

## **EXECUTIVE SUMMARY**



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Parsons Brinkerhoff Ltd. (PB) was commissioned by Gateway Energy Centre Limited (GECL) to undertake a Flood Risk Assessment (FRA) at the proposed site of the Gateway Energy Centre (GEC) Combined Cycle Gas Turbine (CCGT) Power Station. The aim of this FRA is to determine the risk of flooding to the site and the potential flooding impact of the development on the surrounding area.

The proposed GEC site is located on the banks of the River Thames, near Coryton in Thurrock. The site is approximately 11.3 ha and forms one of several plots of land within the former Thames Haven Oil Refinery. Alongside development of the GEC, the remainder of the Thames Haven landholding will be developed as the London Gateway (LG) Logistics and Business Park (for further information on the LG Logistics and Business Park and the wider LG Development see the Environmental Statement (ES) Volume 1 of the GEC ES).

A Level 3 FRA has already been undertaken for the LG Development as a whole. This FRA indicates that the GEC site is at risk from tidal flooding from the Thames Estuary, particularly from storm surge tides. However, it also indicates that the site is currently protected by flood defences which offer adequate protection of the site from both a 1 in 200 and 1 in 1,000 year flood event. This FRA also indicates that a new dock and quay wall will be constructed as part of the LG Port development which will provide extra protection to the site, beyond the predicted 1 in 1,000 year flood event throughout the lifespan of the CCGT site, even taking into consideration the affects of climate change. This FRA for GEC has therefore built on the previous study and focuses specifically on risks to the proposed CCGT site.

The risk posed to the site by tidal inundation is therefore considered negligible. In addition, the site is not considered to be at risk from any fluvial sources.

Raising of site levels, access roads and floor levels in critical areas of the plant will provide further protection to the GEC and allow safe evacuation, even in the unlikely event of a breach of the defences or from overland flow from adjacent sites.

Detailed hydrodynamic modelling has not been undertaken specifically for the GEC site. However, hydrodynamic models undertaken for the larger LG Development have been studied to assess the risk to the site following a breach in flood defences. Results of the modelling exercise have confirmed that any risk to the site, even after a breach in flood defences would be negligible, particularly if site levels and floor levels were raised.

A flood risk management strategy will be prepared for the whole LG Development as a stand alone document to inform the future occupants of the site of emergency planning procedures. This will include an overview of flood risk in the area, the impacts of a defence breach and recommended evacuation procedures.

Notwithstanding the above, the GEC development has also been shown to pass both the sequential and exception tests.





## SECTION 1

# INTRODUCTION



## **1 INTRODUCTION**

### **1.1 Project Background**

1.1.1 Gateway Energy Centre Limited (GECL) proposes to construct and operate a Combined Cycle Gas Turbine (CCGT) plant known as Gateway Energy Centre or GEC. The proposed CCGT will provide up to 900 MWe of power generation capacity and will burn natural gas. Construction of GEC is proposed to commence in 2012, with commissioning in 2014, and first commercial operation expected in 2015. The plant has an anticipated lifespan of 35 years.

1.1.2 As part of the planning process, Parsons Brinckerhoff Limited (PB) was commissioned by GECL to prepare a Flood Risk Assessment (FRA) to support a Section 36 Consent application for the development of GEC. This assessment identifies the flood risk to the site based on the available information and addresses the requirements of Planning Policy Statement 25 (PPS 25) – Development and Flood Risk and CIRIA C624: ‘Development and Flood Risk Guidance’.

### **1.2 Flood Risk Methodology**

1.2.1 The aim of an FRA is to assess the risks of all forms of flooding to and from a development. PPS 25 emphasises the need for a risk-based approach to be adopted through the application of the Source-Pathway-Receptor model. The Source-Pathway-Receptor model firstly identifies the causes or ‘sources’ of flooding to and from a development. The identification is based on a review of local conditions and consideration of the effects of climate change. The nature and likely extent of flooding arising from any one source is considered, e.g. whether such flooding is likely to be localised or widespread. The presence of a flood source does not always infer a risk. It is the exposure pathway or the ‘flooding mechanism’ that determines the risk to the receptor and the effective consequence of exposure. For example, sewer flooding does not necessarily increase the risk of flooding unless the sewer is local to the site and ground levels encourage surcharged water to accumulate.

1.2.2 The varying effect of flooding on the ‘receptors’ depends largely on the sensitivity of the target. Receptors include any people or buildings within the range of the flood source, which are connected to the source of flooding by a pathway. In order for there to be a flood risk, all the elements of the model (a flood source, a pathway and a receptor) must be present. Furthermore, effective mitigation can be provided by removing one element of the model, for example by removing the pathway or receptor.

### **1.3 Site Location and Description**

1.3.1 The GEC site is situated on the north bank of the Thames Estuary and lies approximately 6 km east of the A13. The A1014 dual carriageway (The Manorway) lies to the north of the site and runs east to west to provide a link with the A13, which in turn links in with the M25 at Junction 30.

1.3.2 The nearest residential settlements are at Corringham and Fobbing which lie approximately 4 km to the west, Canvey Island which lies approximately 5 km to the east, and Basildon which lies approximately 7 km to the north.

1.3.3 The Ordnance Survey (OS) Grid Reference of the centre of the site is approximately 573209, 182165.

1.3.4 Whilst the application site boundary for GEC incorporates areas to the north and west which may be used for laydown during construction, overall approximately 29.1 hectares (71.9 acres), once constructed the GEC site will be approximately

11.3 hectares (28.0 acres) in size. The GEC site includes the land to be set aside for the purposes of installing carbon capture equipment if required in the future.

1.3.5 A plan showing the location of the proposed GEC site is shown in Figure 1 of Appendix A.

1.3.6 Although different developments within the LG Development will be constructed at different times, this FRA for GEC has assumed that the build-out of the LG Development will be in line with Outline Planning Permission granted for the site in May 2007.

## **1.4 Geology**

1.4.1 Reference to British Geological Survey (BGS) 1:50,000 Series Sheets 258 and 259, Southend and Foulness (Solid and Drift Editions) indicates that the superficial geology across the site comprises made ground, overlying marine or estuarine alluvium (undifferentiated or clay) overlying solid geology of Lower London Tertiaries. These Tertiaries comprise Woolwich beds (greenish yellow fine sand with frequent shell beds), Oldhaven Beds (firm yellow to buff fine sand) and Thanet Beds (predominantly silty fine sand). Upper chalk deposits are anticipated to underlie the site at significant depth.

1.4.2 This geological sequence has also been largely confirmed by intrusive investigations undertaken at the site by ERM Limited. (2000) and Fugro Limited. (2008). These ground investigations recorded made ground overlying drift deposits of marine / estuarine alluvium and sand and gravels overlying deposits of stiff London Clay. The clay deposits were found to overlie Woolwich and Thanet beds comprising interbedded fine sand, silt and clay with subordinate gravel beds. Made ground deposits were often found to be contaminated.

## **1.5 Hydrology and Indicative Flood Maps**

1.5.1 The main watercourse in the vicinity of the site is the estuary of the River Thames, a large, tidally influenced river which lies approximately 200 m south of the southern site boundary. The Thames is approximately 215 miles long. It originates near Cirencester in the Cotswolds and flows east through London and past the southern boundary of the GEC site, before discharging into the North Sea, approximately 15 km east of the site.

1.5.2 Environment Agency (EA) Indicative Flood Maps indicate that the entire site is located in Flood Zone 3a. Developments in this classification are described as being “*at risk of flooding if flood defences are not present*”. Land in this zone is assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater (>0.5%) annual probability of flooding from the sea. The EA Indicative Flood Map also indicates that the site is offered protection from flood by existing flood defences.

1.5.3 Data from the EA and Thurrock Council indicates that the flood defences were constructed to protect the area from a tidal flood event with an annual occurrence probability of 0.1%, i.e. a 1 in 1000 year event, in the year 2030. The site and surrounding area is therefore already protected to a very high standard under normal circumstances.

## **1.6 Adjacent Sites**

1.6.1 The site is bounded to the south by the River Thames Estuary and associated jetties and mudflats. The riverside location of the proposed development site is characterised by industrial developments including oil refineries, warehouses and depots and sewage works.

- 1.6.2 To the east of the GEC site lies the existing Coryton CCGT Power Station (700 m east), and the existing Coryton Oil Refinery (950 m east).
- 1.6.3 GEC will be located on land within the LG Development. The LG Development includes most of the land at the former Shell Oil Refinery Site at Shell Haven near Corringham and Stanford le Hope (Essex). Further discussion of the GEC site and its surroundings, including the LG Development, is provided in Section 5 of Volume 1 of the ES.
- 1.6.4 Land immediately surrounding the north / west of the former Shell Oil Refinery Site (but within the northern border of the LG Development) largely consists of grazing marshland interspersed by a network of reed-fringed drainage ditches and creeks.
- 1.6.5 The Manorway (A1014) runs along the northern edge of the overall LG Development for much of its length.
- 1.6.6 West of the former Shell Oil Refinery site (but within the western border of the LG Development) is cultivated arable land with rises gently towards the north. This land is characterised by generally rectangular arable fields enclosed by hedgerows and trees.
- 1.6.7 A number of farms are situated in this western area, which include three Grade II Listed Buildings: Old Hall; Old Garlands; and, Great Garlands Farm. Further west, the cultivated arable land abuts a sports ground on the edge of Stanford-le-Hope. This area forms the boundary of Stanford-le-Hope, and adjoins existing housing characterised by a mixture of post-war local authority and 1960s / 1970s sub-urban style housing developments.
- 1.6.8 East of the former Shell Oil Refinery site is the Aviation Fuel Storage Farm, the existing CECL Power Station and the Coryton Oil Refinery.
- 1.6.9 Most of the southern boundary of the LG Development is adjacent the River Thames. Land to the south west consists of marshes and mudflats.

## **1.7 Consultation with Relevant Bodies**

- 1.7.1 On October 1<sup>st</sup> 2006 the Environment Agency (EA) was made a Statutory Consultee for Planning Applications where flood risk is a key issue. The consultation requirement was introduced by Statutory Instrument 2006 No 2375: The Town and Country Planning (General Procedure Order) (Amendment) (No 2) (England) Order 2006. In December 2006, along with the introduction of PPS25, the Department for Communities and Local Government introduced The Town and Country Planning (Flooding) (England) Direction 2007, which introduces the new consultation arrangement.
- 1.7.2 Information provided by the EA, comprising predicted tidal high water levels for the 1 in 200 and 1 in 1,000 year tidal event has been used in this assessment, as have details of the existing flood defences at the Thames Haven site.
- 1.7.3 Previous studies that have been considered as part of the FRA for the proposed GEC include the following:
- The Thames Estuary 2100 Plan (TE2100) has been drafted by the EA and is currently under review. It provides advice on how the EA will respond to the growing threat of flooding in London over the next Century.
  - A previous Flood Risk Assessment, undertaken for the whole of the LG Development in 2007 by Scott Wilson Ltd.
  - Data from the National Tidal Sea Level Facility (NTSLF) provided by Proudman Oceanographic Laboratory has been used to provide information on highest

predicted tides at the Thames Estuary in the first 15 years of the plants operation.

- 1.7.4 Information on current flood defences and historical flooding events has also been taken from the Thurrock Council website.

## SECTION 2

# **FLOODING AND FLOOD RISK**





## **2 FLOODING AND FLOOD RISK**

### **2.1 Historical Flooding**

2.1.1 The Thames Valley has experienced flooding throughout its history. It is likely that the area close to the proposed GEC site has also experienced periodic flooding events, given its low lying location and proximity to the tidal reach of the Thames. There is evidence that flood defences were being built around the Corringham Marshes from as early as Medieval times, in order to create drier land for farming.

2.1.2 Possibly the most severe flood in living memory in the Thames Estuary occurred on January 31st and February 1st 1953. The people and industries of Purfleet, West Thurrock, Tilbury Town and Coryton were most badly affected by this flooding event which was caused by a surge tide. Serious flooding had occurred before, notably in the Stanford-le-Hope and Corringham area in 1881, but the landscape was now very different as settlement had increased along the river front. The floods of 1953 led to the loss of many lives and much property.

2.1.3 Following the 1953 floods, a programme of substantial and permanent flood defences were built all along the northern bank of the Thames Estuary. These flood defences appear to have served the site and surrounding area well, as there have been no recorded major tidal flooding incidents since 1953.

### **2.2 Risk of Tidal Flooding**

2.2.1 The River Thames lies approximately 200 m south of the southern site boundary. The tidal reach of the Thames stretches from the main estuary (approximately 15 km east of the site) to Teddington Lock, (approximately 80 km west of the site). The river drains a total catchment of approximately 15,000km<sup>2</sup> and is approximately 2.1 km wide by the proposed GEC site.

2.2.2 The main danger to the site arises from a combination of high tides and a storm surge. Very high tides occur twice monthly. Storm surges are created by water that has been drawn into the centre of a low-pressure system being pushed south by north or north-westerly winds. The channelling effect of East Anglia and the Dutch coast enhances the surge height. Water levels within the confines of the Thames Estuary can also be increased through a combination of wind-generated and low pressure-generated water level uplift. Global warming and a gradual tilting of the country towards the south east are bringing about a general rise in sea levels and a further risk of flooding to the south east of England.

2.2.3 The resultant risk from tidal sources to the proposed GEC site is therefore considered to be significant.

2.2.4 Estimated high tidal levels at the Thames Estuary and the EA estimated 1 in 200 year return period are given in Table 1. Return periods have been estimated for 2050 (estimated date of decommissioning of GEC) based on figures for predicted sea level rise in the south east of England quoted in Appendix B of PPS 25. These figures state that sea levels are expected to rise by 4.0 mm/yr until 2025 and then by 8.5 mm/yr from 2025-2050. Therefore, the total expected sea level rise during the operational lifetime of the plant is expected to be 256.5 mm.

2.2.5 The 1 in 200 year return period at the date of decommissioning of the whole of the LG development (2068) has been calculated at 5.64 m AOD taking into consideration climate change (Scott Wilson Ltd., 2007). Subtracting anticipated sea level rises over an 18 year period gives a 1 in 200 year return period of 5.44 m AOD at the date of decommissioning of the CCGT plant (2050). The 1 in 1,000 year return period at the date of decommissioning of the LG development has been calculated as 6.01m AOD.

Applying the same calculation as for the 1 in 200 year return period gives a predicted flood level of 5.81 m AOD in 2050. Although data from Thurrock Council and the EA suggest that the site is currently protected to a 1 in 1,000 year return period until 2030 (5.09 m AOD) the actual height of the flood defences in the vicinity of the proposed GEC site are between 6.4 and 6.7 m AOD.

- 2.2.6 Based on these calculations, it is reasonable to assume that the proposed GEC site will be protected from a 1 in 200 year flood event for the entirety of its lifetime, even taking into consideration climate change. The site will also most likely be protected during a 1 in 1000 year event, given that sea levels have not risen as much as anticipated when the flood defences were constructed.
- 2.2.7 It is understood that a new container port will be constructed as part of the larger LG development. The planning details of this port, as agreed by a Harbour Empowerment Order will be constructed upon land reclaimed from the Thames Estuary, approximately 500 m south west of the proposed GEC site.
- 2.2.8 The new quay wall constructed as part of the LG Port development will therefore form the new flood defence line, and the existing flood defence wall will be removed to allow access between the LG Port and the LG Logistics and Business Park. It has been agreed throughout the ongoing application process that the crest level of the new quay will be 6.85 m AOD. This is between 150 and 450 mm above the crest level of the existing defences and therefore provides an increased level of protection for the proposed GEC site.
- 2.2.9 The EA recommend that an additional 600 mm of freeboard is also allowed for in the construction of developments which are considered to be at greater risk from flooding. It is reasonable to assume that the proposed GEC site will still be protected by the flood defences in place, even taking this into consideration. Notwithstanding, floor levels at the site will also be raised slightly as part of the development works.

**TABLE 1- TIDE LEVELS AND RETURN PERIODS AT CORYTON**

<i><b>Tide Level (Return Period)</b></i>	<i><b>2050 (Estimated decommissioning date of GEC)</b></i>	<i><b>2030 (Estimated life of current flood defences)</b></i>	<i><b>Additional 600 mm of freeboard</b></i>
1 in 200 (0.5%)	5.44 m AOD		6.01 m
1 in 1000 (0.1)	5.81 m AOD	5.72 m AOD	6.22 m
<b>Highest predicted tide between 2012-2027 = 6.34m (Sheerness)</b>			
<b>Current Height of EA flood defences at Coryton = between 6.4 and 6.7m AOD</b>			
<b>Estimated height of new quay wall = 6.85 m AOD</b>			

## **2.3 Risk of Fluvial Flooding**

- 2.3.1 As the development is so close to the River Thames Estuary, the main source of flooding is likely to be tidal and mainly dictated by surge tides. The flow and water level in the Thames is dominated by tidal forces and the fluvial flows from the catchment have a minimal impact. The extreme tidal levels shown in Table 1 are far higher than those resulting from a major fluvial event, therefore further investigation is not considered necessary. The wider LG Development site is surrounded by farmland incorporating areas of grazing marsh and flets connected by a network of watercourses and drainage ditches. A significant length of channel is designated as a main river called the Stanford Boundary Drain, the Fobbing Common Sewer, and the

Manorway Creek. However, the local farmer manages water levels in the area by using sluice gates to divert flows for irrigation.

## **2.4 Waves**

- 2.4.1 Although the River Thames is affected by offshore swell and locally generated waves, the development site is protected by flood defences which are able to withstand large waves. For example the highest predicted tide at Sheerness (approximately 18 km south east of the proposed GEC site) in the first 15 years of the lifetime of the GEC is predicted as 6.34 m. Not only do the existing sea defences offer protection from this height, but the site is a significant distance from this anticipated high tide and as such is unlikely to experience these high water levels. The new sea defences constructed as part of the LG Development will be approximately 0.5 m above the highest predicted tide at Sheerness. Therefore even if this tide did travel all the way up the Thames, the site would still be protected.

## **2.5 Risk of Overland Surface Water Flooding from and to Adjacent Sites**

- 2.5.1 Land at the proposed GEC site is at approximately 2.1 m AOD and will be raised and levelled as part of the development. The land within the larger area of land proposed for development of the LG Development is at a similar level and will also be raised and levelled during development. The larger LG Development site is surrounded by relatively flat, permeable marshland. All site drainage at the proposed GEC site and LG Development will be managed so that it discharges into an appropriately designed drainage system before being discharged into the Thames or attenuation ponds. Additionally, floor levels will be raised in critical areas of buildings which are totally enclosed, manned 24 hours a day or where there is electrical equipment. There is therefore not considered to be a risk of the site flooding via overland drainage from adjacent sites, or of causing a significant flood risk to adjacent sites.

## **2.6 Site Generated Surface Water Runoff and Sewers**

- 2.6.1 At the time of this assessment the development layout plan is at an early feasibility stage, therefore this drainage and runoff assessment is not definitive but should guide considerations at the detailed design stage. Most of the details provided below are based on drainage details which are known about the wider LG Development (previously agreed during Outline Planning Permission).
- 2.6.2 The overall drainage strategy for the LG Development involves storage and conveyance of surface water runoff through a network of primary and secondary drainage channels. It is anticipated that these drainage channels will be located within landscaped corridors adjacent to the proposed road system. A number of ponds will also be required to provide the necessary volume of attenuation.
- 2.6.3 The proposed GEC will increase the area of hard, impermeable surfacing, including enclosed buildings by approximately 11.3 ha. Currently, the site is covered in grassland, therefore the development is expected to increase the amount of surface water generated by the site as a whole.
- 2.6.4 However, a new drainage system will be put in place as part of the GEC development which will connect into the wider LG Development's drainage system. The drainage system for the LG Development will provide attenuation for the 1 in 100 year rainfall event including a 30% allowance for climate change. The system will discharge into the Thames Estuary via two pumping stations located at the western and eastern extents of the new port. Due to the low lying and flat nature of the site it is not possible to provide a gravity connection.

- 2.6.5 Where possible, swale ditches and other SuDS drainage techniques will be incorporated into the drainage design. SuDS features primarily provide attenuation with additional water quality, amenity and wildlife benefits. The drainage strategy will follow the SuDS best practice guidance (e.g. CIRIA, publication C698, 2007) and will aim to mimic the natural drainage regime as closely as is practically possible within a development of this scale.

## **2.7 Climate Change**

- 2.7.1 The impact of the possible effects of climate change on flood risk in the south east of England are complex. For the UK as a whole, projections of future climate change indicate that more frequent short-duration, high-intensity rainfall and more frequent periods of long-duration rainfall could be expected. Rising sea levels and hence peak tide levels, will result in an increase in flood risk in those areas identified as being at risk of tidal flooding. In addition, it has been noted by PPS25 that annual rainfall in England and Wales is expected to increase by up to 10 per cent by the year 2050, however, seasonal variations could become wetter by as much as 20 per cent%. This issue affects the overall catchment of the Thames from both coastal and fluvial sources. Specific issues, with regard to the proposed development of the GEC are as follows:

- It is estimated that the lifetime of the plant will be 35 years. Based on the recommended contingency allowances for net sea level rise for the south east of England (Appendix B of PPS 25) sea levels are expected to rise by 4.0mm/yr to 2025 and by 8.5 mm/year from 2025 until the end of the operational life of the plant (2040). Therefore the expected total net sea level rise is expected to be 256.5 mm. Vertical movement of the land is also calculated into the estimated rise.
- As specified previously in this document, there are currently sea defences in place surrounding the proposed GEC site. These defences are designed to protect the site from a 1 in 1000 year flood event in 2030 (taking into consideration climate change). As part of the proposed development of the rest of the LG Development, new flood defences will be constructed which will offer even further protection beyond the anticipated lifespan of GEC plant even taking into consideration worst predictions of climate change.
- The maintenance of flood defences to sustain them at their current level is financed on a rolling programme. This programme does not guarantee that in the future as sea levels rise and the flood risk to the subject site increases that the level of the defences will be raised to maintain the current standard of protection. However, this is in line with current EA policy. The Thames Estuary 2100 Study is also currently being drafted by the EA, and based on initial results, it is likely that the EA will choose to maintain and improve existing flood defences around along the banks of the River Thames following the end of their design life of 2030. It is therefore anticipated that this policy position will be maintained for the lifetime of the development. In this way we can conclude that it appears reasonable to assume that the development will be safe for its design lifetime from rising sea levels due to climate change.
- The River Thames, in the region of the site, is very insensitive to increase in run-off rate because it is dominated by tidal action. Therefore we would not expect that the increased rate of run-off, due to increased rainfall from climate change, will present an additional risk to the site, as any increased fluvial inputs will be outweighed by rises in tidal activity.

**2.8 Flood Warning**

- 2.8.1 There is no residential development planned for the site, although some parts of the plant will be manned 24 hours a day. The statutory responsibility for issuing flood warnings now lies with the Environment Agency, although actions should also be taken by police and borough council staff on the receipt of flood warnings and during a flood event. Warnings are issued using television, local radio broadcasts and loudspeaker vans and, in addition, the Agency operate a system by which flood warning messages are telephoned to properties considered to be at significant risk of flooding. The 'Essex Flood Plan' sets out actions which should be taken by Essex Police, Essex district councils, and Essex County Council and has been prepared in accordance with the joint agreement reached by, Essex County Council, Essex Police, The Department for Environment, Food and Rural Affairs (Regional Service Centre) Cambridge and the Environment Agency (Anglian and Thames Regions). During a severe flood event, the District Councils work with the Police, Fire and Rescue services and the Environment Agency to co-ordinate the response.
- 2.8.2 In addition, a flood risk management strategy will be prepared for the whole LG Development as a stand alone document to inform the future occupants of the site of emergency planning procedures. This will include an overview of flood risks in the area, the impacts of a defence breach and recommended evacuation procedures.

**2.9 Safe access to and from the site**

- 2.9.1 The site is protected by sea defences which offer protection against flooding from the sea for the 1 in 1,000 and 1 in 200 year return period. In addition, it is possible that road access to and from the site will be raised above existing ground levels during construction of the LG development, meaning that even in the extreme event that the flood defences were breached access roads would remain safe.
- 2.9.2 Advance warnings will be provided by EA and other local services in the event of an extreme tidal flood that could overtop the riverbanks. Safe ground is available nearby (by the Manorway to the north of the site) and safe evacuation of the site can be made speedily such that the risk to human life, in the event of an extreme tidal event, is managed at a low residual level.



### SECTION 3

## **THE SEQUENTIAL TEST**





### **3 THE SEQUENTIAL TEST**

#### **3.1 Introduction**

3.1.1 The EA state that a sequential risk-based approach to determining the suitability of land for development in flood risk areas is central to PPS 25 and should be applied at all levels of the planning process.

3.1.2 The purpose of the sequential test is to steer new development towards areas with the lowest probability of flooding. Ideally this would be areas classified as Flood Zone 1. When approving land for development in flood risk areas, Local Authorities are expected to demonstrate that there are no suitable alternative development sites located in lower flood risk areas. A sequential test is used to prioritise sites in order of probability to flood risk and their acceptability in terms of allocation for development.

3.1.3 The Sequential Test should be applied to all developments which are considered at risk from flooding to demonstrate that there are no reasonably available sites in areas with a lower probability of flooding that would be appropriate to the type of development or land use proposed.

#### **3.2 Site Selection**

3.2.1 GECL have considered several sites for the development of the CCGT plant before settling on the preferred site at Thames Haven.

3.2.2 The main decisions influencing the decision making process were:

- The close proximity of the national electricity transmission system;
- The close proximity of the national gas transmissions system;
- Availability of industrial sites with sufficient land area;
- Economic benefits of proximity to the national electricity and gas networks;
- Compatibility with planning policies and local development plan;
- Potential for CHP in the area;
- Environmental considerations (such as conservation designations and the presence of protected species);
- Likely suitability for Carbon Capture and Storage (CCS);
- Opportunities to link beneficially with local industry; and
- Ideally, the site should be located in the south east of the UK so that it is close to centres of high electricity demand.

3.2.3 The location of new generation projects is driven by proximity to fuel sources and centres of demand. In general terms, the disposition of demand and generation capacity across the transmission system is such that much of the generation capacity is located in or towards the north of England, while much of the demand is in the south. For this reason, National Grid encourages new generation to be built near centres of demand, generally in the south. This is through the application of differential charging for transmission, resulting in the lowest charges being in the south and south east.

3.2.4 In addition, the location of existing InterGen Power Generation is an important consideration in the site selection process. Constructing a new plant near to an existing power station is standard industry practice as it allows power generators to

take advantage of economies of scale and utilise existing infrastructure wherever possible.

- 3.2.5 Gas supplies are also an important element of siting a new CCGT and with significant new supplies coming from Europe through pipelines in the south-east and the liquefied natural gas (LNG) terminal at the Isle of Grain, the prime location for a new build CCGT is in the south east of the UK.

### **3.3 Development Sites Considered**

- 3.3.1 A number of prospective sites in the south east were considered and through an iterative review process this lead to the identification of three potential sites located near the existing CECL Power Station.

- Site A – Part of the LG Development;
- Site B – A 45 acre brown field site owned by East of England Development Agency (EEDA) located in Canvey Island; and
- Site C – Not disclosed due to landowner confidentiality requirements.

- 3.3.2 The three sites were assessed for suitability based on potential environmental issues (including flooding) which could arise from the development.

**TABLE 2: ENVIRONMENTAL ISSUES CONSIDERED WHEN ASSESSING POTENTIAL DEVELOPMENT SITES**

<i>Environmental Issue</i>	<i>Proposed Indicators</i>
Flooding	Land lies within an area considered to be at risk of flooding (Flood Zone 3a in particular).
Land Use, Planning Context and Material Assets	Land use/planning designation, mature trees, agricultural resources, mineral resources Land uses of the surrounding area
Air Quality	Background air quality Factors influencing atmospheric dispersion Odour and dust
Noise and Vibration	Existing noise climate Screening and noise attenuation
Landscape and Visual	Visibility of site Existing landscape character of site Existing landscape character of surrounding area Landscape and visual impact
Ecology	Ecological habitats on-site Ecological habitats of surrounding area
Geology, Hydrogeology and Land Contamination	Geology and ground conditions Groundwater resources Surface water resources
Traffic and Infrastructure	Site access Main road network
Cultural Heritage	Archaeology on-site Archaeology and heritage of surrounding area

3.3.3 The key environmental advantages and sensitivities associated with each of the potential development sites identified are summarised in Table 3.

**TABLE3: KEY ENVIRONMENTAL ADVANTAGES AND SENSITIVITIES**

<i>Site</i>	<i>Key Advantage</i>	<i>Environmental Sensitivity</i>
Site A	Brownfield Closest location for grid and gas connections Significant separation from residential receptors Existing access to service the site. Designated for industrial development, on site of the LG Development	Visual impact  Site is within Flood Zone 3a but is protected by primary flood defences which are due to be renewed.
Site B	Brownfield Significant separation from residential receptors	Site is within Flood Zone 3a and not offered as much protection as site A.  Crosses a Site of Special Scientific Interest Located in closest proximity to residential receptors
Site C	Second closest location for grid and gas connections Significant separation from residential receptors Existing access to service the site.	Access issues from road network; Ground conditions and contamination; and Proximity to water course

### **3.4 Preferred Development Site**

3.4.1 Following the consideration of the three development sites, Site A was chosen as the preferred development site.

3.4.2 There are many advantages to Site A that make it an ideal location for power generation. These include, amongst others:

- Although the site is located within Flood Zone 3a, it is shown to be protected by flood defences which are due to be renewed and which offer a substantial level of protection;
- Both Sites B and C are located within Flood Zone 3a and are not offered as much protection as Site A. Therefore more stringent flood control methods would need to be applied to make the sites safe.
- The close proximity of the 400 kV National Grid transmission system;
- A realistic connection date of around 2014;
- The close proximity of the National Grid Gas National Transmission System;
- Availability of sufficient land, including that to be used for the development of a CCGT Power Station and that to be reserved for the retrofitting of a carbon capture plant in the future;
- Transport infrastructure which will accommodate construction traffic;

- The close proximity of the London Gateway development to allow GEC to meet it's expected long-term power requirements of up to 150 MWe;
- Appropriate visual context due to the industrial nature of the immediate area including the existing CECL Power Station and the Coryton Oil Refinery, and the proposed setting on the site of the LG Development;
- The close proximity of GEC to areas of highest national power demand;
- Availability of technical support (if required) from the existing CECL Power Station;
- Compatibility with Planning Policies and Local Development Plans; and
- Opportunities to link beneficially with local industry.

3.4.3 It is therefore considered that the proposed site is suitable for the intended use of power generation.

3.4.4 This Flood Risk Assessment has already demonstrated that this site is also suitable for development as it is protected by adequate flood defences.

3.4.5 Notwithstanding the above, the type of development proposed would be classified as 'Essential Infrastructure'; and an Exception Test will be required. .

## SECTION 4

### **EXCEPTION TEST**



## **4 EXCEPTION TEST**

### **4.1 Introduction**

4.1.1 In accordance with PPS 25, the proposed development is classified as 'Essential Infrastructure' and requires that an Exception Test is applied. For the Exception Test to be passed, it must be demonstrated that:

- The development provides wider sustainability benefits to the community that outweigh the flood risk;
- The development should be preferably on developable, previously-developed land; and
- A Flood Risk Assessment demonstrates that the development will be safe, without increasing flood risk elsewhere.

### **4.2 Justification**

4.2.1 The proposed development provides electricity generation that strengthens the local and regional grid network, which, in turn, underpins the development of other services within the south east region. The plant will be highly efficient when compared with other power stations currently in operation and will assist the UK Government in their aims of reducing overall emissions of carbon dioxide through the displacement of coal and oil power stations which are due to close in the coming years.

4.2.2 This application would be on land already designated as land set aside for future developments under the larger umbrella of the LG Development, headed by Dubai Ports World (DP World). The proposed development is similar to that which already exists approximately 700 m east of the site. Much of the infrastructure required for such a development already exists at the site and can support the development with minimal impact upon the surrounding environment.

4.2.3 This FRA demonstrates that the site is protected by primary flood defences which provide a level of protection that is commensurate with the type of development proposed. It also demonstrates that the development would not increase the risk of flooding to other sites close by.





## SECTION 5

# CONCLUSIONS



## **5 CONCLUSIONS**

### **5.1 Introduction**

- 5.1.1 The proposed GEC development comprises electricity generation infrastructure that is much needed in the south of England and particularly in the south east. The proposed location is on land that is considered a Brownfield site which has been set aside for development and already has the basic infrastructure required for such a facility. An Exception Test has been applied in accordance with PP S25 and is considered to meet the requirements to pass the Exception Test.

### **5.2 Summary of Flood Risk**

- 5.2.1 The Flood Risk Assessment has considered the various types of flooding that could result at this site and concludes that:

- Both the proposed GEC site and wider area proposed for the LG Development are protected by sea defences which have a crest elevation of between 6.4 and 6.7 m AOD. These defences provide a level of protection that is above the estimated 1 in 200 and 1 in 1,000 year tidal high water level, allowing for climate change to a design year beyond the anticipated lifespan of the CCGT plant. As part of the wider LG Development, these flood defences will be raised further to 6.85 m AOD to offer further protection for the site.
- A new surface water drainage system will be provided for the proposed developments that will include a balancing pond to mitigate for the increased amount of surface water runoff generated by the site. The drainage system will also include an oil separator to provide pollution control for the site generated runoff. The drainage system will incorporating SUDS drainage measures wherever possible.
- The development would not increase the risk of flooding either on-site or off-site.
- A flood warning system procedure is already in place and a flood management strategy will be undertaken for the entire LG Development which will further detail evacuation procedures.

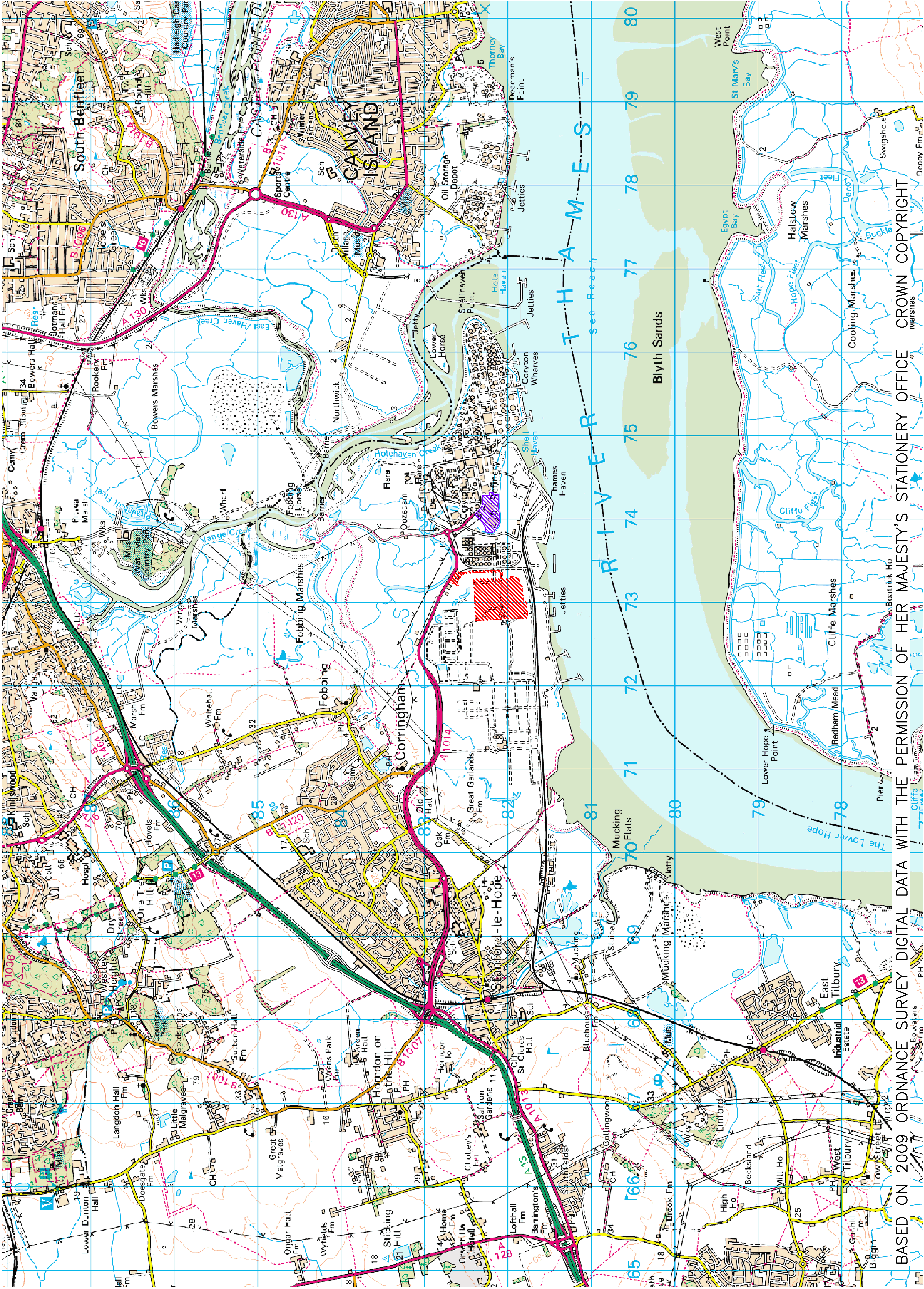
- 5.2.2 As required by PPS 25 the plant which represents essential infrastructure will be designed to remain operational when floods occur in the surrounding area noting that the site itself is not at risk of flooding due to the existing defences.



## APPENDIX A

### **SITE LOCATION**

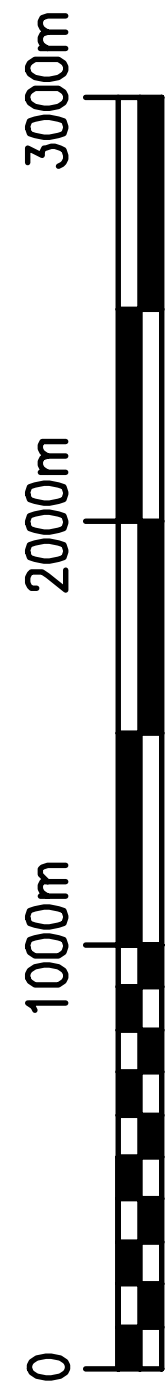




LEGEND

GEC APPLICATION  
SITE LOCATION

CECL POWER  
STATION LOCATION



BAR SCALE 1:50,000

REV

DATE

DESCRIPTION

BY

CHKD

APPD

NOTES

CLIENT/PROJECT

GATEWAY ENERGY CENTRE

DRAWN BY

DD

DATE

13/10/09

PRODUCED BY

DD

SCALE

1/50000

CHECKED

EA

CAD REF

EA

APPROVED

EA

00/00/00

TITLE

GEC APPLICATION  
SITE LOCATION

DRAWING NUMBER

FIGURE 1

Parsons Brinckerhoff

Amber Court, William Armstrong Drive, Newcastle upon Tyne, NE4 7YQ  
Tel: 44-(0)191 2261234 Fax: 44-(0)191 2262345

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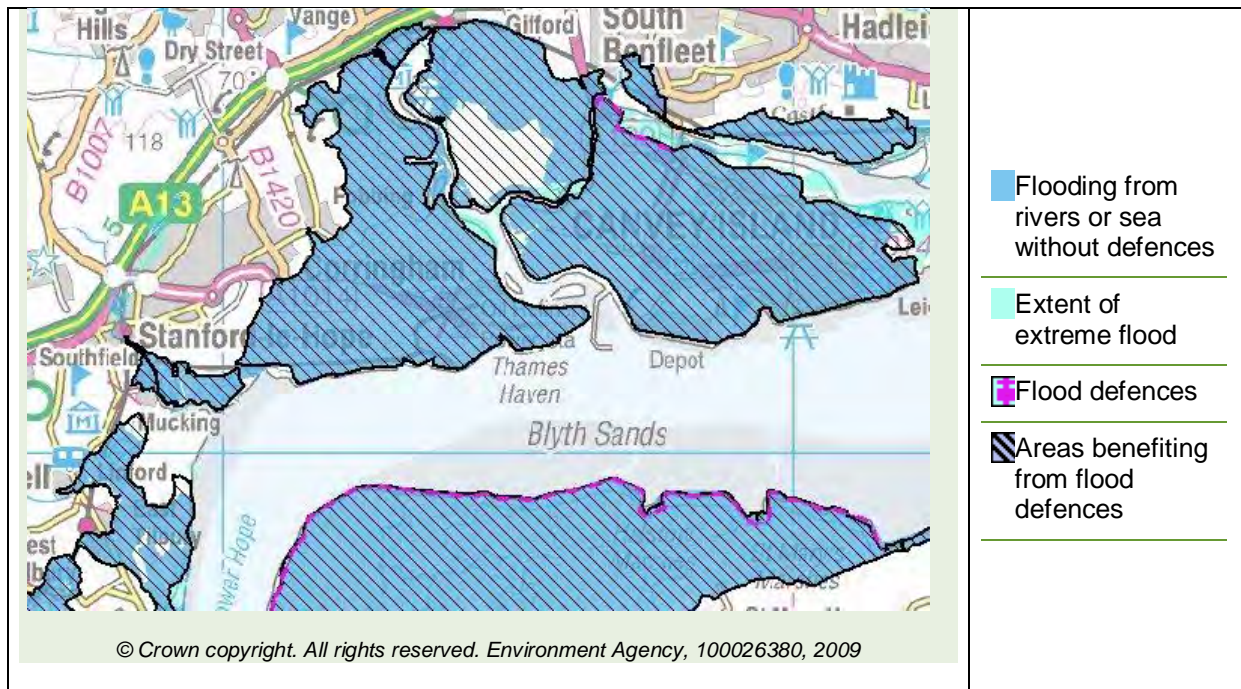


APPENDIX B

**ENVIRONMENT AGENCY INDICATIVE  
FLOODPLAIN MAP**



ENVIRONMENT AGENCY INDICATIVE FLOODPLAIN MAP





APPENDIX E

**ARCHAEOLOGICAL DESK BASED  
ASSESSMENT**



**E                    ARCHAEOLOGICAL DESK BASED ASSESSMENT**

**Contents Summary**

An Archaeological Desk Based Assessment (DBA) was prepared for Centrum Power Station. This is presented in this Appendix in:

**E.1        Archaeological Desk Based Assessment**





## **E.1 Archaeological Desk Based Assessment**



GATEWAY ENERGY CENTRE LIMITED

**ARCHAEOLOGICAL DESK BASED  
ASSESSMENT AND SITE WALKOVER  
SURVEY**

January 2010





## CONTENTS

	Page
<b>SECTION 1</b>	<b>1</b>
<b>EXECUTIVE SUMMARY</b>	<b>1</b>
1.1 Background to the Desk Based Assessment	3
1.2 Baseline Conditions	3
1.3 Assessment of Archaeological and Cultural Heritage Impacts	4
1.4 Recommendations and Conclusions	4
<b>SECTION 2</b>	<b>7</b>
<b>INTRODUCTION</b>	<b>7</b>
2.1 Introduction	9
2.2 Project Background	9
<b>SECTION 3</b>	<b>13</b>
<b>BASELINE CONDITIONS</b>	<b>13</b>
3.1 Geology	15
3.2 Hydrology and Hydrogeology	15
3.3 Topography	15
3.4 Previous Studies	15
<b>SECTION 4</b>	<b>17</b>
<b>HISTORICAL AND ARCHAEOLOGICAL DEVELOPMENT</b>	<b>17</b>
4.1 Introduction	19
4.2 Prehistoric	19
4.3 Romano-British	20
4.4 Medieval	21
4.5 Post Medieval and Industrial/modern	22
4.6 World War 2 and After	24
4.7 Listed Buildings	24
4.8 Scheduled Ancient Monuments	25
<b>SECTION 5</b>	<b>29</b>
<b>SITE WALKOVER</b>	<b>29</b>
5.1 Site Walkover	31
<b>SECTION 6</b>	<b>33</b>
<b>ASSESSMENT OF POTENTIAL IMPACTS ON ARCHAEOLOGY AND CULTURAL HERITAGE</b>	<b>33</b>
<b>SECTION 7</b>	<b>37</b>
<b>CONCLUSIONS AND RECOMMENDATIONS</b>	<b>37</b>
<b>APPENDIX A</b>	<b>41</b>



<b>SITE LOCATION PLAN</b>	<b>41</b>
<b>APPENDIX B</b>	<b>43</b>
<b>ARCHAEOLOGICAL MAPS</b>	<b>43</b>
<b>APPENDIX C</b>	<b>47</b>
<b>HISTORIC MAPS</b>	<b>47</b>

## SECTION 1

### **EXECUTIVE SUMMARY**





## **1 EXECUTIVE SUMMARY**

### **1.1 Background to the Desk Based Assessment**

- 1.1.1 An archaeological desk-based assessment (DBA) and site walkover survey were undertaken at the proposed site of a CCGT Power Station in September - November 2009. The purposes of the study were to define the archaeological baseline conditions at the site and in the surrounding area and make recommendations for any future fieldwork prior to development. The works were conducted within guidelines stated by the Institute for Archaeologists (IfA).

### **1.2 Baseline Conditions**

- 1.2.1 The site is located in the former Thames Haven Oil Refinery in the District of Thurrock, in the county of Essex, at National Grid Reference (NGR) TQ 733 822. The site consists of a rectangular area of land on the banks of the River Thames approximately 11 ha in size. The site on which the power station will be developed is one 'plot' of land within the larger Thames Haven landholding. The majority of this landholding has been cleared of over ground structures and will be developed as a commercial and logistics centre. The proposed power station will form one part of this larger development.
- 1.2.2 A plan showing the boundary of the proposed Power Station site is provided as Figure 1 in Appendix A of this document.
- 1.2.3 The south east of England, and in particular the Thames Estuary was occupied extensively in the past and is known to have been important both as a trade route and for settlement from the Prehistoric period onwards. It is likely that the region was also heavily occupied during the Roman, Medieval and Post Medieval eras. The importance of the area as a trade route is highlighted by records of shipwrecks which show 1,300 ships wrecked in the estuary between AD851 and 1989.
- 1.2.4 The first edition OS plan from 1872 (1:10,560 scale) shows the proposed CCGT site as undeveloped open fields located on the northern bank of the River Thames. However, the wider Thames Haven Landholding was used in the 19<sup>th</sup> century for the import of livestock (beef cattle) and then subsequently as a site for explosives manufacture. Oil storage and refinement and petroleum imports started at the Thames Haven area in the latter part of the 19<sup>th</sup> Century. Major developments connected with the petroleum industry include the London and Thames Haven Oil Refinery (LATHOL) and other refineries owned and operated by subsidiary branches of the Shell Oil Company. By the early 20<sup>th</sup> century, Shell had purchased much of the land at Thames Haven (including the proposed CCGT site) and had bought out the LATHOL Company. Hence, by the mid half of the 20<sup>th</sup> century they had a monopoly at the site and on the London oil trade as a whole. The refinery scaled down operation from 1998-2000 and the site has since largely been cleared of development.
- 1.2.5 A desk based search of available records has shown that there are three Scheduled Ancient Monuments (SAM's) within a 5 km radius of the site. A heavy anti-aircraft gunsite (Monument No.32433), a World War Two bombing decoy (monument number 32445) and The remains of a Roman salt manufactory. These monuments are discussed further in Section 4.8 of this document.
- 1.2.6 A search of the Essex County HER has revealed a further six recorded archaeological sites within a 1km radius of the site. Relating to 20<sup>th</sup> century 'modern' archaeology and are associated with World War Two.
- 1.2.7 A review of the National Monuments Record has indicated a further four entries within 1 km of the site which have been assigned a national monument number, but which do not appear in the Essex County SMR. All four entries date from the post medieval period.

- 1.2.8 Plans showing the location of all entries are shown in Figure 1 in Appendix B.
- 1.2.9 A total of three listed buildings have been recorded within a 1 km radius of the site. These buildings are all Grade 2 listed and are described in more detail in section 4.7 of this DBA.
- 1.2.10 Previous investigations undertaken at the site by Oxford Archaeology Unit (OAU) in 2002, 2003 and 2004 have revealed further sites of archaeological and cultural heritage significance in the surrounding area of the Thames Haven Landholding. These sites have been referred to in this DBA where appropriate.
- 1.3 Assessment of Archaeological and Cultural Heritage Impacts**
- 1.3.1 Most of the proposed CCGT site was undeveloped until the 1920's, when it was purchased by Shell and used as part of the Thames Haven Oil Refinery. It is possible that some archaeology remains in close proximity to the site or directly underlying the site from prehistoric and medieval eras, when the banks of the Thames would have been a desirable place to live or trade. A subsurface deposit model, undertaken by Oxford Archaeology Unit (OAU) as part of the wider archaeological assessment of the regeneration of the Thames Haven landholding has indicated that the site would have been subject to periodic flooding throughout much of its history. It is also likely that the majority of any surviving archaeology has been destroyed by foundations relating to the oil refinery and associated buildings. In addition the widespread contamination which is known to exist under much of the site is likely to have seriously impacted any buried archaeology underlying the site and also limits the potential for safe excavation of any other remains which did survive.
- 1.3.2 Three listed buildings have been identified within a 3 km radius of the site. All of these buildings have been listed as Grade 2 status for their protection because of their historic and archaeological significance. They have not been scheduled for their historic setting. It is also likely that it is difficult to appreciate these buildings in what is an already much altered landscape. The banks of the River Thames are dominated by heavy industry, and the site is also surrounded by the urban areas of Thurrock, London and Essex. The listed buildings identified surrounding the site are unlikely to receive visitors who appreciate the historic setting of the buildings. Therefore, there is not considered to be any impact on listed buildings in the surrounding area.
- 1.3.3 The closest Scheduled Monument to the site is a World War 2 bombing decoy which is associated with the Former Thames haven Oil Refinery. The remains are of national importance and should be protected. However, very little of the decoys now remain and they are of a sufficient distance from the site so as not to be impacted directly by any development. Although the new CCGT will be able to be seen from the monument, it is now difficult to appreciate it in its historical landscape context (especially given the removal of the Thames Haven Oil Refinery and is unlikely to attract large numbers of visitors. Views from and to the monument would also be temporary in nature as there is a substantial amount of development planned for the commercial and logistics centre which will be developed in between the monument and the CCGT plant. The other scheduled monuments in the area are all within sufficient distance so as not to be impacted by the development, either directly or indirectly.
- 1.3.4 The power station development has been located in the south eastern most corner of the proposed commercial and industrial centre in order to limit its potential impacts on sensitive receptors such as listed buildings and scheduled monuments.
- 1.4 Recommendations and Conclusions**
- 1.4.1 The large number of archaeological works undertaken in the immediate vicinity of the site, the paucity of archaeological remains within the former Thames Haven Oil refinery landholding, the industrial nature of the surrounding area and the unlikely indirect impact on any upstanding cultural heritage means that no further

archaeological works are recommended at the proposed Gateway Energy Centre site with the exception of a watching brief.



## SECTION 2

### **INTRODUCTION**



## **2 INTRODUCTION**

### **2.1 Introduction**

- 2.1.1 This report describes the methods and results of an archaeological Desk Based Assessment (DBA) and site walkover study undertaken between September-November 2009. The DBA was commissioned by Interger UK Ltd., undertaken by Parsons Brinckerhoff Ltd. (PB) and technically reviewed by Archaeological Services – Durham University. The DBA was conducted to assess the potential for a proposed development of a Combine Cycle Gas Turbine (CCGT) power station to impact upon buried or upstanding remains of archaeological or cultural heritage significance at a presently undeveloped area of land on the Banks of the River Thames in Coryton, Thurrock. The assessment was based on information sourced from historical records, previous site investigations, cartographic sources and any new information gained from the site walkover. The findings of the DBA have also been used to identify parts of the site for which further archaeological work may be required and to assist in the formulation of recommendations for any further archaeological works considered necessary to inform the planning decision.

### **2.2 Project Background**

#### **Site Location and Description**

- 2.2.1 The site is located in Coryton, Thurrock in the south east of England at National Grid Reference (NGR) TQ 733 822. It is located approximately 3 km south east of Corringham 5 km south west of Canvey Island and 7 km south of Basildon. The Thames Estuary lies approximately 200 m south of the site. The surrounding areas of Corringham, London and Basildon are urban in nature and a significant amount of industrial activity surrounds the banks of the River Thames. The site where the CCGT plant will be located is roughly rectangular in shape and covers an area of approximately 11 ha. It is one 'plot' of land within the larger Thames Haven landholding and is bounded to the north, east and west by other plots of land within the same landholding. The majority of these other plots have been cleared of all upstanding development and are awaiting ground remediation and the subsequent development of a new commercial and logistics centre.
- 2.2.2 The site is covered in a mixture of grassland, ruderal vegetation, scrub and bare exposed soils. Evidence of contaminated ground was noted during the site walkover.
- 2.2.3 A location plan of the site is shown as Figure 1 in Appendix A.
- 2.2.4 The first edition OS plan from 1872 shows the site as undeveloped, open fields located on the northern bank of the River Thames. Development of oil tanks on the southern area of the site are shown from OS plans of 1924 onwards. By 1960 the site is shown as fully developed with tanks, buildings and infrastructure associated with the Thames Haven Oil Refinery. The oil refinery slowed production in 2000 and the site was cleared of development from 2002-2006.

#### **Development Proposal**

- 2.2.5 It is proposed that the site is stripped of any vegetation and topsoil, regarded, levelled and all contamination removed, prior to construction of a Combined Cycle Gas Turbine (CCGT) power station.

#### **Relevant Guidance and Legislation**

- 2.2.6 The need for early consultation in the planning process is identified in Planning Policy Guidance (PPG) 16 – Archaeology and Planning and PPG 15 – Planning and the Historic Environment. PPG 16 sets out the Secretary of State's policy on archaeological remains on land, and how they should be preserved or recorded both in an urban setting and in the countryside. PPG 15 provides a full statement of Government policies for the identification and protection of historic buildings,

conservation areas and other elements of the historic environment. It explains the role played by the planning system in their protection. PPG Both PPG 15 and 16 are due to be replaced shortly by PPS 15 – Planning for the Historic Environment, which reflects a more modern, integrated approach and defines the historic environment in terms of heritage assets to be conserved in accordance with a set of principles and in proportion to their significance. However, as this legislation is still in consultation phase at the time of writing this report, both PPG 15 and 16 have been used as the primary guidance tools.

- 2.2.7 This DBA has also referenced the following policies of Thurrock Council:

**Thurrock Local Plan (1997)**

**Paragraph 3.1.3**

- 2.2.8 “The long history of the area as a place where people have settled is reflected in numerous sites of archaeological interest and the surviving historic cores of rural villages. The Borough’s rich and diverse archaeological and architectural heritage was represented in 1994, by seven designated Conservation Areas, 14 scheduled ancient monuments and 233 Listed Buildings.”

**Policy BE23 – Development Affecting Conservation Areas**

- 2.2.9 Development proposals within, adjacent to or affecting the Boroughs Conservation areas will be expected to preserve and enhance their character or appearance. The council will not permit any development that would be in conflict with this objective. The desirability of preserving or enhancing the area will also be taken into consideration by the council in the handling of development proposals which are outside the area but which would affect its setting, or views into or out of the area.

**Policy BE25 – Sites of Archaeological Importance**

- 2.2.10 Where important archaeological sites and monuments, whether scheduled or not, and their settings are affected by a proposed development, there will be a presumption in the favour of their preservation in situ. If there is evidence that archaeological remains exist in the local plan area whose extent and importance are unknown, the Council may require developers to arrange for an archaeological field evaluation to be carried out before the planning application can be determined, thus enabling an informed and reasonable planning decision to be made. Where preservation is not possible or feasible, then the council will not allow development to take place until satisfactory provision has been made for a programme of archaeological investigation and recording prior to the commencement of the development.

**OASIS**

- 2.2.11 Parsons Brinckerhoff Ltd. is registered with the Online Access to the Index of Archaeological Investigations project (OASIS). The OASIS project brings together a number of strategic partners: the Archaeology Data Service, the Archaeological Investigations Project (AIP) of Bournemouth University, the Archaeology Commissions Section of English Heritage, and the National Monuments Record of English Heritage, all under the umbrella of the University of York. The overall aim of the OASIS project is to provide an online index to the mass of archaeological grey literature that has been produced as a result of the advent of large-scale developer funded fieldwork. As part of this overall vision, the OASIS data capture form has been designed to help in the flow of information from data producers, such as contracting units, through to local and national data managers, such as SMRs and NMRs.

**Sources of Desk Study Information**

- 2.2.12 The following sources have been consulted in the desk based assessment of the site:
- Essex County Sites and Monuments Record (SMR)



- Previous archaeological Desk Based assessments and excavations undertaken within the vicinity of the site (See section 3.4)
- Multi-Agency Geographic Information for the Countryside (MAGIC)
- National Monuments Record (NMR)
- Aerial photographs of the site
- List of all listed buildings within 5 km of the site
- Historic maps of the site and surrounding area, dating from 1872
- Literature on the history of the Thames Estuary
- Previous geoenvironmental site investigation reports undertaken at the site
- British Geological Survey (BGS) maps

2.2.13 A full reference list is provided in Section 8.



### SECTION 3

## **BASELINE CONDITIONS**



### **3 BASELINE CONDITIONS**

#### **3.1 Geology**

3.1.1 BGS 1:50,000 Series Sheets 258 and 259, Southend and Foulness (Solid and Drift Editions) indicates that the superficial geology across the site comprises made ground, overlying marine or estuarine alluvium (undifferentiated or clay) overlying solid geology of Lower London Tertiaries. These Tertiaries comprise Woolwich beds (greenish yellow fine sand with frequent shell beds), Oldhaven Beds (firm yellow to buff fine sand) and Thanet Beds (predominantly silty fine sand). Upper chalk deposits are anticipated to underlie the site at significant depth.

3.1.2 This geological sequence has also been largely confirmed by intrusive investigations undertaken at the site by ERM Ltd. (2000) and Fugro Ltd. (2008). These ground investigations recorded made ground overlying drift deposits of marine /estuarine alluvium and sand and gravels overlying deposits of stiff London Clay. The clay deposits were found to overlie Woolwich and Thanet beds comprising interbedded fine sand, silt and clay with subordinate gravel beds. Made ground deposits were often found to be contaminated.

#### **3.2 Hydrology and Hydrogeology**

3.2.1 The River Thames lies approximately 200 m to the south of the site. Historical plans from 1872 - 1910 have also indicated the presence of two small streams (present before the site was developed), which converge in the centre of the site with Rugwart Fleet, a larger tributary of the River Thames. However, these streams are not shown on later OS plans as the site develops, and no evidence of them was recorded during the site walkover. This suggests that they may have been culverted or re-routed prior to development of the site as an oil refinery.

3.2.2 The groundwater beneath the site has been classified as a minor aquifer by the Environment Agency (EA). Minor aquifers are described as groundwater resources which are "*Fractured or potentially fractured and which do not have a high primary permeability, or other formations of variable permeability including unconsolidated deposits*". Groundwater was encountered at depths between 2 and 4 m in the river terrace deposits during previous ground investigations. Perched groundwater was also encountered in the shallow made ground deposits

#### **3.3 Topography**

3.3.1 The site is relatively flat and low-lying at approximately 5 m AOD.

#### **3.4 Previous Studies**

3.4.1 The following studies have been undertaken as part of an outline planning application, submitted for the development of the former Thames Haven Oil Refinery as a commercial and Logistics centre:

- Several Desk Based Assessments (2002-2004)
- Environmental Statement compiled for outline planning application for the development of a commercial and logistics centre at the former Thames Haven site (2004)
- Archaeological monitoring of contamination test pits at the former Thames Haven site (February and March 2001)
- Photographic survey of the former refinery (June 2001)
- Site walkover at the Thames Haven site (August 2001 and October 2002)
- Subsurface Deposit Model (October 2001)
- Fieldwalking Survey (September and October 2001)
- Geophysical survey (November 2001)
- Preliminary geoarchaeology and palaeoenvironmental investigation (October 2002-February 2003).

- Assessment of past effects within the former Shell haven Oil Refinery (October 2002-February 2003)
- New access road: archaeological geophysics (January-February 2003)
- New access road: Field artefact collection (January-February 2003)
- Listed building and conservation area technical report (March 2003)

#### SECTION 4

### **HISTORICAL AND ARCHAEOLOGICAL DEVELOPMENT**





## **4 HISTORICAL AND ARCHAEOLOGICAL DEVELOPMENT**

### **4.1 Introduction**

4.1.1 This section details the evidence for archaeology from a range of periods that has been discovered within the study site and within a 1 km radius of the centre of the site through researching the documentary evidence listed in Section 2.2.16 and previous reports listed in Section 3.4. Figure 1 in Appendix B shows a detailed map with locations of all entries recorded on the Essex County HER within 1 km of the site. Section 4.8 describes all listed buildings discovered within a 2 km radius of the site.

4.1.2 Other sites of archaeological and cultural heritage significance have been recorded by previous studies outside of the study area but have been referred to in this document as and when appropriate. These entries are prefixed by the letters OAU (Oxford Archaeology Unit) and further details of these finds can be found in the original reports.

4.1.3 The following timescales have been used throughout this DBA:

#### **Prehistoric – up to AD 43**

Palaeolithic – 450,000 – 12,000 BC

Mesolithic – 12,000 – 4,000 BC

Neolithic – 4,000-2,300 BC

Bronze Age - 2,300 – 700 BC

Iron Age - 700 BC – AD 43

#### **Historic (AD 44 – Present)**

Roman AD 44– 410

Anglo Saxon AD 411 – 1066

Medieval AD 1067 – 1485

Post Medieval AD 1486 – 1900

Modern/Industrial AD 1901 - Present

### **4.2 Prehistoric**

4.2.1 There is little evidence for prehistoric archaeology within the site or 1 km surrounding area. No documentary or cartographic evidence of this period could be attained and hence research was limited to SMR or NMR entries.

4.2.2 Other archaeological reports undertaken for the London Gateway Development (see Section 3.4 of this report) have identified that the site of the former Thames Haven Oil Refinery (including the proposed CCGT site) has high potential of having supported human occupation from the prehistoric period onwards. Of particular importance is thought to be a sequence of buried landscapes within the layers of alluvium and gravel underlying the site, as discovered by the sub-surface modelling study (OAU, 2001). The earliest evidence for human occupation in the south east of England comes in the form of flint tools dated to approximately 440,000 BC, found in Hillingdon in West London. However, continuous occupation of the Thames Valley probably didn't occur until much later (approximately 13,000 BC) when changes in climate and land cover would have been more favourable to settlement. Several sources have sited evidence for occupation of the Thames Valley in the Palaeolithic. In particular, gravels in the Thames estuary at Purfleet and Grays have yielded many finds of Palaeolithic flint tools.

- 4.2.3 Although no prehistoric finds are detailed within the proposed CCGT site, the following details prehistoric tools which have been found within the Thames Haven landholding and surrounding area.
- 4.2.4 Site OAU33 records the findspot of Palaeolithic axes found along the 21m AOD contour line in the west of the proposed Thames Haven Landholding. A watching brief, undertaken during the development of the Coryton bypass also revealed a Palaeolithic scraper (site OAU71) approximately 2km north west of the proposed GEC site. A large no of Palaeolithic implements were also found in a gravel pit in Mucking in the 19th century, approximately 4.5 km from the proposed CCGT site.
- 4.2.5 In the early Mesolithic period, sea levels fell (OAU sub surface deposit model 2001) and land at the Thames Haven site would have been more favourable to occupation as it would have been covered in dry, dense forest close to the Thames. Mesolithic flints have been found on numerous occasions during quarrying approximately 1km north of the Thames Haven site (Findspots OAU 75,76,78 and 79).
- 4.2.6 It is likely that by the Neolithic period (4,000 BC), the site of the proposed CCGT was submerged under rising sea and river levels. However, some areas of higher ground to the north of the site, identified as the gravel terrace in the sub-surface deposit model did support occupation. Three flint axes, assumed to be from the Neolithic were discovered during a watching brief in the north of the site. Neolithic flint axes have also been found 500m and 1 km to the west of the site (OAU 25 and 17 respectively), 300m to the north (OAU 75 and 76) and 1km to the north (OAU 80). To the west of the Thames Haven land, evidence of Neolithic activity in the form of pits, pottery and flint has been found at Mucking and West Thurrock. This evidence of occupation shows that by the Neolithic there was most likely continuous occupation of the area. The River Thames would have also likely acted as an important trade route during prehistoric times and on into the early Bronze Age.
- 4.2.7 During the Bronze Age, occupation would have increased further and London would have started to grow as an important economic centre for the trade and production of metal objects. Bronze Age artefacts found within the proposed London gateway landholding include; a flint implement found in the north west of the former Thames Haven refinery in 1970 (OAU38); a Bronze Age flint implement found in the northern part of the Thames Haven site (OAU71) and a cropmark of a possible Bronze Age ring ditch (OAU39). Crop marks and ring ditches thought to date from the Bronze Age have also been discovered immediately to the south west of the Thames Haven Landholding near Mucking.
- 4.2.8 Iron Age occupation of the site is likely to have been more extensive than in the Bronze Age due to the more settled groups. For example, Evidence of Iron Age occupation has been found 1.5 km to the south west of the site of the Thames Haven site (OAU1). Iron age pottery has also been found in a gravel pit 500m south west of the Thames Haven site (OAU8) and a shard of Iron Age pottery was found 500 m west of the site in 1970 (OAU18).
- 4.3 Romano-British**
- 4.3.1 The south east of England, an in particular London and the Thames Valley are known to have been extensively occupied during the Roman period, as the area was strategically placed with excellent links to the continent and was already becoming a large, established trade centre in the late Bronze Age and early Iron Age. London quickly grew in size during the Roman occupation and was later established as the provincial capital in Roman Britain's communication system. Riverside development also increased substantially during the Roman period, suggesting that the Thames became an important trade route as well as an important port to bring in troops from the continent.

- 4.3.2 Six known sites and findspots dating from the Roman period have been discovered within the Thames Haven landholding, including the following:
- Numerous findspots of Roman Pottery, found by chance on the foreshore of Mucking mudflats (OAU 10, 43, 44, 45 and 48)
  - Evidence of salt making in the form of a Roman Saltern. (Described in more detail in Section 4.7 of this document).
- 4.3.3 Roman burials have also been found 1km to the west of the Thames Haven site (OAU 6, 24, 26, 27) and to the north (OAU74). Pottery, brick, wood and animal bones have been recovered from a flint-lined pit 200m west of the Thames Haven landholding (OAU9). Roman pottery has also been found immediately to the north of the development area (OAU 63 and 64). A number of finds of Roman Pottery have also been discovered between 500m – 1 km west of the proposed development site (OAU2, 4, 18 and 10) and 1km to the north (OAU76 and 77).
- 4.4 Medieval**
- 4.4.1 Following the dispersal of Roman Troops from the area, London and the surrounding area would have continued as an important commercial centre in the medieval period. Despite this, no medieval remains have been found within the Thames Haven landholding. There have been findspots of medieval artefacts in the area surrounding the Thames Haven development land. These include the findspot of medieval pottery, approximately 1 km to the west and 1 km to the north of the Thames Haven landholding (OAU 24, 78 and 80), and a medieval beaker discovered in a gravel pit near Stanford le Hope (OAU 26). The Thames Haven landholding once lay within the ancient parishes of Mucking, Stanford-le-Hope, Fobbing and Corringham. The boundaries between these parishes once ran through the Thames Haven site. It is likely that these parishes had origins in the early medieval period as Corringham, Fobbing and Mucking are all mentioned in the Domesday Book. Additionally, the Church of St. Margaret of Antioch in Stanford-le-Hope dates from the 12<sup>th</sup> and 14<sup>th</sup> Centuries, indicating the presence of an organised settlement here at least. It is also possible that the fertile banks of the Thames were important for pasture and arable land. By the 14<sup>th</sup> century, sea level rise had caused tenants of much of the land on the banks of the Thames to construct sea defences. It is possible that defences were constructed around the southern boundary of the Thames Haven site at this point, in order to create fertile farmland free from the risk of flooding.
- 4.4.2 'Old Hall' (HER no. 35361) approximately 2.7 km from the proposed CCGT site was built in the 16<sup>th</sup> century. However, it was constructed on foundations of an earlier building, dating from the 15<sup>th</sup> century. Old Hall is mentioned in the SMR and also in the Essex HER and is described in more detail in Section 4.7 of this report.
- 4.4.3 The site of Oozedam house is recorded on the Essex HER (entry 45737), approximately 1.5 km north of the proposed CCGT site and is shown on maps from 1872. The site of Oozedam House is raised above the surface of the marsh and was probably done so to prevent it being destroyed by floods. For example, during the 1953 floods the house and surrounding land remained as an island. The house is thought to date from medieval times originally, but then subsequently modified during the post medieval and Tudor periods.
- 4.4.4 An area of medieval activity was also discovered in the west of the Thames Haven development land during a watching brief on the excavation of a gas pipeline route in 2001, approximately 2km from the proposed CCGT site. Evidence of medieval occupation in the form of burnt material, floor surfaces, pottery, carved animal bone, postholes and gullies, a kiln, an enclosure and several boundary ditches. It is possible that these finds may represent a large medieval settlement, only part of which was recorded by the limited extent of excavations undertaken as part of the pipeline project.

**4.5 Post Medieval and Industrial/modern**

- 4.5.1 The pattern of occupation for the Thames Haven landholding and surrounding area would have been similar for the post medieval period as for the earlier medieval period described in Section 4.4 of this document. Throughout the post medieval period the construction of sea walls and the drying out and subsequent reclamation of the marshy banks of the Thames continued.
- 4.5.2 The first available OS map of 1872 shows banks crossing the marshes around the Thames Haven site. These banks would have been used for further protection against flooding from the sea. These banks also serve as boundaries in places and by the post medieval period there are clearly defined parcels of land on the Corringham and Fobbing Marshes. The OS map of 1872 shows no development on the proposed CCGT site. Two watercourses appear to be present on site and converge into the Rugwart Fleet in the south of the site (a large tributary of the River Thames). Several developments are shown within the wider Thames Haven Landholding, including a railway track running immediately south of the CCGT site, which runs to the Thames Haven Dock (with associated railway station and dockhouse) approximately 500m south east of the site. Oil Mill Farm is shown 500m north east of the site and Mucking Lighthouse is shown approximately 900m to the south west. The majority of these buildings no longer exist, although some of their foundations may still be present underground.
- 4.5.3 Industrial development of the Thames Haven land started in the latter half of the 19<sup>th</sup> century. An early form of small scale industry on the marshes was probably salt manufacture. This was probably occurring at one scale or another since roman times (See reference to Scheduled Monument No. 32424 in Section 4.8 of this report). However, it seems to be much more widespread in the early 20<sup>th</sup> century, with saltings shown approximately 1 km east of the site on maps dating from 1910 and 1924. The crushing of locally grown flax to produce linseed oil was also undertaken on marshes surrounding the development site, and it is this process which probably lends its name to Oil Mill Farm, which is shown on maps from 1872 - 1938.
- 4.5.4 In the first half of the 19<sup>th</sup> century plans were put forward for the Thames Haven Railway and Port developments. It was envisaged that running a railway connection line from London to Thames Haven would allow the area's favourable location in terms of deep port wharfage potential, to be exploited. In 1838 works were started on the large Thames Haven Dock. As part of the dock construction, two rows of cottages were built for the workforce, as no suitable housing existed in the area. However, the cottages are not shown on maps from 1872 and therefore may have been demolished by then. The construction of the Dock was thwarted by money issues and was stopped several times and never completed (although it is labelled on the 1872 map). The railway line however was completed and is shown on the OS map of 1872 it runs east-west through the Thames Haven landholding, down to a station and pier. The station was a timber built structure. Adjacent to the east siding of the station were a set of cattle pens and a cattle holding area. The railway is labelled on OS plans as the Thames Haven Branch of the London, Tilbury and Southend Railway.
- 4.5.5 The railway was not only used to transport passengers, but also for importing cattle which had been shipped in from the continent and delivered to Thames Haven port. Between 1864 and 1866 cattle imports peaked in activity. In 1866 the Thames Haven Company was established and the construction of a new pier, steam trains, cattle pens and other buildings were introduced. Trade in cattle prospered at Thames Haven so much so that from 1867-76 about a third of total UK livestock imports came through Thames Haven. However, due to outbreaks of disease in cattle and subsequent government legislation, the trade at Thames Haven suffered and the company was eventually wound up in 1884. The railway company still used Thames Haven for importing cattle after this date, on a smaller scale than before, but further

- outbreaks of disease meant that the cattle importation business was finally stopped altogether in 1895. Cattle pens are however still shown on OS maps of 1898.
- 4.5.6 Very little evidence of the cattle importation infrastructure still exists at the Thames Haven site, although the railway line is still present in situ.
- 4.5.7 Further industrialisation of the site occurred in the latter part of the 19<sup>th</sup> century with the construction of the Miners Safety Explosives Factory. Both the OS maps of 1898 and 1924 show the explosives factory as several widely spaced buildings in the western part of Curry Marsh. However, as these buildings are approximately 5 k from the proposed CCGT site they are not included with the historical maps appended to this report. The buildings are connected by a small rail track which was probably used to transport the explosives. The explosives factory closed in 1927 and remained vacant until it was incorporated into the Thames Haven Oil Refinery in the 1960s.
- 4.5.8 Following closure of the Miners Safety Explosives Factory, a much larger explosives factory was then built at the Thames Haven site. Work for the new explosives factory is reported to have started in 1897. The development is not shown on the OS map of 1897, but the map of 1924 shows a large complex of buildings immediately to the west of Holehaven Creek which are widely spaced and connected to a small railway track (similar to the layout of the Miners Safety Explosive plant, but on a larger scale). However, this plant is also outside the study area and therefore not shown on maps appended to this report.
- 4.5.9 Due to the lack of housing and amenities in the area surrounding the explosives plant, a small village, named Kynochtown (after the company that owned the factory) was built close by for the workers. The first few houses were built in 1897 and the village rapidly grew to more than 40 houses, a school, an institute and a shop, all of which are shown on the 1924 OS map, approximately 750m east of the proposed CCGT site. In order to transport more workers to the explosives plant from Corringham and Fobbing, the Corringham Light Railway was opened in 1901. The railway line is shown on OS maps of 1924 to pass approximately 500 m north of the proposed CCGT site. A line was also constructed which linked to the Thames Haven Branch of the London, Tilbury and Southend Railway (see paragraph 4.5.4 of this report).
- 4.5.10 In the 1920's the larger Kynochtown explosives plant closed (after demand fell after World War 1). At around this time land at the plant was taken over by the Cory Brothers, who constructed a large oil refinery at the plant and re-named Kynochtown Coryton. Coryton is first shown on OS maps from 1938.
- 4.5.11 Development at the Thames Haven landholding following explosives manufacture and cattle import was dominated by the oil industry. Suitability of the land at Thames Haven arose because of legislation (the Petroleum Act) put in place which prevented the transport of oil and fuel any further up the Thames Estuary than Mucking Lighthouse. Thames Haven was therefore the closest port that ships could get to London and was used as the main oil transport port. Despite this, it was not until 1876 that the first small oil storage installation was built at the Thames Haven site by the Petroleum Storage Company (PSC). The oil was stored at the site and subsequently transported away by rail branches of the London, Tilbury and Southend Railway. Although the PSC experienced financial difficulties and was wound up in 1881, the site was taken over by a number of companies, including; The London and Thames Haven Petroleum Wharf Ltd; and the London and Thames Haven Oil Wharves Ltd. (LATHOL). The Thames Haven Petroleum Wharf is first shown on OS maps of 1898, approximately 250m south of the proposed CCGT site.
- 4.5.12 By 1900 the oil storage depot had expanded significantly and more land was purchased in 1902 to the east of the Thames Haven Port to expand the plant even further. Boosted by this rapid expansion, the depot quickly developed a monopoly on the London oil trade. By the outbreak of the First World War there was reported to be

a relatively extensive network of pipelines, pump houses and storage buildings, which handled some 400,000 tonnes of refined products per year. Further expansions of the LATHOL site occurred in 1911 when they purchased a refinery owned by The European Petroleum Company and again in 1914 when they purchased a large area of land to the north of Rugwart Fleet, to the North of the Thames Haven landholding. A further oil refinery was developed at the Thames Haven site in 1911 by the Anglo Saxon Petroleum Company (owned by Shell). The Anglo Saxon development included piers, a tank farm and a refinery. The site became known as the Shell Haven site soon after development.

4.5.13 Evidence of significant expansion of the oil refinement and storage capacity in the study area is shown on OS maps of 1924. Where the 1910 map showed approximately 12 storage tanks to the south of the CCGT site, the 1924 map shows approximately 40 to 50 storage tanks south of the CCGT site. 21 further tanks are shown in the south east corner of the CCGT site, as are several small buildings and a water tower. A further 20 tanks are shown immediately to the west of the CCGT site. The development is still named as the Thames Haven Oil Wharves.

4.5.14 The Shell Haven development expanded substantially in the inter-war period. However, this is not shown on the 1938 OS map or historical aerial photographs of 1947. It is possible that this is for reasons of national security, as the large oil depot would have provided a perfect target for bombing operations during World War 2 (See Section 4.6 of this document).

#### **4.6 World War 2 and After**

4.6.1 During World War 2, all of the refinery plants in the Thames Haven Landholding expanded significantly, due to the trend towards refining oil in the UK rather than relying on pre-refined products from abroad. Increased wartime demand also led to the construction of a new unit at the shell plant for the production of paraffin waxes and bitumen. Post-war, the Shell plant expanded further, into an area to the north west of the LATHOL plant, within the Thames Haven landholding. A number of new units were developed on this land including a cooling water pump house, a distillation plant, a boiler plant and a doctor treater. Gradually, the LATHOL and Shell plants started to work together more closely, and finally, in 1969, Shell took over operation at the LATHOL site. The 1960 OS map shows a massive expansion of oil tanks and associated buildings on the Thames Haven landholding. The proposed CCGT site is shown to be almost entirely covered in oil storage tanks, as is land immediately south and west. A further network of oil storage tanks, buildings and developments associated with the oil industry is also present between 500m – 1km east of the site. The OS plan of 1968 also shows further expansion of the plant, with another 28 storage tanks immediately north east of the CCGT site. OS plans from 1976 show no further development to the oil storage depots. A map from 1999 show the site has scaled down operations, and almost all of the CCGT site has been cleared of tanks and overground structures. Maps from 2006 and 2009 show the CCGT site and almost all of the Thames Haven landholding have been cleared of development. However, several storage tanks still exist to the east of the CCGT site.

4.6.2 During World War 2, the proposed CCGT site and surrounding area also supported numerous defences including anti-aircraft ditches 50 m east of the site (HER entry 14771), 200 m north of the site (HER entry 14772) and 1 km north west of the site (HER entry 14763). The site of a World War 2 Pillbox (Her entry 10329) is recorded 1 km west of the site. The site of a World War 2 bomb crater (HER 172277) is recorded approximately 1km north of the site.

#### **4.7 Listed Buildings**

4.7.1 Three listed buildings have been identified within the Thames Haven Landholding and are described in paragraphs 4.72 - 4.74. No listed buildings have been identified

within a 1 km radius of the proposed CCGT site. Those listed buildings identified outside the Thames Haven Landholding and greater than 1 km from the proposed GEC have not been considered. These buildings will not be impacted by the development of the GEC due to large distances and natural topography acting as a visual screen. Additionally, the GEC will be surrounded on three sides by the proposed LG commercial and logistics centre which will further limit any visual impacts. Any impacts which the wider LG development may have on these buildings is discussed in the outline planning application for this development.

- Old Hall Farmhouse (Grade 2 listed) (HER entry 35361)

4.7.2 Described as an “18<sup>th</sup> Century house in red brick with a plain red-tiled roof. The house has two storeys, an attic and cellars, it is of double range plan, with a wing extending to the south-west. Five window range double hung vertical sliding sashes with one vertical glazing bar, in plain reveals, with gauged brick arches. The central window on the first floor has a shaped, carved soffit. There are three gabled dormers with tile hanging. There is a raised stucco bond between storeys and below gables on south-east side”.

- Old Garlands (Grade 2 listed) (HER entry 17169)

4.7.3 Described as a “Late 17<sup>th</sup> century timber framed and black weatherboarded barn with thatched roof. The barn is five bays long with jowled main posts with queen post roof with side purlins. There is a curved bracing to tie the beams and wall bracing to the gable ends”.

- Great Garlands Farmhouse including stable on the north west (Grade 2 listed) (HER entry 19497).

4.7.4 Described as a house built in 1753 in Knapped flint, with red brick dressings. The property is rendered at the sides and the rear. The house is two storeys with a plain red tile roof. The house has a two window range with 19<sup>th</sup> century double hung vertical sliding sashes with single vertical glazing bar. There is a central brick panel at the house, on which is inscribed “This house and stable built by Thos Mashiter, 17532”. The verges are parapetted. There is a small flint and brick outhouse on the north west side”.

#### **4.8 Scheduled Ancient Monuments**

4.8.1 There are 3 Scheduled Ancient Monuments (SAM's) within a 5 km radius of the site. A larger 5 km study area has been chosen for Scheduled Ancient Monuments given their significance and the greater potential to have an adverse effect on their setting.

4.8.2 These scheduled monuments have are described below:

- Heavy anti-aircraft gunsite, situated 380m east of Northwick Farm and approximately 3.5 km north east of the proposed CCGT site (National Monument No. (NMR) 32433).

4.8.3 The monument lies within 3 areas of protection: 1. The gun emplacements, the command post, the site magazine gunstore and an associated section of the military service road. 2. The sewage disposal unit related to the battery accommodation - situated 150 m east of the gun emplacements. 3 – The pump house – 150 m south of the sewage disposal unit.

4.8.4 The site was originally designed for the operation of four anti-aircraft guns. Three of the gun stands still stand, but the fourth is thought to be buried beneath a mound. The gun emplacements are constructed to a known design – The ‘March 1938 Pattern’ and are arranged in an arc with the apex facing towards the usual direction of German aircraft. The three remaining emplacements each contain six internal recesses built into the internal faces of the surrounding walls. The remaining sides of

each unit were originally fitted with steel gates which could be opened to allow the movement of guns. The on site magazine bunker (a bomb proof rectangular building) lies between the two northernmost gun emplacements. A 2<sup>nd</sup>, unroofed rectangular structure (the gunsite command post) occupies the central position within the arc of gun emplacements, accompanied by the generator building which housed the power supply for the guns and locational equipment. The gun store (a concrete, garage like structure lies some 50m south of the emplacements, to the east of the service road and north of the accommodation huts for the garrison. 11 of these brick built huts remain in use a light industrial premises. The hub and service road are not included in the scheduled status.

- 4.8.5 Heavy gun stations such as these were particularly important close to major cities and towards the south east coast, to protect these areas from incoming German bombing raids.
- 4.8.6 English Heritage states that surviving examples of gunsites are sufficiently rare to suggest that they are of national importance.
- World War 2 bombing Decoys on the Fobbing Marshes – situated approximately 1.9km north of the proposed CCGT site. NMR No. 32445
- 4.8.7 The remaining upstanding remains at the site consist of the night shelter and oil storage bay of a World War 2 oil decoy, designed to protect the Shell Haven oil refinery from German bombing raids. Essentially, the decoys consisted of setting light to large pools of oil, which served two purposes. The first was to act as a decoy so it appeared as if the area had already been bombed. German raids would then avoid the target as they would not want to waste extra ammunition. The fires would also act as a screen of flames and smoke which would prevent German pilots from seeing the extent of the oil refinery.
- 4.8.8 What remains at the site is a night shelter, which would have been occupied by the person responsible for igniting and maintaining the fires. The shelter is 6m long, 3.2m wide and aligned north-south, with a single sloping entrance on its northern side. Inside the night shelter are two rooms – the operations room and the engine room. There are also two steel connection pipes which probably contained the wiring terminals for electrical ignition of the decoy devices. Approximately 17m to the west of the night shelter are four parallel walls on heavy concrete foundations. These are probably the remains of six storage bays for drums of oil used in operation of the site.
- 4.8.9 Despite the importance of the Thames Haven Refinery for the production of refined petroleum products to wartime Britain, Records show that the site was only operational from 1941 – 1942 (presumably coinciding with the peak in German Bombing raids on the area).
- 4.8.10 English Heritage has identified these remains of being of national importance as they are of great significance to the study of bombing decoy design.
- Remains of a Roman Saltern and Boat – Approximately 5 km north east of the proposed CCGT site. (NMR No. 32424).
- 4.8.11 The monument is situated on low-lying ground near to the Dutch Village in the western half of Canvey Island. The site includes the remains of a Roman salt manufactory – visible as a series of earthworks and associated buried remains. The principle feature of the saltern is a substantial mound, approximately 60m in diameter and up to 1.1 m high. A smaller mound is situated adjacent to the large mound, and measures approximately 15m in diameter. Small scale excavations around the site in 1972 showed the original extent of the hill to be some 100m in diameter and approximately 3.5 m above Roman ground level.



- 4.8.12 Medieval re-use of the salt works was also evident, in the form of several other, less pronounced earthworks. Salt was an expensive commodity from Roman-Medieval times and water from natural salt springs or the banks of the Thames estuary would have been produced by evaporation of water using earthenware pots.
- 4.8.13 Although salterns are shown on later OS maps of 1910 and 1924, it is likely that any salt production on a larger scale stopped altogether in the 17<sup>th</sup> century due to the production of rock salt which used far cheaper and less labour intensive practices.
- 4.8.14 English Heritage has stated that remains of salterns are nationally very rare. There were approximately 300 salterns in Essex, of which very few still survive. Finds associated with salterns include settling tanks, hearths, flues, fire floors and briquetage.



SECTION 5

**SITE WALKOVER**



**5 SITE WALKOVER**

**5.1 Site Walkover**

- 5.1.1 The site walkover was conducted in September 2009. The aim of the walkover was to identify any potential archaeological remains present on site which had not been previously recorded by excavations, the NMR or the Essex HER. Site topography was noted, as were any areas of exposed geology and soils. Particular attention was paid to patterns and distribution of spoil mounds, changes in vegetation or any other interesting features. A photographic record of the site was conducted and a sketch of the site was drawn to record any interesting features.
- 5.1.2 The walkover at the proposed CCGT site was conducted from paths surrounding the site, as access was not possible.
- 5.1.3 The site was covered in grassland, crushed tarmac and several areas of exposed unvegetated soils. Evidence of contamination was recorded in the form of black staining to soils and areas of stockpiled contaminated materials from other plots of land within the Thames Haven landholding. Historical maps from 1872 show two streams which run across the site and converge into the Rugwart Fleet. It is possible that these streams are culverted beneath the site, although no evidence of this was noted during the site walkover.
- 5.1.4 No evidence of upstanding archaeology in the form of buildings or earthworks was noted during the site walkover. Some underground structures were noted such as disused pipelines and foundations of former tanks/buildings. It is possible that these underground structures, together with contaminated ground conditions have severely impacted any buried archaeology at the site.



## SECTION 6

# **ASSESSMENT OF POTENTIAL IMPACTS ON ARCHAEOLOGY AND CULTURAL HERITAGE**





- 6 ASSESSMENT OF POTENTIAL IMPACTS ON ARCHAEOLOGY AND CULTURAL HERITAGE**
- 6.1.1 The following processes during construction and operation of the proposed CCGT have the potential to impact upon any archaeological and cultural heritage resource present in the site and surrounding area:
- Loss of, or damage to, archaeological sites and remains (from soil stripping, site levelling, laying of access roads, construction of foundations).
  - Adverse impacts on the settings and views to and from upstanding remains, listed buildings and Scheduled Ancient Monuments (from the construction of large, high, visually intrusive buildings).
  - Noise, vibration or air quality impacts which may have a detrimental effect on buried or upstanding remains (e.g. from noisy or polluting operations).
- 6.1.2 The Essex County HER, the NMR and previous studies undertaken by OAU have not revealed any remains of archaeological or cultural heritage significance within the boundary of the proposed CCGT site. Despite this, the paucity of recorded remains does not necessarily mean they are absent, but may simply indicate that there have been no excavations undertaken in that area.
- 6.1.3 The CCGT site lies in the south east corner of the proposed commercial and logistics centre. Boreholes on this plot and adjacent plots indicate a significant depth of made ground with some contamination. Underlying the made ground are deposits of alluvium. The sub-surface deposit model undertaken by OAU has identified that alluvial deposits underlying the site have the potential to harbour archaeological remains from the prehistoric period to the 18<sup>th</sup> century. The sub-surface deposit model also suggests that the site would have experienced periodic flooding in the past and therefore the potential exists for the preservation of organic remains in alluvial deposits at the site. It is also possible that made ground at the site is medieval or post medieval in date and was used to raise site levels of the floodplain when some of the land was used to reclaim the marshes for agriculture. Additionally, settlement on the floodplain may have consisted of salt making, pottery production, farming and fishing. The small streams which are shown to have crossed the site (present on maps from 1872) also have the potential to have harboured remains of archaeological and cultural heritage significance.
- 6.1.4 However, given the massive amount of development at the site throughout the mid and late 20<sup>th</sup> centuries, it is likely that a combination of foundations from buildings, excavations for underground pipelines and a significant amount of contamination will all have significantly impacted any buried archaeology which remains at the site.
- 6.1.5 There are no upstanding remains at the site relating to the Thames Haven Refinery. However, the majority of these buildings were photographed and their details archived prior to demolition in 2001. The original archaeological impacts section of the Environmental Statement compiled in 2004 indicated that any surviving foundations of the original LATHOL installation may be of valuable archaeological significance. However, oil tanks were not erected at the proposed CCGT site until 1924 and their layout remains similar until their demolition.
- 6.1.6 In addition, there are no upstanding remains of archaeological or cultural heritage significance within 1 km of the site.
- 6.1.7 The listed buildings identified in Section 4.7 of this report (e.g. Old Hall Farmhouse, Old Garlands and Great Garlands Farmhouse) have been assessed as part of previous studies (e.g. the Environmental Statement for outline planning application for the Commercial and Industrial Centre) which determined that none of these buildings will be impacted by the proposed development at the Thames Haven site during

**SECTION 6  
ASSESSMENT OF POTENTIAL IMPACTS  
ON ARCHAEOLOGY AND CULTURAL  
HERITAGE-**

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either construction or operation. As the nearest part of the proposed commercial and logistics centre is situated adjacent to the closest listed building (Great garlands and Old Garlands) and the proposed CCGT site is approximately 3km east of the building, it can be assumed that the construction and operation of the CCGT will not impact these upstanding cultural heritage assets either. Factors cited for the lack of impact are the distance of the development from these buildings, the already heavily industrialised nature of the area and the intervening development which will be constructed between the CCGT plant and the buildings.

- 6.1.8 It is unlikely that post medieval or modern archaeology younger than 1861 is present in the site, as historical maps have shown no development taking place within the site boundaries. The potential for discovering remains from this period are therefore considered negligible.

## SECTION 7

# **CONCLUSIONS AND RECOMMENDATIONS**



**7 CONCLUSIONS AND RECOMMENDATIONS**

- 7.1.1 PPG16 states that where preliminary research suggests the potential for survival of archaeological remains, it is reasonable for the planning authority to request a field evaluation to be undertaken prior to planning permission being granted. PPG 16 also states that preference should be given for the preservation of archaeological remains in situ. Where this is not possible, remains should be excavated and recorded.
- 7.1.2 The large number of archaeological works undertaken in the immediate vicinity of the site, the paucity of archaeological remains within the former Thames Haven Oil refinery landholding, the industrial nature of the surrounding area and the unlikely indirect impact on any upstanding cultural heritage means that no further archaeological works are recommended at the proposed Gateway Energy Centre site with the exception of an archaeological watching brief.

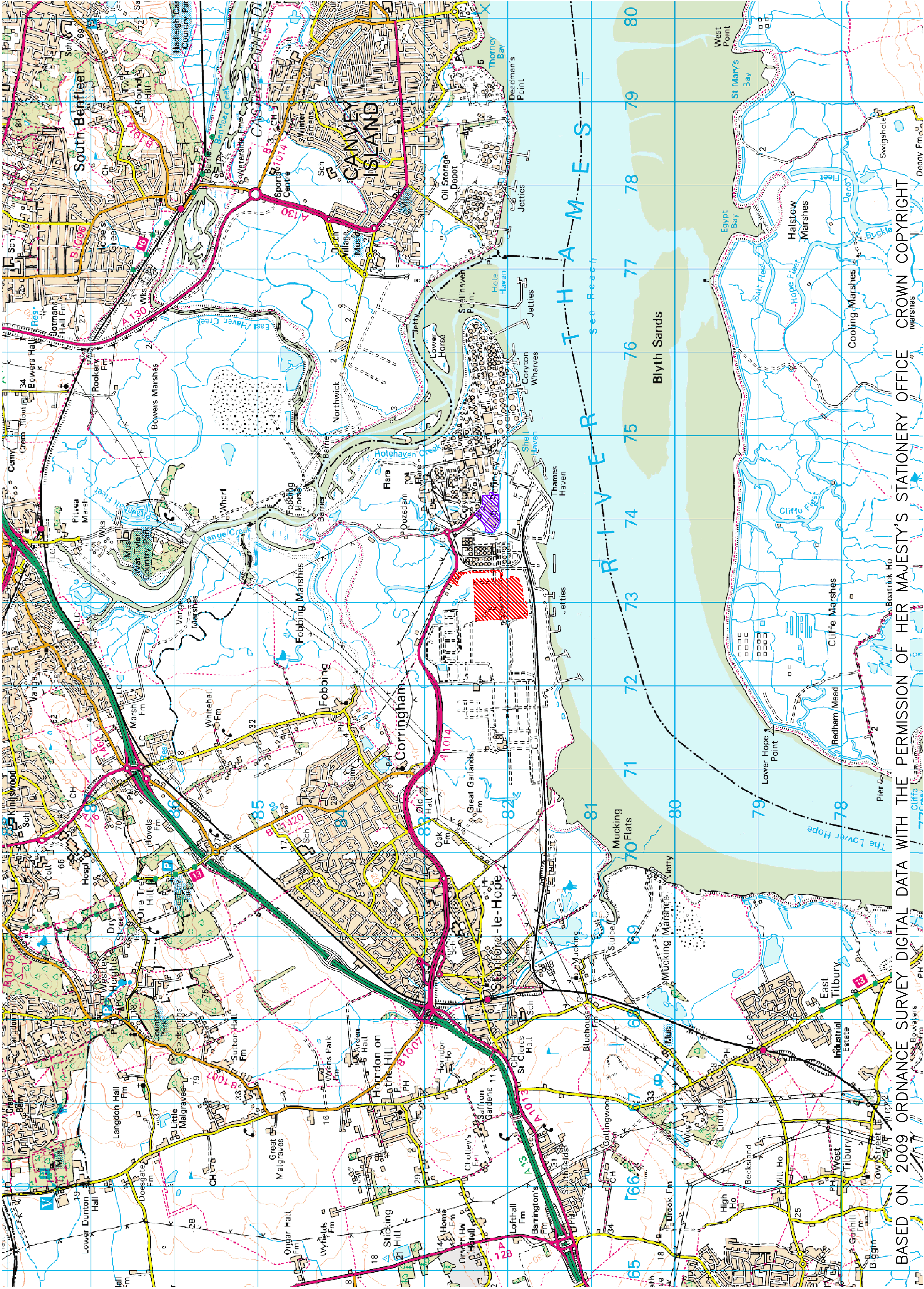


APPENDIX A

## **SITE LOCATION PLAN**



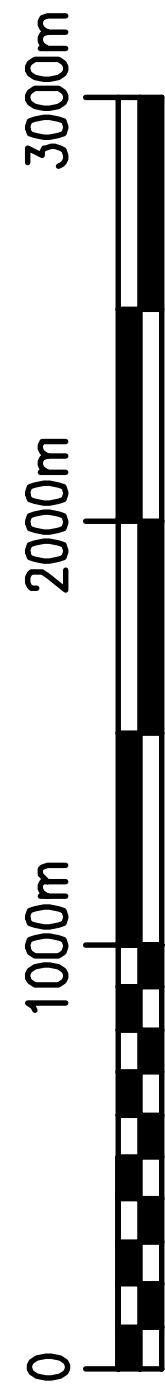




LEGEND

GEC APPLICATION  
SITE LOCATION

CECL POWER  
STATION LOCATION



BAR SCALE 1:50,000

REV

DATE

DESCRIPTION

BY

CHKD

APPD

NOTES

CLIENT/PROJECT

GATEWAY ENERGY CENTRE

DRAWN BY

DATE 13/10/09

PRODUCED BY

SCALE 1/50000

CHECKED

CAD REF

APPROVED

EA

00/00/00

TITLE

GEC APPLICATION  
SITE LOCATION

DRAWING NUMBER

FIGURE 1



Parsons Brinckerhoff

Amber Court, William Armstrong Drive, Newcastle upon Tyne, NE4 7YQ  
Tel: 44-(0)191 2261234 Fax: 44-(0)191 2262345

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AND SHOULD ON NO ACCOUNT BE AMENDED BY HAND

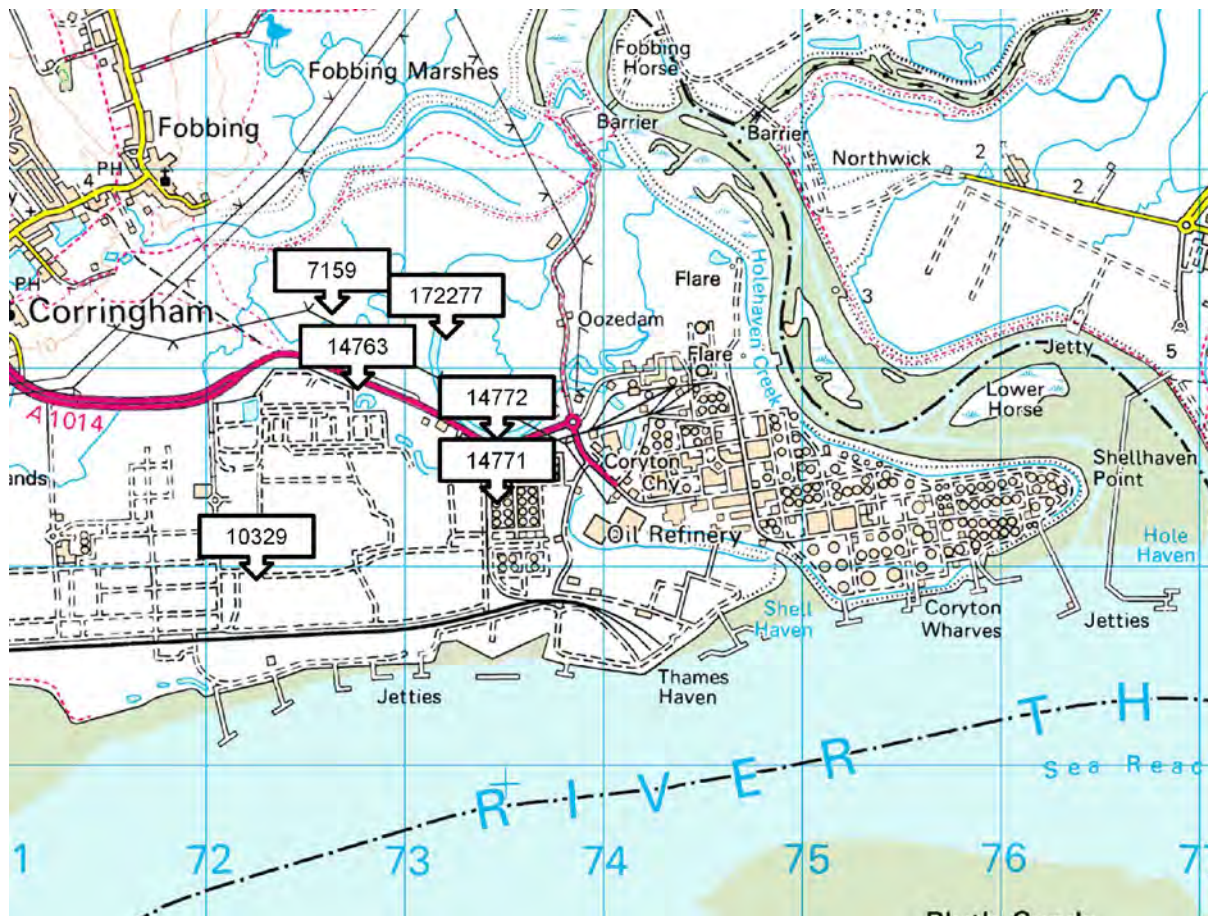


## APPENDIX B

### **ARCHAEOLOGICAL MAPS**





**LOCATION OF ESSEX COUNTY SMR ENTRIES LOCATED WITHIN A 1 KM RADIUS OF THE PROPOSED GEC SITE.**



## APPENDIX C

### **HISTORIC MAPS**





# Historical Mapping Legends

## Ordnance Survey County Series 1:10,560

	Gravel Pit		Sand Pit		Other Pits
	Quarry		Shingle		Orchard
	Osiers		Reeds		Marsh
	Mixed Wood		Deciduous		Brushwood
	Fir		Furze		Rough Pasture
	Arrow denotes flow of water		Trigonometrical Station		
	Site of Antiquities		Bench Mark		
	Pump, Guide Post, Signal Post		Well, Spring, Boundary Post		
	•285 Surface Level				
	Sketched Contour		Instrumental Contour		
	Main Roads		Minor Roads		
	Sunken Road		Raised Road		
	Road over Railway		Railway over River		
	Railway over Road		Level Crossing		
	Road over River or Canal		Road over Stream		
	Road over Stream				
	County Boundary (Geographical)				
	County & Civil Parish Boundary				
	Administrative County & Civil Parish Boundary				
	County Borough Boundary (England)				
	County Burgh Boundary (Scotland)				
	Rural District Boundary				
	Civil Parish Boundary				

## Ordnance Survey Plan 1:10,000

	Chalk Pit, Clay Pit or Quarry		Gravel Pit
	Sand Pit		Disused Pit or Quarry
	Refuse or Slag Heap		Lake, Loch or Pond
	Dunes		Boulders
	Coniferous Trees		Non-Coniferous Trees
	Orchard		Scrub
	Bracken		Heath
	Marsh		Reeds
	Building		Glasshouse
	Sloping Masonry		Pylon
	Cutting		Embankment
	Road Under		Road Over
	Level Crossing		Foot Bridge
	Standard Gauge Multiple Track		Standard Gauge Single Track
	Siding, Tramway or Mineral Line		Narrow Gauge
	Geographical County		Administrative County, County Borough or County of City
	Municipal Borough, Urban or Rural District, Burgh or District Council		Borough, Burgh or County Constituency
	Civil Parish		
	BP, BS Boundary Post or Stone		Police Station
	Church		Post Office
	Club House		Public Convenience
	Fire Engine Station		Public House
	Foot Bridge		Signal Box
	Fountain		Spring
	Guide Post		Telephone Call Box
	Mile Post		Telephone Call Post
	Mile Stone		Well

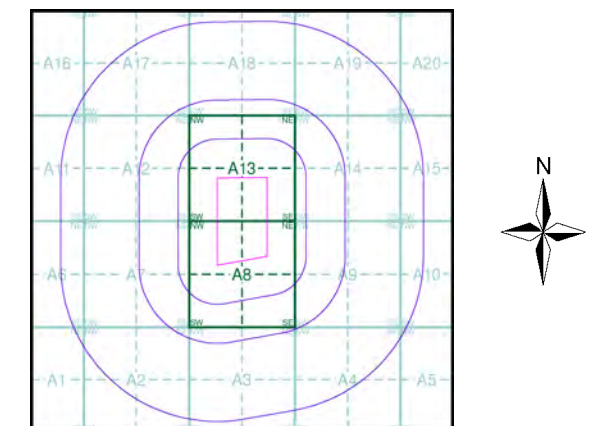
## 1:10,000 Raster Mapping

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

## Historical Mapping & Photography included:

Mapping Type	Scale	Date	Pg
Kent	1:10,560	1869	2
Essex	1:10,560	1872 - 1876	3
Essex	1:10,560	1898	4
Kent	1:10,560	1898	5
Kent	1:10,560	1910	6
Essex	1:10,560	1924	7
Essex	1:10,560	1938	8
Essex	1:10,560	1938	9
Historical Aerial Photography	1:10,560	1947	10
Ordnance Survey Plan	1:10,000	1960	11
Ordnance Survey Plan	1:10,000	1968	12
Ordnance Survey Plan	1:10,000	1976	13
10K Raster Mapping	1:10,000	1999	14
10K Raster Mapping	1:10,000	2006	15
10K Raster Mapping	1:10,000	2009	16

## Historical Map - Slice A

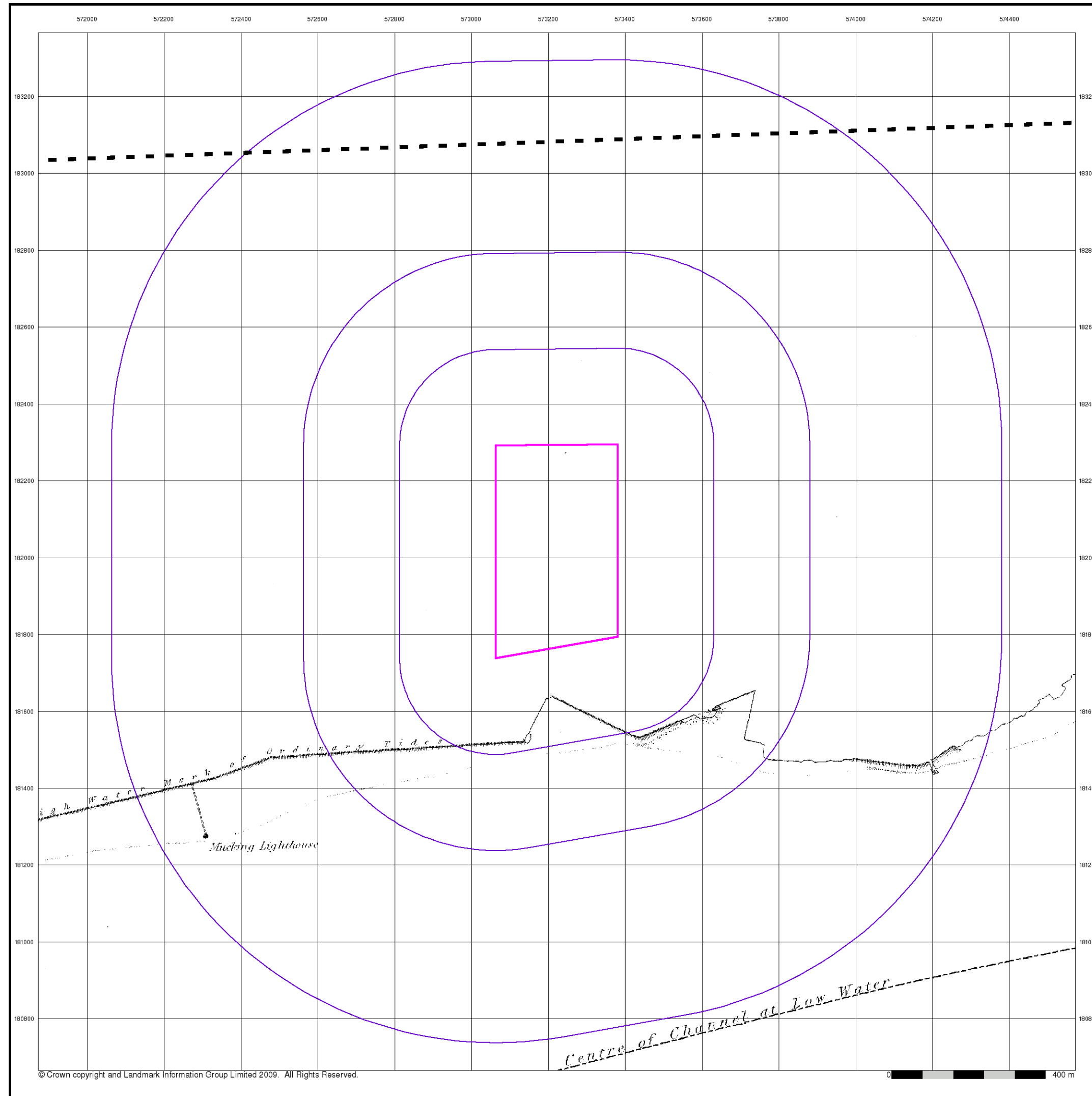


## Order Details

Order Number: 29109000\_1\_1  
Customer Ref: Thames  
National Grid Reference: 573210, 182030  
Slice: A  
Site Area (Ha): 16.75  
Search Buffer (m): 1000

## Site Details

Site at 573370, 182210



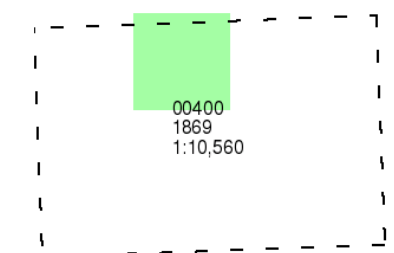
Kent

Published 1869

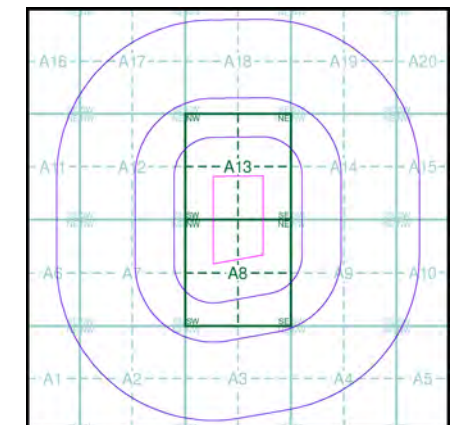
Source map scale - 1:10,560

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; these maps were used to update the 1:10,560 maps. The published date given therefore 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. In the late 1940's, a Provisional Edition was produced, which updated the 1:10,560 mapping from a number of sources. The maps appear unfinished - with all military camps and other strategic sites removed. These maps were initially overprinted with the National Grid. In 1970, the first 1:10,000 maps were produced using the Transverse Mercator Projection. The revision process continued until recently, with new editions appearing every 10 years or so for urban areas.

### Map Name(s) and Date(s)



### Historical Map - Slice A



### Order Details

Order Number: 29109000\_1\_1  
Customer Ref: Thames  
National Grid Reference: 573210, 182030  
Slice: A  
Site Area (Ha): 16.75  
Search Buffer (m): 1000

### Site Details

Site at 573370, 182210



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



## Essex

Published 1872 - 1876

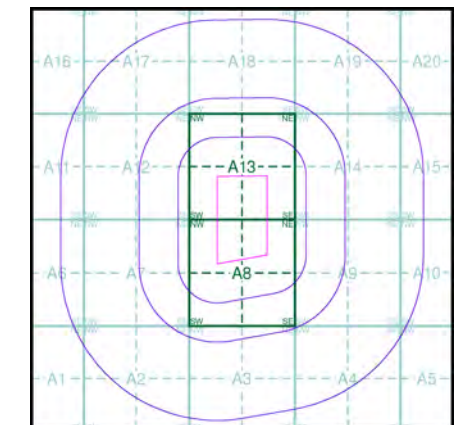
Source map scale - 1:10,560

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; these maps were used to update the 1:10,560 maps. The published date given therefore 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. In the late 1940's, a Provisional Edition was produced, which updated the 1:10,560 mapping from a number of sources. The maps appear unfinished - with all military camps and other strategic sites removed. These maps were initially overprinted with the National Grid. In 1970, the first 1:10,000 maps were produced using the Transverse Mercator Projection. The revision process continued until recently, with new editions appearing every 10 years or so for urban areas.

### Map Name(s) and Date(s)

07600 1876 1:10,560	07700 1876 1:10,560
08400 1873 1:10,560	08500 1872 1:10,560

### Historical Map - Slice A

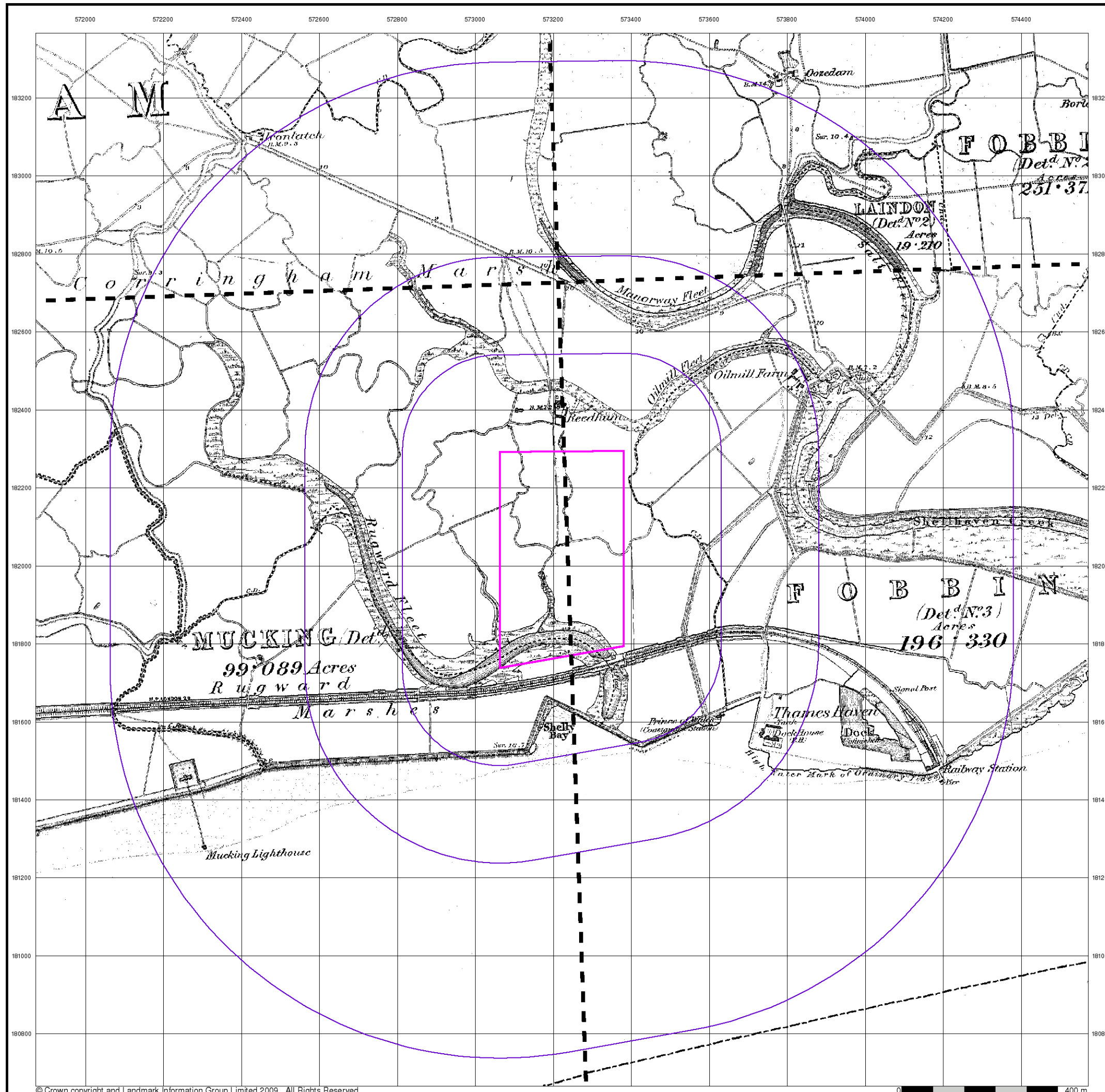


### Order Details

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Customer Ref: Thames  
National Grid Reference: 573210, 182030  
Slice: A  
Site Area (Ha): 16.75  
Search Buffer (m): 1000

### Site Details

Site at 573370, 182210





## Essex

Published 1898

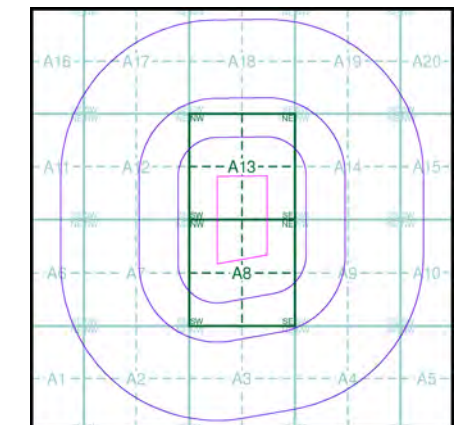
Source map scale - 1:10,560

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; these maps were used to update the 1:10,560 maps. The published date given therefore 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. In the late 1940's, a Provisional Edition was produced, which updated the 1:10,560 mapping from a number of sources. The maps appear unfinished - with all military camps and other strategic sites removed. These maps were initially overprinted with the National Grid. In 1970, the first 1:10,000 maps were produced using the Transverse Mercator Projection. The revision process continued until recently, with new editions appearing every 10 years or so for urban areas.

### Map Name(s) and Date(s)

076SE 1898 1:10,560	077SW 1898 1:10,560
084NE 1898 1:10,560	085NW 1898 1:10,560

### Historical Map - Slice A

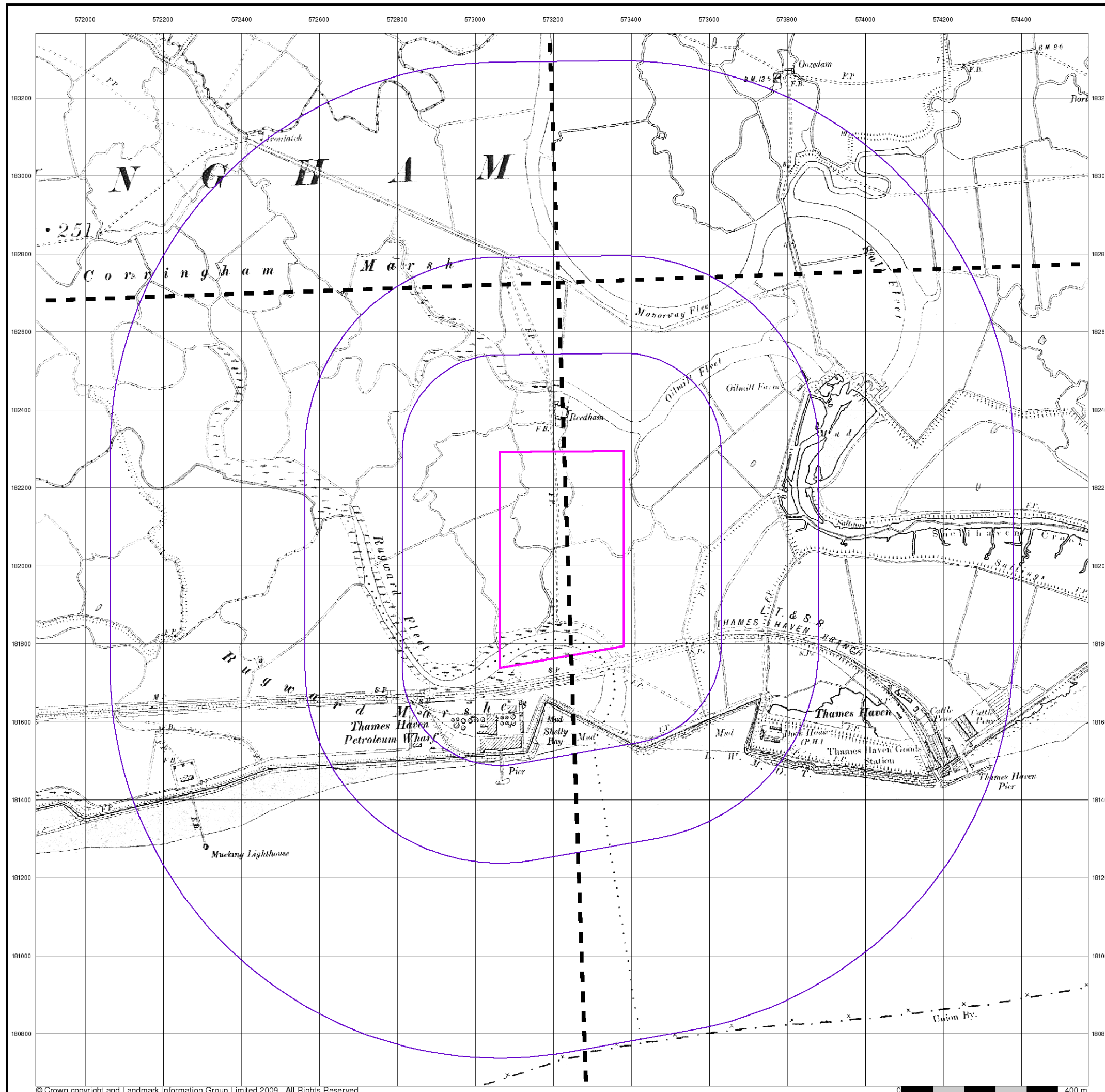


### Order Details

Order Number: 29109000\_1\_1  
 Customer Ref: Thames  
 National Grid Reference: 573210, 182030  
 Slice: A  
 Site Area (Ha): 16.75  
 Search Buffer (m): 1000

### Site Details

Site at 573370, 182210





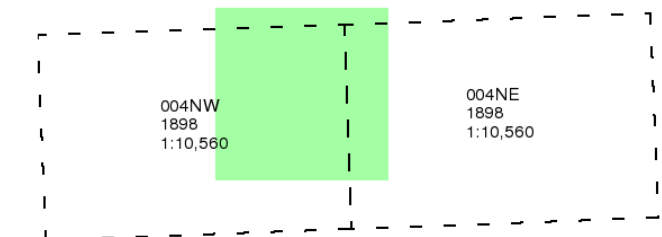
## Kent

Published 1898

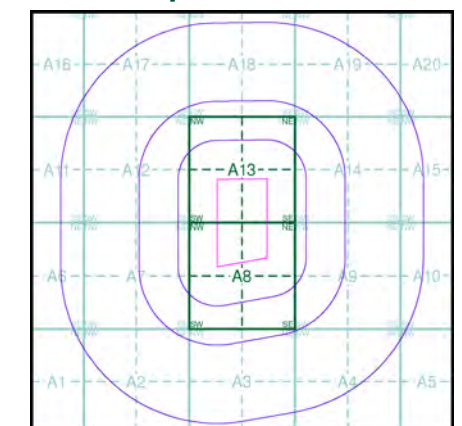
Source map scale - 1:10,560

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; these maps were used to update the 1:10,560 maps. The published date given therefore 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. In the late 1940's, a Provisional Edition was produced, which updated the 1:10,560 mapping from a number of sources. The maps appear unfinished - with all military camps and other strategic sites removed. These maps were initially overprinted with the National Grid. In 1970, the first 1:10,000 maps were produced using the Transverse Mercator Projection. The revision process continued until recently, with new editions appearing every 10 years or so for urban areas.

### Map Name(s) and Date(s)



### Historical Map - Slice A

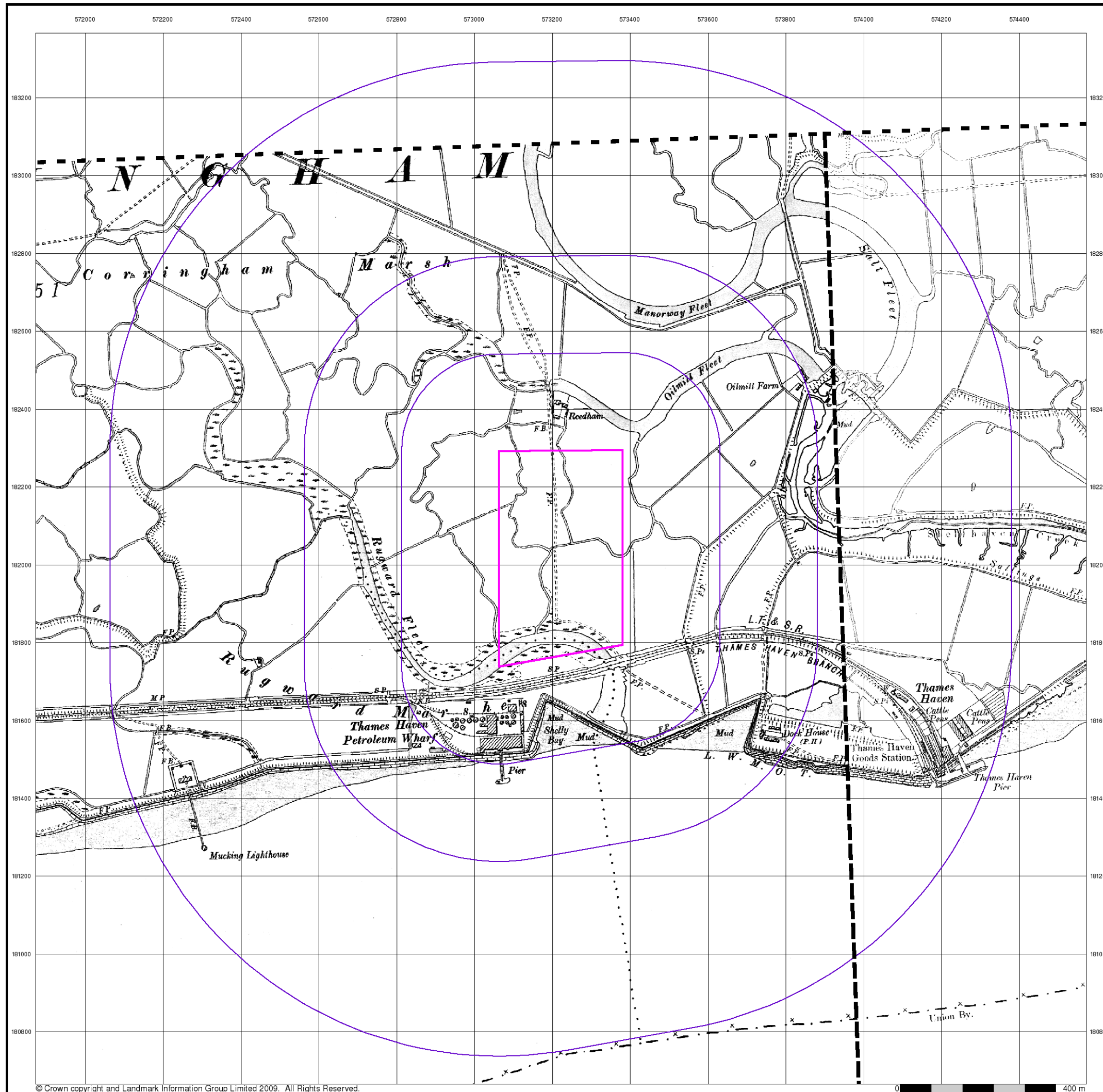


### Order Details

Order Number: 29109000\_1\_1  
 Customer Ref: Thames  
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 Slice: A  
 Site Area (Ha): 16.75  
 Search Buffer (m): 1000

### Site Details

Site at 573370, 182210





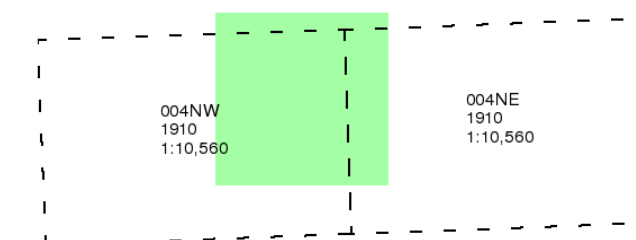
## Kent

Published 1910

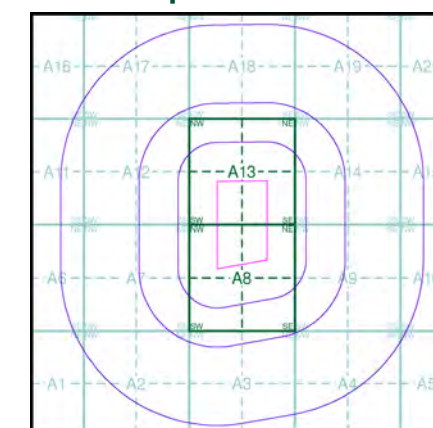
Source map scale - 1:10,560

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; these maps were used to update the 1:10,560 maps. The published date given therefore 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. In the late 1940's, a Provisional Edition was produced, which updated the 1:10,560 mapping from a number of sources. The maps appear unfinished - with all military camps and other strategic sites removed. These maps were initially overprinted with the National Grid. In 1970, the first 1:10,000 maps were produced using the Transverse Mercator Projection. The revision process continued until recently, with new editions appearing every 10 years or so for urban areas.

## Map Name(s) and Date(s)



## Historical Map - Slice A

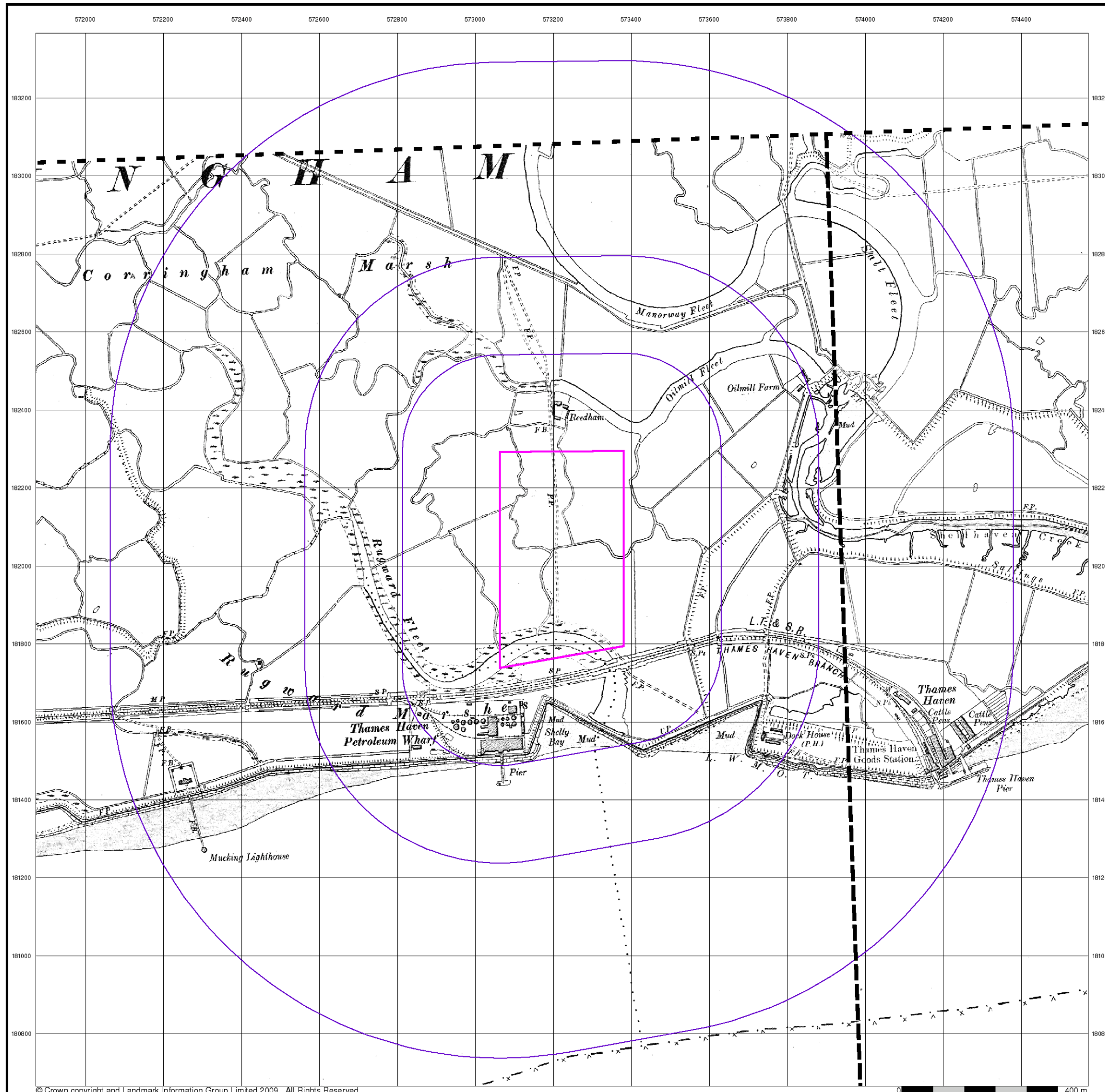


## Order Details

Order Number: 29109000\_1\_1  
Customer Ref: Thames  
National Grid Reference: 573210, 182030  
Slice: A  
Site Area (Ha): 16.75  
Search Buffer (m): 1000

## Site Details

Site at 573370, 182210





## Essex

Published 1924

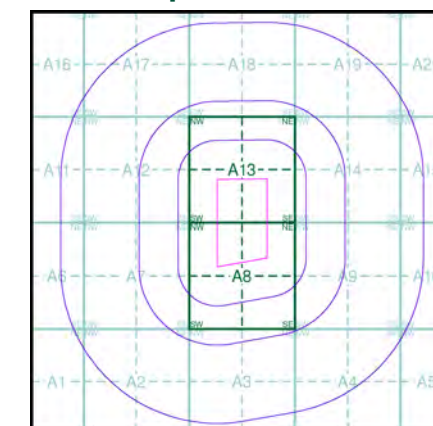
Source map scale - 1:10,560

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; these maps were used to update the 1:10,560 maps. The published date given therefore 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. In the late 1940's, a Provisional Edition was produced, which updated the 1:10,560 mapping from a number of sources. The maps appear unfinished - with all military camps and other strategic sites removed. These maps were initially overprinted with the National Grid. In 1970, the first 1:10,000 maps were produced using the Transverse Mercator Projection. The revision process continued until recently, with new editions appearing every 10 years or so for urban areas.

## Map Name(s) and Date(s)

089NE
1924
1:10,560
089SE
1924
1:10,560

## Historical Map - Slice A

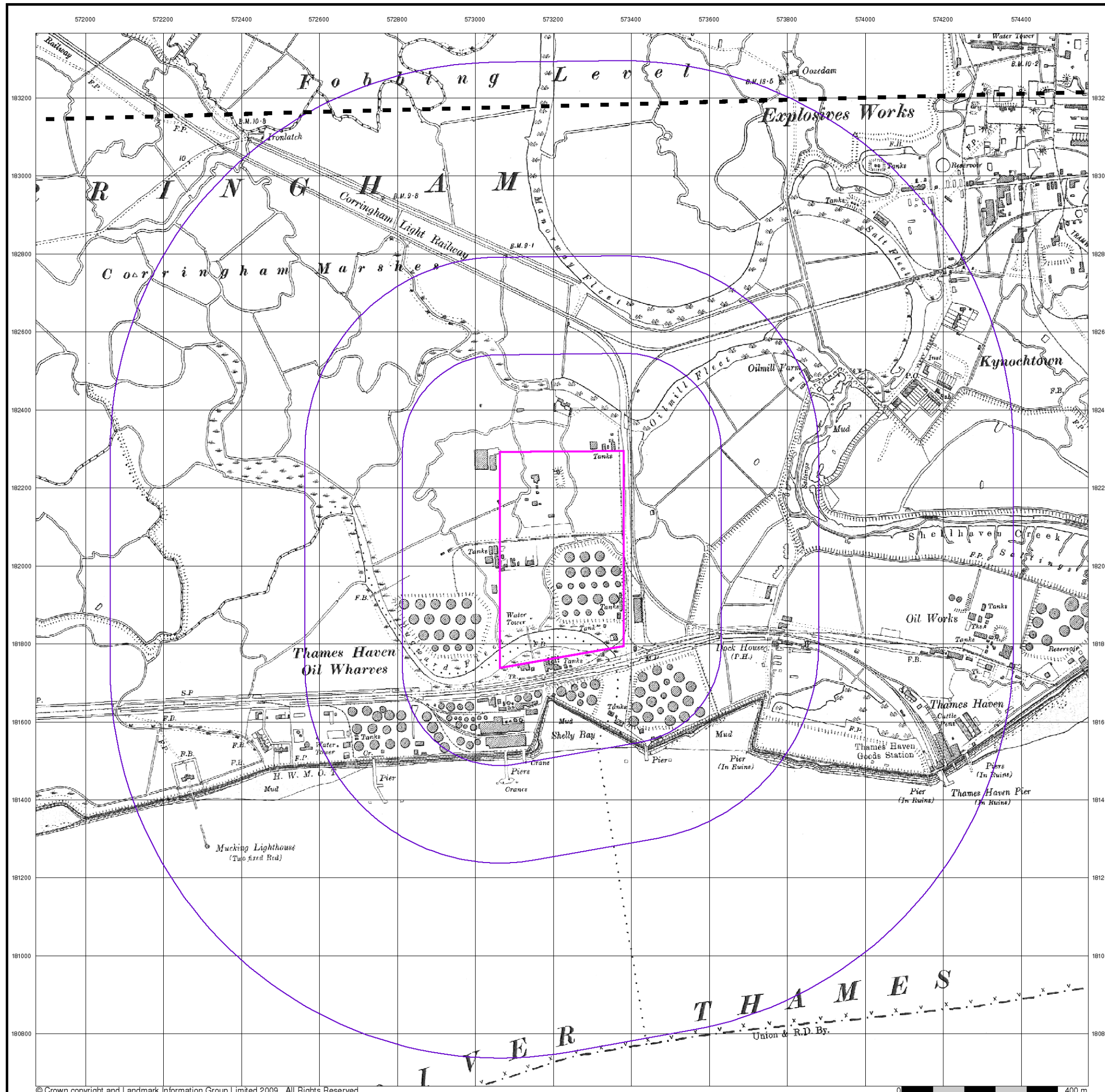


## Order Details

Order Number: 29109000\_1\_1  
 Customer Ref: Thames  
 National Grid Reference: 573210, 182030  
 Slice: A  
 Site Area (Ha): 16.75  
 Search Buffer (m): 1000

## Site Details

Site at 573370, 182210





## Essex

Published 1938

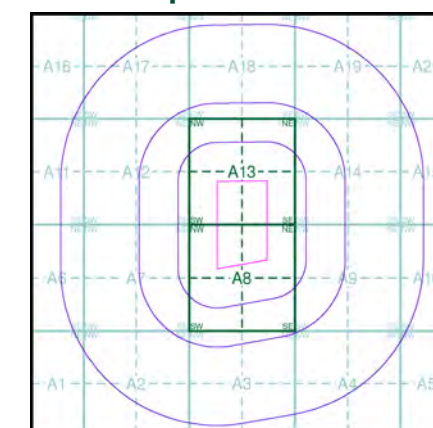
Source map scale - 1:10,560

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; these maps were used to update the 1:10,560 maps. The published date given therefore 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. In the late 1940's, a Provisional Edition was produced, which updated the 1:10,560 mapping from a number of sources. The maps appear unfinished - with all military camps and other strategic sites removed. These maps were initially overprinted with the National Grid. In 1970, the first 1:10,000 maps were produced using the Transverse Mercator Projection. The revision process continued until recently, with new editions appearing every 10 years or so for urban areas.

## Map Name(s) and Date(s)

089NE
1938
1:10,560
089SE
1938
1:10,560

## Historical Map - Slice A

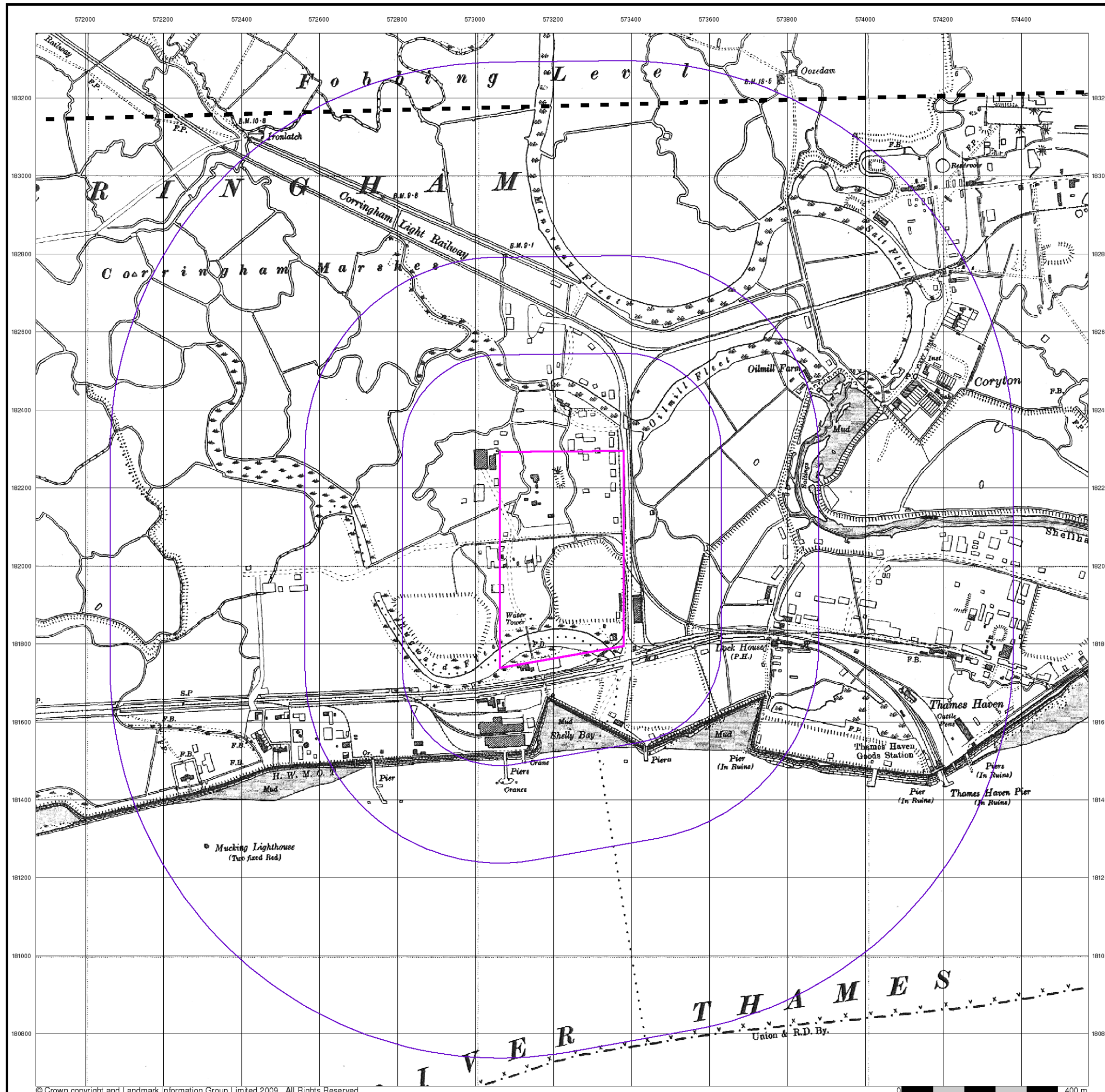


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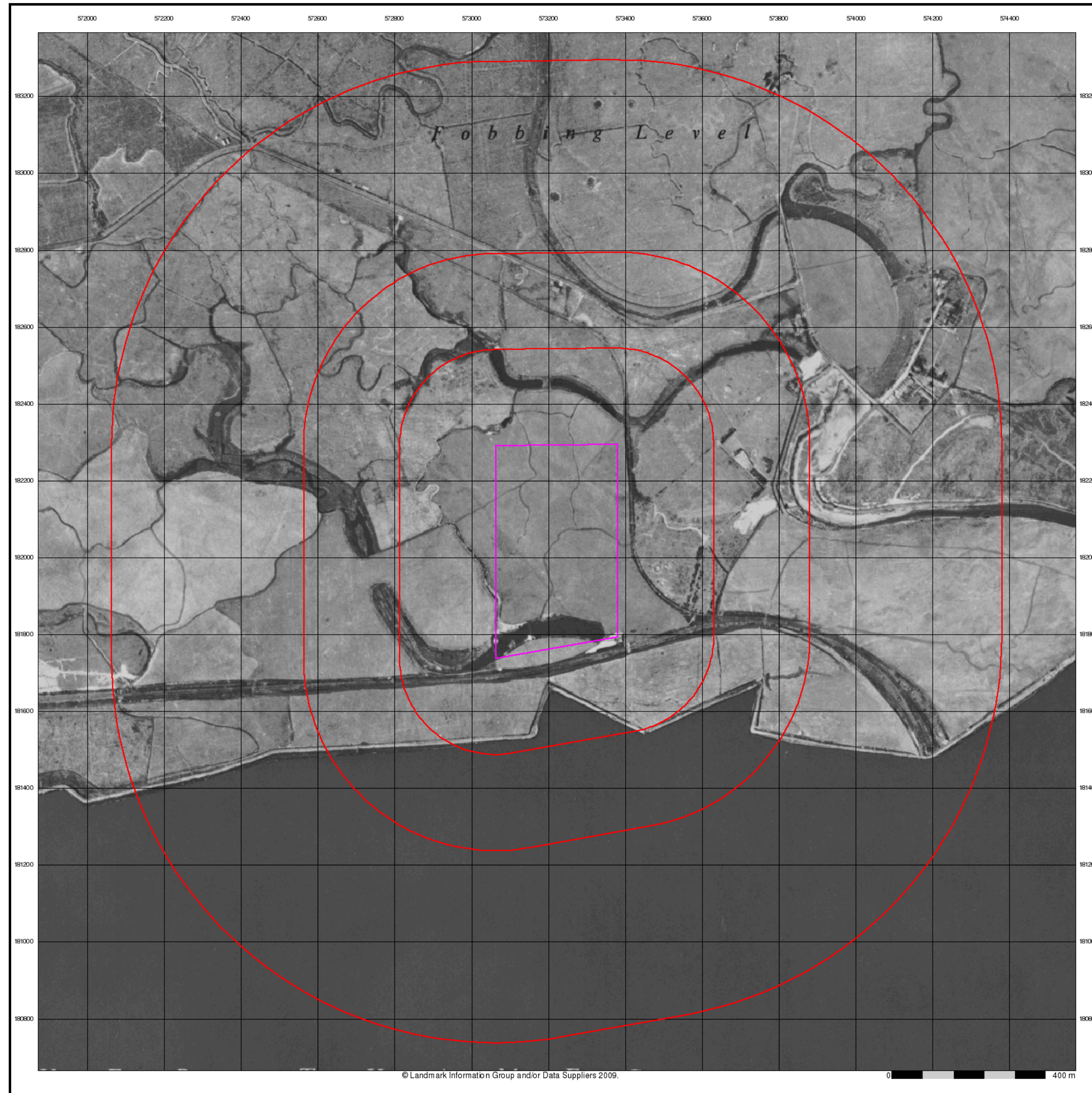
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 Slice: A  
 Site Area (Ha): 16.75  
 Search Buffer (m): 1000

## Site Details

Site at 573370, 182210







## Historical Aerial Photography

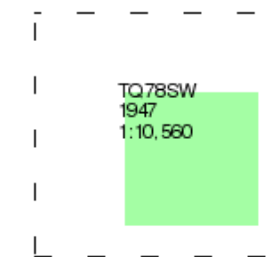
Published 1947

Source map scale - 1:10,560

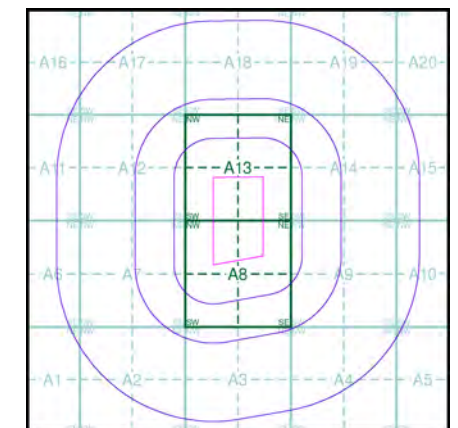
The Historical Aerial Photos were produced by the Ordnance Survey at a scale of 1:1,250 and 1:10,560 from Air Force photography. They were produced between 1944 and 1951 as an interim measure, pending preparation of conventional mapping, due to post war resource shortages. New security measures in the 1950's meant that every photograph was re-checked for potentially unsafe information with security sites replaced by fake fields or clouds. The original editions were withdrawn and only later made available after a period of fifty years although due to the accuracy of the editing, without viewing both revisions it is not easy to spot the edits. Where available Landmark have included both revisions.

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### Map Name(s) and Date(s)



### Historical Aerial Photography - Slice A



### Order Details

Order Number: 29109000\_1\_1  
Customer Ref: Thames  
National Grid Reference: 573210, 182030  
Slice: A  
Site Area (Ha): 16.75  
Search Buffer (m): 1000

### Site Details

Site at 573370, 182210



Tel: 0844 844 9952  
Fax: 0844 844 9951  
Web: [www.envirocheck.co.uk](http://www.envirocheck.co.uk)



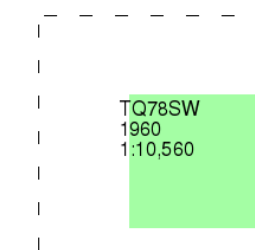
## Ordnance Survey Plan

Published 1960

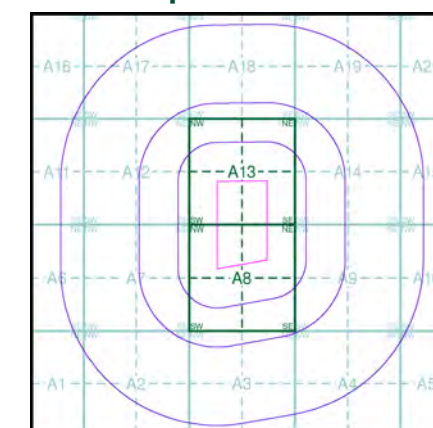
Source map scale - 1:10,000

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; these maps were used to update the 1:10,560 maps. The published date given therefore 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. In the late 1940's, a Provisional Edition was produced, which updated the 1:10,560 mapping from a number of sources. The maps appear unfinished - with all military camps and other strategic sites removed. These maps were initially overprinted with the National Grid. In 1970, the first 1:10,000 maps were produced using the Transverse Mercator Projection. The revision process continued until recently, with new editions appearing every 10 years or so for urban areas.

## Map Name(s) and Date(s)



## Historical Map - Slice A



## Order Details

Order Number: 29109000\_1\_1  
Customer Ref: Thames  
National Grid Reference: 573210, 182030  
Slice: A  
Site Area (Ha): 16.75  
Search Buffer (m): 1000

## Site Details

Site at 573370, 182210





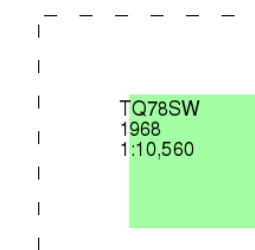
## Ordnance Survey Plan

Published 1968

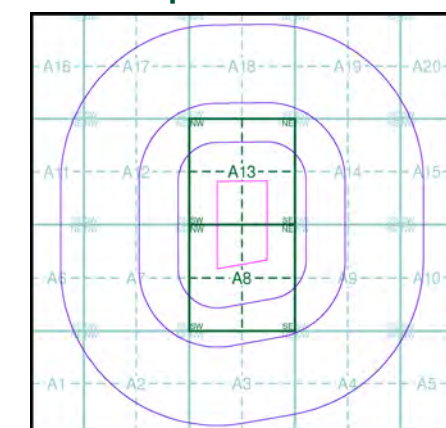
Source map scale - 1:10,000

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; these maps were used to update the 1:10,560 maps. The published date given therefore 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. In the late 1940's, a Provisional Edition was produced, which updated the 1:10,560 mapping from a number of sources. The maps appear unfinished - with all military camps and other strategic sites removed. These maps were initially overprinted with the National Grid. In 1970, the first 1:10,000 maps were produced using the Transverse Mercator Projection. The revision process continued until recently, with new editions appearing every 10 years or so for urban areas.

## Map Name(s) and Date(s)



## Historical Map - Slice A

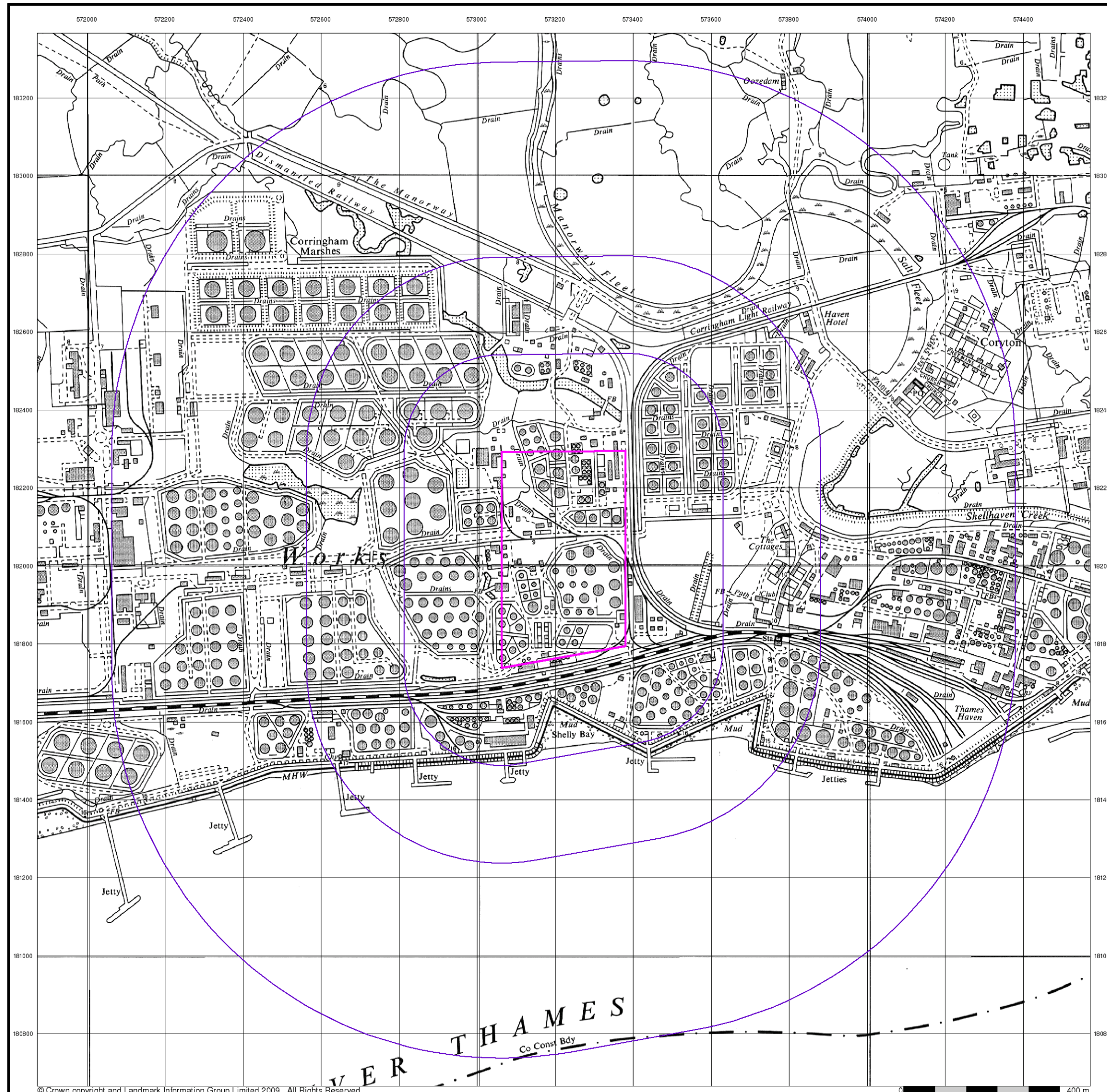


## Order Details

Order Number: 29109000\_1\_1  
Customer Ref: Thames  
National Grid Reference: 573210, 182030  
Slice: A  
Site Area (Ha): 16.75  
Search Buffer (m): 1000

## Site Details

Site at 573370, 182210





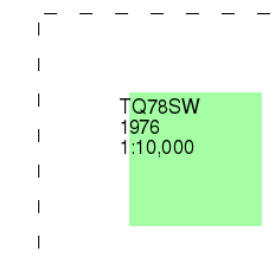
## Ordnance Survey Plan

Published 1976

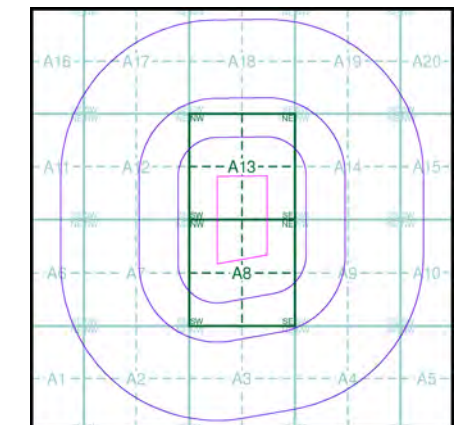
Source map scale - 1:10,000

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; these maps were used to update the 1:10,560 maps. The published date given therefore 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. In the late 1940's, a Provisional Edition was produced, which updated the 1:10,560 mapping from a number of sources. The maps appear unfinished - with all military camps and other strategic sites removed. These maps were initially overprinted with the National Grid. In 1970, the first 1:10,000 maps were produced using the Transverse Mercator Projection. The revision process continued until recently, with new editions appearing every 10 years or so for urban areas.

## Map Name(s) and Date(s)



## Historical Map - Slice A

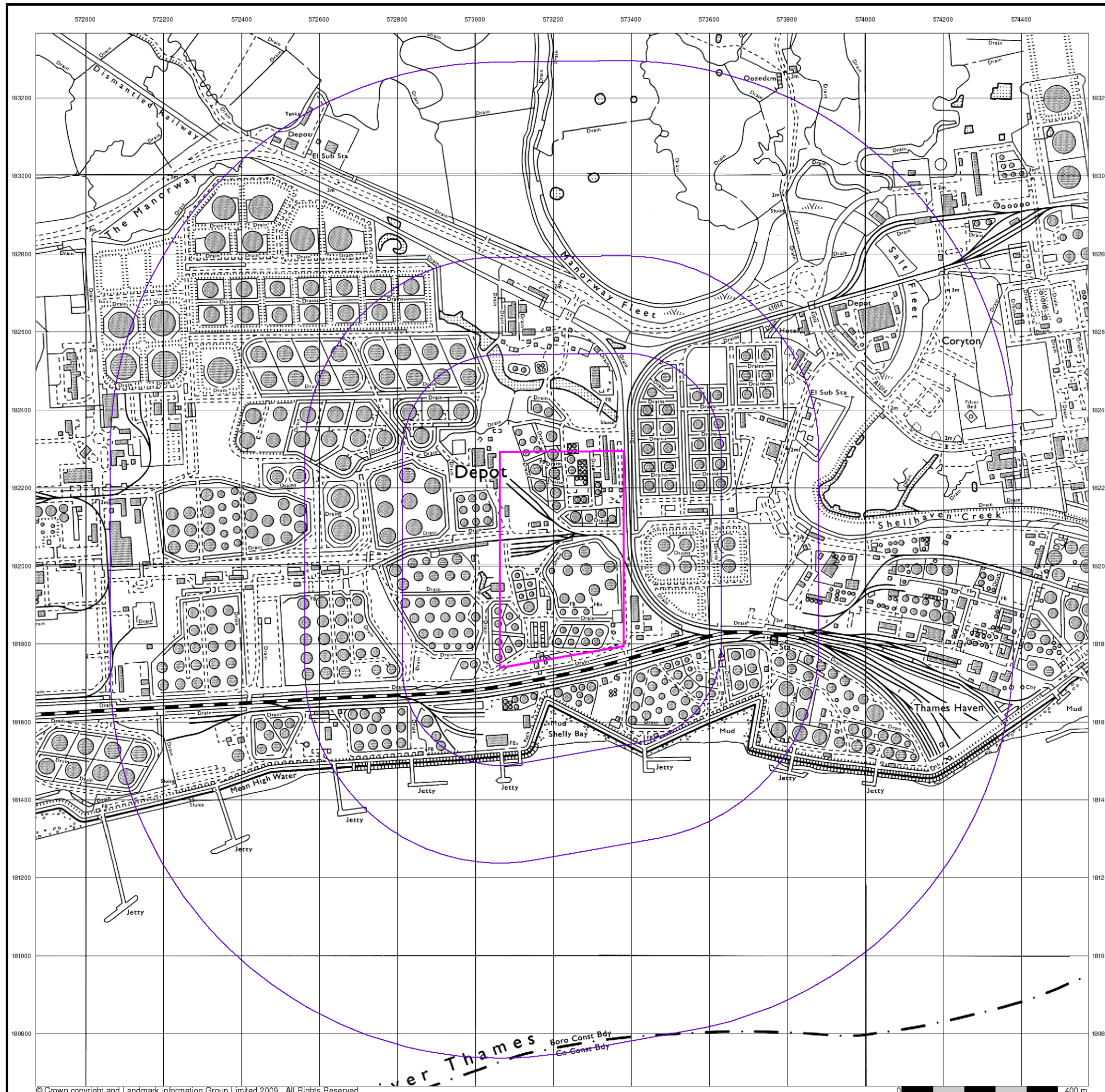


## Order Details

Order Number: 29109000\_1\_1  
Customer Ref: Thames  
National Grid Reference: 573210, 182030  
Slice: A  
Site Area (Ha): 16.75  
Search Buffer (m): 1000

## Site Details

Site at 573370, 182210





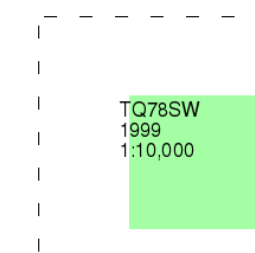
## 10k Raster Mapping

Published 1999

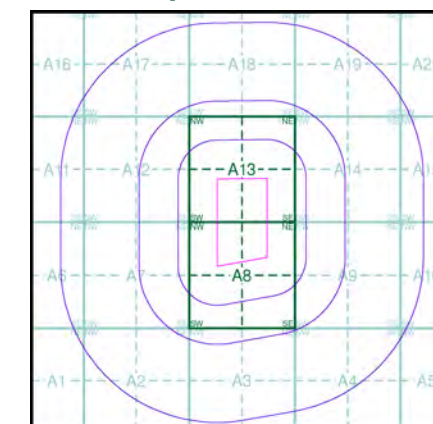
Source map scale - 1:10,000

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

### Map Name(s) and Date(s)



### Historical Map - Slice A



### Order Details

Order Number: 29109000\_1\_1  
Customer Ref: Thames  
National Grid Reference: 573210, 182030  
Slice: A  
Site Area (Ha): 16.75  
Search Buffer (m): 1000

### Site Details

Site at 573370, 182210





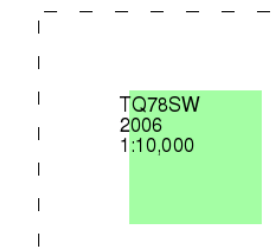
## 10k Raster Mapping

Published 2006

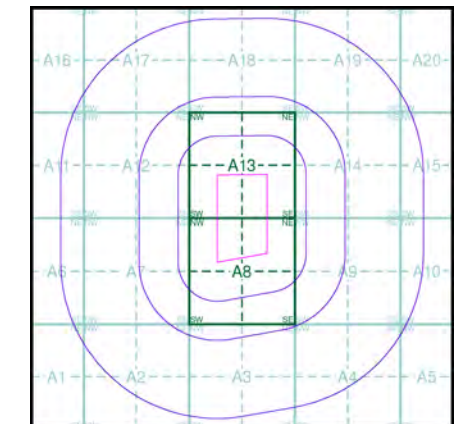
Source map scale - 1:10,000

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

### Map Name(s) and Date(s)



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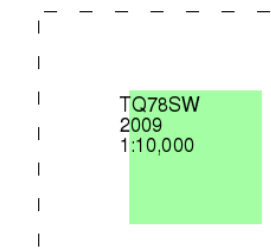
## 10k Raster Mapping

Published 2009

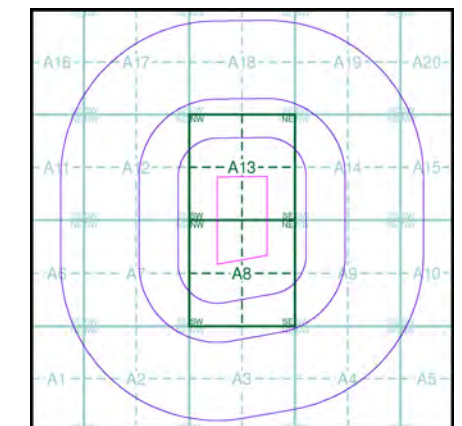
Source map scale - 1:10,000

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

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