

National Grid Cable Tunnel Replacement Project

Land Contamination Preliminary Risk Assessment Gravesend

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Quality information

Prepared by	Checked by	Verified by	Approved by
MV Senior Environmental Scientist	KB Associate Director	PH Technical Director	PH Technical Director

Prepared for:

National Grid

Prepared by:

AECOM Limited
Aldgate Tower, 2 Leman Street
London, E1 8FA
United Kingdom

T: +44 20 7061 7000
aecom.com

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

The opinions expressed in this report and the comments and recommendations given are based on a desk assessment of readily available information.

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

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Executive Summary

A Stage 1, Tier 1 Preliminary Risk Assessment (PRA) (as defined by the Government guidance entitled 'Land Contamination Risk Management') for an area of land to the south of the Eastcourt Marshes Electricity Substation ('the Site'), in Gravesham Borough, has been undertaken by AECOM Limited to support the planning application. This is to help identify potential constraints and limitations in relation to the development of new infrastructure on the southern side of the River Thames in Gravesend, including a proposed sealing end compound (SEC) with headhouse.

The Site is located within a vegetated area which is part of the Canal and Grazing Marsh, Higham Local Wildlife Site (LWS), designated for its grassland habitats and mostly on land owned by National Grid. Part of the Site is used as a Police Training Centre for rifle shooting.

Ground conditions identified from geological maps and a recent ground investigation comprise superficial deposits of Alluvium overlying the River Terrace Deposits, with the bedrock of the White Chalk Subgroup at depth. The superficial deposits underlying the Site are classified as a Secondary (undifferentiated) aquifer (Alluvium) and a Secondary A aquifer (River Terrace Deposits). The solid geology of the Chalk is classified as a Principal aquifer. Groundwater is anticipated to be in hydraulic continuity with the River Thames.

A Preliminary Unexploded Ordnance (UXO) Threat Assessment indicates that the potential for a UXO hazard to occur, and more specifically, the potential for unexploded World War (WWI and WWII) ordnance to exist at this site is assessed as being likely; and a detailed UXO Threat Assessment is recommended.

A UXO Desk Study and Risk Assessment obtained for a wider area indicates that the Site is located within a moderate hazard zone for UXO. Non-intrusive UXO surveys are recommended in advance of intrusive works. Where piling or boreholes/cone penetration tests were proposed, deep Unexploded Bomb (UXB) detection was recommended. It is recommended that a detailed UXO risk mitigation strategy was commissioned when the construction design was finalised.

Historical mapping dated from the 1890s shows the Site as undeveloped marshland and a rifle range. Milton Range was used extensively for training during both WWI and WWII. Records have been found indicating that mortar training was undertaken on the range during WWII. It is considered possible that other close combat munitions, such as grenades, were used during training exercises. Areas of infilled land have been identified at the Site, associated with a watercourse historically flowing in a northerly direction across the western part of the Site toward the River Thames; and associated with historical ponds located at the Site. All of these may have been filled with a variety of (potentially unlicensed) waste materials.

The preliminary risk assessment has identified a low risk to human health for current/future users of the Site. This is mainly based on potential exposure to contaminants in shallow soils. There may be a risk of ground gas associated with the Made Ground, infilling, and natural peat deposits in the Alluvium. Notwithstanding this, it is recognised that the potential for exposure to ground contamination, if present, by future users of the proposed development would be limited, due to only sporadic access to the Site by maintenance workers.

Based on the present and historical land-use of the Site, there is a potential for groundwater in the superficial aquifer to have been (and continue to be) impacted through leaching of contaminants into the groundwater in the locality. The presence of low permeability deposits of the Alluvium may have limited the vertical migration of potentially contaminated groundwater to the deeper aquifers. The Site is not within a groundwater Source Protection Zone and no licensed groundwater abstractions have been identified on-site or downgradient within 1km of the Site. The risk associated with controlled waters is considered to be low.

The potential presence of hydrocarbons, other organic chemicals, vapours and corrosive/aggressive conditions in soils/groundwater may affect development infrastructure and services. The risk to infrastructure and services is considered to be very low.

Most excavated material generated during construction works will require off-site disposal. National Grid would prefer off-site re-use for natural material that provides habitat restoration benefits. The material will require chemical analysis and waste classification prior to removal from the Site for disposal. In preference to off-site disposal, options for re-use should be explored in accordance with the Contaminated Land: Applications in Real Environments (CLAiRE) Definition of Waste: Development Industry Code of Practice.

The information collected as part of this review suggests that there are not likely to be significant constraints with regards to soil and groundwater contamination that would preclude development of the proposed infrastructure. The design would need to take account of the potential to encounter and appropriately manage ground contamination and its associated risks. An allowance should also be made for the handling and disposing of hazardous soil waste arisings.

A ground investigation was recently undertaken at the Site which will allow a generic quantitative assessment (defined as Stage 1, Tier 2 under Land Contamination Risk Management (LCRM) as to whether any of the potential risks identified are present and are of material concern to the Proposed Development. Subject to the findings of the quantitative risk assessment, a site-specific Remediation Strategy (and subsequent verification reporting) may be required if contamination is encountered or considered to pose an unacceptable risk.

1. Introduction

1.1 Terms of Appointment

- 1.1.1 National Grid Electricity Transmission (hereafter referred to as 'National Grid') owns and operates the national high-voltage electricity transmission system throughout England and Wales. The key role of the transmission system is to connect the electricity generating power stations with the local distribution networks of the regional electricity companies.
- 1.1.2 National Grid's operations are dictated by the latest Future Energy Scenarios (FES) and Electricity Ten Year Station (ETYS) reports. In recent years, these reports have begun forecasting a large amount of renewable and low carbon energy generation, connecting into the transmission network in the east coast of England, together with three interconnectors from the continent. Through these forecasts, National Grid Electricity System Operator (ESO) has identified that the Tilbury to Grain, and Tilbury to Kingsnorth (TKRE) 400 kilovolt (kV) circuits will be significantly overloaded in their current capacity and require upgrading.
- 1.1.3 The TKRE 400 kV circuits are currently predominantly overhead line, with a section installed within a deep tunnel beneath the River Thames. As the Transmission Licence Holder with responsibility for the TKRE circuits, National Grid are required to upgrade the existing circuits.
- 1.1.4 The TKRE Cable Tunnel Replacement Project (hereafter 'the Proposed Development') relates to the replacement of the section beneath the River Thames of the TKRE 400 kV circuits only. It is proposed that a new bored tunnel under the River Thames is constructed to house new, cross linked polyethylene cables. In addition, associated new infrastructure is proposed on either side of the River Thames in Tilbury and Gravesend comprising:
- Two Sealing End Compounds (SECs) with two new tunnel headhouses; and
 - Overhead line re-stringing to connect the existing overhead lines to each of the new SECs.
- 1.1.5 On the instruction of National Grid, AECOM Limited (AECOM) has carried out Stage 1, Tier 1 Preliminary Risk Assessment (PRA) (as defined by Government guidance titled 'Land Contamination Risk Management' (Ref 5)) for the proposed infrastructure (SEC and headhouse) located in Gravesend (hereafter referred to as the 'Site').

1.2 Proposed Development

- 1.2.1 The Proposed Development comprises a SEC, with tunnel shaft and headhouse located on the southern side of the new tunnel, in Gravesend, with overhead line works required in the area to the east of the Site. A similar report has been produced for the proposed infrastructure in Tilbury.
- 1.2.2 The Proposed Development comprises the following components:
- **New bored tunnel;**
 - **Two new cable sealing end compounds:** one either side of the tunnel, onshore, which contain:
 - **Two new tunnel headhouses:** one either side of the new tunnel, onshore, which will cover the shaft into the tunnel;
 - **Two new overhead line gantry structures:** these will connect the overhead line downlead conductor and transfer them to six sealing end structures; and

- **Modifications to the existing overhead line (OHL):** The new OHL conductors will be connected to the existing TKRE 400kV OHL conductors via new terminal pylons at Tilbury and Gravesend.

1.2.3 Each required SEC would fall within Thurrock Council and Gravesham Borough Council jurisdictions.

Operational Phase

1.2.4 Once the Proposed Development is commissioned and in operation, it is expected that operational activity would mirror that of the existing SECs. Operational activity of the Proposed Development may include:

- Bi-monthly visits (Tilbury) / monthly visits (Gravesend) with a light van or car for e.g., safety checks on such equipment as fire alarms; inspection or minor maintenance of electrical and ventilation equipment; and
- Maintenance work on electrical/ventilation equipment or buildings involving five to ten light good vehicles visits once every two to five years.

1.2.5 The Gravesend SEC will be surrounded by a 2.4m mesh or palisade security fence topped with an electric pulse fence to a height of 3.4 m.

1.3 Report Objectives

1.3.1 This report has been prepared in general accordance with the technical guidance and procedures described in the UK Government guidance Land Contamination: Risk Management (2019), British Standard (BS) 5930:2015+A1:2020 Code of Practice for Ground Investigations (BSI) and BS 10175:2011+A2:2017 Investigation of Potentially Contaminated Sites – Code of Practice (BSI), to:

- Describe the geology, hydrogeology and shallow mining potential.
- Describe the environmental setting/sensitivity and current/historical land use of the Site and surrounding area.
- Describe the findings of a site reconnaissance visit.
- Summarise the findings of any historical ground investigation works.
- Provide an initial Conceptual Site Model (CSM) for the prevailing ground conditions.
- Using the source-pathway-receptor model present a preliminary qualitative risk assessment of potential land contamination risks to human (chronic), environmental, and controlled water receptors from contamination sources on or in the vicinity of the Site.

1.3.2 As part of the review, an appraisal of the potential for the presence of Remnants of War (RoW) artefacts, using a Preliminary Unexploded Ordnance (UXO) Threat Assessment procured from a UXO Consultant has been carried out.

1.4 Sources of Information

1.4.1 This report has been prepared using a combination of information provided by National Grid and published records (e.g. British Geological Survey (BGS), Environment Agency and Department for Environment, Food & Rural Affairs (Defra)). These include statutory records and historical mapping supplied within a client provided Envirocheck report (Dated October 2022) (Ref 8), published geological and hydrogeological mapping (Ref 11 and Ref 12), historical borehole records (Ref 11), and observations made during a site reconnaissance visit.

1.4.2 Specific information sources are referenced throughout the document and a bibliography is included in Section 12 of this report.

2. Site Setting

2.1 Location

2.1.1 The Site is located in the jurisdiction of Gravesham Borough Council (GBC), north-west Kent, England. The Site area for this report is defined by the Site Boundary shown on Figure 1 in Appendix A. The Site Boundary depicted differs slightly in its western extent from the Planning Application – Red Line Boundary adopted in the Environmental Impact Assessment (EIA), namely the road access to the west which is excluded. This Report covers the land in the Site Boundary shown in Appendix A which includes the proposed construction areas for the Gravesend SEC. The differences in land between Appendix A and the Planning Application – Red Line Boundary are not considered likely to introduce new contaminant linkages due to their proposed usages.

2.2 Description and Setting

2.2.1 The Site is located within a vegetated area which is part of the Canal and Grazing Marsh, Higham Local Wildlife Site (LWS), designated for its grassland habitats and on land owned by National Grid. The eastern part of the Site and the land immediately east is owned by the RSPB and leased and used as a Police Training Centre for rifle shooting. The existing cable tunnel and associated SEC border the Site to the north. The Thameside Campus (National Maritime Training Centre) and the Metropolitan Police Specialist Training Centre adjoin the Site to the west. Thames and Medway Canal borders the Site to the south. The River Thames is approximately 60m north of the Site. Surface water drains are present on the Site.

2.2.2 The topography of the area is relatively flat, with existing ground levels generally at 5m Above Ordnance Datum (AOD) from online Ordnance Survey (OS) (Ref 9).

2.2.3 The Site is accessible from an existing private road belonging to National Grid, which connects to the public Thames and Medway Canal Road, alongside the Thames and Medway Canal.

2.2.4 Relevant features immediately surrounding the Site are summarised in Table 2-1.

Table 2-1: Features Surrounding the Site

Direction	Summary
North	The existing cable tunnel and associated SEC border the Site to the north-west. The River Thames is approximately 60m north of the Site.
South	Thames and Medway Canal Road borders the Site to the South, with Thames and Medway Canal and a railway line beyond.
East	Police Training Centre for rifle shooting extends on-site and to the east.
West	Thameside Campus (National Maritime Training Centre), Metropolitan Police Specialist Training Centre are located adjacent to the west of the Site.

3. Geological and Environmental Setting

3.1 Introduction

- 3.1.1 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-site or off-site, and also the way in which contamination can affect applicable receptors including controlled waters and users of the Site and surrounding areas.
- 3.1.2 The environmental setting of the Site has been assessed by referring to the information sources detailed in Section 1.4.

3.2 Geology and Soils

Published Geology & Exploratory Hole Records

- 3.2.1 AECOM has reviewed publicly available information. The published 1:50,000 scale geological map of the area produced by the BGS (Sheet 271, Dartford, 1998) (Ref 10) and the BGS GeoIndex Onshore online geological mapping (Ref 11) (accessed August 2023) indicates that the Site is underlain by the geological succession summarised in Table 3-1.
- 3.2.2 The BGS mapping suggest that the stratigraphy across the Site comprises Alluvium likely over River Terrace Deposits, with the chalk formations at depth, including Lewes Nodular Chalk Formation, Seaford Chalk Formation and Newhaven Chalk Formation (undifferentiated) of the White Chalk Subgroup. Made Ground is only mapped along the northern boundary of the Site; however, it is expected to be present across other parts of the Site.
- 3.2.3 Extracts of the Superficial Deposits and Bedrock maps are included in the Envirocheck Report (Appendix B).

Table 3-1: Geological Succession from Published Mapping

Age	Geological Stratum	BGS Description
Superficial Deposits		
Quaternary	Made Ground	An area where the pre-existing (natural or artificial) land surface is raised by artificial deposits.
Quaternary	Alluvium	Normally soft to firm consolidated, compressible silty clay, but can contain layers of silt, sand, peat and basal gravel.
Quaternary	River Terrace Deposits	Sand and gravel, locally with lenses of silt, clay or peat (generic description).
Bedrock Geology		
Cretaceous	White Chalk	Chalk with flints. With discrete marl seams, nodular chalk, sponge-rich and flint seams throughout.

Source: Geological Map BGS Sheet 271, Dartford, 1998. BGS GeoIndex Onshore online geological mapping (accessed August 2023).

- 3.2.4 The ground investigation (Ref 26) completed in July 2023 at the Site confirmed the geology shown in the BGS mapping, including the presence of River Terrace Deposits beneath the Alluvium (refer to Section 5.3).
- 3.2.5 The BGS maintains an archive of historical exploratory borehole records. AECOM has searched the database and those which are considered to provide useful information on the ground profile at the Site are highlighted as part of the extract shown in Plate 3-1 below. Copies of these exploratory hole records are included as Appendix D and relevant information from the records is considered as part

of the Preliminary Ground Model in Section 8. Note that records of some of the boreholes shown in Plate 3-1 were not available.



Contains British Geological Survey materials © UKRI [2023]

Plate 3-1: Extract from BGS GeoIndex Online Viewer showing the relevant historical exploratory boreholes (the Site Boundary shown is approximate)

Soils and Soil Chemistry

- 3.2.6 Online Agricultural Land Classification (ALC) mapping from Natural England (Ref 12) indicates that the Site is located in areas of Grade 4. Agricultural land is classified into five grades; where Grade 1 is the best quality and Grade 5 is the poorest quality. Grade 3 is further sub-divided into Subgrade 3a and Subgrade 3b, with Grades 1 to 3a considered best and most versatile (BMV) agricultural land and Grades 3b to 5 considered not BMV agricultural land.

- 3.2.7 Information obtained from Soilscape describes the soils at the Site (Soilscape 21) as loamy and clayey soils of coastal flats with naturally high groundwater.
- 3.2.8 The BGS Soil Chemistry datasets provide indicative information on regional concentrations of five potentially harmful elements (PHEs): arsenic, cadmium, chromium, nickel and lead in soil, as presented within the Envirocheck Report. Elevated concentrations of these PHEs can exist because of natural geological conditions or possible anthropogenic contamination. The following BGS estimated soil chemistry levels are attributed to the vicinity of the Site based on the geometric mean concentrations of available data (presented in Table 3-2).

Table 3-2: Estimated Soil Chemistry

Potentially Harmful Element	Estimated geometric mean concentration (mg/kg)
Arsenic	15 - 25
Cadmium	<1.8
Chromium	60 – 90
Lead	100 – 200
Nickel	15 - 30

Source: Envirocheck Report.

Ground Stability Records

- 3.2.9 Table 3-3 shows the variable risk of ground stability hazards across the Site, taken from the Envirocheck Report:

Table 3-3: Ground Stability Records

Hazard Type	Hazard Potential
Collapsible Ground Stability	No hazard
Compressible Ground Stability	High
Ground Dissolution Stability	No hazard
Landslide Ground Stability	Very low
Running Sand Ground Stability	Low
Shrinking or Swelling Clay Ground Stability	Low

Source: Envirocheck Report.

Mining and Mineral Extraction

Aggregate/Mineral Quarrying and Mining

- 3.2.10 The Envirocheck Report indicates that a BGS recorded mineral site (Clubb's Marine Terminal site) is located approximately 230m west of the Site. This site is classified as an active quarry for crushed rock and marine sand and gravel, operated by J Clubb Ltd.

Coal Mining

- 3.2.11 There is no history of coal mining at the Site or in the surrounding area recorded in the Envirocheck Report.

Radon

- 3.2.12 The Public Health England (PHE) interactive map for radon (UKRadon.org) (Ref 16) indicates the majority of the Site is located within the lower probability radon area where less than 1% of homes

are estimated to be at or above the Action Level. The southern extent of the Site is within an intermediate probability radon area (1% to 3% of homes are estimated to be at or above the Action Level).

3.3 Hydrogeology

Aquifer Classification

- 3.3.1 The Environment Agency's Groundwater Protection Policy adopts aquifer designations that are consistent with the Water Framework Directive. Definitions of the various aquifer types can be found on the Environment Agency section of the gov.uk website (Ref 15). According to this system, the superficial deposits underlying the Site are classified as a Secondary (undifferentiated) aquifer (Alluvium) and Secondary A aquifer (River Terrace Deposits). The solid geology of the White Chalk is classified as a Principal aquifer.

Groundwater Vulnerability

- 3.3.2 The Environment Agency's Groundwater Vulnerability Map in DEFRA's MAGIC map (Ref 12) shows that the Site is located in an area where the groundwater vulnerability to pollution is medium - high. Soluble rock risk is also indicated at the Site. All associated terminology/definitions can be found on the Environment Agency section of the gov.uk website (Ref 15).

Source Protection Zones

- 3.3.3 In terms of identifying the risk of contamination from potentially polluting activities in a given area to groundwater sources (wells, boreholes and springs) used for supplying public drinking water, the Environment Agency identifies Source Protection Zones (SPZ). These show the extent of a groundwater source catchment and are divided into three zones, which can be found on the Environment Agency section of the gov.uk website.
- 3.3.4 The Site does not lie within an SPZ (Ref 12).
- 3.3.5 The Site does not lie within a Drinking Water Safeguard Zones for groundwater (Ref 12).

Licensed Groundwater Abstractions

- 3.3.6 Two licensed groundwater abstractions have been identified within 1km of the Site, approximately 250m west of the Site and 570m south-west of the Site. The abstractions are listed in Table 3-4 and are assumed to be active unless otherwise stated.

Table 3-4: Licensed Groundwater Abstractions

National Grid Reference	Distance & Direction/ Location	Operator	Use
566960 E 174120 N (multiple records)	250m west	J Clubb Ltd	Mineral Products: Mineral Washing
566670 E 174000 N	570m south-west	Southern Water Services Ltd	Other industrial/commercial/public services: general washing/process washing

Source: Envirocheck Report.

Risk of Flooding from Groundwater

- 3.3.7 The Envirocheck Report indicates that the Site is characterised by limited potential for groundwater flooding. There is the potential for groundwater flooding to occur at property situated below ground level, directly south and north of the Site.

3.4 Hydrology

Surface Water Courses and Drainage

- 3.4.1 The Site is located within one Water Framework Directive-relevant (WFD) waterbody; North Kent Medway Chalk Water Body (Ref 17). The latest available water quality classification (2019) shows this waterbody to be classified as having a Poor overall status (Ref 17). Reasons for not achieving Good status are poor soil management, poor nutrient management, transport drainage, contaminated land, poor pesticide management, poor livestock management and leaking utility sewers.
- 3.4.2 Several surface water land drains are shown on-site and in the surrounding area. The River Thames lies 100m north of the Site.

Licensed Surface Water Abstractions

- 3.4.3 One surface water abstraction has been identified on-site; and a further two surface water abstractions have been identified between 250m and 1km of the Site. These are listed in Table 3-5. All are assumed to be active unless otherwise stated.

Table 3-5: Licensed Surface Water Abstractions (On or Within 1km of Site)

National Grid Reference	Distance & Direction/ Location	Operator	Use
567468 E 174076 N	On-site	Gravesham Borough Council	Environmental: remedial river/wetland support: general use (very low loss)
568022 E 174370 N (multiple records)	380m to 430m east	The Royal Society for The Protection of Birds / Mr CJ Glover	Environmental: remedial river/wetland support: make-up or top up water
568194 E 173902 N (multiple records)	500m east	The Royal Society for The Protection of Birds	Environmental: remedial river/wetland support: make-up or top up water

Source: Envirocheck Report.

Risk of Flooding from Surface Water

- 3.4.4 The indicative floodplain map (Ref 18) for the area, published by the Environment Agency, shows that the risk of surface water flooding at the Site is generally very low (annual chance of flooding below 0.1%). Patches of low risk (annual chance of flooding of between 0.1% and 1%) and medium risk (chance of flooding of between 1% and 3.3%) are indicated along the drains on the Site.

Risk of Flooding from Rivers and Sea

- 3.4.5 The indicative floodplain map for the area (Ref 38), published by the Environment Agency, shows that the Site lies within a Flood Zone 3. Flood plains refer to the probability of river and sea flooding (Flood Zone 3 has a 1% probability of flooding from rivers which is defined as a high probability), ignoring the presence of defences.
- 3.4.6 The Site is shown to benefit from flood defences associated with the river wall defences along the south bank of the River Thames. Flood defences reduce but do not completely stop the chance of flooding because they can be topped or fail. Flood defences may also provide reduced protection

over time because of climate change increasing flood risk in the future. The Site is therefore considered to be susceptible to fluvial flooding.

4. Historical & Planned Development

4.1 Historical Ordnance Survey Mapping & Aerial Photographs

- 4.1.1 Historical Ordnance Survey (OS) maps of the Site and the wider environs provided in the Envirocheck Report (scales 1:2,500, 1:10,560 and 1:10,000) and historical aerial photos from Google Earth Pro are reviewed in this section. Selected Envirocheck historical maps are presented as Appendix B.
- 4.1.2 The historical maps obtained with the Envirocheck Report date between mid-1860s and 2021.
- 4.1.3 Table 4-1 presents a summary of the main features present on and within approximately 250m radius of the Site boundary. AECOM notes that only indicative map scales are provided. Where dates are stated, these refer to the dates of maps on which the features are present, have changed use or are no longer annotated, and do not necessarily refer to the exact dates of existence of a particular feature. Development that may have occurred between map editions is recorded as occurring on the latter published map, hence there are some limitations to the accuracy of the date of development unless supplementary evidence is available.

Table 4-1: Summary of Historical Mapping

Date/s	Key Features on-site	Key Features off site
pre-1890	A rifle range extends across the eastern part of the Site, with a series of low earth mound firing points. Firing was orientated from west to east. A shelter shed is indicated in the central part of the Site. Drains are shown across the Site. Marshland is indicated along the western site boundary.	The rifle range extends to the east of the Site. A wharf is located adjacent south of the Site. Railways are indicated approximately 10m south of the Site. A small pond and a sheep fold are shown adjacent north-east of the Site.
1890-1900	The Site is entirely occupied by Milton Rifle Range.	The sheep fold is no longer indicated. A clay pit is indicated approximately 60m east of the Site. Port of London Sanitary Hospital is located 400m west of the Site.
1900-1910	A pond (rectangular in shape) is located in the western part of the Site.	No significant change since previous mapping.
1910-1920	No significant change since previous mapping.	No significant change since previous mapping.
1920-1930	A 'miniature rifle range' is located at the Site.	No significant change since previous mapping.
1930-1940	No significant change since previous mapping.	Marshland is indicated 250m west of the Site. Sewage works are shown extending from 400m south-west of the Site.
1940-1950	No significant change since previous mapping.	No significant change since previous mapping.

Date/s	Key Features on-site	Key Features off site
1950-1960	No significant change since previous mapping.	No significant change since previous mapping.
1960-1970	The shelter shed and 'miniature rifle range' are no longer indicated on-site. An electricity pylon linked to the Eastcourt Marshes Electricity Substation (off-site) is located in the south-eastern part of the Site. The stream along the western boundary of the Site is indicated as partially infilled and reduced to a drain. A few small ponds are located on-site.	The Eastcourt Marshes Electricity Substation is shown adjacent north-west of the Site. The wharf is no longer shown on the map. A few buildings are indicated adjacent south-west of the Site.
1970-1980	No significant change since previous mapping.	The buildings located adjacent south-west of the Site are indicated as a school (the current National Sea Training College).
1980-1990	The layout of the drainage on-site has changed.	Unspecified factory or works are indicated 160m west of the Site.
1990-2000	No significant change since previous mapping.	No significant change since previous mapping.
2000-2010	No significant change since previous mapping.	Works are indicated 250m west of the Site.
2010-2021	No significant change since previous mapping.	A factory is indicated 250m west of the Site.

Additional Historical Records

- 4.1.4 An Unexploded Ordnance (UXO) Desk Study & Risk Assessment (Ref 23) obtained for the Lower Thames Crossing, which includes the Site area is publicly available from the Infrastructure Planning Inspectorate website (Ref 23). This report includes historical records of the Site as reported as follows.

"Milton Range was used extensively for training during both WWI and WWII. Records have been found indicating that mortar training was undertaken on the range during WWII, and it is considered possible that other close combat munitions, such as grenades, were used during training exercises by both regular troops and the Home Guard.

Records have been found indicating that a 'gas compound' was also located at Milton Range. For a short period during WWII, this contained a small store of Mustard Gas, and was used to train troops in decontamination procedures. War diaries indicate that this compound was regularly inspected and vented before being removed."

and

"Milton Range continued to be used as a military firing range until 1995. It currently operates as the practice firing area for the Metropolitan Police Specialist Training Centre".

4.2 Planning Authority Records

- 4.2.1 A search of planning application records for the Site and within 250m of the Site using the search facility on the website of GBC (Ref 19) has been undertaken. Table 4-2 summarises the most relevant applications (where potential impact to ground may have occurred) found during the search.

Table 4-2: Planning Authority Record

Decision date	Application Status	Location	Reference	Description
17 Jun 1974	Permitted	Off-site, adjacent west. Metropolitan Police Specialist Training Centre Mark Lane Gravesend Kent DA12 2HN	19740195	Erection of 6 garages.
24 Jul 1996	Permitted	Off-site, adjacent west. Metropolitan Police Specialist Training Centre Mark Lane Gravesend Kent DA12 2HN	19960194	Outline application for the erection of fire training rooms with associated plant and equipment rooms and the laying out of associated access road.
13 Nov 1997	Not available	Off-site, adjacent west. Metropolitan Police Specialist Training Centre Mark Lane Gravesend Kent DA12 2HN	19960086	Circular 18/84 Consultation for the establishment of a Firearms Training Centre involving the use of the College buildings as tactical training rooms, 25m ranges, classrooms, offices, student accommodation and other ancillary facilities; use of 3 no. dwellings as 360 degree live fire training houses; outline consultation for the erection of a tactical training area including an indoor drive-in range with 50m range and control tower at 1st and 2nd floor levels; and provision of additional car and coach parking.
21 Jul 2000	Permitted	Off-site, adjacent west. Metropolitan Police Specialist Training Centre Mark Lane Gravesend Kent DA12 2HN	19990882	Engineering operations involving a new road, new bridge, paths, culverts, rain shelter, new firing points and targets in connection with the continued use of the rifle range as open air firearms training ranges by the Metropolitan Police firearms and public order training facilities proposed at the former National Sea Training College.

Decision date	Application Status	Location	Reference	Description
08 Oct 2007	Granted Temporary Permission	Off-site, adjacent west. Metropolitan Police Specialist Training Centre Mark Lane Gravesend Kent DA12 2HN	20070736	Application for the continued use of the open air firearms training range for shooting up to 22.30 hours weekdays.
16 Apr 2014	Permitted	Off-site, adjacent west. Metropolitan Police Specialist Training Centre Mark Lane Gravesend Kent DA12 2HN	20131028	Erection of a single wind turbine measuring 47.1m to tip with associated infrastructure
11 Feb 2022	Permitted	Off-site, adjacent west. Metropolitan Police Specialist Training Centre Mark Lane Gravesend Kent DA12 2HN	20211541	Erection of a new concrete live fire skills house training building (plus abseil frame) with new ancillary support building and associated works.

4.3 Unexploded Ordnance Risk

- 4.3.1 Zetica Unexploded Ordnance (UXO) risk maps, show the Site is recorded as having a high density of UXO (Ref 22).
- 4.3.2 A Preliminary UXO Threat Assessment indicates that the potential for a UXO hazard to occur, and more specifically, the potential for unexploded World War (WWI) and WWII ordnance to exist at the Site is assessed as being likely; and a detailed UXO Threat Assessment is recommended. The Preliminary UXO Threat Assessment is included as Appendix D.
- 4.3.3 An Unexploded Ordnance (UXO) Desk Study and Risk Assessment (Ref 23) covering a wider area and produced for the Lower Thames Crossing site is also publicly available from the Infrastructure Planning Inspectorate website (Ref 23). The report indicates that potential sources of UXO hazard have been identified on the Site. These comprise hazards from deep-buried Unexploded Bombs (UXB) and shallow-buried UXO from military activity. The Site is indicated as located within a Moderate hazard zone for UXO (refer to Figure 24 of the UXO Desk Study & Risk Assessment). The assessment indicates that the Site *“encompasses Milton Range, which has been in use from the 19th century until the present day. In addition to training with Small Arms Ammunition, records indicate that the range was used for mortar practice during War World II, providing a potentially significant hazard. This part of the Site is assigned a moderate UXO hazard level due to the potential presence of mortars (and other Close Combat Munitions such as hand grenades) at shallow depths”*.
- 4.3.4 The following recommendations are included in the report:
- Non-intrusive UXO surveys are recommended in advance of intrusive works.
 - Where piling or boreholes/cone penetration tests are proposed in an area with a UXB hazard, deep UXB detection is recommended.
 - When the construction design is finalised, it is recommended that a detailed UXO risk mitigation strategy is commissioned.
- 4.3.5 While the UXO Desk Study and Risk Assessment (Ref 23) produced for the Lower Thames Crossing site provides a useful indication, it should be noted that reliance cannot be placed on this report, and as such does not negate the need for site specific survey.

5. Review of Historical Reports

5.1 Geotechnical and Geo-environmental Desk Study

- 5.1.1 A Geotechnical and Geo-environmental Desk Study (Ref 24) was prepared by BakerHicks Limited in March 2023, in order to support the Front-End Engineering Design (FEED) study for the Proposed Development. The report includes geology and ground conditions considerations and site history for the Site and is consistent with the content of this PRA report. Whilst the existing Geotechnical and Geo-environmental Desk Study (Ref 24) provides an indication that potential ground contamination may be present at the Site, it does not include a risk assessment and would not be considered to meet the requirements of LCRM (Ref 5). The report concluded with the recommendation for a full site investigation to confirm the ground conditions and a detailed UXO investigation.

5.2 Conceptual Geotechnical Interpretative Report

- 5.2.1 A Conceptual Geotechnical Interpretative Report (GIR) (Ref 24) was prepared by BakerHicks Limited in January 2023 to accelerate the selection of a tunnelling corridor and shaft locations, tunnelling methodology, shaft methodology, settlement assessment, damage assessment and land easements. The report was based on existing data available for a wider area, from the existing ground investigation associated with the construction of the Lower Thames Crossing and from boreholes from National Grid located in the area of the former Tilbury 'B' Power Station. The report indicates that the findings of the assessment will need to be validated by site specific ground investigations.
- 5.2.2 The report focuses on the geotechnical setting of the Site, but also includes information on site history and geology, which are consistent with this PRA. Table 20. Geotechnical Parameter of the Conceptual GIR includes (inter alia) a preliminary ground model for the Site, showing the presence of Alluvium (up to 13.9m bgl), over River Terrace Deposits (up to 19.7m bgl), with chalk at depth. No record of groundwater levels at the Site was included.

5.3 Ground Investigation Report (Factual Account of Fieldwork, Monitoring and Laboratory testing)

- 5.3.1 Socotec UK Limited was commissioned in December 2022 by BakerHicks Limited to carry out a ground investigation for the Proposed Development's FEED at the sites in Gravesend and Tilbury. The Ground Investigation Report (Ref 26) covers the work undertaken at Gravesend only (i.e. at the Site). The scope of the investigation was specified by BakerHicks Limited and comprised three boreholes (BH4, BH5 and BH6), ten trial pits (machine dug) (TP11 to TP20), five inspection pits (hand dug) (CPT12 to CPT16), field testing, monitoring, laboratory testing (geotechnical and geo-environmental) and reporting. The fieldwork was carried out between January and May 2023.
- 5.3.2 The report is factual and does not provide any interpretation of the soil and groundwater data.
- 5.3.3 Groundwater and ground-gas monitoring visits were undertaken on four occasions between April and May 2023. Data loggers were installed in BH04, BH05 and BH06 to record measurements every 15 mins for 5 weeks. Geo-environmental laboratory testing was undertaken on selected soil and groundwater samples recovered during the fieldwork. The investigation locations are shown in Plate 5-1.
- 5.3.4 The exploratory logs indicate the geology encountered at the Site, which is detailed below. No visual or olfactory evidence of potential ground contamination was reported in the exploratory logs.

Topsoil

- 5.3.5 Topsoil was found across most of the Site and generally consists of sandy clayey silt, with rootlets. Topsoil is generally between 0.1m to 0.5m thick.

Made Ground

- 5.3.6 Made Ground was found across most of the Site and generally consists of mixed layers of sand, gravel, and clay containing anthropogenic material. Where present, Made Ground is generally between 0.5m to 2.7m thick.

Alluvium

- 5.3.7 The Alluvium encountered was a soft to firm silt and clay with layers of amorphous and fibrous peat. The Alluvium thickness ranges from 11.4m (BH06) to 15.0m (BH04).

River Terrace Deposits

- 5.3.8 The River Terrace Deposits comprise of sandy flint gravel. The River Terrace Deposits are 2.70m (BH04) to 6m (BH05) thick.

Chalk

- 5.3.9 Chalk was recovered as weak to very weak white chalk with nodular flints and occasional fossils and fossil fragments. The top of the Chalk was encountered between 19.20m bgl (BH06) and 20.20m bgl (BH05). The thickness of the Chalk was not proven.

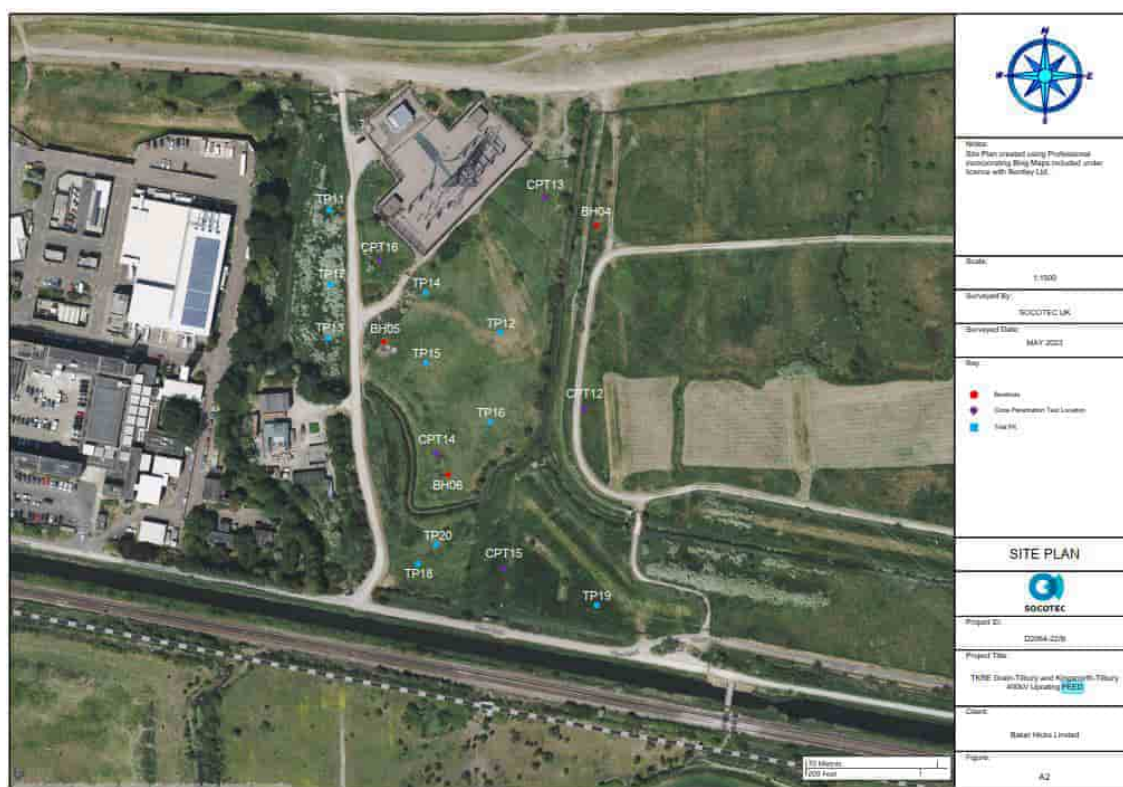


Plate 5-1: Site Investigation Locations (source: Socotec UK, Ground Investigation Report (Factual Account of Fieldwork, Monitoring and Laboratory testing))

Groundwater

- 5.3.10 The Site has a complex groundwater regime with strong tidal influences from the River Thames. Groundwater monitoring was undertaken at the Site between April and May 2023 (refer to Appendix D of the Ground Investigation Report (Ref 26)). The groundwater level in the Alluvium was reported as between 1.05m and 1.30m bgl (BH06; shallow installation). The water level in the River Terrace Deposits was reported as between 0.81m and 2.07m bgl (BH05 and BH04; shallow installation). The

water level in the Chalk was reported as between 1.09m and 2.18m bgl (BH04, BH05 and BH06; deep installations).

6. Regulated Activities and Statutory Consultation

6.1 Introduction

- 6.1.1 The key relevant features that characterise the Site and surrounding area are summarised in this section, along with an indication of the risk to the land quality of the Site.
- 6.1.2 Information on groundwater and surface water abstractions is detailed in Section 0 and 0 and is not repeated here.
- 6.1.3 Generally, any regulated activities within 250m of the Site could, depending upon their nature, represent potential off-site sources of contamination. Whilst a 1km search area was generally adopted this section places emphasis on those activities present within 250m.

6.2 Regulated Processes

- 6.2.1 Table 6-1 summarises information on regulated processes contained in the Envirocheck Report (Appendix B). The report collates data from a variety of sources including the Environment Agency and the BGS. All data suppliers are referenced in the report.
- 6.2.2 There were no instances of the following data identified within the information sources reviewed:
- Contaminated Land Register Entries and Notices;
 - Prosecutions Relating to Controlled Waters;
 - Enforcement and Prohibition Notices;
 - Integrated Pollution Controls;
 - Local Authority Integrated Pollution Prevention and Control;
 - Local Authority Pollution Prevention and Control Enforcements;
 - Prosecutions Relating to Authorised Processes;
 - Registered Radioactive Substances;
 - Control of Major Accident Hazards Sites (COMAH);
 - Explosive Sites;
 - Notification of Installations Handling Hazardous Substances (NIHHS);
 - Planning Hazardous Substance Consents; and
 - Planning Hazardous Substance Enforcements.

Table 6-1: Summary of Regulatory Information

Subject	Number present				Details
	On site	0-250m	250-500m	500-1000m	
Agency & Hydrological					
Discharge Consents	1	2	1	2	One record is listed on-site, operated by Mr P Bell, at the firefighting training centre, east Kent College. It

Subject	Number present				Details
	On site	0-250m	250-500m	500-1000m	
					relates to trade effluent discharge / site drainage into a stream. Two records are listed within 250m of the Site, and detailed as follows. One discharge consent is listed approximately 140m west of the Site. It belongs to National Grid and relates to surface water discharge into a stream/river. The consent is indicated as revoked. One active discharge consent is listed approximately 200m west of the Site. It belongs to Services Support (Gravesend) Limited and relates to trade effluent discharges/site drainage discharges into a stream/river.
Integrated Pollution Prevention and Controls (IPPC)	-	-	-	1	One (effective) record is listed 650m south-west of the Site, associated with Gravesend Wastewater Treatment Works.
Local Authority Pollution Prevention and Controls	-	-	1	2	Three records, listed as authorised or permitted, are indicated 490m west of the Site ('blending, packing, loading and use of bulk cement'), 650m west of the Site ('mineral drying and roadstone coating processes') and 930m west of the Site ('respraying of road vehicles').
Pollution Incidents to Controlled Waters	-		1	6	One record is listed approximately 450m west the Site and relates to a sewage discharge that occurred in April 1990. The incident is Category 3 (Minor Incident). One record is listed approximately 550m west the Site and relates to a general pollutant January 1999. The incident is Category 3 (Minor Incident).
Substantiated Pollution Incident Register	-	-	-	2	One record is listed approximately 790m west the Site and relates to a crude sewage discharge in May 2004. The incident is Category 2 (Significant Incident) for water impact. One record is listed approximately 910m west the Site and relates to waste materials discharged in February 2004. The incident is Category 2 (Significant Incident) for land impact.
Explosive Sites	-	-	-	1	One record, identified as Denton Wharf Ltd and listed as not active, is located 560m west.

Source: Envirocheck Report

6.3 Licensed Waste Management Facilities

- 6.3.1 An attempt has been made to identify any landfilling operations, past and present that have taken place in the vicinity (within 1km) of the Site. Table 6-2 summarises information on landfills and licensed waste management facilities contained in the Envirocheck Report (Appendix B).

- 6.3.2 There are no licenced waste management facilities within 250m of the Site. One historical landfill is listed approximately 500m south-west of the Site. It is indicated that this operation received inert and household waste. The operation dates are not provided. Three further historical landfills are listed within 1km of the Site.
- 6.3.3 Records for two licenced waste management sites and one registered waste treatment site are indicated within 1km of the Site.

Table 6-2: Licensed Waste Management Facilities (<1km of Site)

National Grid Reference	Approx. Distance and Direction	Name	Operator or license holder	Dates	Permitted Wastes	Details
566807 173874	500m south-west	Shamrock Road	Gravesham Borough Council	First input: Not supplied. Last input: Not supplied.	Inert and household waste	Historical landfill
566426 173999	800m west	Denton-Comma Oil	J Clubb Limited	First input: Not supplied. Last input: Not supplied.	Inert waste	Historical landfill
566382 174303	950m west	Norfolk Road	Not supplied.	First input: Not supplied. Last input: Not supplied.	Inert and commercial waste	Historical landfill
566381 174170	950m west	Gas Works - Canal	Not supplied.	First input: Not supplied. Last input: Not supplied.	Inert and commercial waste	Historical landfill
566350 174200	1km west	Not applicable	G M R (Kent) Limited	Issued: 18 December 1996 Revoked: 1 April 2022	Not applicable	Licensed waste management facility – metal recycling site (mixed). Revoked.
566300 174200	1km west	Not applicable	Gurbinder Sall	Issued: 25 April 1997 Last modified: 12 December 2003	Not applicable	Licensed waste management facility – household, commercial and industrial transfer station. Revoked.

National Grid Reference	Approx. Distance and Direction	Name	Operator or license holder	Dates	Permitted Wastes	Details
566350 174195	950m west	Not applicable	Gravesend metals & recycling ltd	Issued: 18 December 1996	Scrap metal, lead/acid batteries	Registered Waste Treatment or Disposal Sites - scrapyard. Operational.

Source: Envirocheck Report

- 6.3.4 In addition, with reference to the historical mapping and data there is clear indication that infilling has taken place on the Site and therefore the presence of Made Ground should be considered.

6.4 Industrial Land Use

- 6.4.1 There are no contemporary trade directory entries within 250m from the Site. There are some points of interest within 250m from the Site. Table 6-3 summarises those that may have the potential to have caused contamination within a search radius of 250m of the Site.

Table 6-3: Potentially Contaminative Industrial Land Use on and Within 250 m of the Site

Subject	Location Details, including approximate distance	
Points of Interest	On Site	Outfall / sluice / weir.
	Off-Site	Works: 320m west of the Site. Tanks: 150m west of the Site
Underground Electrical cables	On-Site	Commissioned underground electrical cables (alternating current)

6.5 Sensitive Land Uses

- 6.5.1 The Site is located within the North Kent Marshes (decommissioned), which is indicated as an Environmentally Sensitive Area (Ref 8). The eastern part of the Site is a RSPB reserve (Shorne Marshes) (Ref 12). The South Thames Estuary and Marshes Site of Special Scientific Interest (SSSI) and the Thames Estuary and Marshes (Ramsar) extend from approximately 10m south of the Site, beyond the Thames and Medway Canal. The Site lies within a Nitrate Vulnerable Zone (Ref 8 and Ref 12).

7. Site Reconnaissance

- 7.1.1 An external inspection of the Site was completed by a qualified and experienced AECOM Consultant on 11th September 2023. The aim of the visit was to identify the range of activities carried out on the Site and obvious potential sources of ground contamination.
- 7.1.2 The observations made are summarised as follows and a photographic record of the visit is included as Appendix E.
- 7.1.3 The Site is located within a vegetated area, characterised by rough grassland and bushes (Photo No. 1). The eastern part of the Site and the land immediately east is leased and used as a Police Training Centre for rifle shooting (Photo No. 2). This area is surrounded by a wire fence.
- 7.1.4 The Eastcourt Marshes Electricity Substation borders the Site to the north-west (Photo No. 3).
- 7.1.5 The Thameside Campus (National Maritime Training Centre) and the Metropolitan Police Specialist Training Centre adjoin the Site to the west.
- 7.1.6 The River Thames runs approximately 100m north of the Site. Thames and Medway Canal adjoins the Site to the south (Photo No. 4). A few surface drains are located on the Site (Photo no. 5). No visual indication of contamination was observed in the surface water.
- 7.1.7 The eastern part of the Site was fenced with horses grazing (Photo No. 6).
- 7.1.8 No visual indication of ground contamination was observed at the Site during the site reconnaissance.

8. Preliminary Ground Model

8.1 Stratigraphy and Groundwater

- 8.1.1 Based on the review of published geological and hydrogeological information and the borehole records from the recent ground investigation (Ref 26), the ground conditions within the Site are considered to comprise the sequence presented in Table 8-1.

Table 8-1: Preliminary Ground Model

Strata	Typical Description ¹	Thickness Range (m) ¹	Groundwater (m bgl) ²
Topsoil	sandy clayey silt, with rootles	0.1 to 0.5	-
Made Ground	Mixed layers of sand, gravel and clay with anthropogenic materials	0.5 to 2.7	-
Alluvium	Soft to firm silt and clay with layers of amorphous and fibrous peat	11.4 to 15.0	1.05 and 1.30m
River Terrace Deposits	Sandy flint gravel	2.7 to 6.0	0.81 and 2.07m
Chalk	Weak to very weak white chalk with nodular flints and occasional fossils and fossil fragments	>52.8	1.09 and 2.18m

¹Descriptions and thicknesses based on the Ground Investigation Report (Ref 26)
²Levels based on the Ground Investigation Report (Ref 26)

8.2 Gas Risk Assessment (based on RB17)

- 8.2.1 The CLAIRE Research Bulletin RB17 A Pragmatic Approach to Ground Gas Risk Assessment 2012 (Ref 28), describes a method of estimating the potential gas risk of a site based on the site geology and historical use. Table 8-2 presents the considerations included in the RB17 methodology together with the likely status for the Site, based upon the data collected and reviewed in the above sections of this report.

Table 8-2: Consideration of Potential Gas Risk

Considerations from RB17	Applicable information for the Site
If there is a credible source underlying or in the close vicinity of the site.	Yes. Potentially infilled land has been identified at the Site. Natural peat deposits have been identified in the Alluvium.
If the site been registered as a landfill (not including general Made Ground) or whether there are mine openings nearby.	No landfill or mine entries. Infilled land may be present at the Site.
If the maximum Made Ground depth is greater than 5m or there is an average depth greater than 3m.	No. The presence of Made Ground at the Site has been confirmed; and is characterised

Considerations from RB17	Applicable information for the Site
	by a maximum thickness of 2.7m (BH05); and average thickness less than 3m.
If the Total Organic Carbon (TOC) in Made Ground exceeds 4% or 6% where the Made Ground is greater than 20 years old.	Unknown.
Whether radon protective measures are required.	No radon protective measures are necessary.
If an off-site source is present, is there a credible pathway to the development site based on the distance, the specific ground conditions and topography, or whether there are potential effects such as rising ground water which would have the potential to force large volumes of gas from the ground in a short period.	Legacy of various industrial land uses has been identified surrounding the Site.

- 8.2.2 Based on this preliminary gas risk assessment, ground gas monitoring may be a requirement for the Site.

9. Initial Conceptual Site Model

9.1 Introduction

- 9.1.1 This section is aimed at identifying possible risks, if any, arising from substances used or deposited on-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 comprising a new headhouse and SEC, as identified in Section 1.2.

9.2 Assessment Framework

- 9.2.1 The Site, in terms of potential land contamination, will be regulated by the Local Authority (GBC) (Ref 1), taking account of the National Planning Policy Framework 2023 (Ref 2), with the Environment Agency, Natural England and Historic England acting as potential statutory consultees.
- 9.2.2 Environmental liabilities can arise through provisions contained within statutory legislation including Part 2A of the Environmental Protection Act 1990 (Ref 3), the Environmental Damage (Prevention and Remediation) (England) (Amendment) Regulations 2019 (Ref 30), the Water Resources Act 1991 (Ref 31), the Environmental Permitting (England and Wales) Regulations 2016 and the Water Act 2003 (Ref 33).
- 9.2.3 Current industry good practice recommends that the determination of health hazards due to contaminated land is based on the principle of risk assessment, as outlined in the Statutory Guidance to Part 2A (2012) and Land Contamination Risk Management (LCRM) (Ref 5).
- 9.2.4 The “suitable for use” approach is adopted for the assessment of contaminated land where remedial measures are undertaken where unacceptable risks to human health or the environment are realised taking into account the use (or proposed use) of the land in question and the environmental setting. The proposed end-use for the Site is a new headhouse and SEC.

- 9.2.5 The risk assessment process for environmental contaminants is based on a source-pathway-receptor analysis. These terms can be defined as follows:
- **Source:** hazardous substance that has the potential to cause adverse impacts; and
 - **Pathway:** route whereby a hazardous substance may come into contact with the receptor: examples include ingestion of contaminated soil and leaching of contaminants from soil into watercourses; and
 - **Receptor:** target that may be affected by contamination: examples include human occupants/users of site, water resources (surface waters or groundwater), or structures.
- 9.2.6 For a risk to be present, there must be a relevant/viable contaminant linkage; i.e. a mechanism whereby a source impacts on a sensitive receptor via a pathway.
- 9.2.7 The following sections detail the CSM which has been developed for the Site with a view to assessing the potential risks/liabilities and constraints associated with the Site in its current condition prior to any proposed development. Risks associated with the Proposed Development have also been assessed based on a future land use scenario as a headhouse/SEC, including any potential sources of contamination, potential receptors and potential contaminant pathways identified during this desk-based assessment.

9.3 Sources of Potential Contamination

On Site

- 9.3.1 The potential for ground contamination has been identified on the Site. This includes the areas historically used by the military for 'live firing' training between 1860s and 1990s (Milton Range); and currently operating as the practice firing area for the Metropolitan Police Specialist Training Centre. Concentrations of small arms ammunition are likely to be present across this area; and in large concentrations it may provide a source of metal contamination, particularly lead, antimony and zinc.
- 9.3.2 Areas of infilled land have been identified at the Site, associated with a drain, historically flowing with a northern direction along the western site boundary; and associated with historical ponds located at the Site. All of these may have been filled with a variety of (potentially unlicensed) waste materials. Made ground may be also associated with the low earthen mound firing points, which are part of the firing range.
- 9.3.3 The presence of natural peat deposits in the Alluvium is a potential source of ground gas.
- 9.3.4 Potential contaminants associated with the above sources include metals, semi-metals, asbestos, organic and inorganic compounds. In addition, there is the potential for ground gases such as methane or carbon dioxide, and the potential for leachate generation.
- 9.3.5 Recent investigation (Ref 26) did not indicate evidence (visual/olfactory) of potential contamination in Made Ground. No interpretation of the ground investigation's results was provided at this stage.

Off Site

- 9.3.6 Potential sources of off-site contamination have been identified, including historical and current land uses/activities, such as: a former wharf (adjacent south of the Site), a railway (adjacent south of the Site); an (unspecified) tank (70m west of the Site); and activities Metropolitan Police Specialist Training Centre.
- 9.3.7 Contamination may also derive from the Eastcourt Marshes Electricity Substation (dated 1960s), located adjacent north-west of the Site, which is a possible source of polychlorinated biphenyls (PCBs) (as their use in new plant and equipment has been banned only since 1986).

- 9.3.8 Although potential pathways for contaminant migration to the Site from these potential off-site sources may be to some degree restricted by the low permeability alluvial deposits, which underlie of the Site, most of the above-mentioned land uses/activities remain relevant potential off-site sources. Potential contamination derived from migration of potentially contaminated groundwater from the Metropolitan Police Specialist Training Centre may be excluded, considering the groundwater flow direction towards north.

9.4 Summary of Potential Sources

- 9.4.1 Table 9-1 indicates potential contaminants that may be associated with the Site.

Table 9-1: Potential Sources of Contamination

Source Reference	Location	Potential Sources	Associated Contaminants of Potential Concern (CoPC)
S1	On Site	Made Ground and contamination associated with Milton Range.	Heavy metals and inorganics (including sulphate, nitrate, phosphate, ammoniacal nitrogen, acidic/alkaline pH), total petroleum hydrocarbon (TPH), polyaromatic hydrocarbons (PAH), semi-volatile organic compound (SVOCs), Volatile Organic Compound (VOCs), asbestos and asbestos containing materials (ACMs). Ground gases (such as methane or carbon dioxide) and leachate generation.
S2	Off-site	Potential sources of off-site contamination including current and historical land uses/activities.	Heavy metals and inorganics (including sulphate, nitrate, phosphate, ammoniacal nitrogen, acidic/alkaline pH), TPH, PAH, SVOCs, VOCs, PCBs, asbestos and ACMs. Ground gases (such as methane or carbon dioxide) and leachate generation.

9.5 Potential Receptors

On-Site Receptors

- 9.5.1 The principal human receptors on-site are considered to be current site users, including users of Milton Range and the general public in the area; and future construction and maintenance worker connected to the Proposed Development.
- 9.5.2 The controlled water receptors include groundwater (Secondary Aquifers and Principal Aquifer); and the drains that form part of the North Kent Medway Chalk Water Body.
- 9.5.3 Property receptors include existing and proposed structures and services; and livestock (horses) observed on-site during the site reconnaissance.
- 9.5.4 The North Kent Marshes Environmentally Sensitive Area and the RSPB reserve (Shorne Marshes) are ecological receptors at the Site.

Off-Site Receptors

- 9.5.5 The principal human receptors off-site are considered to be neighbours in commercial properties adjacent to the Site (Thameside Campus (National Maritime Training Centre) and Metropolitan Police Specialist Training Centre); maintenance workers connected to the existing substation; and the general public in the areas adjacent to the Site.

- 9.5.6 The controlled water receptors include the River Thames, located 100m north of the Site; and the Thames and Medway Canal, located 10m south of the Site.
- 9.5.7 Property receptors include commercial buildings.
- 9.5.8 Ecological receptors include the South Thames Estuary and Marshes SSSI and the Thames Estuary and Marshes (Ramsar), which extends from approximately 10m south of the Site.

Summary of Potential Receptors

- 9.5.9 Potential receptors associated with the potential development are shown on Table 9-2.

Table 9-2: Potential Receptors

Receptor Reference	Receptor	Description
R1	Human Health: Acute ¹	Construction and maintenance workers
R2	Human Health	Current Site Users: users of the Milton Range and the general public.
R3	Human Health	Future Site Users: maintenance workers and the general public on the Site
R4	Human Health: Acute ²	Adjacent site users during earthworks (neighbours in commercial properties adjacent to the Site and the general public in the areas adjacent to the Site)
R5	Water Environment: Aquifers	Secondary (undifferentiated) aquifer (superficial deposits of the Alluvium) Secondary A aquifers (superficial deposits of the River Terrace Deposits) Principal Aquifer (bedrock of the White Chalk)
R6	Water Environment: Surface waters	River Thames Drains (part of the North Kent Medway Chalk Water Body)
R7	Buildings and Infrastructure: Concrete	Future proposed infrastructure
R8	Buildings and Infrastructure: Structures	Proposed structures
R9	Buildings and Infrastructure: Services	Potable water supply pipes and other services (on-site and off-site).
R10	Ecosystem	North Kent Marshes Environmentally Sensitive Area and the RSPB reserve (Shorne Marshes) (on-site) South Thames Estuary and Marshes SSSI and the proposed Thames Estuary & Marshes (Ramsar) (off-site)
R11	Property	Livestock (horses) present on-site

9.6 Potential Pathways

On-Site Pathways

- 9.6.1 The human health exposure pathways that are considered viable based on UK guidance (Environment Agency, Contaminated Land Exposure Model “CLEA UK”) (Ref 20) are listed below:
- Direct contact, dermal absorption or ingestion of soil.

¹ Refers to a considerable exposure to contaminated land in a short period of time (for example during construction activities).

- Inhalation of soil particulates derived from soils.
- Migration of hazardous gases/vapours via permeable strata into confined spaces (asphyxiation/ explosion).

9.6.2 Direct contact, dermal absorption or ingestion of soil; and inhalation of soil particulates derived from soils are also relevant pathways for property receptors (i.e., horses).

9.6.3 The evaluation of exposure pathways for controlled waters receptors requires an understanding of geological and hydrogeological pathways beneath the Site. The controlled waters pathways considered viable with respect to the Site are as follows:

- Spillage/loss/run off from surface direct to receiving water.
- Leaching of chemicals and vertical migration via permeable unsaturated strata to shallow groundwater.
- Lateral migration in groundwater and baseflow into surface waters.

9.6.4 The buildings and infrastructure pathways considered viable with respect to the Site are as follows:

- Direct contact of buried concrete with contaminated soils (i.e. hydrocarbons) and aggressive ground conditions (pH and sulphate).
- Migration of hazardous gases/vapours via permeable strata into enclosed spaces and service/utility trenches.

9.6.5 The ecological receptors pathways considered viable with respect to the Site are as follows:

- Direct contact, dermal absorption or ingestion of soil and/ or waters/inhalation of soil particulates derived from soils.
- Uptake via root system.

Summary of Potential Pathways

9.6.6 Potential pathways associated with the Proposed Development are shown in Table 9-3.

Table 9-3: Potential Pathways

Pathway Reference	Receptor	Description
P1	Human Health: People Property: Livestock	Direct Pathway: direct contact, dermal absorption or ingestion of soil.
P2	Human Health: People Property: Livestock	Indirect Pathway: inhalation of soil particulates or vapour derived from soils.
P3	Human Health: People	Indirect Pathway: migration of hazardous gases/vapours via permeable strata into confined spaces (asphyxiation/explosion)
P4	Water Environment: Surface water	Direct Pathway: spillage/loss/run off from surface direct to receiving water
P5	Water Environment: Groundwater	Indirect Pathway: leaching of chemicals and vertical migration via permeable unsaturated strata to groundwater
P6	Buildings and Infrastructure: Concrete	Direct Pathway: direct contact of buried concrete with contaminated soils (i.e., hydrocarbons) and aggressive ground conditions (pH and sulphate).

Pathway Reference	Receptor	Description
P7	Buildings and Infrastructure: Supply pipes	Direct Pathway: direct contact of services and supply pipes with contaminated soils.
P8	Buildings and Infrastructure: Structures	Indirect Pathway: migration of hazardous gases/vapours via permeable strata into enclosed spaces and service/utility trenches
P9	Ecosystems: Flora and Fauna	Indirect Pathway: uptake via root system. Direct contact, dermal absorption or ingestion of soil and/or waters, and/or inhalation of soil particulates derived from soils

10. Geo-environmental Risk Assessment

10.1 Risk Assessment Principles

- 10.1.1 Current industry good 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 guidance on Land Contamination: Risk Management (LCRM) (Ref 5).
- 10.1.2 For a risk to be present, there must be a viable contaminant linkage (at the current site condition and/or during construction and/or when the Proposed Development is complete and operational); i.e. a mechanism whereby a source impacts on a sensitive receptor via a pathway.
- 10.1.3 Assessments of risks associated with each of these contaminant linkages are discussed in the following sections.
- 10.1.4 Using criteria broadly based on those presented in in Section 6.3 of the CIRIA Report “Contaminated Land Risk Assessment: A Guide to Good Practice” (CIRIA Report C552) (Ref 27), the magnitude of the risk associated with potential contamination at the Site has been assessed. To do this an estimate is made of:
- The magnitude of the potential consequence (i.e. severity);
 - The magnitude of probability (i.e. likelihood).
- 10.1.5 The severity of the risk is classified according to the criteria in Table 10-1.

10.2 Risk Assessment Framework

Table 10-1: Description of Severity of Risk

Term	Description
Severe	Highly elevated concentrations likely to result in significant harm to human health. Catastrophic damage to crops, buildings or property (e.g. by explosion). Equivalent to EA Category 1 pollution incident including persistent and/or extensive effects of water quality. Major damage to aquatic or other ecosystems.
Medium	Elevated concentrations which could result in significant harm to human health. Significant damage to crops, buildings or property (e.g. damage to building rendering it unsafe). Equivalent to EA Category 2 pollution incident including significant effect on water quality. Significant damage to aquatic or other ecosystems.
Mild	Exposure to human health unlikely to lead to significant harm.

Term	Description
	Minor damage to crops, buildings or property (e.g. surface spalling to concrete). Equivalent to EA Category 3 pollution incident including minimal or short-lived effect on water quality. Minor or short-lived damage to aquatic or other ecosystems.
Minor	No measurable effect on humans. Repairable effects of damage to buildings, structures and services. Equivalent to insubstantial pollution incident with no observed effect on water quality of ecosystems.

10.2.1 The probability of the risk occurring is classified according to the criteria in Table 10-2.

Table 10-2: 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.

10.2.2 An overall evaluation of the level of risk is gained from a comparison of the severity and probability, as shown in Table 10-3.

Table 10-3: Risk based on Comparison of Likelihood and Severity

		Severity			
Likelihood		SEVERE	MEDIUM	MILD	MINOR
	HIGH	Very High	High	Moderate	Low
	LIKELY	High	Moderate	Moderate/Low	Low
	LOW	Moderate	Moderate/Low	Low	Very Low
	UNLIKELY	Moderate/Low	Low	Very Low	Very Low

10.3 Preliminary Risk Assessment

10.3.1 A CSM illustrating plausible contaminant linkages has been formulated for the Site. The qualitative preliminary risk assessment is provided in the Table 10-4.

10.3.2 The level of risk is determined based on the current condition of the Site (i.e., the effects of mitigation measures are not included).

10.3.3 The preliminary risk assessment undertaken within this section does not consider acute² linkages for construction and maintenance workers. It is anticipated that these acute linkages will be managed by appropriate health and safety measures.

² Refers to a considerable exposure to contaminated land in a short period of time (for example during construction activities).

- 10.3.4 As construction workers are protected under existing health and safety legislation, any potential effects are considered to be temporary and will be avoided, prevented and reduced through the implementation of standard mitigation measures to be incorporated into a Construction Environmental Management Plan (CEMP). Work will be undertaken in accordance with relevant Construction Design Management (CDM) Regulations 2015 (Ref 35).

Table 10-4: Potential Sources, Pathways and Receptors

Source	Pathway	Receptor	Potential Severity	Likelihood of Occurrence	Potential Risk	Justification
S1: Made Ground and contaminant hotspots, with Milton Range, infilled land and electrical substation.	P1: Direct contact, dermal absorption or ingestion of soil.	R2: Current Site Users	Medium	Unlikely	Low	No potential for gross contamination has been identified at the Site; but Made Ground of unknown quality and localised contaminant hotspots may be present. Current users are workers at the Milton Range and general public who might be exposed to soils. The Site includes areas of unpaved ground, and this may persist in the future. A complete source pathway receptors linkage exists.
		R3: Future Site Users	Medium	Unlikely	Low	
		R11: Property: Livestock	Minor	Unlikely	Very low	
<i>Heavy metals and inorganics (including sulphate, nitrate, phosphate, ammoniacal nitrogen, acidic/alkaline pH), TPH, PAH, SVOCs, VOCs, PCBs, asbestos and ACMS.</i>	P2: Inhalation of soil particulates and vapour derived from soils.	R2: Current Site Users	Medium	Unlikely	Low	The current site layout includes areas of unpaved ground, and this may persist in the future. The potential for inhalation of soil particulates exists.
		R3: Future Site Users	Medium	Unlikely	Low	
		R11: Property: Livestock	Minor	Unlikely	Very low	
<i>Ground gases (such as methane or carbon dioxide) and leachate</i>	P3: Migration of hazardous gases/vapours via permeable strata into confined spaces (asphyxiation/explosion)	R3: Future Site Users	Medium	Unlikely	Low	Potential sources of hazardous gas and vapours have been identified at the Site. The Proposed Development includes a tunnel headhouse and an SEC in terms of structures. A complete source pathway receptor linkage exists.
	P4: Spillage/loss/run off from	R6: Surface water: River Thames and drains within the	Mild	Unlikely	Low	Contaminant linkage may be present but the circumstances under which harm would occur even in the long-term is considered unlikely.

Source	Pathway	Receptor	Potential Severity	Likelihood of Occurrence	Potential Risk	Justification
	surface direct to receiving water	North Kent Medway Chalk Water Body				
	P5: Leaching of chemicals and vertical migration via permeable unsaturated strata to groundwater	R5: Aquifers	Medium	Unlikely	Low	A significant amount of time has elapsed since any potential land filling across the Site. Therefore, any impacts due to rapid migration of contaminants would likely already have occurred. Complete pathways may be present but current information suggests the likelihood is low. The risk to groundwater from leaching of contaminants is considered to be low.
	P6: Direct contact of buried concrete with contaminated soils (i.e. hydrocarbons) and aggressive ground conditions (pH and sulphate).	R7: Buildings and Infrastructure: Concrete	Mild	Unlikely	Very low	Future proposed building materials that are laid in contact with the ground may be impacted by contamination, if present, in particular, any concrete foundations if the subsurface has high sulphate levels.
	P7: Direct contact of services with contaminated soils.	R9: Services	Mild	Unlikely	Very low	Potential hydrocarbons in soils may deteriorate services.
	P8: Migration of hazardous gases/vapours via permeable strata into enclosed spaces and	R8: Structures	Mild	Unlikely	Very low	Any proposed enclosed structures (e.g., tunnel headhouse and an SEC) could be impacted by accumulations of hazardous gases and vapours, giving a potential explosion risk.

Source	Pathway	Receptor	Potential Severity	Likelihood of Occurrence	Potential Risk	Justification
	service/utility trenches					
	P9: Uptake via root system and ingestion	R10: Ecological receptors	Minor	Unlikely	Very low	Complete pathway may be present but current information suggests a gross source is unlikely. Contaminant linkage may be present but the circumstances under which harm would occur even in the long-term are considered improbable.
S2: Off-site potential sources of contamination including current and historical land uses/activities. <i>Heavy metals and inorganics (including sulphate, nitrate, phosphate, ammoniacal nitrogen, acidic/alkaline pH), TPH, PAH, SVOCs, VOCs,</i>	P2: Inhalation of soil particulates and vapour derived from soils.	R2: Current Site Users	Mild	Unlikely	Very low	The potential for inhalation of soil particulates from off-site sources exists.
		R3: Future Site Users	Mild	Unlikely	Very low	
		R11: Property: Livestock	Minor	Unlikely	Very low	
	P3: Migration of hazardous gases/vapours via permeable strata into confined spaces (asphyxiation/explosion)	R3: Future Site Users	Medium	Unlikely	Low	Potential sources of hazardous gas and vapours have been identified adjacent to the Site. The Proposed Development includes a tunnel headhouse and an SEC. A complete source pathway receptor linkage exists.
	P5: Leaching of chemicals and vertical migration via permeable	R5: Aquifers	Medium	Unlikely	Low	Potential current and former sources of contamination have been identified adjacent to the Site. The risk to groundwater from leaching of contaminants and migration to the Site is considered to be low.

Source	Pathway	Receptor	Potential Severity	Likelihood of Occurrence	Potential Risk	Justification
<i>PCBs, asbestos and ACMs.</i>	unsaturated strata to groundwater					
<i>Ground gases (such as methane or carbon dioxide) and leachate</i>	P8: Migration of hazardous gases/vapours via permeable strata into enclosed spaces and service/utility trenches	R8: Structures	Mild	Unlikely	Very low	Any proposed enclosed structures (e.g. tunnel headhouse and an SEC) could be impacted by accumulations of hazardous gases and vapours giving a potential explosion risk.

10.4 Environmental Design and Management

10.4.1 Several environmental mitigation measures are expected to be employed as standard to minimise impacts to both human health and controlled waters from the Proposed Development. The mitigation measures are anticipated to be implemented in order to avoid, prevent, reduce or offset the following potential impacts:

- Human exposure through direct contact / inhalation / dermal uptake of contaminants;
- Creation of preferential pathways and mobilisation of contamination;
- Contamination of natural soils, driving of contamination into an aquifer during piling, contamination of groundwater with concrete, paste or grout;
- Pollution and degradation of water quality of any underlying aquifer;
- Infiltration and / or run off into the local drainage / sewerage network – pollution of drainage and sewerage network and any adjacent surface water features;
- Run-off and infiltration of contaminants from material stockpiles;
- Contamination of drainage and sewerage network and / or groundwater; and
- Spread of nuisance dusts and soils to the wider environment and local roads.

10.4.2 It would be expected that a Final CEMP would be developed prior to commencing construction. An Outline CEMP has been prepared as part of the Environmental Statement and is submitted with the planning application, refer to Volume VI Appendix 3.1. Table 10-5 lists the additional mitigation measures which are included in the Outline CEMP. These mitigation measures, defined by IEMA (Ref 37) are considered to be standard measures that form part of the general environmental management of the Proposed Development.

10.4.3 The assessment of potential effects set out in the following sections takes into account that these measures will be implemented.

Table 10-5: Construction Standard or Tertiary Environmental Mitigation Measures

Potential Impact	Mitigation / Enhancement Measure
Potential for risks to human health associated with waste generation, land contamination, airborne contamination and groundwater contamination. The discovery of ground contamination during groundworks. Levelling of the Site including the possible introduction of new fill materials.	Ground investigation works have been undertaken prior to commencing construction. Results would be reviewed by the appointed contractor, including any additional investigation or mitigation measures beyond the impact avoidance measures stated here. Best practice avoidance and mitigation measures proposed include: • All workers would be required to wear Personal Protective Equipment (PPE) such as dust masks as applicable; • Containment measures would be implemented, including drip trays, bunding or double-skinned tanks of fuels and oils; all chemicals would be stored in accordance with their COSHH guidelines, whilst spill kits would be provided in areas of fuel/oil storage; • All plant and machinery would be kept away from surface water bodies wherever possible, checked regularly and, where necessary, the use of drip trays would be employed. Refuelling and delivery areas would be located away from surface water drains;

Potential Impact	Mitigation / Enhancement Measure
	• An emergency spillage action plan will be produced, which staff would have read and understood, and provisions made to contain any leak/spill; • Should any potentially contaminated ground, including isolated 'hotspots' of contamination and/or potential deposits of asbestos containing materials (ACM), be encountered, the contractor would be required to investigate the areas and assess the need for containment or disposal of the material. The contractor would also be required to assess whether any additional health and safety measures are required; • To further minimise the risks of contaminants being transferred and contaminating other soils or water, construction workers would be briefed as to the possibility of the presence of such materials; • In the event that contamination is identified, appropriate remediation measures would be taken to protect construction workers, future site users, water resources, structures and services; • The contractor would be required to place arisings and temporary stockpiles away from watercourses and drainage systems, whilst surface water would be directed away from stockpiles to prevent erosion; • The risk to surface water and groundwater from run-off from any contaminated stockpiles during construction works would be reduced by implementing suitable measures to minimise rainwater infiltration and/or capture runoff and leachates, through use of bunding and/or temporary drainage systems. These mitigation measures would be designed in line with current good practice, follow appropriate guidelines and all relevant licences/permits; • The contractor would ensure that all material is suitable for its proposed use and would not result in an increase in contamination-related risks on identified receptors, including any landscaped areas and underlying groundwater; • Any waters removed from excavations by dewatering would be discharged appropriately, subject to the relevant permits being obtained from the Environment Agency; • The contractor will implement a dust suppression/management system in order to control the potential risk from airborne contamination migrating off-site to adjacent sites; and • Piling design and construction works will be completed following the preparation of a piling risk assessment.

10.5 Discussion of Acute Risk to Future Construction Workers & Off-Site Receptors.

- 10.5.1 The proposed works will be undertaken in compliance with Construction Design and Management (CDM) 2015 Regulations (Ref 35).
- 10.5.2 Prior to work commencing, a health and safety risk assessment should be undertaken by the appointed Principal Contractor and developed in accordance with current health and safety regulations. This assessment should cover potential risks to construction staff, permanent site staff and the local population. Based on the findings of this risk assessment, appropriate mitigation measures should be implemented during the construction period. These mitigation measures, defined by IEMA (Ref 37) are considered to be standard measures that form part of the general environmental management of the Proposed Development, and are integrated within the Outline CEMP (refer to Table 10-5).
- 10.5.3 The greatest potential for generation of dust will be during the construction phase. Dust generation should be kept to a minimum in accordance with general industry good practice, as outlined in, for example, 'Environmental Good Practice on Site Guide', CIRIA Publication C741 (Ref 27) (refer to Table 10-5).
- 10.5.4 The risk to construction workers during the site preparation and construction phases in terms of potential exposure to high concentrations of contaminants is considered to be low given the historic and current land uses identified at the Site. Should gross contamination be identified during the construction phase, then this may pose a potential acute risk to construction works. It is likely that the risks to construction workers can be effectively managed through good health and safety practices and protocols. Adoption of appropriate dust suppression techniques would also mitigate the degree of potential particulate migration off-site; these will be included within the CEMP for the Proposed Development.

11. Conclusions and Recommendations

- 11.1.1 The preliminary risk assessment has identified a low risk to human health for current and future site users, due to the limited potential for a range of non-volatile and volatile contaminants to be present in Made Ground, unsaturated soils and groundwater based on the Site's historical use and ongoing use as firing area, and the presence of infilled land. The presence of ground gas is a possibility given that potentially infilled land has been identified at the Site.
- 11.1.2 Based on the present and historical land-use of the Site, there is a potential for groundwater to have been impacted through leaching of contaminants from the Made Ground. The hydrogeology of the Site consists of Secondary aquifers overlying a Principal aquifer. The presence of the low permeability deposits of the Alluvium may limit the vertical migration of potentially contaminated groundwater from the surface, a complete source-pathway-receptor linkage for the Principal aquifer cannot be excluded. A potential linkage may also be created by piling and shaft sinking during construction, if mitigation such as safe drilling techniques are not put in place. The insertion of piles into the ground may create preferential pathways for contamination to migrate towards deeper strata. A Piling Risk Assessment should be carried out to determine if piling is a viable solution at this Site.
- 11.1.3 A number of environmental design and management measures will be employed as standard best practice to minimise impacts to both human health and controlled waters during the construction of the SEC and headhouse. A detailed CEMP will be prepared in advance of the construction phase, largely based on the Outline CEMP (provided as in the Environmental Statement, Volume VI Appendix 3.1).
- 11.1.4 The information collected as part of this PRA suggests that there are not likely to be significant constraints with regards to soil and groundwater contamination that would preclude the advancement of the Proposed Development.
- 11.1.5 Prior to construction it may be necessary to test shallow soils around the firing range and any accumulations of spent munitions should be collected and segregated for disposal. Shallow soils may be impacted by metal contamination or residue from munitions.
- 11.1.6 The investigation recently undertaken (Ref 26) will allow a generic quantitative assessment (equivalent to Stage 1, Tier 2 under LCRM) as to whether any of the potential risks identified are present and are of material concern to the Proposed Development. Subject to the findings of the generic quantitative risk assessment, a site-specific Remediation Strategy (and subsequent verification reporting) may be required if contamination is encountered or considered to pose an unacceptable risk.

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Appendix A : Figure 1



AECOM

PROJECT
TKRE National Grid

CLIENT
National Grid

CONSULTANT
AECOM Limited
3rd Floor Portwall Place,
Portwall Lane,
Bristol, BS1 6NA
www.aecom.com

LEGEND
 Site Boundary
 Site Walkover Photograph Location &
Direction of Photograph Shown by
Arrow

NOTES
Basemap source: © 2023 Microsoft
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Distribution Airbus DS

ISSUE PURPOSE
FINAL

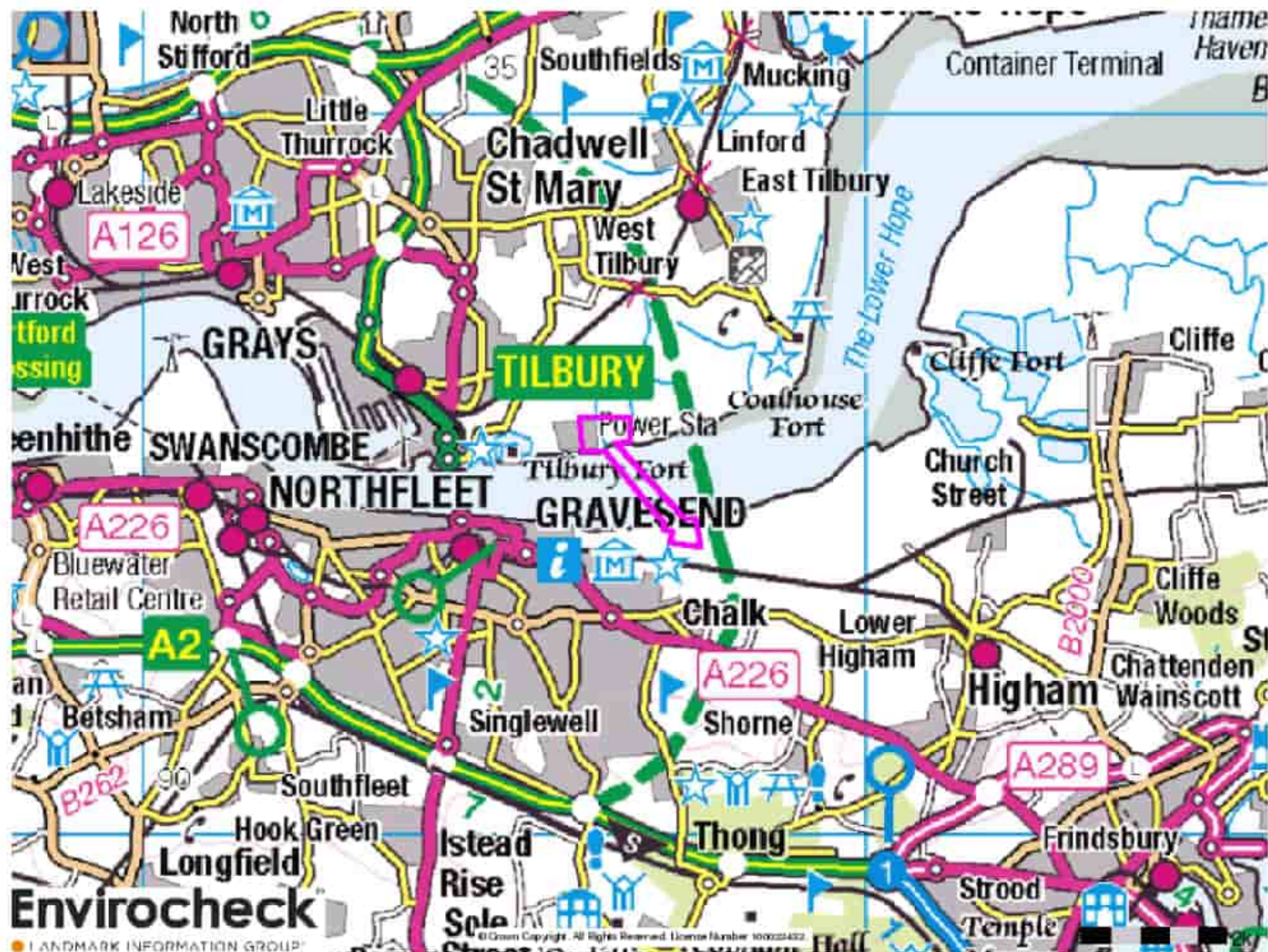
PROJECT NUMBER
60677311

FIGURE TITLE
Site Plan and Photo Locations
Gravesend

FIGURE NUMBER
Figure 1

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Appendix B : Envirocheck Report Extracts







Geology 1:10,000 Maps Legends

Artificial Ground and Landslip

Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	MGR	Made Ground (Undivided)	Artificial Deposit	Holocene - Holocene
	WGR	Worked Ground (Undivided)	Void	Holocene - Holocene
	WMGR	Infilled Ground	Artificial Deposit	Holocene - Holocene
	MGR	Made Ground (Undivided)	Unknown/Unclassified Entry	Holocene - Holocene

Superficial Geology

Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	TRD	Tidal River Or Creek Deposits	Silt	Flandrian - Pleistocene
	ALV	Alluvium	Silt	Flandrian - Pleistocene
	TPGR	Taplow Gravel Formation	Sand and Gravel	Wolstonian - Chokierian
	LHGR	Lynch Hill Gravel Member	Sand and Gravel	Wolstonian - Chokierian
	HEAD	Head	Diamicton	Quaternary - Ryazanian

Bedrock and Faults

Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	LC	London Clay Formation	Clay	Eocene - Eocene
	TAB	Thanet Formation	Sand	Thanetian - Thanetian
	LMBE	Lambeth Group	Sand and Clay	Paleocene - Paleocene
	SECK	Seaford Chalk Formation	Chalk	Santonian - Coniacian
	CK	Chalk Group	Chalk	Maastrichtian - Cenomanian

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Geology 1:10,000 Maps

This report contains geological map extracts taken from the BGS Digital Geological map of Great Britain at 1:10,000 scale and is designed for users carrying out preliminary site assessments who require geological maps for the area around a site. This mapping may be more up to date than previously published paper maps.

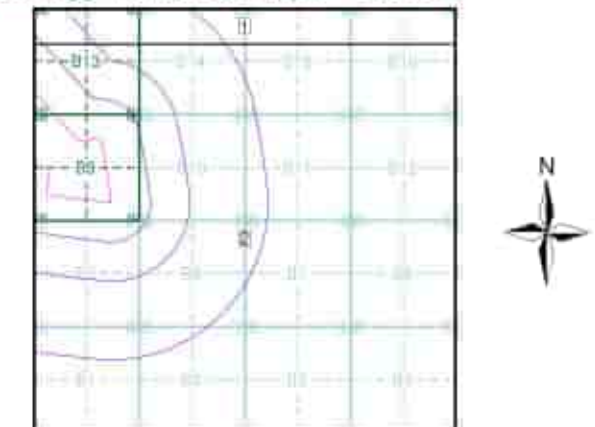
The various geological layers - artificial and landslip deposits, superficial geology and solid (bedrock) geology are displayed in separate maps, but superimposed on the final 'Combined Surface Geology' map. All map legends feature on this page.

Please Note: Not all of the layers have complete nationwide coverage, so availability of data for relevant map sheets is indicated below.

Geology 1:10,000 Maps Coverage

Map ID:	1	Map ID:	2
Map Name:	TQ67NE	Map Name:	TQ67SE
Map Date:	1994	Map Date:	1996
Bedrock Geology:	Available	Bedrock Geology:	Available
Superficial Geology:	Available	Superficial Geology:	Available
Artificial Geology:	Available	Artificial Geology:	Available
Faults:	Not Available	Faults:	Not Available
Landslip:	Not Available	Landslip:	Not Available
Rock Segments:	Not Available	Rock Segments:	Not Available

Geology 1:10,000 Maps - Slice B



Order Details

Order Number:	302366136_1_1
Customer Ref:	500199 TKRE
National Grid Reference:	567880, 174130
Slice:	B
Site Area (Ha):	72.49
Search Buffer (m):	1000

Site Details

Site at: Tilbury, Thurrock

Landmark
LANDMARK INFORMATION GROUP

Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk

Artificial Ground and Landslip

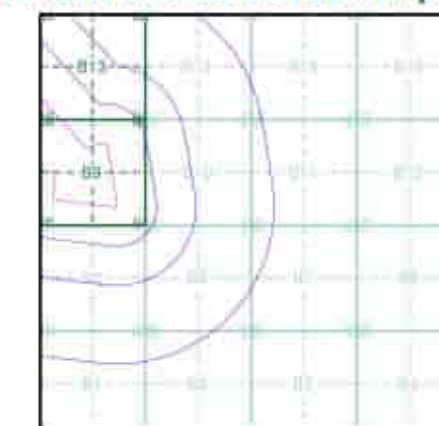
Artificial ground is a term used by BGS for those areas where the ground surface has been significantly modified by human activity. Information about previously developed ground is especially important, as it is often associated with potentially contaminated material, unpredictable engineering conditions and unstable ground.

Artificial ground includes:

- Made ground - man-made deposits such as embankments and spoil heaps on the natural ground surface.
- Worked ground - areas where the ground has been cut away such as quarries and road cuttings.
- Infilled ground - areas where the ground has been cut away then wholly or partially backfilled.
- Landscaped ground - areas where the surface has been reshaped.
- Disturbed ground - areas of ill-defined shallow or near surface mineral workings where it is impracticable to map made and worked ground separately.

Mass movement (landslip) deposits on BGS geological maps are primarily superficial deposits that have moved down slope under gravity to form landslips. These affect bedrock, other superficial deposits and artificial ground. The dataset also includes foundered strata, where the ground has collapsed due to subsidence.

Artificial Ground and Landslip Map - Slice B

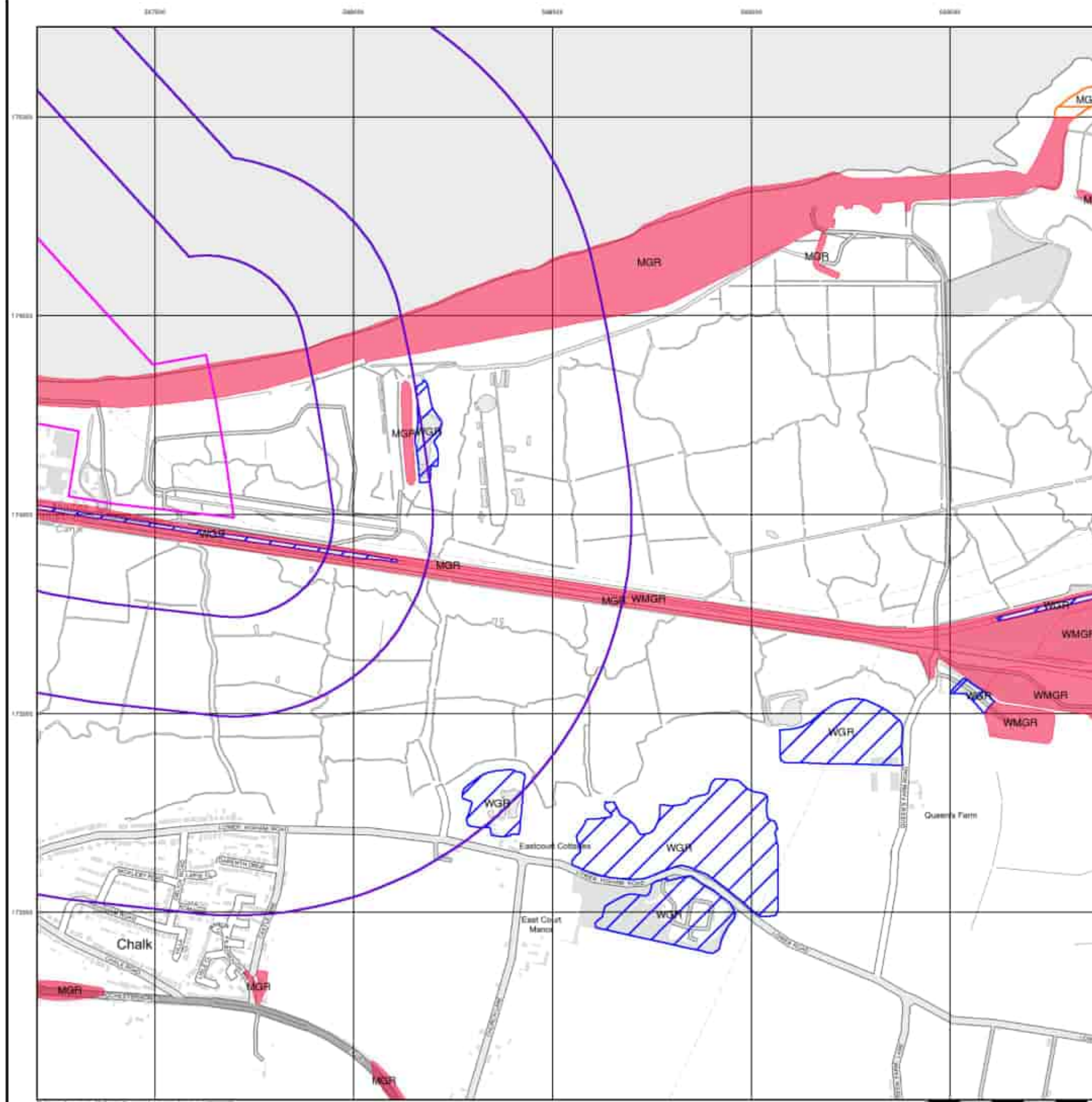


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Site Details

Site at, Tilbury, Thurrock



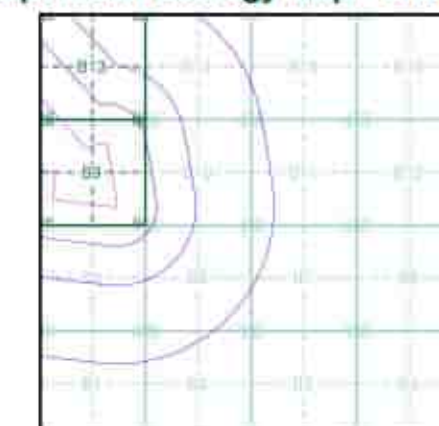
Superficial Geology

BGS 1:10,000 Superficial Deposits are the youngest geological deposits formed during the most recent period of geological time, which extends back about 1.8 million years from the present.

They rest on older deposits or rocks referred to as Bedrock. This dataset contains Superficial deposits that are of natural origin and 'in place'. Other superficial strata may be held in the Mass Movement dataset where they have been moved, or in the Artificial Ground dataset where they are of man-made origin.

Most of these Superficial deposits are unconsolidated sediments such as gravel, sand, silt and clay, and onshore they form relatively thin, often discontinuous patches or larger spreads.

Superficial Geology Map - Slice B

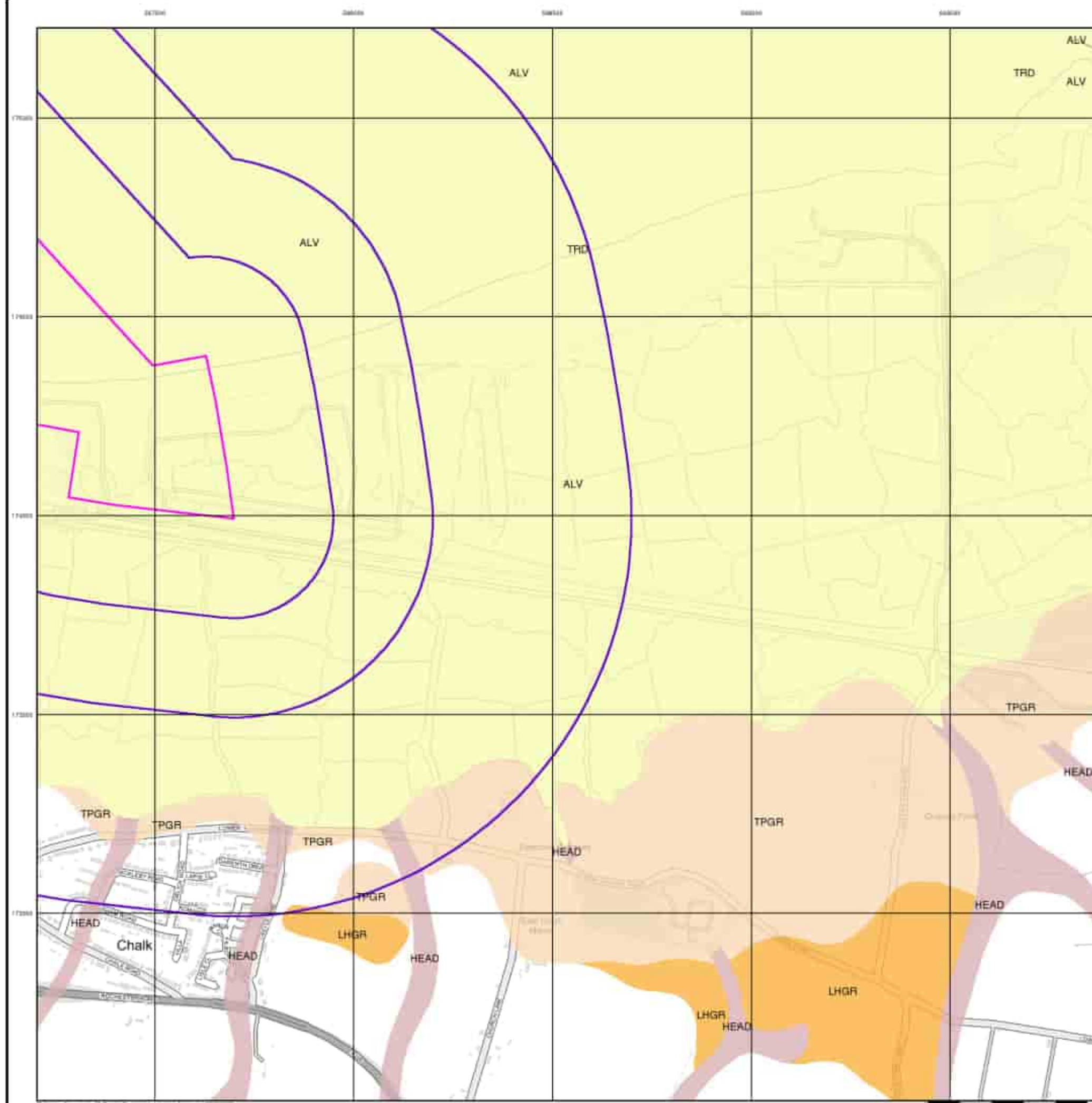


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Order Number: 302366136_1_1
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Site Details

Site at, Tilbury, Thurrock



Bedrock and Faults

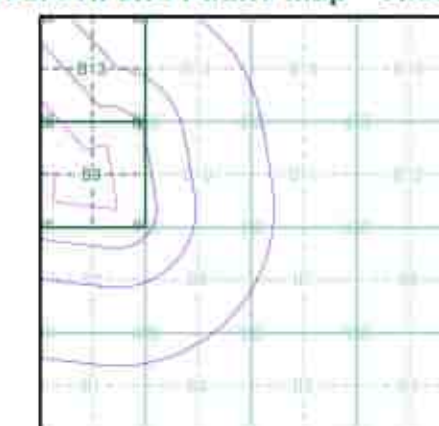
Bedrock geology is a term used for the main mass of rocks forming the Earth and are present everywhere, whether exposed at the surface in outcrops or concealed beneath superficial deposits or water.

The bedrock has formed over vast lengths of geological time ranging from ancient and highly altered rocks of the Proterozoic, some 2500 million years ago, or older, up to the relatively young Pliocene, 1.8 million years ago.

The bedrock geology includes many lithologies, often classified into three types based on origin: igneous, metamorphic and sedimentary.

The BGS Faults and Rock Segments dataset includes geological faults and thin beds mapped as lines such as coal seams and mineral veins. These are not restricted by age and could relate to features of any of the 1:10,000 geology datasets.

Bedrock and Faults Map - Slice B

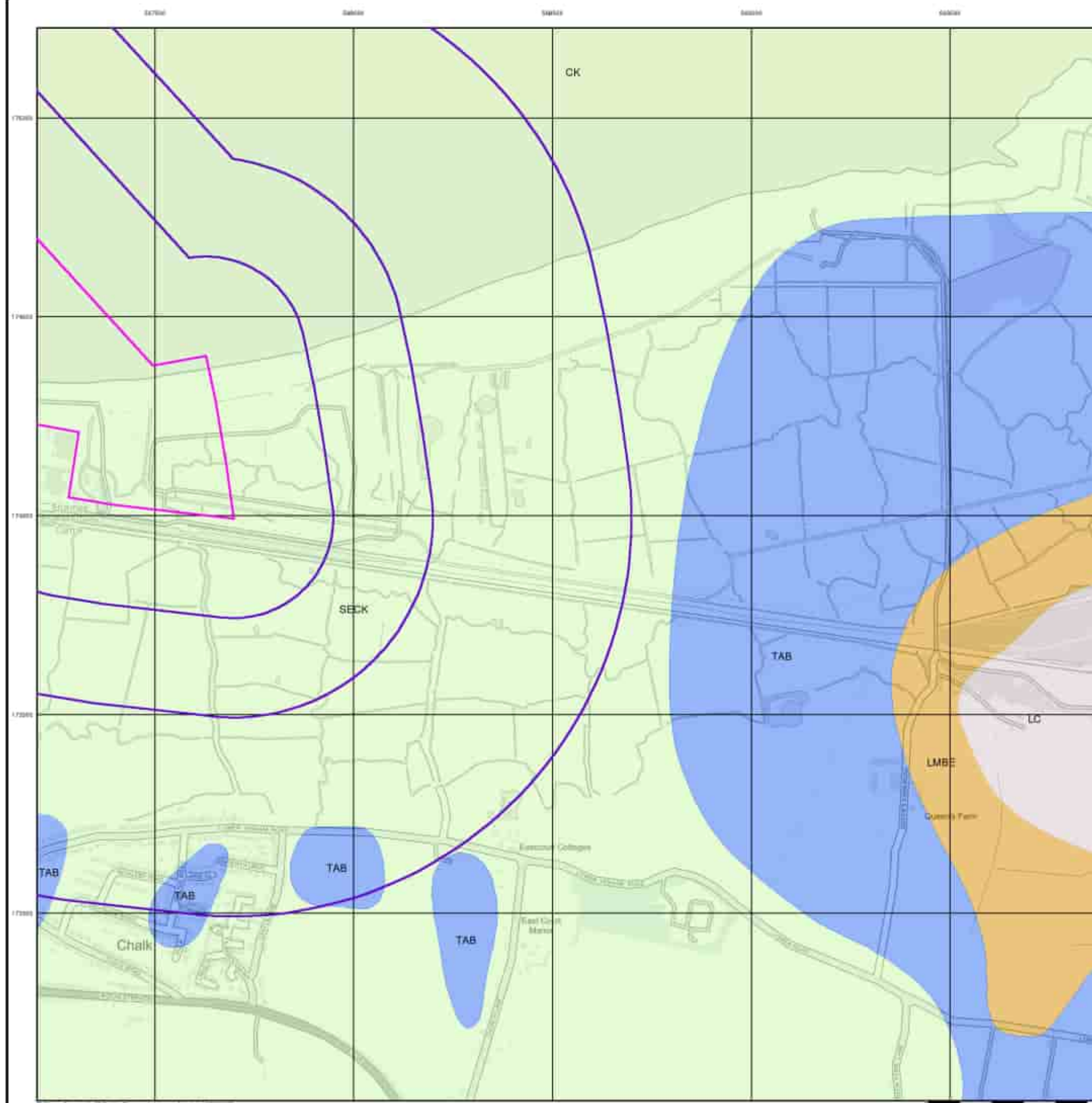


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Site Details

Site at, Tilbury, Thurrock



Combined Surface Geology

The Combined Surface Geology map combines all the previous maps into one combined geological overview of your site.

Please consult the legends to the previous maps to interpret the Combined "Surface Geology" map.

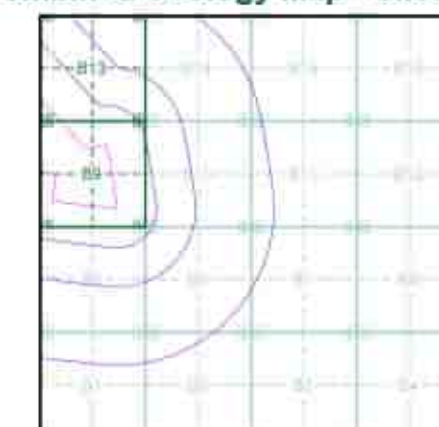
Additional Information

More information on 1:10,000 Geological mapping and explanations of rock classifications can be found on the BGS website. Using the LEX Codes in this report, further descriptions of rock types can be obtained by interrogating the 'BGS Lexicon of Named Rock Units'. This database can be accessed by following the 'Information and Data' link on the BGS website.

Contact

British Geological Survey
Kingsley Dunham Centre
Keyworth
Nottingham
NG12 5GG
Telephone: 0115 936 3143
Fax: 0115 936 3276
email: enquiries@bgs.ac.uk
website: www.bgs.ac.uk

Combined Geology Map - Slice B

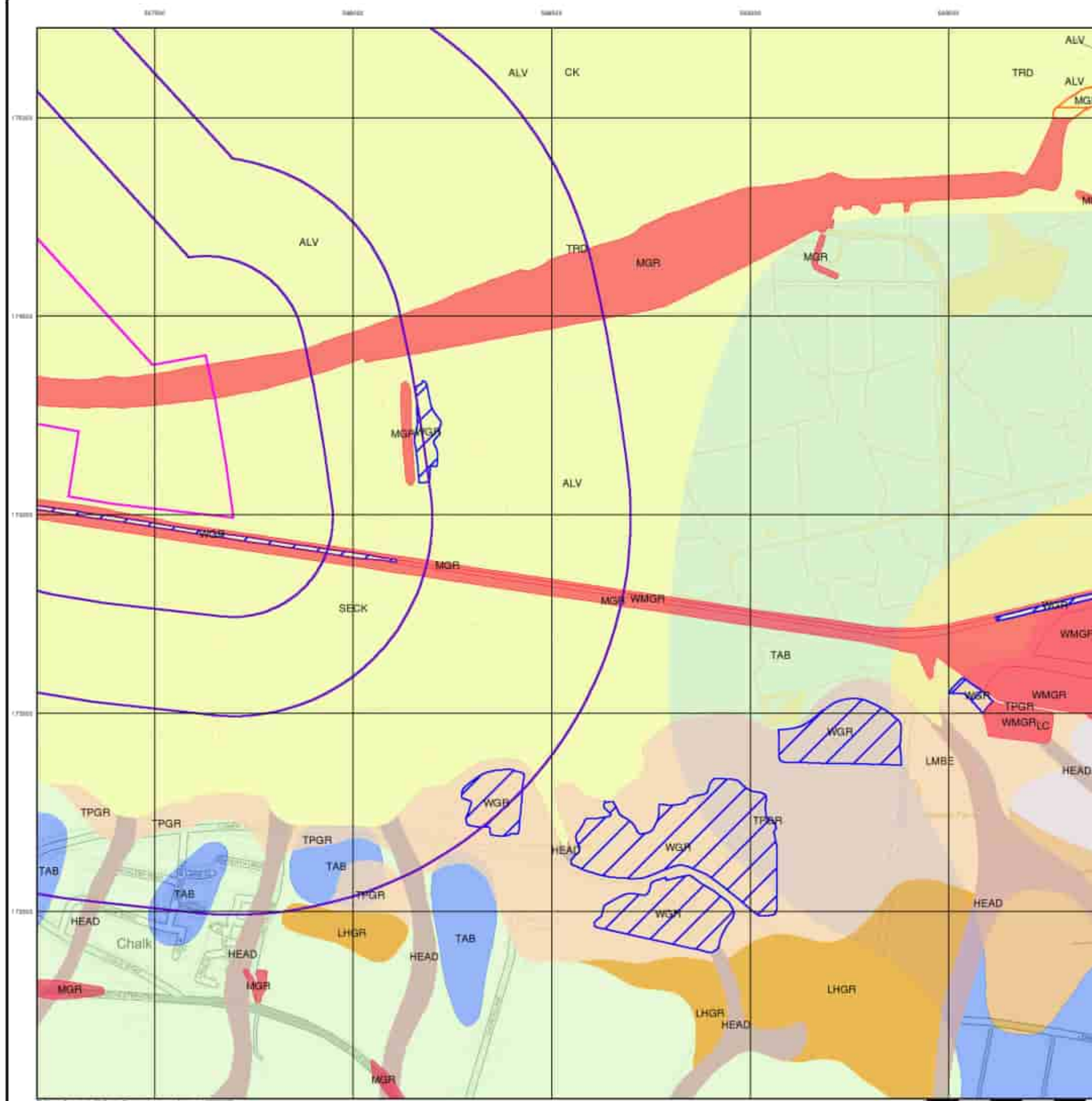


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Slice: B
Site Area (Ha): 72.49
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Site Details

Site at, Tilbury, Thurrock



General

- Specified Site
- Specified Buffer(s)
- Bearing Reference Point
- Map ID
- Several of Type at Location

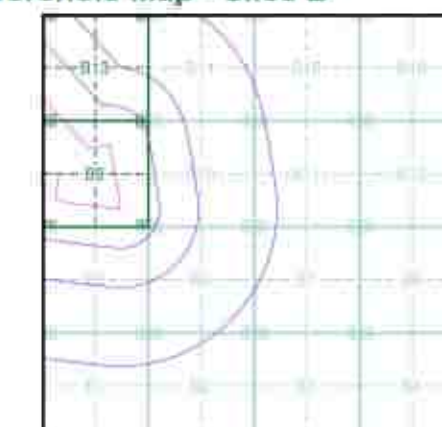
Agency and Hydrological (Boreholes)

- BGS Borehole Depth 0 - 10m
- BGS Borehole Depth 10 - 30m
- BGS Borehole Depth 30m +
- Confidential
- Other

For Borehole information please refer to the Borehole .csv file which accompanied this slice.

A copy of the BGS Borehole Ordering Form is available to download from the Support section of www.envirocheck.co.uk.

Borehole Map - Slice B



Order Details

Order Number: 302366136_1_1
 Customer Ref: 500199 TKRE
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 Slice: B
 Site Area (Ha): 72.49
 Search Buffer (m): 1000

Site Details

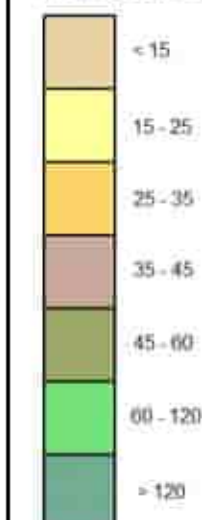
Site at, Tilbury, Thurrock

General

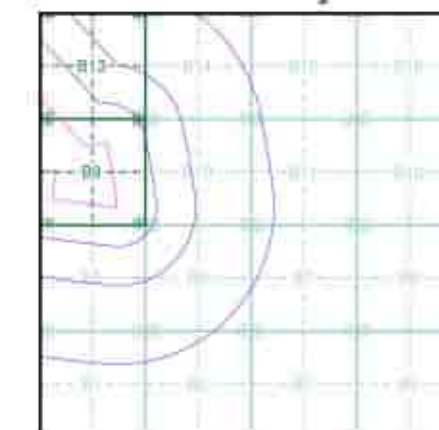
Specified Site Specified Buffer(s) Drawing Reference Point

Estimated Soil Chemistry Arsenic

Arsenic Concentrations mg/kg



Estimated Soil Chemistry Arsenic - Slice B



Order Details

Order Details: 302366136_1_1
 Customer Ref: 500199 TKRE
 National Grid Reference: 557880, 174130
 Slice: B
 Site Area (Ha): 72.49
 Search buffer (m): 1000

Site Details

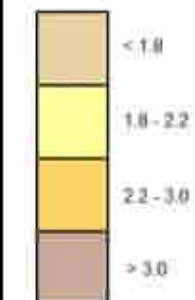
Site at, Tilbury, Thurrock

General

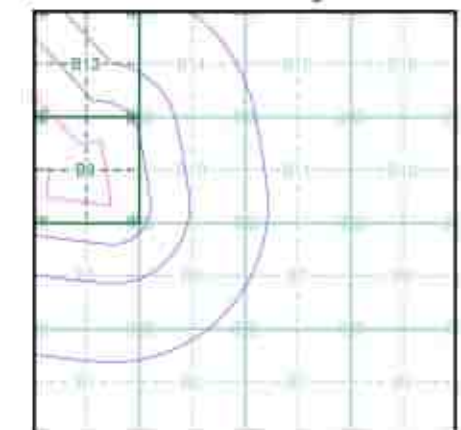
Specified Site Specified Buffer(s) Mining Reference Point

Estimated Soil Chemistry Cadmium

Cadmium Concentrations mg/kg



Estimated Soil Chemistry Cadmium - Slice B



Order Details

Order Details: 302366136_1_1
 Customer Ref: 500199 TKRE
 National Grid Reference: 557880, 174130
 Slice: B
 Site Area (Ha): 72.49
 Search buffer (m): 1000

Site Details

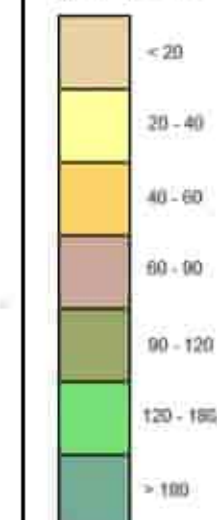
Site at, Tilbury, Thurrock

General

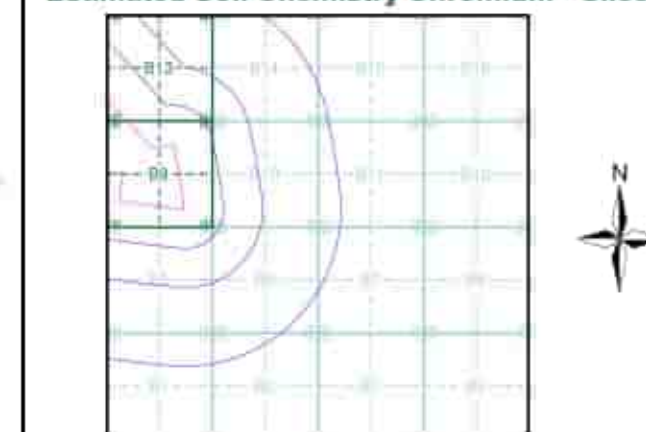
Specified Site Specified Buffer(s) Drawing Reference Point

Estimated Soil Chemistry Chromium

Chromium Concentrations mg/kg



Estimated Soil Chemistry Chromium - Slice B



Order Details

Order Details: 302366136_1_1
 Customer Ref: 500199 TKRE
 National Grid Reference: 557880, 174130
 Slice: B
 Site Area (Ha): 72.49
 Search buffer (m): 1000

Site Details

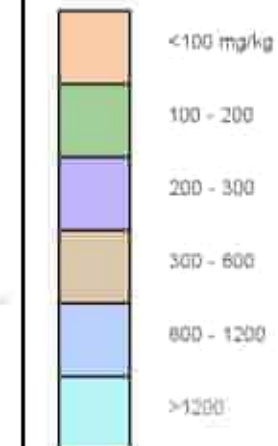
Site at, Tilbury, Thurrock

General

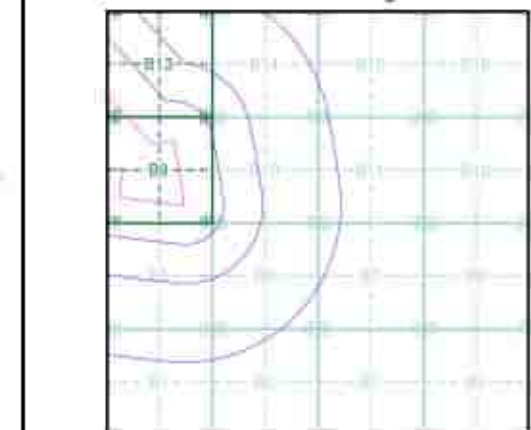
Specified Site Specified Buffer(s) Drawing Reference Point

Estimated Soil Chemistry Lead

Lead Concentrations mg/kg



Estimated Soil Chemistry Lead - Slice B



Order Details

Order Details: 302366136_1_1
 Customer Ref: 500199 TKRE
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 Site Area (Ha): 72.49
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Site Details

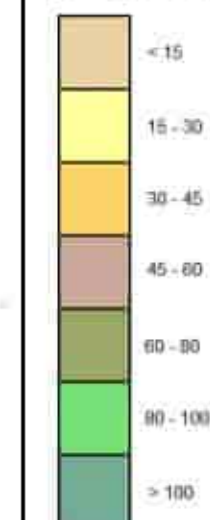
Site at, Tilbury, Thurrock

General

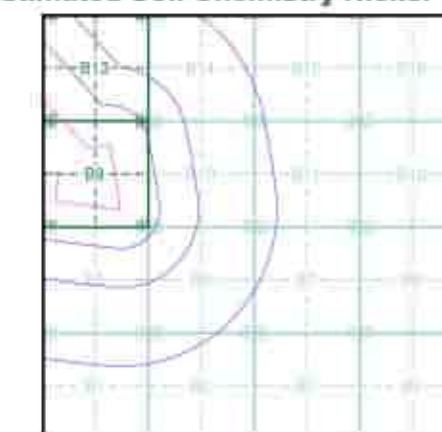
Specified Site Specified Buffer(s) Drawing Reference Point

Estimated Soil Chemistry Nickel

Nickel Concentrations mg/kg



Estimated Soil Chemistry Nickel - Slice B



Order Details

Order Details: 302366136_1_1
 Customer Ref: 500199 TKRE
 National Grid Reference: 557880, 174130
 Slice: B
 Site Area (Ha): 72.49
 Search buffer (m): 1000

Site Details

Site at, Tilbury, Thurrock

Historical Land Use Information (1:10,000)

General

- Specified Site
 ○ Specified Buffer(s)
 X Boreing Reference Point
 ■ Map ID
□ Several of Type at Location

Potentially Contaminative Industrial Uses (Past Land Uses - Mining)

	Point	Line	Polygon
Air Shafts	◆	—	■
Disturbed Ground	◆	—	■
General Quarrying	◆	—	■
Heap, unknown constituents	◆	—	■
Mineral Railway	◆	—	■
Mining and Quarrying General	◆	—	■
Heaving of Coal & Lignite	◆	—	■
Quarrying of Sand and Clay, Operation of Sand and Gravel Pits	◆	—	■

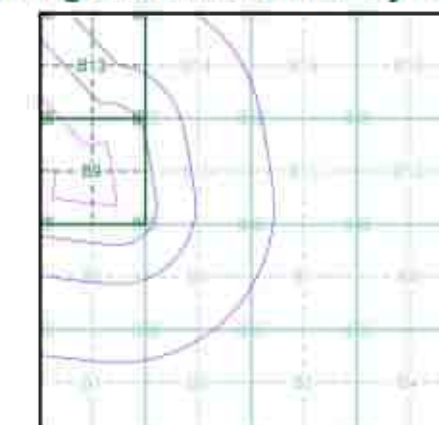
Historical Land Use

	Point	Line	Polygon
Potentially Infilled Land (Non-Water)	●	—	■
Potentially Infilled Land (Water)	●	—	■
Former Marsh	■		

Mining Data

- Potential Mining Area
▼ BGS Recorded Mineral Site

Mining and Ground Stability - Slice B

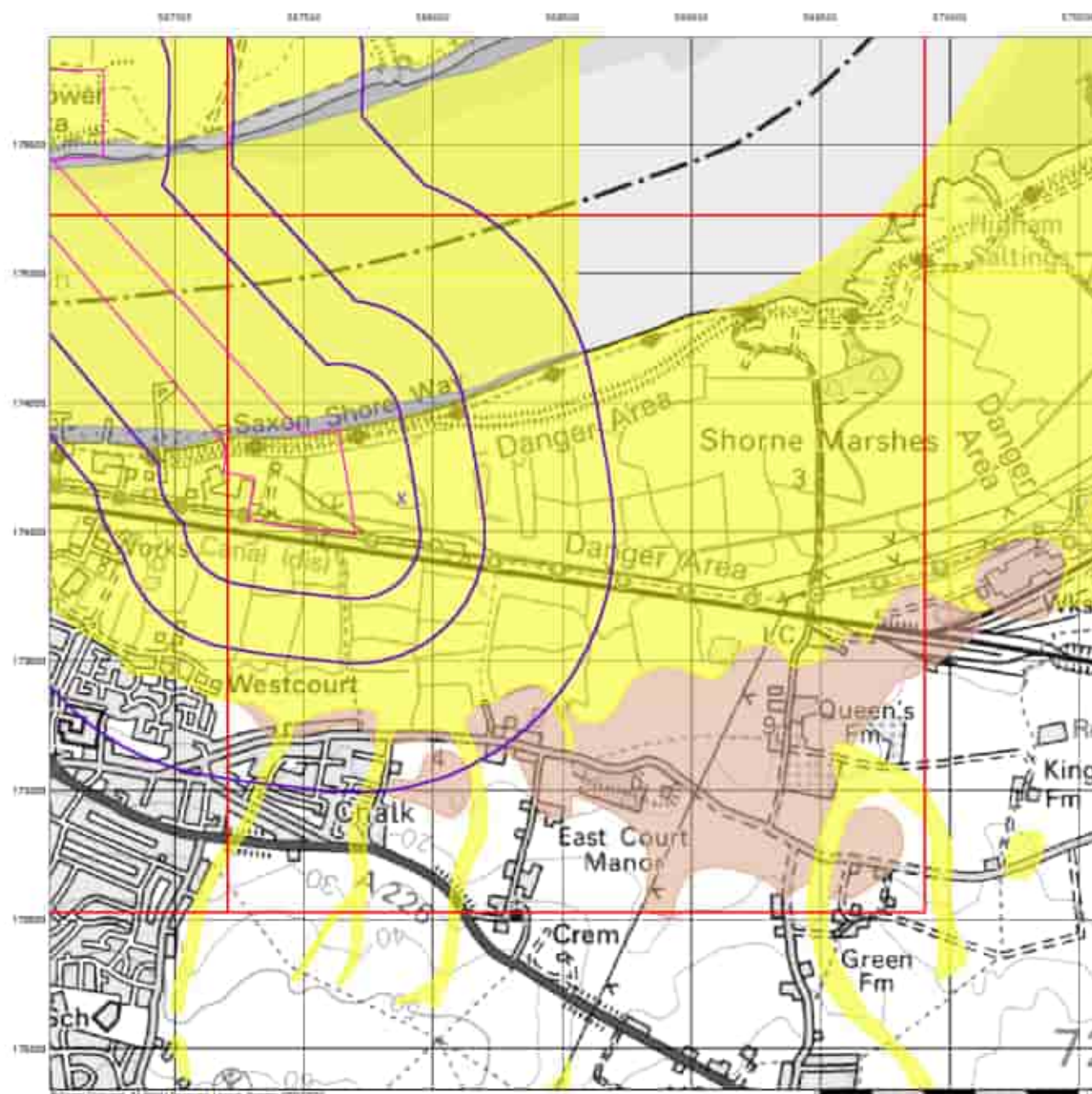


Order Details

Order Number: 302366136_1_1
 Customer Ref: 500199 TKRE
 National Grid Reference: 557880, 174130
 Slice: B
 Site Area (Ha): 72.49
 Search Buffer (m): 1000

Site Details

Site at, Tilbury, Thurrock



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Superficial Aquifer Designation

General

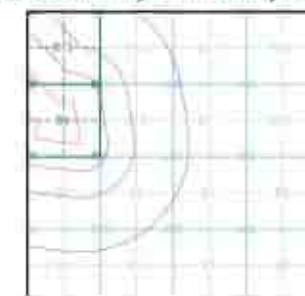
- Search Site
- Search Buffer
- Warning Reference Point
- Site
- Map ID

Agency and Hydrological

Geological Classes

- Principal Aquifer
- Secondary A Aquifer
- Secondary B Aquifer
- Secondary Undifferentiated
- Unproductive Strata
- Unflooded
- Unknown (Lakes and Landscapes)

Site Sensitivity Context Map - Slice B



Order Details

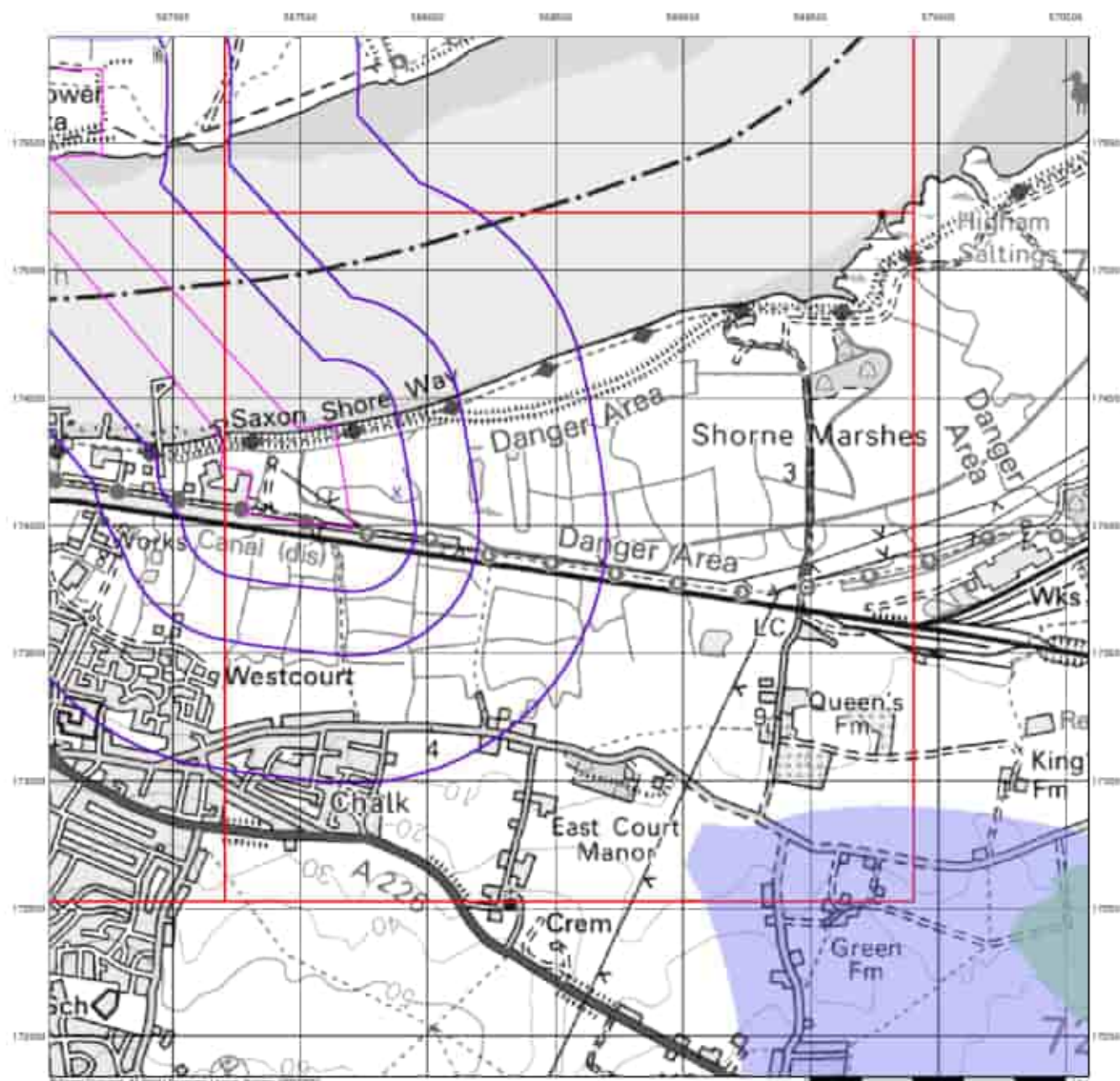
Order Number: 302388136 1:1
 Customer Ref: 500109 THOR
 National Grid Reference: 567580, 174130
 Slice: B
 Site Area (Ha): 72.48
 Search Buffer (m): 1000

Site Details

Site at: Tibbury, Thurrock

Landmark
 LANDMARK INFORMATION GROUP

UK
 Tel: 0200 940 000
 Fax: 0200 940 001
 Email: info@landmark.co.uk
www.landmark.co.uk



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Source Protection Zones

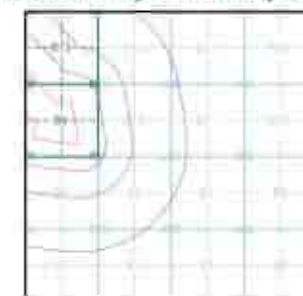
General

- Search'd Site
- Search'd Buffer
- Reservoir Reference Point
- Slice
- Map ID

Agency and Hydrological

- River zone (Zone 1)
- Inter zone - subsurface activity only (Zone 1c)
- Outer zone (Zone 2)
- Outer zone - subsurface activity only (Zone 2c)
- Total catchment (Zone 3)
- Total catchment - subsurface activity only (Zone 3c)
- Special interest (Zone 4)

Site Sensitivity Context Map - Slice B



Order Details

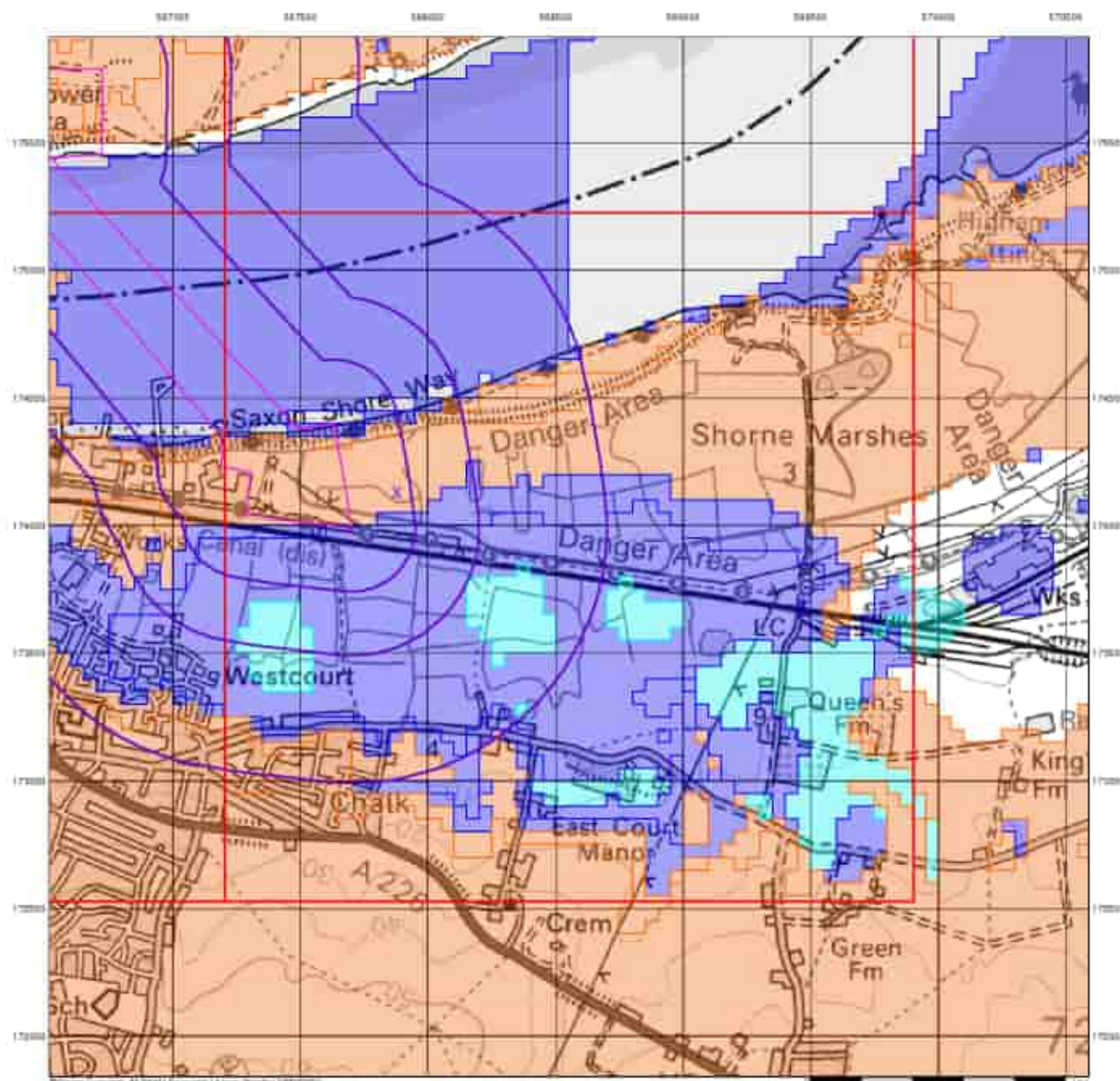
Order Number: 302368136 1:1
 Customer Ref: 500109 THORE
 National Grid Reference: 567580, 174130
 Slice: B
 Site Area (Ha): 72.48
 Search Buffer (m): 1000

Site Details

Site at: Tibury, Thurston

Landmark
 LANDMARK INFORMATION GROUP

UK
 Tel: 01223 316100
 Fax: 01223 316101
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www.landmark.co.uk



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BGS Flood GFS Data

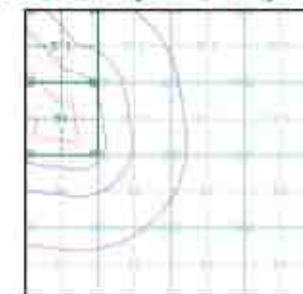
General

- Spoiled Old
- Spoiled Buffers
- Sewing Reference Point
- River

Agency and Hydrological (Flood)

- Limited Potential for Groundwater Flooding to Occur
- Potential for Groundwater Flooding of Property Situated Below Ground Level
- Potential for Groundwater Flooding to Occur at Surface

Site Sensitivity Context Map - Slice B



Order Details

Order Number: 302388136 1:1
 Customer Ref: 500109 THORE
 National Grid Reference: 567980, 174130
 Slice: B
 Site Area (Ha): 72.48
 Search Buffer (m): 1000

Site Details

Site at: Tibbury, Thurrock

Landmark
 LANDMARK INFORMATION GROUP

Tel: 020 300 0000
 Fax: 020 300 0001
 Email: info@landmarkinfo.co.uk

OS Water Network Lines Map (1:10,000)

General

- Specified Site
- Specified Buffer(s)
- X Bearing Reference Point

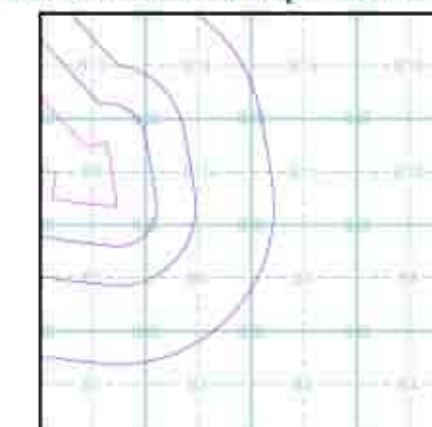
OS Water Network Data

- | | |
|----------------|---------------------------|
| — Canal | — Drain |
| — Reservoir | — Other |
| — Foreshore | — Lake |
| — Marsh | — Transfer |
| — Tidal River | — Lock Or Flight Of Locks |
| — Inland River | — Sea |
| ● Junction | ● Source |
| ● Outlet | ● Other |
| ● Pseudo | |

Contours (height in meters)

- Standard Contour: — 10m —
- Master Contour: — 10m —
- Spot Height: * 10m
- M/LW — Mean Low Water
- M/HW — Mean High Water

OS Water Network Map - Slice B



Order Details

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 Slice: B
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Site Details

Site at, Tilbury, Thurrock

General

-  Specified Site
-  Specified Buffer(s)
-  Bearing Reference Point

Risk of Flooding from Surface Water

-  High - 30 Year Return
-  Medium - 100 Year Return
-  Low - 1000 Year Return

Suitability

See the suitability map below

-  National to county
-  County to town
-  Town to street
-  Street to parcels of land
-  Property

EA/NRW Suitability Map - Slice B



Order Details

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Site Details

Site at, Tilbury, Thurrock

EA/NRW Flood Data Map (1:10,000)

General

- Specified Site
- Specified Burial(s)
- Bearing Reference Point

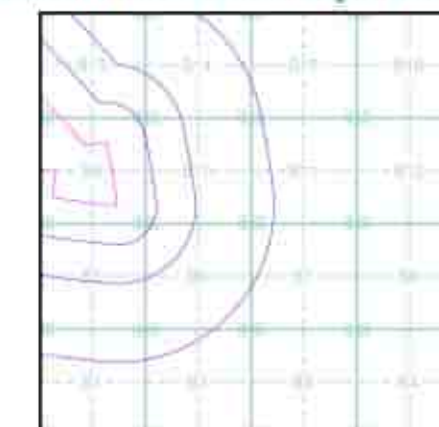
Flood Data

- Extreme Flooding from Rivers or Sea without Defences (Zone 2)
- Flooding from Rivers or Sea without Defences (Zone 3)
- Area Benefiting from Flood Defence
- Flood Water Storage Areas
- Flood Defence

Contours (Height in metres)

- Standard Contour
- Master Contour
- Spot Height
- Mean Low Water
- Mean High Water

EA/NRW Flood Data Map - Slice B



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Site Details

Site at, Tilbury, Thurrock

EA/NRW Historic Flood Map (1:10,000)

General

- Specified Site
- Specified Buffer(s)
- Bearing Reference Point
- Map ID

Historic Flood Events Data

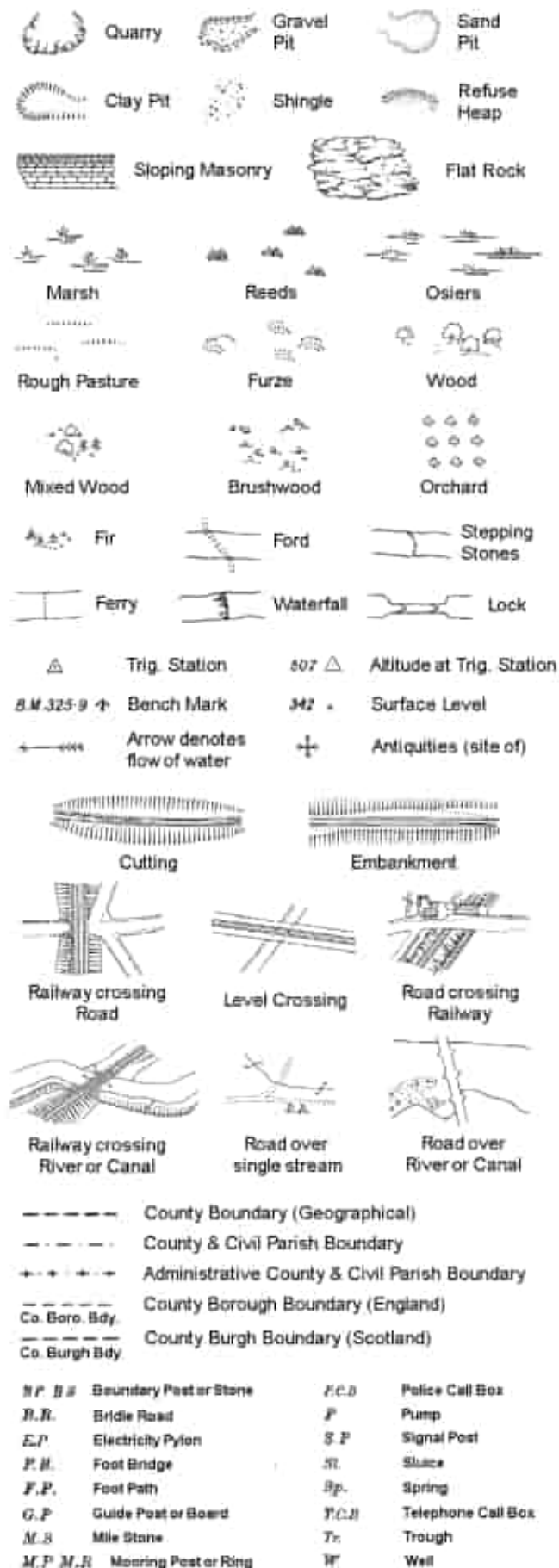
- | | |
|--|--|
| Channel Capacity Exceeded (no raised defences) | Obstruction/Blockage - Culvert |
| Channel Capacity Exceeded / Surface Water | Obstruction/Blockage - Debris Screen |
| Groundwater/High Water Table | Operational Failure/ Breach of Defence |
| Local Drainage/Surface Water | Other |
| Mechanical Failure | Overtopping of Defences |
| Obstruction/Blockage - Bridge | Surface Water |
| Obstruction/Blockage - Channel | Unknown |
| Historical Flood Liabilities | |

Contours (height in metres)

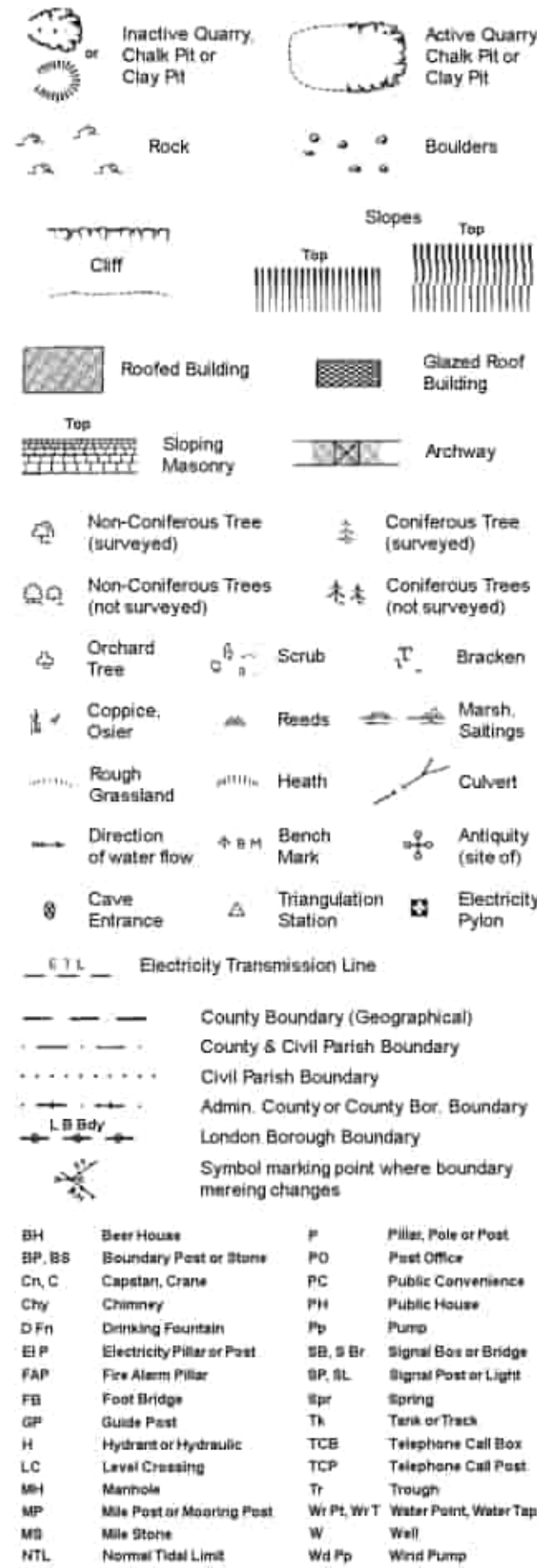
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Historical Mapping Legends

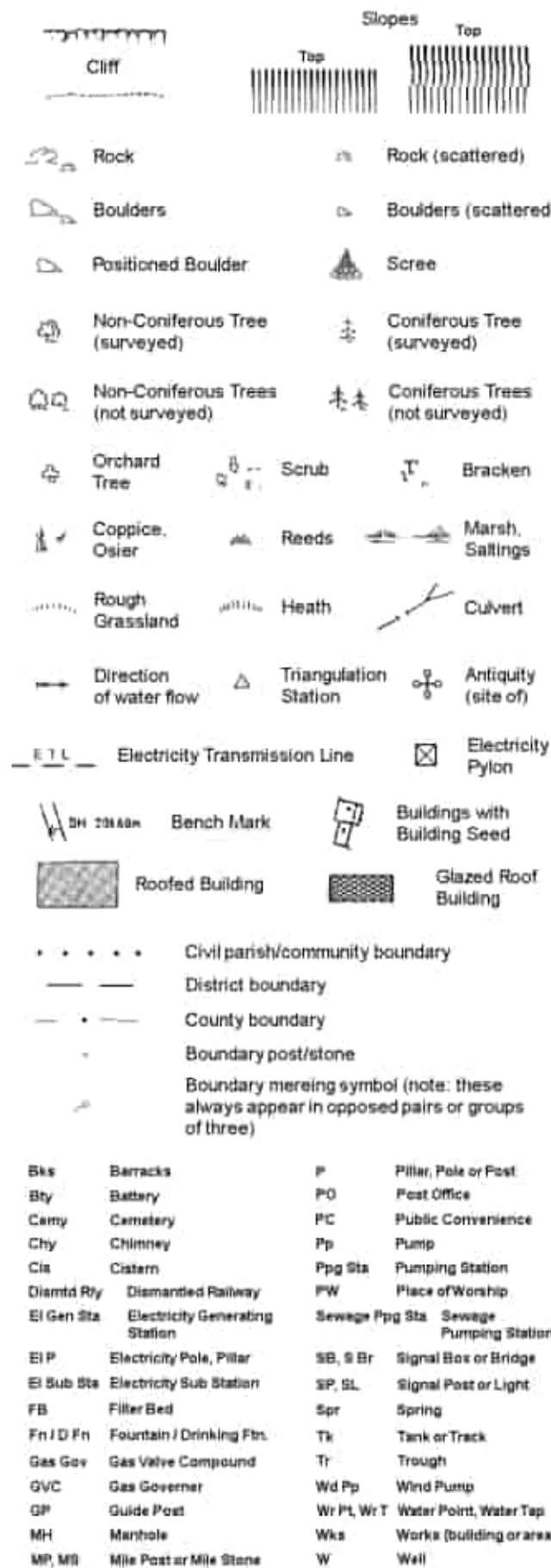
Ordnance Survey County Series and Ordnance Survey Plan 1:2,500



Ordnance Survey Plan, Additional SIMs and Supply of Unpublished Survey Information 1:2,500 and 1:1,250



Large-Scale National Grid Data 1:2,500 and 1:1,250



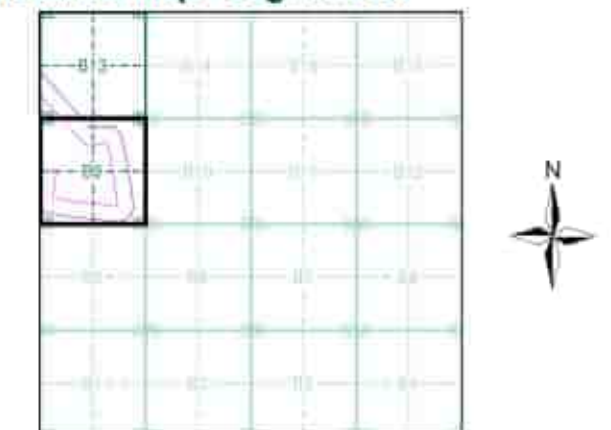
Envirocheck

LANDMARK INFORMATION GROUP

Historical Mapping & Photography included:

Mapping Type	Scale	Date	Pg
Kent	1:2,500	1864	2
Essex	1:2,500	1864	3
Essex	1:2,500	1864	4
Kent	1:2,500	1897	5
Essex	1:2,500	1897	6
Kent	1:2,500	1908	7
Kent	1:2,500	1938	8
Ordnance Survey Plan	1:2,500	1964	9
Additional SIMs	1:2,500	1964	10
Ordnance Survey Plan	1:2,500	1970	11
Supply of Unpublished Survey Information	1:2,500	1973	12
Additional SIMs	1:2,500	1981	13
Large-Scale National Grid Data	1:1,250	1993	14
Large-Scale National Grid Data	1:2,500	1993	15
Historical Aerial Photography	1:2,500	1999	16

Historical Map - Segment B9



Order Details

Order Number: 302366136_1_1
Customer Ref: 500199 TKRE
National Grid Reference: 567880, 174130
Slice: B
Site Area (Ha): 72.49
Search Buffer (m): 100

Site Details

Site at: Tilbury, Thurrock

Landmark
INFORMATION GROUP

Tel: 0844 844 9052
Fax: 0844 844 9051
Web: www.envirocheck.co.uk

Kent

Published 1864

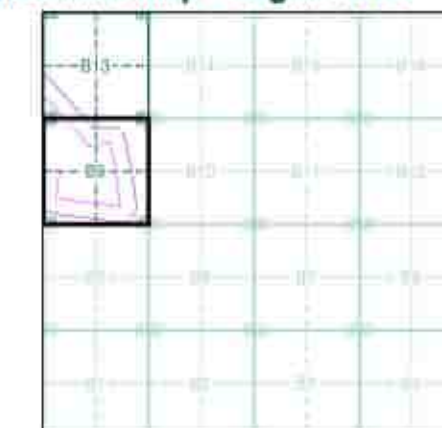
Source map scale - 1:2,500

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: 302366136_1_1
 Customer Ref: 500199 TKRE
 National Grid Reference: 557880, 174130
 Slice: B
 Site Area (Ha): 72.49
 Search Buffer (m): 100

Site Details

Site at, Tilbury, Thurrock



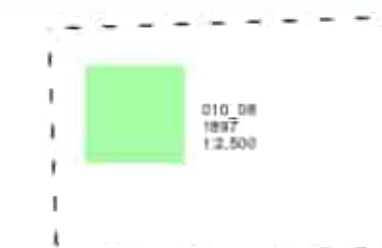
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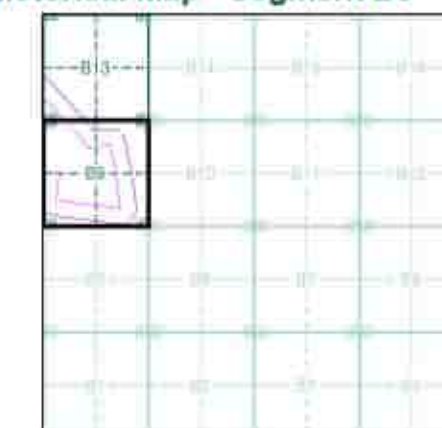
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Site Details

Site at, Tilbury, Thurrock



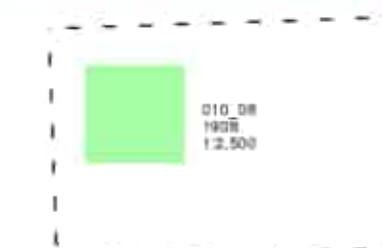
Kent

Published 1908

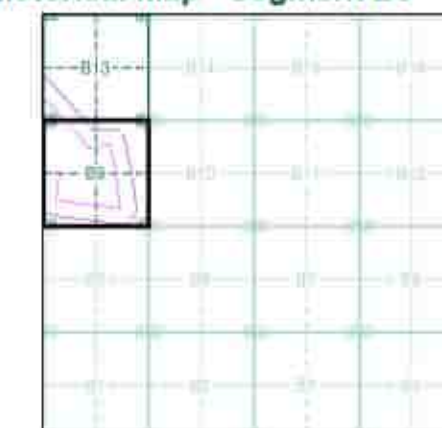
Source map scale - 1:2,500

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

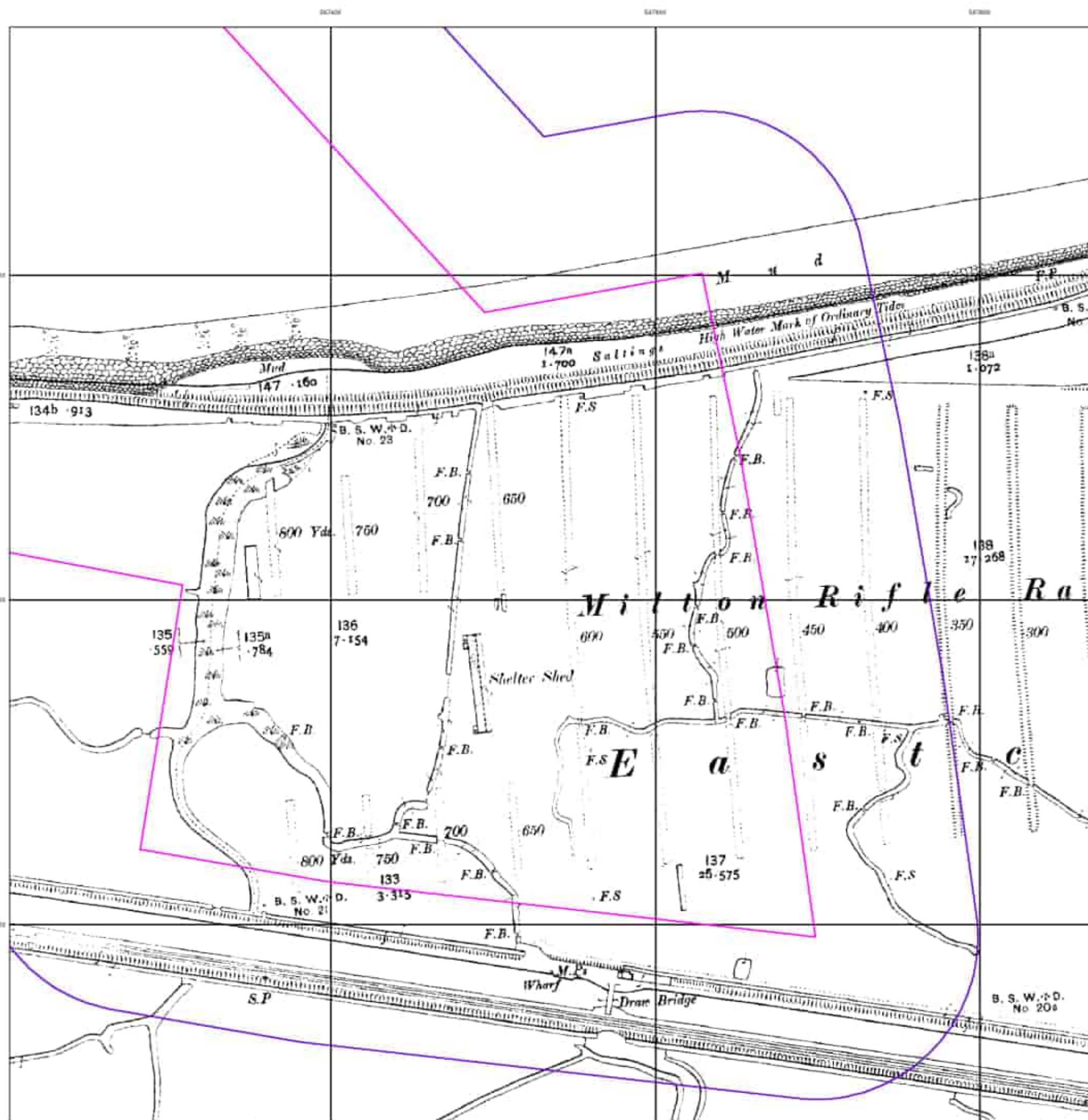


Order Details

Order Number: 302366136_1_1
Customer Ref: 500199 TKRE
National Grid Reference: 557880, 174130
Slice: B
Site Area (Ha): 72.49
Search Buffer (m): 100

Site Details

Site at, Tilbury, Thurrock



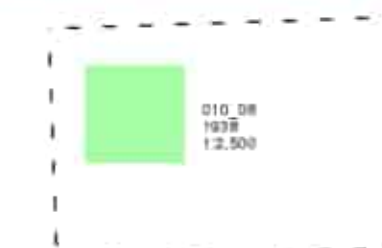
Kent

Published 1938

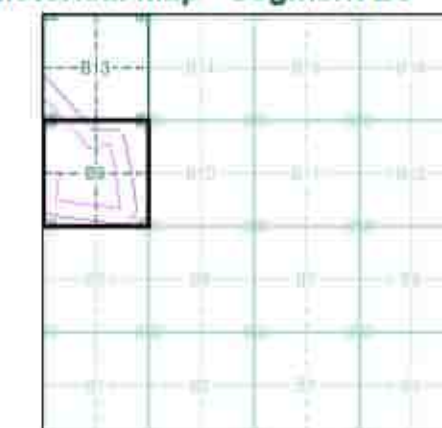
Source map scale - 1:2,500

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

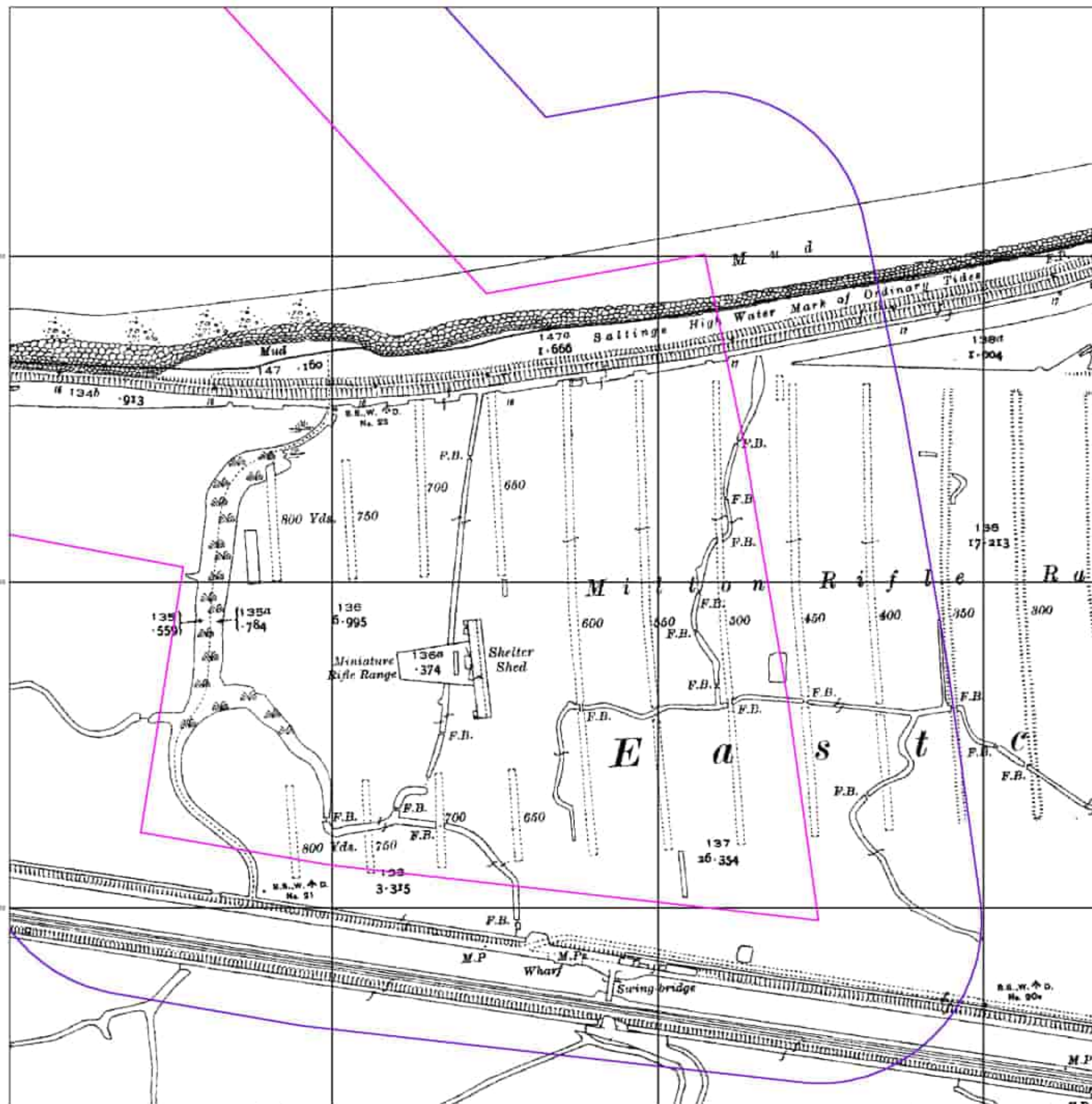


Order Details

Order Number: 302366136_1_1
Customer Ref: 500199 TKRE
National Grid Reference: 557880, 174130
Slice: B
Site Area (Ha): 72.49
Search Buffer (m): 100

Site Details

Site at, Tilbury, Thurrock



Ordnance Survey Plan

Published 1964

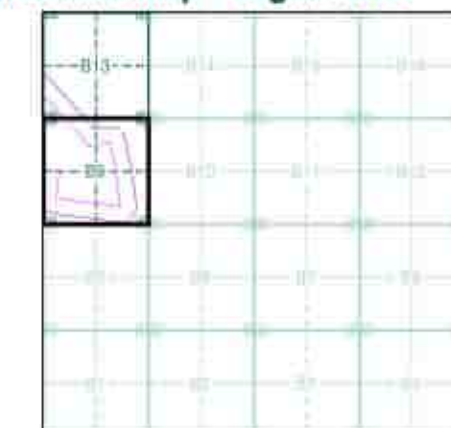
Source map scale - 1:2,500

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

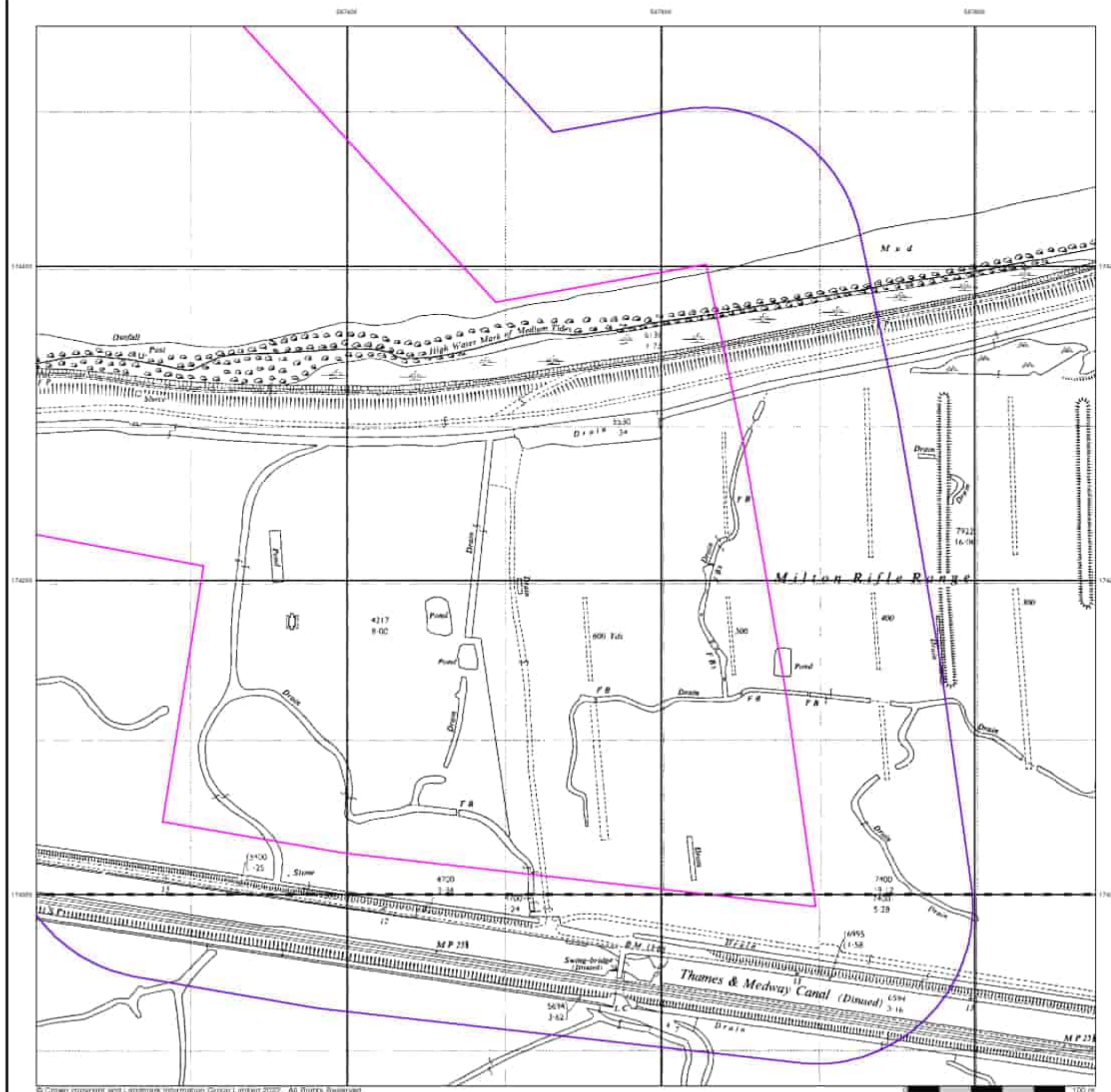


Order Details

Order Number: 302366136_1_1
 Customer Ref: 500199 TKRE
 National Grid Reference: 567880, 174130
 Slice: B
 Site Area (Ha): 72.49
 Search Buffer (m): 100

Site Details

Site at, Tilbury, Thurrock



Additional SIMs

Published 1964

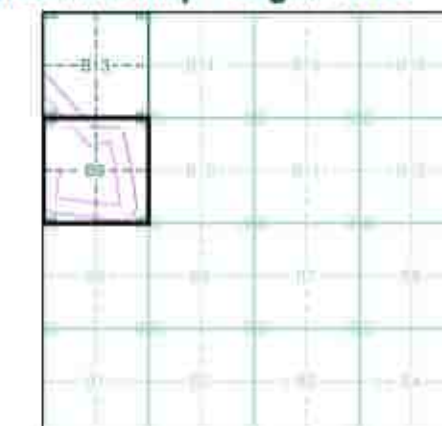
Source map scale - 1:2,500

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

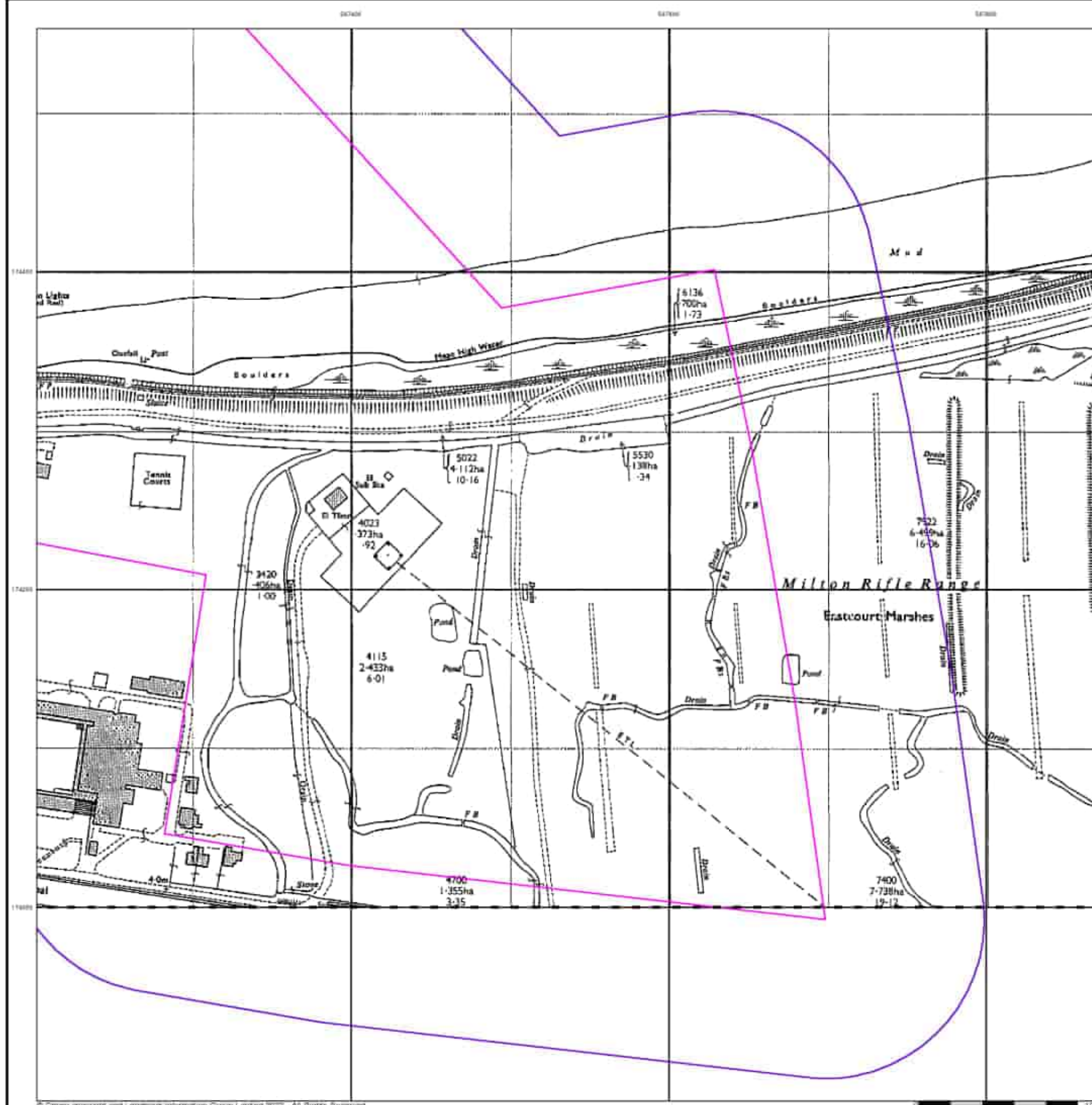


Order Details

Order Number: 302366136_1_1
Customer Ref: 500199 TKRE
National Grid Reference: 557880, 174130
Slice: B
Site Area (Ha): 72.49
Search Buffer (m): 100

Site Details

Site at, Tilbury, Thurrock



Supply of Unpublished Survey Information

Published 1973

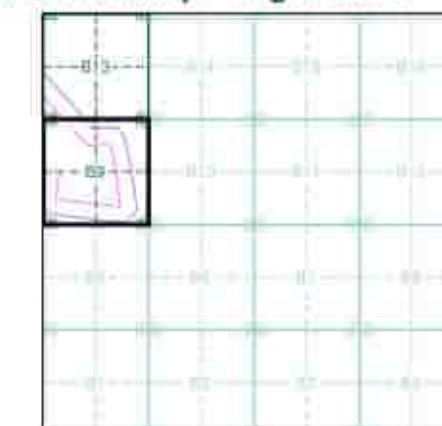
Source map scale - 1:2,500

SUSI maps (Supply of Unpublished Survey Information) were produced between 1972 and 1977, mainly for internal use at Ordnance Survey. These were more of a 'work-in-progress' plan as they showed updates of individual areas on a map. These maps were unpublished, and they do not represent a single moment in time. They were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)

TO5774	1973	1:2,500
TO5773	1973	1:2,500

Historical Map - Segment B9



Order Details

Order Number: 302366136_1_1
 Customer Ref: 500199 TKRE
 National Grid Reference: 567880, 174130
 Slice: B
 Site Area (Ha): 72.49
 Search Buffer (m): 100

Site Details

Site at, Tilbury, Thurrock



Additional SIMs

Published 1981

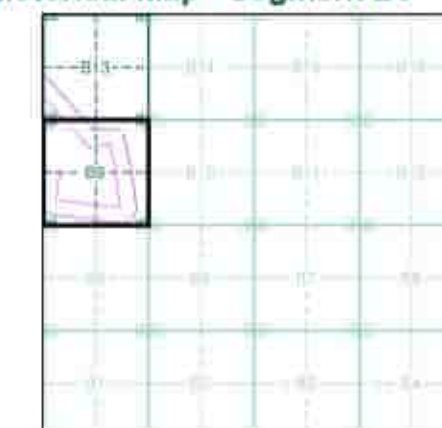
Source map scale - 1:2,500

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: 302366136_1_1
 Customer Ref: 500199 TKRE
 National Grid Reference: 567880, 174130
 Slice: B
 Site Area (Ha): 72.49
 Search Buffer (m): 100

Site Details

Site at, Tilbury, Thurrock



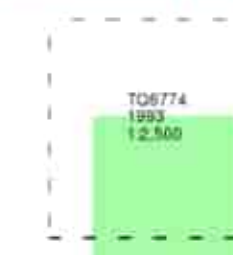
Large-Scale National Grid Data

Published 1993

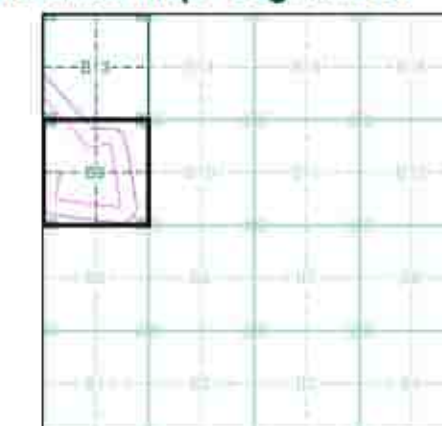
Source map scale - 1:2,500

'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

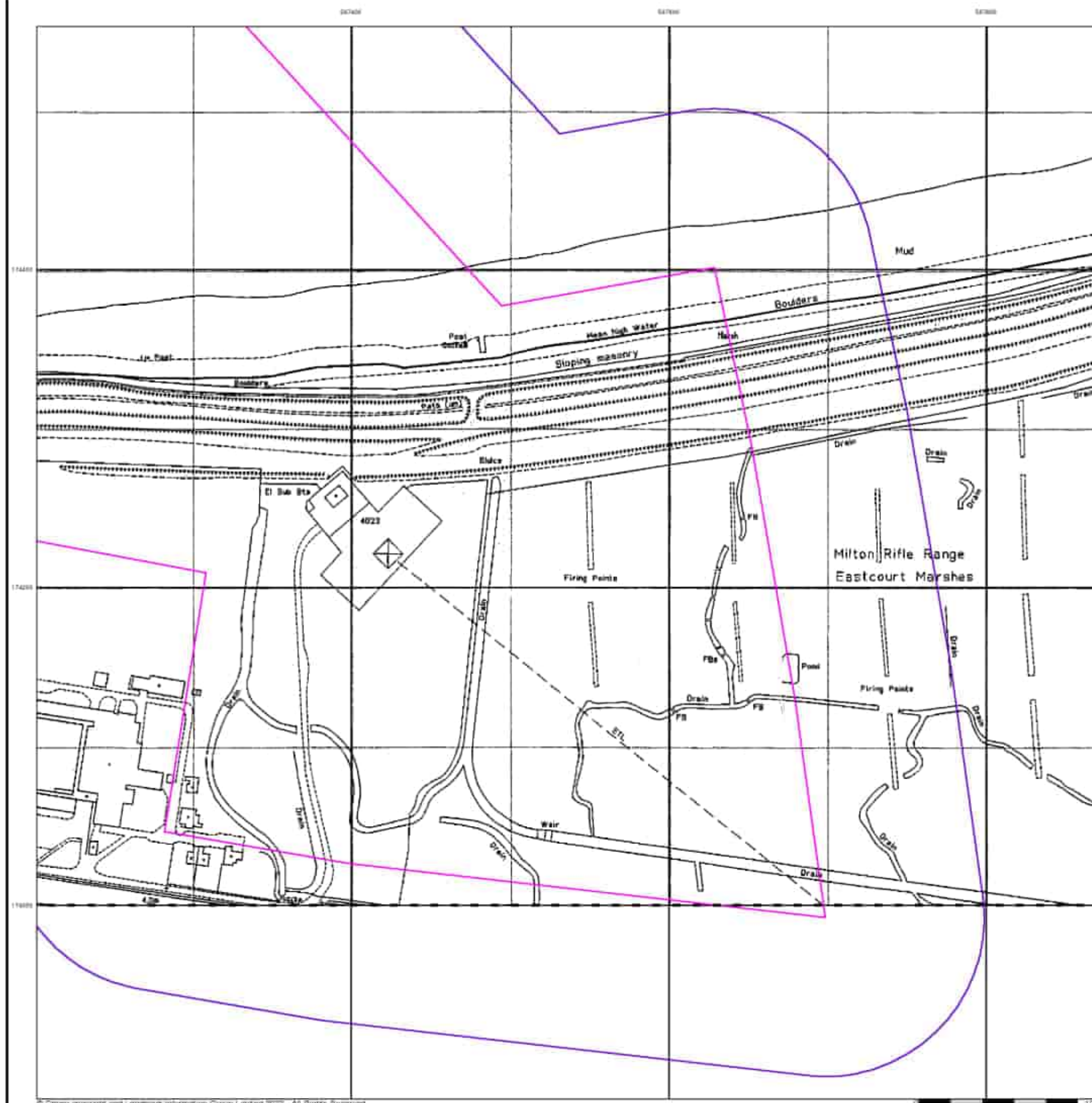


Order Details

Order Number: 302366136_1_1
 Customer Ref: 500199 TKRE
 National Grid Reference: 557880, 174130
 Slice: B
 Site Area (Ha): 72.49
 Search Buffer (m): 100

Site Details

Site at, Tilbury, Thurrock

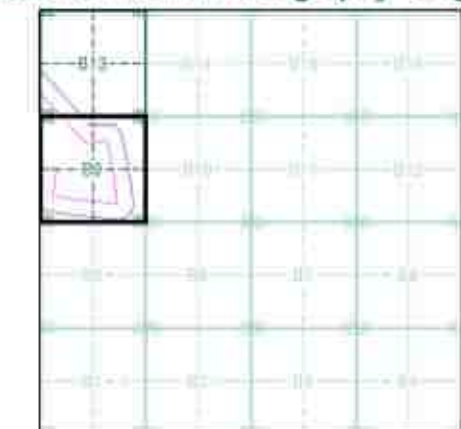


Historical Aerial Photography

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 B9



Order Details

Order Number: 302366136_1_1
 Customer Ref: 500199 TKRE
 National Grid Reference: 567880, 174130
 Slice: B
 Site Area (Ha): 72.49
 Search Buffer (m): 100

Site Details

Site at: Tilbury, Thurrock



General

- Specified Site
- Specified Buffer(s)
- Bearing Reference Point
- Map ID

Agency and Hydrological

- Contaminated Land Register Entry or Notice (Location)
- Contaminated Land Register Entry or Notice
- Discharge Consent
- Enforcement or Prohibition Notice
- Integrated Pollution Control
- Integrated Pollution Prevention Control
- Local Authority Integrated Pollution Prevention and Control
- Local Authority Pollution Prevention and Control
- Local Authority Pollution Prevention and Control Enforcement
- Pollution Incident to Controlled Waters
- Prosecution Resulting to Authorised Processes
- Prosecution Resulting in Controlled Waters
- Registered Radioactive Substance
- River Network or Water Feature
- River Quality Sampling Point
- Substantiated Pollution Incident Register
- Water Abstraction
- Water Industry Act Referral

- Waste
- BOS Recorded Landfill Site (Location)
- BOS Recorded Landfill Site
- EA Historic Landfill (Buried Pipe)
- EA Historic Landfill (Rigged)
- Integrated Pollution Control Registered Waste Site
- Licensed Waste Management Facility (Landfill Boundary)
- Licensed Waste Management Facility (Location)
- Local Authority Recorded Landfill Site (Location)
- Local Authority Recorded Landfill Site
- Potentially Infilled Land (Non-water)
- Potentially Infilled Land (Non-water)
- Potentially Infilled Land (Non-water)
- Potentially Infilled Land (Water)
- Potentially Infilled Land (Water)
- Potentially Infilled Land (Water)

- Registered Landfill Site
- Registered Landfill Site (Location)
- Registered Landfill Site (Over Buried or Other)
- Registered Landfill Site (Over Buried or Other)
- Registered Waste Transfer Site (Location)
- Registered Waste Transfer Site
- Registered Waste Treatment or Disposal Site (Location)
- Registered Waste Treatment or Disposal Site

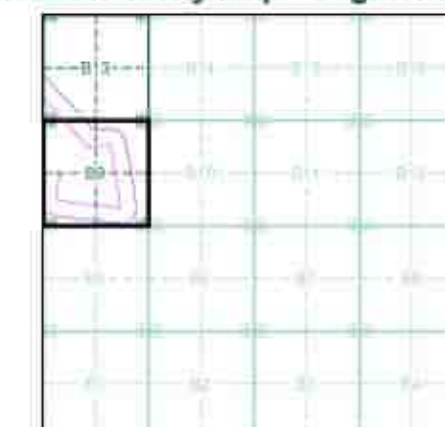
Hazardous Substances

- COMAH Site
- Explosive Site
- HMHS Site
- Planning Hazardous Substance Consent
- Planning Hazardous Substance Enforcement

Geological

- BOS Recorded Mineral Site

Site Sensitivity Map - Segment B9



Order Details

Order Number: 302366136_1_1
 Customer Ref: 500199 TKRE
 National Grid Reference: 567880, 174130
 Slice: B
 Site Area (Ha): 72.49
 Plot Buffer (m): 100

Site Details

Site at, Tilbury, Thurrock



Industrial Land Use Map

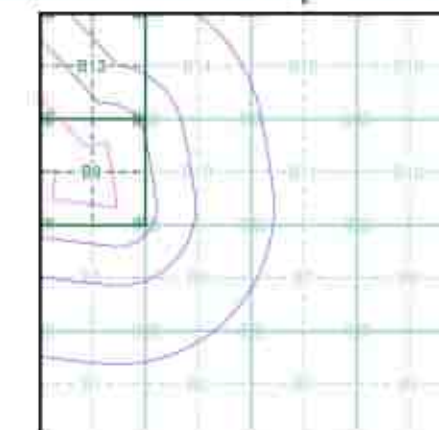
General

- Specified Site
- Specified Buffer(s)
- Bearing Reference Point
- Site
- Map ID

Industrial Land Use

- Contemporary Trade Directory Entry
- Fuel Station Entry
- Gas Pipeline
- Points of Interest - Commercial Services
- Points of Interest - Education and Health
- Points of Interest - Manufacturing and Production
- Points of Interest - Public Infrastructure
- Points of Interest - Recreational and Environmental
- Underground Electrical Cables

Industrial Land Use Map - Slice B



Order Details

Order Number: 302366136_1_1
 Customer Ref: 500199 TKRE
 National Grid Reference: 557880, 174130
 Slice: B
 Site Area (Ha): 72.49
 Search Buffer (m): 1000

Site Details

Site at, Tilbury, Thurrock

General

- Specified Site
- Specified Buffer(s)
- Bearing Reference Point
- Map ID

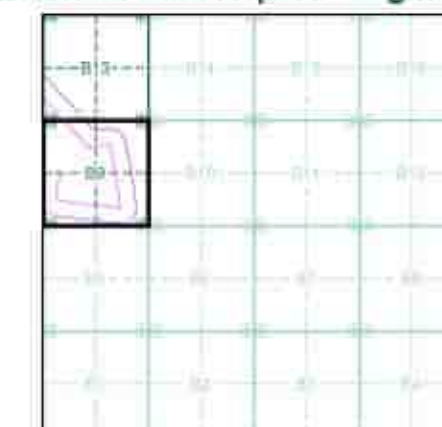
Historical Building Plans

- Area Cleared due to Entry Action
- Asbestos
- Above Ground Fuel Tanks
- Benzeno/Benzonaphthalene, Naphthalene/Kerosene
- Electricity Generation
- Electricity Sub-Station
- Gas Industry
- Gas Storage
- Gas Use
- Oil Industry
- Oil Storage
- Oil Use
- Pest based Oils
- Pesticides
- Petrol and Diesel Industry
- Petrol and Diesel Storage
- Petrol and Diesel Use
- Potential Fuel Gas
- Potential Fuel Oil
- Potential Fuel Use
- Potential Petrol and Diesel
- Potential Tanks
- Potentially Fuel-related Tanks
- Underground Fuel Tanks

Historical Tanks and Energy Facilities

- Electrical Gas Station Facility
- Electricity Industry Facility
- Gas Industry Facility
- Gas Monitoring Facility
- Miscellaneous Power Facility
- Oil Industry Facility
- Petroleum Storage Facility
- Potential Tank
- Tank

Historical Data Report - Segment B9

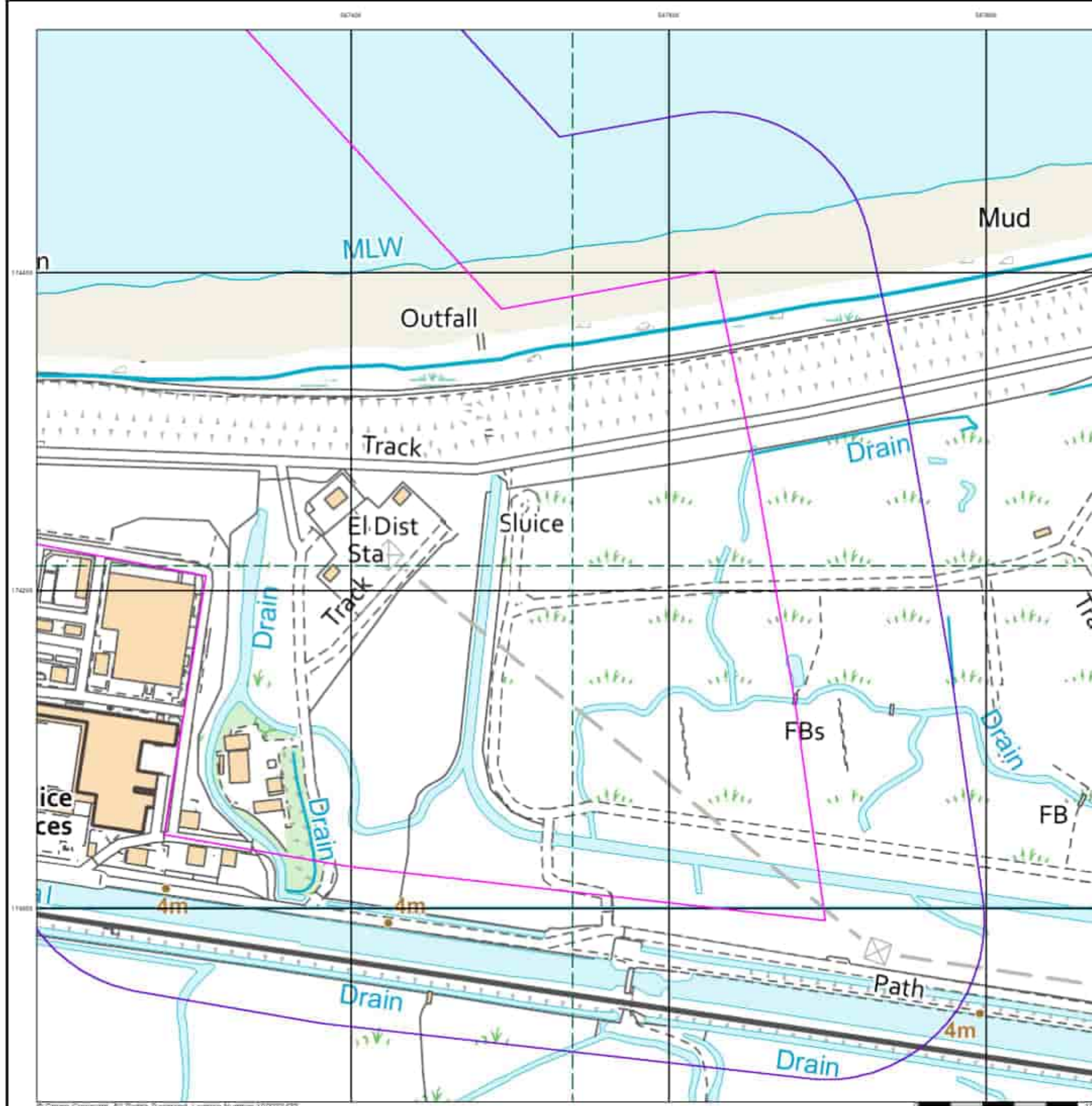


Order Details

Order Number: 302366136_1_1
 Customer Ref: 500199 TKRE
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 Slice: B
 Site Area (Ha): 72.49
 Plot Buffer (m): 100

Site Details

Site at, Tilbury, Thurrock



Appendix C : BGS Exploratory Hole Records



NGRC
BOREHOLE RECORDS
ADJUSTMENT FORM

QUARTER SHEET

TQ 67SE

BH REGISTRATION NUMBER

142-150

RECORDS ENTERED AND HELD BY WALLINGFORD

BH REGISTRATION NUMBER(S)



SOUTHERN LS SOUTHERN EA

271

TQ67SE

TQ 67/88

Site Identifier	Data Sheet	Data Source	Original File ID
10403	104/1/0147	TONS RIDGE	1/0493/119

IDS:

Class	Name
BGSHG	
EA	

NGR: 566960 174120 Precision: 5
Elevation: Units:
Measuring Point:
Site Name: GRAVESEND
Locality: GRAVESEND
Catchment:

Well Depth: 18 Units: m
Casing Dep: Units:
Well Diameter Max: 10 Units: in
Well Diameter Min: 2 Units:
Observation boreholes ☒
Obs_notes: 4 OBS. 1 EXTENDS INTO CLAY

Borehole Stratigraphy	Soil	Type	From	To	Thick	Unit	Dot	Tested
GRAVEL			0	20		m		☒
CLAY								

no gravel at base
between 20 & 25m

TQ 67/88

Pump Test Id:	1				
Date of Test:	12/9/74				
Length of Test:	7.25 hrs	Hours:	7.25 hr		
Type of Test					
RWL:	2.24	WL Units:	m		
PWL:	3.98	Equilibrium:		Q/S:	
Drawdown:		Units:	gpm	Units:	
Pumping Rate:	1000				

Confidence

☐ Excellent ☐ Good ☐ Average ☐ Poor ☐ Very Poor

T + S:

[illegible]

COMMENTS: DD only distinguishable in 1st 3 mins of test (to 2.36 m), then water level shows tidal fluctuation, reaching lowest level of 4.24 m at low tide, $5\frac{1}{2}$ hrs after start of pumping. Flared & checked salt at one corner while being pumped.



Driller.....Herbert.....

SMITH & WEBB (DRILLING) LTD
BORING RECORD

Site Gravesend B.H. No 1

Client Baker Associates

Site Address Denton Wharf, Mark Lane, Gravesend DA12 2PL NGR TQ 66913 74190

Boring Started 31st July 2015 Boring Completed 5th August 2015 Level

Dia. of Bore 230 & 200mm Cased to 18.5m b.s. with 150mm dia. casing and to b.s. with dia. casing

Water struck at: (1) b.s. (2) b.s. (3) b.s. (4) b.s.

Standing W.L. in bore at on b.s.

Remarks. 18.5m of 150mm diameter uPVC lining tube installed with lower 5m slotted with 10mm gravel.

pack surround.

	DEPTH		THICKNESS	SAMPLE DETAILS		
	FROM	TO		NO.	TYPE	DEPTH
Brown sand & gravel	G.L.	0.50	0.50			
Black sand & gravel	0.50	1.50	1.00			
Grey clay and silt	1.50	11.50	10.00			
Sand and gravel	11.50	12.20	0.70			
Grey clay, brown sand & gravel	12.20	13.50	1.30			
Sand and gravel	13.50	18.50	<u>5.00</u> <u>18.50</u>			

Appendix D : Preliminary Unexploded Ordnance (UXO) Threat Assessment

PRELIMINARY UNEXPLODED ORDNANCE (UXO) THREAT ASSESSMENT

Meeting the requirements of *CIRIA C681* 'Unexploded Ordnance (UXO) – A guide for the Construction Industry' Risk Management Framework



6 ALPHA PROJECT NUMBER	10165	ORIGINATOR	L. Hayes
LANDMARK ORDER NUMBER	302771717_1	REVIEWED BY	L. Gregory
CLIENT REFERENCE	500199 TKRE	RELEASED BY	L. Gregory
PROJECT	Tilbury	DATE	19 th October 2022
RECOMMENDATION	This Study Site requires a Detailed UXO Threat and Risk Assessment		

STUDY SITE

The Study Site is described as “Site at, Tilbury, Thurrock”, and it is centred on National Grid Reference 566820, 175000.

THREAT POTENTIAL AND RECOMMENDATIONS

The potential for a UXO hazard to occur, and more specifically, the potential for unexploded WWI and WWII ordnance to exist at this site is assessed as being **LIKELY** (*Figure 2*).

In accordance with CIRIA C681 Chapter 5 on managing UXO risks, *6 Alpha* recommends that the next stage in the risk management framework is:

DETAILED UXO THREAT & RISK ASSESSMENT

We would be pleased to provide this service, please contact *Envirocheck* for further details:



REPORT SUMMARY

During WWII, the Study Site was situated within *Thurrock Urban District* and *Gravesend Municipal Borough*, which recorded 10 and 17 High Explosive (HE) bomb strikes per 100 hectares respectively; both “low” levels of bombing.

Luftwaffe aerial reconnaissance photography associated with the Study Site identified *Tilbury Fort* (705m west) as a primary bombing target.

Air Raid Precaution (ARP) records did not document any HE bomb strikes on-site but two were recorded impacting in the wider area; 795m west-south-west and 995m west of the Site. Further research also uncovered evidence of bombs impacting in the *River Thames* near *Tilbury Fort*, though their precise locations have not been. In addition, anecdotal accounts suggested that over 100 Incendiary Bombs (IBs) impacted around *Milton Rifle Range* (located on-site).

Official bomb damage mapping was not available. Nonetheless, further research of historical records identified areas of bomb damage at the former *Denton Isolation Hospital* (385m south-west), within *Tilbury Fort* (705m west) and at the railway line near *Denton Halt* (745m south-west).

Furthermore, the aforementioned *Milton Range* is located across the southern portion of the Study Site and comprises a rifle range, and a police training area is located immediately south-west. Numerous WWII-era defensive installations were also noted within the vicinity of the Study Site, including a *Pillbox* within the Site’s northern portion.

Given that bombing and military activity were recorded on-site; it would suggest that further action is warranted to address the potential for UXO encounter.

USING THIS REPORT

This Preliminary Assessment is designed to inform environmental and construction professionals of the potential threat of military related explosives and/or ordnance on, or in, the vicinity of the Study Site.

This assessment is designed to be employed as a site-screening tool to meet with the requirement of Phase One of the *CIRIA UXO Risk Management Framework*; there are two broad prospective outcomes; either the threat level requires a detailed threat & risk assessment; or no further action is required. In the former instance we can provide a report within 10 working days (or more quickly upon application).

Two figures accompany the report, the *Second World War* (WWII) High Explosive (HE) Bomb Density and the final Probability of UXO Encounter. The purpose of this approach is to demonstrate that whilst bomb density statistics give an indication for WWII bombing, they should not be relied upon exclusively to generate a holistic assessment.

For further information, please contact *Envirocheck*:

Website: <http://www.envirocheck.co.uk>

Telephone: +44 (0)844 844 9952

Email: customerservice@envirocheck.co.uk

DATA FINDINGS

Threat Source (within 1,000m)	Detail	
	Identified	Comments
 Military Facilities/Activity	✓	<i>Tilbury Fort</i> (705m west).
 Ordnance Manufacture/Storage	✓	<i>Tilbury Fort</i> (705m west) was used as an ammunition store during WWII.
 WWII Decoy Bombing Sites	✓	A QF/QL decoy bombing site was located 940m north.
 WWII Defensive Features	✓	Six WWII-era defensive features were located within 880m, including a <i>Pillbox</i> directly on-site.
 WWII <i>Luftwaffe</i> Designated Bombing Targets	✓	<i>Luftwaffe</i> aerial photography identified <i>Tilbury Fort</i> (705m west) as a primary bombing target.
 WWII Bomb Strikes (Study Site Boundary)	✓	Further research noted numerous IB strikes within the Study Site.
 WWII Bomb Strikes (Wider Area)	✓	ARP records identified HE bomb strikes 725m south-west, 795m west-south-west and 995m west.
 WWII Bomb Damage	✓	Bomb damage was documented to structures 385m south-west, 705m west and 745m south-west.
 Abandoned Bomb Register	✗	The official abandoned bomb list did not identify any abandoned bombs located within 1,000m.
 Potential Threat Sources	✓	The most probable UXO threat is posed by WWII <i>German</i> HE bombs and <i>British</i> AXO/LSA/SAA.
 WWII Bombing Density Per 100 Hectares	✓	<i>Thurrock Urban District</i> and <i>Gravesend Municipal Borough</i> recorded 10 and 17 HE bomb strikes per 100 hectares, respectively.

IMPORTANT NOTES

1. The term 'Preliminary UXO Threat Assessment' has been used to describe this report, to fall in line with the *CIRIA* C681 guidelines. Whilst the term 'Risk' can be justifiably used at this stage, the reader should note that the 'Consequence' function of 'Risk' is not considered. Should it be required, this would be addressed in the 'Detailed UXO Threat & Risk Assessment' (Stages 2 and 3).
2. This report is accurate and up to date at the time of writing.
3. The assessment levels have been generated from historical data and third-party sources. Where possible *6 Alpha* have sought to verify the accuracy of such data, but cannot be held accountable for inherent errors that may be in third party data sets (e.g. *National Archives* or library sources).
4. *6 Alpha* have exercised all reasonable care, skill and due diligence in producing this service.
5. Whilst every effort has been used to identify all potential UXO/explosive threats, there were a number of private facilities, which may not have released privately recorded information concerning UXO/explosive threats into the public domain. It is therefore possible that some of the aforementioned sites may not be included within the database.

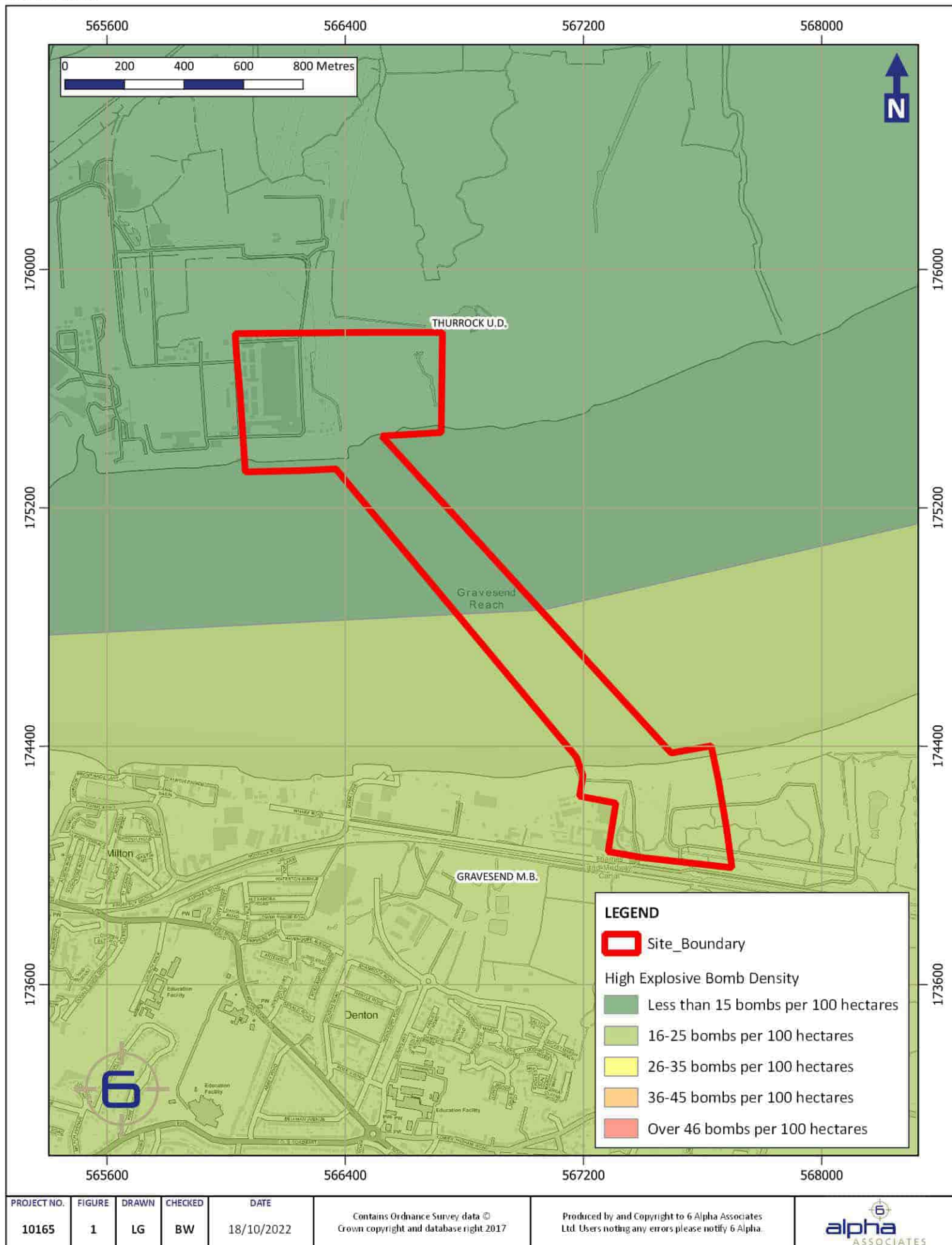


British National Grid

Site at, Tilbury, Thurrock



WWII High Explosive Bomb Density

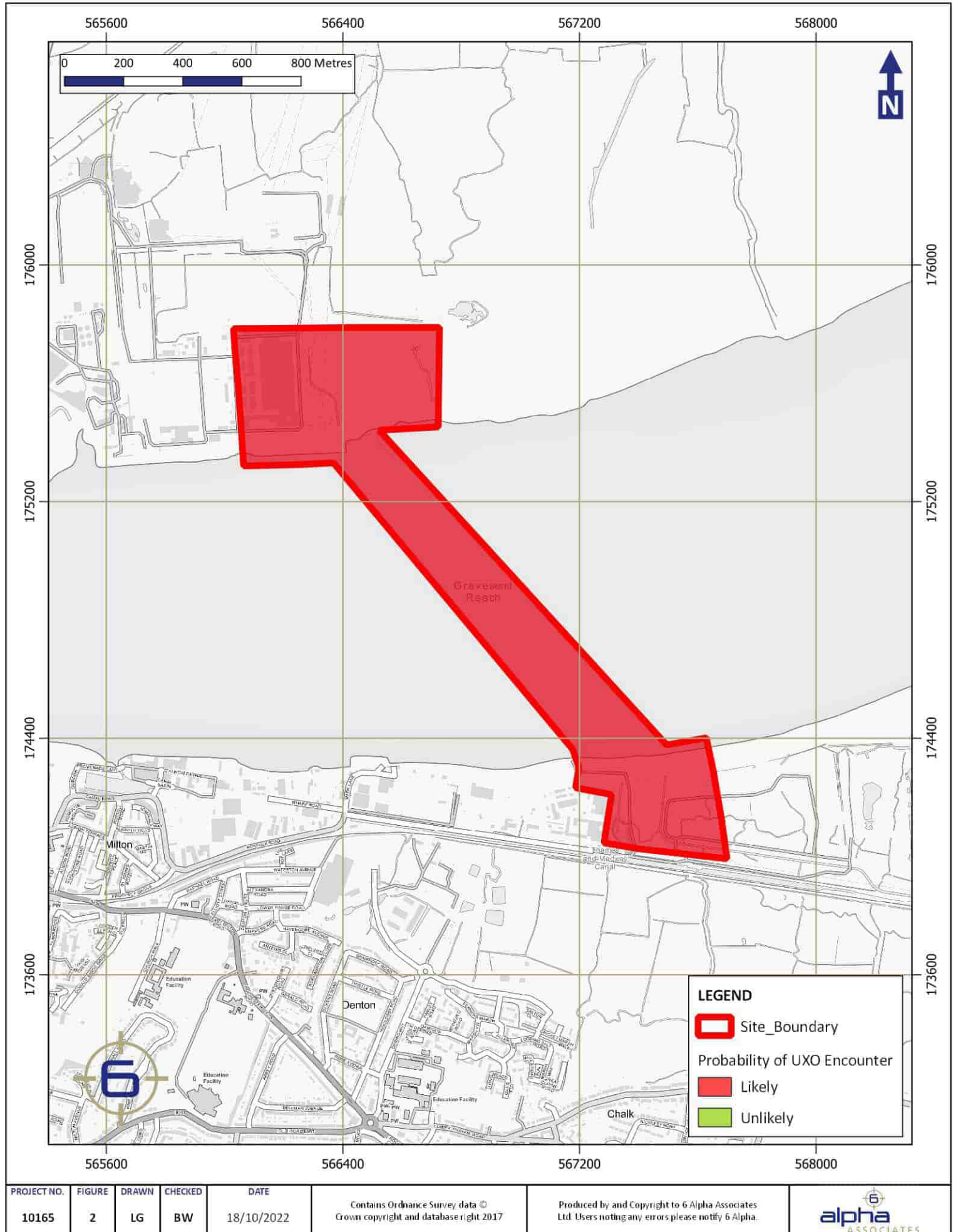




British National Grid

Site at, Tilbury, Thurrock

Probability of UXO Encounter

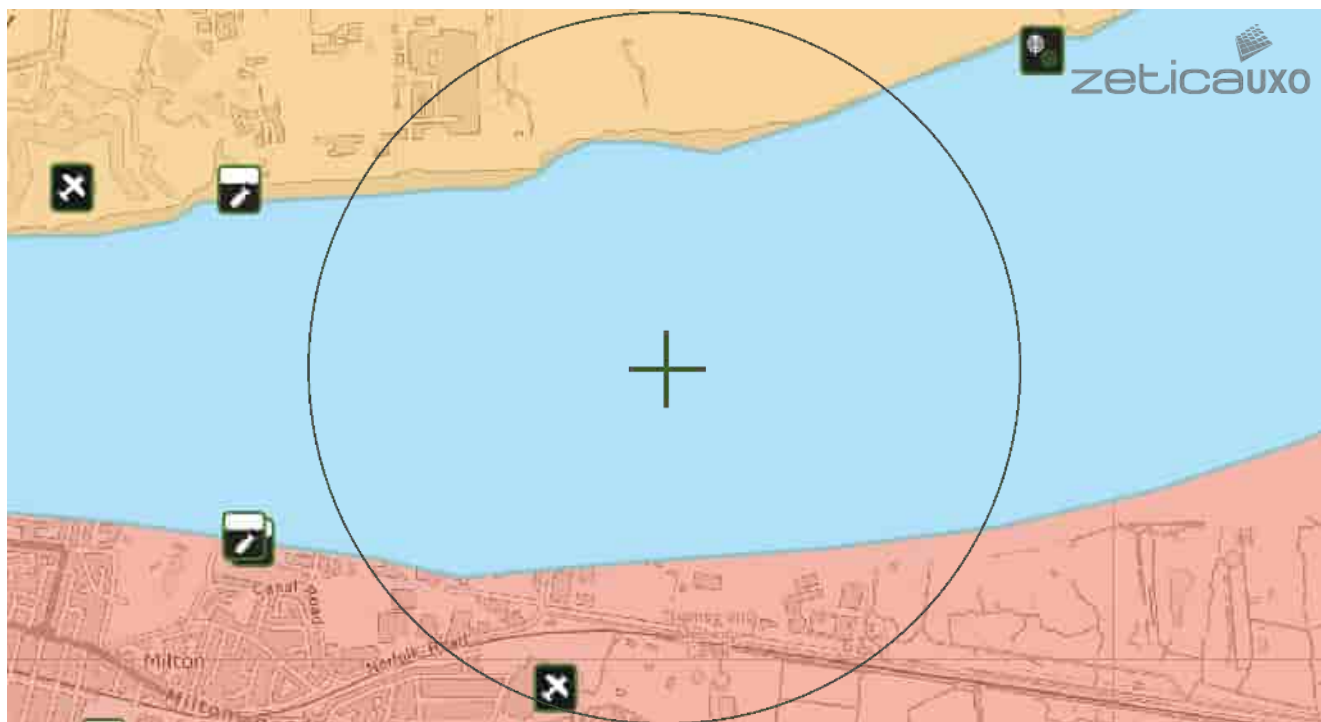


UNEXPLODED BOMB RISK MAP



SITE LOCATION

Map Centre: 566763,174811



LEGEND

- High:** Areas indicated as having a bombing density of 50 bombs per 1000acre or higher.
- Moderate:** Areas indicated as having a bombing density of 15 to 49 bombs per 1000acre.
- Low:** Areas indicated as having 15 bombs per 1000acre or less.

- military**
- industry**
- UXO find**
- transport**
- dock**
- Luftwaffe targets**
- utilities**
- Bombing decoy**
- other**

How to use your Unexploded Bomb (UXB) risk map?

The map indicates the potential for Unexploded Bombs (UXB) to be present as a result of World War Two (WWII) bombing.

You can incorporate the map into your preliminary risk assessment* for potential Unexploded Ordnance (UXO) for a site. Using this map, you can make an informed decision as to whether more in-depth detailed risk assessment* is necessary.

What do I do if my site is in a moderate or high risk area?

Generally, we recommend that a detailed UXO desk study and risk assessment is undertaken for sites in a moderate or high UXB risk area.

Similarly, if your site is near to a designated Luftwaffe target or bombing decoy then additional detailed research is recommended.

More often than not, this further detailed research will conclude that the potential for a significant UXO hazard to be present on your site is actually low.

Never plan site work or undertake a risk assessment using these maps alone. More detail is required, particularly where there may be a source of UXO from other military operations which are not reflected on these maps.

If my site is in a low risk area, do I need to do anything?

If both the map and other research confirms that there is a low potential for UXO to be present on your site then, subject to your own comfort and risk tolerance, works can proceed with no special precautions.

A low risk really means that there is no greater probability of encountering UXO than anywhere else in the UK.

If you are unsure whether other sources of UXO may be present, you can ask for one of our **pre-desk study assessments (PDSA)**

If I have any questions, who do I contact?

tel: **+44 (0) 1993 886682**

email: **uxo@zetica.com**

web: **www.zeticauxo.com**

The information in this UXB risk map is derived from a number of sources and should be used in conjunction with the accompanying notes on our website: (<https://zeticauxo.com/downloads-and-resources/risk-maps/>)

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*Preliminary and detailed UXO risk assessments are advocated as good practice by industry guidance such as CIRIA C681 'Unexploded Ordnance (UXO), a guide for the construction industry'.

Appendix E : Photolog

Client Name: National Grid
Electricity Transmission

Site Location: Gravesend

Project No.
60677311

Photo No.
1

Date:
11/09/2023

Direction Photo Taken:

East

Description

The Site is located within a vegetated area, characterised by rough grassland and bushes.



Photo No.
2

Date:
11/09/2023

Direction Photo Taken:

South-east

Description

The eastern part of the Site and the land immediately east is leased and used as a Police Training Centre for rifle shooting.



Client Name: National Grid
Electricity Transmission

Site Location: Gravesend

Project No.
60677311

Photo No.
3

Date:
11/09/2023

Direction Photo Taken:

North-east

Description

The Eastcourt Marshes Electricity Substation borders the Site to the north-west.



Photo No.
4

Date:
11/09/2023

Direction Photo Taken:

West

Description

Thames and Medway Canal adjoins the Site to the south.



Client Name: National Grid
Electricity Transmission

Site Location: Gravesend

Project No.
60677311

Photo No.
5

Date:
11/09/2023

Direction Photo Taken:
South

Description
Several surface water drains are located on the Site. Photo shows the sluice gate / outfall which leads to the River Thames.



Photo No.
6

Date:
11/09/2023

Direction Photo Taken:
South-east

Description
The eastern part of the Site was fenced with horses grazing.



