

ASSESSMENT OF EFFECTS
ARCHAEOLOGICAL HERITAGE: INTERTIDAL AND MARINE

in respect of the proposed development of

London Gateway

October 2001

Draft and Confidential

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Prepared by :.....

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NON-TECHNICAL SUMMARY

Wessex Archaeology has been commissioned by Posford Haskoning to undertake an archaeological assessment of 'wetside' elements of the London Gateway proposals at Shell Haven in Essex. The proposal encompasses development of a container port and associated development on land, reclamation of predominantly intertidal areas to a new quay line, and dredging of the berths and sections of the navigational channels approaching and entering the Thames. The proposal is being promoted by P&O/Shell in conjunction with the Port of London Authority (PLA).

The 'wetside' comprises all areas seaward of the seawall at Shell Haven, including intertidal areas and marine (subtidal) areas. The marine areas include the series of proposed dredging areas along the approaches to the Thames as far as The Sunk, some 12 nautical miles east-south-east of Harwich.

Oxford Archaeological Unit, commissioned by Oscar Faber Consulting Engineers, is carrying out the dryside assessment, and both the dryside and wetside archaeological assessments are being carried out in an integrated manner under the advice of Gill Andrews, Consultant Archaeologist.

Data has been obtained principally from two sources, the UK Hydrographic Office and the National Monument Record, generating 232 records from the UKHO and 1362 records from the NMR. These datasets were correlated with other sources and cross-referenced to the Study Area, resulting in a total of 254 wrecks within the Study Area and 519 casualties for relevant named locations.

Additionally, an extensive review of secondary sources and of historic charts and sailing instructions has been undertaken, together with a site visit, observation of marine geotechnical investigations, and examination of historic air photographs. Further surveys are anticipated and will be submitted as addenda to this assessment.

The assessment identifies a series of likely significant effects on the archaeological heritage, encompassing known sites and potential sites in former creeks, in Shell Haven wetside and in the areas proposed for channel dredging and wreck clearance. The effects vary from Minor Adverse to Major Adverse, though it is noted that field investigation is required to establish the importance of some sites.

Mitigation measures are proposed, in the form of investigation, monitoring and procedures for reporting fortuitous discoveries. The detail of mitigation measures for individual sites will be based on further archaeological investigations, including geophysical surveys and archaeological inspections. Analysis, material conservation, archiving and dissemination will accompany mitigation.

The proposed mitigation will offset any physical loss of the archaeological heritage, such that the residual effect of the London Gateway proposals is only Minor Adverse or even beneficial. The net result is that accompanied by appropriate mitigation, the effects of the London Gateway proposals on the intertidal and marine archaeological heritage are sustainable.

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This assessment was carried out by David Parham, Mark Beattie-Edwards, Mark Dunkley and Antony Firth. The illustrations were prepared by Rob Goller. The project was managed for Wessex Archaeology by Antony Firth.

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1. INTRODUCTION

1.1. PROJECT BACKGROUND

- 1.1.1. Wessex Archaeology has been commissioned by Posford Haskoning to undertake an archaeological assessment of 'wetside' elements of the London Gateway proposals at Shell Haven in Essex. Posford Haskoning has previously prepared a Cultural Heritage Scoping of the proposals (Posford Haskoning 2001).
- 1.1.2. The proposal encompass development of a container port and associated development on land, reclamation of predominantly intertidal areas to a new quay line, and dredging of the berths and sections of the navigational channels approaching and entering the Thames. The proposal is being promoted by P&O/Shell in conjunction with the Port of London Authority (PLA).
- 1.1.3. The 'wetside' comprises all areas seaward of the seawall at Shell Haven, including intertidal areas and marine (subtidal) areas. The marine areas include the series of proposed dredging areas along the approaches to the Thames as far as The Sunk, some 12 nautical miles east-south-east of Harwich (see Fig. 1).
- 1.1.4. Elements of the London Gateway proposals landward of the seawall – known as 'dryside' – are being assessed by Oxford Archaeological Unit (OAU), commissioned by Oscar Faber Consulting Engineers.
- 1.1.5. Both the dryside and wetside archaeological assessments are being carried out in an integrated manner under the advice of Gill Andrews, Consultant Archaeologist.
- 1.1.6. The integrated approach adopted to the archaeology of dryside and wetside elements of London Gateway has led to a degree of overlap in respective interests. Consequently, the archaeology of the various jetties forming part of the industrial archaeology of Shell Haven are being assessed by OAU, whereas Wessex Archaeology is advising on maritime aspects of the creeks formerly underlying the dryside.

1.2. STUDY AREA

- 1.2.1. Wessex Archaeology defined a Study Area (see Fig. 1) encompassing all wetside elements, including the various areas of proposed dredging and an overlap with the dryside. The Study Area was defined by reference to the principal sandbanks and navigational features either side of the Thames approach, providing a substantial margin around the areas where development is actually proposed.
- 1.2.2. Additionally, Wessex Archaeology selected a series of 'named locations', which are the nominal positions used by the National Monuments Record for ships that are documented losses ('casualties') but whose actual position is not known. The named locations selected by Wessex Archaeology are as follows:

Named Location	
Barrow Sand	Oaze Deep
Below Gravesend	Off Whitstable
Blyth Sand	Offshore Harwich
Chapman Lighthouse	Offshore the Naze
Entrance to River Thames	Red Sand
Essex Coastal waters	River Thames Coastal Waters
Gunfleet	Shingles
Hole Haven	Shivering Sand
Knock Sand	Shoebury Sand
Leigh Channel	South East Spit
Long Sand	South West Sunk Sand
Long Sand Head	Southend on Sea
Lower Hope Point	Sunk Sand
Maplin Sand	The Cant
Middle Sunk Sand	The Girdler
Mouse Sand	The Swin
Mucking	West Swin
Nore Sands	Yantlet Channel

- 1.2.3. Many of the recorded losses have been obtained from the *Lloyd's Register of Shipping* established in 1734. Prior to this, vessels cast ashore were considered of little importance in themselves and their details were seldom, if ever, recorded. Even then wrecks could only be recorded if there was a witness to the loss, either as an observer or a survivor, which becomes increasingly unlikely the further from shore that losses occur. Accordingly, the *Select Committee appointed to Inquire into the Causes of Shipwreck* noted in 1836 that their data did not 'embrace the whole extent of the loss...these returns include only the losses entered in Lloyds books...whereas it is well known that many vessels and lives are lost by wreck...of which no entry is made in Lloyds book...' (Larn and Larn 1995: vi). The processes by which casualties have been recorded mitigate against the desktop identification of older wreck sites, particularly those occurring offshore.

2. LEGISLATIVE AND PLANNING CONTEXT

2.1. STATUTORY PROTECTION

Protection of Wrecks Act 1973

- 2.1.1. The Prospecting Area lies within UK territorial waters, in which the Protection of Wrecks Act 1973 may be applied. Under the 1973 Act, wrecks and wreckage of historical, archaeological or artistic importance can be protected by way of designation. It is an offence to carry out certain activities in a defined area surrounding a wreck that has been designated unless a licence for those activities has been obtained from the Government. Generally, the relevant Secretary of State must consult appropriate advisors prior to designation, though it is also possible to designate a wreck in an emergency without first seeking advice.
- 2.1.2. In England, the Protection of Wrecks Act 1973 is administered by the Department for Culture, Media and Sport (DCMS). Specialist advice is sought from the Advisory Committee on Historic Wreck Sites (ACHWS) and a team of professional diving archaeologists employed on contract. Licences can be obtained to carry out survey, excavation and other activities that would be otherwise prohibited.
- 2.1.3. There are no areas subject to designation under the Protection of Wrecks Act within the Study Area. The closest protected wreck is South Edinburgh Channel c. 2½ nautical miles south east of the proposed channel at the head of Black Deep.
- 2.1.4. If a wreck of historical, archaeological or artistic importance were to be discovered in the course of dredging, then it would be possible for DCMS to designate it at very short notice, irrespective of any inconvenience to construction.

Ancient Monuments and Archaeological Areas Act 1979

- 2.1.5. Monuments that are of national importance can be protected by being added to the schedule (list) of monuments protected under the Ancient Monuments and Archaeological Areas Act 1979. It is an offence to damage such a 'scheduled monument' or to carry out a range of specified activities, unless a licence for these activities has been obtained, in the form of 'scheduled monument consent'. Monument is a wide term that covers many types of archaeological site, including buildings, structures, works, caves, excavations and their sites. Monument can also mean the site of any vehicle, vessel, aircraft or other movable structure. As monuments that are situated in, on or under the seabed within UK territorial waters (referred to as a

monument in territorial waters) can be scheduled, then it would be possible to schedule a historic wreck. However, government policy in England is currently to use the Protection of Wrecks Act 1973 in preference to the 1979 Act in protecting wrecks.

2.1.6. The Ancient Monuments and Archaeological Areas Act 1979 is administered in England by English Heritage.

2.1.7. There are no sites protected by the Ancient Monuments and Archaeological Areas Act 1979 in the wetside.

Protection of Military Remains Act 1986

2.1.8. Under the Protection of Military Remains Act 1986, all aircraft that have crashed in military service are protected, and the Ministry of Defence has powers to protect vessels that were in military service when they were wrecked. The Ministry of Defence can designate named vessels as 'protected places' even if the position of the wreck is not known. In addition, the Ministry of Defence can designate 'controlled sites' around wrecks whose position is known. In the case of 'protected places', the vessel must have been lost after 4 August 1914, whereas in the case of a wreck protected as a 'controlled site' no more than 200 years must have elapsed since loss. In neither case is it necessary to demonstrate the presence of human remains. Diving is not prohibited at a 'protected place' but it is an offence to tamper with, damage, move or remove sensitive remains. However, diving, salvage and excavation are all prohibited on 'controlled sites', though licences for restricted activities can be sought from the Ministry of Defence. Additionally, it is an offence carry out unauthorised excavations for the purpose of discovering whether any place in UK waters comprises any remains of an aircraft or vessel which has crashed, sunk or been stranded while in military service.

2.1.9. Nine known wrecks in areas subject to dredging sank while in military service or due to military action:

HMSM Truculent	5004
Argus	5008
Ash	5013
MTB106	5039
Aquity	5040
HMS Aisha	5057
HMS Coquet	5092
UC-72	5134

2.1.10. A further known wreck within 100 m of a proposed dredging area, HMS Amethyst (5063, and see 5067), also sank in action.

2.1.11. Thirty-seven other known wrecks within the Study Area sank while in military service or due to military action, as follows:

HMS Capricornus	5001	Erna Boldt	5108
Letchworth	5005	Storm	5109
HMS Conquistador	5017	HNLMS 227	5111
Kinnaird Head	5034	HMS Commandant	5113
Houston City	5052	HMS Lord Airedale	5117
Actuality	5058	HMTB 10	5118
HMS Kennymore	5061	HMTB No. 11	5130
Bradglen	5069	Michail Ontchoukoff	5158
Ryall	5070	HMSM E6	5160
Margam Abbey	5071	Monitoria	5163
Sun VII	5072	Greenhill	5166
HM Torpedo Boat No. 12	5089	GW Humphreys	5176
Dynamo	5100	Lunula	5177
Norhauk	5101	Tilburyness	5179
Marie Leonhardt	5102/5106	Ocean Retriever	5184
Unknown submarine	5103	Bolbec	5194
Bonnington Court	5104	Araby	5231
HMS Resono	5105	Arinia	5232
Argyle	5107		

2.1.12. Many other vessels, whose position is not known, are recorded as being lost in military service or military action in the region.

2.1.13. Although the above might be regarded as 'war graves', this term has no meaning in law. Moreover, none of these wrecks have been designated as a 'protected place' or 'controlled site', hence the site-specific provisions of the Protection of Military Remains Act 1986 do not apply. However, it would be an offence to carry out unauthorised excavations for the purpose of discovering military remains.

2.1.14. As noted above, all aircraft that have crashed in military service are protected under the Protection of Military Remains Act 1986. There are two known aircraft wrecks in the Study Area, 5024 and 5041. In addition, two aircraft are reported lost in the Yantlet: a Sunderland (5828) and a Spitfire (5829). A Mosquito was lost on Long Sand (6288) and Hurricane in the Cant (6514).

2.1.15. Given the position of the Study Area on the approaches to London and other targets of air attack during WWII there is potential for further, hitherto unknown, aircraft or related material to be present within the Study Area.

2.2. STATUTORY PROCEDURES

Merchant Shipping Act 1995

- 2.2.1. The ownership of finds from tidal waters that turn out to be 'wreck' is decided according to procedures set out in the Merchant Shipping Act 1995. Finders should assume at the onset that all recovered wreck has an owner. Ownership of wreck lies in the original owner or their successor, unless they fail to make a claim to the Receiver of Wreck within one year of notification. Ownership of unclaimed wreck from within territorial waters lies in the Crown or in a person to whom rights of wreck have been granted; unclaimed wreck from beyond territorial waters is returned to the salvor.
- 2.2.2. The Receiver of Wreck has a duty to ensure that finders who report their finds as required receive an appropriate salvage payment. In the case of material considered to be of historic or archaeological importance, a suitable museum is asked to buy the material at the current valuation and the finder receives the net proceeds of the sale as a salvage payment. If the right to, or the amount of, salvage cannot be agreed, either between owner and finder or between competing salvors, the Receiver of Wreck will hold the wreck until the matter is settled, either through amicable agreement or by court judgement.

2.3. PLANNING GUIDANCE

Application

- 2.3.1. Planning law applies within the territory of local authorities which, as a general rule, extends only to the low water mark. However, in the Thames, local authority boundaries upstream of a line between Southend and the Isle of Grain extend across the estuary to meet each other on the centreline of the channel. Accordingly, the area of proposed dredging immediately off Shell Haven and a substantial proportion of the Yantlet Channel fall within the county of Essex or Kent.
- 2.3.2. Downstream of the line between Southend and the Isle of Grain, planning law stops at the low water mark. However, English Heritage and RCHME included the following statement in *England's Coastal Heritage*, referred to below:

Although it remains government policy not to extend the Town and Country Planning system to the territorial sea, the principles set out in Planning policy guidance note 16: archaeology and planning should be applied to the treatment of sub-tidal archaeological remains in order to secure best practice.

PPG 16

- 2.3.3. Planning Policy Guidance: Archaeology and Planning (PPG 16) sets out the Secretary of State's policy on archaeological remains. It acknowledges the potentially fragile and finite or irreplaceable nature of such remains (para. 6), and states that the desirability of preservation of archaeological remains and their setting is a material consideration within the planning process (para. 18). PPG 16 provides that there is a presumption in favour of the physical preservation of nationally important archaeological remains (para. 8), and that where preservation in situ is not justified it is reasonable for planning authorities to require the developer to make appropriate and satisfactory provision for excavation and recording of remains (para. 25).
- 2.3.4. Paragraph 19 of PPG 16 suggests that it is in developers' own interests to include an initial assessment of whether the site is known or likely to contain archaeological remains as part of their research into the development potential of a site. Paragraph 22 adds: 'Local planning authorities can expect developers to provide the results of such assessments ... as part of their application for sites where there is good reason to believe there are remains of archaeological importance'. PPG 16 also notes that in spite of the best pre-planning application research, there may be occasions when the presence of archaeological remains only becomes apparent once development has commenced (para. 31).

PPG 15

- 2.3.5. Planning Policy Guidance: Planning and the Historic Environment (PPG 15) states that 'It is fundamental to the Government's policies for environmental stewardship that there should be effective protection for all aspects of the historic environment' para. 1.1). In respect of Development Control, PPG15 says of local planning authorities (para. 2.11):

They should expect developers to assess the likely impact of their proposals on the site or structure in question, and to provide such written information or drawings as may be required to understand the significance of a site or structure before an application is determined.

PPG 20

- 2.3.6. Planning Policy Guidance: Coastal Planning (PPG 20) notes that the coastal zone has a rich heritage both above and below low water mark, which includes buildings and areas of architectural or historic interest, industrial archaeology, scheduled and other ancient monuments and other archaeological sites (para. 2.8). PPG 20 also makes specific references to sites of archaeological and built heritage

interest in the information required by local planning authorities in addressing coastal planning (para. 4.6).

2.4. PLAN POLICIES

Structure Plan

- 2.4.1. Details of Structure Plan policies relating to archaeological heritage are yet to be received from the Project Team.

Local Plan

- 2.4.2. Details of Local Plan policies relating to archaeological heritage are yet to be received from the Project Team.

2.5. NON-STATUTORY PLANS, POLICIES AND CODES

England's Coastal Heritage

- 2.5.1. *England's Coastal Heritage: a statement on the management of coastal archaeology* was published in 1996 by English Heritage and the Royal Commission on the Historical Monuments of England (RCHME). The statement set out a number of principles for managing coastal archaeology:

The coastal zone of England includes a finite, irreplaceable, and, in many cases, highly fragile archaeological resource which by virtue of its value, variety, and vulnerability justifies a presumption in favour of the physical preservation *in situ* of the most important sites, buildings, and remains.

Although archaeological remains situated within inter-tidal and sub-tidal areas may be less visible and accessible than remains on dry land, this does not affect their relative importance and they should be managed in accordance with the principles which apply to terrestrial archaeological remains.

As historic landscapes can extend seamlessly from dry land, through the inter-tidal zone, and into sub-tidal areas, effective management of the coastal archaeological resource cannot be achieved without due consideration of marine as well as terrestrial archaeological remains.

Where economic development in the coastal zone is likely to impact on important archaeological remains, decisions should be taken with regard to the best available information and the precautionary approach should be adopted wherever possible.

- 2.5.2. The statement also included a number of detailed recommendations, which include the following:

Development control and environmental assessment

Coastal archaeological interests should be adequately reflected in structure and local plans, and consistently and comprehensively included in Environmental Assessment procedures for coastal and marine developments (including harbour works, mineral extraction, oil and gas related projects, capital dredging projects, cable projects, and waste water treatment and disposal) and other activities requiring sectoral consent.

Harbours

Many of England's major ports and historic harbours have been in use for many centuries and consequently have a high archaeological potential which needs to be considered when harbour works are being carried out. Where appropriate English Heritage and the RCHME will seek to alert relevant authorities to the archaeological potential of harbours... We will seek to ensure that archaeological interests are adequately recognised in the consultation of local authorities carried out by the Department of Transport prior to the approval of harbour revision and empowerment orders and enactments empowering harbour authorities to licncse and carry out works...

Code of Practice for Seabed Developers

- 2.5.3. The Code of Practice for Seabed Developers, which was prepared by the Joint Nautical Archaeology Policy Committee (JNAPC), extends the principles of development-led archaeology on land to development at sea. It was endorsed by the Department of National Heritage (now DCMS) following discussion between archaeologists and many industry groups.

3. ASSESSMENT GUIDELINES

- 3.1. There is little detailed guidance in England on the consideration of archaeological heritage within the environmental assessment process, or on the archaeological content of Environmental Statements. However, this assessment has been compiled in the light of Appendix 10: Cultural Heritage/Material Assets of *Preparation of Environmental Statements for Planning Projects that Require Environmental Assessment: a good practice guide* (DETR n.d.) and the Institute of Field Archaeologists' *Standard and guidance for Archaeological Desk based Assessment* (IFA 1999).

4. ASSESSMENT METHODOLOGY

4.1. The methodology adopted in this assessment comprised the following stages:

Requests for baseline data

- UK Hydrographic Office (UKHO) Wreck Index
- National Monuments Record (NMR)
- Receiver of Wreck
- Naval Staff Directorate, MOD
- Department for Culture, Media and Sport

Compilation of baseline data

- Review of secondary sources
- Review of historic cartographic/navigational sources
- Data entry (UKHO Wreck Index / NMR)
- Examination of air photographs
- Site visit

Correlation and interpretation of data

Impact assessment

- Identification of known and potential archaeological heritage
- Review of development proposals
- Identification of past impacts
- Assessment of effects on the wetside archaeological heritage of impacts arising from development proposals

Preparation of environmental statement in respect of wetside archaeological heritage

4.2. Following the requests for data, responses were received from the UKHO Wreck Index, the NMR, the Receiver of Wreck and Naval Staff Directorate. Substantial datasets were obtained from the UKHO and NMR.

4.3. In anticipation of the receipt of data, a project database that is common to both the wetside and dryside was developed by OAU in discussion with Wessex Archaeology. An integrated structure and taxonomies were agreed and implemented. The database can be accessed and manipulated using a mapping system.

4.4. As well as compiling datasets from the UKHO and NMR into the project database and mapping system, the compilation stage included preparation of a chronological overview of the archaeology of the Thames based on secondary sources, a review of historic charts and sailing instructions relating to the navigation of the Thames estuary, examination of historic air photographs, and a site visit.

4.5. Having been assembled, the baseline data was correlated with the footprints of development proposals and considered 'in the round' to arrive at an overall interpretation that can adequately inform the impact assessment. In the course of correlation, additional information on wrecks within the Study Area provided by Halcrow from the Port of

London Authority wreck database was incorporated within the project database and mapping system.

- 4.6. The impact assessment is based on known sites – as held in the project database and mapping system – and archaeological potential, inferred from the overall interpretation arrived at above. Information on previous impacts – i.e. natural and human processes that have affected the survival and condition of archaeological material since its deposition – was obtained principally from historic and modern charts and from general knowledge of activity in the Thames.
- 4.7. The impact assessment considers the likely significant effects on the archaeological heritage of impacts arising in the construction and operational phases of development, and other effects (indirect, secondary, cumulative) arising from the existence of the development and the use of natural resources. The impact assessment seeks to classify the significance of effects on a nine point scale (from severe adverse to maximum benefit) by comparing the magnitude of each proposed impact with the sensitivity and importance of elements of the archaeological heritage within the impact footprint. The magnitude of impact is characterised as high, medium or low for both adverse and beneficial impacts. The sensitivity of elements of the archaeological heritage to proposed impacts is characterised on a five point scale from very high to low. In view of the limited application of statutory designation to the forms of archaeological heritage encountered in wetland environments, then importance is gauged by reference to non-statutory criteria for protecting archaeological sites rather than to existing designations.
- 4.8. Where the impact assessment suggests that significant adverse effects are likely, then mitigation measure (i.e. measures to reduce, prevent and where possible offset those effects) have been outlined.
- 4.9. The impact assessment has also included a consideration of residual effects, being those effects that are not entirely susceptible to mitigation, and of the 'do nothing' scenario, that is to say, the effects of impacts on the archaeological heritage that will occur if the development does not go ahead.

5. DATA GATHERING

5.1. As indicated above, data was obtained principally from two sources, the UK Hydrographic Office and the National Monument Record.

5.2. The above sources generated the following datasets for the Study Area:

UKHO	232 (150 Charted, 82 uncharted)
NMR	1362

5.3. Due to the form of its searches, the results from the NMR covered a far wider area than the Study Area and named locations requested. In the course of correlation – in which 129 duplicates present in both UKHO and NMR listings were also identified – a total of 254 wrecks within the Study Area and 519 casualties for relevant named locations was established.

5.4. The total includes additional information received from the PLA's wreck index, via Halcrow, which added four sites not already identified from the UKHO or NMR. The total also includes one further wreck identified from an air photograph.

5.5. The correlated results of data gathering are set out in Appendix I.

6. SURVEYS

6.1. INTRODUCTION

- 6.1.1. A series of surveys (field investigations) relating to wetside archaeology is being undertaken. Some field investigations have already taken place, others will be undertaken in the run-up to submission, and further investigations will be undertaken pre-inquiry and, subject to determination, pre-construction.

6.2. GEOTECHNICAL OBSERVATIONS

- 6.2.1. Wessex Archaeology observed the drilling of a number of marine boreholes off Shell Haven, and logged both the marine boreholes and a series of vibrocores from the channel in the course of laboratory extraction of borehole/vibrocore samples.
- 6.2.2. The results of these observations will inform the detailed development of a deposit model for Shell Haven. The results will also contribute to the interpretation of palaeo-geographic maps of the Thames, based on digital terrain models, that will be developed pre-submission.
- 6.2.3. The results of the deposit model and of palaeo-geographic mapping, and their implications in terms of likely significant effects arising from the proposed development, will be submitted as an addendum to this assessment.

6.3. SITE VISIT

- 6.3.1. Wessex Archaeology Staff undertook a site visit of Shell Haven waterfront. The site visit took place at mid tide and some of foreshore was underwater. Nothing of any significance was noted. Demolition work had started on some of the jetties. A series of photographs were taken; the position and direction of view of each photograph is marked on a map that is in the project file.

6.4. AIR PHOTOGRAPHS

- 6.4.1. Wessex Archaeology staff examined historic air photographs resulting from a coversearch of the NMR commissioned by OAU. The photographs were examined for evidence of foreshore structures revealed by low tide and other items of interest.
- 6.4.2. In most cases nothing of interest was seen. Photocopies were made of a representative sample of the sorties to indicate the foreshore coverage.

- 6.4.3. Only one new feature was identified, being the wreck of a large merchant vessel, possible a tanker situated 2-300m off the waterfront at c. NGR 572700 181400 (6596). The vessel had broken its back and appeared to be lying across a deep channel. Both the bow and stern were visible at low water, with the amidships underwater. The entire wreck appeared to be underwater at high water. The wreck was present in 1945 and 1946 but by 1952 a jetty had been built in its place. It is assumed that due to its relative completeness and position this wreck was removed rather than dispersed. The wreck is visible on the following sorties:

106G LA 205
106G/UK/1447 3066-3072
106G/UK/1447 3023-3025
CPE/UK/1923 4018-4024

6.5. INTERTIDAL WALKOVER SURVEYS

- 6.5.1. Provision has been made to undertake a walkover survey of intertidal areas subject to development proposals, to be undertaken pre-submission.
- 6.5.2. The results of the walkover surveys, and their implications in terms of likely significant effects arising from the proposed development, will be submitted as an addendum to this assessment.

6.6. PRE-CONSTRUCTION SURVEYS

- 6.6.1. It is anticipated that a series of further surveys will be undertaken pre-construction to inform detailed design of the London Gateway proposals, and to tailor mitigation measures to the specific requirements of wetland archaeological heritage.
- 6.6.2. These further surveys are likely to include:
- Marine geophysical investigation using sidescan and magnetometer;
 - Archaeological diving inspection of selected targets;
 - Seabed investigation comprising sub-bottom survey and/or purposive marine boreholes.

7. CONSULTATIONS

- 7.1. A formal pre-scoping consultation meeting addressing dryside archaeology was held by Gill Andrews and OAU with English Heritage and attended by Essex County Council Heritage Conservation and Thurrock Borough Council's Conservation Officer.
- 7.2. In its letters to DCMS and to the Naval Staff Directorate requesting data, Wessex Archaeology asked if there were any curatorial issues or issues relating to military remains that they wished to raise respectively. No response has been received from DCMS. The Naval Staff Directorate referred Wessex Archaeology to the UKHO but indicated that should the UKHO identify any military maritime graves then the Naval Staff Directorate should be contacted prior to undertaking any action.
- 7.3. No further consultation has yet been undertaken in respect of wetside archaeology.

8. DESCRIPTION OF BASELINE CONDITIONS

8.1. ASSESSMENT AREAS

Former Creeks

- 8.1.1. In its dryside assessment, OAU identified two distinct topographical and geological zones, namely the Gravel Terrace above the +10 m OD contour, and the Alluvial Floodplain below that contour.
- 8.1.2. Although a dryside/wetside division along the seawall has been implemented for practical reasons, the integrated approach adopted to this assessment has meant that the 'wetside' component also addresses the maritime archaeological dimension of the dryside. In particular, the Alluvial Floodplain identified by OAU was formerly intersected by a series of creeks. The former creeks intersecting the dryside footprint – including Carters Creek, Rugward Fleet and Oilmill Fleet – are readily apparent on the 1st Edition OS map of the area. Such creeks, which are certain to have Medieval if not earlier precedents, would have been navigable at least at high tide. As such, they are likely to have formed locally important conduits between the Gravel Terrace and the main channel of the Thames, as well as providing access to the Alluvial Floodplain itself. It is therefore possible that maritime structures – including waterfronts and landing places as well as watercraft – may survive in association with former creek deposits. The potential date range of such maritime structures in the former creeks is very broad; subject to the formation of the alluvial floodplain in the context of coastal and sea-level change, it is possible that maritime structures may survive of any date between the Mesolithic and the nineteenth century. It is worth noting that the majority of early watercraft discovered in the UK – often preserved in outstanding condition – have been found in 'dryside' alluvial contexts.

Shell Haven Wetside

Reclaim

- 8.1.3. For the purposes of this assessment, a distinction has been drawn between 'Shell Haven wetside' – being the wetside areas immediately off the London Gateway site – and the more extensive and increasingly distant areas proposed for the Channel Dredge (see below).
- 8.1.4. Crossing the seawall, the first seaward 'wetside' area is that proposed for reclamation to a new 'built-forward' quayline. The Reclaim comprises both intertidal and subtidal areas, and a series of jetties. As

noted above, the jetties are being considered by OAU as part of its integrated assessment of the industrial archaeology of Shell Haven.

- 8.1.5. The intertidal area extends from c.+3.9m CD to low water, where the channel drops steeply to a general depth of c. -9-10m CD.
- 8.1.6. The correlation between OD and CD at various states of tide (taken from Admiralty Chart 2484, for Coryton) is as follows:

	OD	CD
MHWS	3.15	6.2
MHWN	1.95	5.0
OD	0	3.05
MLWN	-1.9	1.6
MLWS	-2.55	0.5
CD	-3.05	0

Berths

- 8.1.7. Seaward of the proposed quay line for a distance of c. 100m is the berth area, which is to be dredged to -16m CD.

Channel

- 8.1.8. Seaward of the berths, and extending from just upstream of the proposed quay to the rail terminal, the channel of the Thames is to be dredged to -14.5m CD.
- 8.1.9. The general depth drops from c. -10m CD to -12 to 14m CD before rising up to form the other side of the channel. The channel is to be dredged to the full width of the present navigable channel, including the toe of the opposite side from c. -12 to -2m CD.
- 8.1.10. Dredging of the channel east of the rail terminal is considered as Channel Dredge, below.

Channel Dredge

Yantlet Dredged Channel

- 8.1.11. The Yantlet Dredged Channel, as referred to here, extends from the rail terminal to navigational buoy Sea Reach No. 1, off Maplin Sands.
- 8.1.12. The Yantlet Dredged Channel lies generally at c. -10 to -12 m CD, locally deeper. Either side of the channel, the bed is either flat, or rises gently to the toe of the intertidal flats and sands either side of the Thames.

Oaze Deep

- 8.1.13. The proposed channel dredge in the vicinity of Oaze Deep lies approximately between navigational buoys SW Oaze and Bell Knob. The seabed is generally below -15m CD but shallower locally. The bed rises to the toe of Oaze – a submerged bank – in the north, and to the toes of Red Sand and Shivering Sand in the south.

Knock John Channel

- 8.1.14. The proposed channel dredge in the vicinity of Knock John lies approximately between navigational buoys Knock John No. 7 and Knock John. The seabed is generally -10m to -14m CD. The bed rises to the toe of Mouse and North Knob (which is exposed at low water) in the north, and to the toe of Knob/Tizard in the south.

Fisherman's Gat

- 8.1.15. The Fisherman's Gat proposed dredging area comprises an irregular polygon at the head of Black Deep, lying between Long Sand in the south and Sunk Sand in the north. The seabed generally lies below -15m CD but there is a localised patch c. 4 km long rising to -13.8m CD.

Sunk Head

- 8.1.16. The Sunk Head proposed dredging area lies at the seaward end of Black Deep and includes areas of seabed that shallow locally to c. -13 to -14 m CD.

Sunk

- 8.1.17. The proposed dredging area at Sunk is generally -15 to -19 m CD, but sandwaves cause local shallowing to -10 to -11 m CD.

Wreck Clearance

- 8.1.18. There is a small number of wrecks outside the proposed dredging areas outlined above that are upstanding to such an extent that they will impinge upon proposed navigation, even though the general seabed level is sufficiently deep. As a result, it is proposed that such wrecks are cleared as part of the development.
- 8.1.19. Halcrow has undertaken a study of wrecks proposed for clearance. Where they fall within a proposed dredging area, they are considered below under the heading of the relevant proposed dredging area.

The wrecks outside proposed dredging areas are addressed under the heading 'Wreck Clearance'.

8.2. ARCHAEOLOGICAL CONTEXTS

- 8.2.1. As well as falling into a series of distinct footprints, the archaeology of the Study Area can be expected to exhibit a series of relatively discrete contexts of formation. These contexts represent coincidences between patterns of human activity and their contemporary landscape. Of particular note is the extent to which these landscapes have changed in their topography and in their motivation.
- 8.2.2. As these contexts are defined at least partly by patterns of human activity in the past, the character of which is still poorly understood, their definition must remain provisional. New discoveries and insights – including archaeological findings arising from the London Gateway development itself – may cause our understanding of the (potential) location and importance of the archaeological heritage to change.
- 8.2.3. The purpose of this section is, therefore, to posit a series of contexts within which the archaeology of the wetside can be addressed, based on current knowledge. Their provisional status within the overall dynamic of archaeological research is openly admitted. Delimitation of the contexts presented below has been informed by *An Archaeological Research Framework for the Greater Thames Estuary* (Williams and Brown 1999), and by other investigations by Wessex Archaeology in the Thames and other marine areas.

Riverside Inhabitation

- 8.2.4. For the vast majority of human history, the interpretational context of the Shell Haven site and much of the Channel is as part of a river system, with the contemporary coastline far off in the North Sea and/or English Channel. This is true of Lower, Middle and Early Upper Palaeolithic periods, from which archaeological material is most likely to be found entrained within sands and gravels deposited by precursors to the Thames river. It is also true for the Late Upper Palaeolithic and Early Mesolithic periods, from which archaeological material may be found *in situ* on the surface of gravel terraces and within alluvial horizons.
- 8.2.5. Periods of higher sea-level did occur during warm stages of the Pleistocene, including the Cromerian Interglacial (Oxygen Isotope Stage (OIS) 13, c. 478,000 BP), Hoxnian interglacial (OIS 11, 380-423,000 BP), interglacials during the Wolstonian (OIS 9 and OIS 7, 303-339,000 BP and 186-245,000 BP) and the Ipswichian Interglacial (OIS 5e, 110-130,000 BP). However, the position of coastlines during these periods is

not easy to establish, being complicated by major changes in drainage patterns, massive movements of sediment, the formation of lakes and deltas, and so on. In the intervening cold stages, the coastline may have retreated as far as the northern North Sea and the western approaches to the English Channel.

- 8.2.6. The outer channels of the Thames are likely to have become increasingly estuarine in the course of the Early Mesolithic (from c. 9500 BP), with the channel immediately off Shell Haven only becoming estuarine at the beginning of the Late Mesolithic period, c. 6300 BC.
- 8.2.7. In view of the relatively late development of coastal conditions in the Study Area, the archaeological heritage of earlier periods is best addressed from a terrestrial perspective. The areas proposed for development would have hosted sparse, nomadic populations in a wide, flat-bottomed river valley many miles from the sea. The changes in climate that have occurred in human history are such that this landscape will have varied from verdant to tundra.

Coastal Inhabitation

- 8.2.8. The Thames developed its current form in the course of the Mesolithic period, reflecting climatic changes that were accompanied by changing flora and fauna, and coinciding with the re-population of Britain by societies that were themselves in transition.
- 8.2.9. These early Holocene societies are known to have exploited coastal and marine resources, and also provide the earliest evidence of building and using boats.
- 8.2.10. The extent of the Channel Dredge, from Sunk to Shell Haven, is such that the time at which human inhabitation is best described as 'coastal' will have varied from point to point over c. 500-1000 years. Yet the gradient of the Thames channel is so slight that sea-level rise, which is known to be relatively fast in this period, may have caused rapid changes in the coast and in coastal society.
- 8.2.11. It should be noted that the rising sea would not have been limited to the existing channel, but would have spilled across what is now the Alluvial Floodplain to lap at the base of the Gravel Terrace.
- 8.2.12. From the Mesolithic through to the present, the whole of Shell Haven is properly regarded as a coastal location, encompassing inhabitation of the higher, dryer ground, activity in the coastal wetlands, and water traffic within the intertidal creeks and along the shores of the Thames.

Passage

- 8.2.13. Without detracting from the local inhabitation of Shell Haven through history, it should be recognised that much of the traffic within the Study Area has simply been 'passing through'. People and goods have been transported along the Thames to and from London and other upstream ports. The web of departure and destination points has grown through the centuries to encompass the entire globe.
- 8.2.14. Generally speaking, the presence of ship-derived archaeological material in the Study Area is a result of misfortune, bearing no relation to the history of Shell Haven and the Thames except that they represent an important and hazardous passage.
- 8.2.15. The context for understanding changing patterns of Thames shipping, from prehistory to the present, is at once regional, national and international.

Warfare

- 8.2.16. One arena in which the whole of the Thames stands out as a region is that of warfare. The water has acted as a defensive moat for shore-based defences, and it has served as a conduit for supplies to come in and for warships to go out. It has also provided an advantageous line of attack by sea and, in the twentieth century, by air. As a result, the remains of defensive and offensive structures can be found throughout the region, and losses from the first and second world wars in particular are the source of many of the wrecks and anomalies known in the Thames.

Fishing

- 8.2.17. The history of fishing in the Thames contrasts to the relatively well-documented and archaeologically-visible remnants of warfare, in that very few remains have been recognised. This is particularly true of boat-based fishing. Although some fishing-related structures are recognised on land, little attention is paid to the scope for archaeological traces of that activity where it actually took place, at sea. Boat-based fishing in the Thames is likely to have been extensive over long periods, but even in well-documented periods, losses of the small craft engaged in fishing – however numerous and deadly – have not been noted in the lists of casualties upon which archaeological records are based.
- 8.2.18. Somewhat paradoxically, the best opportunity to understand the character of past fishing is likely to arise from sequences of successive fishing gear impacts – as reported snags or traces of physical disturbance – on seabed wrecks.

8.3. CHRONOLOGICAL OVERVIEW

Lower, Middle and Early Upper Palaeolithic (500,000 – 12,000 BC)

- 8.3.1. The earliest traces of human activity in the Thames estuary area comprise tools and flakes dating to the Lower Palaeolithic period. Such artefacts are generally found in isolation or small groups, entrained within gravel, sand and occasionally finer alluvium. Findspots along the modern Thames shoreline include Tilbury and Castle Point in Essex and Swanscombe in Kent (Wessex Archaeology 1996). Whitstable and Herne Bay in Kent have also produced numerous hand axes (Wessex Archaeology 1993: 134, 152). Several examples of Acheulian hand-axes have also been dredged from the riverbed at Grays and Tilbury (Wessex Archaeology 1996: 132-134).

Late Upper Palaeolithic (12,000 – 10,000 BC)

- 8.3.2. Sites of Late Upper Palaeolithic date, corresponding to the earliest occupation of Britain since the last ice age, have been recorded relatively rarely. Late upper Palaeolithic artefacts have been found at Shoeburyness and a small site has been identified at Oare, near Faversham (Barton 1992: 188). Other examples comprising dense distributions of finely-worked blades and other tools are known from sites overlooking major rivers elsewhere in north west Europe, including southern Britain (see Barton 1992: 189-200).

Mesolithic (10,000 – 4,000 BC)

- 8.3.3. The Mesolithic period sees the continuation of the stone and flint tool technologies, with the development of tranchet axes and small flint blades or microliths as well as tools made from antler (Darvill 1987: 40). Riverine and coastal situations would have continued to provide favourable habitats for Mesolithic hunter-gatherer communities in the Thames area. This development of maritime-based economies was demonstrated by excavations of a late prehistoric timber structure at Walton, Essex in 1937 with the discovery of a floor 'strewn' with cockle shells (Buckley 1980: 24).
- 8.3.4. In order to maximise the cultivation of oysters, cockles and winter cod within the Thames estuary it would have been necessary to use boats. Although no Mesolithic boat remains have been found in the UK, Mesolithic logboats have been discovered in Denmark; the discovery at Starr Carr, Yorkshire of a wooden paddle dating to circa 7000BC probably represents the oldest evidence for boats in Britain (Marsden 1997: 22).

Neolithic (4,000 – 2,400 BC)

- 8.3.5. During the Neolithic the predominant pattern of activity in southern England changed to one of woodland clearance and the establishment of farming. The main focus for settlement, usually in the form of isolated farmsteads, was on the more fertile land associated with the stream and river valleys. Around these habitation sites a funerary and ritual landscape developed, including monuments such as long-barrows, cursuses and henges.
- 8.3.6. There have been no discoveries of boats of sea going quality during this period in the UK, but archaeological evidence indicates contact between Britain and Ireland from the late third millennium BC. Neolithic axes from as far afield as Brittany, Northern Ireland, Scandinavia and Central Europe have been found in the UK, emphasising the links formed by the seaways in this period (Darvill 1987).
- 8.3.7. Neolithic polished flint axes have been recovered from the Thames Estuary area, with recorded finds from the junction of the Thames and Medway and also off Shoeburyness (Adkins and Jackson 1978). The appearance of these tools in the archaeological record has been attributed to both accidental losses from simple log or skin boats serving as river craft on the estuary and the ritual deposition of prized items.

Bronze Age (2,400 – 700 BC)

- 8.3.8. The general picture for the Bronze Age is one of population growth leading to more widespread deforestation and the expansion of farmland, with the majority of the occupation sites remaining within the river valleys like the Thames. In practice there is little change from the Neolithic until the Middle Bronze Age when a transformation in the landscape is affected by a move to more extensive agricultural production. Within southern England the most prominent remains relating to these populations are round barrows (burial mounds) that occur as single monuments and in cemetery groups (Darvill 1987).
- 8.3.9. In Britain the arrival in the Bronze Age of tools to fashion timber into planks results in some of the oldest remains of watercraft known in north-west Europe. The technological capability of Bronze Age society suggests that all the basic types of water transport could have been in use, including dugouts, rafts and boats of hide, bark or planks. Examples of plank boat finds from the UK include the remains of two stitched plank boats from Ferriby, Yorkshire (c.1300BC); a large fragment of a stitched boat from Caldicot, Gwent (c.1600BC); a large portion of a similar vessel from Dover, Kent (c.1300BC); two fragments of stitched planking from Goldcliff, in the Severn estuary (c.100BC);

and the Brigg Raft, Lincolnshire (c.800BC) (Gardiner 1996). The Canewdon paddle, roughly contemporary with the Dover boat has also been recovered from the Crouch estuary in Essex (Fulford *et. al.* 1997: 114). Constructional detail suggests that all the vessels found to date were only suitable as river, estuary and coastal craft rather than being utilised as sea-going vessels and must have certainly been intensively involved in the exploitation of marine resource in the Thames estuary.

- 8.3.10. By utilising these shallow drafted vessels Bronze Age people would have been able to access the terrestrial coastline that surrounded estuaries and tidal waters with great ease, using sheltered bays and the inter-tidal zone as landing places (McGrail 1998: 269). Although none as yet have been identified in the Thames estuary as such landing places would probably have left little archaeological trace other than artefact clusters it is certain that these waters must have provided natural routes for exploration, trade and exchange and social interaction (Gardiner 1996: 38).
- 8.3.11. Despite the lack of sea-going craft, the geographical distribution of metalworking styles does point to cross channel journeys being widely undertaken in the Bronze Age. The typological parallels seen on both sides of the channel at this time demonstrate the movement of both objects and ideas from the Continent into Britain and visa versa (Darvill 1987: 100). Substantial concentrations of Bronze Age artefacts have been discovered at Salcombe, Devon and at Langdon Bay, Kent. These underwater sites contained no ship remains, but consisted of a concentration of metalwork indicating the loss of merchant trading vessels around 1000BC. The seabed scatter from Langdon Bay in Kent comprised around 350 swords, daggers, axes and other items, of which 50% were of French type (Marsden 1997: 24).
- 8.3.12. A significant number of Bronze Age finds have come from the River Thames. Dredging activities along the river, especially in the area around Syon Reach and Richmond have produced a large quantity of bronze weapons. Human skulls radiocarbon dated to the Bronze Age have also been recovered from this stretch of the Thames suggesting that the deposition may have been part of a funerary rite rather than accidental loss (Pearson 1993: 117).

Iron Age (700 BC – 43 AD)

- 8.3.13. The general pattern of settlement during the Late Bronze Age continued into the Iron Age, with the addition of small defended enclosures. These enclosures have been variously interpreted as enclosures for animals, as having a ritual function or being enclosed settlements. Social contact between these settlements and those on

the Continent continued in the Iron Age, with the south-east of Britain demonstrating a particularly strong cross-channel link.

- 8.3.14. Although archaeological evidence has provided little information on the societies that occupied the coastal zone of the Thames in the Iron Age, the ceramic assemblages that have been found show a close parallel with those from Gaul (modern northern France and southern Holland). An example comes from the region east of the River Medway where a distinctive rusticated pottery bears close comparison to similar styles on the Continent. Another pottery type from the Thames Valley, consisting of sharp shouldered bowls and finger marked coarse wares is mirrored in northern France and Holland. (Cunliffe 1995: 44-45). Such a migration of objects and ideas probably represents cross-cultural exchange between the tribes of Kent and Essex with the Continent, rather than a Gallo-Belgic invasion. An exchange that would have relied upon boats of a sea-going build and quality securing safe passage across the channel.
- 8.3.15. The potential of the Iron Age use of water transport is well demonstrated by an account, dating to 330BC, from a Greek merchant Pytheas of Massalia who described the tin trade in Celtic Britain. (Gardiner 1996: 52-5). Although this document does not talk about the actually vessels that were being used to transport the tin, it does point to the complexity of the trade and the capabilities of the boats that were making the voyage to Gaul with great success during the Iron Age.
- 8.3.16. Unfortunately there have been no discoveries of sea-going boats dating to the Iron Age in the UK although their existence is certain. The only British examples of Iron Age vessels are of dugout type rather than plank built boats or rafts. The best of these was found at Hasholme, North Humberside in 1984. Other remains include Shapwick, Somerset, Poole, Dorset and Holme Pierrepont, Nottinghamshire (McGrail 1998). The Hasholme boat, dating to around 300BC would have been perfectly suited for lake and river transport, but it is uncertain whether it would have achieved the necessary stability for open sea voyages. Technologically this vessel demonstrated the earliest use of treenails, which were employed in fastening the thwart (Marsden 1997: 30). The use of such fastenings continues today and can be seen in ethnographic studies of shipbuilding technique (McGrail 1998: 136).
- 8.3.17. As witnessed in the archaeological record from the earlier Bronze Age, the Iron Age sees the continuance of the tradition of votive offerings being placed in lake and rivers to appease the deities. The Thames has produced an outstanding collection of these objects, including famous pieces such as the Battersea and Wandsworth shields, the bronze horned helmet from Waterloo Bridge, iron daggers with bronze

sheaths from Mortlake, Surrey and many other swords and daggers (Cunliffe 1975: 65,282-3). These artefacts, recovered during eighteenth and nineteenth century dredging of the Thames probably indicate the selective deposition of high value objects as acts of ritual offering. Interestingly it has been found that particular reverence appears to have been given to those rivers that flowed east, in particular the Thames, Witham, Trent and Tyne (Cunliffe 1995: 102).

- 8.3.18. Britain in the latter years of the Iron Age was subjected to an increasing amount of contact with Roman culture. In 55BC and again in 54BC this contact intensified with the invasions of Britain by Julius Caesar who on the second attempt used over 800 ships to transport troops to Kent, from which they moved across the Thames into Essex. Caesar had already undertaken a sea battle in northern Europe in 56BC and was impressed with the shipbuilding of the Veneti in north-west Gaul, describing how they were well suited to harsh seas as well as coastal sailing (Greene 1986: 22). The Celtic tribes in Britain may have built similar ships during this time, but until archaeological evidence for such vessels is found their place in the evolution of boats into ships will remain uncertain.

Roman (AD 43-410)

- 8.3.19. After the Roman invasion of Britain in AD43 the maritime use of the River Thames and its tributaries must have increased considerably. To supply both the demands of Londinium and other settlements such as Rochester and Canterbury as well as the Saxon Shore forts of Richborough and Reculver, an influx of merchants whose goods crossed the Channel from the Continent, would have plied their trade along the Thames (Maxfield 1989). The Channel would have represented just a short sea crossing for merchant vessels that may have already travelled from the Mediterranean and Spain (Cleere 1978: 38).
- 8.3.20. Founded in about AD50, the importance of Londinium in terms of commercial trade was indicated by Tacitus (*Annals* XIV, 33) who described it as a famous centre of commerce teeming with merchants. In fact much of the wealth of Londinium must have been derived from maritime trade, with the quantity and variety of goods suggesting that the city served as the main port of entry as well as a provincial distribution centre for both imports and exports (Marsden 1994: 15-6).
- 8.3.21. The River Thames has produced several examples of vessels from within the Roman period that must have been utilised for maritime trade. These so-called '*Romano-Celtic*' vessels have illustrated the nature and extent of maritime activity taking place on the river.

Examples include the remains at Blackfriars (c.AD150); the County Hall ship (c.AD300) and at New Guy's House, Bermondsey (second-century AD) (Marsden 1994). These vessels represent some of the different ship types that would have probably been using the River Thames during the Romano-British period. A total of four types have been identified, these being seagoing merchantmen, flat-bottomed river barges, small fishing boats suitable for coastal and river transport and warships (Marsden 1977). In combination these craft could have transported large quantities of imported and exported goods over considerable distances and importantly they could have achieved this much more efficiently than using overland routes (Greene 1986).

- 8.3.22. The Blackfriars 1 ship found in 1962 probably sunk in the Thames in about AD150. At the time of her sinking she was carrying a cargo of Kentish ragstone that had been transported from the Maidstone region on the River Medway. The ragstone along with limestone from Lincolnshire was most probably destined for use in the construction of houses and public buildings required by the Roman inhabitants of London. The scale of maritime activity required can be gauged from the estimate that for the city wall alone (built soon after AD200) about 45,000 tonnes of stone would have had to be shipped into London (Milne 1985: 42). Large quantities of other building materials, including flint and chalk would also have been travelling down the Medway and the Thames in ships similar to the Blackfriars 1 (Marsden 1994: 83).
- 8.3.23. Transportation of materials using large Roman merchant vessels would have required some degree of transshipment of cargoes as the tidal Thames prevented those vessels with a deep draft from entering the city. Other settlements in the area like Reculver and Rochester may have provided deep enough water to allow cargoes of stone or heavy goods like wine amphorae to be transferred to smaller craft like the versatile Blackfriars 1 type. A second factor that could have necessitated such transshipment could be that the shifting shoals or sands of the Thames estuary might have proved navigational hazards. Today many of these shoals including Margate Sand, West Barrow, Pan Sand and Shingles Patch, dry at lowest astronomical tides and would have represented ship-traps for unknowing vessels trying to enter London and thus it may be that local pilots were employed to ensure safe passage.
- 8.3.24. Possible wreck locations in the Thames estuary include Ooze, where six pottery mortaria stamped CAVARIUS have been recovered Deep (Rhodes 1989) and Pan Sand off Whitstable, Kent where a large number of pottery fragments, mainly of second-century Gaulish samian ware have been trawled up (Marsden 1997: 40). The latter area is undergoing current investigation by the British Museum and the Centre for Maritime Archaeology, University of Southampton.

- 8.3.25. From the amount of oyster shells and fish bones found in Roman London it can be assumed that marine agriculture would have been quite intensive from the first to fourth centuries AD. Fish bones from c.70-125AD found at Billingsgate include estuary fish such as sprat and open sea fish such as Black Sea bream (Marsden 1994: 16). Oyster fishing appears to have been of great importance in the Thames estuary during the Roman occupation. One contemporary reference to the particular liking for Richborough oysters comes from Macrobius in the fourth-century AD (Milne 1985: 92). Natural oyster colonies along the coastlines of Essex and Kent would have supplied much of the demand of London and its hinterland, but it has also been proposed that, as in Italy, artificial oyster beds were introduced (Milne 1985: 91).
- 8.3.26. Isolated Roman findspots from the Thames include the bronze head of a statue of Hadrian (Greene 1986: 149) and a boat-hook found at Smith's Wharf and said to have been found in association with first-century coins and samian pottery (Marsden 1994: 17).

Early Medieval (410-1066)

- 8.3.27. Archaeological and historical evidence demonstrates that in Celtic Britain the fourth to eleventh centuries AD were a crucial period of conquest and settlement by five different tribes – the Angles, Saxons, Jutes, Vikings, and finally the Normans.
- 8.3.28. The process by which rule passed from Roman administration to one of Anglo-Saxon kingdoms is much debated with disparate schools of thought proposing disruption and discontinuity or alternatively overlap and continuity (Welch 1992: 97). Either way there is no evidence to indicate that the area of Roman London continued to thrive as an organised port as it had done during occupation. There is a notable absence of finds from within the Roman sector after AD500 and settlement shifts its focus further upstream to the modern Strand area where *ad hoc* shoreline or beach markets succeeded as the principle avenue for trade.
- 8.3.29. By the seventh and eighth centuries the area of London was under the successive control of the kingdoms of Kent and Mercia and by AD672 *Lundenwic* was recorded as being a trading centre 'where ships come to tie up' (Marsden 1994: 131). Later, around AD720 Bede described the city as '*a mart of many peoples coming by land and sea*' (Marsden 1997: 51). Archaeological remains suggest that fishing continued to be important and pottery assemblages indicate that considerable maritime activity was probably taking place with other trading centres located at Ipswich (Wade 1981), Fordwich and Sandwich. The pottery assemblage from Mucking, Essex is suggestive

of an Anglo-Saxon cross channel link (Clarke 1985: 41) and other smaller trading centres no doubt existed within the Thames estuary coastline, with Canvey, Greenwich, Woolwich and Faversham being the most likely (Fulford *et al* 1997: 215-33).

- 8.3.30. Although no ship remains dating to the seventh and eighth centuries have yet been found in the Thames estuary, there are a number of other vessels that provide some indication of what types of craft were using the Thames. Most notably are the Saxon ship burials from Snape and Sutton-Hoo, Suffolk (Welch 1992). These princely graves contained evidence for clinker built vessels whose ancestry derived from Nordic shipbuilding traditions and provide indirect evidence for the vessel types crossing the Thames estuary between the kingdoms of Kent and Mercia. It is likely that the great rivers of Britain like the Thames offer potential for finds of Angle, Saxon and Jutish vessels (Crumlin-Pederson 1990: 113).
- 8.3.31. By the ninth century the Anglo-Saxon Chronicle records attacks by Viking raiding parties in the east coast of Britain. Over a period of 300 years these raids included London (AD842 and AD851), Rochester (AD842) and Sheppey (AD835). Various references suggests that 350 Viking ships wintered on the Isle of Thanet in AD850 (Richards 1991) and that in AD851 after sacking the countryside, a Norse vessel sank in the river below London (Larn and Larn 1995). In AD892 a '*great army*' crossed the channel and encamped on the edge of Romney Marsh, while a second fleet of 80 ships came up the Thames to Milton Regis (Rodger 1997: 11). Another account from AD893 indicates that Viking forts had been constructed at Benfleet and Shoebury on the Essex coast (Richards 1991: 17-23). A Scandinavian presence in Britain continued in to the late tenth and early eleventh century (Lewis and Runyan 1990).
- 8.3.32. From c.AD1000 a table of harbour dues or law codes for Billingsgate provides evidence for the types of vessels that were landing in London. The Billingsgate code outlines that a small ship and those containing fish had to pay one half-penny, and that a larger sailing vessel would pay one penny. A keel (*ceol*) and a hulk (*hulcus*) had to pay fourpence and a ship with a cargo of planks had to pay a toll of one plank and merchants from Rouen were charged an extra duty of six shillings plus a percentage of their cargo (Marsden 1994: 135). Small ships might have included simple logboats, used for ferrying and fishing, like that excavated at Clapton, Essex dating to the tenth century. The class of vessel described as a keel could be represented in the archaeological record by boat remains found in the Graveney marsh, near Whitstable, Kent. Dating evidence suggests that this clinker built merchant vessel was abandoned in a creek around AD950. The remains included hops that may have been a cargo from

Kent being carried up the Thames estuary, as well as ballast of unfinished lava millstones that may indicate North Sea crossings (Richards 1991: 92). Larger sea-going vessels are possibly represented by the discovery of two side rudders trawled up from the North Sea off Southwold, Suffolk (Marsden 1997: 54) and by a large mast partner from the Thames Exchange site in London (Richards 1991: 92).

- 8.3.33. Other finds of actual vessels or associated equipment dating to the tenth and eleventh centuries have been found in London waterfront locations. These include timbers from New Fresh Wharf (AD920-955), Billingsgate and Fennings Wharf, Southwark (AD985-1100); an oar or paddle from Hibernia Wharf, Southwark and a broken anchor from the river at Blackfriars. Isolated finds include a group of Viking weapons dated to c.1000 found near London Bridge (Marsden 1994: 141-162).
- 8.3.34. An area that may prove to be of exceptional importance came to light before 1890 at Benfleet, Essex. Here during the construction of a railway bridge on the north bank of the Thames estuary it was recorded in the *Essex Naturalist* (1890: 153) that there were '*many ships deep in the mud, several of which on exposure had been burnt, as their charred remains showed. Indeed, about them lay numerous human skeletons*', and proposed that these vessels could have been part of a Danish fleet destroyed in AD893 (Marsden 1994: 136).

Medieval (1066-1499)

- 8.3.35. Following the Norman invasion of Britain in 1066 a period of stability and economic growth allowed significant developments to take place in commercial trade and shipping. The Normans had already established links with the Mediterranean and these expanding trade networks required larger and stronger ships to carry bigger and more valuable cargoes (Marsden 1997: 60). Larger ships would have required organised docking facilities and as a result many major medieval ports such as Southampton, King's Lynn, York, London and Poole become established in the eleventh and twelfth centuries. Not since the Roman occupation had London's riverside witnessed such high levels of complexity.
- 8.3.36. In conjunction with trading activities, shipbuilding was undertaken on or very close to the Thames foreshore east of Tower Bridge and at many other locations within the Greater Thames area (Williams and Brown 1999: 13). A shipwright's guild was certainly in existence in London from the late 1360's and between 1428 and 1433, six London shipwrights are noted in the city records as being sworn in as masters of the *mistery of shipwryghtis* (Friel 1995: 39-40).

- 8.3.37. The sheer scale of trade on the Thames is indicated by documentary evidence in the form of customs accounts. These accounts encompassing both banks of the Thames as far as Gravesend and Tilbury provide a clear indication as to the type and scale of traded goods from the thirteenth century to the sixteenth century. This is particularly true of the country's two main exports, wool and cloth as well as for the importation of wine from Gascony in France (Friel 1995: 131). Customs payments were due from vessels using the Billingsgate wharf on corn, sea-coal, ale, fish, butter, leather, nuts, honey, lead, iron, wine, onions, garlic, clay, flax, feathers and litmus. Contemporary accounts describe particular trading vessels, like the *Le Cog Thomas de la Tour*, which carried wine from Bordeaux to London in 1350-4 and the *Marie Cog* of Greenwich which was used in the wine trade between London and Sluys in 1338-9 (Marsden 1996: 30). Figures of London trade show that English ships made up 31% of the vessels entering the port in 1465-1466. By 1519 this figure had risen to 41% (Burwash 1969: 148).
- 8.3.38. Documentary sources from the twelfth century onwards also point to a new appreciation of the hazards involved with the navigation around the south-east coast of Britain. From this time the City of London acquired an increasing responsibility of the port's approaches including downstream to Yantlett Creek in the estuary (Marsden 1996: 32). The thirteenth century also sees the earliest known record of tide calculation, with high tide times for London Bridge (Marsden 1996: 37). Risk of running aground is demonstrated by a fourteenth century record describing how the *Little Edward*, a London trading ship, under the control of a London merchant John Brand, was attacked by the French while she was aground off Margate in 1315. The account continues that the French believed the *Little Edward* was a Flemish vessel, possibly because it was carrying a cargo of 120 half-sacks of wool being shipped from London to Antwerp on behalf of three Hanse merchants (Marsden 1996: 34).
- 8.3.39. Recorded losses in the Thames estuary area during the medieval period include two vessels. Firstly the *Custance*, an unspecified sailing vessel, was lost at the mouth of the Thames in 1343. A contemporary account states: '*To make inquisition in the county of Essex, whereas a ship called Custance of Dartmouth, William Waryn master, Bordeaux to London with wines and other goods and merchandise, lost at the mouth of the Thames, and all the crew escaped alive, ought not to be wreck of the sea. The men of the said county carried away much of this which had been washed ashore in divers(e) places*' (Larn and Larn 1995).
- 8.3.40. The second loss of an unidentified vessel in 1345 is described: '*Whereas Henry Fynch of Winchlesea, freighted a ship with 40 Tuns, 120 pipes of*

wine, worth £500, was driven by storm into the Thames between the sands of Rodsond, Longesond and Snoutes, by the townes of Leiston and Gravene, county Kent, and there anchored in safety, where men boarded her and carried away the whole of the gear in the ship as well as the wine, and raised the anchor, whereby the ship was sunk and lost' (Larn and Larn 1995).

- 8.3.41. Medieval ship remains appear in two archaeological contexts from the Thames area, as wrecks from the riverbed or as reused timbers utilised as parts of waterfront revetments. The twelfth century is represented two large fragments of clinker-built hull, excavated in 1973 at the Old Custom House site in the City. These fragments, probably from the same vessel, dated to c.1160-90 during the reign of Henry II and had been reused in the construction of a late thirteenth and fourteenth century medieval waterfront revetment. The size of the Custom House vessel suggests it was a small broad flat-bottomed barge for use on the inland water of the Thames, being rather small for sea voyages (Marsden 1996: 41-54).
- 8.3.42. A second vessel from the bed of the Thames was found in 1970. This river barge, named Blackfriars 3, sank between 1480 and 1500 although it was constructed much earlier, sometime between 1380 and 1415. Study suggests that the Blackfriars 3 boat was about 15 metres in length and could have carried a cargo of 7.5 tonnes. It was propelled by a sail from a mast of around 8 metres in length and probably steered by a steering oar and poles. These specifications would have made it perfectly suited to the shallow waters of the Thames (Marsden 1996: 55-104). Lying near the Blackfriars 3 ship were further structural remains of another presumed fifteenth century clinker-built vessel, named Blackfriars 4, carrying a cargo of Kentish ragstone that must have travelled up the estuary into London (Marsden 1996: 105-6).
- 8.3.43. Other boat fragments from the London waterfront dating to the medieval period come from Southwark at Hays Wharf, Symonds Wharf, Gun and Shot Wharf and Bankside; Trig Lane and Bridewell, City of London. Associated finds include an anchor fluke from the riverbed off Custom House Wharf, City of London (Marsden 1996: 107-30) and a fourteenth century bronze trumpet, used as a ship's whistle dredged from the riverbed (Marsden 1997: 69).
- 8.3.44. The use of larger vessels like the Blackfriars 3 boat allowed substantial cargoes to be carried on the Thames. Major construction projects in London after the Norman invasion required building materials from Kent such as ragstone, as well as Caen in Normandy and other towns from the Greater Thames area. This movement represents only a small part of the traded goods travelling on the estuary either between Kent

and Essex or between destinations across the North Sea and the Channel (Williams and Brown 1999: 13).

Post-medieval and Modern (1500-present)

Overview

- 8.3.45. At the beginning of the sixteenth century England's merchants were mainly trading with the North Sea and Channel countries. However by the middle and late sixteenth century these maritime links had grown dramatically to incorporate much of the New World. London soon became the headquarters of trading organisations such as the Turkey and Africa Companies and the East India Company.
- 8.3.46. This commercial development occurred alongside the creation of England's first permanent navy by Henry VII, which was later enlarged by Henry VIII. In order to cope with the increasing demands of a fighting navy Henry VIII established a dockyard at Woolwich around 1512 with storehouses also built around the same time at Deptford. Chatham Dockyard followed soon after in about 1547. Chatham's location on the River Medway ensured sheltered deep water channels, numerous mud banks for anchorage and was close to the Royal Armouries in London (MacDougall 1982: 18-35). During the seventeenth century further dockyards were established at Harwich and Sheerness. Despite these naval establishments there was still a risk of pirates on the Thames, as recorded in 1526 when two ships were *'taken away, robbed, and disployed on the Ryver of Tamyse by certeyn pyrotts'* (Marsden 1996: 37).
- 8.3.47. Several archaeological finds and numerous documentary references to ship losses demonstrate the use of the Thames estuary during the early post-medieval period. Excavated from the riverbed in 1987 one example of sixteenth century shipbuilding was found at Morgan's Lane, Southwark. These remains consisted of seven articulated planks of 'reverse clinker' style that had been incorporated into a waterfront revetment (Marsden 1996: 136-44). A seventeenth century ship was found and partially salvaged in 1969 at Blackfriars. This Blackfriars 2 ship was described as a river vessel, perhaps like a lighter, that was carrying a cargo of bricks when it sank in c.1670. It is interesting to note that this vessel sank shortly after the Great Fire of London when the rebuilding of London had necessitated the use of numerous brickworks located some distance from the city (Marsden 1996: 156).
- 8.3.48. Other ship and boat fragments from the sixteenth and seventeenth centuries have been recovered from the Southwark area of London. These include material from Bankside, Hays Wharf, Gun and Shot Wharf, Morgans Lane, Abbots Lane, Guys Hospital, National Wharf and

Blackfriars Road (Marsden 1996: 160-81). Offshore finds include a sixteenth century wreck that was found in 1847 on the Girdler Sand, off Whitstable, Kent. These remains included iron guns, stone shot and a cargo of over 2700 ingots, possibly of tin, one of which was stamped with the royal mark of a rose and crown (Marsden 1997: 75).

- 8.3.49. Records for losses in the Thames estuary predating the establishment of the *Lloyds Register of Shipping* in 1734 consist of 37 vessels. Many of these are unnamed, but fourteen named ships are described as being lost, in or near the Thames estuary, during encounters with the Dutch in 1666 and 1667. One of these, the *Royal Prince* was recorded to have run aground on the Galloper Sand before being sunk by the Dutch (Larn and Larn 1995).
- 8.3.50. By the early eighteenth century, at the start of the Industrial Revolution, London was reckoned to carry 77% of the value of all Britain's foreign trade (Williams and Brown 1999: 13). This increase in shipping was accompanied with an intensification of recorded losses. As well as the Lloyd's List other sources of information provided at this time include the *Board of Trade Wreck Returns* whose accounts for the Thames area first appear in 1818 with the wrecking of the *George* on Knock Sand. The *Cobb Manuscript* held by KCC also documents shipping losses and salvage activity from the 1780's including the loss of the East Indiamen ships *Walpole*, *Mars*, *Hindostan*, *Britannia*, *Marquis*, *Cornwallis* and *Nottingham* off Margate (Larn and Larn 1985). Subsequent to sinking, the *Hindostan* (1803) and another East Indiamen vessel, the *Albion* (1765) were plundered by salvagers (Marsden 1997: 92).
- 8.3.51. Archaeological sites from this period include the well preserved remains of an eighteenth century merchant vessel that were found in the 1970's by the *Port of London Authority* in the South Edinburgh Channel area in the estuary. Finds included Swedish copper plate money, iron bars and wine bottles. This site has been naturally reburied by shifting sands but remains a designated site under the Protection of Wrecks Act 1973 (Archaeological Diving Unit website 2001).
- 8.3.52. Losses of particular note in the nineteenth century include the sloop *Leveret* that struck Long Sand in 1807. Despite heaving eighteen cannon into the sea in an attempt to lighten the vessel it sank the following day near the Sunk lightship. In 1841 around 200 emigrants, destined for the United States, died when the sailing barque *Floridan* grounded and wrecked on Long Sand (Larn and Larn 1995). The large number of wreckings off the north-Kent coast must have been instrumental in the birth of the commercial salvage diving industry in Whitstable during the early nineteenth century.

- 8.3.53. Although the cause of casualties from this period were still primarily due to extreme weather conditions and poor navigation, the advent of steam power and iron construction meant that more vessels survived grounding on sandbanks. Compared with sailing vessels, steam powered ships could hold their course much better in high winds and strong tides, which taken together with the later advent of tugs to assist ships in difficulty, must have resulted in a decline in the number of losses by these methods (Lane 1999: 7).
- 8.3.54. During World War I and again during World War II the River Thames and the outer estuary attracted a great deal of attention from German minelaying vessels and aircraft bombing raids. The index of recorded losses in WWI due to enemy action amounts to 105 vessels including two German U-boats, the UC-6 and the UC-9. The *Batavier V* sank after striking a mine in 1916 near the Inner Gabbard. It was carrying a cargo of 7,000 bales of rice, coffee and piece goods as well as 14 cases of gold and £5,000 in sterling (Larn and Larn 1995). During WWII the figure of losses totalled 91 vessels sunk in the estuary by either bombing, torpedo or mine. These losses include HMS *Vimiera*, a Royal Navy destroyer that sank near the West Oaze Buoy on the 9th January 1942 after striking a mine, killing one officer and 90 ratings (Larn and Larn 1995). Many of these wrecks have since been swept clear or dispersed by explosives by the Admiralty.

The Navigation of the Thames Estuary

- 8.3.55. Navigational hazards within the Thames estuary including those from North Foreland to Harwich have no doubt contributed to the high number of recorded losses. Long stretches of sand reach out into the North Sea, some as far out as 30 to 40 miles, creating natural confined shipping channels. Many of these sands, including Long Sand, West Barrow, Knock John and Shingles Patch, can become dry during low water and as documentary evidence indicates their mobility presented a challenge to navigators since earliest times.
- 8.3.56. The modern *Dover Strait Pilot* provides sailing directions to navigators using the Thames estuary (Admiralty 1999). This publication advises sailors to navigate through the channels and banks using the numerous buoys and beacons and indicates that poor visibility often obscures the shore-based landmarks, which can therefore not be relied upon. The *Pilot* goes on to recommend continuous sounding as changes in depth are often frequent and rapid and that storm surges could cause the sea level to fall by three metres below predicted level. The proposed dredge area follows the main modern route up the estuary from the north-east. This route begins at Sunk, through Black Deep, through the Knock John Channel, on to Oaze Deep and

the Warp before entering the Yantlet Dredged Channel. Historically however this has not always been the chosen route.

- 8.3.57. Early maps and charts of the Thames estuary dating from the sixteenth century illustrate the natural hazards within the waterway by taking care to depict the many shoals and sands. A chart by Richard Caundish dated about 1535 delineates numerous sandbanks within the estuary, details of which were probably copied from local sailing directions. Many of the names used for these banks persist to the present day, including Oaze Edge, Red Sands and Long Sands (Robinson 1962: 207, Fig 5). In the Caundish chart the main channel is referred to as the Kings Channel, which is suggestive of royal and therefore naval use. However Caundish also depicts a small channel to the south called Black channel, probably the modern Black Deep channel.
- 8.3.58. In 1580 Robert Norman compiled a manuscript chart of the outer estuary. Although this chart depicts distorted coastlines of Kent and Essex it does represent the first time that a detailed picture of the intricate pattern of banks and channels is given and must have been of great utility to navigators of the time (Robinson 1962: 27-9, Fig 1).
- 8.3.59. In 1588 the master of Trinity House, William Borough sketched a chart of the channels approaching the River Thames. One of Borough's channels, called Black in the latter 1596 chart, followed the path north of Long Sand, past Oaze edge to the Warpe before reaching the Nore (Robinson 1962: Fig 11). In this 1588 depiction and in Norman's earlier chart of 1580, Long Sand is shown as one elongated area, very different to how it appears on modern charts. This phenomenon occurs also in John Seller's *The English Pilot*, published in 1671 where Long Sand is joined to Girdler Sand, but by the time Edmond Haley surveyed the estuary in 1700 the Long Sand had been divided into five sections and incorporated Pan Sands (Robinson 1962: Fig 16, 38).
- 8.3.60. Documentary references to the navigation of the estuary also begin in the sixteenth century. One of the earliest of these comes from 1570 when an account by the masters of Trinity House reported that '*many sands, shallows and flatts reach many miles into the main sea, lying from thence dispersed up to the estuarie or fote of the Thames, commonly changing the usuall channell.....pilots dare not adventure to crosse or come nigh to them without conduct of beacons*' (Marsden 1996: 33).
- 8.3.61. By the end of the seventeenth century Greenville Collins had charted much of the coastal waters of Great Britain. The charts to accompany Collin's *Great Britain's Coasting Pilot* published in 1690 depict most of the channels and navigational hazards know today, including

Shivering Sand, Knock John and Sunk. Long Sand is shown as one elongated sandbank with Girdler to the south-west. Although named by Collins and on many later charts the Girdler sandbank does not appear on the modern chart, but is delineated as a smaller sandbank called Shingles. Some later surveys by Mackenzie (1774) and Grosvenor (1781) suggest that the Girdler was not connected to Long Sand and that there was a passage between, whilst Moore (1807) depicts a single long stretch of drying sand. Such discrepancies could be in part due to survey inaccuracy or due to the constant shifting of the sandbanks in the estuary. Either reason would have resulted in considerable shipping losses.

- 8.3.62. Collins also provides soundings in fathoms for the channels which for the length of Black Deep ranges between 5 and 14 fathoms, around 9 and 25 metres (Collins 1690). Despite the detail of the chart Collins does not provide any sailing directions for the Thames estuary, but instead states: *'It may be expected that I should have given Directions for sailing from the River of Thames over the Flats into the Downs, and likewise from the River of Thames down the Swin and King's Channel, and so into the Downs. But upon Consideration that these places are under the Care of Pilots, and for the constant supply of them, the Trinity House of Deptford-Strand, have taken Care that there be a sufficient Number of them, both for great and small ships....'* The fact that in 1690 Collins recommended the use of pilots and was not willing to provide directions demonstrates the considerable dangers that must have accompanied sailing in the estuary.
- 8.3.63. In order to reduce the number of losses taking place a number of navigation buoys and beacons were placed in the Thames estuary from the eighteenth century onwards. Many of these stations are still in position today. The Nore light vessel was first placed in 1732 and the Sunk Head lightship was later located in 1802. By 1781 numerous buoys were already in place on several of the sandbanks, including Oaze Edge, Shivering Sand, and on the southern tip of Girdler. A buoy light was on Nore Sand and a swinging beacon was located on Red sand. Such a multitude of navigational aids much have reduced the number of groundings and losses, but it is interesting to note the absence of buoys on Sunk, Long Sand, Knock John and East Shivering.
- 8.3.64. An account from 1802 by Grame Spence considers the position a new floating light planned to be placed at Sunk by the Trinity Corporation. Spence states *'that a floating light properly placed, in the mouth of the Thames, would be of very great benefit to Navigation, I believe no seafaring man will deny....'* (Spence 1802). He also goes on to suggest that the northern channel of the Swin is by far the most frequented and dangerous route and that *'vessels any way at all acquainted (with the Thames), never go near the sunk, for that would be going out*

of their way' (Spence 1802). This situation of coastal voyages hugging the Essex or Kent coastline continued into the late nineteenth century and suggests that in prehistory although open sea voyages would have been taking place any journeys between these two counties would have followed these in-shore coasting passages.

- 8.3.65. Mackenzie's survey of the north Kent coast carried out for the Admiralty in 1774 depicts the southern portion of the survey area as far eastwards as the Girdler (Shingles) sandbank. These charts are considered extremely accurate by modern surveying standards and were used by the Admiralty until the 1840's. As well as depth data Mackenzie provides navigators with bearings to landmarks, tidal and current information, and the location of buoys and places of safe anchorage. There are three of these anchorages that appear in the survey area, all within part of a channel Mackenzie identifies as The Middle Channel. The navigation of the Thames estuary must have become considerable safer with the introduction of Mackenzie's charts although still difficult enough for losses to continue.
- 8.3.66. Navigational hazards continued to be depicted with some accuracy during the late eighteenth and nineteenth centuries. A chart dating to 1781 by James Grosvenor shows all the modern names for the shoals and sands of the estuary and depicts more channels running between the sands, presumably as hydrographic techniques continued to develop and improve. At the beginning of the nineteenth century Spence's chart of the East Swin included the southern part of the assessment area and illustrates a light being located at Sunk Head and that '*La Reunion Frigate was lost on the Sunk Head a few years ago*'.
- 8.3.67. In the mid nineteenth century at the time of Captain Bullock's survey's, the Thames estuary had even more buoys, beacons and lights to aid sailors through the numerous channels that were by now marked on charts. The sandbanks on both sides of Oaze Deep and Black Deep were well known and the Girdler-Shingles sandbank in particular was provided with two buoys, two beacons and one light. Bullock also describes how a lighthouse was located '*on the north shore, above Shell Haven which serves for vessels coming up Sea Reach and down the Lower Hope*' (Bullock 1855: 27).
- 8.3.68. Sailing directions to accompany the charts published at this time provide a useful insight to the navigational complexities of the estuary. Directions from 1858 state that '*owing to the nature of the navigation in the East Swin, and to a want of due caution, more wrecks have occurred in it than upon any other portion of the eastern coast*' and that '*the principal causes of accident are gross neglect...*' (Admiralty 1858: 196). Specific directions are provided for passage through the

Princes Channel, The East Swin, and from the Girdler, to the Nore through Oaze Deep, the latter of which includes part of the assessment area. From this account onwards Sunk is described as a danger.

- 8.3.69. In the 1863, 1871 and 1887 sailing directions Blyth Sand, opposite Shell Haven is described as *'a dangerous bank, in places occupying half the breadth of the river...'* (Admiralty 1863: 4). The 1878 directions state that since the establishment of an artillery depot and range at Shoeburyness in 1862 it is forbidden to anchor or ground on the eastern area of Maplin Sand. It goes on to document that *'the ordinary ranges of the guns are between 200 and 1,200 yards, but the extreme range may occasionally be nearly five miles'* (Admiralty 1878: 4-5). Such an extreme range would have resulted in ordnance falling in the assessment area.
- 8.3.70. By 1882 telegraphic communications had been provided between the Sunk lightship and the shore at Ramsgate to enable the faster dispatch of assistance and by 1887 wreck-marking vessels were in use on some parts of the eastern coast (Admiralty 1887: 3). The 1889 directions documented that *'the frequent casualties on the sands in the Thames Estuary have caused the Trinity House to adopt...signals on board the light-vessels, and at the lighthouses, to facilitate the diffusion of the intelligence of a vessel being in distress, and of the locality of the mishap'* (Admiralty 1889: 295). In this 1889 account Black and Oaze Deeps are for the first time described as the main channel to which all smaller channels lead. It was also reported that at the end of 1889 it is intended to provide two light-vessels in this main channel, one at the south-west of Long Sand and one between West Long Sand and East Knock (Admiralty 1889: 340).
- 8.3.71. Black Deep was no longer the main channel by 1922 and the sailing directions warned vessels that this un-buoyed route *'should not under ordinary circumstances be used; but, if necessary to do so, vessels should beware of the spoil ground at its southern end'* (Admiralty 1922: 283). This advice was still being given in the 1948 sailing directions in which it is also stated that *'the tidal streams in Black Deep have not been observed during recent years...'* (Admiralty 1948: 266). *Notices to Mariners* from 1948 included the dumping of bomb damage rubble in the area of Black deep. There was also a proposal by Imperial Chemicals to dump explosives in the area, the result of which is likely to be the disused explosives dumping ground that appears on the modern chart just to the north of the assessment area.
- 8.3.72. Modern charts clearly demonstrate the navigational hazards of the shoals and sandbanks of the Thames estuary (Admiralty 2001). These charts also include the known locations of wrecks and obstructions

that could be a potential hazard to shipping. This practise of recording wrecks magnifies in the early twentieth century, but had its origins much earlier. Some of the wreck sites in the estuary have been named, whilst others still await identification with the potential of being of historical and archaeological importance. Other modern hazards include a number of precautionary or restricted areas, such as Sunk and Fisherman's Gat where there is a high risk of coming into contact with large vessels with restricted manoeuvrability.

8.4. KNOWN SITES

Former Creeks

- 8.4.1. As indicated above, Wessex Archaeology's assessment has addressed the wetside, being seaward of the sea wall. Comments relating to the maritime archaeology of the dryside – landward of the seawall – draw upon OAU's assessment and on cartographic sources.
- 8.4.2. There is only one 'known' maritime site within the former creeks of Shell haven, and even this record is ambiguous. The remains of a Roman boat are reputed to have been found in association with pottery and salt-making material (OAU 52). The report of a boat is unconfirmed. The reported location appears to coincide with the seaward end of Manor Way as named on the OS 6" 1st Edition (1870) and shown on the OS 1" 1st Edition (1805).
- 8.4.3. Mucking Lighthouse (OAU 100) is the only other known dryside site that is clearly 'maritime'. Bullock refers to the lighthouse in 1855. The light was on a pier served by the Light Keepers House, behind the seawall. Both the light, its pier and the Light Keepers House are shown on maps and charts until 1924. The site of the Light Keepers House appears to be in an area that has not been subject to refinery development, and some traces of the pier may survive.

Shell Haven Wetside

- 8.4.4. Roman pottery (OAU 45) has been found on the foreshore on the eastern waterfront of Shell Haven.

Reclaim

- 8.4.5. Two known sites within the area proposed for reclaim have been removed in the past. First, a large merchant vessel, possible a tanker (6596) identified from wartime air photographs. A jetty was later built at this location and it seems likely that the vessel was removed entirely. Second, the UKHO reports an obstruction removed in 1990 (5033).

Berths

8.4.6. There are no known sites in the area proposed for berths.

Channel

8.4.7. There are two known sites within the proposed channel immediately off Shell Haven.

8.4.8. There is a charted Foul (5149, Halcrow E) of uncertain origin at -13 m CD. Of more immediate interest is an 'ancient wooden wreck' (5185). This site was subject to clearance by grabbing in 1968 and lies at -10.4 m CD.

8.4.9. There is a further known site (5148) less than 100m to the west of the proposed channel immediately off Shell Haven, within the Yantlet Dredge Channel. This site is dealt with under Channel Dredge, below.

8.4.10. There are two further known sites within 100m of the proposed channel immediately off Shell Haven. There is a charted obstruction (5187, -9.5 m CD) to the south that reportedly comprises fishing gear, and an obstruction (5035, -3.1 m CD) of uncertain origin immediately west.

Channel Dredge

Yantlet Dredged Channel

8.4.11. There are 15 recorded sites within the area proposed for dredging as the Yantlet Dredge Channel.

8.4.12. Foul 5148 (Halcrow H), referred to above, is of uncertain origin and lies at -11 m CD. Foul or wreck 5051 (Halcrow L) lies at -11.56 m CD and is described as old timber and concrete.

8.4.13. Wrecks MTB 106 (5039) and the *Aquity*(5040) sank in wartime, possibly with loss of life. Their depths are not recorded. Similarly, the depths of obstruction 5186 and features 5038 and 5045 are not recorded.

8.4.14. The north part of the *Dovenby*(5012, Halcrow F4), an iron bark sunk in collision in 1914, lies at -11.7 m CD. The south part (5010, Halcrow G4) lies at -12.2 m CD.

8.4.15. The following obstructions and fouls are also known:

5025	Foul	-11 m CD	
5026	Obstruction	-10.8 m CD	Halcrow T3
5028	Foul	-11 m CD.	Halcrow Q2
5049	Obstruction	-15.4 m CD	

5178	Foul	-17 m CD	
5193	Obstruction	-11.2 m CD	Halcrow Y3

8.4.16. There are a further 19 known sites within 100 m of proposed dredging in the Yantlet Dredge Channel. The majority comprises fouls or obstructions, as follows:

5021	Foul	Halcrow R
5027	Foul	Halcrow W
5030	Foul	Halcrow J
5044	Debris	Halcrow N1
5050	Obstruction	Halcrow C1
5150	Foul	
5180	Foul	
5181	Foul	
5183	Foul	
5195	Foul	Halcrow S3
5197	Foul	Halcrow A3
5198	Undefined	Halcrow L3
5204	Undefined	Halcrow F3
5229	Foul	
5230	Undefined	
5860	Obstruction	

8.4.17. The remaining three sites within 100 m are of more immediate interest. Wreck 5792 is reportedly the London, a 64 gun ship lost in 1665. Wreck 5605 is known as the *King* (Halcrow U2); a cannon inscribed 1636 has been recovered from the site. Wreck 5020 is a wooden vessel carrying iron bars partly salvaged in 1978.

Oaze Deep

8.4.18. There are seven known sites in the proposed Oaze Deep dredging area, one of which – HM Submarine *Truculent* (5004), lost with 60 lives in 1942 – was lifted in 1950. The sludge carrier *Sir Joseph Rawlinson* (5006), lost in 1965, has also been subject to salvage.

8.4.19. The *Atherton* (5011), *Ash* (5013) and East Oaze Light Vessel (5056) lie at -14 m, -13.7 m and -13.6 m CD respectively. The *Atherton* – a steamship – was lost in 1921, whereas the *Ash* (a steam trawler serving as an Admiralty minesweeper) and the light vessel were lost in wartime.

8.4.20. The *Argus* (5008) and HMS *Aisha* (5057) lie in deeper water, both having been lost to mines.

8.4.21. There are two further known sites within 100 m of the proposed Oaze Deep dredging area. HMS *Amethyst* (5063) was a trawler mined in 1940 and lying at -15.6 m CD. There is also an obstruction (5138) in -19.2 m CD.

Knock John Channel

8.4.22. There are four known sites in the proposed Knock John Channel dredging area, as follows:

5146	Foul	-14.5 m CD	Halcrow F6
5147	Foul	-14 m CD	Halcrow E6
5171	Obstruction	-6.4 m CD	
5172	Undefined		

Fisherman's Gat

8.4.23. There is one known site in the proposed Fisherman's Gat dredging area, being an obstruction (5079) at -17 m CD

Sunk Head

8.4.24. There are four known sites in the proposed Sunk Head dredging area: HMS *Coquet* (5092) is a destroyer mined in 1916 and lying at -13.5 m CD; *Salerno* (5093) is a Norwegian steam ship mined in 1915, lying at -12.5 m CD; *Balgownie* (5094) is a steamship mined in 1916 lying at 14m CD; and *Iris* (5132) is also a WWI loss, lying at 16m.

Sunk

8.4.25. There are five known sites in the proposed Sunk dredging area. Four are of uncertain origin: foul 5155 at -17 m CD; undefined/magnetic anomaly 5043 at -15 m CD; undefined 5140 at -15 m CD; and foul 5152 at -18 m CD.

8.4.26. The fifth site may be German submarine UC-72 (5134), sunk in 1917 and lying at -15.6 m CD.

8.5. ARCHAEOLOGICAL POTENTIAL

Former Creeks

8.5.1. The archaeological potential of the majority of 'dryside' contexts is addressed by OAU. Of concern here is the potential for maritime archaeological heritage within the former creeks crossing the Alluvial Floodplain from the Gravel Terrace to the main channel of the Thames.

- 8.5.2. Such creeks are mapped and named on eighteenth and nineteenth century cartographic sources, and can be expected to date back into the earlier Post-medieval and Medieval periods. The form and location of creeks predating those shown on the maps is harder to establish, because of the complex interplay of sea-level change, sedimentation, and the environmental impact of human activity. In principal, it seems likely that the Alluvial Floodplain was crossed by creeks that would have been navigable at least at high tide throughout prehistory and into the Roman period. A detailed deposit model is in preparation, which should provide more information on earlier creeks.
- 8.5.3. The chronological overview set out above has demonstrated a high level of maritime activity in the region throughout history, including evidence of watercraft suitable for navigating the shallow fringes of the estuary. As well as remains of watercraft, other maritime structures – waterfronts, and hards, for example – might be expected, which could have been used both in navigating to dryer land at the heads of creeks, and in exploiting the resources of the Alluvial Floodplain itself. As such, chance finds of Roman pottery (OAU 48) at Shell haven, and at Stanford Le Hope marshes (OAU 43, 44) are as much an indicator of maritime archaeological potential as of 'terrestrial' settlement and industry.
- 8.5.4. The importance of former creeks to the Medieval and Post-medieval inhabitants of the Shell Haven area is apparent in the overall structure of the landscape, as recorded on eighteenth and nineteenth century maps. Each of the settlements and farmsteads on the Gravel Terrace is at the head of a lane running down to the Alluvial Floodplain to meet a creek or former creek, as indicated by field boundaries or embankments funnelling out towards the sea. Successive episodes of reclamation, starting in the thirteenth century if not earlier, appear to have enclosed areas of marsh while respecting the creeks in order that access to open water be maintained. Only in the latest episodes of reclamation, perhaps dating to the seventeenth century (see OAU 2001: 18), was the link between the sea and its Gravel Terrace hinterland severed by the seawall.
- 8.5.5. Several dryside sites suggest a close correlation between terrestrial sites and creeks in earlier periods, indicative of maritime archaeological potential. In particular, there is an interesting cluster of sites at the base of Old Garlands / Great Garlands (OAU 46, 96, 166, 180, 181) corresponding to the head of Stanford Le Hope Creek and Manor Way.
- 8.5.6. Circumstantial evidence for a re-orientation of Shell Haven away from the creeks giving access to a local hinterland, and towards the

passing trade of the main channel of the Thames, arises from the place-name itself. Shell Haven is a maritime place-name, and it was of sufficient import to warrant labelling on Collins' chart of England's east coast in 1688. Shell Haven House, mapped by Chapman and Andrew and named on the OS 1" 1st Edition, may have been established to serve vessels using the haven.

Shell Haven Wetside

- 8.5.7. The likely archaeological potential of the proposed Reclaim, Berths and Channel comprising Shell Haven Wetside can be dealt with under three headings. First, isolated artefacts of Lower Palaeolithic date within gravels and sands. Second, *in situ* former terrestrial sites on the surface of the sand/gravel and within alluvium, dating from the Late Upper Palaeolithic to the Roman period. Third, maritime sites – including wreck, flotsam and jetsam – of Mesolithic to Modern date on or in the seabed.
- 8.5.8. The potential for isolated artefacts of Lower Palaeolithic date is indicated by the regional distribution outlined in the Chronological Overview above and by other Palaeolithic material found in the vicinity (e.g. OAU 7, 33, 71). The potential could be clarified by correlating the sand/gravel underlying Shell Haven with regional schemas for the terraces and their archaeological importance.
- 8.5.9. The potential for *in situ* former terrestrial sites is indicated by other intertidal and subtidal discoveries in the region, and by discoveries at other shore line locations in the vicinity (e.g. OAU 2, 4, 8, 9, 10, 43, 45, 49). Peat horizons are often regarded as indicators of higher archaeological potential because they represent former landsurfaces that may have been inhabitable and because of their capacity to preserve organic remains such as wooden structures. Peat has been identified near Mucking (OAU 5) and in at least one marine borehole off Shell Haven (HMMB1). The deposit model that is in preparation will clarify the archaeological potential for *in situ* sites in the Reclaim, Berth and Channel off Shell Haven.
- 8.5.10. The potential for maritime sites in the Reclaim, Berth and Channel off Shell Haven is indicated by the known sites already discussed above, and the generally high level of maritime activity in the Thames throughout history. In addition to the wrecks whose positions are known, numerous losses have occurred whose position is only known through documentary records. These documented losses – 'casualties' – are ascribed to a nominal position or 'named location' in the National Monuments Record. There are two named locations relevant to the Reclaim, Berth and Channel off Shell Haven, namely Mucking

and Lower Hope Deep: there are seven recorded casualties for Mucking and 30 for lower Hope Point.

- 8.5.11. Insofar as these are documented losses, they represent only those periods for which losses are recorded in accessible documents, i.e. post c. 1730. It seems likely that losses also occurred in the Reclaim, Berth and Channel off Shell Haven in previous centuries.

Channel Dredge

- 8.5.12. As in the Reclaim, Berths and Channel off Shell Haven, the likely archaeological potential of the Channel Dredge falls under three headings:
- isolated artefacts of Lower Palaeolithic date within gravels and sands;
 - *in situ* former terrestrial sites on the surface of the sand/gravel and within alluvium, dating from the Late Upper Palaeolithic to the Roman period;
 - maritime sites – including wreck, flotsam and jetsam – of Mesolithic to Modern date on or in the seabed.
- 8.5.13. The potential for Lower Palaeolithic artefacts and for *in situ* sites is as described for the Reclaim, Berths and Channel off Shell Haven, indicated principally by the regional distributions discussed in the Chronological Overview. The only substantial difference is a lower potential for *in situ* sites of later prehistoric and Roman date. The Channel Dredge largely comprises depths that would have been inundated by sea level rise relatively earlier in prehistory, and – with the possible exception of some segments of the Yantlet Dredged Channel – the Channel is a fair distance from ‘high’ ground in the form of intertidal deposits.
- 8.5.14. The potential for *in situ* sites will be clarified by palaeo-geographic mapping of the Thames on the basis of a digital terrain model, currently in preparation.
- 8.5.15. The potential for wreck, jetsam and flotsam of all periods is also as described for the Reclaim, Berths and Channel off Shell Haven. The high level of maritime activity and the hazardous navigation of the Thames have been discussed in the Chronological Overview. The lack of information on wrecks pre-dating the start of systematic recording in the 1730s has also been noted. The following table, therefore, hopes to give an indication of potential based only on recorded casualties ascribed to nearby named locations.

Proposed Dredging Area	Named Location	Casualties
Yantlet Dredged Channel	Blyth Sand	4
	Hole Haven	8
	Chapman Lighthouse	16
	Swatchway	9
	Nore Sands	64
	Shoebury Sand	19
	Below Gravesend	5
	Yantlet	39
	The Entrance of the Thames Estuary	38
	Shoebury Sand	19
Oaze Deep	Red Sand	10
	Shivering Sand	5
Knock John Channel	Mouse Sand	48
	Knock Sand	12
Fisherman's Gat	Middle Sunk Sand	6
	Long Sand	95
Sunk Head	Sunk Sand	60
	Black Deep	1
	Long Sand Head	20
Sunk	River Thames Coastal Waters	5

8.5.16. As above, the limitations of casualties ascribed to named locations should be borne in mind. Insofar as these are documented losses, they represent only those periods for which losses are recorded in accessible documents, i.e. post c. 1730. The massive losses in recent centuries recorded for Nore Sands, the Yantlet, Mouse Sand, Long Sand and Sunk Sand, for example, hint at the many wrecks for which these hazards must have accounted in earlier times.

8.6. PAST IMPACTS

Former Creeks

8.6.1. Past impacts on the area of former creeks underlying the Alluvial Floodplain are discussed in detail by OAU. Piling and deep excavation are likely to have compromised the survival of maritime sites within and adjacent to their footprint.

Shell Haven Wetside

8.6.2. The area of proposed Reclaim has, in the past, been subject to the construction of numerous jetties, demolition of jetties, wreck clearance and navigational dredging. The proposed berths may have been subject to dredging, and the Channel off Shell Haven may have been subject to dredging and wreck clearance.

8.6.3. Although bathymetric profiles across the area clearly demonstrate the effects of navigational dredging (see Halcrow 2001), which will have truncated some natural deposits, a comparison of Admiralty Charts

dated 1852 and 1995 indicates that the overall bathymetry has not changed substantially other than in localised areas. Accordingly, it is possible that extensive areas of seabed have not been truncated by dredging.

- 8.6.4. Wreck 6596 and Obstruction 5033 within the proposed Reclaim appear to have been cleared. It is not known whether Foul 5149 has been subject to clearance. 'Ancient Wreck' 5185 was subject to clearance by grabbing in 1968, though some debris and artefacts might be expected to have survived.

Channel Dredge

- 8.6.5. The available information on past impacts in the areas proposed for the Channel Dredge is limited, so only general comments are possible at this stage.
- 8.6.6. Navigational dredging and wreck clearance are known to have occurred. The Yantlet is referred to as a dredged channel on current charts, but comparison of the charts of 1997 and 1836 suggest that the prevailing depths have not changed substantially. Consequently, navigational dredging may not have had a major impact on the seabed in the past. The extent of past navigational dredging in the other areas proposed for dredging is not apparent.
- 8.6.7. Many of the wrecks within the Study Area have been subject to clearance to a safe depth by removal, or dispersal by wire, explosives or dredging. The record of activities on each wreck is contained in the UKHO wreck index and the wreck database of the PLA.
- 8.6.8. As noted above, the Study Area has been subject to extensive fishing activity in the past, some of which will have used gear such as trawls and dredges that are pulled across the seabed. Such benthic equipment is known, in general terms, to have an impact on archaeological material on the seabed. Many of the fouls and obstructions recorded by the UKHO have been located by fishing, and elsewhere in the Thames fishing has resulted in the recovery of – for example – Roman pottery.
- 8.6.9. Other past uses of the region that may have resulted in impacts on the archaeological heritage of the Survey Area include aggregate dredging, anchoring, installation of navigation and mooring aids, and dumping of spoil and explosives.
- 8.6.10. In addition to human impacts, natural marine processes such as erosion and deposition are likely to have truncated or obscured archaeological deposits.

9. IMPACTS

9.1. METHOD OF ASSESSMENT

- 9.1.1. As discussed above, the impact assessment seeks to classify likely significant effects on a nine-point scale from severe adverse to maximum benefit.
- 9.1.2. The classification of each likely significant effect is arrived at by comparing the magnitude of proposed impacts with the sensitivity and importance of elements of the archaeological heritage within the impact footprint.
- 9.1.3. The magnitude of impact is characterised as high, medium or low for both adverse and beneficial impacts.
- 9.1.4. The sensitivity of elements of the archaeological heritage to proposed impacts is characterised on a five point scale from very high to low.
- 9.1.5. In view of the limited application of statutory designation to the forms of archaeological heritage encountered in wetland and maritime environments, then importance is gauged qualitatively.
- 9.1.6. The impact assessment seeks to account for effects on known sites, and on hitherto unknown sites whose possible presence is indicated by the archaeological potential of the area.
- 9.1.7. It should be noted that the importance of many of the ostensibly 'known' sites is far from apparent, as at this stage they are indicated only by fossils and obstructions. Field investigation is required in order to establish the archaeological (or other) character and importance of these sites.

9.2. CONSTRUCTION PERIOD IMPACTS

9.2.1. The direct effects of construction are summarised below:

Assessment Area	Impact Processes	Magnitude	Features	Sensitivity	Importance	Effect
		High Medium Low		Very High High Moderate Low-moderate Low	International National Regional High Local Moderate Local	Severe Adverse Major Adverse Moderate Adverse Minor Adverse None Minor Benefit Moderate Benefit Major Benefit Maximum Benefit
Former Creeks	Piling Excavation Drains	Medium	Possible Roman boat (OAU 52)	High	*National	Major Adverse
		High	Mucking Lighthouse (OAU 100)	Moderate	Moderate Local	Minor Adverse
		Low to Medium	Potential maritime	High	Regional to National	Major Adverse
Shell Haven Wetside	Piling for gantries	Medium	Source of Roman pottery (OAU 45)	Moderate	*High Local	Minor Adverse
	Reclamation Quay wall construction	Low	Foul 5149	Moderate	*Moderate Local	Minor Adverse
		High	'Ancient Wreck' 5185	Moderate	Regional to National	Major Adverse
	Jetty construction Berth Dredging (-16.5 m CD)	Medium	Obstructions 5035, 5187	Moderate	*Moderate Local	Minor Adverse
		High	Potential Lower Palaeolithic	Low-moderate	Moderate Local	Minor Adverse
	Channel Dredging (-14 m CD)	High	Potential in situ terrestrial	High	Regional to National	Major Adverse
	Wreck Clearance	High	Potential maritime	High	Regional to International	Major Adverse
Channel Dredge	Channel Dredging (-14 m CD) Wreck Clearance	High	Foul 5148, Foul/wreck 5051	Moderate	*Moderate Local	Minor Adverse
		High	MTB 106 (5039), Aquity (5040), Dovenby (5010, 5012)	Moderate	High Local to Regional	Moderate Adverse
			Obstructions/fouls/features 5186, 5038, 5045, 5025, 5026, 5028, 5193	Moderate	*Moderate Local	Minor Adverse
			Obstructions/fouls 5049, 5178	Low-moderate	*Moderate Local	Minor Adverse

		Fouls and obstructions within 100m of Channel Dredge	Low-moderate	*Moderate Local	Minor Adverse
		<i>London</i> (5792), <i>King</i> (5605), wooden vessel 5020	Moderate to High	Regional to International	Major Adverse
		<i>Atherton</i> (5011), <i>Ash</i> (5013) and East Oaze Light Vessel (5056)	Moderate to High	Regional to National	Moderate Adverse
		<i>Argus</i> (5008) and HMS <i>Aisha</i> (5057)	Low-moderate	Regional to National	Minor Adverse
		<i>HMS Amethyst</i> (5063)	Low-moderate	Regional to National	Minor Adverse
		Obstruction 5138	Low-moderate	*Moderate Local	Minor Adverse
		Fouls/obstructions 5146, 5147, 5171, 5172	Moderate	*Moderate Local	Minor Adverse
		Obstruction 5079	Low-moderate	*Moderate Local	Minor Adverse
		HMS <i>Coquet</i> (5092), <i>Salerno</i> (5093), <i>Balgownie</i> (5094), <i>Iris</i> (5142)	Moderate to High	Regional to National	Moderate Adverse
		Fouls/anomalies 5155, 5043, 5140, 5152	Low-moderate	*Moderate Local	Minor Adverse
		UC-72 (5134)	Moderate to High	National to International	Moderate Adverse
		Potential Lower Palaeolithic	Low-moderate	Moderate Local	Minor Adverse
		Potential in situ terrestrial	High	Regional to National	Major Adverse
		Potential maritime	High	Regional to International	Major Adverse

NB: * indicates that field investigation required.

Construction period impacts are predominantly short term – i.e. they occur within the timescale of the process itself – and permanent. The impacts are negative – entailing damage or disturbance of elements of the archaeological heritage – except insofar as mitigation provides an opportunity to understand more about human history and to add to public awareness.

9.3. OPERATIONAL PERIOD IMPACTS

Former Creeks

- 9.3.1. Operational period processes are not expected to have significant effects on maritime archaeological heritage within former creeks.

Shell Haven Wetside and Channel Dredge

- 9.3.2. The only operational period processes likely to impact on the archaeological heritage of Shell Haven Wetside and Channel Dredge are increased currents caused by the displacement of large vessels and their propellers. It is possible that these increased currents could cause localised mobilisation of light sediments on archaeological sites already exposed on the seabed. However, mobilisation is likely to be only temporary so such processes are unlikely to have a significant effect overall.
- 9.3.3. Vessel wash may also prompt erosion of any local intertidal archaeological deposits. Such erosion is, however, likely to be relatively insignificant compared to storm erosion.

9.4. OTHER EFFECTS

- 9.4.1. Effects attributable to the existence of the development on the wetside archaeological heritage have been discussed under operational effects, above. They are unlikely to be significant.
- 9.4.2. Natural resources used in the development will be obtained from already licensed sources – for which archaeological effects are considered in licensing processes – or will arise from activities such as dredging that are integral to the proposals and have been assessed above.
- 9.4.3. Dredging of the Berths and Channel off Shell Haven and of the Channel Dredge may have an indirect effect in altering the overall hydrodynamics of the estuary, which may result in erosion of archaeological sites. The effects of the proposals on the hydrodynamics of the estuary are still being assessed. The indirect archaeological effects will be assessed in due course.
- 9.4.4. Although the proposed development is large scale, the footprint of specific impacts is quite small in terms of the Thames Estuary as a whole. Consequently, the proposal is not expected to have a significant cumulative effect on the wetside and maritime archaeological heritage of the region. Moreover, any cumulative effect is likely to be substantially outweighed by the increased

knowledge and awareness of the regional archaeological heritage likely to arise from mitigation, which will contribute to the assessment of future development proposals.

9.5. MITIGATION PROPOSALS

Former Creeks

- 9.5.1. Mitigation proposals for the maritime archaeological heritage of the former creeks will be incorporated within the mitigation proposals developed by OAU for the dryside in general.

Shell Haven Wetside

- 9.5.2. It is anticipated that Shell Haven Wetside will be subject to marine geophysical investigation and – where necessary – archaeological inspection to characterise known maritime sites and to identify hitherto unknown sites.
- 9.5.3. It is also anticipated that sub-bottom surveys and/or purposive archaeological marine boreholes will be carried out to further clarify the potential for former terrestrial sites.
- 9.5.4. Where sites of firm archaeological importance are identified, provision will be made for their investigation and recording, supported by such analysis, material conservation, archiving and dissemination as might reasonably be agreed with the relevant archaeological curators.
- 9.5.5. Where sites of firm archaeological importance are identified in areas beyond the immediate footprint of impacting processes, provision will be made to monitor them before, during and after construction, and to carry out such consolidation as might reasonably be agreed with the relevant archaeological curators.
- 9.5.6. In addition, provision will be made for the reporting to an archaeologist of fortuitous discoveries in the course of construction, and for such inspection, investigation, recording and post-fieldwork activities as might reasonably be agreed with the relevant archaeological curators.

Channel Dredge

- 9.5.7. It is anticipated that the proposed dredging areas and wrecks proposed for clearance will be subject to marine geophysical investigation and – where necessary – archaeological inspection to characterise known maritime sites and to identify hitherto unknown sites.

- 9.5.8. Where sites of firm archaeological importance are identified, provision will be made for their investigation and recording, supported by such analysis, material conservation, archiving and dissemination as might reasonably be agreed with the relevant archaeological curators.
- 9.5.9. Where sites of firm archaeological importance are identified in areas beyond the immediate footprint of dredging/clearance, provision will be made to monitor them before, during and after dredging/clearance, and to carry out such consolidation as might reasonably be agreed with the relevant archaeological curators.
- 9.5.10. In addition, provision will be made for the reporting to an archaeologist of fortuitous discoveries in the course of dredging, and for such inspection, investigation, recording and post-fieldwork activities as might reasonably be agreed with the relevant archaeological curators.

10. CONCLUSION: OVERVIEW OF EFFECTS

- 10.1. This assessment has identified a series of likely significant effects on the archaeological heritage attributable to the London Gateway proposals. The effects encompass known sites and potential sites in former creeks, in Shell Haven wetside and in the areas proposed for channel dredging and wreck clearance. The effects vary from Minor Adverse to Major Adverse, though it is noted that field investigation is required to establish the importance of some sites.
- 10.2. Mitigation measures are proposed, in the form of investigation, monitoring and procedures for reporting fortuitous discoveries. The detail of mitigation measures for individual sites will be based on further archaeological investigations, including geophysical surveys and archaeological inspections. Analysis, material conservation, archiving and dissemination will accompany mitigation.
- 10.3. The proposed mitigation will offset any physical loss of the archaeological heritage, such that the residual effect of the London Gateway proposals is only Minor Adverse or even beneficial. This is in contrast to the current situation, in which the intertidal and marine archaeological heritage in the region is poorly understood or appreciated, and is subject to impacts apparent in the past that continue today, such as fishing and anchoring. Even known wrecks in the Study Area whose archaeological importance is readily apparent have not been protected or investigated archaeologically, hence it would be more advantageous to the intertidal and marine archaeological heritage for the London Gateway proposals to be implemented than for the current situation to continue.
- 10.4. The net result is that accompanied by appropriate mitigation, the effects of the London Gateway proposals on the intertidal and marine archaeological heritage are sustainable.

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11.2. ILLUSTRATIONS

Illustration	Date	Location of Ref.	Source / Ext. ref. and Shelf No.
Richard Caundish	1535	2.1.3	Robinson 1962:207 – Copyright?
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Mackenzie	1774	2.1.7 & 2.1.11	H.O. D923/11 1k
Grosvenor	1781	2.1.7 & 2.1.12	H.O. 17/336 10
Moore	1807	2.1.7	H.O. E30 3a
Grame Spence "Remarks on SUNK"	1802	2.1.10	H.O. h81 0g
Spence "East Swin"	?	2.1.12	H.O. 664 1h

Bullock	1843	2.1.13	H.O. 1607 A1 edition
1610 East Coast of England	2001	2.1.18	H.O. 1610 2001 edition