PORT OF TILBURY LONDON

PLANNING ACT 2008
INFRASTRUCTURE PLANNING (EXAMINATION PROCEDURE) RULES 2010

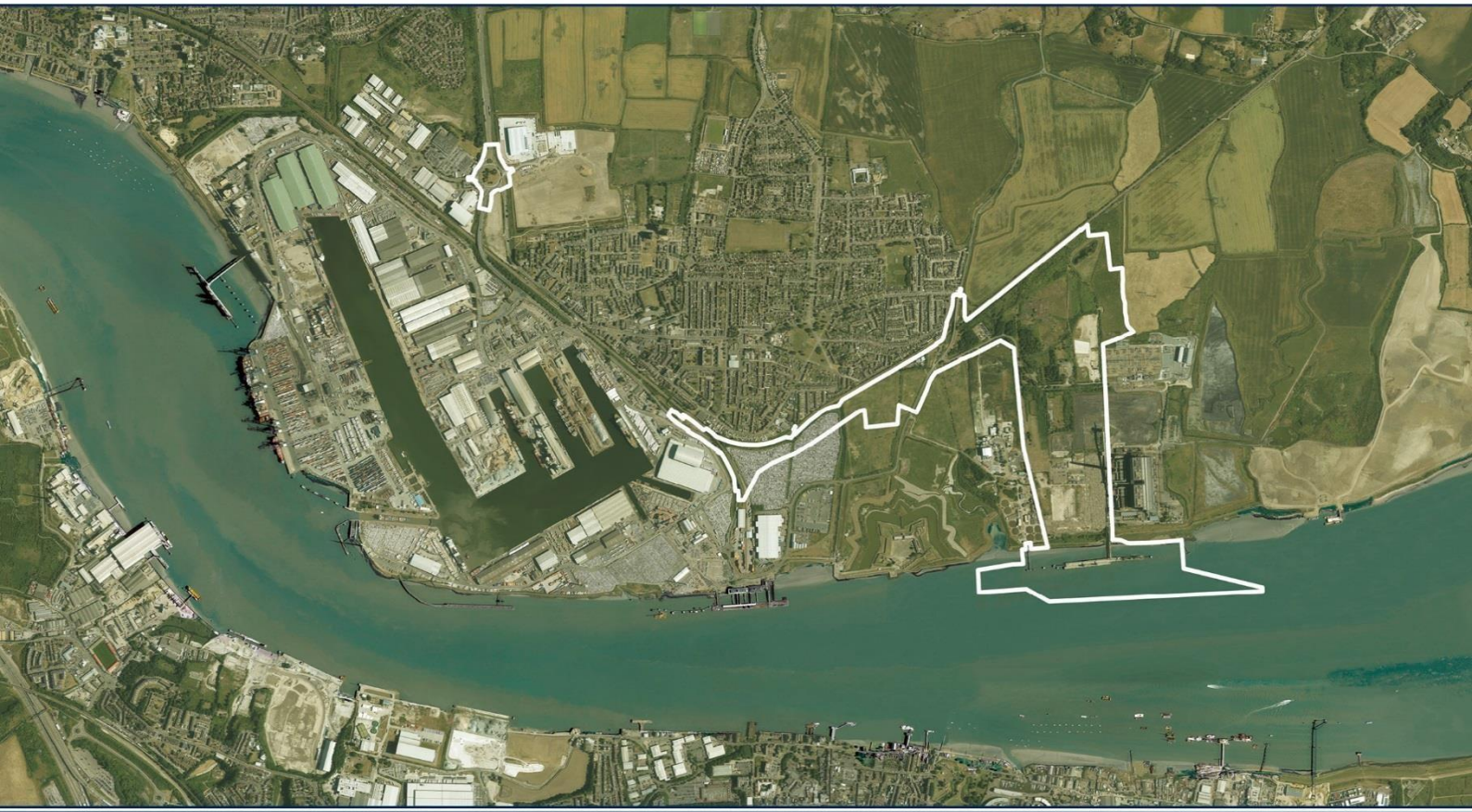
# PROPOSED PORT TERMINAL AT FORMER TILBURY POWER STATION

# TILBURY2

TR030003

## MARINE ARCHAEOLOGICAL WRITTEN SCHEME OF INVESTIGATION V4 - TRACKED CHANGES

## TILBURY2 DOCUMENT REF: PoTLL/T2/EX/150



TILBURY2

# Tilbury 2
# Land at the former RWE Power Station

Marine Archaeological WSI

Planning Ref: PINS TRO30003
Ref: 116222.01
June 2018

wessexarchaeology

# Report Information

| | |
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| Project name | Tilbury 2<br>Land at the former RWE Power Station |
| Type of report | Marine Archaeological WSI |
| Document reference | 116222.01 v2 |
| Client name | CgMs Consulting Ltd |
| Address | 140 London Wall<br>London<br>EC2Y 5DN |
| On behalf of | Port of Tilbury London Ltd |
| Address | Leslie Ford House<br>Tilbury<br>Tilbury, Essex<br>RM18 7EH |
| Site location | Thames Estuary at Tilbury, to east of Tilbury Fort |
| County | Essex |
| National grid reference | TQ6570075951 |
| Statutory designations | |
| Planning authority | |
| Planning reference | PINS TRO30003 |
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| Project management by | Dr Dan Atkinson |
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**Quality Assurance**

| *Version and issue date* | | *Status* | *Approved by* |
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| V1 | 15/05/2018 | External Draft | Dr Dan Atkinson |
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## Contents

**Figures**



**Tables**

# Tilbury 2 Development

# Marine Archaeological Written Scheme of Investigation

## 1 INTRODUCTION

### 1.1 Project background

1.1.1 Wessex Archaeology has been commissioned by CgMs Consulting Ltd and Port of Tilbury London Ltd (PoTLL) to produce a Written Scheme of Investigation (WSI) for work to be conducted in the intertidal and marine zones of the Tilbury 2 Development (hereafter 'the Development Area', **Figure 1**).

1.1.2 A draft Archaeological WSI was produced in 2017 by Wessex Archaeology (Wessex Archaeology 2017a). The present WSI document comprises the updated WSI that will account for the mitigation appropriate to the full life cycle of the Tilbury 2 Development with respect to the required dredging activities and intertidal works. The proposed mitigation measures in this WSI will be reassessed and will be enhanced by site and process specific Method Statements which will be produced and agreed for each measure and work stage implemented as appropriate.

1.1.3 This WSI is based on a geophysical survey report (Wessex Archaeology 2017b), a maritime cultural heritage baseline Desk Based Assessment (Wessex Archaeology 2017c); a Stage 1 Geoarchaeological Assessment (Wessex Archaeology 2017e); and the Geoarchaeological Fieldwork, Radiocarbon Dating & Updated Deposit Model Report by Quest (2017).

1.1.4 This WSI has been developed in consultation with Historic England.

1.1.5 The WSI comprises the mitigation strategy below Mean High Water Springs (MHWS).

### 1.2 Development description

1.2.1 The proposed Development within the Development Area involves the re-development of the location as a new port terminal, upgrading the present jetty with new berthing dolphins, a link bridge and additional hopper and conveyor belt and a new berth for Roll-on/Roll-off (Ro-Ro) ships. The raised pipeline to the Anglian Water Services sewage treatment plant to the west of the site will be removed. Associated dredge pockets around the jetty to create the berth will also be included in the Development, and are included within the Red Line Boundary (RBL) of the Development Area.

1.2.2 To facilitate its use for both the Ro-Ro terminal and the aggregates facility the existing jetty will be modified at both its upstream and downstream arms. The Ro-Ro berth, located at the western end of the existing jetty, will accommodate two vessels at a time and thus the existing jetty will be modified and extended to enable this. Similarly, the Construction Materials and Aggregates Terminal (CMAT) berth located at the eastern end of the existing jetty will be extended to accommodate barges and vessels of the required size.

1.2.3 These adaptations will be made up of the following (and may be subject to change).

1.2.4 The upstream berth will have five additional berthing dolphins, each with associated fenders, and four additional supports for a new footbridge. Should multiple foundations be used, each berthing dolphin will require 12 *c.*1.22 m diameter piles (making 60 in total), while the fenders will require three *c.*1.22 m diameter piles, making 15 in total. The four

footbridge supports will require two *c.*0.914 m diameter piles, making a total of eight. Should monopile foundations be used, each berthing dolphin will require one *c.*3.5 m diameter pile, making a total of five piles. There are no monopile foundation options for the fender foundations or footbridge supports.

1.2.5 The downstream berth (Jetty A) will have two additional berthing dolphins, each with associated fenders, and 13 new fenders for the jetty itself. Should multipile foundations be used, each berthing dolphin will require 12 *c.*1.22 m diameter piles (making 24 in total), while the dolphin and jetty fenders will each require three *c.*1.22 m diameter piles, making 45 in total. Should monopile foundations be used, each berthing dolphin will require one *c.*3.5 m diameter pile, making a total of two piles. There are no monopile foundation options for the fender foundations.

1.2.6 The CMAT Berth (Jetty B and beyond) will have eight additional berthing dolphins, each with associated fenders, and two additional supports for a new footbridge, as well as a conveyor hopper platform and three additional supports for the conveyor. Should multipile foundations be used, each berthing dolphin will require 12 *c.*1.22 m diameter piles (making 96 in total), while the fenders will require three *c.*1.22 m diameter piles, making 24 in total. The two footbridge supports will require two *c.*0.914 m diameter piles, making a total of four. Should monopile foundations be used, each berthing dolphin will require one *c.*3.5 m diameter pile, making a total of eight piles. There are no monopile foundation options for the fender foundations, footbridge supports, conveyor hopper platform or conveyor supports.

1.2.7 The Ro-Ro pontoon and approach bridges will have two additional restraint dolphins, one additional bank seat, six piled bents and an abutment. The six piled bents and the abutment will be onshore, while the bank seat and the dolphins will be within the intertidal and marine zones. Should multipile foundations be used, each restraint dolphin will require 14 *c.*1.22 m diameter piles (making 28 in total), as will the bank seat and the abutment, making a further 28 *c.*1.22 m piles. The piled bents will require four 1.22 m piles each, making a total of 24. Should monopile foundations be used, each restraint dolphin will require two *c.*3.5 m diameter pile, making a total of four piles. There are no monopile foundation options for the bank seat, piled bents or abutment.

1.2.8 Dredging will take place around the improved terminal jetty to create a berthing pocket. In relation to the downstream (CMAT) jetty, the depth of pocket will be 14.98 m below Chart Datum (CD) and cater for the largest likely bulk aggregate vessels to visit the site in the future (100,000 tonnes). This will therefore mean the river bed will need to be lowered by up to *c.*6.98 m. A *c.*330 m long, 25 m high sheet pile wall will be installed to run along the northern edge of the dredge pocket. The Ro-Ro berthing pocket (next to the western end of the existing jetty and around its westward extension) will require less dredging in order to create a dredged depth of 7.88 m. The river bed will be lowered by up to *c.*3.98 m. The immediately adjoining approaches to the berth pockets will also need dredging and are included within the Order limits.

1.2.9 It is understood that there are three scenarios for dredging operations currently under consideration:

- *Scenario 1: Water Injection Dispersal (WID) dredging;*
- *Scenario 2: backhoe excavator dredging (open bucket except in the area of contaminated sediment where it would use a closed bucket excavator); and*
- *Scenario 3: a combination of these techniques.*

1.2.10 From an archaeological viewpoint, WID dredging has the potential to be damaging to archaeological receptors within the dredge area and lacks the opportunity to identify and

recover unexpected or previously unknown archaeological receptors buried within the silt. Backhoe excavator dredging would remove quantities of sediment and any associated buried archaeological material using an excavator arm on the stern of a specially adapted ship, and transfer the sediment to a lighter or barge nearby. In open bucket excavation this would allow investigation of the sediment of each bucket by an archaeologist and offers a level of control that is not available in dispersal dredging. The closed bucket excavation of the contaminated sediment in the area located on **Figure 2** would not allow any investigation of the material as it was recovered, but there is the potential for inspection for artefactual recovery from material brought ashore for decontamination.

1.2.11 This WSI therefore encompasses the range of development options assessed and consented to allow post-consent flexibility in the final project design. As such, this high level WSI addresses all possible requirements for archaeological consideration at all stages of development of the Tilbury 2 Site; set out in Section 9.

1.2.12 The Proposals are shown in detail in **Figure 2**.

## 1.3 Construction Programme

1.3.1 The construction programme for the Development is as yet unspecified. However, following the Development Consent Order, PoTLL will provide the Marine Management Organisation (MMO) with the programme of construction within the order limits.

## 1.4 Scope of document

1.4.1 The contents of this WSI comprise the Development Area below Mean High Water Springs (MHWS) within the Thames Estuary (see **Figure 1**).

1.4.2 This document is written in accordance with Schedule 9 (the Deemed Marine Licence) of the draft Development Consent Order.

1.4.3 This WSI sets out the methodologies and standards that will be employed by PoTLL and the Retained Archaeologist (RA) to implement the mitigation strategy in format and content. Wessex Archaeology has been appointed to the role of RA. This WSI conforms to current best practice and to the guidance outlined in Management of Research Projects in the Historic Environment (MoRPHE, Historic England 2015), The Assessment and Management of Marine Archaeology in Port and Harbour Development (Gane and Cooper 2016), the Joint Nautical Archaeology Policy Committee Code of Practice for Development (JNAPC 2006), and the Chartered Institute for Archaeologists' (CIfA) Standards and Guidance for an Archaeological Watching Brief (CIfA 2014a) as applicable.

# 2 THE ARCHAEOLOGICAL ASSESSMENT AREAS

## 2.1 Co-ordinate System

2.1.1 Positions are reported in the British National Grid coordinate system for all aspects of this report.

## 2.2 Archaeological Assessment Areas

2.2.1 The recorded marine historic environment resource within 2 km of the limits of the offshore and intertidal portion of the Development Area was considered. This is referred to hereafter as the Marine Study Area (MSA). The MSA includes both the intertidal and marine zones within the Development Area. The recorded terrestrial historic environment resource is discussed in a separate report (CgMs 2017).

2.2.2 The 2 km buffer (forming the MSA) used for this assessment allows for the capture of relevant archaeological records that may have poor positional data, including for example historic wrecks and aircraft losses, both of which are prevalent in this area.

# 3 AIMS AND OBJECTIVES

## 3.1 Aim

3.1.1 The specific aim of this WSI is to set out the baseline resource for the known and potential archaeological assets within the MSA, and the mitigation strategies proposed to address the impacts identified.

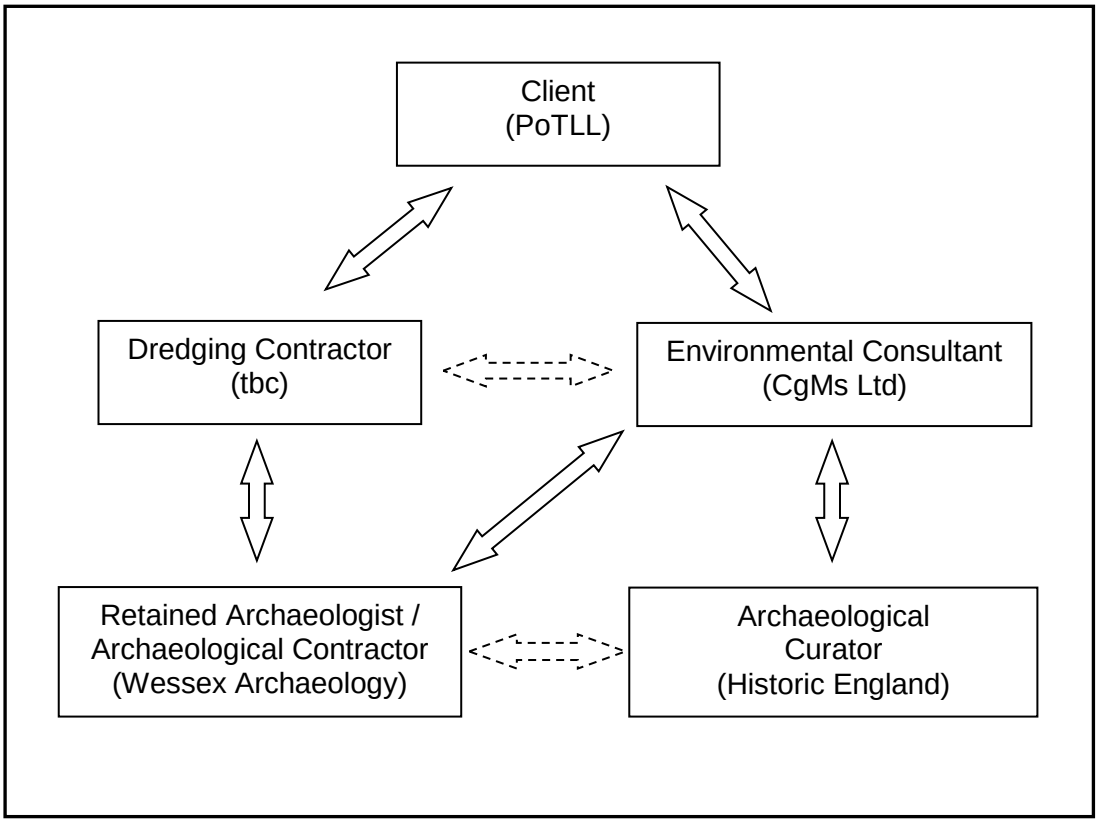
## 3.2 Objectives

3.2.1 The objectives of this WSI are as follows:

- *to fulfil the requirements of the Archaeological Curator (Historic England)- in respect of archaeological monitoring and mitigation of works associated with the dredging activities aspect of this project;*
- *to mitigate the impact of dredging within the Tilbury 2 Site via appropriate and recognised strategies;*
- *to propose measures for mitigating effects upon any archaeological material that may be encountered during the operations associated with the scheme including an appropriate programme of pre-dredge clamshell grab/targeted backhoe excavation anomaly investigation, intra-dredge clamshell grab/targeted backhoe excavation sediments investigation and, if necessary and practicable, watching briefs in the intertidal zone;*
- *to ensure that any further geophysical and geotechnical investigations associated with the project are subject to archaeological input and review with subsequent recording and sampling if necessary;*
- *to provide for archaeological involvement in any diver and/or Remotely Operated Vehicle (ROV) obstruction surveys conducted for the scheme;*
- *set out a practicable Protocol for Archaeological Discoveries, to be in place throughout the project; and*
- *to establish the reporting, publication, conservation and archiving requirements for the archaeological works undertaken in the course of the scheme.*

# 4 ROLES, RESPONSIBILITIES AND COMMUNICATION

4.1.1 The following diagram shows the lines of communication between PoTLL, CgMs, the dredging contractor (currently unassigned), Wessex Archaeology and Historic England, with regards to this archaeological WSI. Further details are provided below regarding the dynamics of the diagram and also the roles and responsibilities of those involved.




## 4.2 Client (referred to in the Deemed Marine License as the undertaker)

4.2.1 Port of Tilbury London Limited (PoTLL) is the overall client for the Tilbury 2 Development. PoTLL will directly engage with the Dredging Contractor and the Environmental Consultant as necessary.

4.2.2 PoTLL has committed to following guidance set out in The Assessment and Management of Marine Archaeology in Port and Harbour Development (Gane and Cooper 2016), as applicable.

4.2.3 The responsibility for implementing this WSI rests with PoTLL and their appointed representatives. Any work undertaken on behalf of PoTLL in accordance with this WSI will not relieve PoTLL of any liability.

4.2.4 For the operation of the Protocol for Archaeological Discoveries (PAD- see **Section 9.13**), the Nominated Contact for PoTLL will be confirmed.

4.2.5 Following the Development Consent Order, PoTLL will provide the MMO and the Environmental Consultant with the programme of construction.

4.2.6 PoTLL will submit the archaeological Method Statements or reports to the MMO for approval following approval from the Archaeological Curator.

## 4.3 Dredging Contractor

4.3.1 The Dredging Contractor has, at the time of writing, not been confirmed. This will be confirmed during the detailed design stage following provision of the DCO.

4.3.2 The key responsibilities of the Dredging Contractor will include:

- *notifying the Retained Archaeologist when dredging works are to commence, giving enough warning so that Wessex Archaeology (the Archaeological Contractor) can ensure the vessel staff/UXO specialists are aware of any specific considerations;*
- *Informing Wessex Archaeology of any environmental constraint or matter relating to health, safety and welfare of which they are aware that is relevant to the archaeologists' activities;*
- *Obeying legal obligations in respect of 'wreck' and 'treasure' under the Merchant Shipping Act 1995 and the Treasure Act 1996 respectively;*
- *Respecting any constraint maps including AEZs supplied by Wessex Archaeology;*
- *notifying Wessex Archaeology, prior to any diving, in the event that an obstruction on the seabed is to be ground-truthed by divers. If the obstruction is identified as being of potential archaeological interest the dredging contractor will notify Wessex Archaeology within 24 hours;*
- *allowing suitably trained and inducted Wessex Archaeology staff safe access to any wharves, containers or barges containing dredged material as part of the archaeological watching brief (where open bucket backhoe dredging methodology to be used- see **Section 9.11**);*
- *contacting Wessex Archaeology staff in the event of a discovery identified as being of potentially high archaeological interest. Wessex Archaeology will be notified as soon as possible after the discovery and within 24 hours of the discovery (see **Section 9.13**); and*
- *suspending work in a particular location in the event that objects of potential archaeological interest are encountered. On receiving such a request, the dredging contractor will immediately inform the PoTLL Project Manager verbally and will redeploy its equipment to work in an alternative location. The dredging contractor will submit a Change Notification to the PoTLL Project Manager within 7 days.*

4.3.3 All Construction Contractors engaged in the project whereby there is an archaeological element will:

- *familiarise themselves with the generic requirements of the WSI and make them available to their staff;*
- *record the participation of their staff in all necessary briefings and awareness training relating to the archaeological works, and provide this to PoTLL;*
- *obey legal obligations in respect of 'wreck' under the Merchant Shipping Act 1995;*
- *assist and afford safe access to archaeologists contracted by PoTLL;*
- *inform the Retained Archaeologist of any environmental constraint or matter relating to health, safety and welfare of which they are aware that is relevant to the archaeologists' activities; and*
- *implement the Protocol for Archaeological Discoveries via the dredge vessel's master and Project Manager.*

## 4.4 Environmental Consultant

4.4.1 CgMs Limited is the Environmental Consultant for the project.

4.4.2 The key responsibilities of the Environmental Consultant will include:

- *advising the Dredging Contractor and PoTLL on the necessary interaction with third parties with archaeological interests, including the Archaeological Curator(s);*
- *ensuring that copies of any Method Statements are provided to the Archaeological Curator(s) for approval;*
- *monitoring the preparation and submission of Archaeological Reports as appropriate and making them available to the Archaeological Curator(s);*
- *advising the Retained Archaeologist of their requirements or responsibilities under any Environmental Management Plan and the Construction Method Statement for the project; and*
- *notifying Historic England in advance of the commencement of the fieldwork and if material of archaeological interest is recovered at any time, following the procedures outlined in the Protocol for Archaeological Discoveries (Section 9.13).*

## 4.5 Archaeological Curator

4.5.1 Historic England is the Archaeological Curator providing advice for the historic environment within the English Inshore and offshore marine planning areas. In consideration of this project within the tidal Thames, Historic England will coordinate advice with the relevant local authority regarding activities to be undertaken in accordance with this WSI and further Method Statements.

4.5.2 The relevant contacts at Historic England are:

- *Dr Chris Pater, Head of Marine Planning, Historic England, Guildford Office.; and*
- *Zoe Outram, Historic England Regional Science Advisor, Historic England, Cambridge Office.*

4.5.3 Contact with the Archaeological Curator will be administered by CgMs and/or Wessex Archaeology.

4.5.4 Where Method Statements are submitted by CgMs/Wessex Archaeology to the Archaeological Curator(s), their agreement / acceptance will be assumed if no contrary response is received within 15 working days of submission.

4.5.5 For archaeological mitigation on discoveries during the programme of works, including the implementation, managing and removal of Archaeological Exclusion Zones or Temporary Exclusion Zones, consultation with Historic England will be required. This will be completed as expediently as possible as part of the mitigation strategy to allow the continuation of the programme of works as smoothly as possible.

4.5.6 Where assessment reports or other deliverables are submitted following each phase of fieldwork by the Environmental Consultant/Retained Archaeologist to the Archaeological Curator(s), their agreement / acceptance will be assumed if no contrary response is received within 15 working days of submission.

## 4.6 Retained Archaeologist Services (RAS)

4.6.1 The Retained Archaeologist, also acting as the Archaeological Contractor, is Wessex Archaeology, a suitably qualified and experienced archaeological company.

4.6.2 The key responsibilities of the Retained Archaeologist will include:

- *ensuring the effective implementation of the WSI and other contractual commitments in relation to archaeology;*
- *maintaining, reviewing and updating this WSI, as required ahead of approval;*
- *developing and reviewing the research framework within which the WSI is applied;*
- *advising the dredging contractor and/or their sub-contractor(s) where elements warrant archaeological involvement;*
- *advising the dredging contractor and/or their sub-contractor(s), and the piling/excavation contractors for the intertidal works, in the course of evaluating scope of work specifications on their capacity to meet archaeological requirements;*
- *advising the dredging contractor and/or their sub-contractor(s) on the implementation of all archaeological requirements applicable to all dredging and maintenance activities;*
- *advising the piling/excavation contractors and/or their sub-contractor(s) on the implementation of all archaeological requirements applicable to all intertidal excavation and piling activities;*
- *liaise with the Environment Consultant, PoTLL and the dredging contractor to determine a draft programme and timescale for site investigations which must allow sufficient time to complete fieldwork in accordance with the WSI, which will be submitted to the Environmental Consultant and PoTLL for approval prior to submission to the Archaeological Curator;*
- *advising the Environmental Consultant on Method Statements for archaeological investigations;*
- *preparing detailed Method Statements for all archaeological activities;*
- *implementing and monitoring the Protocol for Archaeological Discoveries;*
- *preparing provisions for the management of the project archives in consultation with an appropriate Museum;*
- *advising PoTLL on final arrangements for analysis, archive deposition, publication and popular dissemination;*
- *providing initial advice to vessel staff/UXO specialists in the event of a discovery identified as being of potentially high archaeological significance;*
- *being given the authority by the Client to require the dredging contractor and their sub-contractor(s) to suspend work in a particular location in the event that objects of archaeological significance are encountered; and*
- *maintaining direct telephone and email contact with the Nominated Contact (see Section 9.13) on board the vessel during dredging in order to monitor the functionality of the onboard finds reporting protocol. A weekly telephone call is to be maintained with Wessex Archaeology to provide a project progress report regardless of whether or not any discoveries of archaeological significance have occurred.*

# 5 ARCHAEOLOGICAL BASELINE SUMMARY

## 5.1 Introduction

5.1.1 The results within this baseline are those identified in the Marine Archaeological Desk Based Assessment (Wessex Archaeology 2017c); a Marine Geophysics Archaeological Report (Wessex Archaeology 2017b); a Stage 1 Geoarchaeological Assessment (Wessex Archaeology 2017e); and the Geoarchaeological Fieldwork, Radiocarbon Dating & Updated Deposit Model Report by Quest (2017).

## 5.2 Previous archaeological work

5.2.1 An onshore archaeological assessment of the site was completed by Wessex Archaeology in 2007 and a marine assessment in 2009 for RWE nPower. Geoarchaeological work have been completed by Wessex Archaeology (2008a) which build on the work of Devoy (1979) who completed an extensive study of the geoarchaeological potential of the Thames Estuary during the late 1970s and early 1980s. A programme of excavations and surveys of the intertidal zone south of Tilbury Fort by the Passmore Edwards Museum took place ahead of the restoration of the fort's outer defences in 1988-89. These have formed the basis of the current archaeological baseline, and has been updated with any new information uncovered or reported since then, including those studies identified in **Section 5.1.1** above.

## 5.3 Data limitations

5.3.1 The sidescan sonar data utilised for this assessment have been rated as 'Variable' using the above criteria table, with some lines exhibiting good quality data and others being below average quality with some evidence of poor weather conditions or sea state. Overall the data were generally of good quality for archaeological assessment.

5.3.2 The magnetometer data utilised for this assessment have been rated as 'Variable' using the above criteria table. The site contains high magnetic background variation which is visible throughout the data caused by the underlying geology throughout the area, there is also a large amount of likely modern ferrous debris in the Study Areas. These factors make identifying magnetic anomalies of archaeological potential difficult and may also mask smaller magnetic anomalies.

5.3.3 The multibeam bathymetry data utilised for this assessment have been rated as 'Good' using the criteria table above, the data quality and resolution of 0.25 cm was found to be of a high standard and suitable for the archaeological assessment of seabed objects and debris over 0.25 cm.

5.3.4 The sub-bottom profiler .pdf images of the 3D chirp data utilised for this assessment have been rated as average for the identification of possible buried objects.

## 5.4 Summary of known and potential archaeological assets

*Known riverbed and intertidal prehistory*

5.4.1 The Historic Environment Record (HER) includes a poorly located (it is unclear whether it was found in the Thames or at Tilbury Docks) worked flint (**WA 1007**- also noted in the CgMs 2017 terrestrial DBA) possibly dating to the Palaeolithic period which is listed as a hand-axe. This is likely to be redeposited rather than in situ.

5.4.2 Some of the most favoured areas for occupation during the Mesolithic were the margins of the swampy regions of the tributaries of the Thames, and remains of Mesolithic occupation sites have been discovered on a number of sites beneath peat, tufa or alluvium deposits along with a human skull discovered during the construction of the Tilbury Docks within the alluvial sediments which dated to this period (BGS 1996:136). The peat deposits Tilbury I and Tilbury II occurred during the Mesolithic period (c.10,000-6,000 BP) and as such it is possible that artefacts may remain within these sediments which relate to this period of human activity.

5.4.3 Tilbury III, the thickest peat in the succession, dates to the Neolithic period (c.6,000-4,000 BP). It is possible that Neolithic artefacts are discovered within this peat lens. Early Neolithic pottery has been found at Northfleet in deposits dating to this time (BGS 1996:127). There is little evidence for prolonged habitation of wetland areas during the Neolithic period, although human activities such as the clearance of fen woodland may have occurred (BGS 1996:127).

5.4.4 Eight borehole records and eight riverbed samples were reviewed by specialist geoarchaeologists from Wessex Archaeology as part of the Stage 1 Geoarchaeological Assessment (Wessex Archaeology 2017e). The eight boreholes all have limited potential for Stage 2 geoarchaeological sampling and assessment, primarily due to the lack of suitable peat horizons likely to contain palaeoenvironmental remains (e.g. pollen, plant macrofossils) and *in-situ* organic material to support radiocarbon dating. The key limiting factor is the absence of terrestrial plant macrofossils and other organic material in alluvium suitable for radiocarbon dating; any palaeoenvironmental data will therefore lack a secure chronological context, and will be coarsely dated at best, if at all, precluding reliable interpretations to any archaeology from the adjacent dry ground (Wessex Archaeology 2017e).

5.4.5 The Geoarchaeological Fieldwork, Radiocarbon Dating & Updated Deposit Model Report by Quest (2017) identified increased potential onshore with three distinct horizons of peat identified. Radiocarbon dating of Borehole QBH3 has identified the importance of these deposits for regional environmental and relative sea-level records in the Thames basin (Quest 2017).

5.4.6 The excavations of the Tilbury Fort foreshore by the Passmore Edwards Museum in 1988-89 recovered *c.* 1,670 wooden timbers, mostly comprising beams, planks, posts and piles relating to drainage and defensive works since 1670 AD. These excavations are sadly unpublished excluding brief summaries in *Essex Archaeology and History* (Gilman (ed.) 1989; 1990) and *Post-Medieval Archaeology* (Egan (ed.) 1990). A report from the Ancient Monument Laboratory into the tree ring analysis of the 213 samples taken (Groves 1993) noted that the structures included an ammunition magazine constructed in 1847 AD, a sluice pre-dating 1850 AD, the foundation piling for the fifth bastion of the fort built in 1670 AD and a series of piers.

*Riverbed and intertidal prehistory potential*

5.4.7 The presence of Mesolithic and Neolithic palaeo-environmental data from the surrounding area would suggest that there is a low to medium potential for more to be found within the estuarine and fluvial sediments within the wider MSA. As noted in 5.4.4 above however the results of the Geoarchaeological Stage 1 Assessment indicated that there is limited potential for palaeo-environmental data within the marine element of the Development Area (Wessex Archaeology 2017e).

5.4.8 The Mesolithic record of the UK suggests a strong relationship between human activity and coasts, wetlands, rivers and streams. These areas provide rich sources of food and resources for hunter/gatherer groups, as well as important transport routes inland or

between islands (Waddington and Bonsall 2016). Any surviving sedimentary deposits from this period could potentially contain both *in situ* and derived artefacts from a time when these coastal and littoral landscapes, now submerged by the sea, in a landscape known to be extensively used by early human populations (Bicket and Tizzard 2015). In addition, the area is likely to have been marsh/swamp for much of the Mesolithic and Neolithic, periods which saw extensive use of coastal and estuarine zones for subsistence. The estuarine silts are likely to preserve any features present from these periods, such as fish traps, if they are present.

5.4.9 As the Passmore Edwards Museum excavations demonstrated, there are a large number of partially exposed timbers relating to structures associated with Tilbury Fort within the foreshore to the south of the fort. There is therefore the potential for future timbers, partial and complete structures to be present buried within the intertidal sediments in front of the fort. These may be extensions of the features already identified by the previous excavations or may be currently unknown. However, there is a lower potential for timber structures associated with Tilbury Fort to be present within the order limits of the site which lies due east of the Fort.

*Known maritime*

5.4.10 **Figure 3** presents the receptors within the MSA. **Appendix I** contains the gazetteer of receptors with archaeological potential. **Appendix II** contains the medium and low potential receptors from the geophysical archaeological assessment (2017b). The gazetteer comprises a range of features which may be debris or of possible archaeological interest.

5.4.11 Evidence of Romano-British occupation has been found in the intertidal zone to the east of the Development Area, comprising the remains of four adjacent hut circles (**WA 1008**) which are thought to still be preserved below the mud. These remains, found in 1920 but not excavated, are extensive, with the largest two having three rings of stakes each, with wattlework still surviving and rings of stone in between the stake rings, suggesting complex building techniques. One of these huts also had evidence for floor planking and an oven. The smallest hut circle also contained evidence for daub covered walling, while a number of roofing tile fragments has also been discovered in the area, suggesting they were roofed. The foreshore 100 m either side of the site of **WA 1008** was covered with Romano-British ceramics, generally of “native” types but with some examples of Samian ware. The record suggests this may have been a landing point for material from abroad during the Romano-British period. These features are highly significant, with the potential for high quality survival of organic material in the protective riverine silts. If the site was a landing point for goods, then there is potential for damaged, lost or abandoned examples to be preserved within the river bed sediments in the immediate area.

5.4.12 The discovery of more Roman ceramic fragments (**WA 1003**) from the foreshore is a further indication of Roman activity within the area. This record also notes Romano-British burial material from the area, although it does not give more details of exact location and extent. Three other findspots for Roman material are also noted in the HER data, although there is minimal data for two (**WA 1004** and **WA 1005**), while the other, sherds of Samian ware (**WA 1002**) originally held by Tilbury Fort, has an uncertain origin, with a note suggesting the artefacts may have in fact come from Kent.

5.4.13 There are currently no modern shipwrecks subject to statutory protection within the Development Area or MSA.

5.4.14 An unusually shaped pillbox (**WA 1001**) dating to the Second World War is present on the intertidal zone to the east of the Development Area. It is 28 ft x 15 ft double ended octagon shape. This feature is half submerged at high tide.

5.4.15 A spigot mortar base (**WA 1006**) is located within a pre-Second World War gun pit on the High Water Mark in Tilbury Fort and may suggest the presence of mortar round UXO within the Development Area.

5.4.16 Two steel/iron barge hulks (**WA 1015** and **WA 1016**) lie on the High Water Mark, partly covered by gravel, intertidal mud and vegetation, within the eastern half of the MSA 500m outside the Development Area. These are likely to be 20th century barges, more commonly known as lighters.

5.4.17 UKHO records note two further hulked wrecks further east (**WA 1022**) which appear on PLA surveys in 1992 as three areas of debris, suggesting that they have now broken up. These were not obvious during the site visit and may be multiples of the exact steel/iron barge wrecks noted above.

5.4.18 Two barge wrecks are listed in the UKHO dataset to the east of the Development Area, **WA 1026** and **WA 1028**. Both of these are listed as dead wrecks.

5.4.19 The wreck of the motor vessel *Hartnel* (**WA 1029**) is located by the UKHO as being almost mid-channel to the south-east of the Development Area, however the record also notes that the wreck was lifted around 1956. Some debris may remain. Similarly, the wreck of the SS *Southport* (**WA 1031**) was located to the west of the Development Area, having sunk following a collision. It was refloated in 1956 as well. Some debris may remain on the river bed.

5.4.20 Another wreck further east again (**WA 1023**) is known from a 2012 survey, and is located within the Thames, rather than in the intertidal zone.

5.4.21 Five UKHO obstructions or fouls are recorded on the north side of the Thames within the MSA, with one being a foul area of 80 m x 30 m (**WA 1021**), a set of three 8 m long concrete piles listed as lifted (**WA 1027**), an uncategorised obstruction listed as dead (**WA 1030**) and two being remains of ground tackle from mooring buoys (**WA 1024** and **WA 1025**). The concrete piles **WA 1027** are within the dredging area but as the records say they have been lifted they should no longer be present.

5.4.22 The geophysical report (Wessex Archaeology 2017b) identified 116 anomalies of archaeological potential (**Appendix II**), which should be investigated further, as outlined in **Section 9**. It also identified an additional 70 isolated anomalies identified in the 3D chirp data that could represent buried material, with no associated magnetic anomaly indicating a non-ferrous composition (**Appendix III**). These anomalies could represent buried material which has the potential to be archaeological in nature. These are shown in **Figure 4** and **Figure 5** which also show them in relation to the dredge pockets.

*Known aviation*

5.4.23 There are no definite known aviation wrecks within the MSA.

*Maritime and aviation archaeological potential*

Maritime Potential

5.4.24 Data informing the potential marine archaeological resource relate to a location of loss rather than to actual remains on the seabed, except by chance, and were assessed in

order to provide an indication of the type of maritime activity that occurred across the study area, as well as providing an indication of the potential for the presence of the remains of currently uncharted wrecks to exist within the study area.

5.4.25 There is potential for the presence of archaeological material of a maritime nature spanning from the Mesolithic period to the present day within the study area, and are summarised by general period ranges in **Table 1** below.

**Table 1:** Summary of maritime and intertidal potential by period within the Study Area

| Period | Summary |
|---|---|
| Pre-1508 AD | Potential for material associated with prehistoric maritime activities. Prehistoric maritime activities include coastal travel, fishing and the exploitation of other marine and coastal resources. Vessels of this period include rafts, hide covered watercraft and log boats. |
| | Potential for material associated with later prehistoric maritime activities, including seaworthy watercraft suitable for overseas voyages to facilitate trade and the exploitation of deep water resources. Such remains are likely to comprise larger boat types, including those representing new technologies such as the Bronze Age sewn plank boats that are associated with a growing scale of seafaring activities. |
| | Potential for material of Romano-British/Romano-Gallo date, associated with the expansion and diversification of trade with the Continent. Watercraft of this period, where present, may be representative of a distinct shipbuilding tradition known as 'Romano-Celtic' shipbuilding, often considered to represent a fusion of Roman and northern European methods. |
| | Potential for material associated with coastal and seafaring activity in the 'Dark Ages', associated with the renewed expansion of trade routes and Germanic and Norse invasion and migration. Vessels of this period may be representative of new shipbuilding traditions including changes in technique. |
| | Potential for material associated with medieval maritime activity, including that associated with increasing trade between the UK and Europe, the development of established ports around the North Sea and the expansion of fishing fleets and the herring industry. Vessels of this period are representative of a shipbuilding industry which encompassed a wide range of vessel types (comprising both larger ships and vernacular boats). Such wrecks may also be representative of new technologies (e.g. the use of flush-laid strakes in construction), developments in propulsion, the development of reliable navigation techniques and the use of ordnance. |
| 1509 to 1815 AD | Increasing potential for post-Medieval shipwrecks representative of continuing technological advances in the construction, fitting and arming of ships, and in navigation, sailing and steering techniques. Vessels of this period continued to variously represent both the clinker techniques and construction utilising the flush-laid strakes technique. |
| | Increasing potential for post-medieval shipwrecks associated with the expansion of transoceanic communications and the opening up of the New World. |
| | Increasing potential for post-medieval shipwrecks associated with the establishment of the Royal Navy during the Tudor period and the increasing scale of battles at sea. |
| | Increasing potential for post-medieval shipwrecks associated with continuing local trade and marine exploitation including the transport of goods associated with the agricultural revolution. |
| | Increasing potential for timber structures within the foreshore of Tilbury Fort relating to drainage, defensive positions and maritime activity associated with the construction and supplying of the fort. |

| Period | Summary |
|---|---|
| 1816 to 1913 AD | Increasing potential for the discovery of shipwrecks associated with the introduction of iron and later steel in shipbuilding techniques. Such vessels may also be representative of other fundamental changes associated with the industrial revolution, particularly with regards to propulsion and the emergence of steam propulsion and the increasing use of paddle and screw propelled vessels. |
| | Potential for the discovery of shipwrecks demonstrating a diverse array of vernacular boat types evolved for use in specific environments. |
| | Potential for wrecks associated with large scale worldwide trade, the fishing industry or coastal maritime activity including marine exploitation. |
| | Potential for timber structures within the foreshore of Tilbury Fort relating to drainage, defensive positions and maritime activity associated with the construction and supplying of the fort. |
| 1914 to 1945 AD | Potential for the discovery of shipwrecks associated with the two world wars including both naval vessels and merchant ships. Wrecks of this period may also be associated with the increased shipping responding to the demand to fulfil military requirements. A large number of vessels dating to this period were lost as a result of enemy action. |
| Post 1946 | Potential for wrecks associated with a wide range of maritime activities, including military, commerce, fishing and leisure. Although ships and boats of this period are more numerous, losses decline due to increased safety coupled with the absence of any major hostilities. Vessels dating to this period are predominantly lost as a result of any number of isolated or interrelated factors including human error, adverse weather conditions, collision with other vessels or navigational hazards or mechanical faults. |

Aviation Potential

5.4.26 A Recorded Loss of a single aircraft crash is listed in the National Record of the Historic Environment (NRHE) records: that of a Mk VI de Havilland Mosquito fighter bomber (**WA 1042**) which crashed in the area in 1944. The precise location of the crash site is unknown and so potentially could be within the Development Area'. The Mosquito was built almost entirely of moulded wood and so is likely to be very broken up.

5.4.27 There is the potential for aircraft crash sites, or debris associated with aircraft crash sites, to be uncovered. These would particularly relate to the Second World War, with the high amount of Allied and Axis air traffic over this area during the Battle of Britain, Blitz and bombing of Germany. This includes both Allied aircraft on operations to the Continent and Axis aircraft on operations to London, the east of England and the east coast shipping channels (Firth 2014). There is also potential, although not as high for pre- and post-Second World War aircraft crashes in the area. These sites often have poor/non-existent locational data of crashes, particularly in water or lowly-populated areas such as the south Essex Marshes, in general due to poor weather conditions, inaccurate reporting or a lack of survivors and witnesses. Previous reports into aircraft archaeology in the UK have noted that it is likely that over 10,000 aircraft have crashed in UK waters since the advent of flight in the early 20th Century (Wessex Archaeology 2008b: 18). Due to high population levels and the predominance of world war activity in the area, the Thames estuary can be considered to have a significant number of these losses. The potential for currently unknown aircraft remains should therefore be seen as low to medium.

5.4.28 There is therefore potential for the presence of aviation material dating from the early 20th century until more recent times, with a concentration dating to the World Wars and in particular the Second World War and are summarised by general period ranges in **Table 2** below. Discoveries may occur anywhere within the study area, but are likely to increase nearer the coastlines.

**Table 2:** Summary of aviation potential by period within the Study Area

| Period | Summary |
|---|---|
| Pre-1939 | Minimum potential for material associated with the early development of aircraft. Aircraft of this period may represent early construction techniques (e.g. those constructed of canvas covered wooden frames) or may be associated with the mass-production of fixed wing aircraft in large numbers during the First World War. |
| | Minimum potential for material associated with the development of civil aviation during the 1920s and 1930s, with the expansion of civilian flight from the UK to a number of European and worldwide destinations. |
| 1939 to 1945 | High potential for Second World War aviation remains, particularly as the study area was a hub for hostile activity. Aircraft of this period are likely to be representative of technological innovations propelled by the necessities of war that extended the reliability and range of aircraft. |
| Post-1945 | Potential for aviation remains associated with military activities dominated by the Cold War, the evolution of commercial travel and recreational flying and the intensification of offshore industry (including helicopter remains). Aircraft of this period may be representative of advances in aerospace engineering and the development of the jet engine. |

# 6 POTENTIAL IMPACTS

## 6.1 Impacts on marine archaeology

6.1.1 The following aspects of the project have the potential to adversely affect marine and intertidal archaeology within the Tilbury 2 Site. No impacts have been identified during operation of the jetty and associated activities. For each aspect the assessment has considered the different project aspects which could cause the impact and from these selected the worst-case zone of influence; presented in **Table 3**. For piling operations, the worst-case zone of influence would be multipile displacement type foundations, which range from a cumulative area of disturbance from a minimum of *c.*14.64 $m^2$ (three *c.*1.22 m diameter piles for each fender with disruption to area 4 times area of pile – as described in Historic England 2015a) to a maximum of *c.*58.56 $m^2$ (twelve *c.*1.22 m diameter piles per berthing dolphin with disruption to area four times area of pile- as described in Historic England 2015a) as set out in the Atkins piling note in Technical Appendix 12A AS7. This is particularly true of the soft fine sediments within the Thames riverbed. Should replacement piling techniques or monopile foundations be used, the zone of influence for piling would be reduced.

6.1.2 As noted in **Section 1.2.10** the worst-case scenario in terms of impact for the dredging works would be the use of WID dredging, although all dredging techniques require the full removal of sediments from within the dredge pockets, which may contain or be supporting archaeological receptors.

**Table 3:** Impact zone of influence- marine archaeology

| Project Phase | Aspect | Potential Impact | Receptor | Zone of Influence |
|---|---|---|---|---|
| Construction | Dredging (WID, backhoe or a combination of the two) | Direct disturbance to seabed | Potential riverbed prehistory receptors | 30-50 m |
| | | | Potential maritime and aviation receptors | 30-50 m |
| | | | Geophysical anomalies of possible anthropogenic origin | 30-50 m |
| | | | Currently unknown archaeological sites and artefacts | 30-50 m |
| Construction | Piling foundations/supports for dolphins and jetty uprights | Direct disturbance to buried archaeological remains and associated sediments | Potential riverbed and intertidal prehistory receptors, maritime receptors and aviation receptors | 15-60 m cumulative influence depending of pile arrangement |
| Construction | Sheet piling revetment wall to revet riverbed to north of eastern dredge pocket. 330 m long and 25 m high. | Direct disturbance to buried archaeological remains and associated sediments | Potential riverbed and intertidal prehistory receptors, maritime receptors and aviation receptors | 2-10 m either side along its 330 m length |
| Construction | Dredging (WID, backhoe or a combination of the two) | Indirect changes to sedimentary regimes due to removal of sediment | Potential riverbed prehistory receptors | Judged to be minor and localised in HR Wallingford 2017 |

| Project Phase | Aspect | Potential Impact | Receptor | Zone of Influence |
|---|---|---|---|---|
| | | | Potential maritime and aviation receptors | Judged to be minor and localised in HR Wallingford 2017 |
| | | | Geophysical anomalies of possible anthropogenic origin | Judged to be minor and localised in HR Wallingford 2017 |
| | | | Currently unknown archaeological sites and artefacts | Judged to be minor and localised in HR Wallingford 2017 |

6.1.3 Both direct and indirect impacts may damage, disturb or destroy archaeological receptors that include riverbed and intertidal prehistory, shipwreck and/or aviation remains.

## 6.2 Direct impacts

6.2.1 Archaeological receptors may be buried within seabed sediments, particularly preserved within the finer-grained sediments of the Thames Estuary riverbed, or may rest upon the seafloor, either with or without height. As such, direct impacts to these receptors can occur during any development or related activity that makes contact with the sea floor or cuts through seabed deposits. Archaeological receptors with height, such as wrecks, may also be impacted by development or activities that occur within the water column (discussed below); these seabed morphologies may offer increased preservation potential for unknown cultural heritage receptors.

6.2.2 Construction activities have the potential to have the following direct impacts; which are listed below along with an indication of the effect on the receptor:

- *Dredging of riverbed sediments, removing either archaeological material or the supporting sediment around archaeological material;*
- *Piling of new berthing dolphins and jetty access damaging or removing buried in situ archaeological remains; and*
- *Sheet piling of riverbed revetment wall along 330 m of northern side of eastern dredge pocket and associated potential tiebacks to riverbed damaging or removing in situ archaeological remains.*

6.2.3 Operational activities have the potential to have the following direct impacts, which are listed below along with an indication of the effect on the receptor:

- *Maintenance dredging of riverbed sediments following build up during operation of the jetty, removing archaeological material which has been redeposited in the sediments from elsewhere*

## 6.3 Indirect impacts

6.3.1 Potential indirect impacts arise when direct impacts have effects beyond their primary footprint and can affect archaeological sites or material some distance away. Indirect impacts can include changes to erosion patterns, sediment transport, currents and water quality during installation, caused by the direct impacts listed above. In general, archaeological receptors exposed to marine processes will deteriorate faster than those

buried within seabed sediments. Aspects of the project works that result in increased sediment cover may afford additional protection to archaeological receptors, thereby causing a positive beneficial effect.

6.3.2 However, aspects of the Development that result in increased scouring or removal of sediment cover may expose previously buried receptors thereby increasing the rate of deterioration.

6.3.3 Construction activities have the potential to have the following indirect impacts; which are listed below along with an indication of the effect to the receptor:

- *Changes to the hydrodynamic and sedimentary regimes due to spoil removal and distribution caused by dredging operations – increased protection to, or deterioration through erosion of, receptors resulting in a positive or negative effect on receptors in the vicinity.*
- *Should dispersal dredging be used, there is the potential for large quantities of dispersed sediment to accumulate elsewhere, which may adversely or positively affect archaeological receptors outside the study area*

## 6.4 Significance of impacts

6.4.1 Due to the fragile and non-renewable nature of the marine archaeological receptors on and/or under the seabed, any direct impacts have the potential to be permanent and negative. As a result, and in the absence of appropriate mitigation, both the sensitivity and the magnitude of direct impacts on such resources will automatically be considered high resulting in major negative impact significance. Appropriate mitigation is necessary to reduce this.

6.4.2 The report into the hydrodynamics and sediment movement of the Study Area by HR Wallingford (2017) has noted that the effects on both of these are likely to be minor and local, with the majority of sediment change being the berthing pockets filling up with fine sediments again. The origin of this sediment is likely to be from tidal movements bringing in sediment from outside the Study Area; as the Wallingford study shows minimal changes in either accretion or erosion within the foreshore, intertidal or riverbed zones within the Study Area. Therefore, the magnitude of indirect impacts discussed above should be regarded as low, resulting in negligible impacts on archaeological receptors. Current levels of sediment are shown in the Environment Agency LiDAR survey from 2016 presented in **Figure 6**.

# 7 MITIGATION

## 7.1 Introduction

7.1.1 This section provides an overview of the mitigation for each of the receptor types. Eleven mitigation measures proposed are listed in **Table 4**. More detailed information about the types of mitigation and the way they will be implemented for currently unknown receptors that may be encountered during works can be found in the Scheme of Investigations (**Section 9**).

**Table 4:** Mitigation measures

| **Proposed Mitigation Measures** |
|---|
| **1:** A Protocol, similar to the established Protocol for Archaeological Discoveries: Offshore Renewables Projects (The Crown Estate 2014) and the Marine Aggregate Industry Protocol for the Reporting of Finds of Archaeological Interest (BMAPA and Historic England 2005), will be established for the construction phase of the project, including the pre-dredge surveys and sampling. The Protocol provides a system for reporting and investigating unexpected archaeological discoveries encountered during the course of the project. The aim of the Protocol is to reduce any adverse effects of the development upon the historic environment by enabling project staff, contractors and sub-contractors to report finds in a manner that is both convenient to their every-day work and effective with regard to curatorial requirements. Archaeological discoveries reported via the Protocol may include submerged prehistoric material, shipwreck material or aviation material. The Protocol will also make provision for the institution of temporary exclusion zones around areas of possible archaeological interest, for prompt archaeological advice and, if necessary, for archaeological inspection of important features prior to further works in the area. This may include a watching brief, diver inspection and/or diver/ROV assisted lifts, as outlined elsewhere in this section.<br><br>**The Protocol is outlined in Sections 9.8, 9.13 and 9.14. It should be applied to all works when a suitably qualified archaeologist is not present on site and requires awareness training for all contractors involved in relevant work. All contractors should be made aware of their contractual obligations through the Protocol.** |
| **2:** A proportion of the medium and low potential geophysical anomalies (agreed in discussion with Historic England and outlined in an action-specific Method Statement) will be investigated, either as part of the UXO clearance, through non-archaeological diver investigation for those considered potential UXO, or through grab sampling or targeted backhoe excavation for those considered potential archaeology, with archaeological assessment of any footage or still image of each receptor. All divers carrying out this work will be fully briefed by a qualified WA archaeologist for the range of potential archaeological finds, and their responsibilities as part of the Protocol for Archaeological Discoveries, so that they can describe objects which may be of archaeological significance, should poor visibility make it impossible to view the footage. It is possible that these anomalies could represent important archaeological material; however, they may also represent modern debris of no archaeological significance. Equally the receptor may be buried and not extant during the survey, although the use of grab sampling or targeted backhoe excavation may help to uncover them. ROVs are not anticipated to be of use due to the extremely poor visibility within the Thames. Following investigation of each receptor, three options for further mitigation will be implemented:<br>• Should the receptor not have an archaeological potential, there will be no need for further mitigation;<br>• Should the receptor be a Minor or Intermediate Archaeological Find (as set out in **Section 9.13**), methods for recovering and recording the receptor should be outlined in a specific Method Statement; and<br>• Should the receptor be a Major Archaeological Find (as set out in **Section 9.13**), then an Archaeological Exclusion Zone (AEZ) should be implemented around it, or, if the location |

| Proposed Mitigation Measures |
|---|
| of the receptor renders it necessary, a Temporary Exclusion Zone (TEZ) will be implemented around it until full recovery and recording has taken place, as outlined in a specific Method Statement.<br>For both proposed dredging methodologies this mitigation will be required to be fully completed prior to any commencement of dredging. Archaeological assessment of the footage will be the subject of a further task-specific Method Statement, to be approved by Historic England. This mitigation is based on guidelines on the investigation and ground-truthing of anomalies as set out in *The Assessment and Management of Marine Archaeology in Ports and Harbours* (Gane and Cooper 2016).<br><br>**See Appendices I and II. The proportion and method of sampling will be agreed in discussion with the Client and Historic England.** |
| **3:** Preservation of archaeological remains *in situ*, as the primary option for mitigation, can be achieved through the implementation of Archaeological Exclusion Zones (AEZs) and Temporary Exclusion Zone (TEZs). AEZs are permanent exclusion zones which will remain in place to protect archaeological receptors which are to be kept in situ. TEZs are temporary exclusion zones to protect archaeological receptors while an appropriate mitigation programme (recording, excavation and/or recovery/removal) is completed on them, after which the Exclusion Zone can be removed or modified. The mitigation will establish appropriately sized AEZs around receptors which, following diver inspection, have been considered to be of **High** archaeological potential, in consultation as expediently as possible with Historic England. These areas would be out of bounds to dredging activities and to anchored Jack Up and Spud Leg barges. Monitoring of any AEZs to ensure there is no disturbance to them will be part of this mitigation.<br><br>**There are currently no AEZs recommended within the dredge area.** |
| **4:** Recovery of artefacts and/or other archaeological receptors should be a final resort, when all other mitigation has failed. Any recovery should be completed under the supervision of an appropriately trained/experienced archaeologist. Safe archaeological recovery can take many forms, from clamshell grabs of individual artefacts to ROV collection to full diver assisted lifts. Due to the vast differences in practice and implementation between these methods, each will be covered by a specific Method Statement, approved by the Archaeological Curator, should they be implemented.<br><br>**Archaeological recovery could be implemented on Minor and Intermediate Archaeological Finds, and on Major Archaeological Finds if AEZ mitigation proves unfeasible.** |
| **5:** It is recommended that a systematic programme of sampling of the alluvial riverbed sediments and their buried archaeological potential which may contain potential archaeological receptors is undertaken across the dredging area prior to any dispersal dredging works being completed, excluding the area of identified contaminated ground (see below). The strategy will be defined and outlined in a task specific Method Statement and will be clear as to what is to be targeted, as identified by geophysical survey or diver survey or at systematically defined sample points. This would allow for the potential recovery of unknown and buried marine archaeology which would be lost during dispersal dredging, while also potentially identifying previously unknown concentrations of archaeological material. Should Minor and Intermediate Archaeological Finds be recovered, a Watching Brief will be initiated to allow recovery of these. Should Major Archaeological Finds be recovered during this sampling then mitigation will either revert to AEZ/TEZ mitigation, as discussed above, or into a Watching Brief to allow full recovery and recording. This would be repeated following the removal of an agreed depth of sediment (e.g. 0.75m) until the required depth of the dredge pocket, or when the transition with the river terrace deposits below is established, whichever is reached first. The sampling strategy and methodology would be outlined in a further task specific Method Statement, and will be based on a strategy of systematic sampling of the dredge areas agreed in discussion with Historic England. This would inform any later watching brief or further investigation by dive teams to access any discoveries. This |

| Proposed Mitigation Measures |
|---|
| mitigation would operate prior to a dredging watching brief and the use of a Protocol for Archaeological Discoveries. It is based on guidelines on ground-truthing of anomalies as set out in *The Assessment and Management of Marine Archaeology in Ports and Harbours* (Gane and Cooper 2016).<br><br>**The sampling programme requirements will be set out in an activity-specific Method Statement in advance of any dredging works.** |
| **6:** Due to the contaminated nature of the sediment within the identified area in the east of the approach dredging pocket (**Figure 2**) it will not be possible to conduct mitigation on the removal of the sediment, as it must be removed in a closed bucket and transferred to a closed barge. Depending on further tests and adequate risk assessment, it may be possible for Wessex Archaeology staff to conduct artefact recovery from this material, given adequate controls. It may however be necessary for processes to be used on the material to decontaminate it which would entirely remove any archaeological potential. This is unavoidable.<br><br>**Artefactual recovery would only be completed under adequate risk assessment and with all recommended safety and environmental controls in place.** |
| **7:** Following the results of the sampling programme, 'safe areas' for the anchoring of dredgers, barges and Jack Up/Spud Leg barges will be identified which contain no known archaeological receptors to ensure no surface/near surface archaeological receptors are damaged by this action.<br><br>**'Safe areas' for anchoring will be located away from any active AEZs and in areas where geophysical anomalies with archaeological potential have been checked and proved non-archaeological.** |
| **8:** A formal programme of archaeological monitoring in the form of a watching brief on board will be conducted during all open bucket backhoe dredging work close to identified receptors of archaeological potential (excluding those within the area of contaminated sediment) attended by a suitably qualified archaeologist. The purpose of a watching brief is to safeguard, to as great a degree as possible, any potential archaeological sites that may exist in this area. Watching brief activities will be conducted in accordance with the standards outlined in the CIfA's Standard Guidance for an archaeological watching brief (CIfA 2014a). This mitigation would occur following grab/targeted backhoe excavation sampling mitigation outlined above and prior to the establishment of a Protocol for Archaeological Discoveries, as detailed below.<br><br>**The dredging watching brief programme requirements will be set out in an activity-specific Method Statement in advance of any dredging works.** |
| **9:** A formal programme of archaeological monitoring in the form of a watching brief will be conducted during all construction work in the intertidal zone for the construction of the Ro-Ro off-ramp and proposed surface water outfall to ensure any potential archaeological deposits, particularly of Mesolithic date, are identified and recorded. This work is likely to include excavation pits at the pile locations for the Ro-Ro ramp supports as well as the excavation of the channel for the surface water outfall, as shown on Figure 2. This work would be conducted during periods when these areas were uncovered by the tide, to enable any archaeological remains present to be identified and recorded in safety by a suitably qualified archaeologist employed or contracted by Wessex Archaeology. The purpose of a watching brief is to safeguard, to as great a degree as possible, any potential archaeological sites that may exist in this area. Watching brief activities will be conducted in accordance with the standards outlined in the CIfA's Standard Guidance for an archaeological watching brief (CIfA 2014a).<br><br>**The intertidal watching brief programme requirements will be set out in an activity-specific Method Statement in advance of any construction work in the intertidal zone.** |

| Proposed Mitigation Measures |
|---|
| **10:** Archaeological assessment of the post-dredge marine geophysical surveys will be completed to ensure that any archaeological remains exposed by the removal of sediment in the dredge are identified and protected by AEZs for the maintenance dredge programme during the operational phase of the Development. Should an archaeological receptor be identified, it will be decided through consultation with Historic England whether it should be lifted or whether an AEZ should be placed around it, with all future programmes of work being made aware of it.<br><br>**The standards and processes of archaeological assessment of marine geophysical survey are outlines in Section 9.6.** |
| **11:** A second Protocol similar to the established Protocol for Archaeological Discoveries: Offshore Renewables Projects (The Crown Estate 2014) and the Marine Aggregate Industry Protocol for the Reporting of Finds of Archaeological Interest (BMAPA and Historic England 2005) will be established for the operation and maintenance phase of the project. The Protocol provides a system for reporting and investigating unexpected archaeological discoveries encountered during the course of any maintenance dredging conducted during the life of the development. The aim of the Protocol is to reduce any adverse effects of the maintenance dredging on the historic environment by enabling project staff, contractors and sub-contractors to report finds in a manner that is both convenient to their every-day work and effective with regard to curatorial requirements. Archaeological discoveries reported via the Protocol may include submerged prehistoric material, shipwreck material or aviation material. The Protocol will also make provision for the institution of TEZ's around areas of possible archaeological interest, for prompt archaeological advice and, if necessary, for archaeological inspection of important features prior to further works in the area.<br><br>**The Protocol is outlined in Sections 9.8, 9.13 and 9.14. It should be applied to all maintenance dredging works when a suitably qualified archaeologist is not present on site and requires awareness training for all contractors involved in relevant work during maintenance dredging. All contractors should be made aware of their contractual obligations through the Protocol.** |

7.1.2 The three dredging technique scenarios outlined in **Section 1.2.9** would each require different combinations of these mitigation measures. These are outlined below in Table 5.

**Table 5:** Mitigation measures for different dredging scenarios

| Dredging scenario | Mitigation measures |
|---|---|
| WID dredging only | 1: Implementation of a Protocol for Archaeological Discoveries, with full awareness training for all appropriate contractors. Records of training to be kept and passed on to Client.<br>2: Pre-dredge investigation of geophysical anomalies with archaeological potential through diver inspection, grab sampling or targeted excavation with a backhoe excavator.<br>3: Implementation of AEZs to protect known archaeological receptors<br>4: Recovery of archaeological material as a last resort, if AEZ mitigation is not feasible.<br>5: Systematic grab sampling or targeted backhoe excavation sampling of the alluvial sediments, both prior to dredging beginning and then repeat sampling of up to 30 sampling points in each berth dredging pocket after an agreed depth of sediment (e.g. 0.5-0.75m) has been removed. This would be conducted in one berth dredging pocket while the dredger was removing the next spit of sediment from the other, allowing overall dredging operations to continue without pause.<br>7: Identification and use of 'safe areas' for anchoring. |

| Dredging scenario | Mitigation measures |
|---|---|
| | 9: Intertidal watching brief for all works in the intertidal zone.<br>10: Archaeological Assessment of the post-dredge geophysical surveys |
| Backhoe excavator dredging only (open and closed bucket) | 1: Implementation of a Protocol for Archaeological Discoveries, with full awareness training for all appropriate contractors. Records of training to be kept and passed on to Client.<br>2: Pre-dredge investigation of geophysical anomalies with archaeological potential through diver inspection, grab sampling or targeted excavation with a backhoe excavator.<br>3: Implementation of AEZs to protect known archaeological receptors<br>4: Recovery of archaeological material as a last resort, if AEZ mitigation is not unfeasible.<br>5: (Only in the event of closed bucket/closed barge) Systematic grab sampling or targeted backhoe excavation sampling of the alluvial sediments, both prior to dredging beginning and then repeat sampling of up to 30 sampling points in each berth dredging pocket after an agreed depth of sediment (e.g. 0.5-0.75m) has been removed. This would be conducted in one berth dredging pocket while the dredger was removing the next spit of sediment from the other, allowing overall dredging operations to continue without pause.<br>6: Investigation of contaminated sediments for artefactual recovery only if material has been decontaminated to a safe level and work has been fully risk assessed.<br>7: Identification and use of ‘safe areas’ for anchoring.<br>8: (If open bucket/barge backhoe dredging is used) A watching brief onboard the spoil barges for all open bucket backhoe excavator dredging completed in the vicinity of identified anomalies, excluding those in the area of contaminated sediment.<br>9: Intertidal watching brief for all works in the intertidal zone.<br>10: Archaeological Assessment of the post-dredge geophysical surveys |
| Combination of WID dredging and backhoe dredging | 1: Implementation of a Protocol for Archaeological Discoveries, with full awareness training for all appropriate contractors. Records of training to be kept and passed on to Client.<br>2: Pre-dredge investigation of geophysical anomalies with archaeological potential through diver inspection, grab sampling or targeted excavation with a backhoe excavator.<br>3: Implementation of AEZs to protect known archaeological receptors<br>4: Recovery of archaeological material as a last resort, if AEZ mitigation is not unfeasible.<br>5: Systematic grab sampling or targeted backhoe excavation sampling of the alluvial sediments, both prior to dredging beginning and then repeat sampling of up to 30 sampling points in each berth dredging pocket after an agreed depth of sediment (e.g. 0.5-0.75m) has been removed. This would be conducted in one berth dredging pocket while the dredger was removing the next spit of sediment from the other, allowing overall dredging operations to continue without pause.<br>6: Investigation of contaminated sediments for artefactual recovery only if material has been decontaminated to a safe level and work has been fully risk assessed.<br>7: Identification and use of ‘safe areas’ for anchoring.<br>8: A watching brief onboard the spoil barges for all open bucket backhoe excavator dredging completed in the vicinity of identified anomalies, excluding those in the area of contaminated sediment.<br>9: Intertidal watching brief for all works in the intertidal zone. |

| Dredging scenario | Mitigation measures |
|---|---|
| | 10: Archaeological Assessment of the post-dredge geophysical surveys |

# 8 METHOD STATEMENTS

8.1.1 This WSI provides an overarching framework for archaeological investigations for the Tilbury 2 Site, following consultation with Historic England. More specific details on investigations relating to archaeological analysis or works, detailed in the Scheme of Investigations in **Section 9**, will be contained within detailed individual Method Statements. These will be produced and submitted as required.

8.1.2 Method Statements will be prepared in consultation with Historic England, as the Historic Environment advisor to the MMO, or the appropriate local authority and then provided to PoTLL for comment. On receipt of comments from PoTLL and related updates, Method Statements will then be submitted to Historic England for further comment and approval, within 15 working days of receipt of the document. The approved WSI will then be submitted to the MMO for approval 6 weeks prior to any works commencing. Such Method Statements will include provision for Historic England where appropriate to monitor the progress of the archaeological works, as appropriate to that element, be that through site visits or meetings with PoTLL, the Contractor(s), and Wessex Archaeology.

8.1.3 Where appropriate, all contractors and sub-contractors will be sent the approved Archaeological Method Statements including the results of any relevant archaeological surveys prior to work commencing.

8.1.4 In the event that detailed specific archaeological analysis of survey data and reports is deemed necessary by Wessex Archaeology an archaeological Method Statement will be produced to correspond to a package of works, for example, archaeological assessment of marine geophysical data, archaeological investigation using divers or a watching brief in the intertidal zone.

8.1.5 No package of construction work can commence until the archaeological mitigation measures have been implemented in accordance with the separate task specific Method Statements approved by the MMO and their advisors at Historic England.

8.1.6 Method Statements will provide details about:

- *Relation between the Method Statement, the WSI and the licence condition(s);*
- *Context in terms of relevant construction works;*
- *Specific objectives of archaeological works;*
- *Extent of investigation;*
- *Investigation methodology;*
- *Anticipated post-investigation actions, including processing, assessment and analysis of finds and samples;*
- *Reporting;*
- *Timetable;*
- *Monitoring arrangements; and*
- *Health, safety and welfare.*

8.1.7 As noted in **Section 12** below Wessex Archaeology will undertake review of the survey data and reports produced by the survey contractor and produce an interpretive report. As Wessex Archaeology will have the opportunity to advise on survey methods and reporting requirements it is expected that the need for detailed archaeological analysis of raw data and/or reprocessing of data will be limited.

**The following Scheme of Investigations provides a structure for implementing any additional mitigation that may subsequently be required in response to unexpected discoveries during construction, operation and decommissioning phases of the project. It is drawn from relevant guidance, as referenced below**

# 9 SCHEME OF INVESTIGATIONS

## 9.1 Introduction

9.1.1 The Mitigation section above provided a brief overview of the types of further archaeological investigations recommended for identified High, Medium and Low archaeological receptors, unknown, and riverbed prehistory and other archaeological receptors (Wessex Archaeology 2017b; 2017c; 2017e). The Scheme of Investigations section sets out how these investigations will be undertaken.

9.1.2 The RA (Wessex Archaeology) will provide input on any appropriate proposed Method Statements from other contractors on the Project to ensure data collection is optimised so that it can be used to identify features of archaeological importance that could be impacted by the Project and inform mitigation proposals such as avoidance of wrecks and wreck debris.

## 9.2 Standards and Guidance

9.2.1 The Method Statements and specifications in this document are based on archaeological best practice and guidance for ports and harbour development. The principal source is *The Assessment and Management of Marine Archaeology in Ports and Harbours* (Gane and Cooper 2016. Additional sources are:

- *Dredging and Port Construction: Interactions with Features of Archaeological or Heritage Interest, PIANC Guidance Document No. 124-2014 (PIANC 2014);*
- *Marine Aggregate Industry's Protocol for Reporting Finds of Archaeological Interest (BMAPA and Historic England 2005).*
- *Identifying and Protecting Palaeolithic Remains: Archaeological Guidance for Planning Authorities and Developers (Historic England 1998);*
- *Managing Lithic Scatters: Archaeological Guidance for Planning Authorities and Developers (Historic England 2000);*
- *Military Aircraft Crash Sites: Guidance on their Significance and Future Management (Historic England 2002);*
- *The Code of Practice for Seabed Developers (Joint Nautical Archaeology Policy Committee and The Crown Estate 2006);*
- *Conservation Principles, Policies and Guidance for the Sustainable Management of the Historic Environment (Historic England 2008);*
- *Our Seas – A Shared Resource: High Level Marine Objectives (Department for Environment, Food and Rural Affairs 2009);*
- *Ships and Boats: Prehistory to Present – Designation Selection Guide (Historic England 2012); and,*
- *Marine Geophysics Data Acquisition, Processing and Interpretation Guidance Notes (Bates et al. 2013).*

9.2.2 As Gane and Cooper 2016 does not include guidance on intertidal and marine archaeological watching briefs, the guidance for these is taken from *Model Clauses for Archaeological Written Schemes of Investigation: Offshore Renewables Projects* (The Crown Estate 2010).

9.2.3 The scheme of investigation outlined below includes guidance outlining the requirements and expected standards in relation to:

- *recording, reporting, data management and archiving;*
- *samples and artefacts;*
- *marine geophysical investigations;*
- *marine geoarchaeological investigations;*
- *investigations using divers;*
- *Ground-truthing and targeted excavations/grab-sampling;*
- *watching briefs; and*
- *the Protocol for Archaeological Discoveries (PAD)*

## 9.3 Overview

9.3.1 The format and content of this WSI will be prepared and agreed with the MMO as the marine Licensing Authority, and their advisors at Historic England in advance of the provision of the Development Consent Order. Subsequent task specific Method Statements will be agreed with PoTLL, Historic England and the MMO following provision of the DCO.

9.3.2 The scope of each Method Statement will be informed by the results of any previous archaeological work undertaken as outlined in **Section 5** above. Approval by the Archaeological Curator(s) will be assumed if no contrary response is received within 15 working days of submission of individual Method Statements.

## 9.4 Structure of proposed investigations

9.4.1 The following Scheme of Investigations has been devised to be implemented along the three dredging scenarios outlined in **Section 1.2.9**: the use of Water Injection Dispersal dredging solely; the use of Backhoe Dredging solely (both open and closed bucket); or a combination of the two.

9.4.2 Should Water Injection Dispersal (WID) dredging or closed bucket/barge backhoe dredging be chosen as the primary dredging technique then the workflow for the investigations will consist of:

- *Prior to any dredging works all relevant contractors will be briefed by Wessex Archaeology on the use of a PAD and the appropriate system of contacts set up (see **Section 9.13**);*
- *the ground-truthing of identified geophysical anomalies not part of the UXO clearance, conducted after the UXO clearance works through ground truthing by diver inspection, grab sampling or targeted backhoe excavation (see **Section 9.9**);*
- *systematic sampling of the dredge areas using further grab sampling or targeted excavation (see **Section 9.10**) to investigate the potential for archaeological deposits within the river bed sediments;*
- *Should any archaeological deposits be discovered during the grab sampling then they will either be further investigated through diver inspection and if deemed necessary protected using an AEZ, or lifted depending on their level of importance (see **Appendix VII**).*
- *The dredging would then begin in one of the berth pockets. Given that several metres of alluvial sediment are planned to be removed, it is noted that further systematic sampling of each berth dredging pocket through grab sampling/targeted backhoe excavation may be required following the removal of an agreed depth of*

*sediment. This would occur once the dredger has removed the specified depth of sediment, at which point it would move to the other berth dredge pockets to dredge that area while the newly uncovered sediments were investigated by grab sampling/targeted backhoe excavation. This should allow a near continuous period of dredging, provided archaeological material is not encountered.*

- *A final post-dredge geophysical survey will be archaeologically assessed for any material, wrecks or structures which may have been exposed by the dredge, to inform any AEZs required for the maintenance dredging.*

9.4.3 Should open bucket backhoe dredging be used, the workflow will be as follows:

- *Prior to any dredging works all relevant contractors will be briefed by Wessex Archaeology on the use of a PAD and the appropriate system of contacts set up (see **Section 9.13**);*
- *the ground-truthing of identified geophysical anomalies not part of the UXO clearance, conducted after the UXO clearance works through ground truthing by diver inspection, grab sampling or targeted backhoe excavation (see **Section 9.9**);*
- *an archaeological watching brief onboard the accompanying barges (see Section 9.11) for areas identified as having archaeological potential through their proximity to receptors from the geophysical surveys. A sampling strategy based on the gridding (the screening of material through an iron/steel grid of agreed size placed over a section of the open hull of a spoil barge) of one bucket in every 10 or similar will be agreed in consultation with Historic England.*
- *Should any archaeological deposits be discovered during the watching brief then they will either be further investigated through diver inspection and if deemed necessary protected using an AEZ, or lifted depending on their level of importance (see **Appendix VII**).*
- *The dredging would then begin in one of the berth pockets. Given that several metres of alluvial sediment are planned to be removed, it is noted that further systematic sampling of each berth dredging pocket through grab sampling/targeted backhoe excavation may be required following the removal of an agreed depth of sediment. This would occur once the dredger has removed the specified depth of sediment, at which point it would move to the other berth dredge pockets to dredge that area while the newly uncovered sediments were investigated by grab sampling/targeted backhoe excavation. This should allow a near continuous period of dredging, provided archaeological material is not encountered.*
- *A final post-dredge geophysical survey will be archaeologically assessed for any material, wrecks or structures which may have been exposed by the dredge, to inform any AEZs required for the maintenance dredging.*

9.4.4 The applied investigations for both dredge techniques will be completed in addition to the system of recording set out in **Section 9.5**, the intertidal watching brief works set out in **Section 9.12,** and the Awareness Training set out in **Section 9.8**, as well as any further geoarchaeological assessments deemed necessary (**see Section 9.7**)

## 9.5 Archaeological Reporting, Data Management and Archiving

*Relevance and Application: Tilbury 2 Proposals*

9.5.1 Each package of archaeological works will be accompanied by written reports pursuant to the requirements of those works and demonstrating appropriate planning, recording and data management and commitment to archiving and public dissemination of results.

9.5.2 For all aspects of recording, reporting, data management and archiving PoTLL will adhere to standards and guidance as set out in CIfA 2014b.

9.5.3 Key points relevant to recording, reporting, data management and archiving are included below.

*Reports*

9.5.4 Each package of work will give rise to one or more Archaeological Reports, as set out in the Method Statement relating to the work.

9.5.5 Each Archaeological Report will satisfy the Method Statement for the investigation and will present the project information in sufficient detail to allow interpretation without recourse to the project archive.

9.5.6 Archaeological reports will be prepared in accordance with the guidance given in the relevant CIfA Standards and Guidance document (CIfA 2014b). Reports will typically include:

- *a non-technical summary;*
- *the aims and methods of the work;*
- *the results of the work including finds and environmental remains;*
- *a statement of the potential of the results;*
- *proposals for further analysis and publication; and*
- *illustrations and appendices to support the report.*

9.5.7 Illustrations will include a plan of the area subject to investigation in relation to the development scheme.

9.5.8 Each Archaeological Report will be submitted in draft to PoTLL by Wessex Archaeology or their sub-contractors through Wessex Archaeology. Upon approval by PoTLL, Archaeological Reports will be submitted to the archaeological curator for approval within 4 weeks of completion of each phase of fieldwork and their agreement/acceptance will be assumed if no contrary response is received within 15 working days of submission. Once approved by the Archaeological Curator the final report will be submitted to the MMO.

9.5.9 On completion of all archaeological works relating to construction of the scheme and to a timetable agreed with PoTLL and Historic England, an overarching report on the archaeology of the scheme will be prepared.

9.5.10 Except where further analysis and publication are to take place (see below), a note based on the overarching report should be published in at least one appropriate peer-reviewed local, national, thematic or period-based journal.

*Post-fieldwork Assessment*

9.5.11 Following the completion of construction of all relevant work, PoTLL will secure the implementation of all the post-construction archaeological work applicable to that relevant work.

9.5.12 Decisions regarding the scope of post-fieldwork assessment will be made by agreement between PoTLL and Historic England following submission of investigation reports, based

on the possible importance of the results in terms of their contribution to archaeological knowledge, understanding or methodological development.

9.5.13 The assessment phase may include (but is not limited to) the following elements:

- *the conservation of appropriate materials, including the X-raying of metalwork;*
- *the spot-dating of all pottery from any investigation. This will be corroborated by the scanning of other categories of material and may include scientific dating methods;*
- *the preparation of Site matrices with supporting lists of contexts by type, by spot-dated phase and by structural grouping supported by appropriate scaled plans;*
- *an assessment statement will be prepared for each category of material, including reference to quantity, provenance, range and variety, condition and existence of other primary sources; and*
- *a statement of potential for each material category and for the data set as a whole will be prepared, including specific questions that can be answered and the potential value of the data to local, regional and national investigation priorities.*

9.5.14 Once the final overarching assessment report has been approved by the MMO and any subsequent analysis of the finds is completed, important results will be published in a recognised peer-reviewed journal or as a monograph.

*Archiving*

9.5.15 Historic England and Wessex Archaeology will agree with the receiving institution a policy for the selection, retention and disposal of excavated material, and confirm requirements in respect of the format, presentation and packaging of archive records and materials, and will notify the receiving institution in advance of any fieldwork.

9.5.16 In England, the NRHE is the repository for fieldwork records. The NRHE operates a policy for the selection of records relating to sites of national importance. Wessex Archaeology must produce an OASIS (Online AccesS to the Index of archaeological investigationS') form for any completed and agreed archaeological reports produced as a result of this WSI and that a copy is submitted as a PDF file to Historic England's NRHE (oasis@english-heritage.org.uk) within 6 months of the completion of construction of the Development, and will notify the MMO and the relevant planning authority that the OASIS form has been submitted to the National Record of the Historic Environment within two weeks of submission .

## 9.6 Marine geophysical investigations

9.6.1 Geophysical surveys have already been undertaken for the proposals and these have been archaeologically assessed in a Marine Geophysics Archaeological Assessment Report (Wessex Archaeology 2017b).

9.6.2 No further geophysical surveys solely for archaeological purposes are planned, however, PoTLL will allow for archaeological involvement in the planning, acquisition and review of any further geophysical surveys, should any be undertaken. For all aspects of marine geophysical investigations, PoTLL will adhere to standards and guidance, as set out in Gane and Cooper 2016.

9.6.3 Further geophysical surveys, including pre- and post-dredge multi-beam echosounder (MBES) bathymetry surveys are planned, as well as the potential for re-survey of the dredge pockets following the removal of a defined depth of sediment. All of these will

require archaeological assessment to investigate the potential for archaeological receptors to be exposed by the dredge works. In particularly the post-dredge bathymetry survey will be used to investigate whether the final dredge has exposed riverbed features of archaeological potential which should be protected through AEZs during future maintenance dredging, and this will therefore form part of the mitigation for the operational phase of the Development.

*Marine Geophysical Investigations procedure*

9.6.4 Key points relevant to marine geophysical investigations are set out below.

9.6.5 The specification of any proposed marine geophysical survey whose primary aim is non-archaeological (i.e.: engineering or environmental) will be subject to advice from Wessex Archaeology to ensure that archaeological input is provided at the planning stage and to enable archaeological considerations to be taken into account without compromising the primary objective of the survey.

9.6.6 The archaeological input will take the form of advice from an appropriately qualified marine archaeologist on the following points:

- *Available details of sites and/or anomalies identified in the desk-based assessment;*
- *Archaeological potential of areas where no existing sites and/or anomalies are yet known;*
- *Geophysical sources/equipment;*
- *Methodologies, including spacing and orientation of lines and cross lines;*
- *Source/equipment settings; and*
- *Requirements for post-processing, interpreting and archiving resulting data*

9.6.7 Where archaeological objectives have been added to a survey whose primary objectives are non-archaeological, consideration will be given to having a suitably qualified marine archaeologist or marine geophysicist with appropriate archaeological expertise on-board during the acquisition of data. The on-board representative responsible for archaeology will advise on the suitability for archaeological purposes of the data being acquired and be able to propose, through communication with Wessex Archaeology, minor changes to the survey method, settings, etc., in order to optimise archaeological results, and thereby minimise the need for repeat surveys.

9.6.8 Where a survey is carried out primarily for archaeological purposes, the specification should be prepared by a suitably qualified marine archaeologist from Wessex Archaeology or their sub-contractors. In addition, the survey should be carried out by a survey company with appropriate archaeological expertise and including geophysicists with appropriate archaeological expertise on-board if required.

9.6.9 Data sources with the potential for identifying archaeological remains are as follows:

- *Sidescan data may identify wrecks and other related debris of all periods that lie (at least in part) above the surface of the seabed;*
- *Magnetometer data may identify wrecks and other related debris of all periods (though principally post-medieval and modern) on the surface of and under the seabed;*

- *Sub-bottom profiler data may identify features and deposits that relate to the topography of an area prior to its burial and inundation during the prehistoric period, and buried objects such as wrecks; and*
- *Bathymetry may be used to characterise wrecks and other related debris of all periods that lie (at least in part) on the surface of the seabed, and can be integrated with sub-bottom profiler data to calculate absolute depths.*

9.6.10 Any new survey data will be reviewed by Wessex Archaeology, and will be interpreted by an archaeologist with an appropriate level of expertise. If any further items of interest are identified, Historic England will be consulted prior to any changes to the mitigation strategy.

9.6.11 The results of further geophysical interpretation will be compiled as an Archaeological Report by Wessex Archaeology, consistent with the provisions on reporting within this WSI (**Section 9.5**) and with any appropriate Method Statements.

## 9.7 Marine and intertidal geoarchaeological investigations

9.7.1 A substantial amount of geoarchaeological work has already been completed within the Tilbury 2 Site. The latest programme of investigation was set out in a geoarchaeological Method Statement (Wessex Archaeology 2017d), forming a Stage 1 Assessment of the marine cores recovered from the Tilbury 2 Site, which allowed a deposit model of the Study Area to be completed. This assessment (Wessex Archaeology 2017e) found limited potential for Stage 2 Geoarchaeological sampling and assessment due to a lack of defined peat horizons and so recommended no further work to be conducted on the cores.

9.7.2 Further geoarchaeological investigation in the marine zone is therefore not recommended.

9.7.3 Any future geotechnical investigations within the intertidal zone will be monitored by Wessex Archaeology, in their role as Retained Archaeologist for the Development. To help frame any further geoarchaeological investigations of this nature within the intertidal zone, Wessex Archaeology has developed a five-stage approach, encompassing different levels of investigation appropriate to the results obtained, accompanied by formal reporting of the results at the level achieved. These include desk-based borehole log assessments through to full sampling, assessment and reporting to inform the preparation of a deposit model for the area. The stages are summarised in **Table 6**.

**Table 6:** Geoarchaeological programme of analysis

| Stage | Method | Description |
|---|---|---|
| 1 | Assessment | A desk-based archaeological assessment of the borehole and CPT logs generated by geotechnical contractors aims to establish the likely presence of horizons of archaeological interest and broadly characterise them, as a basis for deciding whether and what Stage 2 archaeological recording is required. The Stage 1 report will state the scale of Stage 2 work proposed. |

| Stage | Method | Description |
|---|---|---|
| 2 | Geoarchaeological Recording | Each sample containing sediment units identified as having archaeological, palaeoenvironmental or dating potential will be cleaned, recorded, and the sediments described geoarchaeologically following Hodgson (1997). Core analysis for magnetic susceptibility will also be undertaken (if appropriate) using a Bartington MS2 meter, typically at 5cm intervals. Preliminary interpretations will be made, those units of particular archaeological / palaeoenvironmental interest will be highlighted, and an outline deposit model will be constructed/ added to if appropriate. The Stage 2 report will set out the nature and scope of any Stage 3 work which may be required to further characterise and interpret the sediment units in order to identify areas of potential archaeological or palaeoenvironmental significance.<br>If during Stage 2 the potential is shown to be limited to well-defined areas which could be addressed by specific targeted sampling, a programme of investigation combining limited Stage 3/4 works may be proposed. This work would output to a final client report or straight to publication, depending on the requirements of the client and curator. |
| 3 | Sampling and Assessment | Sub-sampling and assessment of any units of archaeological and/or palaeoenvironmental interest. Sub-samples for the assessment of microfossil environmental indicators (including pollen, diatoms, plant macrofossils, molluscs, ostracods and/or foraminifera) will be taken; deposits which have good potential for the preservation of palaeoenvironmental indicators, such as peat, will be a focus. As far as possible the subsamples will be taken in such a manner that the remaining core is retained intact should further sub-sampling be required.<br>The subsamples will be assessed, with the relevant ecofacts being identified to at least main Taxon, with quality of preservation and approximate quantification). This enables the value of the palaeoenvironmental material surviving within the samples to be identified.<br>Should radiocarbon dating have been specified at this stage by the Stage 2 report, then suitable material will be extracted from appropriate subsamples and submitted. If not, then sub-samples will also be taken and retained at this stage in case radiocarbon dating is required during Stage 4. The Stage 3 report will set out the results of each laboratory assessment, and summarise the archaeological implications of the combined results. The potential of the material will be summarised, and recommendations will be made as to whether any Stage 4 work is warranted. If Stage 4 work is recommended, then the specifics will be laid out. |

| Stage | Method | Description |
|---|---|---|
| 4 | Analysis and Dating | Full analysis of environmental indicators (including pollen, diatoms, plant macrofossils, molluscs, ostracods and/or foraminifera) from subsamples specified in the Stage 3 report. Typically, Stage 4 will be supported by scientific techniques including magnetic susceptibility and radiocarbon dating (14C) of suitable sub-samples if warranted. Should Stage 3 assessment indicate that there is no further analytical work required on the microfossil assemblages, consideration will still be given for a programme of radiocarbon analyses to provide a chronological framework for the deposits encountered unless no suitable samples could be procured. The Stage 4 report will provide an account of the palaeoenvironment(s) at each relevant sample location within a chronological framework (absolute or relative) and an outline of the archaeological implications of the analysis. |
| 5 | Final Report | If the archaeological results are sufficiently significant, a final report will be compiled for submission to a suitable journal, to be agreed with the client and curator. This publication report will cover all aspects of the palaeo-topography and prehistory of the area affected by the development, incorporating the results of each stage.<br>If the archaeological results are not significant then the relevant Stage Report(s) will constitute the final documents for the investigation. |

9.7.4 Cores should be split in half prior to any further sampling to enable further analysis if required. This should be completed with adequate safeguards to best serve the proposed scheme of analysis.

9.7.5 The results of any further geoarchaeological assessment will be combined with the terrestrial geoarchaeological work being undertaken by Quest.

## 9.8 Awareness Training

*Pre-Dredging*

9.8.1 Wessex Archaeology will provide awareness training to all contractors engaged for the works prior to any pre-dredge surveys or dredging works being carried out. The detailed training on the identification of finds of archaeological potential will ensure that staff are aware of what constitutes an appropriate find and the procedure for reporting such discoveries. Where the origin or nature of an item is in question the precautionary principle will be employed and the item fully reported through the Protocol outlined below.

9.8.2 Records of the attendees and of the details of each awareness training event will be collected by the contractors and collated by Wessex Archaeology in a form that can be easily submitted to Historic England.

9.8.3 Training will focus in particular on the types of material likely to be discovered during the dredging, for example:

- *Aircraft material, what constitutes it, what types of material could be present and how to recognise it;*

- *Shipwreck material, including identifying wood that has been worked (for example, includes the presence of treenails and/or has been shaped, for example for a logboat or a clinker-built boat), fixtures and fittings, pottery, and other material that could be present on a shipwreck; and*
- *Prehistoric material, such as handaxes and palaeoenvironmental material that could be encountered.*

9.8.4 Training will include an overview of levels of importance, and what constitutes a *Major Archaeological Find*, an *Intermediate Archaeological Find* and a *Minor Archaeological Find* (as defined in **Section 9.13**). More information regarding the types of materials that could be discovered can be found in **Appendix VII**.

9.8.5 Training will also include information on handling and storing archaeological discoveries, as outlined in **Appendix VIII**.

9.8.6 Training given to the UXO and any diving contractors will have a substantially greater level of detail than that provided for general staff under the terms of the Protocol and will include advice on their responsibilities with regard to the implementation of the WSI and Protocol as agreed by the MMO.

9.8.7 In addition, training will ensure that all staff understand their role and the methods for reporting finds of archaeological potential through the Protocol.

9.8.8 Awareness visits will take place prior to the commencement of work, and they will include: the works manager, superintendents, UXO experts, UXO divers and general vessel crew and office staff.

9.8.9 The timing of these visits will be based upon the dredging scheduled and staff/vessel changeovers, including pre-dredge clearance operations.

9.8.10 An awareness visit will be provided for each vessel before the dredging work commences. The captain and other crew members will be responsible for the training handover with their colleagues, however, additional awareness visits could be provided if requested to smooth the transition.

9.8.11 PoTLL will keep Wessex Archaeology informed of the exact arrival dates for each vessel during construction.

9.8.12 Provision will be made for Historic England to attend a training session to monitor the approach and provide additional information if required. Wessex Archaeology will contact Historic England regarding the most suitable awareness training.

9.8.13 Periodic visits to the pre-dredge works and to the dredge plant by Wessex Archaeology will be planned to ensure proper adherence to the Protocol. The frequency and timing of these visits will be determined in accordance with the dredging programme.

9.8.14 Although unlikely to be an issue, should the need arise, Historic England and the MMO will be informed if the methods of reporting are falling short of necessary standards. This is to ensure that the MMO, as Regulator and Historic England, as their historic environment advisor, can be confident that every effort is made to protect and record archaeological material from unwarranted impacts.

## 9.9 Ground-truthing of Geophysical Anomalies

*Relevance and Application: Tilbury 2 Proposals*

9.9.1 A programme of ground-truthing of identified geophysical anomalies through either diver inspection, targeted excavation, grab sampling or a combination of these techniques of identified geophysical anomalies (Wessex Archaeology 2017b) is suggested for all dredging techniques under consideration. This will allow the assessment of potential archaeological receptors, identifying them as either archaeological or non-archaeological. This work would take place prior to any capital dredging work of any type commencing and be undertaken with a suitably qualified archaeologist from Wessex Archaeology or their sub-contractors present.

9.9.2 A minimum of 50% of A2 anomalies will be ground-truthed, with the potential to widen this should quantities of identified archaeological material be found. The proportion of anomalies to be ground-truthed will be decided in consultation with Historic England and set out in a separate Method Statement covering the works. It is suggested that this process is completed alongside the UXO assessment and clearance.

9.9.3 For all aspects of sampling for ground-truthing PoTLL and Wessex Archaeology will adhere to standards and guidance as set out in *The Assessment and Management of Marine Archaeology in Ports and Harbours* (Gane and Cooper 2016).

9.9.4 Key parts of the techniques that may be used are described in the following three sub-sections:

*Non-archaeological Diver Surveys*

9.9.5 In order to maximise the potential benefits of any proposed diver surveys undertaken primarily for engineering, ecological or other non-archaeological purposes, PoTLL will seek archaeological input at the planning stage of any such works. Any such survey specification will be informed by previous stages of the project, including any documentary studies, as well as geophysical and geotechnical analysis, so that archaeological considerations can be taken into account.

9.9.6 Where the primary objectives of dive survey are non-archaeological, consideration will be given to having suitably qualified members of Wessex Archaeology and/or their sub-contractors present during any diver surveys, either as observer(s) or participating diver(s) to optimise archaeological results and thereby reduce the need for repeat survey.

9.9.7 Following the completion of a non-archaeological diver survey, all data, including video footage, will be reviewed by a suitably qualified member of Wessex Archaeology or their sub-contractors. If non-archaeological survey does not provide clear results the additional archaeological diver survey may be required.

*Archaeological Diver Site Assessment*

9.9.8 Archaeological diver investigations will take place where the primary objectives are archaeological and the diving is led by archaeologists.

9.9.9 Archaeological diver surveys can be employed in order to gather archaeological data concerning wreck sites and geophysical anomalies to safeguard the archaeological record. Specifically, an archaeological diver-based assessment may be required where it is not possible to protect an archaeological site through avoidance.

9.9.10 A total of 116 A2 anomalies (those of uncertain origin of possible archaeological interest) have been identified by marine geophysics; 25 in Study Area West; and 91 in Study Area East. As mentioned in Section 10.6.1 it is currently unknown as to whether any diver surveys are planned and therefore how many of these anomalies will be targeted. It is recommended that all A2 anomalies (excluding those in the area of contaminated sediment) be surveyed either during non-archaeological diver survey as part of the UXO clearance works, through the grab sampling/targeted excavation strategy outlined below, or through archaeological diver site assessment.

9.9.11 The results of assessments will be compiled as an Archaeological Report consistent with the provisions on reporting within this WSI (**Section 9.5**).

*Grab sampling/targeted backhoe excavation*

9.9.12 The grab-sampling programme for ground truthing will be a targeted sampling completed over the dredge area. It uses either a hydraulic clamshell grab or a targeted excavation with a backhoe excavator to assess the sediment on the riverbed, along with any potential archaeological receptor on or within that sediment and will involve attendance by a suitably qualified member of Wessex Archaeology or their sub-contractors during the works. Should any material be recovered, it will be analysed and recorded according to the principles set out in **Section 9.5**.

9.9.13 No grab sampling will take place in the area of contaminated ground within the eastern dredge area until all contaminated sediment has been removed, to avoid environmental damage.

9.9.14 Wessex Archaeology have previously used a Kinshofer 280 litre clamshell grab which has a maximum surface penetration of 0.5m. Depending on discussions with Historic England, and sediment conditions, it may be more effective to complete the sampling using a backhoe excavator, depositing the excavated sediment onto a grid for screening. It is likely that due to the depth of dredging, repeated sampling following removal of this depth of sediment will be necessary to ensure no surviving archaeological receptors are present buried within the sediments.

9.9.15 Excavated surfaces and material will be inspected by a suitably qualified member of Wessex Archaeology or their sub-contractors. Any finds will be collected and allocated a record number and their position will be logged.

9.9.16 The Sediment Study report (HR Wallingford 2017) suggests that the majority of the river bed sediments are fine riverine clays, silts and organics, up to 6 m in depth (minimum of 0.8 m) overlying sands and terrace gravels. It is likely therefore that the majority of the material to be removed will be homogeneous riverine silts, offering no obvious stratigraphic layering.

9.9.17 There is the remote potential for preserved stratigraphy to be observed within a sample from a clamshell grab, but not within the contents of a backhoe excavator bucket. To check for preserved stratigraphy within a clamshell grab, the clamshell will be ‘cracked’ or opened slightly to allow a suitably qualified archaeologist to investigate the contents before they are emptied. Should no stratigraphy be identified then the contents of the clamshell will be emptied onto a gridded area of deck and washed over with fire hoses to reveal any potential source of the A2 anomaly. This will also sieve the sample for any other archaeological finds.

9.9.18 Should stratigraphy be identified within the clamshell, then it will be carefully opened over a non-gridded area of deck and the stratigraphic elements separated and investigated by

a suitably qualified archaeologist. Any archaeological features or structures will be examined. A sufficient sample of each layer/feature type will be investigated in order to elucidate the date, character, relationships and function of the feature/structure.

9.9.19 Recording will include written, drawn, and photographic elements as conditions allow.

9.9.20 The results of the sampling strategy will be compiled as an Archaeological Report consistent with industry standards set out in **Section 9.5**.

## 9.10 Systematic sampling for archaeological deposits on the riverbed: Grab sampling/targeted excavation

*Relevance and Application: Tilbury 2 Proposals*

9.10.1 A programme of systematic sampling of the sediments within the dredge areas to check for buried archaeological deposits that are not picked up by marine geophysical techniques is suggested for WID dredging or closed bucket backhoe excavator dredging. This will allow the assessment of the potential for further archaeological receptors within the dredge area prior to the removal of any archaeological deposits, or the supporting sediments around any archaeological receptors.

9.10.2 The initial sampling survey would take place prior to any capital dredging work of any type commencing, and be undertaken in the presence of a suitably qualified archaeologist from Wessex Archaeology. Follow up sampling surveys would then take place after the removal of an agreed depth of sediment in each berth dredging pocket (suggested depths of 0.5-0.75m based on known maximum penetration depth of clamshell grabs), while the dredger begins the removal of sediment from the other dredge pocket. It is hoped that this will allow continuous dredging operations to occur, provided no significant archaeological remains were found. The number of sample locations within each dredging pocket will be determined in the task specific Method Statement (suggested amounts of 30 for the larger eastern berth and 20 for the western berth are based on one sample every 50m$^2$) in consultation with Historic England.

9.10.3 Should any archaeological remains be found during this sampling process, then the find will be accessed through the Criteria set out in **Appendix VII** and the appropriate level of recording, investigation or recovery implemented, as set out in the Protocol in **Section 9.13**.

9.10.4 Any necessary AEZs or TEZs will be implemented according to the principles set out in **Table 4**.

9.10.5 The exact system of sampling to be undertaken will be decided in consultation with Historic England and set out in a separate Method Statement covering the works. It is suggested that this process is completed after the UXO assessment and clearance to ensure risks from potential UXO are removed.

9.10.6 For all aspects of grab sampling PoTLL and Wessex Archaeology will adhere to standards and guidance as set out in *The Assessment and Management of Marine Archaeology in Ports and Harbours* (Gane and Cooper 2016).

9.10.7 Key parts of the technique to be used is described in the following sub-section:

*Grab sampling/targeted backhoe excavation*

9.10.8 The grab-sampling/targeted excavation programme for buried archaeological deposits/receptors will be a systematic sampling programme completed over the dredge

area. It uses a hydraulic clamshell grab or backhoe excavator to assess the sediment on the riverbed, along with any potential archaeological receptor on or within that sediment and will involve attendance by a suitably qualified member of Wessex Archaeology or their sub-contractors during the works, using the same principles as laid out in **Section 9.9**. Should any material be recovered, it will be analysed and recorded according to the principles set out in **Section 9.5**.

## 9.11 Archaeological Watching Briefs: Dredging

*Relevance and Application: Tilbury 2 Proposals*

9.11.1 A Watching Brief is recommended to monitor the pre-dredge survey and sampling works, and the dredging work within areas either close to receptors with archaeological potential as identified by the geophysical surveys or through areas of archaeological potential as identified in the grab sampling/targeted excavations, as outlined in **Sections 9.9 and 9.10**. A watching brief in this capacity will only be implemented where an open bucket backhoe excavator dredging methodology is used. This work would be located on the dredger itself, or on the barges used to hold excavated material, depending on access.

9.11.2 Recovery of any archaeological material within the Watching Brief will be completed under the supervision of suitably qualified Wessex Archaeology staff, with any artefacts or structural fragments returned to the quayside for storage in an allotted archaeological storage area, which may consist of accessible skips or tanks. Any archaeological artefact will then be assessed as part of the quayside monitoring programme (see **Section 9.14**)

9.11.3 Should dispersal dredging be employed, there will be no useful function in an archaeological watching brief on board the dredger, and more emphasis should be put on the mitigation completed during the potential ground truthing work for UXO and grab sampling/targeted excavation survey (**Sections 9.9 and 9.10**).

9.11.4 For all aspects of archaeological watching briefs on board PoTLL and Wessex Archaeology will adhere to standards and guidance as set out in CIfA 2014a, *Dredging and Port Construction: Interactions with Features of Archaeological or Heritage Interest* (PIANC 2014) and *The Assessment and Management of Marine Archaeology in Ports and Harbours* (Gane and Cooper 2016).

*Watching Brief*

9.11.5 A watching brief is a formal programme of archaeological monitoring and will involve attendance by a suitably qualified member of Wessex Archaeology during pre-dredging surveys/sampling and capital dredging. A Method Statement will be developed to include archaeological monitoring on board the survey vessel or dredger, and should any material be recovered, it will be analysed and recorded according to the principles set out in **Section 9.5**.

9.11.6 Up-cast material from pre-dredge sampling and/or surveys or from any open bucket backhoe excavator dredging will be inspected by a suitably qualified member of Wessex Archaeology, with a proportion of upcast material (agreed in consultation with Historic England and as set out in an activity specific Method Statement) will be passed through a grid within the sampling vessel, dredger or spoil barge. Any finds will be collected and allocated a record number and their position will be logged.

9.11.7 Recording will include written, drawn, and photographic elements as conditions allow.

9.11.8 The findings of any watching briefs will be compiled as an Archaeological Report consistent with industry standards set out in **Section 9.5**.

## 9.12 Archaeological Watching Briefs: Intertidal works

*Relevance and Application: Tilbury 2 Proposals*

9.12.1 A Watching Brief is recommended to monitor the construction work in the intertidal zone for the construction of the conveyor hopper platform, the conveyor supports, the Ro-Ro off-ramp, the bank seat for the Ro-Ro ramp and the excavation of the surface water runoff for the Ro-Ro compound to ensure that any surviving buried archaeological deposits, particularly those of Mesolithic date, are recovered and recorded.

9.12.2 This intertidal watching brief would take the form of pile position examination pits to investigate the deposits within the location of the piles for the bank seat, the conveyor hopper platform, the conveyor supports and the Ro-Ro ramp, and an open area watching brief for the surface water runoff.

9.12.3 These will be conducted during periods of receding and low tide as the areas become exposed. Further details will be included within a work-specific Method Statement, agreed in consultation with Historic England.

9.12.4 For all aspects of intertidal archaeological watching briefs PoTLL and Wessex Archaeology will adhere to standards and guidance as set out in CIfA 2014a.

*Watching Brief*

9.12.5 A watching brief is a formal programme of archaeological monitoring and will involve attendance by a suitably qualified member of Wessex Archaeology or their sub-contractors during groundworks. A Method Statement will be developed to include archaeological monitoring, and should any material be recovered, it will be analysed and recorded according to the principles set out in **Section 9.5**.

9.12.6 Excavated surfaces and up-cast material will be inspected by a suitably qualified member of Wessex Archaeology or their sub-contractors. Any finds will be collected and allocated a record number and their position will be logged.

9.12.7 Archaeological features or structures will be examined and/or excavated during low tide. A sufficient sample of each layer/feature type will be investigated in order to elucidate the date, character, relationships and function of the feature/structure.

9.12.8 Recording will include written, drawn, and photographic elements as conditions allow.

9.12.9 The findings of any watching briefs will be compiled as an Archaeological Report consistent with industry standards set out in **Section 9.5**.

## 9.13 On-board Finds Reporting Protocol (The Protocol)

*Relevance and Application: Tilbury 2 Proposals*

9.13.1 The Protocol will be implemented throughout the duration of the channel dredge and across the full geographical extent of the project, with particular attention paid to areas of interest defined by the DBA and previous archaeological reports (**Figure 3**). It remains a final safety net, to catch any archaeological material that was not found during the active mitigation methods outlined above. A second version of the Protocol will also be in place for the maintenance dredging during the lifetime of the development.

9.13.2 The Protocol will be implemented in order to ensure that unexpected discoveries of archaeological material made outside of the above mitigation methods– including submerged prehistoric material, shipwreck material aircraft remains, and any other archaeological material – are addressed in a timely and appropriate manner.

9.13.3 Archaeological finds made during the course of dredging activities are important, because they can shed light on past human use of landscape, sea and seabed. The information that such discoveries bring to light can help archaeologists better understand the past and should therefore be conserved to better protect these aspects of our history on behalf of further generations.

9.13.4 The Protocol that follows has specifically been designed to deal with any discoveries made in the proposed capital dredging area undertaken during the Tilbury 2 Project. Flow charts of actions/communications and recording sheets associated with the Protocol can be found in **Appendices IV-VI**.

9.13.5 This Protocol is designed to be used in conjunction with the pre-dredge surveys, capital dredging and any other works completed during the construction phase of the project, and the maintenance dredging and marine surveys conducted during the operation and maintenance phase of the project.

*A Protocol for Archaeological Discoveries for the Tilbury 2 capital dredging project*

9.13.6 The types of dredgers and when they will be employed will be outlined at the detailed design stage which will be subject to a task specific Method Statement in accordance with this WSI.

9.13.7 Prior to the commencement of dredging, dredging vessel staff, UXO and diving contractors, and other key staff will receive information regarding any identified areas of archaeological interest. Details of these areas will be supplied to vessel staff via this task specific Method Statement. In addition, such areas will be identified during the awareness training, and copies of site diagrams that illustrate the areas will be provided both as handouts and as part of the Protocol binder for on-board reference. In addition, ESRI ArcGIS shapefiles of the areas will be provided to PoTLL in British National Grid (BNG). The shapefiles will ensure that the areas are clearly visible on the dredge plant computer dredge screens, to ensure complete awareness of these areas and the potential for archaeological and/or historical finds.

9.13.8 PoTLL will notify Wessex Archaeology when key areas are to be dredged, so that Wessex Archaeology can ensure the vessel staff/UXO specialists are aware of any specific considerations.

9.13.9 For the WID dredging technique, computer systems and displays on each vessel, linked to a differential GPS system and radio tide gauge, give the dredge master continuous visual information on the exact position of the dredger. For backhoe excavator dredging the dredger works from a fixed position, which is easily recorded, but care must be taken to note the location and depth of the backhoe bucket from the overall dredger location, as it will be this location which is where any finds are originating from.

9.13.10 However, it will likely be more difficult for crews to accurately position discoveries made on the dredgers/associated spoil barges, as discussed in the following paragraphs.

9.13.11 The Project Manager will ensure that all staff on-board the dredging vessel are aware of the nominated Site Representative. A flowchart detailing actions on-board the dredging

vessel in the event of anomalies discovered on the seabed or finds recovered from the seabed can be found in **Appendix IV**.

9.13.12 All finds of archaeological interest will be reported by the on-board dredging operatives to the Site Representative, who will inform the Project Manager, who will then inform Wessex Archaeology.

9.13.13 In the event that an unexpected archaeological obstruction is encountered on the seabed, PoTLL will notify Wessex Archaeology whether it merits further investigation to determine historic or archaeological significance and consideration as a heritage asset. Obstructions with archaeological potential will be photographed and/or videoed *in situ* if conditions allow, and the photographs and/or video data will be forwarded to Wessex Archaeology for further assessment by a suitably qualified marine archaeologist. If conditions are too poor for photography or video then a diver survey will be undertaken, using the principles outlined in **Section 9.9**. If a site of potential archaeological interest (based on the criteria outlined in **Appendix VII**) is identified, the Contractor will follow the strategy outlined in the *Major Archaeological Find, Intermediate Archaeological Find* and *Minor Archaeological Find* sections below.

9.13.14 In the event that a find is discovered on-board either the dredger or the associated spoil barges in the case of backhoe dredging, the find will be assessed for their level of archaeological interest by the on-board operatives, based on awareness training and the criteria outlined in **Appendix VII**). If the find is of potential archaeological interest, they will follow the strategy outlined in the *Major Archaeological Find, Intermediate Archaeological Find* and *Minor Archaeological Find* sections below.

*Major Archaeological Finds*

9.13.15 Major archaeological finds could include a shipwreck, logboat, aircraft, human remains or large assemblages of non-human bone and teeth (see **Appendix VII** for more details).

9.13.16 Following the discovery of a major archaeological find either on-board or on the seabed, PoTLL will cease all dredging immediately within the area, and a Temporary Exclusion Zone (TEZ) will be implemented around the location of the find.

9.13.17 The Site Representative (generally the foreman on the dredger) will notify the Project Manager of the dredging project, who will then notify Wessex Archaeology within 24 hours of discovery. In addition, the Site Representative will:

- *Ensure that the find is photographed and/or videoed if on the seabed by a diver or an ROV if conditions allow, or if on the surface by the on-board operatives;*
- *Provide the find with a reference number from a continuous unique numbering system;*
- *Obtain a position for the find from the vessel's GPS location (in conjunction with input from the dredger operator on depth of bucket and position of jib arm for backhoe);*
- *Fill in a preliminary recording form (**Appendix V**)*
- *Forward the preliminary recording form, and any additional information, to the Project Manager;*
- *The Project Manager will confirm all details in the preliminary recording form are comprehensive and correct and will forward it, along with copies of any photographs, video and other relevant information, to Wessex Archaeology within 24 hours of discovery;*

- *On receipt of a report, the marine archaeologist will review the data provided and supply further advice as relevant.*

9.13.18 If the discovery is on the seabed:

- *An archaeological diver from Wessex Archaeology or their sub-contractors, or a suitable ROV will investigate the site and provide further advice within 48 hours. The archaeological diver will undertake a significance assessment and provide advice; and*
- *The methodology for addressing these sites will be agreed prior to any further dredge activity at that location. Existing geophysical data from these locations will be reviewed to determine the extent of the site if possible and to correlate new discoveries with existing data assessment.*

9.13.19 If the discovery is made on-board:

- *All material will be handled with care;*
- *Any rust, sediment, concretion or marine growth, should not be removed, and 'groups' of items or sediments should not be separated;*
- *It will be assumed that the find is not isolated and further material may be present on the seabed;*
- *An archaeological diver from Wessex Archaeology or their sub-contractors, or a suitable ROV will investigate the site and provide further advice within 48 hours;*
- *If the discovery is determined to be an isolated find, then the find will be provided with 'first aid' conservation, including keeping the find submerged in clean, cold water until further requirements can be determined;*
- *The find will be moved to the quay side lay down area for immediate attention by a marine archaeologist; and*
- *Advice from Wessex Archaeology will be provided regarding the most suitable place to store the object prior to the arrival of a marine archaeologist at the site.*

9.13.20 It should be noted that archaeological investigation of *in situ* discoveries on the seabed does not typically cause undue disruption to dredging programmes and timescales, instead, archaeological divers are able to quantify and qualify the extent of any remains relatively quickly, which in turn facilitates the reporting of findings by Wessex Archaeology or their sub-contractors to PoTLL and Historic England.

9.13.21 Following initial recording and review the marine archaeologist will provide further advice in accordance with the Protocol and WSI. Additional works will be carried out to ensure the appropriate recording and removal of archaeological material in accordance with specific methodology to be advised by Wessex Archaeology and agreed with Historic England.

9.13.22 Only in agreement with the MMO and Historic England will any action be taken to implement any potential lift and recovery operations following satisfactory completion of in situ inspection.

9.13.23 Any human remains (articulated or disarticulated, cremated or unburnt) discovered, will be left *in situ*, covered and protected. If identified when removed by backhoe dredging, all dredging in the area will be stopped immediately. A Ministry of Justice licence will be obtained by Wessex Archaeology before any further excavation (including where remains are to be left *in situ*). Following discussions with PoTLL and Historic England, and with

advice from Wessex Archaeology's osteoarchaeologist, the need for and appropriateness of their excavation/removal or sampling as part of the evaluation will be determined. Should human remains require excavation, they will be fully recorded, excavated and removed from the site in compliance with the terms of the Ministry of Justice licence.

9.13.24 Any excavation and post-excavation processing of human remains will be undertaken in accordance with Wessex Archaeology protocols, and in line with current guidance documents (eg, McKinley 2013) and CIfA standards (McKinley and Roberts 1993). Appropriate specialist guidance will be provided by Wessex Archaeology's osteoarchaeologist, with site visits undertaken if required. The final deposition of human remains, following analysis, will be in accordance with the terms of the Ministry of Justice licence.

9.13.25 Dredging will not recommence within the area of the TEZ until confirmation has been received from Historic England that the TEZ can be removed.

*Intermediate Archaeological Find*

9.13.26 Intermediate archaeological finds could include: an anchor, individual mammoth tooth, isolated animal bone, isolated ships timbers or concretions (see **Appendix VII** for more details).

9.13.27 If an intermediate archaeological discovery is identified on the seabed in the course of operations, the discovery will be photographed and/or videoed in situ by an archaeological diver from Wessex Archaeology or their sub-contractors, or a suitable ROV.

9.13.28 Then the following steps will be undertaken:

- *Provide the find with a reference number from a continuous unique numbering system;*
- *If possible, attach a label to the find with information regarding the object and its reference number, or photograph the find with the label prominently displayed, in order for the item to be identified during the Quay Side Archaeological Monitoring;*
- *Record the location of the find from the vessel's GPS location (in conjunction with input from the dredger operator on depth of bucket and position of jib arm for backhoe);*
- *Fill in a preliminary recording form (**Appendix V**);*
- *The Site Representative will forward the preliminary recording form to the Project Manager, along with any photographs, videos or other information;*
- *The Project Manager will then forward the preliminary recording form, along with any photographs, videos or other information, to Wessex Archaeology (**Appendix VI**);*
- *On receipt of a report, the marine archaeologist will review the data provided and provide further advice as relevant; and*
- *Dredging will not recommence at the location of the discovery until the find has been fully recorded and removed in accordance with the advice of Wessex Archaeology.*

9.13.29 During the Quay Side Archaeological Monitoring (**Section 9.14**), the find will be reviewed by a suitably qualified member of Wessex Archaeology or their sub-contractors, additional recording will be carried out and further advice sought from experts as required. Details of the find will be entered in the finds database and provision will be made for the removal of the find to Wessex Archaeology's storage facilities in Maidstone or Salisbury for further conservation and recording if required or to an alternative facility if appropriate.

*Minor Archaeological Find*

9.13.30 Minor archaeological finds could include modern debris such as fishing gear (see **Appendix VII** for more details).

9.13.31 If a minor archaeological discovery is identified on the seabed in the course of operations, the discovery will be photographed and/or videoed *in situ*. Small finds may be brought to the surface.

9.13.32 The following steps will be taken:

- *Photograph and/or video the find, using a camera with a time/date stamp;*
- *Provide the find with a reference number from a continuous unique numbering system;*
- *If possible, attach a label to the find with information regarding the object and its reference number, or photograph the find with the label prominently displayed, in order for the item to be identified during the Quay Side Archaeological Monitoring;*
- *Fill in a preliminary recording form (**Appendix V**), to be sent to Wessex Archaeology along with any photographs and/or video.*
- *The Site Representative will forward any photographs and/or video to the Project Manager who will forward them to Wessex Archaeology; and*
- *The find will be provided with 'first aid' if appropriate and placed in the skip containing archaeological material. The skip will then be removed to the quay side lay down area to await assessment by a suitably qualified member of Wessex Archaeology or their sub-contractors.*

9.13.33 On receipt of photograph and/or video data and/or a preliminary recording form, the marine archaeologist will review the data provided and provide further advice as relevant. Should the material be determined to be of intermediate archaeological interest, the location of the discovery will be determined based on the vessel track plot corresponding with the time/date stamp on the photographs and/or video of the find.

9.13.34 During the Quay Side Archaeological Monitoring, the find will be reviewed by the marine archaeologist and additional recording will be carried out if required. Details of the find will be entered in the finds database prior to disposal.

## 9.14 Quay Side Archaeological Monitoring

9.14.1 For any major archaeological finds that have been recovered during the pre-dredge sampling, surveys, or during any watching brief on the capital dredging, they will be kept onboard the dredger or within an associated spoil barge until dredging has been completed for the day. If on a spoil barge then the potential archaeological material should be kept separate from the non-archaeological spoil. The dredger or barge will then return to the quay where the finds recovered will be offloaded and stored safely for review by Wessex Archaeology. Finds will be stored in a secure location on the quay side, and treated with basic 'first aid': keeping the finds wet, cool and dark, which will be covered in the Awareness training detailed in **Section 9.8**. PoTLL will notify Wessex Archaeology of any major archaeological finds within 24 hours of discovery, and Wessex Archaeology will provide further advice regarding suitable storage on a case by case basis'

9.14.2 For the intermediate and minor archaeological finds, PoTLL will notify Wessex Archaeology when the finds are in a secure lay-down area, and will grant access.

9.14.3 Following confirmation of a drop off of material to shore, staff from Wessex Archaeology will attend the agreed laydown area at a time agreed with the client representative. It is expected that Wessex Archaeology staff will visit the quay once or twice per week, depending on the quantity of material recovered and the results of the assessments of the preliminary recording forms.

9.14.4 Wessex Archaeology staff will be subject to international port security, and will be provided with the same level of clearance as PoTLL staff.

9.14.5 Arrangements will be made for PoTLL to remove the material from the dredgers or barges and lay it down on the quay side prior to the archaeological assessment. Whether this is done in the presence of Wessex Archaeology staff or prior to their arrival will depend on the material in the secure lay-down area and advice provided by the marine archaeologists upon review of the preliminary recording forms. Wessex Archaeology staff must not be required to access the secure lay-down area in order to record the archaeological material.

9.14.6 The on-site archaeologist(s) will visually review the material in conjunction with their corresponding preliminary reporting forms, if completed. Where reports have not been completed, Wessex Archaeology staff will review photographs and/or video footage against the items recovered in order to establish the time of recovery and an approximate location for the item, the material will be examined and should material of archaeological interest be confirmed, the material will be fully recorded on the lay down area.

9.14.7 Archaeological finds will be dealt with in accordance with the Archaeological Finds Strategy outlined in **Section 11**.

9.14.8 Quay side archaeological monitoring will be undertaken either by a team of two marine archaeologists, or by a single marine archaeologist if supported by a member of the dredge team staff to avoid lone working. The work will be undertaken as required and will be informed by the dredge vessel programme.

9.14.9 Regular contact will be maintained with the dredge team/vessel throughout the dredging works.

9.14.10 Consistency of staff will be maintained throughout the life of the project and that, where handovers of key staff members are necessitated, comprehensive briefings to new staff are provided to ensure understanding of the project in advance of staff changeover.

# 10 ARCHAEOLOGICAL REVIEW OF SURVEY DATA AND REPORTS

10.1.1 Survey data and reports will be reviewed from an archaeological perspective to ensure suitable mitigation is put in place for the proposed works, as outlined in **Section 9.5.8**. The reviews will take into account:

- *Relationship between the survey work, the WSI and the licence condition(s);*
- *Context in terms of relevant construction works;*
- *Specific objectives data review;*
- *Extent of investigations undertaken;*
- *Methodology for data review or analysis;*
- *Mitigation requirements;*
- *Monitoring arrangements;*
- *Recommendations.*

10.1.2 Reports will be prepared in accordance with the relevant Standards and Guidance documents produced by the CIfA, as outlined in **Section 9.5.16** and will typically include:

- *A non-technical summary;*
- *The aims and methods of the work;*
- *The results of the work including finds and environmental remains;*
- *A statement of the potential of the results;*
- *Proposal for further analysis and publication; and*
- *Illustrations and appendices to support the report.*

# 11 APPROACH TO FINDS AND ENVIRONMENTAL ASSESSMENT

## 11.1 Artefacts

11.1.1 All artefacts identified from material recovered will be retained, processed and recorded in accordance with the CIfA's Standard and Guidance for Archaeological Watching Briefs (2014a) and Standard and guidance for the collection, documentation, conservation and research of archaeological material (2014b).

11.1.2 All finds and other items of archaeological interest have an owner, but the law regarding ownership varies according to the character of the material, the environment in which it was found, and national legislation. From the point of discovery, all finds will be held by Wessex Archaeology in appropriate conditions pending further recording, investigation, study or conservation. Ownership will be transferred to the institution receiving the archive unless other arrangements are agreed with Historic England.

11.1.3 Artefacts that are exposed in the course of scheme works will be recovered by Wessex Archaeology or, where recovery is impracticable, recorded. All finds will be recorded by context and in the case of significant objects ('special finds'), in three dimensions using a unique sequence of reference numbers.

11.1.4 Recovered objects will be selected, retained or disposed of in accordance with the policy agreed with the institution receiving the archive, and in consultation with the Historic England.

11.1.5 Subject to the agreement reached with the receiving institution regarding selection, retention and disposal of material, Wessex Archaeology will retain all recovered objects unless they are undoubtedly of modern or recent origin. The presence of discarded objects will, however, be noted on context records. In these circumstances sufficient material will be retained to characterise the date and function of the deposit from which it was recovered.

11.1.6 In the event of the discovery of unexpected, unusual or extremely fragile and delicate objects and deposits, Wessex Archaeology, PoTLL and Historic England will be notified immediately. Additional work required to recover, record, analyse, conserve and archive such objects and deposits will be agreed in consultation with Historic England.

11.1.7 In the event of the discovery of items that may be eligible for legal protection, the Contractor will immediately notify Wessex Archaeology who will notify the relevant legal authority as soon as possible. PoTLL and the Historic England will be notified as soon as possible.

11.1.8 Wessex Archaeology will prepare and implement a finds monitoring and maintenance programme, which will cross-refer to finds management/monitoring systems maintained by Wessex Archaeology and PoTLL.

11.1.9 Contingency will be made for specialist advice and conservation needs on-site should unexpected, unusual or extremely fragile and delicate objects be recovered, and the advice and input from an appropriate Conservation Service will be sought through Wessex Archaeology's Finds Manager. A range of internal and external specialists will be consulted as appropriate.

11.1.10 Objects that require immediate conservation treatment to prevent deterioration will be treated according to guidelines laid down in First Aid for Finds (Watkinson 1998) and First

Aid for Underwater Finds (Robinson 1998). A full record will be made of any treatment given.

11.1.11 Finds will be primarily conserved, bagged and boxed in accordance with guidelines set out in the United Kingdom's Institute for Conservation's Conservation Guidelines No 2 (UKIC 1984).

11.1.12 Finds and other items of archaeological interest recovered offshore in the course of investigation are the property of The Crown Estate as the landowner, with the exception of all human remains, and 'wreck' for the purposes of the Merchant Shipping Act 1995.

### 11.2 Ordnance

11.2.1 In the event that any item(s) of ordnance is discovered it should be treated with extreme care as it may not be inert. Industry guidelines provided by the UXO contractor must be followed prior to any recording of items for archaeological purposes.

11.2.2 Depending on the items' age, ordnance may be of archaeological interest, especially when discovered with other related material from a wreck, either shipwreck or aircraft, and should be recorded if it is safe to do so.

11.2.3 Any firearms and ammunition (e.g. from a crashed military aircraft) are likely to be subject to the Firearms Acts (various dates). Ammunition should be regarded as ordnance, irrespective of its size.

### 11.3 Treasure

11.3.1 In the event of the discovery of any material covered or potentially covered by the Treasure Act 1996, PoTLL and the Curator(s) will be notified immediately. All necessary information required by the Treasure Act 1996 (i.e. finder, location, material, date, associated items, etc.) will be reported to the Coroner within 14 days. Items falling under the Treasure Act will be removed from the site by Wessex Archaeology and stored in a secure location, pending a decision by the Coroner.

### 11.4 Aircraft

11.4.1 The majority of aircraft wrecks are military and therefore fall under the Protection of Military Remains Act 1986. Any finds that are suspected of being military aircraft will be reported immediately to Wessex Archaeology. In the case of a military aircraft being investigated under licence, any human remains will be reported immediately.

### 11.5 Wreck

11.5.1 Archaeological artefacts that have come from a ship are 'wreck' for the purposes of the Merchant Shipping Act 1995. PoTLL, via Wessex Archaeology, should ensure that the Receiver of Wreck is notified within 28 days of recovery, for all items of wreck that have been recovered.

### 11.6 Environmental

11.6.1 Deposits (i.e. sediments) of archaeological/ historical/cultural interest that do not comprise artefactual remains will not be considered to be 'finds' but may be subject to sampling. Any artefactual material subsequently discovered in the course of processing such samples would be treated as finds thereafter.

11.6.2 For each programme of archaeological work, environmental sampling strategies and methods – including methods for processing, assessing and/or analysing samples – will be set out in the Method Statement for the archaeological work.

11.6.3 Approaches and methods will be consistent with Environmental Archaeology: a guide to the theory and practice of methods, from sampling and recovery to post-excavation (Centre for Archaeology Guidelines, English Heritage 2011) and Geoarchaeology: using earth sciences to understand the archaeological record (Historic England 2015b).

## 11.7 Conservation and storage

11.7.1 All recovered materials will be subject to a Conservation Assessment to gauge whether special measures are required while the material is being held. This Conservation Assessment will be carried out by Wessex Archaeology or their sub-contractor with an appropriate level of expertise, with advice from appropriate specialists. Wessex Archaeology or their sub-contractor with appropriate expertise will implement recommendations arising from the assessment. If no special measures are recommended, finds will be conserved, bagged, boxed and stored in accordance with industry guidelines (CIfA 2014b: Standard and guidance for the collection, storage, documentation, conservation and research of archaeological materials).

# 12 STORAGE AND CURATION

## 12.1 Museum

12.1.1 The project archive should be deposited with the Thurrock Museum. Deposition of any finds with the archive will only be carried out with the full agreement of The Crown Estate or the owner (as confirmed by the Receiver of Wreck).

12.1.2 If the archive is not accepting archaeological archives at the close of the project, every effort will be made to identify a suitable repository for the archive resulting from the fieldwork, and if this is not possible, Wessex Archaeology will initiate discussions with the local planning authority in an attempt to resolve the issue. If no suitable repository is identified, Wessex Archaeology will continue to store the archive, but may institute a charge to the Client for ongoing storage beyond a set period.

## 12.2 Preparation of archive

12.2.1 It is accepted practice to keep project archives, including written, drawn, photographic and artefactual elements together whenever possible, along with a summary of the contents of the archive, and to deposit them in appropriate receiving institutions once their contents are in the public domain.

12.2.2 The complete site archive, which may include paper records, photographic records, graphics, artefacts, ecofacts and digital data, will be prepared following standard conditions for the acceptance of excavated archaeological material by the Essex Record Office, and in general following nationally recommended guidelines (Society of Museum Archives 1995; Brown 2011; ADS 2013; Archaeology Archives Forum 2007; CIfA 2014c; UKIC 1984 and Walker 1990). The archive will be deposited with the Essex Record Office once the contents are in the public domain.

12.2.3 Historic England and Wessex Archaeology will agree with the receiving institution a policy for the selection, retention and disposal of recovered or excavated material, and confirm requirements in respect of the format, presentation and packaging of archive records and materials. The receiving institution will be notified in advance of any fieldwork.

12.2.4 All digital data will be considered part of the primary archive and will accord with the procedures recommended by The Crown Estate, Marine Environment Data and Information Network (MEDIN), Archaeological Data Service (ADS) and Historic England.

12.2.5 Data will be compiled in a format suitable for submission of Monument, Event and Source records for entry into the NRHE (offshore) and the Essex Historic Environment Record (inshore).

12.2.6 Following completion of the scheme of construction, the Client will produce an OASIS form for any completed and agreed Archaeological Reports produced as a result of this WSI and will submit a copy as a PDF file to Historic England's NRHE (oasis@english-heritage.org.uk).

## 12.3 Discard policy

12.3.1 Wessex Archaeology should follow the guidelines set out in Selection, Retention and Dispersal (Society of Museum Archaeologists 1993) which allows for the discard of selected artefact and ecofact categories which are not considered to warrant any future analysis. Any discard of artefacts will be fully documented in the project archive.

12.3.2 The discard of environmental remains and samples follows nationally recommended guidelines (SMA 1993; SMA 1995; English Heritage 2011).

## 12.4 Security copy

12.4.1 In line with current best practice (e.g. Brown 2011); on completion of the project a security copy of the written records will be prepared, in the form of a digital PDF/A file. A PDF/A is an ISO-standardised version of the Portable Document Format (PDF) designed for the digital preservation of electronic documents through omission of features ill-suited to long-term archiving.

# 13 QUALITY ASSURANCE PROCEDURES

## 13.1 Internal quality standards

13.1.1 Wessex Archaeology is an ISO 9001:2015 accredited organisation (certificate number FS 606559), confirming the operation of a Quality Management System which complies with the requirements of ISO 9001:2015 – covering professional archaeological and heritage advice and services. The award of the ISO 9001 certificate, independently audited by the British Standards Institution (BSI), demonstrates WA's commitment to providing quality heritage services to our clients. ISO (the International Organisation for Standardisation) is the most recognised standards body in the world, helping to drive excellence and continuous improvement within businesses.

13.1.2 Wessex Archaeology operates a computer-assisted Project Management system. Projects are assigned to individual managers who are responsible for the successful completion of all aspects of the project. This includes monitoring project progress and quality; control budgets from inception to completion; all aspects of Health and Safety. At all stages the manager will carefully assess and monitor performance of staff and adherence to objectives, timetables and budgets, while the manager's performance is monitored in turn by the Team Leader/Regional Manager.

13.1.3 All work is monitored and checked whilst in progress on a regular basis by the Project Manager, and all reports and other documents are checked by the Team Leader/Technical Manager, or Regional Manager, before being issued. A series of guideline documents or manuals form the basis for all work. The Technical Managers in the Graphics, Finds & Analysis and GeoServices and IT Sections provide additional assistance and advice.

13.1.4 All staff are responsible for following Wessex Archaeology's quality standards but the overall adherence to and setting of these standards is the responsibility of the Executive Management Team in consultation with the Team Leaders/Regional Managers who also ensure projects are adequately programmed and resourced within Wessex Archaeology's portfolio of project commitments.

# 14 HEALTH AND SAFETY

## 14.1 Health and safety

14.1.1 Health and Safety considerations will be of paramount importance in conducting all fieldwork. Safe working practices will override archaeological considerations at all times. Wessex Archaeology will supply trained, competent and current staff to perform the tasks and operate the equipment used on site.

14.1.2 All work will be carried out in accordance with the Health and Safety at Work Act 1974 and the Management of Health and Safety Regulations 1999, and all other applicable Health and Safety legislation, regulations and codes of practice in force at the time.

14.1.3 Wessex Archaeology will supply a copy of the company's Health and Safety Policy and a Risk Assessment to the Client before the commencement of any fieldwork. The Risk Assessment will have been read, understood and signed by all staff attending the Site before any groundwork commences.

14.1.4 WA staff will comply with the Personal Protective Equipment (PPE) requirements for working on site (hard hat, safety boots, high visibility clothing, ear, eye and hand protection) and any other specific additional requirements of the Principal Contractor.

14.1.5 All work will be carried out in accordance with the Health and Safety at Work etc. Act 1974 Health and Safety Management Regulations 1992, the Standing Conference of Archaeological Unit Managers (SCAUM) health and safety manual, Health and Safety in Field Archaeology 2007, and all other relevant Health and Safety legislation, regulations and codes of practice in force at the time.

# 15 COPYRIGHT

## 15.1 Archive and Report Copyright

15.1.1 The full copyright of the written/illustrative archive relating to the site will be retained by Wessex Archaeology under the Copyright, Designs and Patents Act 1988 with all rights reserved. The Client will be licenced to use each report in all matters directly relating to the project as described in the specification. The museum/receiving organisation, however, will be granted an exclusive licence for the use of the archive for educational purposes, including academic research, providing that such use shall be non-profitmaking, and conforms to the Copyright and Related Rights Regulations 2003.

15.1.2 Once the scheme is completed and/or contents of the archive are in the public domain, information relating to the project will be deposited with the Historic Environment Record (HER) where it can be freely copied without reference to Wessex Archaeology for the purposes of archaeological research or Development Control within the planning process.

## 15.2 Third Party Data Copyright

15.2.1 This document, the report and the project archive may contain material that is non-Wessex Archaeology copyright (e.g. Ordnance Survey, British Geological Survey, Crown Copyright), or the intellectual property of third parties, which Wessex Archaeology are able to provide for limited reproduction under the terms of our own copyright licences, but for which copyright itself is non-transferable by Wessex Archaeology. Users remain bound by the conditions of the Copyright, Designs and Patents Act 1988 with regard to multiple copying and electronic dissemination of such material.

# 16 REFERENCES

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# 17 APPENDICES

## Appendix I: Updated gazetteer of Receptors of archaeological potential within 2km MSA (adapted from Wessex Archaeology 2017c)

Dimensions in metres.

| WA ID | MonUID | EHCR_No | RecordType | Site_Name | MonType | Description | Easting | Northing |
|---|---|---|---|---|---|---|---|---|
| 1001 | MEX31812; NRHE 1423397 | 10287 | MON | Pillbox, S of Tilbury Power Station | PILLBOX | An unusual pillbox standing on the mud at the river's edge. Basically, a 28' long x 15' wide double-ended octagon with the entrance on the W side - but built 3' high on top and across the middle is a 22" thick wall. This was probably intended as an extra firing position. This wall projects some 5' each side of the pillbox. The entire structure is now sinking into the mud which has filled the interior. | 566200 | 175400 |
| 1002 | MEX6471 | 1785 | FS | West Tilbury - Tilbury Fort | | Samian ware, RB vessel (1871) in BM, fibulae (Roman?). "I understand that Tilbury Fort had a Roman collection. Were the fibulae from that collection at its disposal or were they excavated. Material was brought from Kent for foundation consolidation, and all excavated items are suspect" | 565000 | 175100 |
| 1003 | MEX6630 | 1828 | FS | Tilbury Foreshore | | Roman pottery reported from foreshore along frontage. Notable collection of RB Burial material by P Benton of Southend-on-Sea. Mid 19th S.end of West Tilbury Manor Way". <1> May well duplicate other sites-see TQ67-008, 1694, TQ67-038, 1734, 1735. | 566500 | 175400 |
| 1004 | MEX6468 | 1783 | FS | West of West Tilbury - Tilbury Fort | | RB remains found around 1960? | 564720 | 175100 |
| 1005 | MEX6254 | 1734 | FS | West Tilbury - Foreshore | | RB ceramics (rim sherd) remains found around 1968? | 566600 | 175500 |
| 1006 | MEX31804 | 10280 | MON | Spigot Mortar Base, SE Bastion, Tilbury Fort | SPIGOT MORTAR EMPLACEMENT | The SE bastion of Tilbury Fort has two pre-WWII 6" gun pits and the eastern pit has been converted to a spigot mortar position. The pit is constructed of concrete and is 12' in diameter. In the centre a 7' square x 2' high concrete platform has been constructed. On top of this a standard spigot mortar pedestal has been built so that the stainless steel pintle is 6" below the level of the parapet. Thus the mortar could have fired across the parapet onto the eastern approaches and the Thames. The iron cage inside the pedestal is now showing through due to deterioration of the concrete. | 565210 | 175310 |
| 1007 | MEX6469 | 1784 | FS | Find from Tilbury Fort, West Tilbury | | Worked flint found, possibly Palaeolithic. A Palaeolithic implement found at Tilbury dock in 1913 now in the British Museum is possibly from this same site. See TQ67-070, 1710, for `Tilbury Dock' finds, presumably the 1913 find is the 1st hand-axe mentioned there. | 565200 | 175300 |

| WA ID | MonUID | EHCR_No | RecordType | Site_Name | MonType | Description | Easting | Northing |
|---|---|---|---|---|---|---|---|---|
| 1008 | MEX6102; NRHE 413469 | 1694 | MON | East Tilbury Foreshore | SETTLEMENT, HUT CIRCLE, WOOD, FLOOR, OVEN, TRACKWAY | Below 'present' high tide level, remains of settlement of hut circles, associated with much 1st-2nd century pottery. In 1920 3 adjacent huts and fragmentary remains of a 4th nearby were visible. The two largest circles had 3 rings of stakes forming a frame for wattlework which was still preserved below the mud. Between the 2 inmost stake rings were the remains of a stone ring, a similar ring seemed to have been outside the outer stake ring. One hut had traces of a partition, another had a small circular platform in the middle, probably a support for a central pole. The latter hut had a piece of floor-planking, close by this were foundations for an oven with hard clay walls, no indication of its function however. The smallest circle appeared to have an entrance marked by two thick posts. In and around the huts were fragments of clay daub for covering walls. The stone rings can't have gone up to a great height. Many roofing tile fragments may indicate roofing. East of the huts, a shallow channel ran north east-south west with traces of flanking stakes. This may have been a former trackway from the old river edge. The foreshore for c100yds either side of the huts was covered with pottery, including 1st-2nd century Samian of forms 15-17, 18, 18-31, 27, 30, 31, 37, 38, 54 (plain), 78, 79. Stamps-list in this source. Most pottery was "of native type, with marked late Celtic elements"-eg cordons, bosses, incised linear patterns-"and represents the production of native manufacturers working under Roman influence". No wasters were noticed, there was no evidence that pottery was made on the site. The site "may have been a landing-place for traffic from Kent or elsewhere", the amount of pottery "seems excessive for the ordinary requirements of a small hut settlement". Source 1 has plan and photos of the oven. | 567100 | 175600 |
| 1009 | CITIZAN 8737; NRHE 1180031 | | WRK | Anne Royal | Recorded Loss | 1636 wreck of English Third Rate ship of the line which was bilged when she took the ground at Tilbury Hope, on her arrival at Tilbury from Chatham and/or Gillingham. She was afterwards weighed and taken to Blackwall but was judged too expensive to repair and instead broken up. Constructed of wood as a galleon in 1587 for Sir Walter Raleigh, she was purchased by the Crown and served as ARK ROYAL under Howard of Effingham against the Armada in 1588 (1583091). She was renamed ANNE ROYAL on the accession of James I of England and was rebuilt in 1608. | 565180 | 175160 |
| 1010 | CITIZAN 58503; NRHE 896342 | | WRK | Three Sisters | Recorded Loss | Wreck of an English Barge, 1880 | 565180 | 175160 |
| 1011 | CITIZAN 58547; NRHE 896638 | | WRK | Sultan | Recorded Loss | Wreck of an English Barge, 1886 | 565180 | 175160 |
| 1012 | CITIZAN 58558; NRHE 896657 | | WRK | Georgian | Recorded Loss | Wreck of an English cargo vessel, 1887 | 565180 | 175160 |
| 1013 | CITIZAN 58690; NRHE 896945 | | WRK | Pearl | Recorded Loss | Wreck of an English schooner, 1898 | 565180 | 175160 |
| 1014 | CITIZAN 58731; NRHE 897434 | | WRK | H C | Recorded Loss | Wreck of an English Barge, 1908 | 565180 | 175160 |

| WA ID | MonUID | EHCR_No | RecordType | Site_Name | MonType | Description | Easting | Northing |
|---|---|---|---|---|---|---|---|---|
| 1015 | UKHO 13336 | | WRK | Iron Hulk | Wreck | Hulked iron/steel barge on the north Thames foreshore to east of Tilbury B power station. Overgrown with vegetation and partially covered with gravel and intertidal mud. Pointed bow and rounded stern with straight stem. Small fore and aft decks, now badly corroded and a large rectangular internal cargo space now filled with mud and gravel. | 566764 | 175468 |
| 1016 | UKHO 13337 | | WRK | Iron Hulk | Wreck | Hulked iron/steel barge on the north Thames foreshore to east of Tilbury B power station. Overgrown with vegetation and partially covered with gravel and intertidal mud. Snub-nosed punt bow and square stern. Small fore and aft decks, now badly corroded and a large rectangular internal cargo space now filled with mud and gravel. | 566802 | 175452 |
| 1017 | | | MON | Linear stakes and stones | | A linear feature of stones and stakes running ENE-WSW within the intertidal mud, with an arc of stones/stakes to the east of it, again within the intertidal mud. Noted on the walkover | 565091 | 175182 |
| 1018 | | | MON | Linear stone pier | | A linear pier/jett feature running from foreshore out into Thames, made of stone. Broken and falling down on west side. Noted during walkover | 565067 | 175168 |
| 1019 | | | MON | Linear stakes | | A line of small stakes within the intertidal mud to the east of the covered conveyor belt on the coaling jetty. These may be part of a fish trap or revetment but their definite purpose and date remains unknown. Noted on the walkover | 566202 | 175340 |
| 1020 | | | MON | Concrete blocks | | A set of parallel poured concrete blocks on the foreshore, just above the High Tide Mark. They are likely to be modern in date, and may relate to the construction or use of the power station. Noted on the walkover | 565709 | 175291 |
| 1021 | UKHO 13400 | | FOUL | Obstruction | UKHO obstruction | FOUL AREA CENTRED ON 512711.2N, 002421E. ORIENTATED 083/263DEGS. 80MTRS LONG, 30MTRS WIDE. SHOWN ON PLA 337/13 [APR-SEP'97, REC'D 9.3.98]. BR STD. | 567139 | 175478 |
| 1022 | UKHO 12776 | | WRK | Wreck | Wreck | 25.11.63 2 STF HULKS, OF OLD BARGES, SHOWN CENTRED IN 512711N, 002415E ON SURVEY K3034/47C - NE2151, 20.3.92 SHOWN AS 3 AREAS OF WRECKAGE ON PLA SURVEY - NE1186. | 567050 | 175490 |
| 1023 | UKHO 79651 | | WRK | Wreck | Wreck | 30.10.12 ST SHOWN IN 5127.182N, 0024.059E [WGD] ON BA 1186 [EDN 11 DTD 12.5.11]. | 566919 | 175406 |
| 1024 | UKHO 66740 | | FOUL | Obstruction | Cables/Chains/ Mooring/Nets/T ackle/Wires | 6.10.05 GROUND TACKLE LOCATED IN 5127.024N, 0022.310E [WGD] USING DGPS. HEIGHT 0.25MTR. (HMSML GLEANER, HI 1092). INS AS FOUL. BR STD. | 564903 | 175047 |
| 1025 | UKHO 57638 | | FOUL | Obstruction | UKHO obstruction | 3.8.99 OBSTN 5.3MTRS SHOWN IN 5127.091N, 0023.630E [OGB] ON PLA 336/12 [JAN 1999]. NE 1186. BUT 25.8.05 NOT LOCATED BY M/B, DCS3 | 566419 | 174592 |
| 1026 | UKHO 12777 | | WRK | Wreck | Wreck | Barge wreck. 14.11.63 DWP SHOWN IN 512713.8N, 002432E [OGB] ON SURVEY [K2954]. NE 2151. 14.8.78 NO LONGER SHOWN ON PLA 337 DTD 19.9.77. AMENDED TO DEAD. DELETE. BR STD. | 567465 | 175513 |
| 1027 | UKHO 57638 | | FOUL | Obstruction | UKHO obstruction | 3 x 8m long concrete piles. 5.3m depth. UKHO record says lifted | 566313 | 175279 |
| 1028 | UKHO 13228 | | WRK | Wreck | Wreck | Barge wreck. Listed as dead. 9.2.90 STBD HAND BUOY, FL G 5S, TEMPORARILY ESTABLISHED IN POSN 318 DEG, 1000MTRS FROM MILTON MILE MARK, TO MARK SUNKEN BARGE LYING CLOSE W. (PLA NAV WARNING NO.2 OF 1990). NCA YET. | 567492 | 175267 |
| 1029 | UKHO 69976 | | WRK | Hartnel | Wreck | Motor vessel wreck. Listed as lifted. 13.2.56 WK IN 512656N, 002358E [OGB], LYING IN MID CHANNEL, GRAVESEND REACH, IS NOW REMOVED. (LLOYDS LIST & PLA NM 1/56). AMENDED TO LIFT. NFA. | 566827 | 174942 |

| WA ID | MonUID | EHCR_No | RecordType | Site_Name | MonType | Description | Easting | Northing |
|---|---|---|---|---|---|---|---|---|
| 1030 | UKHO 13107 | | FOUL | Obstruction | UKHO obstruction | 13.5.82 OBSTN 8.2MTRS SHOWN IN 512700N, 002204.5E ON PLA 96/5. NE 2151. 7.5.85 DELETE OBSTN, RETAIN AS SOUNDING ONLY. (PLA LTR, 15.4.85). AMENDED TO DEAD. NE 2151. | 564515 | 175046 |
| 1031 | UKHO 69991 | | WRK | Southport | Wreck | Steamship wreck. EX- YEWHILL [1937], EX- SPORTSMAN, BUILT 1914 BY ARDROSSAN D.D. & S.B CO LTD, WITH 3 CYLINDER TRIPLE EXPANSION ENGINE, SINGLE SHAFT. OWNED AT TIME OF LOSS BY PARK SHIPPING CO. LTD. PASSAGE ANTWERP FOR LONDON. SANK FOLLOWING A COLLISION. Wreck refloated in 1956. Amended to lifted. | 564545 | 174991 |
| 1032 | AIME Event 915227 | | EXC | Tilbury_Fort | Excavation | Excavations of the Tilbury Fort foreshore by the Passmore Edwards Museum in 1988-89 recovered c. 1,670 wooden timbers, mostly comprising beams, planks, posts and piles relating to drainage and defensive works since 1670AD | 565200 | 175200 |

## Appendix II: Gazetteer of Medium and Low receptors of archaeological potential within geophysical survey area (from Wessex Archaeology 2017b)

| WA ID | Classification | Easting | Northing | Archaeological Discrimination | Length (m) | Width (m) | Height (m) | Magnetic Amplitude (nT) | Description | External References | Area |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 7000 | Debris | 566266 | 175226 | A2 | 1.8 | 1.4 | 0.2 | 108 | A distinct right angled dark reflector with a bright and tapered shadow, distinct feature on a sandy and even area of the seabed and identified in the bathymetry data as a small mound. Has a large magnetic anomaly associated indicating ferrous debris. Interpreted as a possible anchor. | | East |
| 7001 | Debris | 566271 | 175264 | A2 | 5.3 | 1 | 0.2 | 4824 | A long, thin and distinct dark reflector with a bright shadow, possibly debris, located on a rough and uneven area of the seabed. Has a very large magnetic anomaly possibly associated with it, indicating ferrous debris. | | East |
| 7002 | Dark reflector | 566176 | 175249 | A2 | 2.1 | 0.3 | 0 | - | A long and very thin curvilinear dark reflector with no shadow, looks anthropogenic compared to surrounding seabed features, non-ferrous. | | East |
| 7003 | Dark reflector | 565479 | 175177 | A2 | 1.7 | 0.3 | 0 | - | A distinct and solid oval shaped dark reflector with no shadow, located on a sandy area of the seabed. Non-ferrous object. 3D chirp target is situated 2.8 m from this location buried less than 1m and may be associated. | TIL2_3DC_003 | West |
| 7004 | Debris | 565687 | 175222 | A2 | 2.5 | 0.4 | 0.2 | - | A thick linear dark reflector, possibly debris located on a rough and uneven area of the seabed. Located close to modern infrastructure and possibly related. This is not covered by the magnetometer data and as such ferrous composition unknown. | | West |
| 7005 | Dark reflector | 565681 | 175223 | A2 | 2.4 | 0.3 | 0.1 | - | An indistinct dark reflector with a bright shadow, long and thick linear item similar to other objects on this area of the seabed, possibly debris though not as distinct as other anomalies. Located close to modern infrastructure, possibly related. This is not covered by the magnetometer data and as such ferrous composition unknown. | | West |
| 7006 | Debris | 565685 | 175191 | A2 | 6.3 | 1.5 | 0.8 | 870 | A large thick and distinct curvilinear dark | TIL2_3DC_057 | West |

| WA ID | Classification | Easting | Northing | Archaeological Discrimination | Length (m) | Width (m) | Height (m) | Magnetic Amplitude (nT) | Description | External References | Area |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | reflector with some smaller dark reflector features coming off its centre and a bright bulbous shadow, possible large item of debris, has a very large magnetic anomaly associated indicating ferrous debris. 3D chirp target is located 7 m from this location at a depth of 2.10 m and could be associated. | | |
| 7007 | Debris field | 566146 | 175269 | A2 | 80 | 30 | 2 | - | A large spread of debris possibly related to the construction of the port seen next to the debris field. Tens of thin, linear and rounded dark reflectors scattered across the riverbed, example dimensions of distinctive linear features 6.6 m x 0.6 m x 0.1 m; 3.4 m x 0.3 m x 0.1 m and 1 m x 0.3 m x 0.1 m. This area is not fully covered by the magnetometer data and as such ferrous composition is unknown. | | East |
| 7008 | Debris field | 566277 | 175277 | A2 | 6.6 | 6 | 0.6 | - | Possible debris field, three distinct and thin linear dark reflectors with bright shadows aligned with smaller debris pieces in-between. Highly anthropogenic debris field visible in the bathymetry data as aligned linear mounds, not covered by the magnetometer data and may be ferrous debris. 3D chirp target is located 9 m from this location and may be associated. | TIL2_3DC_240 | East |
| 7009 | Debris | 566313 | 175274 | A2 | 7 | 3 | 0.5 | 185 | A very long, thick and distinct linear piece of debris visible as a dark reflector with a bright, short shadow, has a large magnetic anomaly associated indicating ferrous debris, distinct in the bathymetry data as a long linear piece with one bulbous end | | East |
| 7010 | Debris | 566327 | 175279 | A2 | 4.1 | 0.2 | 0.1 | - | A long, thin and slightly curvilinear dark reflector with a dull shadow, possibly a rope or chain or debris feature, very indistinct linear depression in bathymetry data. This is not covered by the magnetometer data and ferrous composition is unknown | | East |
| 7011 | Debris | 566317 | 175230 | A2 | 1.7 | 1.3 | 0.5 | 302 | An indistinct almost diamond shaped dark reflector with a dull, tapered shadow, has a large magnetic anomaly associated indicating ferrous debris | | East |

| WA ID | Classification | Easting | Northing | Archaeological Discrimination | Length (m) | Width (m) | Height (m) | Magnetic Amplitude (nT) | Description | External References | Area |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 7012 | Debris | 566298 | 175280 | A2 | 6.5 | 4.2 | 0.2 | - | Very indistinct possible debris feature, a small circular hollow dark reflector with a possible rope or chain attached and a 'T' shaped object at one end with a dull shadow. This is not covered by the magnetometer data and as such ferrous composition is unknown | | East |
| 7013 | Bright reflector | 566233 | 175252 | A2 | 10.9 | 2 | 0 | - | An oval bright reflector object with a curvilinear bright reflector coming off this, possibly a rope or chain attached to something, oval object measures 1.7 x 1.4 m, probable non-ferrous debris | | East |
| 7014 | Debris | 565441 | 175168 | A2 | 3.5 | 0.4 | 0.3 | - | A very distinct curvilinear piece of debris, a long and thin dark reflector with a large and bright shadow located on a sandy area of the seabed, non-ferrous debris | | West |
| 7015 | Dark reflector | 566128 | 175235 | A2 | 2.5 | 1.1 | 0.1 | - | A hollow circular dark reflector feature, looks anomalous to the surrounding seabed, visible in the bathymetry as two small mounds within a depression, non-ferrous. Two 3D chirp targets are located 8 m from this location at depths of 0.86 and 1.02 m sub-seabed, which may be associated buried debris | TIL2_3DC_221, TIL2_3DC_222 | East |
| 7016 | Dark reflector | 566135 | 175242 | A2 | 0.8 | 0.4 | 0.1 | - | A very small hollow dark reflector feature with a bright shadow, possibly natural, non-ferrous | | East |
| 7017 | Debris | 566321 | 175251 | A2 | 1.3 | 0.7 | 0.4 | 154 | A hollow circular dark reflector with a bright shadow, possibly tyre. Has a large magnetic anomaly associated indicating ferrous debris | | East |
| 7018 | Debris | 566333 | 175223 | A2 | 2.3 | 0.6 | 0.7 | 440 | Possible debris. Dark reflector slightly right-angled at one end with a bright shadow. Located on a rough and uneven area of the seabed, has a large magnetic anomaly identified on more than one survey line indicating ferrous debris | | East |
| 7019 | Dark reflector | 566121 | 175119 | A2 | 1.2 | 0.8 | 0.1 | - | A rounded dark reflector that does not appear to be solid, anomaly has no shadow and is situated on a rough and uneven area of the seabed, visible in the bathymetry data as a small mound identified within a geological depression. Possible non-ferrous debris or natural feature. | | East |

| WA ID | Classification | Easting | Northing | Archaeological Discrimination | Length (m) | Width (m) | Height (m) | Magnetic Amplitude (nT) | Description | External References | Area |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 7020 | Debris | 566121 | 175119 | A2 | 18 | 1.8 | 0.2 | 423 | A very long thick and slightly curvilinear dark reflector with a short bright shadow, possibly large piece of debris, clearly visible in the bathymetry and has a large magnetic anomaly associated indicating ferrous debris | | East |
| 7021 | Debris | 565560 | 175220 | A2 | 2.8 | 2.2 | 0.4 | 549 | A distinct rectangular dark reflector with a large but dull shadow, has a large magnetic anomaly possible associated indicating ferrous debris | | West |
| 7022 | Debris | 565541 | 175210 | A2 | 1 | 0.3 | 0 | - | A long, thick and curvilinear dark reflector with a slight shadow and in a slight depression. Possibly non-ferrous debris | | West |
| 7023 | Bright reflector | 565560 | 175211 | A2 | 0.8 | 0.7 | 0 | - | A medium sized oval bright reflector, possibly debris or could just be natural | | West |
| 7024 | Dark reflector | 565627 | 175233 | A2 | 0.3 | 0.3 | 0.1 | - | A thick short linear dark reflector with a shadow and possibly in a slight depression. This is not covered by the magnetometer data and therefore ferrous composition unknown | | West |
| 7025 | Debris | 565620 | 175222 | A2 | 2.1 | 0.1 | 0.4 | - | An indistinct rounded dark reflector with an internal shadow, or hollow object on a rough area of seabed, in the bathymetry this is visible as a small but distinct mound within a depression measuring 2.2 x 2 m. Non-ferrous debris. 3D chirp target is located 5 m from this location at a depth of 0.22 m sub-seabed | TIL2_3DC_053 | West |
| 7026 | Dark reflector | 565611 | 175206 | A2 | 0.5 | 0.4 | 0.3 | - | A thick linear dark reflector with a slight shadow, distinctive on a sandy area of the seabed. Non-ferrous material. | | West |
| 7027 | Dark reflector | 565625 | 175189 | A2 | 0.4 | 0.2 | 0.3 | - | A distinct S shaped linear dark reflector with a bright shadow, possibly two stretched rocks but maybe anthropogenic non-ferrous feature | | West |
| 7028 | Dark reflector | 565719 | 175241 | A2 | 1 | 0.4 | 0.6 | - | An indistinct dark reflector with a bright and rectangular shadow, possibly in a slight depression. This is not covered by the magnetometer data and therefore ferrous composition unknown | | West |
| 7029 | Dark reflector | 565792 | 175247 | A2 | 0.6 | 0.1 | 0 | - | A very small linear dark reflector with no shadow. This is not covered by the magnetometer data and therefore ferrous | | West |

| WA ID | Classification | Easting | Northing | Archaeological Discrimination | Length (m) | Width (m) | Height (m) | Magnetic Amplitude (nT) | Description | External References | Area |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | composition unknown | | |
| 7030 | Dark reflector | 566209 | 175275 | A2 | 2.4 | 0.2 | 0 | - | A long and thin curvilinear dark reflector with no shadow, very distinct. This is not covered by the magnetometer data and therefore ferrous composition unknown | | East |
| 7031 | Magnetic | 566627 | 175151 | A2 | - | - | - | 379 | Large anomaly identified on more than one survey line. Indicative of possible buried ferrous debris | | East |
| 7032 | Magnetic | 566583 | 175161 | A2 | - | - | - | 69 | Medium asymmetric dipole only identified on one survey line. Indicative of possible buried ferrous debris | | East |
| 7033 | Magnetic | 566418 | 175190 | A2 | - | - | - | 87 | Small negative monopole identified on more than one survey line. Indicative of possible buried ferrous debris | | East |
| 7034 | Magnetic | 566210 | 175139 | A2 | - | - | - | 83 | Medium asymmetric dipole only identified on one survey line. Indicative of possible buried ferrous debris | | East |
| 7035 | Magnetic | 566124 | 175132 | A2 | - | - | - | 321 | Large dipole only identified on one survey line. Indicative of possible buried ferrous debris | | East |
| 7036 | Magnetic | 566238 | 175144 | A2 | - | - | - | 157 | Large negative monopole only identified on one survey line. Indicative of possible buried ferrous debris | | East |
| 7037 | Magnetic | 566256 | 175155 | A2 | - | - | - | 15 | Small dipole identified on more than one survey line. Indicative of possible buried ferrous debris | | East |
| 7038 | Magnetic | 566450 | 175179 | A2 | - | - | - | 56 | Medium asymmetric dipole only identified on one survey line. Indicative of possible buried ferrous debris | | East |
| 7039 | Magnetic | 566435 | 175178 | A2 | - | - | - | 31 | Small positive monopole only identified on one survey line. Indicative of possible buried ferrous debris | | East |
| 7040 | Magnetic | 566380 | 175174 | A2 | - | - | - | 58 | Medium asymmetric dipole only identified on one survey line. Indicative of possible buried ferrous debris | | East |
| 7041 | Magnetic | 566396 | 175180 | A2 | - | - | - | 23 | Small positive monopole only identified on one survey line. Indicative of possible buried ferrous debris | | East |
| 7042 | Magnetic | 566290 | 175170 | A2 | - | - | - | 63 | Medium asymmetric dipole only identified on one survey line. Indicative of possible buried | | East |

| WA ID | Classification | Easting | Northing | Archaeological Discrimination | Length (m) | Width (m) | Height (m) | Magnetic Amplitude (nT) | Description | External References | Area |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | ferrous debris | | |
| 7043 | Magnetic | 566419 | 175185 | A2 | - | - | - | 208 | Large dipole only identified on one survey line. Indicative of possible buried ferrous debris | | East |
| 7044 | Magnetic | 566450 | 175189 | A2 | - | - | - | 83 | Medium positive monopole only identified on one survey line. Indicative of possible buried ferrous debris | | East |
| 7045 | Magnetic | 566361 | 175182 | A2 | - | - | - | 85 | Medium asymmetric dipole only identified on one survey line. Indicative of possible buried ferrous debris | | East |
| 7046 | Magnetic | 566330 | 175179 | A2 | - | - | - | 211 | Large dipole weakly identified on more than one survey line. Indicative of possible buried ferrous debris | | East |
| 7047 | Magnetic | 566361 | 175192 | A2 | - | - | - | 36 | Small anomaly only identified on one survey line. Indicative of possible buried ferrous debris | | East |
| 7048 | Magnetic | 566360 | 175220 | A2 | - | - | - | 42 | Small dipole only identified on one survey line. Indicative of possible buried ferrous debris | | East |
| 7049 | Magnetic | 566188 | 175213 | A2 | - | - | - | 112 | Large anomaly only identified on one survey line. Indicative of possible buried ferrous debris | | East |
| 7050 | Magnetic | 566228 | 175218 | A2 | - | - | - | 154 | Large dipole weakly identified on more than one survey line. Indicative of possible buried ferrous debris | | East |
| 7051 | Magnetic | 566291 | 175224 | A2 | - | - | - | 137 | Large dipole identified on more than one survey line. Indicative of possible buried ferrous debris | | East |
| 7052 | Magnetic | 566164 | 175217 | A2 | - | - | - | 195 | Large asymmetric dipole only identified on one survey line. Indicative of possible buried ferrous debris | | East |
| 7053 | Magnetic | 566185 | 175220 | A2 | - | - | - | 143 | Large asymmetric dipole only identified on one survey line. 3D chirp target is located 4.6 m from this location, possibly buried ferrous object | | East |
| 7054 | Magnetic | 566276 | 175228 | A2 | - | - | - | 59 | Medium dipole only identified on one survey line. Indicative of possible buried ferrous debris | | East |
| 7055 | Magnetic | 566314 | 175241 | A2 | - | - | - | 278 | Large asymmetric dipole only identified on one survey line. Indicative of possible buried ferrous debris | | East |

| WA ID | Classification | Easting | Northing | Archaeological Discrimination | Length (m) | Width (m) | Height (m) | Magnetic Amplitude (nT) | Description | External References | Area |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 7056 | Magnetic | 565685 | 175197 | A2 | - | - | - | 462 | Large anomaly identified on more than one survey line. Indicative of possible buried ferrous debris | | West |
| 7057 | Magnetic | 565701 | 175209 | A2 | - | - | - | 2622 | Very large dipole identified on more than on survey line. Indicative of possible buried ferrous debris | | West |
| 7058 | Magnetic | 565566 | 175201 | A2 | - | - | - | 2163 | Very large dipole identified on more than on survey line. 3D chirp target is located 5 m from this location, possibly buried ferrous object at depth of 0.29 m | TIL2_3DC_031 | West |
| 7059 | Magnetic | 566496 | 175136 | A2 | - | - | - | 37 | Small dipole only identified on one survey line. Indicative of possible buried ferrous debris | | East |
| 7060 | Magnetic | 566553 | 175141 | A2 | - | - | - | 2307 | Very large dipole identified on more than on survey line. Indicative of possible buried ferrous debris | | East |
| 7061 | Magnetic | 566618 | 175142 | A2 | - | - | - | 118 | Large asymmetric dipole identified on more than one survey line. Indicative of possible buried ferrous debris | | East |
| 7062 | Magnetic | 566672 | 175140 | A2 | - | - | - | 1781 | Very large negative monopole possibly identified on more than one survey line. Indicative of possible buried ferrous debris | | East |
| 7063 | Magnetic | 566178 | 175119 | A2 | - | - | - | 66 | Medium dipole possibly on more than one survey line, possibly natural. Indicative of possible buried ferrous debris | | East |
| 7064 | Magnetic | 566160 | 175118 | A2 | - | - | - | 80 | Medium positive monopole only identified on one survey line, possibly natural. Indicative of possible buried ferrous debris | | East |
| 7065 | Magnetic | 566134 | 175115 | A2 | - | - | - | 56 | Medium positive monopole only identified on one survey line. Indicative of possible buried ferrous debris | | East |
| 7066 | Magnetic | 566109 | 175113 | A2 | - | - | - | 86 | Medium dipole only identified on one survey line. Indicative of possible buried ferrous debris | | East |
| 7067 | Magnetic | 566066 | 175109 | A2 | - | - | - | 65 | Medium dipole only identified on one survey line. 3D chirp target is located 2 m from this location, possibly buried ferrous object at depth of 2.34 m | TIL2_3DC_100 | East |
| 7068 | Magnetic | 566331 | 175218 | A2 | - | - | - | 113 | Large dipole identified on more than one survey line. Indicative of possible buried | | East |

| WA ID | Classification | Easting | Northing | Archaeological Discrimination | Length (m) | Width (m) | Height (m) | Magnetic Amplitude (nT) | Description | External References | Area |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | ferrous debris | | |
| 7069 | Magnetic | 566155 | 175236 | A2 | - | - | - | 703 | Very large anomaly only identified on one survey line, possibly natural. Indicative of possible buried ferrous debris | | East |
| 7070 | Magnetic | 566195 | 175238 | A2 | - | - | - | 155 | Large dipole identified on more than one survey line. Indicative of possible buried ferrous debris | | East |
| 7071 | Magnetic | 566483 | 175137 | A2 | - | - | - | 56 | Medium dipole only identified on one survey line. Indicative of possible buried ferrous debris | | East |
| 7072 | Magnetic | 566189 | 175133 | A2 | - | - | - | 50 | Medium asymmetric dipole identified on more than one survey line. Indicative of possible buried ferrous debris | | East |
| 7073 | Magnetic | 566349 | 175184 | A2 | - | - | - | 115 | Large negative monopole possibly identified on more than one survey line. Indicative of possible buried ferrous debris | | East |
| 7074 | Magnetic | 566349 | 175225 | A2 | - | - | - | 73 | Medium dipole only identified on one survey line. Indicative of possible buried ferrous debris | | East |
| 7075 | Magnetic | 566296 | 175254 | A2 | - | - | - | 85 | Medium negative monopole weakly observed on more than one survey line. Indicative of possible buried ferrous debris | | East |
| 7076 | Magnetic | 565695 | 175201 | A2 | - | - | - | 2741 | Very large anomaly only identified on one survey line. Indicative of possible buried ferrous debris | | West |
| 7077 | Magnetic | 566178 | 175252 | A2 | - | - | - | 1732 | Very large dipole identified weakly on more than one survey line. Indicative of possible buried ferrous debris | | East |
| 7078 | Magnetic | 566193 | 175254 | A2 | - | - | - | 6428 | Very large dipole identified on more than one survey line. Indicative of possible buried ferrous debris | | East |
| 7079 | Magnetic | 566461 | 175175 | A2 | - | - | - | 215 | Large anomaly identified on more than one survey line. Indicative of possible buried ferrous debris | | East |
| 7080 | Magnetic | 566446 | 175173 | A2 | - | - | - | 150 | Large positive monopole only identified on one survey line. Indicative of possible buried ferrous debris | | East |
| 7081 | Magnetic | 566538 | 175149 | A2 | - | - | - | 94 | Large negative monopole identified on more than one survey line. Indicative of possible | | East |

| WA ID | Classification | Easting | Northing | Archaeological Discrimination | Length (m) | Width (m) | Height (m) | Magnetic Amplitude (nT) | Description | External References | Area |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | buried ferrous debris | | |
| 7082 | Magnetic | 565559 | 175240 | A2 | - | - | - | 190 | Large dipole only identified on one survey line. Indicative of possible buried ferrous debris | | West |
| 7083 | Magnetic | 566282 | 175228 | A2 | - | - | - | 74 | Medium dipole only identified on one survey line. Indicative of possible buried ferrous debris | | East |
| 7084 | Magnetic | 566277 | 175232 | A2 | - | - | - | 74 | Medium dipole possibly identified on more one survey line. Indicative of possible buried ferrous debris | | East |
| 7085 | Magnetic | 566077 | 175213 | A2 | - | - | - | 150 | Large dipole only identified on one survey line. 3D chirp target is located 10 m from this location, possibly buried ferrous object at depth of 0.54 m | TIL2_3DC_113 | East |
| 7086 | Magnetic | 566299 | 175220 | A2 | - | - | - | 40 | Small dipole identified on more than one survey line. 3D chirp target is located 5 m from this location, possibly buried ferrous object at depth of 1.92 m sub-seabed | TIL2_3DC_128 | East |
| 7087 | Magnetic | 565474 | 175169 | A2 | - | - | - | 736 | Very large dipole only identified on one survey line. Indicative of possible buried ferrous debris | | West |
| 7088 | Magnetic | 565614 | 175174 | A2 | - | - | - | 391 | Large negative monopole only identified on one survey line. 3 D chirp target is located 7 m from this location, may be buried ferrous object at a depth of 0.53 m | TIL2_3DC_043 | West |
| 7089 | Magnetic | 565575 | 175171 | A2 | - | - | - | 81 | Medium asymmetric dipole only identified on one survey line. 3D chirp target is located 6 m from this location, possibly buried ferrous object at a depth of 1.81 m | TIL2_3DC_024 | West |
| 7090 | Magnetic | 566145 | 175229 | A2 | - | - | - | 591 | Large asymmetric dipole identified on more than one survey line. Indicative of possible buried ferrous debris | | East |
| 7091 | Magnetic | 566263 | 175248 | A2 | - | - | - | 560 | Very large dipole only identified on one survey line. 3d chirp target is located 3.5 m from this location, possibly buried ferrous object at a depth of 1.42 m sub-seabed | TIL2_3DC_238 | East |
| 7092 | Magnetic | 565576 | 175181 | A2 | - | - | - | 217 | Large dipole only identified on one survey line. Indicative of possible buried ferrous debris | | West |
| 7093 | Magnetic | 566262 | 175252 | A2 | - | - | - | 431 | Large dipole only identified on one survey line. Indicative of possible buried ferrous debris | | East |

| WA ID | Classification | Easting | Northing | Archaeological Discrimination | Length (m) | Width (m) | Height (m) | Magnetic Amplitude (nT) | Description | External References | Area |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 7094 | Magnetic | 566151 | 175241 | A2 | - | - | - | 522 | Very large anomaly identified on more than one survey line. Indicative of possible buried ferrous debris | | East |
| 7095 | Magnetic | 566376 | 175156 | A2 | - | - | - | 60 | at a depth of 0.26 m sub-seabedMedium dipole possibly faintly seen on more than one survey line. 3D chirp target is located 6 m from this location, possibly buried ferrous object | TIL2_3DC_118 | East |
| 7096 | Magnetic | 566184 | 175144 | A2 | - | - | - | 176 | Large dipole possibly faintly seen on more than one survey line. Indicative of possible buried ferrous debris | | East |
| 7097 | Magnetic | 566218 | 175256 | A2 | - | - | - | 499 | Large anomaly identified on more than one survey line. Indicative of possible buried ferrous debris | | East |
| 7098 | Magnetic | 566238 | 175261 | A2 | - | - | - | 417 | Large negative monopole faintly identified on more than one survey line. Indicative of possible buried ferrous debris | | East |
| 7099 | Magnetic | 566116 | 175248 | A2 | - | - | - | 469 | Large dipole only identified on one survey line. Indicative of possible buried ferrous debris at a depth of 0.43 m sub-seabed | TIL2_3DC_227 | East |
| 7100 | Magnetic | 566541 | 175143 | A2 | - | - | - | 243 | Large anomaly identified on more than one survey line. Indicative of possible buried ferrous debris | | East |
| 7101 | Magnetic | 566430 | 175139 | A2 | - | - | - | 75 | Medium dipole identified on more than one survey line. Indicative of possible buried ferrous debris | | East |
| 7102 | Magnetic | 566112 | 175203 | A2 | - | - | - | 56 | Medium dipole only identified on one survey line. Indicative of possible buried ferrous debris | | East |
| 7103 | Magnetic | 566055 | 175225 | A2 | - | - | - | 619 | Very large dipole only identified on one survey line. 3d chirp target is located 5 m from this location, possibly buried ferrous object at a depth of 0.48 m sub-seabed | TIL2_3DC_206 | East |
| 7104 | Magnetic | 566282 | 175265 | A2 | - | - | - | 145 | Large dipole only identified on one survey line. 3D chirp target is located 7 m from this location, possibly buried ferrous object at a depth of 0.89 m sub-seabed | TIL2_3DC_239 | East |
| 7105 | Magnetic | 566247 | 175258 | A2 | - | - | - | 869 | Very large dipole identified on more than one survey line. Indicative of possible buried ferrous debris | | East |

| WA ID | Classification | Easting | Northing | Archaeological Discrimination | Length (m) | Width (m) | Height (m) | Magnetic Amplitude (nT) | Description | External References | Area |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 7106 | Magnetic | 566201 | 175255 | A2 | - | - | - | 1350 | Very large positive monopole only really seen on one survey line. Indicative of possible buried ferrous debris | | East |
| 7107 | Magnetic | 565598 | 175208 | A2 | - | - | - | 312 | Large dipole only identified on one survey line. Indicative of possible buried ferrous debris | | West |
| 7108 | Magnetic | 566098 | 175214 | A2 | - | - | - | 291 | Large dipole only identified on one survey line. 3D chirp target is located 7 m from this location, possibly buried ferrous object at a depth of 1.20 m sub-seabed | TIL2_3DC_216 | East |
| 7109 | Magnetic | 565593 | 175235 | A2 | - | - | - | 67 | Medium dipole only identified on one survey line. Indicative of possible buried ferrous debris | | West |
| 7110 | Magnetic | 566096 | 175230 | A2 | - | - | - | 249 | Large dipole only identified on one survey line, possibly buried ferrous object | | East |
| 7111 | Magnetic | 566143 | 175218 | A2 | - | - | - | 71 | Medium dipole only identified on one survey line. 3D chirp target is located 8 m from this location, possibly buried ferrous object at a depth of 0.96 m sub-seabed | TIL2_3DC_213 | East |
| 7112 | Magnetic | 566163 | 175248 | A2 | - | - | - | 253 | Large dipole only identified on one survey line, noisy area, they have picked it and it is quite large. 3D chirp target is located 7 m from this location, possibly buried ferrous object at a depth of 0.86 m sub-seabed | TIL2_3DC_237 | East |
| 7113 | Magnetic | 566316 | 175264 | A2 | - | - | - | 652 | Large dipole only identified on one survey line. Indicative of possible buried ferrous debris | | East |
| 7114 | Magnetic | 566283 | 175256 | A2 | - | - | - | 134 | Large positive monopole only identified on one survey line. Indicative of possible buried ferrous debris | | East |
| 7115 | Magnetic | 566148 | 175130 | A2 | - | - | - | 46 | Small asymmetric dipole only identified on one survey line. Indicative of possible buried ferrous debris | | East |

Notes:

1. All coordinates are in OSGB36 British National Grid
2. Positions are considered accurate to within approximately ±10 m

## Appendix III: Potential buried anomalies identified on the 3D chirp data

| 3D_CHIRP_ID | Easting | Northing | Depth (m) sub-seabed (@1600 m/s) | Width (m) | Length (m) | Thickness (m@1600 m/s) | Notes | WA ID | Area |
|---|---|---|---|---|---|---|---|---|---|
| TIL2_3DC_001 | 565451 | 175175 | 0.56 | 0.9 | 0.9 | 0.3 | May be geology | | West |
| TIL2_3DC_002 | 565466 | 175175 | 0.22 | 0.9 | 2.2 | 0.3 | | | West |
| TIL2_3DC_003 | 565476 | 175178 | 0.59 | 0.8 | 0.8 | 0.2 | May be geology | 2.8 m from 7033 | West |
| TIL2_3DC_004 | 565455 | 175165 | 1.38 | 0.7 | 2.1 | 0.15 | | | West |
| TIL2_3DC_005 | 565465 | 175179 | 0.17 | 1.1 | 1.7 | 0.4 | | | West |
| TIL2_3DC_006 | 565481 | 175181 | 0.44 | 1 | 1 | 0.3 | | | West |
| TIL2_3DC_007 | 565465 | 175181 | 0.24 | 1.2 | 2.4 | 0.5 | | | West |
| TIL2_3DC_010 | 565476 | 175190 | 0.26 | 2.5 | 3.7 | 0.3 | | | West |
| TIL2_3DC_011 | 565488 | 175191 | 0.24 | 1.9 | 2.5 | 0.4 | May be geology | | West |
| TIL2_3DC_014 | 565470 | 175212 | 0.42 | 0.7 | 0.8 | 0.3 | | | West |
| TIL2_3DC_015 | 565444 | 175213 | 1.79 | 1.1 | 1.1 | 0.5 | | | West |
| TIL2_3DC_018 | 565475 | 175225 | 2.32 | 1.3 | 1.7 | 0.3 | | | West |
| TIL2_3DC_019 | 565483 | 175231 | 2.62 | 0.7 | 0.7 | 0.3 | | | West |
| TIL2_3DC_020 | 565505 | 175232 | 1.98 | 0.7 | 1.2 | 0.3 | | | West |
| TIL2_3DC_024 | 565566 | 175172 | 1.81 | 0.6 | 1.4 | 0.2 | | 6 m from 7089 | West |
| TIL2_3DC_028 | 565514 | 175186 | 8.66 | 1.4 | 1.5 | 0.4 | | | West |
| TIL2_3DC_030 | 565515 | 175192 | 1.03 | 0.7 | 0.9 | 0.3 | | | West |
| TIL2_3DC_031 | 565565 | 175196 | 0.29 | 1.2 | 1.2 | 0.5 | | 5 m from 7058 | West |
| TIL2_3DC_032 | 565577 | 175197 | 0.29 | 1.5 | 1.6 | 0.3 | | | West |
| TIL2_3DC_034 | 565552 | 175206 | 4.18 | 1 | 1.1 | 0.4 | | | West |
| TIL2_3DC_039 | 565529 | 175229 | 1.90 | 0.8 | 2 | 0.4 | | | West |
| TIL2_3DC_040 | 565533 | 175236 | 2.06 | 0.9 | 1 | 0.3 | | | West |
| TIL2_3DC_041 | 565514 | 175237 | 2.41 | 0.6 | 0.6 | 0.3 | | | West |
| TIL2_3DC_042 | 565650 | 175179 | 1.06 | 0.8 | 0.9 | 0.4 | | | West |

| 3D_CHIRP_ID | Easting | Northing | Depth (m) sub-seabed (@1600 m/s) | Width (m) | Length (m) | Thickness (m@1600 m/s) | Notes | WA ID | Area |
|---|---|---|---|---|---|---|---|---|---|
| TIL2_3DC_043 | 565620 | 175178 | 0.53 | 0.9 | 0.9 | 0.3 | | 7 m from 7088 | West |
| TIL2_3DC_045 | 565616 | 175189 | 2.78 | 0.8 | 1.8 | 0.4 | | | West |
| TIL2_3DC_046 | 565642 | 175197 | 2.36 | 0.8 | 0.8 | 0.3 | | | West |
| TIL2_3DC_051 | 565646 | 175215 | 0.23 | 1 | 1.5 | 0.2 | | | West |
| TIL2_3DC_053 | 565625 | 175220 | 0.22 | 1.2 | 1.6 | 0.3 | | 5 m from 7025 | West |
| TIL2_3DC_054 | 565635 | 175222 | 0.26 | 1 | 2 | 0.3 | | | West |
| TIL2_3DC_057 | 565691 | 175186 | 2.10 | 1.4 | 2.5 | 0.2 | | 7 m from 7006 | West |
| TIL2_3DC_058 | 565711 | 175191 | 1.72 | 1.3 | 2.4 | 0.2 | | | West |
| TIL2_3DC_059 | 565712 | 175194 | 1.71 | 0.8 | 1.2 | 0.3 | | | West |
| TIL2_3DC_060 | 565682 | 175212 | 1.19 | 0.9 | 1.7 | 0.2 | | | West |
| TIL2_3DC_061 | 565721 | 175215 | 0.82 | 1.1 | 1.5 | 0.4 | | | West |
| TIL2_3DC_063 | 565706 | 175217 | 1.51 | 1.2 | 2.3 | 0.3 | | | West |
| TIL2_3DC_064 | 565694 | 175216 | 1.18 | 0.8 | 1.7 | 0.3 | | | West |
| TIL2_3DC_065 | 565684 | 175217 | 1.42 | 2.1 | 2.7 | 0.3 | | 5 m from 7004 | West |
| TIL2_3DC_066 | 565698 | 175219 | 1.46 | 0.9 | 1.4 | 0.1 | | | West |
| TIL2_3DC_067 | 565722 | 175220 | 1.07 | 1.6 | 1.7 | 0.4 | | | West |
| TIL2_3DC_071 | 565733 | 175203 | 0.71 | 1.4 | 1.6 | 0.1 | | | West |
| TIL2_3DC_074 | 565732 | 175218 | 1.48 | 0.9 | 1.3 | 0.2 | | | West |
| TIL2_3DC_100 | 566068 | 175111 | 2.34 | 0.9 | 2 | 1.5 | | 2 m from 7067 | East |
| TIL2_3DC_113 | 566072 | 175203 | 0.54 | 1.5 | 1.8 | 0.4 | | 10 m from 7085 Mag | East |
| TIL2_3DC_118 | 566370 | 175155 | 0.26 | 1.5 | 3.6 | 0.2 | | | East |
| TIL2_3DC_119 | 566386 | 175164 | 0.19 | 1.6 | 2.4 | 0.3 | | | East |
| TIL2_3DC_121 | 566376 | 175196 | 1.60 | 1.7 | 3.2 | 0.3 | | | East |
| TIL2_3DC_124 | 566321 | 175208 | 1.84 | 2.4 | 3.5 | 0.4 | | | East |
| TIL2_3DC_125 | 566317 | 175207 | 2.08 | 1.2 | 2.2 | 0.4 | | | East |
| TIL2_3DC_126 | 566302 | 175206 | 2.17 | 1.7 | 3.4 | 0.4 | | | East |

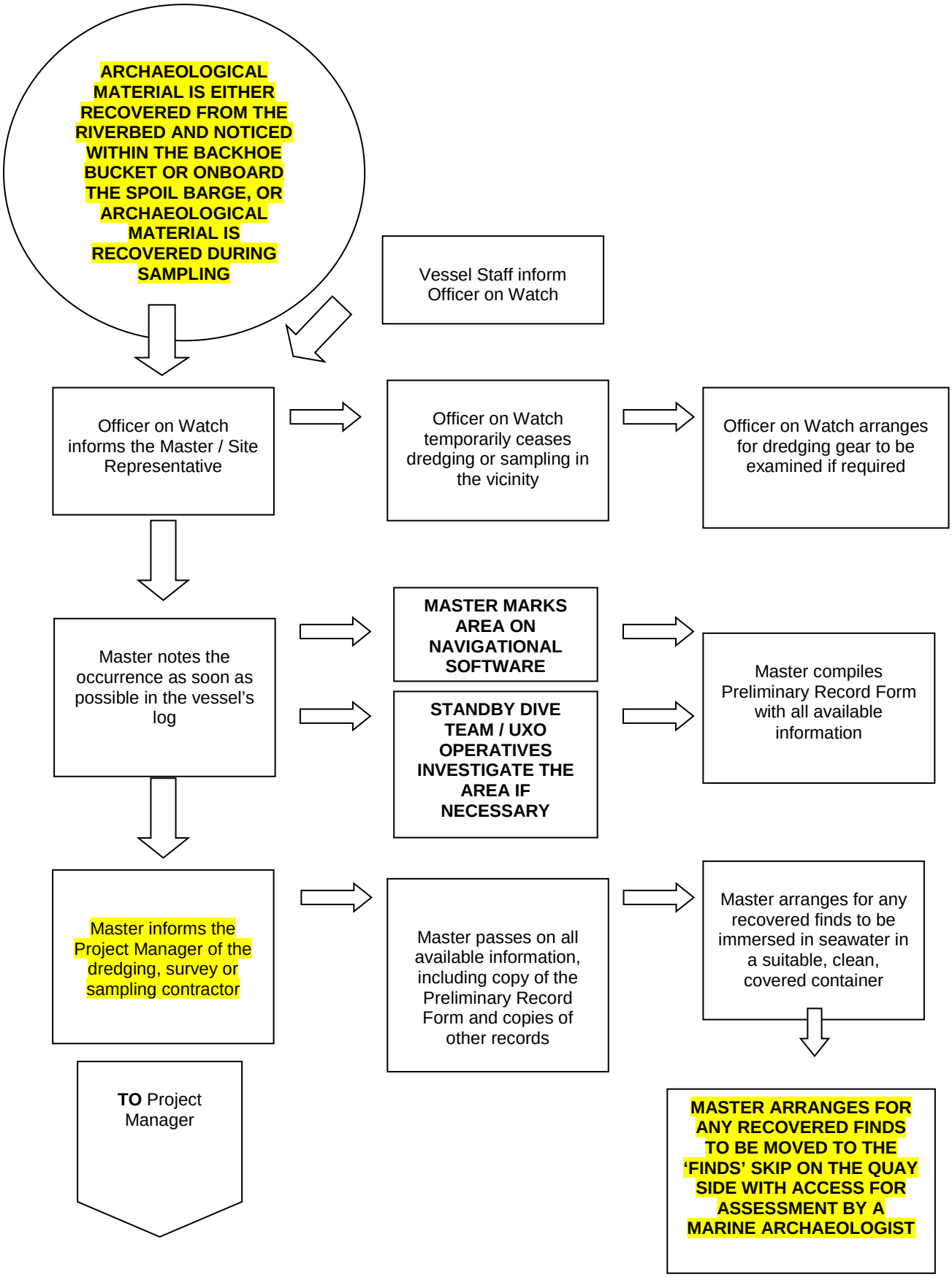
| 3D_CHIRP_ID | Easting | Northing | Depth (m) sub-seabed (@1600 m/s) | Width (m) | Length (m) | Thickness (m@1600 m/s) | Notes | WA ID | Area |
|---|---|---|---|---|---|---|---|---|---|
| TIL2_3DC_127 | 566306 | 175211 | 1.84 | 2.2 | 3.1 | 0.4 | | | East |
| TIL2_3DC_128 | 566300 | 175216 | 1.92 | 1 | 1.8 | 0.3 | | 5 m from 7086 | East |
| TIL2_3DC_131 | 566403 | 175194 | 1.62 | 1.6 | 3.8 | 0.3 | | | East |
| TIL2_3DC_132 | 566576 | 175136 | 2.26 | 1.3 | 2 | 0.4 | | | East |
| TIL2_3DC_133 | 566564 | 175137 | 2.06 | 1.2 | 1.5 | 0.4 | | | East |
| TIL2_3DC_202 | 566057 | 175212 | 0.45 | 1.2 | 2.3 | 0.3 | | | East |
| TIL2_3DC_203 | 566064 | 175213 | 0.38 | 0.9 | 3.3 | 0.3 | | | East |
| TIL2_3DC_204 | 566044 | 175213 | 1.32 | 2.1 | 2.2 | 0.4 | | | East |
| TIL2_3DC_205 | 566021 | 175216 | 0.64 | 1 | 1 | 0.5 | | | East |
| TIL2_3DC_206 | 566051 | 175224 | 0.48 | 1.5 | 4 | 0.4 | | 5 m 7103 | East |
| TIL2_3DC_209 | 566089 | 175210 | 0.58 | 1.6 | 2.5 | 0.3 | | | East |
| TIL2_3DC_210 | 566107 | 175213 | 1.10 | 2.1 | 2.1 | 0.3 | | | East |
| TIL2_3DC_213 | 566135 | 175214 | 0.96 | 1.2 | 1.6 | 0.3 | | 8 m from 7111 | East |
| TIL2_3DC_214 | 566128 | 175218 | 1.46 | 2 | 2.3 | 0.3 | | | East |
| TIL2_3DC_215 | 566120 | 175216 | 0.46 | 1.2 | 1.2 | 0.4 | | | East |
| TIL2_3DC_216 | 566105 | 175217 | 1.20 | 1.6 | 2.5 | 0.3 | | 7 m from 7108 | East |
| TIL2_3DC_220 | 566109 | 175223 | 1.15 | 0.7 | 1.8 | 0.2 | | | East |
| TIL2_3DC_221 | 566130 | 175227 | 0.86 | 1.5 | 1.5 | 0.4 | | 8 m from 7015 | East |
| TIL2_3DC_222 | 566133 | 175227 | 1.02 | 1.6 | 1.6 | 0.4 | | 8 m from 7015 | East |
| TIL2_3DC_223 | 566087 | 175231 | 1.06 | 0.9 | 1.3 | 0.3 | L-shaped | | East |
| TIL2_3DC_224 | 566102 | 175238 | 1.48 | 1.7 | 2.6 | 0.4 | | | East |
| TIL2_3DC_225 | 566121 | 175245 | 0.45 | 1.8 | 3.7 | 0.5 | Possibly geology? | | East |
| TIL2_3DC_226 | 566128 | 175250 | 0.54 | 1.2 | 2 | 0.2 | | | East |
| TIL2_3DC_227 | 566118 | 175249 | 0.43 | 1.1 | 2.7 | 0.3 | | 2 m from 7099 | East |
| TIL2_3DC_228 | 566136 | 175251 | 0.68 | 2.1 | 2.2 | 0.3 | | | East |
| TIL2_3DC_229 | 566141 | 175252 | 0.37 | 1.2 | 1.2 | 0.2 | Possibly 2 targets | | East |

| 3D_CHIRP_ID | Easting | Northing | Depth (m) sub-seabed (@1600 m/s) | Width (m) | Length (m) | Thickness (m@1600 m/s) | Notes | WA ID | Area |
|---|---|---|---|---|---|---|---|---|---|
| TIL2_3DC_230 | 566101 | 175253 | 1.70 | 1 | 1.9 | 0.3 | | | East |
| TIL2_3DC_231 | 566111 | 175253 | 0.81 | 0.7 | 1.8 | 0.3 | | | East |
| TIL2_3DC_232 | 566117 | 175253 | 3.05 | 1.1 | 3 | 0.2 | | | East |
| TIL2_3DC_233 | 566121 | 175254 | 0.51 | 2 | 2.5 | 0.2 | | | East |
| TIL2_3DC_234 | 566121 | 175263 | 4.33 | 1.9 | 2.6 | 0.6 | | | East |
| TIL2_3DC_237 | 566156 | 175251 | 0.86 | 1.2 | 1.8 | 0.3 | | 7 m from 7112 | East |
| TIL2_3DC_238 | 566261 | 175245 | 1.42 | 1.3 | 2.2 | 0.5 | | 3.5 m from 7091 | East |
| TIL2_3DC_239 | 566289 | 175266 | 0.85 | 1.2 | 1.8 | 0.4 | | 7 m from 7104 | East |
| TIL2_3DC_240 | 566285 | 175282 | 2.74 | 2.5 | 2.5 | 0.5 | | 9 m from 7008 | East |
| TIL2_3DC_244 | 566314 | 175298 | 4.11 | 3 | 3 | 0.6 | Possibly artifact | | East |
| TIL2_3DC_246 | 566117 | 175228 | 1.32 | 1.5 | 2 | 0.4 | | | East |
| TIL2_3DC_248 | 566114 | 175252 | 3.05 | 1.2 | 2.2 | 0.3 | | | East |
| TIL2_3DC_249 | 566118 | 175225 | 1.32 | 1.5 | 2.5 | 0.4 | | | East |
| TIL2_3DC_250 | 566116 | 175228 | 1.32 | 0.6 | 0.9 | 0.3 | | | East |

Notes:

1. All coordinates are in OSGB36 British National Grid
2. Data as provided in SAND (2017)

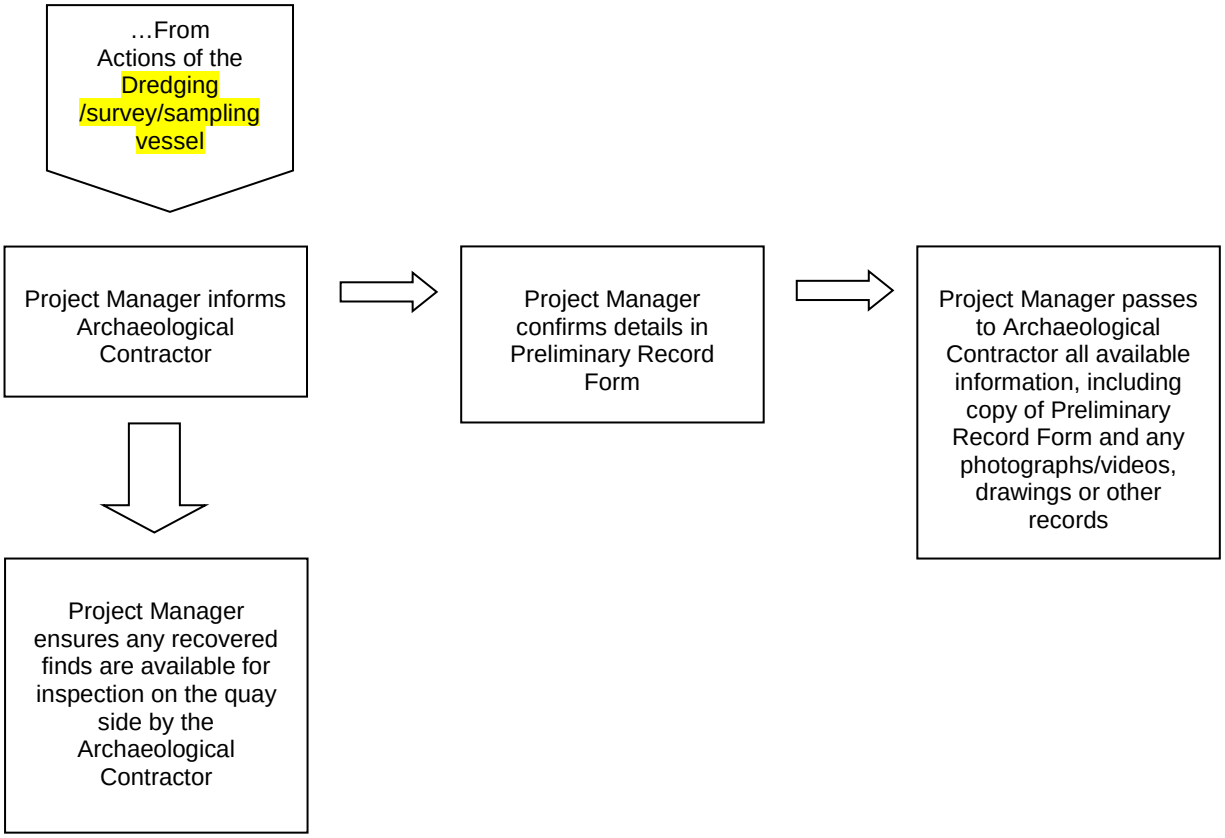
## Appendix IV: Actions on the survey, sampling or dredging vessel - anomalies on the seabed or finds recovered from the seabed



## Appendix V: Preliminary Recording Form

| | | |
|---|---|---|
| | Unique ID: | |
| Date: | Name of Report Compiler: | Contact details: |
| Vessel Name: | Dredging Area: | Name of Master: |
| Name of Officer on Watch: | Name of Finder: | Time that anomaly was encountered / find discovered |
| Vessel position at time when the anomaly was encountered / find discovered: | | |
| BNG Eastings: | BNG Northings: | Datum (if different from BNG): |
| Notes on position given: ie: How accurate is the position given above? Is the position the original position of the anomaly on the seabed or have operations moved the material some distance from its original location? | | |
| Description of the anomaly / find: | | |
| For Anomalies: Apparent extent of anomaly: m long x m wide x m above general level of seabed: | | |
| For Anomalies: Extent of deviation and of route development: | | |
| For Finds: Details of any photographs, drawings or other records made of the find: | | |
| For Finds: Details of any treatment given to the find: | | |
| Date and time at which Project Manager was informed: | General notes: | |

## Appendix VI: Actions for the Project Manager



## Appendix VII: Guidelines for Identifying Finds of Archaeological Interest

This text is based on the categories outlined in the Protocol for Reporting Finds of Archaeological Interest, published by the British Marine Aggregate Producer's Association (BMAPA) and English Heritage (now Historic England), 2005. The variety in significance across each type of find means that the day to day assessment of individual receptors as Major, Intermediate or Minor finds will be completed by an appropriately qualified archaeologist, either working directly on site with each receptor or remotely using images, dimensions and video stills.

### Bone

*Major Archaeological Finds*

Human bone is definitely of archaeological interest and is also subject to special legal requirements under the Burial Act 1857. Any suspected human bone should be reported and treated with discretion and respect.

Large quantities of animal bone may indicate a wreck (the remains of cargo or provisions) and should be reported.

Objects made out of bone – such as combs, harpoon points or decorative items – can be very old and are definitely of archaeological interest. All occurrences should be reported and recovered if feasible.

*Intermediate Archaeological Finds*

Individual fragments or small quantity/low densities of animal bone, teeth and tusks are of archaeological interest because they may date to periods when the seabed formed dry land, and should be reported. Such bones, teeth, tusks etc. may have signs of damage, breaking or cutting that can be directly attributed to human activity. Should any such anthropomorphic damage, breaking of cutting be identified then the find will be considered a Major Archaeological Find.

### Pottery

*Intermediate Archaeological Finds*

Any fragment of pottery is potentially of interest, especially if it is a large fragment. Individual fragments or small quantity/low densities of pottery are considered an Intermediate Archaeological Find and likely to date prior to 1750. Items with unusual shape, glaze or fabric should be reported. It is noted that there is the potential for residue analysis on ceramic sherds and vessels recovered from marine environments, and this should be considered where these are recovered (Historic England 2017).

As the area may have been used as a landing place for ships during the Roman period (see Section 5.4.11), there is also the potential for trade and exchange to be visible within the ceramic assemblage.

*Minor Archaeological Finds*

Items which look like modern crockery would be considered to be a minor archaeological find, until further assessment.

### Brick

*Intermediate Archaeological Finds*

Bricks that do not have v-shaped hollows ('frogs') and/or are small, thin, or generally appear different than modern bricks could date back to the medieval or Roman period and should be reported.

*Minor Archaeological Finds*

Bricks with modern proportions and 'frogs' are of little to no archaeological interest.

**Wood**

*Major Archaeological Finds*

If the material discovered on the seabed, or recovered to the surface, appears to represent material from a wreck site, it must be reported.

Pieces of wood that have been shaped or jointed may be of archaeological interest, especially if fixed with wooden pegs, bolts or nails. All occurrences should be reported. Objects made out of dark, waterlogged wood, such as bowls, handles, shafts and so on – can be very old and are definitely of archaeological interest. All occurrences should be reported.

*Intermediate Archaeological Finds*

Roundwood that has clearly been shaped or made into a point should be reported.

*Minor Archaeological Find*

Light coloured wood, or wood that floats easily, is probably modern and is unlikely to be of archaeological interest. 'Roundwood' with bark, such as branches – is unlikely to be of archaeological interest.

**Peat and Clay**

*Major Archaeological Find*

Peat is black or brown fibrous soil that formed when sea-level was so low that the seabed formed marshy land, on the banks of a river or estuary, for example. The peat is made up of plant remains, and also contains microscopic remains that can provide information about the environment at the time it was formed. This information helps us to understand the kind of landscape that our predecessors inhabited, and about how their landscape changed. It can also provide information about rising sea-level and coastline change, which are important to understanding processes that are affecting us today. Prehistoric structures (such as wooden trackways) and artefacts such as stone tools, including hand axes, are often found within or near peat, because our predecessors used the many resources that these marshy areas contained. As these areas were waterlogged, and have continued to be waterlogged because the sea has risen, organic artefacts made of wood, leather, textile and so on often survive together with the stone and pottery which are found on 'dry' sites. Should evidence for trackways associated with peat be uncovered, this would constitute a Major Find and further investigations would be necessary.

Fine-grained sediments such as silts and clays are often found in the same places as peat. These fine-grained sediments also contain the microscopic remains that can provide information about past environments and sea-level change.

*Intermediate Archaeological Finds*

Isolated discoveries of peat or clay.

**Stone**

*Major Archaeological Finds*

The recovery of numerous stones may indicate the ballast mound of a wreck or a navigational cairn, and all occurrences should be reported. Additionally, if a large concentration of stone material (as described below) is encountered, it would also be considered a major archaeological find.

*Intermediate Archaeological Finds*

Small to medium size stones that are shaped, polished and/or pierced may be prehistoric axes. Objects such as axe heads or knife blades made from flint are also of prehistoric date. Large blocks of stone that have been pierced or shaped may have been used as anchors or weights for fishing nets. All occurrences should be reported.

**Rubber, Plastic, etc.**

*Major Archaeological Finds*

If rubber and plastic materials are discovered in the same area as aluminium objects and structures, they could indicate wreckage from a World War II aircraft, and therefore this material should be reported.

*Minor Archaeological Finds*

Except for the above, in most cases, rubber, plastic, Bakelite and similar modern materials are of little to no archaeological interest.

**Iron and Steel**

The potential range and date of iron and steel objects is so wide that it is difficult to provide general guidance. However, the following provides an outline of what might constitute a major or intermediate find.

*Major Archaeological Finds*

If the material discovered on the seabed, or recovered to the surface appears to represent material from a wreck site.

If an area contains numerous ‘concretions’ (iron and steel objects covered by a thick amorphous concrete-like coating), it could represent a wreck site, and should be treated as a major archaeological find.

A concentration of pieces of metal sheet and structure may also represent a wreck site, and should be treated as a major archaeological find.

*Intermediate Archaeological Finds*

The discovery of an isolated anchor would be considered to be an intermediate archaeological find, however, if it is discussed in association with timber or iron and steel material as discussed above, it could be part of a wreck site.

Isolated concretions, pieces of sheet metal and/or structure may also be of archaeological interest, and should be reported.

*Minor Archaeological Finds*
Isolated modern material, such as lost fishing gear, would be considered a minor archaeological find.

**Other Metals**

*Major Archaeological Finds*

Aluminium objects may indicate aircraft wreckage from World War II, especially if two or more pieces of aluminium are fixed together by rivets. All occurrences should be reported.

Concentrations of copper and copper alloy (bronze, brass) objects, precious metal objects and coins are of interest, as they could indicate a wreck site.

*Minor Archaeological Finds*

Items made of thin, tinned or painted metal sheet are unlikely to be of archaeological interest.

Isolated discoveries.

**Ordnance**

Any ordnance that is discovered should be dealt with based on the company UXO policy, as safety takes priority over archaeological objectives. However, discoveries of ordnance may be of archaeological interest (including cannonballs, bullets and shells), and they should be reported.

## Appendix VIII: Guidelines for Artefact Handling and Storage

It should be noted that 'time is of the essence' in terms of the recovery of wet archaeological material. If organic objects such as wood are allowed to dry out, this can cause irreparable damage. Care in handling items is therefore paramount. A recovered object should be handled and stored in the following manner, particularly those identified as major archaeological finds:

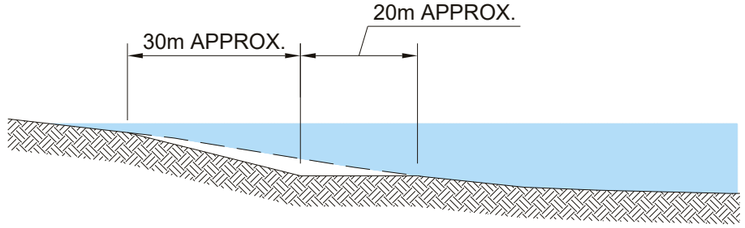
- *Handle all material with care;*
- *Do not remove any rust, sediment, concretion or marine growth and do not separate 'groups' of items or sediments;*
- *All objects should be kept completely immersed in sea water if possible; if this is not possible because of their size, they should be kept damp and wrapped in plastic to prevent them drying out;*
- *Objects should be kept in clean storage containers, preferably rigid plastic boxes with lids, which should be kept in a safe, sheltered location (preferably cool and dark); large objects that will not fit in containers should be kept covered so that they do not dry out;*
- *Each object should be marked with its unique number, either by means of a tag attached to the object(s) or by writing the number on the bag that it is stored on. If this is not possible, photographs of the artefact with a label clearly displayed on it should be taken, in order for the artefact to be identified later;*
- *Each small object should be kept in its own zip-lock plastic bag;*
- *Any sediments of interest should be collected and double-bagged into zip-lock bags, if possible; and*
- *If particularly delicate or significant items are recovered, Wessex Archaeology should be contacted as soon as possible for further advice.*



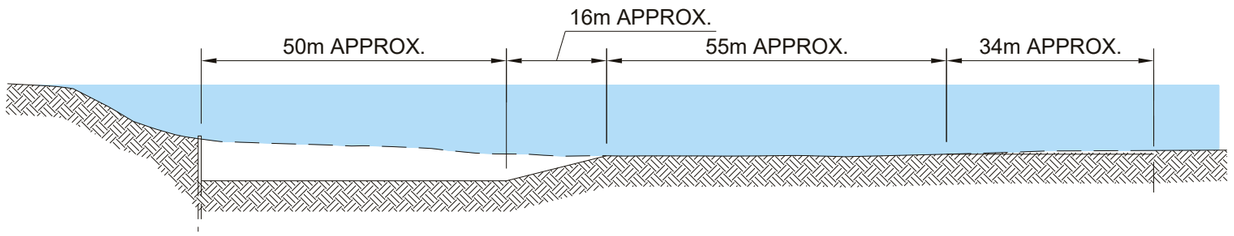

| | | | |
|---|---|---|---|
| Date: | 15/05/2018 | Revision Number: | 0 |
| Scale: | Main: 1:30,000 at A4 | Illustrator: | RG/KJF |
| Path: | Y:\PROJECTS_Edinburgh\116222\GIS\FigsMXD\WSI\2018_05_15 | | |

Location map

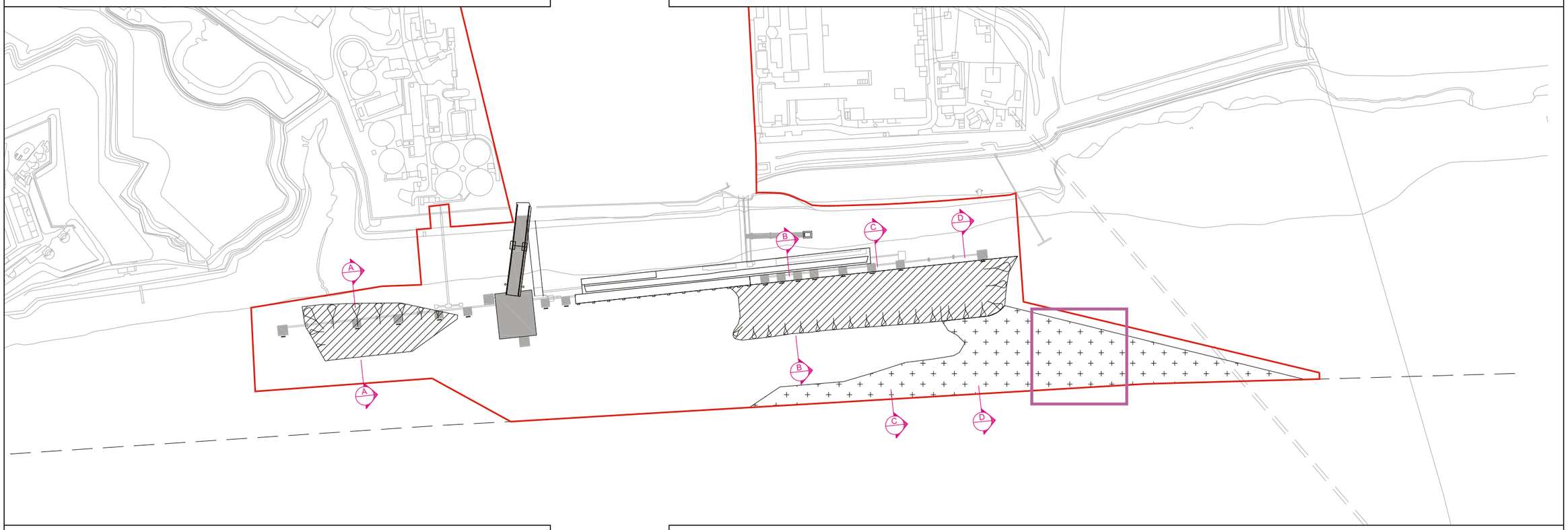
Figure 1

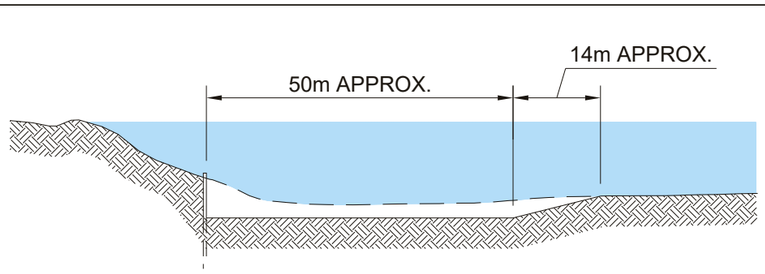



Section A

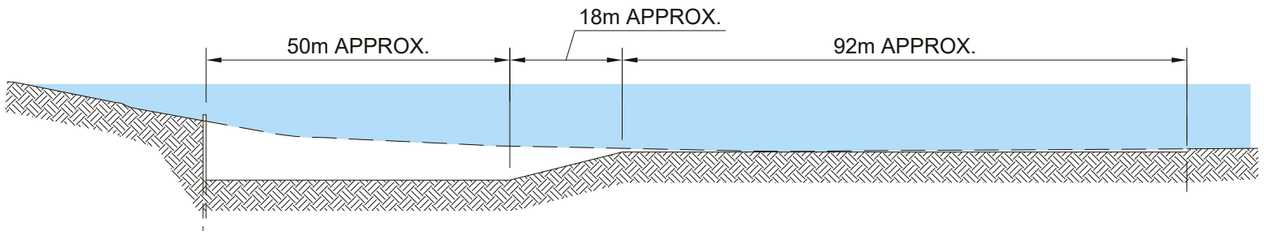



Section C




Section B




Section D

Approximate extent of berth dredging

Approximate extent of approach dredging

Order limits

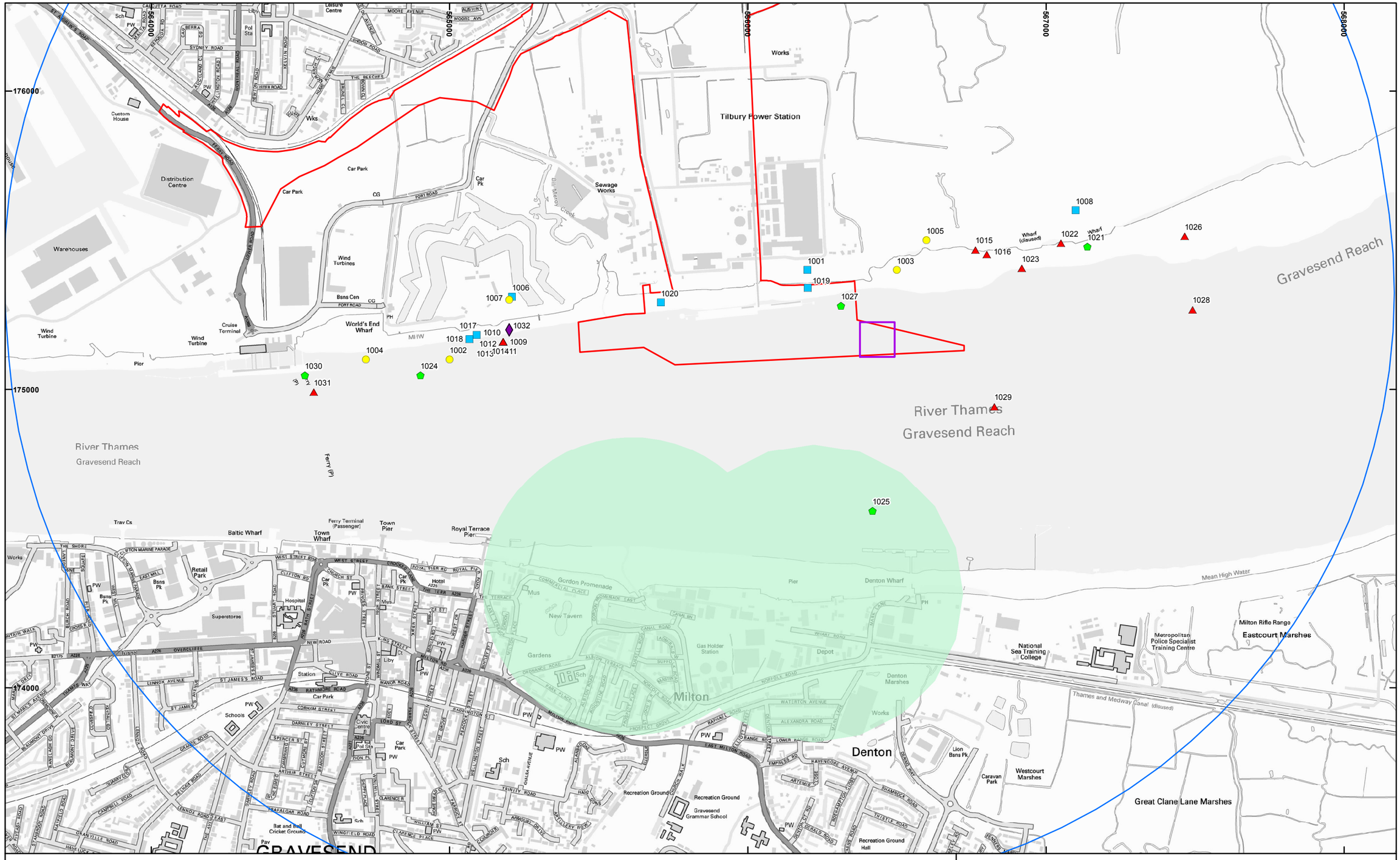
Exclusion Zone



| | | | |
|---|---|---|---|
| Date: | 2018/05/15 | Revision Number: | 0 |
| Scale: | 1:5000 @A3 | Illustrator: | KJF |
| Path: | Y:\PROJECTS_Edinburgh\116222\Graphics_Office\Rep figs\WSI\2018_05_15 | | |

CAD drawing of Proposed Development, showing dredge areas, berthing dolphins and upgrades to jetty

Figure 2

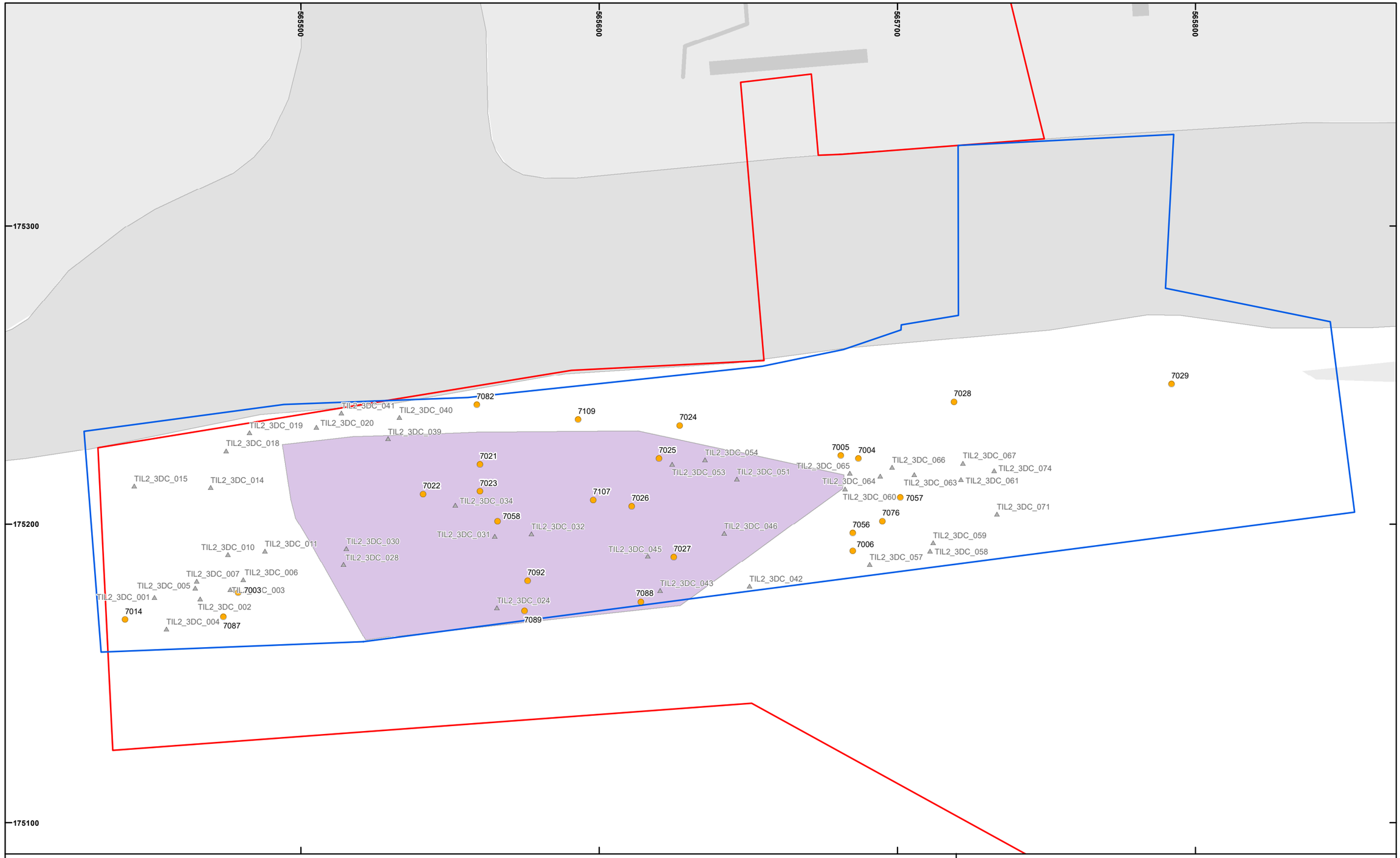





| | | | |
|---|---|---|---|
| Date: | 15/05/2018 | Revision Number: | 0 |
| Scale: | 1:12,500 at A3 | Illustrator: | KJF |
| Path: | Y:\PROJECTS_Edinburgh\116222\GIS\FigsMXD\WSI\2018_05_15 | | |

2km MSA with inter-tidal and marine archaeological receptors

Figure 3



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| Scale: | 1:1250 at A3 | Illustrator: | KJF |
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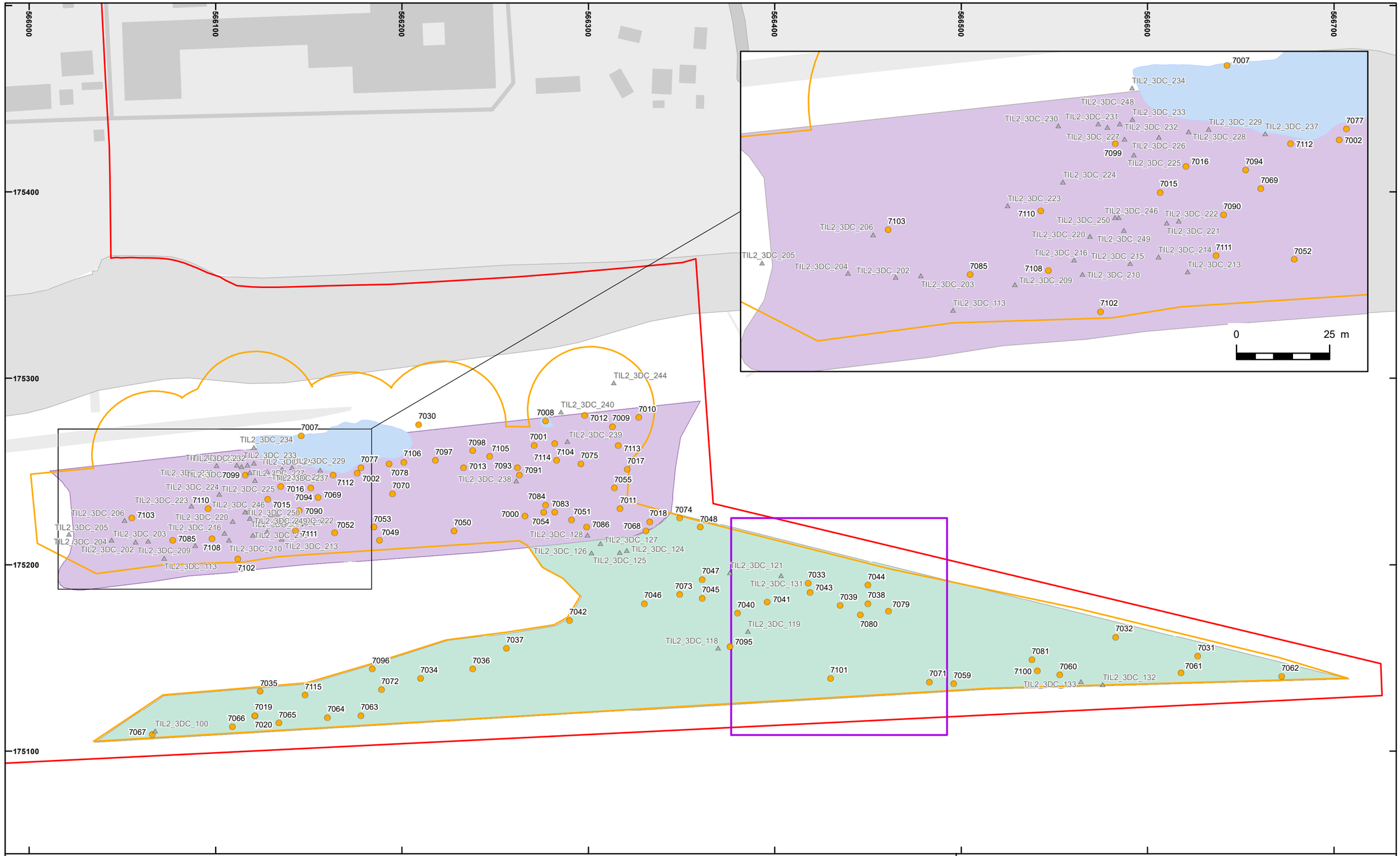
Seabed features of archaeological potential (Study Area West) (Wessex Archaeology 2017b)

Figure 4



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| Path: | Y:\PROJECTS_Edinburgh\116222\GIS\FigsMXD\WSI\2018_05_15 | | |

Seabed features of archaeological potential (Study Area East) (Wessex Archaeology 2017b)

Figure 5


Tilbury2 Site

2km MSA

Coordinate system:
OSGB36 (OSTN15/OSGM15)

**Multibeam bathymetry (supplied by client)**

3.35 m

-14.88 m

**Multibeam bathymetry (Wessex Archaeology)**

Metres CD

2.50

-12.50

0 500 m



| | | | |
|---|---|---|---|
| Date: | 15/05/2018 | Revision Number: | 0 |
| Scale: | 1:12,500 at A3 | Illustrator: | KJF |
| Path: | Y:\PROJECTS_Edinburgh\116222\GIS\FigsMXD\WSI\2018_05_15 | | |

LiDAR survey of intertidal zone of MSA and bathymetry of subtidal zone of MSA. LiDAR data © Environment Agency copyright and/or database right 2018. All rights reserved.

Figure 6