waste). The Made Ground was found to be on average 2m thick, though this could vary across the Keadby 2 Power Station site between 0.2m and 3m thickness. The various artificial fragments were considered likely to have been derived from the previous coal fired power station activities.
- 7.6.6 The superficial deposits beneath the Made Ground comprised Alluvium associated with the River Trent. The Alluvium was classified as 'Upper Drift' and 'Old River Sand'. The Upper Drift comprised loose and medium-dense, medium grained sands with soft and firm silt and clays. Soft peat clay or peat deposits were locally present within the upper limits of the unit, particularly in eastern sections where they were up to 3.7m in thickness. The general thickness of this unit was approximately 5m however this extended to over 8m in areas. The Old River Sand (Granular Alluvium) comprised medium-dense to dense, medium-grained silty sand, encountered at approximately 7.5 8m bgl. The total thickness of the unit was approximately 7m, with a coarse-grained sand base.
- 7.6.7 The Mercia Mudstone underlying the superficial deposits was divided into a weathered unit and the bedrock unit. The weathered unit included the upper part of the bedrock up to 5m in thickness and was recovered as silty clay with occasional thin bands of mudstone. The Mercia Mudstone bedrock was encountered between 19 30m bgl, which was composed of thinly laminated mudstone with subordinate siltstone and occasional gypsum veins (up to 5mm thick).

ERM's Screening of Soil Contamination Results from Previous Ground Investigations

- 7.6.8 Previous ground investigations (references 1 and 2) provided baseline soil quality data. As part of a site-wide investigation, Wimtec (1998) provided data from 10 boreholes and 10 trial pits, whilst Exploration Associates (1992) advanced 4 boreholes and 31 trial pits across the Keadby 2 Power Station and areas immediately to the east (within the existing Keadby 1 Power Station).
- 7.6.9 The Keadby 2 ES reported on screening for a range of heavy metals, polycyclic aromatic hydrocarbons (PAH) and other organic material concentrations recorded during these previous investigations against ERM's adopted General Assessment Criteria (GAC) for commercial end use.
- 7.6.10 It was summarised that the baseline soil metal concentrations recorded during the previous investigations were typical of natural levels found within agricultural soils, and in general, were significantly below the adopted GAC values for a commercial end-use environment. There was one recorded exceedance from the Wimtec (1998) samples, for chromium (418 mg/kg verses the GAC value of 330 mg/kg), as well as some elevated concentrations of lead, up to 4,620 mg/kg. The location of the chromium exceedance was from a trial pit Made Ground sample, in the south-east corner of the eastern part of Keadby 2 Power Station. This isolated and limited exceedance was not considered significant by ERM given the number and range of analyses reported within the GAC. Two samples were also submitted for PAH analysis during the Wimtec (1998) investigation, with no exceedances of the GAC identified.





ERM's Screening of Groundwater Contamination Results from Previous Ground Investigations

- 7.6.11 The observed hydrogeology at the Keadby 2 Power Station Site from previous site investigations (references 1 and 2) indicated two shallow groundwater systems; one within the Made Ground and the other in permeable layers in the Alluvium. During the Exploration Associates (1992) investigation, groundwater levels were observed between 0.92 10.7m bgl across the Keadby 2 Power Station, while the Wimtec (1998) investigation observed a groundwater level of 1.8 8.0m bgl in the eastern section and 0.9 1.4m bgl in the western section. It was considered that locally, groundwater is laterally continuous and hydraulically connected to the surface watercourses adjacent to the Keadby 2 Power Station site and/ or the River Trent to the east. Mott MacDonald (1991) previously suggested that the level of the local groundwater table is artificially maintained by the extensive drainage systems in the area.
- 7.6.12 Previous investigations (references 3 and 4) provided baseline groundwater quality data. The range of heavy metals and selected organic compound concentrations recorded during these investigations was compared with the freshwater Environmental Quality Standards (EQS). Direct comparisons with the Drinking Water Standards (DWS) were not made due to the absence of groundwater abstractions for use in potable supplies.
- 7.6.13 In groundwater samples (from boreholes and grab samples from trial pits), previous site investigation data recorded exceedances of lead, sulphate, sulphide, pH and chloride when compared to the freshwater EQS assessment criteria. In the instances of sulphate, sulphide and chloride, the exceedances were by orders of magnitude. The large exceedances recorded in shallow groundwater were considered likely to be in relation to the chemical composition of the Made Ground in the area, through which the water flows. The method of sampling (i.e. grab samples from trial pits) at the time of the Exploration Associates (1992) investigation may also have contributed to the higher values recorded. Selenium was also found to be occasionally elevated, though no relevant EQS was available at the time of screening.

Ground Gas

7.6.14 A single round of gas monitoring was undertaken from two boreholes in the western section of Keadby 2 Power Station during the Wimtec (1998) investigation. No elevated levels of the landfill gases methane or carbon dioxide were detected It was reported by ERM that the risk of ground gas was very low in these areas.

7.7 Structural Soils (2016) Interpretive Geotechnical Assessment on Ground Investigation

7.7.1 This report was also summarised in the ERM Phase 1 desk study (see Section 7.4 for further details).





Introduction

7.7.2 Structural Soils carried out intrusive investigations, laboratory testing and a geotechnical assessment of the site. The report discusses the findings of the investigations and determines the implications on foundation design for the Keadby 2 Power Station. Contamination testing and assessment did not form part of the scope of works.

Summary of Ground Conditions

- 7.7.3 Made Ground was encountered at most of the exploratory locations, with a typical thickness of 2m. The Made Ground had a variable composition of cobbles, clinker, concrete, metal, plastic and tarmac in a slightly sandy clayey matrix. PFA was also encountered at a shallow depth in one of the boreholes.
- 7.7.4 The superficial deposits had a total thickness of around 11-12m. Five separate sand and clay strata were noted in the Alluvium. Overall, the clays, silts and sands transitioned from cohesive to granular with depth. Organic clays and peat were noted in the superficial deposits between 1.8m and 3.5m bgl.
- 7.7.5 The weathered Mercia Mudstone bedrock was proven at an average depth of 15m bgl. The stratum was found to be unweathered at an approximate depth of 18m bgl.
- 7.7.6 The geotechnical assessment of the site details site preparation, foundation design, earthworks, pavement design and the protection of buried concrete.
- 7.7.7 Groundwater was encountered during the investigation in all the exploratory boreholes between 2.50m and 5.00m bgl. Longer term groundwater monitoring indicated groundwater levels between 1.00m and 1.50m bgl.

7.8 Structural Soils (2016) Additional Geotechnical Reports

7.8.1 These reports were also summarised in the ERM Phase 1 desk study (see Section 7.4 for further details).

Introduction

- 7.8.2 Three additional reports from Structural Soils Geotechnical were made available for review. These included:
 - Structural Soils 2016. Geophysical Report;
 - Structural Soils 2016. Minimum Requirements of Detailed Site Investigation; and
 - Structural Soils 2016. Static Cone Penetration Testing Factual Report.

Summary of Key Findings

7.8.3 The Geophysical Report describes a geophysical survey carried out at Keadby 2 Power Station to investigate the presence of foundation structures. Four anomalies were identified in the survey and intrusive investigations were recommended to determine the nature of the objects.





- 7.8.4 The Minimum Requirements of Detailed Site Investigation describes the detailed ground investigation required prior to the construction of the Keadby 2 Power Plant.
- 7.8.5 The Static Cone Penetration Testing Factual Report describes the cone penetration tests carried out, the results and the derived geotechnical parameters for soils at the Keadby 2 site.

7.9 RSK (2016) Keadby Power Station, Preliminary Risk Assessment

7.9.1 This report was also summarised in the ERM Phase 1 desk study (see Section 7.4 for further details).

Introduction

7.9.2 The objectives of this report were to assess potential geo-environmental issues associated with proposed development west of the Keadby 1 Power Station, and to identify any implications for the subsequent soil and geotechnical ground investigation in accordance with Siemens' (the Client) Specification of Contamination Survey.

Summary of Key Findings

- 7.9.3 RSK carried out a robust assessment of historical data, and the study identified the possibility of low to moderate contamination on site, with potential linkages to sensitive receptors.
- 7.9.4 The assessment confirmed a potential moderate risk to future building structures and services associated with contaminants potentially present in soils, including corrosive substances and hydrocarbons, and risk to future site users and structures from ground gases within the Made Ground and infilled areas.
- 7.9.5 Moderate to low potential risks were identified that could affect future and adjacent site users, ground water and surfaces water, from contaminants such as asbestos. The potential contaminants stem from the sites historic use as a power station and its associated activities, as well as the potential for Made Ground.
- 7.9.6 During the site walkover, it was noted that there were no obvious signs of contamination, with the exception of rubble piles, which may have contained asbestos and other contaminants from the demolition of previous structures.
- 7.9.7 Therefore, recommendations were suggested by RSK for future investigation into the potential sources of contamination, to allow for the refinement of the CSM to confirm or eliminate potential linkages.

7.10 URS (2012) SSE Keadby, High pH (Alkaline) Drainage Water Options Appraisal

7.10.1 This report was also summarised in the ERM Phase 1 desk study (see Section 7.4 for further details).





Introduction

- 7.10.2 URS were commissioned by SSE to undertake an options appraisal to address the issue of high pH drainage water at Keadby Power Station (the site).
- 7.10.3 On 21 February 2012, a white cloudy substance was observed discharging into Red House Dyke (located approximately 120m north of the site) from a drainage line originating from the Power Station.

Conclusion

- 7.10.4 A preliminary CSM was developed. Steel slag reportedly used as a fill material during the construction of the Power Station was identified as the most likely source of the white cloudy substance observed.
- 7.10.5 Analysis of the white cloudy discharge indicated that the composition was typical of water influenced by the dissolution of lime. In addition, pH monitoring undertaken by SSE identified high pH drainage effluent in sections of the drainage network, indicating that the source of the high pH discharge is likely to be in this area. This monitoring also indicated that the potential release of the white cloudy discharge appeared likely to correspond to periods of low rainfall when there is minimal dilution of any groundwater that may have ingressed into the site drainage network by surface water run-off from the site.

Recommendations

- 7.10.6 Following a review of the potential remedial options available, URS considered that the relining of the existing perforated drainage pipe presented the greatest costbenefit to prevent potential future releases of the white cloudy substance into Red House Dyke. Prevention of potential groundwater ingress into the site drainage network in this area was considered likely to break the suspected source-pathway-receptor linkage.
- 7.10.7 In advance of any potential relining works being undertaken, URS recommended that further investigative works were undertaken in order to refine the preliminary CSM and provide additional supporting evidence.

7.11 URS (2010) Keadby Power Station, Environmental Site Assessment

7.11.1 This report was also summarised in the ERM Phase 1 desk study (see Section 7.4 for further details).

Introduction

- 7.11.2 URS Corporation Ltd was commissioned by Scottish and Southern Energy (SSE) to undertake an environmental site investigation at Keadby Power Station. The aim of this investigation was to assess the potential for contamination and the risks to receptors, as a result of an historical oil spill in the west of the site.
- 7.11.3 Five boreholes were drilled to a maximum depth of 3.0m bgl and were installed with groundwater monitoring wells.





Summary of Ground Conditions

- 7.11.4 Made Ground was encountered in each of the boreholes to a maximum depth of 1.45m bgl. The Made Ground comprised decorative gravel overlying sandy gravel and gravelly sand, which had a variable silt and clay content.
- 7.11.5 The Made Ground was underlain by Alluvium, which was predominantly composed of soft sandy silt. However silty sand with occasional clay and silt bands were also encountered in two boreholes.
- 7.11.6 Initial groundwater strikes varied between 0.9m 2.0m bgl. Information obtained during the groundwater monitoring round indicates that the groundwater flows to the east.

Summary of Findings

- 7.11.7 Soil and groundwater samples were submitted to the laboratory for chemical analysis focusing specifically on the presence of TPH. URS review of the test results indicated that some contamination was detected, particularly in the soil and groundwater samples of BH102, located adjacent to the tanks to the west of Keadby 1. The bulk of the hydrocarbons were assessed to comprise predominantly long chained hydrocarbons.
- 7.11.8 URS compared the site specific screening criteria based on a continued commercial land use. A review of the information indicated that ground contamination detected in this investigation was unlikely to pose a significant risk of significant harm to human health.
- 7.11.9 Reported soil TPH and ethyl benzene concentrations were generally within two orders of magnitude of the screening criteria (which were considered by URS to be overly conservative). Therefore, URS stated the potential risks to controlled waters from the identified soil contamination were considered to be low.
- 7.11.10The potential risks associated with TPH concentrations in groundwater were also considered to be low, given the conservatism of the screening criteria and the absence of dissolved phase contamination down hydraulic gradient of the identified source area.

7.12 Exploration Associates (2002) Settlement Monitoring, Keadby Power Station

Introduction

- 7.12.1 This report presents and summarises the results from the settlement monitoring at Keadby Power Station, between June 2001 and June 2002. The purpose, reason for the settlement monitoring was not stated within the Exploration Associates report.
- 7.12.2 Fourteen settlement monitoring points were monitored around the water treatment plant area, in the south eastern section of the site. Additionally, piezometers were installed at 3 no. locations at depths of 2.5m bgl, 5m bgl and 6m bgl. Piezometers were also monitored over a 12-month period.





Summary of Key Findings

- 7.12.3 The magnitude of the observed ground movements was very small. The maximum movement observed was -17.9mm, whereas the smallest movement was +0.2mm.
- 7.12.4 The piezometers showed an average groundwater fluctuation range of 0.15m. There was a sharp increase of 0.47m in the 6m deep piezometer in February 2002, likely corresponding to increased precipitation.
- 7.12.5 No correlation was found between the observed settlement and groundwater levels.

7.13 SSE (1999) Keadby Power Station, Permitted Preliminary Works and Access Road, Discover of Asbestos 11 September 1998 – Close Out Report

- 7.13.1 AMEC Civil Engineering were carrying out cut and fill operations to the new road layout north of 'Bonnyhale Road'. Asbestos was discovered whilst carrying out the earthworks and the works were halted. As part of site remediation, material was taken from the PFA stockpiles and used to cap the area prior to recommencement of the roadworks. The asbestos analysis results indicated amosite and chrysotile (consistent with insulation or coating type material).
- 7.13.2 The asbestos contamination was indicated on a plan in an appendix of the report. It was located to the north of the North Soak Drain and Sheffield and South Yorkshire Navigation to the east of the Proposed Development Site.
- 7.13.3 It was recommended that further investigation was necessary to ascertain the extent of asbestos contamination. A remediation and/or containment strategy would then be required.

7.14 Mouchel (1992) Geotechnical Interpretative Report

7.14.1 This report was also summarised in the ERM Phase 1 desk study (see Section 7.4 for further details).

Introduction

- 7.14.2 This report contains information from four previous ground investigations undertaken in 1947, 1991 (2 no) and 1992 on the Keadby Power Station site. The purpose of the report was to discuss the findings of the investigations and assess the implications on foundation design. Contamination testing and assessment did not form part of the scope of works.
- 7.14.3 The previous ground investigations summarised in the report included:
 - Soil Mechanics Ltd 1947. Investigation of the Site, Proposed Keadby Power Station;
 - Wimpey Geotech 1991. Keadby Power Station, Phase 1 Site Investigation, Report on Ground Investigation;





- Exploration Associates Ltd 1992. Keadby Power Station: Site Contamination Assessment; and
- Exploration Associates Ltd 1992. Keadby Power Station, Factual Report on Ground Investigation.

Summary of Ground Conditions

- 7.14.4 Made Ground was reported to cover the site to an average depth of 2m bgl. The Made Ground was composed of sand, silt and clay, with PFA, clinker and other rubble.
- 7.14.5 Alluvium was encountered beneath the Made Ground and comprised loose to medium dense silty sands. The upper layers of the Cohesive Alluvium were encountered typically up to depths of 8.5m bgl. These upper layers contained thin lenses of soft peat. The lower sandy Alluvium layers contained gravel in places, with no organic matter being present.
- 7.14.6 The superficial deposits overlay the Mercia Mudstone, which was typically encountered at around 16m bgl. The mudstone was classified as weathered for approximately 5m, before the boreholes encountered unweathered bedrock.
- 7.14.7 A large tip of PFA to the west of the main site was investigated in the 1991 Wimpey Geotech report. The material was considered to be reused in backfilling the basement area.
- 7.14.8 Geotechnical properties of the Alluvium and the weathered Mercia Mudstone are presented within the Mouchel report.
- 7.14.9 Groundwater was typically encountered at the base of the Made Ground typically at around 2m bgl.

7.15 Mott MacDonald (1991) Report on Pile Testing and Concrete Coring/Laboratory Testing

Introduction

7.15.1 Mott MacDonald was commissioned by Scottish Hydro-Electric (SHE) to assess the integrity and load bearing capacity of the piled foundations and sub-basement floor slab, beneath the previous main building at Keadby Power Plant prior to its demolition. This report describes the results and conclusions from these tests.

Summary of Key Findings

- 7.15.2 A non-destructive test on the two tested piles concluded that the piles were approximately 15m in length and of constant cross-section.
- 7.15.3 The pile testing showed that the integrity and load bearing capacity of the precast driven piles and sub-basement floor slab had been retained. They were considered adequate for the similarly loaded new building development.





- 7.15.4 Slightly longer piles than tested appeared to be a satisfactory method for providing additional support to the driven piles on any future developments, which would enable a larger working load.
- 7.15.5 Three additional Mott MacDonald Engineering reports were available, with limited information on ground conditions. These are listed below:
 - Mott MacDonald 1991. Report on Demolition Vibration Monitoring;
 - Mott MacDonald 1991. Stage 1 Engineering Report; and
 - Mott MacDonald 1991. Structural Assessment Report.
- 7.16 Mott MacDonald (1991) Project Phoenix, Proposed Groundwater Abstraction

Introduction

7.16.1 Mott MacDonald were commissioned to assess whether it was feasible to extract 650m³/day of groundwater from the underlying Sherwood Sandstone Aquifer, at the location of the decommissioned coal-fired power station, Keadby.

Summary of Ground Conditions

7.16.2 Historical deep boreholes at the location of the power station, revealed 20m of silty sands and gravels, overlying the Mercia Mudstone (approximately 170m thickness), and that this deposit was found to overlie the Sherwood Sandstone Aquifer (estimated to be 1km thickness).

Conclusion

7.16.3 It was concluded that the underlying Sherwood Sandstone Aquifer could provide an accessible and relatively cheap source of feedwater make-up for the proposed new power station. However, this was dependent upon whether a licence to construct and operate a well would be granted by the National River Authority (NRA). At the time of writing, it was unlikely that the licence would be granted; however, the decision could be appealed against.





8.0 INITIAL CONCEPTUAL SITE MODEL

8.1 Introduction

- 8.1.1 This section is aimed at identifying possible risks, if any, arising from substances used or deposited on the Proposed Development Site, or from other sources of land contamination. Both past and current potentially contaminative land uses have been considered. It is based on the Proposed Development as a Low Carbon CCGT Generating Station and associated development including water, gas and grid connections and a landscaping and biodiversity management area, as described in **Chapter 4**: The Proposed Development (PEI Report Volume I).
- 8.1.2 The risk assessment process for environmental contaminants is based on a sourcepathway-receptor analysis. These terms can be defined as follows:
 - **Source:** a contaminant or pollutant that is in, on or under the land and that has the potential to cause harm or pollution; and
 - **Pathway:** a route by which a receptor is or could be affected by a contaminant : examples include ingestion of contaminated soil and leaching of contaminants from soil into watercourses; and
 - **Receptor:** something that could be adversely affected by a contaminant: examples include human occupants/ users of Proposed Development Site, water resources (surface waters or groundwater), or structures.
- 8.1.3 For a risk to be present, there must be a relevant/ viable contaminant linkage; i.e. a mechanism whereby a source can reasonably impact on a sensitive receptor via a pathway.
- 8.1.4 The following sections detail the initial CSM which has been developed for the Proposed Development Site with a view to assessing the potential risks/ liabilities and constraints associated with the Proposed Development Site in its current condition prior to the Proposed Development taking place. Risks associated with the Proposed Development have also been assessed based on an industrial future land use scenario, including any potential sources of contamination, potential receptors and potential contaminant pathways identified during this desk-based assessment.

8.2 Sources of Potential Contamination

- 8.2.1 This section highlights those former and current on-site and off-site activities that have been identified as potential sources of contamination for the Proposed Development Site. These activities may have in turn impacted on soil, soil leachate and groundwater.
- 8.2.2 Table 10 indicates potential on-site and off-site sources of contamination identified from this phase 1 desk-based assessment. With reference to the NHBC/ CIEH/ Environment Agency Guidance for the Safe Development of Housing on Land Affected by Contamination, R&D Publication 66: 2008. Table 10 also indicates the potential contaminants that may be associated with the potential sources identified.





Source reference	Location with respect to the Proposed Development Site	Potential source	Associated Contaminants of Potential Concern (CoPC)
S1	On-site (central/ eastern area)	Keadby I Power Station (formerly coal-fired, currently gas-fired), including tanks	Potential for metals and semi- metals; inorganics (sulphate, sulphide, asbestos, pH); organics (oil/ fuel hydrocarbons, PAH, VOC and semi volatile organic compounds (SVOC), PCB.
S2	6 no. located on- site (central/ western areas)	Former landfill sites	Various deposited wastes including inert, industrial, commercial, household and special waste. Potential for a range of inorganic and organic contaminants including but not limited to heavy metals, acids, organic compounds, inorganic compounds, asbestos, TPH, PAH, VOC, SVOC, solvents, lubricants, fuel oils, alkalis, PCB. Potential for ground gases including methane, hydrogen sulphide and carbon dioxide.
S3	On-site and off- site (various directions)	Current and former agricultural land	Contamination resulting from leaks and spills of liquids and solids, use of agricultural chemicals, potential burial of animal remains. Potential for a range of organic and inorganic contaminants including, but not limited to, metals, hydrocarbons (diesel range, lubricating oils, solvents), ammonia, elevated biochemical oxygen demand (BOD), elevated chemical oxygen demand (COD), pesticides pathogens and asbestos.
S4	On-site (in the south and south- west) and off-site (adjacent to the southern boundary)	Current and former railways	Potential for metals and semi- metals; inorganics (sulphate, asbestos); organics (PAH, chlorinated aliphatic hydrocarbons, PCB).

Table 10: Potential sources of contamination





Source reference	Location with respect to the Proposed Development Site	Potential source	Associated Contaminants of Potential Concern (CoPC)
S5	On-site and off- site	Marshland, peat	Potential low levels of ground gas – methane and carbon dioxide.
S6	2 no. located off- site (15m and 25m to the west)	Former landfill sites	Waste types unknown, although one of which was named a 'Pulverised Fuel Ash' Settlement Lagoon Potential for a range of inorganic and organic contaminants including but not limited to heavy metals, acids, organic compounds, inorganic compounds, asbestos, TPH, PAH, VOC, SVOC, solvents, lubricants, fuel oils, alkalis, PCB. Potential for ground gases including methane, hydrogen sulphide and carbon dioxide.
S7	Off-site (20m and 120m from the Waterborne Transport Off- Loading Area)	Depot and warehouse	Unknown. Potential contamination resulting from leaks and spills of liquids and solids; asbestos.
S8	Off-site (55m west of the Additional Abnormal Indivisible Load Route)	PD Ports Marina	Potential for metals and semi- metals; inorganics (sulphate, sulphide, asbestos); organics (phenol, PAH, chlorinated aliphatic hydrocarbons, hexachlorocyclohexane, chlorinated aromatic hydrocarbons, PCB).
S9	Off-site (200m north and south- east of the Water Connection Corridor)	Former S L Cleaning Services; commercial cleaning services	Potential for metals and semi- metals; inorganics (free cyanide, nitrate, sulphate, asbestos, pH); organics (aromatic hydrocarbons, chlorinated aliphatic hydrocarbons, PCB).
S10	Off-site (220m south of the Waterborne Transport Off- Loading Area)	Historical tank	Potential for TPH, PAH, hydrocarbons





8.3 Potential Pathways

8.3.1 Potential pathways associated with the Proposed Development Site are shown in Table 11.

Pathway Reference	Pathway
P1	Direct contact/ ingestion of contaminants within Made Ground/ soils, together with soil derived dust and groundwater.
P2	Inhalation of organic vapours from Made Ground/ soils, soil derived dust, and groundwater.
P3	Leaching of soluble contaminants and migration of mobile contaminants into shallow groundwater.
P4	Vertical groundwater flow through Made Ground and superficial deposits to underlying bedrock aquifer.
P5	Lateral groundwater flow and direct run-off to surface waters.
P6	Vertical migration of ground gases to indoor and outdoor air and migration of ground gases into enclosed spaces (inhalation/ asphyxiation/ explosion).
P7	Inhalation of asbestos fibres.
P8	Direct contact of buried concrete with contaminated soils (i.e. hydrocarbons) and aggressive ground conditions (pH and sulphate)/ direct contact of services and supply pipes with contaminated soils.
P9	Indirect Pathway: Migration of hazardous gases/vapours via permeable strata into enclosed spaces and service/utility trenches.

Table 11: Potential Pathways

8.4 **Potential Receptors**

8.4.1 Potential receptors associated with the Proposed Development Site are shown on Table 12.

Receptor reference	Receptor
R1	Human health (on-site users): (chronic)
	Current commercial users (workers at Keadby 1 Power Station)
R2	Human health (on-site users): (acute)
	Current public open space users (Keadby Common users)
R3	Human health (on-site users): (chronic)
	Current residential users (residential on the eastern-most spur only)

Table 12: Potential receptors





Receptor reference	Receptor
R4	Human health (on-site users): (chronic) Future commercial users (workers at Keadby 2 Power Station and Keadby 3)
R5	Human Health (off-site users): (acute) Current and future commercial and public open space users (surrounding) Current and future residential users (Keadby village, adjacent to the east)
R6	Groundwater: superficial geology (Alluvium/ Warp) is classified as a Secondary A aquifer Groundwater abstraction located on-site (not potable)
R7	Groundwater: bedrock geology (Mercia Mudstone Formation) is classified as a Secondary B aquifer.
R8	Surface Waters: located on-site and off-site (various unnamed drains, River Trent, Eastoft Moors (Warping) Drain, Sewer Drain, North Soak Drain, Sheffield and South Yorkshire Navigation/ Stainforth and Keadby Canal, South Soak Drain, Three Rivers) Surface water abstractions located on-site and off-site (not potable)
R9	Building and infrastructure: located on-site and off-site: infrastructure at risk from ignition of gas in confined space, below ground infrastructure at risk from aggressive ground conditions
R10	Ecological sites: Ramsar Site, SSSI and SAC – Humber Estuary
R11	Non-statutory designated ecological sites: LWS – Keadby Warping Drain, Stainforth and Keadby Canal Corridor, Keadby Boundary Drain, Keadby Wetland, South Soak Drain, Keadby, Keadby Wet Grassland, Three Rivers Future Landscape and Biodiversity Management Area





9.0 ENVIRONMENTAL RISK ASSESSMENT

9.1 Risk Assessment Principles

- 9.1.1 Current best practice recommends that the determination of hazards due to contaminated land is based on the principle of risk assessment, as outlined in the Environment Agency's recently published revised online guidance for the management of land contamination 'Land contamination: risk management (LCRM)' (Environment Agency, 2020).
- 9.1.2 For a risk to be present, there must be a viable contaminant linkage; i.e. a mechanism whereby a source impacts on a sensitive receptor via a pathway.
- 9.1.3 Assessment of risks associated with each of these potential contaminant linkages are discussed in the following sections.
- 9.1.4 Using criteria broadly based on those presented in Section 6.3 of the CIRIA Report "Contaminated Land Risk Assessment: A Guide to Good Practice" (CIRIA Report C552) the magnitude of the risk associated with potential contamination at the Proposed Development Site has been assessed. To do this, an estimate is made of:
 - the magnitude of the potential consequence (i.e. severity); and
 - the magnitude of probability (i.e. likelihood).
- 9.1.5 The severity of the risk is classified according to the criteria in Table 13.

Table 13: Severity of the risk

Severity	Definition and Examples
Severe	Acute risks to human health, likely to result in "significant harm" (e.g. very high concentrations of contaminants/ ground gases). Catastrophic damage to buildings/ property (e.g. by explosion, sites with high gassing potential, extensive VOC contamination). Major pollution of controlled waters (e.g. surface watercourses or Principal aquifers/ SPZ).
Medium	Chronic (long-term) risk to human health likely to result in "significant harm" (e.g. elevated concentration of contaminants/ ground gases). Pollution of sensitive controlled waters (e.g. surface watercourses or Principal/ Secondary aquifers). Significant effects on sensitive ecosystems or species.
Mild	Pollution of non-sensitive waters (e.g. smaller surface watercourses or non-aquifers). Significant damage to crops, buildings, structures or services (e.g. by explosion, sites with medium gassing potential, elevated concentrations of contaminants).





Severity	Definition and Examples					
Minor	Non-permanent human health effects (requirement for protective equipment during site works to mitigate health effects).					
	Damage to non-sensitive ecosystems or species.					
	Minor (easily repairable) damage to buildings, structures or services (e.g. by explosion, sites with low gassing potential).					

9.1.6 The probability of the risk occurring is classified according to the criteria in Table 14.

Table 14: Likelihood of risk occurrence

Likelihood	Explanation
High	Contaminant linkage may be present that appears very likely in the short-term and risk is almost certain to occur in the long term, or there is evidence of harm to the receptor.
Likely	Contaminant linkage may be present, and it is probable that the risk will occur over the long term.
Low	Contaminant linkage may be present and there is a possibility of the risk occurring, although there is no certainty that it will do so.
Unlikely	Contaminant linkage may be present but the circumstances under which harm would occur even in the long-term are improbable.

9.1.7 An overall evaluation of the level of risk is gained from a comparison of the severity and probability, as shown in Table 15.

Table 15: Risk based on comparison of likelihood and severity

	Severity								
		SEVERE	MEDIUM	MILD	MINOR				
d	HIGH	Very High	High	Moderate	Moderate/ low				
hoo	LIKELY	High	Moderate	Moderate/ low	Low				
keli	LOW	Moderate	Moderate/ low	Low	Very Low				
Ξ	UNLIKELY	Moderate/ low	Low	Very Low	Very Low				

9.2 Preliminary Risk Assessment

9.2.1 In accordance with the risk assessment principles outlined above, a preliminary evaluation of the potential risks associated with all the identified sources at the Proposed Development Site, through the potential pathways (P1 to P9) to the various potential receptors (R1 to R11) is discussed and presented in Table 16, below. The level of risk is determined based on the current condition of the Proposed Development Site (i.e. the effects of mitigation measures are not included). Mitigation is then proposed based on the significance of the risk. In some cases, a degree of mitigation is assumed as part of legislative requirements or standard construction practice. This is acknowledged where these assumptions are made.





9.2.2 The preliminary risk assessment undertaken within this section does not consider acute linkages for construction and maintenance workers. AECOM anticipates that these acute linkages will be managed by appropriate health and safety measures. These are discussed further in Section 9.3.





Table 16: Preliminary risk assessment

Receptor	Pathway	Potential severity	Likelihood of occurrence	Potential risk	Linkage reference	Justification
R1, R2, R3: Human Health (on-site users): Current commercial and public open space users (workers at existing Keadby Power Station and Keadby Common users) Current residential users (residential on the eastern-most spur only)	P1: Direct contact/ingestion of contaminants within Made Ground/soils, together with soil derived dust and groundwater	Medium	Low	Moderate/ low	L1	The Proposed Development Site has the potential for contamination from various sources, predominantly including the former coal fired power station and the current Keadby 1 power station and a number of on-site and nearby off-site former landfills. L1: The potential risk to current on-site users from direct contact/ ingestion of contaminants has been assessed as moderate/low. The current Keadby 1 Power Station area is currently hardstanding and buildings, reducing exposure risk. Areas of exposed ground are not routinely used by members of the public beyond the immediate
	P2: Inhalation of organic vapours from Made Ground/ soils, soil derived dust and groundwater	Medium	Low	Moderate/ low	L2	power station footprint; the risk is therefore considered to be moderate/low as they are temporary site users and their time on-site will be transient. It should also be noted that access by members of the public will be classed as unofficial due to the Proposed Development Site being secure with no public right of way. The residential users are located on the eastern-most spur only, and therefore although considered to be a high sensitivity receptor, the potential risk is considered to be moderate/low due to their proximity
	P6: Vertical migration of ground gases to indoor and outdoor air and migration of ground gases into enclosed spaces (inhalation/ asphyxiation/ explosion)	Severe	Unlikely to low	Moderate/ low to moderate	L3	from the main potential sources of contamination (i.e. the former of fired power station, current Keadby 1 Power Station and the form- landfills). L2: The level of risk with regards to potential vapours emanating from within Made Ground is considered to be moderate/low due to the severity of the hazard rather than the likelihood of occurrence Hardstanding across some of the Proposed Development Site ag reduces the risk to a degree. L3: Ground gases may be present due to the extent of former landfills on-site and off-site. The risks are considered to be
	P7: Inhalation of asbestos	Severe	Unlikely	Moderate/ low	L4	 moderate/low for the public open space users (as they will not be accessing confined environments) and residential users (based on their distance from the former landfills); and moderate for the workers within the existing Keadby 1 Power Station and current Keadby 2 construction workers. L4: There is potential for asbestos to be present in any Made Ground on-site and potentially within buildings (depending on their age). As asbestos presents a risk if it is disturbed, it is considered that the likelihood of this risk being realised is unlikely and therefore the





Receptor	Pathway	Potential severity	Likelihood of occurrence	Potential risk	Linkage reference	Justification
						overall risk moderate/low has been concluded. If asbestos is encountered during future redevelopment, it must be managed in accordance with the Control of Asbestos Regulations 2012. Further site characterisation/assessment will be required to quantify the significance of the risks identified.
R4: Human Health (on-site users): Future commercial users (workers at existing Keadby Power Station and Proposed PCC Site)	P1: Direct contact/ingestion of contaminants within Made Ground/ soils, together with soil derived dust and groundwater	Medium	Unlikely	Low	L5	The Proposed Development will comprise of mainly hardstanding and buildings. It is understood that there are no plans to provide public access to the Proposed Development Site post-construction. L5: The potential risk to future on-site users from direct contact/ ingestion of contaminants has been assessed as low due to
	P2: Inhalation of organic vapours from Made Ground/soils, soil derived dust, and groundwater	Medium	Low	Moderate/ low	L6	proposed hardstanding and buildings limiting the potential exposure to CoPC and hence reducing exposure risk. Furthermore, wind- blown particulates are unlikely to be mobilised due to future development cover.
	P6: Vertical migration of ground gases to indoor and outdoor air and migration of ground gases into enclosed spaces (inhalation/ asphyxiation/ explosion)	Severe	Low	Moderate	L7	 L6: The risk from vapours emanating from within Made Ground is considered to be moderate/low. Hardstanding will reduce the likelihood of risk being realised to a degree. L7: Ground gases may be present due to the extent of former landfills on-site and off-site. The risks from ground gases are considered to be moderate for the future workers within the present due to be moderate
	P7: Inhalation of asbestos	Severe	Unlikely	Moderate/ low	L8	 Proposed Development Site. If ground gases are found to be present, these will need to be mitigated as part of any future building design. L8: Any Made Ground found to be contaminated with asbestos or buildings containing asbestos will require suitable management if it is to be retained on-site. Further site characterisation/assessment will be required to quantify the significance of the risks identified.
R5: Human Health (off-site users): Current and future commercial and public open space users	P1: Direct contact/ingestion of contaminants within Made Ground/ soils, together with soil derived dust and groundwater	Medium	Unlikely	Low	L9	L9: The potential for direct contact/ingestion of contaminants on-site is considered to be low based on the proximity of the off-site users. L10: There is a potential for organic soil contamination to be present on-site. The risk to confined spaces located in off-site areas from accumulation of site-derived vapour and potential inhalation is





Receptor	Pathway	Potential severity	Likelihood of occurrence	Potential risk	Linkage reference	Justification
(surrounding) Current and future residential users (Keadby village, adjacent to the east)	P2: Inhalation of organic vapours from Made Ground/soils, soil derived dust, and groundwater	Medium	Unlikely	Low	L10	considered to be low. Measures to control the generation of soil derived dust/vapours should be outlined in the Construction Environmental Management Plan taking into account CIRIA C741 4th Edition 'Environmental Good Practice On Site' (2015). L11: Ground gas may be generated within the Proposed Development Site due to the extent of Made Ground expected as a
	P6: Vertical migration of ground gases to indoor and outdoor air and migration of ground gases into enclosed spaces (inhalation/ asphyxiation/ explosion)	Severe	Unlikely	Moderate/ low	L11	result of the former landfills. There is potential for ground gas (if present) to migrate off-site and affect nearby properties although there is no evidence this is happening currently.
R6 and R7: Groundwater: Secondary A aquifer (superficial - Alluvium/ Warp) Secondary B aquifer (bedrock - Mercia Mudstone Formation) Groundwater abstraction located on-site (not potable)	P3: Leaching of soluble contaminants and migration of mobile contaminants into shallow groundwater P4: Vertical groundwater flow through Made Ground and superficial deposits to underlying bedrock aquifer	Medium	Low	Moderate/ low	L12	L12: Groundwater levels within the historical borehole records indicate shallow groundwater levels within the superficial geology of between $0.9m - 3.0m$ bgl. Occasionally, deeper groundwater strikes were recorded between $5.4m - 6.9m$ bgl. Lateral and vertical migration through preferential pathways within the Made Ground may facilitate infiltration to the underlying superficial Secondary A aquifer. The extent to which the groundwater in the superficial deposits is connected to groundwater in the underlying Mercia Mudstone (Secondary B aquifer) is not confirmed. There is a groundwater abstraction located on-site although this is not for potable water. It is considered that there is a moderate/ low risk for contamination to impact the groundwater within the superficial deposits and potentially bedrock. Monitoring would be required to confirm the current groundwater quality regime.
R8: Surface Waters: located on-site and off-site Surface water abstractions located on-site and off-site (not potable)	P5: Lateral groundwater flow and direct run-off to surface waters	Medium	Low to likely	Moderate/ low to moderate	L13	L13: The nature of the Proposed Development Site and it's surrounding area, including the indicated naturally high groundwater levels and the proximity of numerous surface water features, indicates a potential for the groundwater to provide base flow to surface water receptors. The surface water features vary in quality, with various river quality gradings between Grade E (year: 2000) to Grade A - very good (year: 2009). Therefore, there is considered to be a moderate/low to moderate potential risk to surface watercourses and the surface water abstractions (not potable), depending on the proximity of a specific water course/ abstraction, its sensitivity, and whether the canals and drains are lined





Receptor	Pathway	Potential severity	Likelihood of occurrence	Potential risk	Linkage reference	Justification
						(potentially reducing the potential pathway).
	P8: Aggressive attack through direct contact with natural ground or contaminants within	Mild	Likely	Moderate/ low	L14	L14: The risk to foundations and services is considered to be moderate/low based on the potential for on-site contamination within the Made Ground/soils, leachate and groundwater.
R9: Building and	and groundwater					L15: Ground gases may be present due to the extent of former landfills on-site and off-site and so there is the potential for ground
on-site and off-site	P9: Ground gas accumulation and potential explosion risk	Severe	Unlikely to low	Moderate/ low to moderate	L15	gas migration and build-up in confined spaces. Where methane is identified at certain levels, there is the potential for explosion to occur, albeit unlikely. If ground gases are found to be present, these will need to be mitigated as part of the future Proposed Development design.
R10: Ecological sites: Ramsar Site, SSSI and SAC – Humber Estuary	P1: Direct contact/uptake of contaminants within Made Ground/soils, leachate and groundwater	Medium	Low	Moderate/ low	L16	L16: The risk to the Humber Estuary SAC, Ramsar site and SSSI which encompass the River Trent at the locations of the proposed cooling water abstraction and outfall for the Proposed Development is considered to be moderate/low based on the sensitivity of this designated ecological site.
R11: Ecological sites: LWS and future Landscape and Biodiversity Management Area	P1: Direct contact/uptake of contaminants within Made Ground/soils, leachate and groundwater	Mild	Low	Low	L17	L17: The risks to the identified non-statutory designated ecological sites (LWS) and the future Landscape and Biodiversity Management Area is considered to be low. If phytotoxic contaminants are found to be present within the Made Ground, these can normally be mitigated through suitable topsoil/ subsoil cover.



9.3 Discussion of Risks to Construction Workers and Off-site Receptors during Construction Works.

- 9.3.1 As described in **Chapter 4:** The Proposed Development (PEI Report Volume I) and **Chapter 5:** Construction Programme and Management (PEI Report Volume I), the Proposed Development works will be undertaken in compliance with Construction Design and Management Regulations 2015 (CDM).
- 9.3.2 Prior to work commencing, a health and safety risk assessment should be carried out by the appointed Principal Contractor and this should be developed in accordance with current health and safety regulations. This assessment should cover potential risks to construction staff, permanent site staff and the local surrounding population. Based on the findings of this risk assessment, appropriate mitigation measures should be implemented during the construction period.
- 9.3.3 The greatest potential for generation of dust will be during the enabling and construction works. Dust generation will be minimised through the use of measures which will be outlined in the Framework Construction Environmental Management Plan (CEMP) submitted with the DCO Application. This will take into account relevant best practice, for example, 'Environmental Good Practice on Site', CIRIA Publication C692 to reduce this risk to acceptable levels.
- 9.3.4 The risk to future construction workers is considered to be low; however, this assumes the preparation of a construction management and health and safety plan including the use of PPE in accordance with statutory health and safety requirements. The potential for ground gas risks should be considered when developing Health and Safety Plans for works at the Proposed Development Site and a monitoring programme for occupational exposure risk should be considered.
- 9.3.5 Further details regarding the management of dust during the construction phase are available within Chapter 8: Air Quality (PEI Report Volume I) and **Appendix 8A:** Construction Air Quality (PEI Report Volume II).





10.0 PRELIMINARY GROUND ENGINEERING RISK ASSESSMENT

10.1.1 A summary of the ground-related risks identified in this report is given in Table 17. The risks identified as being potentially present on the Proposed Development Site could have potential implications on both ground engineering and foundation design.

Table 17: Summary of the ground-related risks

Hazard	Source	Hazard Potential	Engineering Implication	Mitigation Methods
Soft/ compressible deposits (low bearing capacity and high settlement)	The published geology and historic boreholes indicate the presence of soft/firm clay, silt and peat. The peat might cause local areas of settlement. Envirocheck data for the site confirms that the potential for compressible ground stability hazards is moderate.	High	Potential for excessive settlement and differential settlement.	Ground investigation with appropriate testing to understand the compressibility of the deposits, to determine the ground conditions and ensure a safe design.
Made Ground	Made Ground associated with the historical development of the Proposed Development Site as a former power station and on-site historical landfill activities will likely be present and potentially deep, especially in the areas of former landfill.	Medium	Made Ground, given its general vertical and lateral variability, is unsuitable as a founding stratum unless re-engineered.	The extent of any Made Ground will be confirmed through the ground investigation. Dependent on depth/thicknesses and material types ground improvement, appropriate foundations are to be considered. Removal/replacement of the Made Ground may be considered as an option.



Hazard	Source	Hazard Potential	Engineering Implication	Mitigation Methods
Lateral changes in ground conditions	The Published Geology and historical ground investigation reports indicate that there could be lateral variation in the unit thicknesses and geotechnical properties across the site.	Medium	Variable ground conditions could mean that a single engineering solution might not be appropriate for the whole site.	Ground investigation would reduce the uncertainty in the variable ground conditions; however, it is unlikely to completely eliminate the risk.
High groundwater table (including waterlogged ground)	The historical records indicate a shallow groundwater level, between 0.9m and 3.0m bgl. Two groundwater tables are implied, namely a perched table in the Made Ground and a permanent table in the Alluvium. Excavations at Keadby 2 Power Station (currently under construction) required dewatering.	Medium	High groundwater levels lead to the flooding of excavations, which can make any excavations for foundations or services unstable. It can also impact the stability of strata below the groundwater table and cause uplift.	Groundwater monitoring as part of the ground investigation to confirm the site-specific groundwater levels. If a high groundwater table is confirmed, suitable dewatering and/or temporary support may be required.
Aggressive ground (e.g. expansive slags, weathering of sulphides to sulphates)	Made Ground. The Mercia Mudstone Group is also generally pyritic and contains naturally elevated sulphate concentrations.	Medium	Concrete attack on the structure's foundations.	Concrete foundations and service ducts are likely to need to be designed against natural chemical attack from aggressive ground conditions.
Existing sub- structures (e.g. foundations, basements, and adjacent sub- structures)	Given the almost exclusive agricultural history of the main proposed development site, it is unlikely that buried structures will be encountered. However, it is possible that construction waste from the construction of Keadby	Medium	Delays in ground investigation and construction works due to obstructions.	Ground investigation will reduce the uncertainty of the ground conditions but is unlikely to eliminate the risk.





Hazard	Source	Hazard Potential	Engineering Implication	Mitigation Methods
	1 and 2 Power Plants is present.			
Utilities	Utilities Survey identified utilities within and adjacent to the proposed development site.	High	Design to avoid utilities or reroute utilities as necessary. Potential to strike utilities as part of design or construction works.	Use of Ground Penetrating Radar and CAT scan before breaking ground to avoid utility strikes. Detailed survey of utilities present for design. Possible consultation with utility companies regarding diversions.
UXO	Zetica Risk Map and 6 Alpha Threat Assessment indicates that the UXO risk is low for the site.	Low	No engineering implication.	No mitigation measures required.





11.0 CONCLUSIONS

11.1.1 The assessment presented in this Appendix has identified that:

- The Proposed Development Site is currently occupied by Keadby 1 Power Station (in the central and eastern areas) and Keadby 2 Power Station (under construction) as well as former agricultural land. The Proposed Development Site includes land associated with the former coal-fired Keadby Power Station (now demolished). The current Keadby 1 Power Station is gas-fired. Extensive historical landfilling has been identified on-site and off-site in close proximity (to the west). Based on a review of current and historical mapping and identification a number of potential sources (the aforementioned coal-fired power station and associated infrastructure and the former landfills being potentially the most significant), encountering ground contamination is considered to be likely.
- Ground gas sources exist from the underlying Made Ground (depending on its thickness and composition) and from historical landfills.
- The geological stratigraphic sequence beneath the Proposed Development Site is likely to comprise Made Ground, overlying superficial deposits. These superficial deposits are composed of Warp and Alluvium, which is more cohesive at the top and becomes more granular closer to the bedrock. The bedrock is Mercia Mudstone, which lies at an approximate depth of 14m bgl.
- The superficial deposits are classified as a Secondary A aquifer and the solid geology a Secondary B aquifer. There is a groundwater abstraction located onsite (not for potable water). Groundwater is likely to be present near surface (1m to 3m bgl) located within the superficial deposits. This may affect temporary and permanent works.
- There are numerous surface watercourses and surface water abstractions (not for potable water) on-site and within the study area. The surface water features vary in chemical quality, with various reported river quality gradings between Grade E (year: 2000) to Grade A very good (year: 2009).
- The Humber Estuary is located on the eastern-most extent of the Proposed Development Site and adjacent to the east. This is a designated Ramsar Site, SSSI and SAC. A number of LWS site have also been identified in proximity to the Proposed Development Site.
- 11.1.2 Based on the initial CSM and preliminary risk assessment, the Proposed Development Site represents a generally moderate/ low to moderate risk in terms of the risk to the human health of current and future on-site occupants in the absence of mitigation and a low to moderate/ low risk to the human health of off-site users. A moderate/ low risk for contamination to impact the groundwater within the superficial deposits and bedrock, and a moderate/ low to moderate potential risk to surface water receptors has been assigned. The risk to the Humber Estuary statutory ecological designations is considered to be moderate/low based on the sensitivity of this designated ecological site. The risks to the non-statutory designated LWS sites and the future Landscape and Biodiversity Management Area is considered to be low.







- 11.1.3 The risk ratings are mainly related to the potential for contamination to be present at elevated concentrations which may pose harm to receptors because of the type of land use (heavy industrial and landfilling) undertaken at the Proposed Development Site. However, generally the likelihood of the linkage being realised was mainly assigned as low rating. The overall risk rating of low to moderate is not uncommon for brownfield sites.
- 11.1.4 Key identified geotechnical hazards that should be considered in future design of the Proposed Development include; the presence of potentially deep Made Ground, lateral changes in the ground conditions, potential for compressible ground stability hazards, high groundwater table, adverse ground chemistry and existing sub-structures. The depth of the Alluvium and potential presence of compressible deposits might require ground improvement and/or a deeper piled foundation solution.
- 11.1.5 The contaminative and geotechnical risks can be mitigated by further assessment through intrusive ground investigation and risk assessment at the detailed design stage, and if necessary, the inclusion of routine construction measures for example, ground gas protection measures within buildings.





12.0 RECOMMENDATIONS

- 12.1.1 In order to characterise the potential risks identified and allow for the refinement of the initial CSM, it is recommended that a preliminary intrusive ground investigation is carried out. From this the composition, extent and depth of the Made Ground, the natural superficial deposits and the bedrock across the Proposed Development Site can be confirmed. This will determine the underlying stratigraphy to inform the detailed ground investigation and design of suitable engineering works.
- 12.1.2 During the intrusive investigation, it is recommended that representative soil samples are taken to determine the chemical status of Made Ground and natural soils. Samples should also be taken to determine the ground strength and compressibility parameters to inform the geotechnical design. Groundwater monitoring and sampling and ground gas monitoring will also need to be undertaken at the Proposed Development Site.
- 12.1.3 The site investigation should be designed with due consideration of the requirements of BS 5930 (2015) Code of Practice for Ground Investigation; Environment Agency (2005), BS10175: 2011+A2:2017 Investigation of potentially contaminated sites Code of Practice and the UK Specification for Ground Investigation (2nd Edition) published by ICE Publishing in 2012 and Eurocode BS EN 1997-1:2004, BS EN 1997-2:2007 'Eurocode 7 Geotechnical design Ground investigation and testing'.
- 12.1.4 After completion of intrusive works and monitoring, the geo-environmental condition of the Made Ground and underlying superficial deposits should be assessed. The soil, soil leachate and groundwater samples and ground gas readings should be analysed for the purpose of risk assessment to human health, controlled waters and assessment of the chemical properties with respect to buried structures. Identification of geotechnical design parameters for earthworks and preliminary foundation design should also be undertaken.
- 12.1.5 A ground investigation report should be produced for geo-environmental and geotechnical risk identification and interpreted.
- 12.1.6 The investigation will allow a quantitative assessment as to whether any of the potential risks identified in this Appendix are present and are of material concern to the Proposed Development.







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6 Alpha Associates – Preliminary UXO Threat Assessment





ANNEX A FIGURES

- Figure 13A.1 Site Location Plan
- Figure 13A.2 Site Layout Plan
- Figure 13A.3 Proposed Development Layout





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PROJECT

Keadby 3 Low-Carbon Gas Power Station Project

CLIENT

SSE Generation Limited

CONSULTANT

AECOM Limited Midpoint Alencon Link Basingstoke, RG21 7PP T: +44-(0)20-7061-7000 www.aecom.com

LEGEND

Proposed Development Site

NOTES

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ISSUE PURPOSE PEIR PROJECT NUMBER 60625943

SHEET TITLE

Site Location Plan

SHEET NUMBER

Figure 13A.1







PROJECT

Keadby 3 Low-Carbon Gas Power Station Project

CLIENT

SSE Generation Limited

CONSULTANT

AECOM Limited Midpoint Alencon Link Basingstoke, RG21 7PP T: +44-(0)20-7061-7000 www.aecom.com

LEGEND



Proposed Development Site



Option for Construction Access to the Proposed Development Site

NOTES

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ISSUE PURPOSE PEIR **PROJECT NUMBER** 60625943

SHEET TITLE Indicative DCO Site

SHEET NUMBER

Figure 13A.2





Keadby 3 Low-Carbon Gas Power Station Project

CLIENT

SSE Generation Limited

CONSULTANT

AECOM Limited Midpoint Alencon Link Basingstoke, RG21 7PP T: +44-(0)20-7061-7000 www.accom.com

LEGEND Proposed Development Site Main Site Indicative Area: Proposed PCC Site Keadby 1 Keadby 2 K2 Operational / Laydown / CCR Area K2/K3 Turnaround Area Potential Keadby 3 Laydown . . . Option Waterborne Transport Off-Loading Area Construction and Operational Access Route Potential Electrical Connection to 132kV Substation Emergency Vehicle Access Road and Electrical Connection to 132kV Substation Additional Abnormal Indivisible Load Route A18 Junction Improvement Option Water Connection Corridor 🚫 Water Discharge Corridor Abstraction Option Electrical Connection Area to National Grid 400kV Substation

NOTES

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ISSUE PURPOSE

PEI REPORT PROJECT NUMBER

60625943 SHEET TITLE

Areas of the Site Described in PEI Report

SHEET NUMBER

Figure 13A.3

AECOM Imagine it. Delivered.

Annex B – Photographic Record

Client Name:

SSE Generation Ltd

 Plate No.
 Date:

 1
 16/07/2020

Description:

Temporary spoil storage (right) located on the southern portion of former agricultural land that encompasses both Keadby 3 CCGT and Keadby 3 CO2 Capture Plant. Northern portion of former agricultural land remains undeveloped (left).



Keadby 3 Low Carbon Gas Power Station Project

Project No. 60625943



Plate No. 2	Date: 16/07/2020
Description	1:
Extensive ve cover noted	egetative in Keadby
biodiversity some areas	area, with of exposed
ground.	


Client Name:

SSE Generation Ltd

Plate No.	Date:
3	16/07/2020

Description:

Example of fly tipped materials on Keadby 3 Indicative Laydown and Biodiversity area. Potential presence of ACM in areas.



Site Name:

Keadby 3 Low Carbon Gas Power Station

Project No. 60625943



AECOM Imagine it. Delivered.

Annex B – Photographic Record

Client Name:

SSE Generation Ltd

Plate No.	Date:
5	16/07/2020

Description:

Waste oil storage area with bunded water oil container, waste oil IBCs, barrels of insulating oils and smaller container of waste lubricating oil placed on concrete hardstanding.



Keadby 3 Low Carbon Gas Power Station

Project No.

60625943



Plate No.	
6	16

Date: 16/07/2020

Description:

Five ASTs (above ground storage tanks) present in concrete bund adjacent to Keadby 1 Power Station site water treatment works. ASTs found to contain caustic soda, sulphuric acid and alum. Two of the ASTs were reportedly empty and previously contained sodium hypochlorite.





SSE Generation Ltd

 Plate No.
 Date:

 7
 16/07/2020

Description:

Two of the four large ASTs running along southern perimeter of Keadby 1 Power Station site, for storage of demineralised water.

Site Name:

Keadby 3 Low Carbon Gas Power Station

Project No. 60625943

Annex B – Photographic Record









AECOM Imagine it. Delivered.

Annex B – Photographic Record

Client Name:

SSE Generation Ltd

 Plate No.
 Date:

 13
 16/07/2020

Description:

One of the two buildings housing emergency diesel generators, adjacent to the main boiler house at the centre of Keadby 1 Power Station site.

Site Name:

Keadby 3 Low Carbon Gas Power Station

Project No. 60625943







Annex B – Photographic Record

Client Name:

SSE Generation Ltd

Plate No.	Date:
15	16/07/2020

Description:

Large AST containing distillate fuel oil to the north east of Keadby 1 Power Station site. AST contained within concrete bund.



Keadby 3 Low Carbon Gas Power Station

Project No. 60625943









Keadby 3 Low Carbon Gas Power Station Preliminary Environmental Information Report, Volume II - Appendix 13A: Phase 1 Desk Based Assessment Application Reference EN010114

ANNEX B HISTORICAL MAPS PROVIDED BY ENVIROCHECK



Historical Mapping Legends

Ordnance Survey County Series 1:10,560	Ordnance Survey Plan 1:10,000	1:10,000 Raster Mapping
Gravel Sand Other Pit Pit Pits	్రాహానా Chalk Pit. Clay Pit ్లిసిస్తోంది Gravel Pit క్రియోగా or Quarry లో కిల్లిండి	Gravel Pit Gravel Pit or sk
🏷 Quarry 💥 Shingle 👯 Orchard	Sand Pit	Rock Scal
Andreas Andrea	Refuse or Lake, Loch	ົ້ຳ້ຳ Boulders ໍໍິ Boulders (scal
	Dunes 200 Boulders	Shingle Mud
Mixed Wood Deciduous Brushwood	ネネ Coniferous のの Non-Coniferous ネネ Trees アロク Trees	Sand Sand Sand
	ດງ ດາ Orchard ທີ່ ດີ Scrub ໃນ Coppice	Top Contractor Top
Fir Furze Rough Pasture	ന്ന് Bracken ഡ്ഡ്. Heath ്റ്റം, Rough നെ Grassland	General detail — — — — Unde detai — — — — Overhead detail — — — Narry Narry
He Arrow denotes <u>a</u> Trigonometrical	→ <u></u> Marsh → <u>-</u> V///, Reeds → <u>-</u> Saltings	Multi-track Singler railway railw
-++ Site of Antiquities	Direction of Flow of Water Building	County boundary Civil, (England only) boun
Pump, Guide Post, Well, Spring, Signal Post Boundary Post • 285 Surface Level	Glasshouse Sand	District, Unitary, Metropolitan, Con: London Borough bour boundary
Sketched Instrumental	Pylon ————————————————————————————————————	ລ⇔ ມ≉ Area of wooded ລ⇔ Non- trees
Main Roads	Cutting Embankment Standard Gauce	 ○ Non-coniferous ○ trees (scattered) ▲ Coniferous ○ Posil
Sunken Road Raised Road	Multiple Track	☆ trees (scattered) ↔ tree
Road over Railway over Railway River	Road " " Road // Level \\ Foot Single Frack Under Dver Crossing Bridge Siding, Tramvay or Mineral Line	Crenard r Or
Railway over Level Crossing	-+ + + + + + + + + + + + Narrow Gauge	offic Grassland
Road over Road over	Geographical County Administrative County, County Borough	on Scrup Mars
Road over	er County of City Municipal Borough. Urban of Rural District, Burgh of Diablet Council	MHW/S) Mean high MLW/S) Mea
Stream	Borough, Burgh or County Constituency Niction only when our colucideur with other boundaries Civil Parish	water (springs) wate
County & Civil Parish Boundary	Nitown alternately when collucidence of boundaries occurs	(where shown) (with Bench mark
+ · + · + · + Administrative County & Civil Parish Boundary	BF, BS Boundary Post or Stone PoliSta, Police Station Dh Church PO Post Office CH Club House PC Public Convenience	■ (where shown) Stati Point feature Pvio
Co. Boro. Bdy.	FE Sta Fire Engine Station PH Public House FB Foot Bridge SB Signal Box Fn Fountain Spr Spring	 (e.g. Guide Post ⊠ or lig or Mile Stone)
s	GP Guide Post TCB Telephone Call Box MP Mile Post TCP Telephone Call Post MS Mile Stone W Weil	•+• Site of (antiquity) Glas
Civil Parish Boundary		Build

(333) Refuse tip or slag heap Rock (scattered) Boulders (scattered) Mud Mud 888 B Sand Pit 101101101 Top of cliff (مليليل المليل المليل Underground ____ detail Narrow gauge -------railway Single track railway Civil, parish or idary community boundary Constituency boundary దది Non-coniferous trees 00 Coniferous 22 ± ≭ trees ered) Positioned Q. ered) tree 1 Coppice or Osiers Heath 🏄 Marsh, Salt Ma Marsh or Reeds Flow arrows -Mean low MLW(S) water (springs) Electricity transmission line

> (with poles) Triangulation

Pylon, flare stack

or lighting tower

Glasshouse

Important

Building

station

AECOM

Historical Mapping & Photography included:

Mapping Type	Scale	Date	Pg
Yorkshire	1:10,560	1854	2
Lincolnshire	1:10,560	1885 - 1886	3
Yorkshire	1:10,560	1894	4
Lincolnshire	1:10,560	1907 - 1908	5
Lincolnshire	1:10,560	1938 - 1950	6
Lincolnshire	1:10,560	1951	7
Lincolnshire	1:10,560	1951	8
Ordnance Survey Plan	1:10,000	1956	9
Ordnance Survey Plan	1:10,000	1969	10
Ordnance Survey Plan	1:10,000	1987	11
10K Raster Mapping	1:10,000	2000	12
10K Raster Mapping	1:10,000	2006	13
VectorMap Local	1:10,000	2020	14

Historical Map - Slice A



Order Details

Order Number: Customer Ref: National Grid Reference: 482060, 411790 Slice: Site Area (Ha): Search Buffer (m):

242986885_1_1 60625943 А 68.12 500

Site Details Keadby



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10k Raster Mapping

Published 2000

Source map scale - 1:10,000

The historical maps shown were produced from the Ordnance Survey's 1:10,000 colour raster mapping. These maps are derived from Landplan which replaced the old 1:10,000 maps originally published in 1970. The data is highly detailed showing buildings, fences and field boundaries as well as all roads, tracks and paths. Road names are also included together with the relevant road number and classification. Boundary information depiction includes county, unitary authority, district, civil parish and constituency.

Map Name(s) and Date(s)



Historical Map - Slice A



Order Details

Order Number: Customer Ref: National Grid Reference: 482060, 411790 Slice: Site Area (Ha): Search Buffer (m):

242986885_1_1 60625943 Α 68.12 500

Site Details Keadby



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10k Raster Mapping

Published 2006

Source map scale - 1:10,000

The historical maps shown were produced from the Ordnance Survey's 1:10,000 colour raster mapping. These maps are derived from Landplan which replaced the old 1:10,000 maps originally published in 1970. The data is highly detailed showing buildings, fences and field boundaries as well as all roads, tracks and paths. Road names are also included together with the relevant road number and classification. Boundary information depiction includes county, unitary authority, district, civil parish and constituency.





Historical Map - Slice A



Order Details

Order Number: Customer Ref: National Grid Reference: 482060, 411790 Slice: Site Area (Ha): Search Buffer (m):

242986885_1_1 60625943 А 68.12 500





Tel: Fax: Web:







AECOM

Historical Mapping & Photography included:

Mapping Type	Scale	Date	Pg
Lincolnshire	1:2,500	1886	2
Lincolnshire	1:2,500	1907	3
Ordnance Survey Plan	1:2,500	1967	4
Additional SIMs	1:2,500	1967	5
Large-Scale National Grid Data	1:2,500	1994	6
Large-Scale National Grid Data	1:2,500	1995	7
Historical Aerial Photography	1:2,500	1999	8

Historical Map - Segment A6



Order Details

Order Number: Customer Ref: National Grid Reference: 482060, 411790 Slice: Site Area (Ha): Search Buffer (m):

242986885_1_1 60625943 Α 68.12 100

Site Details Keadby



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Lincolnshire

Published 1886

Source map scale - 1:2,500

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840's. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.

Map Name(s) and Date(s)



Historical Map - Segment A6



Order Details

Order Number: Customer Ref: National Grid Reference: 482060, 411790 Slice: А Site Area (Ha): Search Buffer (m): 68.12 100

242986885_1_1 60625943

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Web:

Site Details Keadby







Lincolnshire

Published 1907

Source map scale - 1:2,500

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840's. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.

Map Name(s) and Date(s)



Historical Map - Segment A6



Order Details

Order Number: 242986885_1_1 Customer Ref: National Grid Reference: 482060, 411790 Slice: А Site Area (Ha): Search Buffer (m): 68.12 100

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Site Details Keadby







Ordnance Survey Plan

Published 1967

Source map scale - 1:2,500

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840's. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.

Map Name(s) and Date(s)



Historical Map - Segment A6



Order Details

Order Number: Customer Ref: National Grid Reference: 482060, 411790 Slice: Α Site Area (Ha): Search Buffer (m):

242986885_1_1 60625943 68.12 100

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Additional SIMs

Published 1967

Source map scale - 1:2,500

The SIM cards (Ordnance Survey's 'Survey of Information on Microfilm') are further, minor editions of mapping which were produced and published in between the main editions as an area was updated. They date from 1947 to 1994, and contain detailed information on buildings, roads and land-use. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)



Historical Map - Segment A6



Order Details

Order Number: Customer Ref: National Grid Reference: 482060, 411790 Slice: Site Area (Ha): Search Buffer (m):

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Large-Scale National Grid Data

Published 1994

Source map scale - 1:2,500

'Large Scale National Grid Data' superseded SIM cards (Ordnance Survey's 'Survey of Information on Microfilm') in 1992, and continued to be produced until 1999. These maps were the fore-runners of digital mapping and so provide detailed information on houses and roads, but tend to show less topographic features such as vegetation. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)



Historical Map - Segment A6



Order Details

Order Number: Customer Ref: National Grid Reference: 482060, 411790 Slice: Site Area (Ha): Search Buffer (m):

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Large-Scale National Grid Data

Published 1995

Source map scale - 1:2,500

'Large Scale National Grid Data' superseded SIM cards (Ordnance Survey's 'Survey of Information on Microfilm') in 1992, and continued to be produced until 1999. These maps were the fore-runners of digital mapping and so provide detailed information on houses and roads, but tend to show less topographic features such as vegetation. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)



Historical Map - Segment A6



Order Details

Order Number: Customer Ref: National Grid Reference: 482060, 411790 Slice: Site Area (Ha): Search Buffer (m):

242986885_1_1 60625943 Α 68.12 100

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Historical Aerial Photography

Published 1999

This aerial photography was produced by Getmapping, these vertical aerial photographs provide a seamless, full colour survey of the whole of Great Britain

Historical Aerial Photography - Segment A6



Order Details

Order Number:242986885_1_1Customer Ref:60625943National Grid Reference:482060, 411790Slice:ASite Area (Ha):68.12Search Buffer (m):100

Site Details Keadby



Tel: Fax: Web:



AECOM

Historical Mapping & Photography included:

Mapping Type	Scale	Date	Pg
Lincolnshire	1:2,500	1886 - 1887	2
Lincolnshire	1:2,500	1907	3
Ordnance Survey Plan	1:2,500	1967	4
Additional SIMs	1:2,500	1967 - 1978	5
Additional SIMs	1:2,500	1991	6
Large-Scale National Grid Data	1:2,500	1994	7
Large-Scale National Grid Data	1:2,500	1995	8
Large-Scale National Grid Data	1:2,500	1995	9
Historical Aerial Photography	1:2,500	1999	10

Historical Map - Segment A7



Order Details

Order Number: Customer Ref: National Grid Reference: 482060, 411790 Slice: Site Area (Ha): Search Buffer (m):

242986885_1_1 60625943 Α 68.12 100

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Lincolnshire

Published 1907

Source map scale - 1:2,500

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840's. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.



Historical Map - Segment A7



Order Details

 Order Number:
 242986885_1_1

 Customer Ref:
 60625943

 National Grid Reference:
 482060, 411790

 Slice:
 A

 Site Area (Ha):
 68.12

 Search Buffer (m):
 100

Site Details Keadby



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Published 1995

Source map scale - 1:2,500

'Large Scale National Grid Data' superseded SIM cards (Ordnance Survey's 'Survey of Information on Microfilm') in 1992, and continued to be produced until 1999. These maps were the fore-runners of digital mapping and so provide detailed information on houses and roads, but tend to show less topographic features such as vegetation. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)



Historical Map - Segment A7



Order Details

 Order Number:
 242986885_1_1

 Customer Ref:
 60625943

 National Grid Reference:
 482060, 411790

 Slice:
 A

 Site Area (Ha):
 68.12

 Search Buffer (m):
 100

Site Details Keadby



Tel: Fax: Web:





Historical Aerial Photography

Published 1999

This aerial photography was produced by Getmapping, these vertical aerial photographs provide a seamless, full colour survey of the whole of Great Britain

Historical Aerial Photography - Segment A7



Order Details

Order Number:242986885_1_1Customer Ref:60625943National Grid Reference:482060, 411790Slice:ASite Area (Ha):68.12Search Buffer (m):100

Site Details Keadby



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AECOM

Historical Mapping & Photography included:

Mapping Type	Scale	Date	Pg
Lincolnshire	1:2,500	1887	2
Lincolnshire	1:2,500	1907	3
Ordnance Survey Plan	1:2,500	1967	4
Additional SIMs	1:2,500	1978 - 1982	5
Additional SIMs	1:2,500	1991	6
Large-Scale National Grid Data	1:2,500	1994	7
Large-Scale National Grid Data	1:2,500	1995	8
Large-Scale National Grid Data	1:2,500	1995	9
Historical Aerial Photography	1:2,500	1999	10

Historical Map - Segment A8



Order Details

Order Number: Customer Ref: National Grid Reference: 482060, 411790 Slice Site Area (Ha): Search Buffer (m):

242986885_1_1 60625943 Α 68.12 100

Site Details Keadby



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Historical Aerial Photography - Segment A8



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A Landmark Information Group Service v50.0 21-May-2020 Page 10 of 10



AECOM

Historical Mapping & Photography included:

Mapping Type	Scale	Date	Pg
Lincolnshire	1:2,500	1886	2
Lincolnshire	1:2,500	1907	3
Ordnance Survey Plan	1:2,500	1966 - 1967	4
Additional SIMs	1:2,500	1966 - 1967	5
Large-Scale National Grid Data	1:2,500	1994	6
Large-Scale National Grid Data	1:2,500	1995	7
Large-Scale National Grid Data	1:2,500	1996	8
Historical Aerial Photography	1:2,500	1999	9

Historical Map - Segment A10



Order Details

Order Number: Customer Ref: National Grid Reference: 482060, 411790 Slice: Site Area (Ha): Search Buffer (m):

242986885_1_1 60625943 Α 68.12 100

Site Details Keadby



Tel

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Published 1886

Source map scale - 1:2,500

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Map Name(s) and Date(s)



_

Historical Map - Segment A10

_ _



Order Details

 Order Number:
 242986885_1_1

 Customer Ref:
 60625943

 National Grid Reference:
 482060, 411790

 Slice:
 A

 Site Area (Ha):
 68.12

 Search Buffer (m):
 100

Site Details Keadby



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Published 1907

Source map scale - 1:2,500

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840's. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.

Map Name(s) and Date(s)



Historical Map - Segment A10

_ _



Order Details

Order Number: 242986885_1_1 Customer Ref: 60625943 National Grid Reference: 482060, 411790 Slice: Α Site Area (Ha): Search Buffer (m): 68.12 100

Site Details Keadby



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Ordnance Survey Plan Published 1966 - 1967 Source map scale - 1:2,500

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Map Name(s) and Date(s)



_ _ _'

Historical Map - Segment A10



Order Details

Order Number: Customer Ref: National Grid Reference: 482060, 411790 Slice: А Site Area (Ha): Search Buffer (m): 100

242986885_1_1 60625943 68.12





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Additional SIMs

Published 1966 - 1967

Source map scale - 1:2,500

The SIM cards (Ordnance Survey's `Survey of Information on Microfilm') are further, minor editions of mapping which were produced and published in between the main editions as an area was updated. They date from 1947 to 1994, and contain detailed information on buildings, roads and land-use. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)



Historical Map - Segment A10



Order Details

Order Number: Customer Ref: National Grid Reference: 482060, 411790 Slice: Α Site Area (Ha): Search Buffer (m):

242986885_1_1 60625943 68.12 100





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Published 1994

Source map scale - 1:2,500

'Large Scale National Grid Data' superseded SIM cards (Ordnance Survey's 'Survey of Information on Microfilm') in 1992, and continued to be produced until 1999. These maps were the fore-runners of digital mapping and so provide detailed information on houses and roads, but tend to show less topographic features such as vegetation. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)



_ _ _

Historical Map - Segment A10



Order Details

Order Number: Customer Ref: National Grid Reference: 482060, 411790 Slice: Α Site Area (Ha): Search Buffer (m):

242986885_1_1 60625943 68.12 100

Tel:

Fax:

Web:

Site Details Keadby







Published 1995

Source map scale - 1:2,500

'Large Scale National Grid Data' superseded SIM cards (Ordnance Survey's 'Survey of Information on Microfilm') in 1992, and continued to be produced until 1999. These maps were the fore-runners of digital mapping and so provide detailed information on houses and roads, but tend to show less topographic features such as vegetation. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)



Historical Map - Segment A10



Order Details

Order Number: Customer Ref: National Grid Reference: 482060, 411790 Slice: Site Area (Ha): Search Buffer (m):

242986885_1_1 60625943 Α 68.12 100

Tel:

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Web:





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A Landmark Information Group Service v50.0 21-May-2020 Page 7 of 9





Published 1996

Source map scale - 1:2,500

'Large Scale National Grid Data' superseded SIM cards (Ordnance Survey's 'Survey of Information on Microfilm') in 1992, and continued to be produced until 1999. These maps were the fore-runners of digital mapping and so provide detailed information on houses and roads, but tend to show less topographic features such as vegetation. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)



Historical Map - Segment A10



Order Details

Order Number: Customer Ref: National Grid Reference: 482060, 411790 Slice: Site Area (Ha): Search Buffer (m):

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481800



Historical Aerial Photography

Published 1999

This aerial photography was produced by Getmapping, these vertical aerial photographs provide a seamless, full colour survey of the whole of Great Britain

Historical Aerial Photography - Segment A10



Order Details

 Order Number:
 242986885_1_1

 Customer Ref:
 60625943

 National Grid Reference:
 482060, 411790
 Slice: А 68.12 100 Site Area (Ha): Search Buffer (m):

Site Details Keadby



Tel: Fax: Web:



AECOM

Historical Mapping & Photography included:

Mapping Type	Scale	Date	Pg
Lincolnshire	1:2,500	1886 - 1887	2
Lincolnshire	1:2,500	1907	3
Ordnance Survey Plan	1:2,500	1966 - 1967	4
Additional SIMs	1:2,500	1966 - 1982	5
Additional SIMs	1:2,500	1991	6
Large-Scale National Grid Data	1:2,500	1994	7
Large-Scale National Grid Data	1:2,500	1995	8
Large-Scale National Grid Data	1:2,500	1995	9
Large-Scale National Grid Data	1:2,500	1996	10
Historical Aerial Photography	1:2,500	1999	11

Historical Map - Segment A11



Order Details

Order Number: Customer Ref: National Grid Reference: 482060, 411790 Slice: Site Area (Ha): Search Buffer (m):

242986885_1_1 60625943 Α 68.12 100

Tel

Fax: Web

Site Details Keadby







Published 1886 - 1887

Source map scale - 1:2,500

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840's. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.





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Historical Map - Segment A11

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Order Details

Order Number: 242986885_1_1 Customer Ref: 60625943 National Grid Reference: 482060, 411790 Slice: Α Site Area (Ha): Search Buffer (m): 68.12 100

Site Details Keadby



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A Landmark Information Group Service v50.0 21-May-2020 Page 2 of 11





Published 1907

Source map scale - 1:2,500

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840's. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.





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Historical Map - Segment A11

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Order Details

Order Number: 242986885_1_1 Customer Ref: 60625943 National Grid Reference: 482060, 411790 Slice: А Site Area (Ha): 68.12 Search Buffer (m): 100

Site Details Keadby



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Ordnance Survey Plan Published 1966 - 1967 Source map scale - 1:2,500

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840's. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.

Map Name(s) and Date(s)



Historical Map - Segment A11

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Order Details

 Order Number:
 242986885_1_1

 Customer Ref:
 60625943

 National Grid Reference:
 482060, 411790

 Slice:
 A

 Site Area (Ha):
 68.12

 Search Buffer (m):
 100

Site Details Keadby



Tel: 0 Fax: 0 Web: v





Additional SIMs

Published 1966 - 1982

Source map scale - 1:2,500

The SIM cards (Ordnance Survey's `Survey of Information on Microfilm') are further, minor editions of mapping which were produced and published in between the main editions as an area was updated. They date from 1947 to 1994, and contain detailed information on buildings, roads and land-use. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)



_ __ _ _ _ Historical Map - Segment A11



Order Details

Order Number: 242986885_1_1 Customer Ref: 60625943 National Grid Reference: 482060, 411790 Slice: Α Site Area (Ha): Search Buffer (m): 68.12 100

Site Details Keadby



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A Landmark Information Group Service v50.0 21-May-2020 Page 5 of 11





Additional SIMs

Published 1991

Source map scale - 1:2,500

The SIM cards (Ordnance Survey's `Survey of Information on Microfilm') are further, minor editions of mapping which were produced and published in between the main editions as an area was updated. They date from 1947 to 1994, and contain detailed information on buildings, roads and land-use. These maps were produced at both 1:2,500 and 1:1,250 scales.





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Historical Map - Segment A11



Order Details

242986885_1_1 60625943 Order Number: Customer Ref: National Grid Reference: 482060, 411790 Slice: А Site Area (Ha): Search Buffer (m): 68.12 100

Site Details Keadby



Tel: Fax: Web:





Published 1994

Source map scale - 1:2,500

'Large Scale National Grid Data' superseded SIM cards (Ordnance Survey's 'Survey of Information on Microfilm') in 1992, and continued to be produced until 1999. These maps were the fore-runners of digital mapping and so provide detailed information on houses and roads, but tend to show less topographic features such as vegetation. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)



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Historical Map - Segment A11



Order Details

 Order Number:
 242986885_1_1

 Customer Ref:
 60625943

 National Grid Reference:
 482060, 411790

 Slice:
 A

 Site Area (Ha):
 68.12

 Search Buffer (m):
 100

Site Details Keadby



Tel: Fax: Web:





Published 1995

Source map scale - 1:2,500

'Large Scale National Grid Data' superseded SIM cards (Ordnance Survey's 'Survey of Information on Microfilm') in 1992, and continued to be produced until 1999. These maps were the fore-runners of digital mapping and so provide detailed information on houses and roads, but tend to show less topographic features such as vegetation. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)



_ _ __ _ _

Historical Map - Segment A11



Order Details

Order Number: 242986885_1_1 Customer Ref: 60625943 National Grid Reference: 482060, 411790 Slice: Α Site Area (Ha): Search Buffer (m): 68.12 100

Site Details Keadby



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Published 1996

Source map scale - 1:2,500

'Large Scale National Grid Data' superseded SIM cards (Ordnance Survey's 'Survey of Information on Microfilm') in 1992, and continued to be produced until 1999. These maps were the fore-runners of digital mapping and so provide detailed information on houses and roads, but tend to show less topographic features such as vegetation. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)



Historical Map - Segment A11



Order Details

 Order Number:
 242986885_1_1

 Customer Ref:
 60625943

 National Grid Reference:
 482060, 411790

 Slice:
 A

 Site Area (Ha):
 68.12

 Search Buffer (m):
 100

Site Details Keadby



Tel: 0 Fax: 0 Web: w





Historical Aerial Photography

Published 1999

This aerial photography was produced by Getmapping, these vertical aerial photographs provide a seamless, full colour survey of the whole of Great Britain

Historical Aerial Photography - Segment A11



Order Details

Order Number:242986885_1_1Customer Ref:60625943National Grid Reference:482060, 411790Slice:ASite Area (Ha):68.12Search Buffer (m):100

Site Details Keadby



Tel: Fax: Web:



AECOM

Historical Mapping & Photography included:

Mapping Type	Scale	Date	Pg
Lincolnshire	1:2,500	1886 - 1887	2
Lincolnshire	1:2,500	1907	3
Ordnance Survey Plan	1:2,500	1966 - 1967	4
Additional SIMs	1:2,500	1978 - 1982	5
Additional SIMs	1:2,500	1991	6
Large-Scale National Grid Data	1:2,500	1994	7
Large-Scale National Grid Data	1:2,500	1995	8
Large-Scale National Grid Data	1:2,500	1995	9
Large-Scale National Grid Data	1:2,500	1996	10
Large-Scale National Grid Data	1:2,500	1996	11
Historical Aerial Photography	1:2,500	1999	12

Historical Map - Segment A12



242986885_1_1 60625943 Α 68.12 100

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Fax:

Web:



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A Landmark Information Group Service v50.0 21-May-2020 Page 1 of 12





Published 1886 - 1887

Source map scale - 1:2,500

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840's. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.

Map Name(s) and Date(s)



Historical Map - Segment A12



Order Details

 Order Number:
 242986885_1_1

 Customer Ref:
 60625943

 National Grid Reference:
 482060, 411790

 Slice:
 A

 Site Area (Ha):
 68.12

 Search Buffer (m):
 100

Site Details Keadby



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A Landmark Information Group Service v50.0 21-May-2020 Page 2 of 12

Tel:

Fax:

Web:




Published 1907

Source map scale - 1:2,500

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840's. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.

Map Name(s) and Date(s)



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Historical Map - Segment A12

_ _ |



Order Details

 Order Number:
 242986885_1_1

 Customer Ref:
 60625943

 National Grid Reference:
 482060, 411790

 Slice:
 A

 Site Area (Ha):
 68.12

 Search Buffer (m):
 100

Site Details Keadby



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A Landmark Information Group Service v50.0 21-May-2020 Page 3 of 12





Ordnance Survey Plan Published 1966 - 1967 Source map scale - 1:2,500

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840's. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.

Map Name(s) and Date(s)



Historical Map - Segment A12



Order Details

 Order Number:
 242986885_1_1

 Customer Ref:
 60625943

 National Grid Reference:
 482060, 411790

 Slice:
 A

 Site Area (Ha):
 68.12

 Search Buffer (m):
 100

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A Landmark Information Group Service v50.0 21-May-2020 Page 4 of 12





Additional SIMs

Published 1978 - 1982

Source map scale - 1:2,500

The SIM cards (Ordnance Survey's `Survey of Information on Microfilm') are further, minor editions of mapping which were produced and published in between the main editions as an area was updated. They date from 1947 to 1994, and contain detailed information on buildings, roads and land-use. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)



Historical Map - Segment A12

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Order Details

Order Number: Customer Ref: National Grid Reference: 482060, 411790 Slice: Α Site Area (Ha): Search Buffer (m): 100

242986885_1_1 60625943 68.12

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A Landmark Information Group Service v50.0 21-May-2020 Page 5 of 12

Tel:

Fax:





Additional SIMs

Published 1991

Source map scale - 1:2,500

The SIM cards (Ordnance Survey's `Survey of Information on Microfilm') are further, minor editions of mapping which were produced and published in between the main editions as an area was updated. They date from 1947 to 1994, and contain detailed information on buildings, roads and land-use. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)



Historical Map - Segment A12

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Order Details

Order Number: Customer Ref: National Grid Reference: 482060, 411790 Slice: А Site Area (Ha): Search Buffer (m): 100

242986885_1_1 60625943 68.12

Site Details Keadby



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A Landmark Information Group Service v50.0 21-May-2020 Page 6 of 12

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Fax: Web:





Published 1994

Source map scale - 1:2,500

'Large Scale National Grid Data' superseded SIM cards (Ordnance Survey's 'Survey of Information on Microfilm') in 1992, and continued to be produced until 1999. These maps were the fore-runners of digital mapping and so provide detailed information on houses and roads, but tend to show less topographic features such as vegetation. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)



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Historical Map - Segment A12



Order Details

Order Number: Customer Ref: National Grid Reference: 482060, 411790 Slice: Α Site Area (Ha): Search Buffer (m): 100

242986885_1_1 60625943 68.12

Tel:

Fax:

Web:

Site Details Keadby



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A Landmark Information Group Service v50.0 21-May-2020 Page 7 of 12





Published 1995

Source map scale - 1:2,500

'Large Scale National Grid Data' superseded SIM cards (Ordnance Survey's 'Survey of Information on Microfilm') in 1992, and continued to be produced until 1999. These maps were the fore-runners of digital mapping and so provide detailed information on houses and roads, but tend to show less topographic features such as vegetation. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)



Historical Map - Segment A12



Order Details

Order Number: Customer Ref: National Grid Reference: 482060, 411790 Slice: Site Area (Ha): Search Buffer (m):

242986885_1_1 60625943 Α 68.12 100

Site Details Keadby



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A Landmark Information Group Service v50.0 21-May-2020 Page 8 of 12

Tel:

Fax:





Published 1995

Source map scale - 1:2,500

'Large Scale National Grid Data' superseded SIM cards (Ordnance Survey's 'Survey of Information on Microfilm') in 1992, and continued to be produced until 1999. These maps were the fore-runners of digital mapping and so provide detailed information on houses and roads, but tend to show less topographic features such as vegetation. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)



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Historical Map - Segment A12



Order Details

Order Number: Customer Ref: National Grid Reference: 482060, 411790 Slice: Site Area (Ha): Search Buffer (m):

242986885_1_1 60625943 Α 68.12 100

Site Details Keadby



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Published 1996

Source map scale - 1:2,500

'Large Scale National Grid Data' superseded SIM cards (Ordnance Survey's 'Survey of Information on Microfilm') in 1992, and continued to be produced until 1999. These maps were the fore-runners of digital mapping and so provide detailed information on houses and roads, but tend to show less topographic features such as vegetation. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)



Historical Map - Segment A12



Order Details

Order Number: Customer Ref: National Grid Reference: 482060, 411790 Slice: Site Area (Ha): Search Buffer (m):

242986885_1_1 60625943 А 68.12 100

Site Details Keadby



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Tel:

Fax:





Published 1996

Source map scale - 1:2,500

'Large Scale National Grid Data' superseded SIM cards (Ordnance Survey's 'Survey of Information on Microfilm') in 1992, and continued to be produced until 1999. These maps were the fore-runners of digital mapping and so provide detailed information on houses and roads, but tend to show less topographic features such as vegetation. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)



Historical Map - Segment A12



Order Details

Order Number: Customer Ref: National Grid Reference: 482060, 411790 Slice: Α Site Area (Ha): Search Buffer (m): 100

242986885_1_1 60625943 68.12





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Tel:

Fax: Web:

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Historical Aerial Photography

Published 1999

This aerial photography was produced by Getmapping, these vertical aerial photographs provide a seamless, full colour survey of the whole of Great Britain

Historical Aerial Photography - Segment A12



Order Details

 Order Number:
 242986885_1_1

 Customer Ref:
 60625943

 National Grid Reference:
 482060, 411790
 Slice: А Site Area (Ha): Search Buffer (m):

68.12 100

Tel: Fax: Web:





Historical Mapping Legends

Ordnance Survey County Series 1:10,560	Ordnance Survey Plan 1:10,000	1:10,000 Raster Mapping
Gravel Sand Other Pit Pit Pits	Gravel Pit ورویکی Gravel Pit ورویکی Gravel Pit	Gravel Pit Gravel Pit or sk
🕐 Quarry	Sand Pit	Rock Scale
Andrea Angela An	Refuse or Lake, Loch	ີ້ຊີ້ຊີ້ Boulders ໍ Boulders (scat
and the second	Dunes 200 Boulders	Shingle Mud
	A A Coniferous	Band Sand Sand Sand
	ጥ ተ Trees ፡፡ የንድን Trees	Tapation Slopes Contrology Tapa
	Ο Οrchard Οο_ Scrub (Υη Coppice	General detail — — — — Unde
Fir Furze Rough Pasture	ന്ന് Bracken ഡ്ഡ്. Heath ്റ്റ്, Rough ന്ന് Grassland	— — — Overhead detail — — — Narro raitw
Hind Arrow denotes <u>a</u> Trigonometrical flow of water Station	<u>→-⊥</u> MarshV///, Reeds - <u>→-</u> ⊥ Saltings	Multi-trackSingl railway railw
🕂 Site of Antiquities 🔹 🔹 Bench Mark	Direction of Flow of Water Building	County boundary Civil, (England only) boun
Pump, Guide Post, Well, Spring, Signal Post Boundary Post	Glasshouse	District, Unitary, Metropolitan, Cons London Borough boun boundary
Sketched Instrumental	Pylon ————————————————————————————————————	a Area of wooded a Anon trees
Main Roads Un-Fenced Minor Roads Un-Fenced Un-Fenced	Cutting	Non-coniferous Non-coniferous Trees (scattered) A Coniferous Coniferous Coniferous
Sunken Road Raised Road	Multiple Track	
	Road ''' Road Level Foot Single Track Under Dver Crossing Bridge	ခိုမိ Orchard 🦹 Copy ခု နှ or Os
Railway River	or Mineral Line	्योक Rough कार्यात Heat जीव Grassland ज्यात
Railway over Level Crossin	g Geographical County	o _{a-} ^{Oa} - Scrub
Road over Road over	Administrative County, County Borough or County of City	V/ater feature 📒 Flow
∬-⇒ Road over Stream	Burgh or District Council Borough, Burgh or Clebrict Council	MHW(S) Mean high MLW(S) Mean water (springs) wate
—————— County Boundary (Geographical)	Shown only when our coincideur with other boundariesCivil ParishShown alternately when coincidence of boundaries occurs	Elect
County & Civil Parish Boundary	······································	(where shown) (with
+ · + · + · + Administrative County & Civil Parish Boundary	BP, BS Boundary Post or Stone Pol Sta Police Station Ch Church PO Post Office	← Bench mark _ Inan ™ ^{123/46} ™ (where shown)
Co. Boro. Bdy.	FE Sta Fire Engine Station PH Public Convenience FE Sta Fire Engine Station PH Public House FB Foot Bridge SB Signal Rov	 eature Point reature Pyloi (e.g. Guide Post ⊠ or lig or lig
Co. Burgh Bdy.	Fn Fountain Spr Spring GP Guide Post TCB Telephone Call Box	•‡• Site of (antiquity) Glas
RD. Bdy.	MP Mile Post TCP Telephone Call Post MS Mile Stone W Well	General Building
a contraction of the second se	1	

Refuse tip 620 Gravel Pit or slag heap Rock Rock (scattered) Boulders Boulders a. (scattered) Shingle Mud Mud Sand Pit Sand TTTTTTTTTTT Top of cliff Slopes Underground General detail detail Narrow gauge Overhead detail --------railway Single track Multi-track railway railway Civil, parish or County boundary community (England only) boundary District, Unitary, Constituency Metropolitan, London Baraugh boundary boundary Area of wooded Non-coniferous 00 a trees vegetation Non-coniferous Coniferous 22 trees (scattered) ± 本 trees Coniferous Positioned Q. trees (scattered) tree Coppice Orchard or Osiers Rough Heath Grassland Marsh, Salt SM12 Scrub Ma Marsh or Reeds Water feature Flow arrows Mean high Mean low MLW(S) water (springs) water (springs) Electricity Telephone line transmission line (where shown) (with poles) Triangulation Bench mark Δ (where shown) station Point feature Pylon, flare stack \boxtimes (e.g. Guide Post or lighting tower or Mile Stone) Site of (antiquity) Glasshouse Important General Building Building

AECOM

Historical Mapping & Photography included:

Mapping Type	Scale	Date	Pg
Yorkshire	1:10,560	1854	2
Lincolnshire	1:10,560	1886	3
Lincolnshire	1:10,560	1907 - 1908	4
Lincolnshire	1:10,560	1938 - 1946	5
Lincolnshire	1:10,560	1951	6
Lincolnshire	1:10,560	1951	7
Ordnance Survey Plan	1:10,000	1956	8
Ordnance Survey Plan	1:10,000	1969	9
Ordnance Survey Plan	1:10,000	1971	10
Ordnance Survey Plan	1:10,000	1982 - 1987	11
Ordnance Survey Plan	1:10,000	1991	12
10K Raster Mapping	1:10,000	2000	13
10K Raster Mapping	1:10,000	2006	14
VectorMap Local	1:10,000	2020	15

Historical Map - Slice B



Order Details

Order Number: Customer Ref: National Grid Reference: 483610, 411850 В Slice: Site Area (Ha): Search Buffer (m):

242986885_1_1 60625943 68.12 500

Site Details Keadby



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A Landmark Information Group Service v50.0 21-May-2020 Page 1 of 15

Tel:

Fax:



























































AECOM

Historical Mapping & Photography included:

Mapping Type	Scale	Date	Pg
Lincolnshire	1:2,500	1887	2
Lincolnshire	1:2,500	1907	3
Ordnance Survey Plan	1:2,500	1967	4
Additional SIMs	1:2,500	1982	5
Large-Scale National Grid Data	1:2,500	1994	6
Historical Aerial Photography	1:2,500	1999	7

Historical Map - Segment B5



Order Details

Order Number: Customer Ref: National Grid Reference: 483610, 411850 Slice: В Site Area (Ha): Search Buffer (m):

242986885_1_1 60625943 68.12 100

Site Details Keadby



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Published 1887

Source map scale - 1:2,500

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840's. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.





Historical Map - Segment B5



Order Details

 Order Number:
 242986885_1_1

 Customer Ref:
 60625943

 National Grid Reference:
 483610, 411850

 Slice:
 B

 Site Area (Ha):
 68.12

 Search Buffer (m):
 100

Site Details Keadby



Tel: Fax: Web:





Published 1907

Source map scale - 1:2,500

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840's. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.

Map Name(s) and Date(s)



Historical Map - Segment B5



Order Details

 Order Number:
 242986885_1_1

 Customer Ref:
 60625943

 National Grid Reference:
 483610, 411850

 Slice:
 B

 Site Area (Ha):
 68.12

 Search Buffer (m):
 100

Site Details Keadby



Tel: Fax: Web:





Ordnance Survey Plan

Published 1967

Source map scale - 1:2,500

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840's. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.

Map Name(s) and Date(s)



Historical Map - Segment B5



Order Details

 Order Number:
 242986885_1_1

 Customer Ref:
 60625943

 National Grid Reference:
 483610, 411850

 Slice:
 B

 Site Area (Ha):
 68.12

 Search Buffer (m):
 100

Site Details Keadby



Tel: Fax: Web:





Additional SIMs

Published 1982

Source map scale - 1:2,500

The SIM cards (Ordnance Survey's `Survey of Information on Microfilm') are further, minor editions of mapping which were produced and published in between the main editions as an area was updated. They date from 1947 to 1994, and contain detailed information on buildings, roads and land-use. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)



Historical Map - Segment B5



Order Details

 Order Number:
 242986885_1_1

 Customer Ref:
 60625943

 National Grid Reference:
 483610, 411850

 Slice:
 B

 Site Area (Ha):
 68.12

 Search Buffer (m):
 100

Site Details Keadby



Tel: Fax: Web:





Published 1994

Source map scale - 1:2,500

'Large Scale National Grid Data' superseded SIM cards (Ordnance Survey's 'Survey of Information on Microfilm') in 1992, and continued to be produced until 1999. These maps were the fore-runners of digital mapping and so provide detailed information on houses and roads, but tend to show less topographic features such as vegetation. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)



Historical Map - Segment B5



Order Details

Order Number: Customer Ref: National Grid Reference: 483610, 411850 Slice: В Site Area (Ha): Search Buffer (m): 100

242986885_1_1 60625943 68.12

Tel:

Fax:

Web:

Site Details Keadby



0844 844 9952 0844 844 9951 www.envirocheck.co.uk

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AECOM

Historical Mapping & Photography included:

Mapping Type	Scale	Date	Pg
Lincolnshire	1:2,500	1886 - 1887	2
Lincolnshire	1:2,500	1907	3
Ordnance Survey Plan	1:2,500	1966 - 1967	4
Additional SIMs	1:2,500	1982	5
Large-Scale National Grid Data	1:2,500	1994	6
Large-Scale National Grid Data	1:2,500	1996	7
Historical Aerial Photography	1:2,500	1999	8

Historical Map - Segment B9



Order Details

Order Number: Customer Ref: National Grid Reference: 483610, 411850 Slice: В Site Area (Ha): Search Buffer (m):

242986885_1_1 60625943 68.12 100

Site Details Keadby



Tel Fax: Web:





Published 1886 - 1887

Source map scale - 1:2,500

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840's. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.

Map Name(s) and Date(s)



Historical Map - Segment B9



Order Details

 Order Number:
 242986885_1_1

 Customer Ref:
 60625943

 National Grid Reference:
 483610, 411850

 Slice:
 B

 Site Area (Ha):
 68.12

 Search Buffer (m):
 100

Site Details Keadby



Tel: Fax: Web:





Published 1907

Source map scale - 1:2,500

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840's. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.

Map Name(s) and Date(s)



Historical Map - Segment B9



Order Details

Order Number: 242986885_1_1 Customer Ref: 60625943 National Grid Reference: 483610, 411850 Slice: В Site Area (Ha): Search Buffer (m): 68.12 100

Site Details Keadby





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Tel:

Fax:





Ordnance Survey Plan Published 1966 - 1967 Source map scale - 1:2,500

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840's. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.

Map Name(s) and Date(s)



_ _

Historical Map - Segment B9



Order Details

 Order Number:
 242986885_1_1

 Customer Ref:
 60625943

 National Grid Reference:
 483610, 411850

 Slice:
 B

 Site Area (Ha):
 68.12

 Search Buffer (m):
 100

Site Details Keadby



Tel: Fax: Web:




Additional SIMs

Published 1982

Source map scale - 1:2,500

The SIM cards (Ordnance Survey's `Survey of Information on Microfilm') are further, minor editions of mapping which were produced and published in between the main editions as an area was updated. They date from 1947 to 1994, and contain detailed information on buildings, roads and land-use. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)



Historical Map - Segment B9



Order Details

 Order Number:
 242986885_1_1

 Customer Ref:
 60625943

 National Grid Reference:
 483610, 411850

 Slice:
 B

 Site Area (Ha):
 68.12

 Search Buffer (m):
 100

Site Details Keadby



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Large-Scale National Grid Data

Published 1994

Source map scale - 1:2,500

'Large Scale National Grid Data' superseded SIM cards (Ordnance Survey's 'Survey of Information on Microfilm') in 1992, and continued to be produced until 1999. These maps were the fore-runners of digital mapping and so provide detailed information on houses and roads, but tend to show less topographic features such as vegetation. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)



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Historical Map - Segment B9



Order Details

 Order Number:
 242986885_1_1

 Customer Ref:
 60625943

 National Grid Reference:
 483610, 411850

 Slice:
 B

 Site Area (Ha):
 68.12

 Search Buffer (m):
 100

Site Details Keadby



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Large-Scale National Grid Data

Published 1996

Source map scale - 1:2,500

'Large Scale National Grid Data' superseded SIM cards (Ordnance Survey's 'Survey of Information on Microfilm') in 1992, and continued to be produced until 1999. These maps were the fore-runners of digital mapping and so provide detailed information on houses and roads, but tend to show less topographic features such as vegetation. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)



Historical Map - Segment B9



Order Details

 Order Number:
 242986885_1_1

 Customer Ref:
 60625943

 National Grid Reference:
 483610, 411850

 Slice:
 B

 Site Area (Ha):
 68.12

 Search Buffer (m):
 100

Site Details Keadby



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Historical Aerial Photography

Published 1999

This aerial photography was produced by Getmapping, these vertical aerial photographs provide a seamless, full colour survey of the whole of Great Britain





Order Details

1200

 Order Number:
 242986885_1_1

 Customer Ref:
 60625943

 National Grid Reference:
 483610, 411850

 Slice:
 B

 Site Area (Ha):
 68.12

 Search Buffer (m):
 100

Site Details Keadby



Tel: Fax: Web:





Index Map

For ease of identification, your site and buffer have been split into Slices, Segments and Quadrants. These are illustrated on the Index Map opposite and explained further below.

Slice

Each slice represents a 1:10,000 plot area (2.7km x 2.7km) for your site and buffer. A large site and buffer may be made up of several slices (represented by a red outline), that are referenced by letters of the alphabet, starting from the bottom left corner of the slice "grid". This grid does not relate to National Grid lines but is designed to give best fit over the site and buffer.

Segment

A segment represents a 1:2,500 plot area. Segments that have plot files associated with them are shown in dark green, others in light blue. These are numbered from the bottom left hand corner within each slice.

Quadrant

A quadrant is a quarter of a segment. These are labelled as NW, NE, SW, SE and are referenced in the datasheet to allow features to be quickly located on plots. Therefore a feature that has a quadrant reference of A7NW will be in Slice A, Segment 7 and the NW Quadrant.

A selection of organisations who provide data within this report:





British Geological Survey NATURAL ESTABORHERT RESEARCH COURCIL





Envirocheck reports are compiled from 136 different sources of data.

Client Details

Ms L Coles, Aecom Infrastructure & Environment UK Ltd, Victoria Square House, Victoria Square, Birmingham, B2 4AJ

Order Details

 Order Number:
 242986885_1_1

 Customer Ref:
 60625943

 National Grid Reference:
 482310, 411790

 Site Area (Ha):
 68.12

 Search Buffer (m):
 500

Site Details

Keadby

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