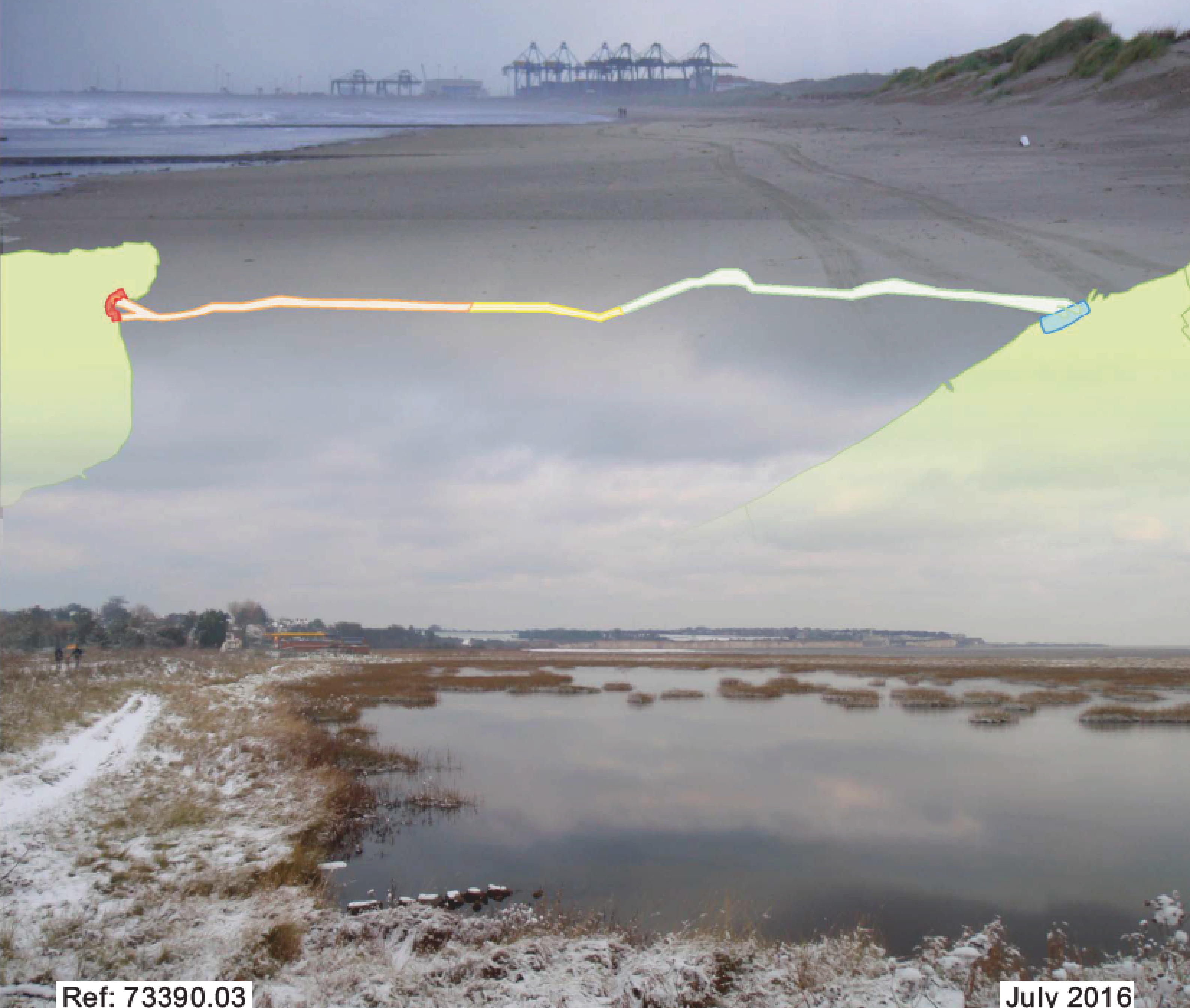
Wessex Archaeology

# Project Nemo UK-Belgium Electrical Interconnector Richborough to West Zeebrugge

## Archaeological Environmental Impact Assessment
## Volume I: Report



Ref: 73390.03

July 2016

# PROJECT NEMO
# UK-BELGIUM ELECTRICAL INTERCONNECTOR
# RICHBOROUGH TO WEST-ZEEBRUGGE

**ARCHAEOLOGICAL ENVIRONMENTAL IMPACT ASSESSMENT**

**Volume I: Report**

**(*cf.* Volume II: Appendices)**

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**Report reference: 73390.03**

**July 2016**

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|---|---|
| Title: | Project Nemo: UK-Belgium Electrical Interconnector – Richborough to West-Zeebrugge Archaeological Environmental Impact Assessment |
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| Origination date: | March 2011 |
| Date of last revision: | July 2016 |
| Version: | 73390.03 – Volume I |
| Wessex Archaeology QA: | Caroline Budd |
| Status: | Final Report |
| Summary of changes: | Final Report produced from previous drafts with amendments to the France/Belgium maritime boundary. |
| Associated reports: | 73390.01 – Volume I, 73390.02 – Volume I, 73390.03 – Volume II |
| Client Approval: | Jason Cunningham/ Rachel McCall PMSS |

## DATA USAGE AND COPYRIGHT

# PROJECT NEMO
# UK-BELGIUM ELECTRICAL INTERCONNECTOR

## ARCHAEOLOGICAL ENVIRONMENTAL IMPACT ASSESSMENT
## Volume I: Report

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**Summary**

Wessex Archaeology was commissioned by PMSS, on behalf of Elia Asset S.A. (Elia) and National Grid International Ltd (NGIL), to carry out an archaeological desk-based assessment for the Project Nemo UK-Belgium Electrical Interconnector cable route.

This assessment comprises an archaeological baseline study, including an archaeological assessment of geophysical and geotechnical data and an assessment of the effects of the cable route development on archaeological receptors. This will ultimately form part of the Environmental Statement for the proposed Project Nemo development. This present assessment does not include an evaluation of the intertidal data because they have not been made available at the writing stage of this report, however once accessible these data will be archaeologically assessed and included in an updated report.

The cable route extends from the English Landfall at Pegwell Bay in Kent to the Belgian Landfall in West-Zeebrugge, and a wide variety of local, regional, national, and international guidance and legislation applies. Therefore, this report has been structured to facilitate the interpretation of the archaeological resource within this legislative framework. The Study Areas comprised the Kent Landfall (inland of the mean high water mark level), English Waters (from mean high water, including the 12 nm limit and EEZ), French Waters (EEZ), Belgian Waters (from mean high water, including the 12 nm limit and EEZ), and the Belgian Landfall (inland of the mean high water mark level). Within this report, the known and potential archaeological resource of each area is individually examined. The combined results of the desk-based assessment of archaeological data sources and archaeological geophysical and geotechnical assessments revealed:

- At the Kent Landfall:
  - 2 Listed Buildings
  - 67 other archaeological sites and findspots, dating from the Neolithic to modern period
- In English, French and Belgian Waters:
  - 8 sites of anthropogenic origin of archaeological interest identified or confirmed with the archaeological assessment of geophysical survey data including:
    - 3 wreck sites recorded by the UKHO, SHOM and VIOE;
    - 1 previously unrecorded wreck (located in the English Exclusive Economic Zone),;
    - 4 further geophysical anomalies of anthropogenic origin and archaeological interest, including a live obstruction recorded by the UKHO;
  - 254 additional geophysical anomalies of possible archaeological interest;

- A number of channels of probable prehistoric date and potential archaeological interest; and
- 24 additional wrecks recorded by the UKHO, SHOM and VIOE but outside of the geophysical survey coverage.

- At the Belgian Landfall:
  - 37 archaeological sites and findspots dating from the Roman period to the modern period, plus numerous findspots on the beach.

The baseline study also revealed further potential for as yet undiscovered sites and material dating from the Palaeolithic to modern period, including terrestrial sites and findspots, submerged prehistoric material, shipwrecks, aircraft crash sites and related material.

The impact assessment outlines the nature of the likely direct, indirect and secondary impacts on the known and potential archaeological sites during the course of the construction, operation and decommissioning of the Project Nemo interconnector cable. With the exception of a few modern wrecks, the effects of all potential direct and secondary impacts on the known archaeological receptors (including terrestrial sites and findspots, submerged prehistoric material, shipwrecks, aircraft crash sites and related material) are judged to be significant where an unmitigated impact occurs. The effects resulting from all potential indirect or cumulative impacts are expected to be negligible.

Although it is not possible to assess the significance of impacts on potential archaeological sites and material, as the magnitude of effects and the sensitivity of the receptor cannot be evaluated until further details regarding the presence/absence and nature of each receptor have been established, any damage or destruction to them would be permanent and effects are likely to be judged to be significant. If sites or findspots are discovered during the development, each would need to be considered on a site by site basis.

All known wrecks were avoided during the cable route design phase, but further mitigation measures proposed in the impact assessment include:

- Temporary Archaeological Exclusion Zones with a 50 m diameter around the extents of 8 known wreck sites and geophysical anomalies of anthropogenic origin identified in the geophysical survey data:

| WA ID | Easting | Northing | Description | Study Area |
|---|---|---|---|---|
| 7024 | 389786 | 5685532 | Previously unrecorded wreck | English Waters |
| 7027 | 391279 | 5685143 | Geophysical anomaly of anthropogenic origin | English Waters |
| 7047 | 394777 | 5685245 | Geophysical anomaly of anthropogenic origin | English Waters |
| 7049 | 395957 | 5685445 | Geophysical anomaly of anthropogenic origin – recorded by the UKHO as a live obstruction | English Waters |
| 7098 | 416527 | 5686440 | Geophysical anomaly of anthropogenic origin | English Waters |
| 7141 | 438175 | 5686526 | Live wreck, possibly the HMS *Westella*, recorded by the UKHO and SHOM | French Waters |
| 7151 | 446702 | 5685213 | Live wreck recorded by the UKHO and SHOM | French Waters |
| 7200 | 460851 | 5689298 | Live wreck, *Tringa*, recorded in by the UKHO and VIOE | Belgian Waters |

- Buffers around the location of 18 wrecks or archaeological importance recorded by the UKHO, SHOM or VIOE, which are located outside of the geophysical survey data area. The buffers provide a guide as to the potential extents of the wrecks, in order to protect them from secondary impacts such as vessel anchorages. A full list can be found in **Table 12.2**;

- Further investigation of identified anomalies (rated High or Medium) that are likely to be impacted along the cable route, as specified in the WSI, including in the intertidal zone during watching briefs, in the offshore area during a pre-lay grapnel run, and by the Archaeological Reporting Protocol;
- The establishment of a Written Scheme of Investigation and an Archaeological Reporting Protocol, in order to minimise impact on potential sites, which will ensure that any finds are promptly reported, archaeological advice is obtained, and any recovered material is stabilised, recorded and conserved;
- A watching brief for intertidal works, pre-lay grapnel runs, and cable installation;
- Further examination of potential prehistoric deposits identified in the geoarchaeological investigations, including Stage 3 to 5 geoarchaeological recording of recovered sub-samples, and archaeological input into any future sampling programme, particularly in the intertidal or foreshore areas; and
- Should they be planned, then archaeological assessment of any further geophysical, geotechnical, dropdown camera, video or diver survey undertaken for the construction, operation or decommissioning of Project Nemo.

It is expected that with the implementation of mitigation, based on the assessment outlined in this report, the residual effects of the development on any archaeological receptors will be minor.

## Glossary

Dead wreck: according to the UKHO it refers to a wreck which has not been detected by repeated surveys and is considered to not exist (or be absent) from the designated location.

Devensian: this term is used by British geologist and archaeologist in order to refer to the most recent glacial period.

Eocene: it refers to a geological epoch comprised between 55.8 Ma and 33.9 Ma.

Holocene: is a geological period beginning approximately 11700 years BP.

Live wreck: according to the UKHO this terms gather all wrecks which are not dead of which have not been lifted, either charted or uncharted.

Mesolithic: is a period in the human development of human technology between the Palaeolithic and the Neolithic.

Neolithic: this is a period of human evolution and specifically which sees the passage from a nomadic to sedentary life style.

Palaeocene: it refers to a geological epoch comprised between 65.5 Ma and 55.8 Ma.

Pleistocene: is the name of a geological period that spans over the recent repeated glaciations between 2.588 Ma and 12000 years BP.

Palaeolithic

Lower Palaeolithic: this term comprise the first subdivision of the Palaeolithic from 2.5 Ma until approximately 300,000 years BP.

Middle Palaeolithic: it refers to the second subdivision of the Palaeolithic which spans from 300,000 years BP to 30,000 years BP.

## Abbreviations

BP: Before Present

EEZ: Exclusive Economic Zone

HER: Historic Environment Record

NMR: National Monuments Record

UKHO: United Kingdom Hydrographic Office

# PROJECT NEMO
# UK-BELGIUM ELECTRICAL INTERCONNECTOR

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**Acknowledgments**

This study was commissioned by PMSS, on behalf of Elia Asset S.A. (Elia) and National Grid International Ltd (NGIL). Special thanks to Jason Cunningham and Rachel McCall at PMSS for their assistance.

Wessex Archaeology would also like to thank following people and organisations for their assistance in supplying records and additional data:

Geophysical and geotechnical data:
- Robin Dymlid (MMT)

UK:
- Alison Kentuck (Receiver of Wreck, MCA)
- Rebecca Tye (Deputy Receiver of Wreck, MCA)
- Amanda McKelvie (Navy Command Heritage, MOD)
- Ben Croxford (Kent HER)
- Lorraine Beale (UKHO)
- Angharad Wicks (NMR)

Belgium:
- Ine Demerre (VIOE / Erfgoedonderzoeker Maritieme Archeologie)
- Katrien Cousserier (VIOE / CAI)
- Marnix Pieters (VIOE)
- Jean Plumier (SPW-DGO4 –Departement du Patrimoine)
- Marie-Jeanne Ghenne (SPW-DGO4 –Departement du Patrimoine)
- Patricia De Bruyne (Vlaamse Hydrowinkel)

France:
- Denis Degez (DRASSM)
- Stephane Revillion (SRA Nord-Pas-de-Calais)
- Aurelie Counil (Creocean)

This report was compiled by Andrea Hamel and Nic Bigourdan, the archaeological geophysical assessment was undertaken by David Howell and the archaeological assessment of geotechnical work was undertaken by Kevin Stratford and Jack Russell. Illustrations were prepared by Kitty Brandon. The project was managed for Wessex Archaeology by Euan McNeil and quality control was provided by Caroline Budd.

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# UK-BELGIUM ELECTRICAL INTERCONNECTOR

## ARCHAEOLOGICAL ENVIRONMENTAL IMPACT ASSESSMENT
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**Contents**

## Figures



## Plates

# PROJECT NEMO
# UK-BELGIUM ELECTRICAL INTERCONNECTOR

**ARCHAEOLOGICAL ENVIRONMENTAL IMPACT ASSESSMENT**
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## 1 INTRODUCTION

1.1.1 Wessex Archaeology was commissioned by PMSS, on behalf of Elia Asset S.A. (Elia) and National Grid International Ltd (NGIL), to carry out an archaeological desk-based assessment of the Project Nemo UK-Belgium Electrical Interconnector.

1.1.2 The aim of the archaeological assessment is to inform the overall Environmental Statement for the Project. The assessment comprises a baseline study, incorporating a review of existing geophysical and geotechnical data, an assessment of the impact of the cable route on the known and potential archaeological resource, and suggested mitigation measures.

1.1.3 Due to the unavailability of intertidal data, this report does not provide such assessment, but once accessible these data will be archaeologically assessed and the results included in an updated report.

## 2 STUDY AREA

2.1.1 The proposed Nemo electrical interconnector cable will extend approximately 130 km between Pegwell Bay in Kent to the West-Zeebrugge in Belgium.

2.1.2 The archaeological Study Area comprises a composite of the original route and further iterations buffered to 500 m on either side (**Figure 1**). Additional buffers were applied to the potential landfalls. The buffers provide confidence that all relevant sites are considered, given the relatively poor positional data of known marine and terrestrial archaeological sites and material.

2.1.3 A Regional Archaeological Overview provides a backdrop and context for the general area, however, to assist with regulatory divisions the known and potential archaeological resource has been examined in more detail within five sub-study-areas: Kent Landfall, English Waters, French Waters, Belgian Waters, Belgian Landfall.

## 3 METHODOLOGY

### 3.1 APPROACH

3.1.1 This assessment was carried out in a manner consistent with available guidance, including the Joint Nautical Archaeology Policy Committee (JNAPC) Code of Practice for Seabed Development, in line with Defra's *Explanatory Memorandum to The Marine Works* (*Environmental Impact Assessment) Regulations 2007 No. 1518*, and European Directives for Environmental Impact Assessments (85/337/EEC, 97/11/EC 2003/35/EC), DETR 02/99, Meylemans *et al.* 2005, and with the Institute for Archaeologists (IfA) Standard and Guidance for Desk-based Assessment (IfA 2008).

### 3.2 SOURCES

3.2.1 The principal sources consulted in drafting this desk-based assessment comprised:

- United Kingdom Hydrographic Office (UKHO) wreck record;
- English Heritage's National Monuments Record (NMR) (now Historic England's National Record for the Historic Environment);
- Kent Historic Environment Record (Kent HER);
- Service Hydrographique et Oceanographique de la Marine (SHOM) wreck record;
- Vlaams Instituut voor het Onroerent Erfgoed (VIOE) wreck record;
- Centrale Archeologische Inventaris (CAI) terrestrial sites record;
- previous archaeological studies in the area;
- a wide range of secondary sources, including those providing an overview of the historical and archaeological resources of Kent, France, Belgium and the Southern North Sea, and with particular reference to:
    - sources related to historic shipping patterns and potential wreck sites and casualties, specifically *England's Shipping* (Wessex Archaeology 2004) and *Navigational Hazards* and *Areas of Marine Archaeological Potential* projects (Bournemouth University 2007, 2008, Seazone ongoing);
    - sources related to historic aviation patterns and the potential for aircraft crash sites, specifically *Aircraft Crash Sites at Sea* (Wessex Archaeology 2008) which provided an understanding of the potential density and general distribution of wartime aircraft activity across the English Channel;
    - sources relating to the palaeoenvironment of the Southern North Sea, with specific reference to submerged palaeolandscapes and coastal change; and
    - sources related to the terrestrial and marine historic environment of Kent, including the South East Research Framework (Kent County Council), the Maritime and Marine Historic Environment Research Framework (University of Southampton, ongoing); the Isle of Grain to South Foreland Shoreline Management Plan (South East Coastal Group 2010).
- Geophysical data provided by Marin Mätteknik (MMT) AB that had been gathered from the Study Area during the summer of 2010, including: sidescan sonar, sub-bottom profiler (sparker and boomer), multibeam bathymetry and marine magnetometer datasets; and
- Geotechnical data provided by Marin Mätteknik (MMT) AB including 100 vibrocore logs and 10 actual vibrocores acquired from the Study Area during the summer of 2010.

## 3.3 Legislation

3.3.1 The Cable Route Study Area falls within several different jurisdictions, each covered by different legislation and guidance and under the responsibility of different curators and heritage agencies. The Kent Landfall to low water is covered by English Heritage (now Historic England), Kent County Council and local councils. English Heritage is responsible for the archaeological resource within England's Territorial Waters (to the 12 nm limit) and is consultee for the resource in the UK Exclusive Economic Zone (EEZ). The Study Area is located beyond French Territorial Waters (the 12 nm limit), and the archaeological resource in the French EEZ is administered by Pas de Calais, with the support of DRASSM if requested. In the Belgian EEZ and within Belgian Territorial Waters (to the 12 nm limit), the archaeological resource is administered by VIOE. At the Belgian Landfall to low water, the archaeological resource is also administered by VIOE with local councils.

3.3.2 Details about the applicable legislation and guidance for England, France, Belgium, the Exclusive Economic Zones are presented in **Appendix I** in **Volume II**.

## 3.4 Production of Base-Line – Research and Assessment

3.4.1 Searches of third party data sources, outlined above, were carried out to establish the archaeological baseline. These searches requested data regarding known terrestrial sites and marine sites (including ship and aircraft wrecks) and documented losses (casualties). Further information was obtained from published sources and available unpublished reports relevant to the study areas.

3.4.2 The spatial data has been imported into ESRI ArcGIS 9.3 software package. The use of GIS allows spatial comparison of the data in relation to mapping, charts and bathymetry and facilitated interpretation of the known sites with respect to the available secondary sources. Information that could not be mapped in the GIS was compiled in a project archive and used qualitatively.

3.4.3 The spatial data from the Kent Landfall were supplied in British National Grid, and have been conserved in that format in the GIS, appendices and figures. The spatial data for English Waters were supplied in WGS84 lat/long, French Waters in WGS84 lat/long and French National Grid (RGF 1993 Lambert 93), Belgian Waters in WGS84 lat/long and the Belgium Landfall in Belgium National Grid Projection (Belge Lambert 72 datum). These spatial data were converted to WGS84 UTM Zone 31N using Quest Geodetic calculator by Quest Geo Solutions, and are presented in WGS84 UTM Zone 31N in the GIS, appendices and figures, although the Belgian Landfall co-ordinates are also presented in Belgium National Grid in the appendices. Further details about the transformation parameters are included in Volume II Appendix X.

3.4.4 The known archaeology has been examined in five separate areas to facilitate review by statutory consultees and to best manage and assess the terrestrial and marine data and the potential development impacts. The areas are the English Landfall, English Waters (from high water including the English 12 nm limit and English EEZ), French Waters (comprising the French EEZ), Belgian Waters (from high water including the Belgian 12 nm limit and Belgian EEZ), and Belgian Landfall. The known archaeological data was queried in combination with secondary sources in order to contribute to the assessment of the archaeological potential of the area.

## 3.5 ARCHAEOLOGICAL INTERPRETATION OF GEOPHYSICAL DATA

### Data Sources

3.5.1 As part of the EIA of the proposed scheme, Wessex Archaeology (WA) carried out an archaeological assessment of marine geophysical data previously collected by Marin Mätteknik (MMT) AB.

3.5.2 The aims of this assessment were to carry out an archaeological interpretation of the marine geophysical data acquired from the survey area. This has resulted in an archaeological review of the effects of the proposed development upon sites of archaeological interest. The objectives were as follows:

- To assess geophysical data acquired by MMT in order to identify any material of archaeological interest lying within the limits of the survey area.
- To locate, identify and characterise any previously unrecorded archaeological sites, and confirm the presence and condition of any known sites within the survey area.
- To identify the presence of any sedimentary deposits of archaeological potential.
- To propose future mitigation for material of archaeological interest within the survey area.

3.5.3 The geophysical data used for this report were assessed for quality and were rated as variable using the following criteria (**Table 3.1**):

**Table 3.1: Criteria for assigning data quality rating.**

| Data Quality | Description |
|---|---|
| Good | Data which are clear and unaffected by weather conditions or sea state. The dataset is suitable for the interpretation of standing and partially buried metal wrecks and their character and associated debris field. These data also provide the highest chance of identifying wooden wrecks and debris. |
| Average | Data which are affected by weather conditions and sea state to a slight or moderate degree. The dataset is suitable for the identification and partial interpretation of standing and partially buried metal wrecks, and the larger elements of their debris fields. Wooden wrecks may be visible in the data, but their identification as such is likely to be difficult. |
| Variable | This category contains datasets with the quality of individual lines ranging from good to average to below average. The dataset is suitable for the identification of standing and some partially buried metal wrecks. Detailed interpretation of the wrecks and debris field is likely to be problematic. Wooden wrecks are unlikely to be identified. |

3.5.4 A particular issue which adversely affected the quality of all data sets appears to have been variable weather conditions encountered during the survey. This has resulted in varying degrees of noise being present on both the sub-bottom profiler and sidescan sonar data sets. Additionally, a large amount of periodic noise from an unknown source, possibly electrical noise or interference from the other geophysical equipment, was visible on the marine magnetometer data set, though it proved possible to remove a large portion of this during data processing. As a result of these factors, it is not possible to guarantee that all the potential archaeological features in the data have been correctly identified during archaeological assessment at WA.

**Geophysical Data – Technical Specifications**

3.5.5 The data assessed were obtained by MMT between the 15th and 29th August 2010 on the *MV IceBeam* (offshore) and the *MV Ping* (near shore), and consisted of sidescan sonar, sub-bottom profiler (sparker and boomer), multibeam bathymetry and marine magnetometer data sets.

3.5.6 MMT used an Edgetech 4200 dual frequency sidescan sonar system operated at 75 m (near shore) and 100 m (offshore) ranges, with towfish positioning provided by a USBL system offshore and by fixed layback near shore. The data were digitally recorded using Edgetech Discover software, and provided to WA as *.xtf* files.

3.5.7 The sub-bottom profiler data were acquired using a boomer system for the near shore, and a sparker for the offshore section. The data were digitally recorded using Triton software as *.SGY* files. These were converted into *.cod* files by WA using Coda File Utilities software.

3.5.8 The magnetometer data were acquired using a Geometrics G-882 caesium vapour marine magnetometer.

3.5.9 The multibeam bathymetry data were acquired using a Kongsberg EM3002D system. The data were digitally recorded by Kongsberg SIS acquisition software and provided to WA as *.txt* files.

3.5.10 Both near shore and offshore vessel positioning was provided by a POS MV 320 system with a C-Nav RTG IALA, with an additional Fugro Starfix system used offshore (this would give a submeter accuracy for the vessel position).

**Geophysical Data - Processing**

3.5.11 The sidescan sonar data were processed by WA using Coda Geosurvey software. This allowed the data to be replayed with various gain settings in order to optimise the quality of the images. The data were initially scanned to give an understanding of the geological nature of the area and were then interpreted for any objects of possible anthropogenic origin: the position and dimensions of any such objects were recorded in a gazetteer, and an image of each anomaly was acquired. Only the key anomalies are illustrated within the present report, however the remaining images are held in the project archive for future reference).

3.5.12 During this stage of the interpretation, the sidescan sonar anomalies were ascribed an archaeological flag in order to record the geophysicist's initial assessment of each anomaly. These flags were ascribed as follows (**Table 3.2**):

**Table 3.2: Criteria for assigning archaeological potential rating**

| Flag | Description |
|---|---|
| High | Ascribed only where the geophysical anomalies clearly represent a wreck site or were very near to a previously known site. |
| Medium | Geophysical anomalies with no directly corroborating data but being of a size, shape or amplitude such as to suggest that they possibly relate to archaeological sites or features. |
| Low | Small, isolated, geophysical anomalies of uncertain origin, which are likely to be 'artefacts' in the data or natural features. |
| Very Low | Anomalies that are known or are highly likely to be of modern origin, and which are not archaeologically interesting (e.g. moorings, etc) |

3.5.13 The form, size, and/or extent of an anomaly is a guide to its potential to be an anthropogenic feature, and therefore of its potential archaeological interest. A single, small, but prominent anomaly may be part of a much more extensive feature that is largely buried. Similarly, a scatter of minor anomalies may define the edges of a buried but intact feature, or it may be all that remains of a feature as a result of past impacts from, for example, dredging or fishing. The application of a ratings system is therefore a means of prioritising sites in order to inform further staged of the interpretation process, and on its own is not definitive.

3.5.14 The shallow seismic data were studied in order to detect any in-filled palaeochannels, ravinement surfaces and peat/fine-grained sediment horizons that may have archaeological potential.

3.5.15 The shallow seismic data were processed by WA using Coda Seismic+ software. This software allows the data to be visualised with user selected filters and gain settings in order to optimise the appearance of the data for interpretation. The software then allows an interpretation to be applied to the data by identifying and selecting a sedimentary boundary that might be of archaeological interest.

3.5.16 The shallow seismic data were interpreted with a two-way travel time (TWTT) along the z-axis. In order to convert from TWTT to depth, the velocity of the seismic waves was estimated to be 1,600 $ms^{-1}$. This is a standard estimate for shallow, unconsolidated sediments.

3.5.17 Any small reflectors which appear to be buried material, such as a wreck site covered by sediment were also recorded, the position and dimensions of any such objects noted in a gazetteer, and an image of each anomaly acquired. It should be noted that anomalies of this type are rare, as the sensors must pass directly over such an object in order to produce an anomaly.

3.5.18 The magnetometer data were processed by WA using Geometrics MagPick software in order to identify any discrete magnetic contacts which could represent buried metallic debris or structures such as wrecks.

3.5.19 The software enables both visualisation of individual lines of data and gridding of data to produce a magnetic anomaly map. Smoothed averages of the data were first calculated, and then subtracted from the raw data values in order to reduce the effect of natural variations in the magnetic field such as changes in geology or water depth.

3.5.20 The multibeam bathymetry data were used to provide a vertical reference for the sub-bottom profiler data, and were fully analysed to identify any unusual seabed structure that could be shipwrecks or other anthropogenic debris. The data were gridded and analysed using Fledermaus software, which enables 3-D visualisation of the acquired data and geo-picking of seabed anomalies.

**Geophysical Data – Anomaly Grouping and Discrimination**

3.5.21 The previous section describes the initial interpretation of all available geophysical data sets, which were conducted independently of each other. This inevitably leads to the possibility of any one object being the cause of numerous anomalies in different data sets and apparently overstating the number of archaeological features in the study area.

3.5.22 To address this fact, the anomalies were grouped together along with the results of the desk-based study of known archaeological sites. This allows one ID number to be assigned to a single object for which there may be, for example, a UKHO record, a magnetic anomaly, and multiple sidescan sonar anomalies.

3.5.23 Once all the geophysical anomalies and desk-based information have been grouped, a discrimination flag is added to the record in order to discriminate against those which are not thought to be of an archaeological concern. These flags are ascribed as follows (**Table 3.3**):

**Table 3.3: Criteria discriminating relevance of feature to proposed scheme.**

| | | |
|---|---|---|
| Non-Archaeological | U1 | Not of anthropogenic origin |
| | U2 | Known non-archaeological feature |
| | U3 | Non-archaeological hazard |
| Archaeological | A1 | Anthropogenic origin of archaeological interest |
| | A2 | Uncertain origin of possible archaeological interest |
| | A3 | Historic record of possible archaeological interest with no corresponding geophysical anomaly |

3.5.24 All the sites that have been identified within the study areas are presented in gazetteers in **Volume II** and discussed in this report. Recommendations have been made for mitigation measures should the sites be impacted by the proposed development scheme.

3.5.25 The grouping and discrimination of information at this stage is based on all available information and is not definitive. It allows for all features of potential archaeological interest to be highlighted, while retaining all the information produced during the course of the geophysical interpretation and desk-based assessment, enabling further evaluation should more information become available.

3.5.26 All the geophysical data sets are handled in the same way, beginning by discerning what is present, then qualifying the initial interpretation and finally characterising the output. For sidescan sonar and magnetic data sets this results in point data, while sub-bottom profiler data produces an interpretation with a wider spatial extent. However, including the start and end co-ordinates for each reflector in the sub-bottom profile gazetteer would be misleading as the anomalies are not simply straight lines between these points. The spatial distribution and extent of these sub-bottom anomalies is shown in the report figures and can be made available as a shapefile. The sidescan sonar, magnetometer and sub-bottom profile anomalies are all taken as screen dumps with an associated ID and stored within the project folder.

This allows us to view the image for any WA# when requested. This applies to all anomalies identified during the initial interpretation, not just those later classified as A1 or A2's. Also the sidescan sonar and sub-bottom profile tags are stored within the Coda project. The original data can then be replayed and skip to any given anomaly if there are questions which can't be answered by looking at the screen dump, without the need to replay the entire data set.

### 3.6 Archaeological Interpretation of Geotechnical Data

3.6.1 The geoarchaeological investigation of geotechnical data followed a staged approach, where each stage of the process is dependent on the results from the preceding stage, including recommendations as to the need for further work. For this assessment, Stage 1, Stage 2 and part of Stage 3 were completed, comprising:

- Stage 1: archaeological assessment of geotechnical logs – a review of all the vibrocore fieldwork logs (100) upon completion of the geotechnical ground investigation. Of these, ten were positioned specifically to assess sediments identified as having archaeological potential. The sediments described within the vibrocores were then grouped into a number of sedimentary units (and sub-units) based on the observed sedimentary characteristics;
- Stage 2: archaeological recording of available vibrocores (10) – detailed description of the sediments contained within the cores; examination of the sediments for a range of palaeoenvironmental indicators and dating material; identification of sediments with archaeological potential; interpretation of sedimentary descriptions to place them within a stratigraphic framework. The sediments described within the vibrocores were then grouped into a number of sedimentary units based on the observed sedimentary characteristics, and compared with the sub-bottom profiler geophysical survey data;
- Stage 3: subsampling of vibrocores to retain material of archaeological interest for potential further assessment.

3.6.2 Vibrocore logs were provided for 92 core logs, and 10 vibrocores were physically provided for geoarchaeological assessment. All of the vibrocore locations were plotted in the GIS (see **Figure 3**), and all of the vibrocore logs were assessed by Wessex Archaeology.

3.6.3 The 10 vibrocores (acquired in clear liners) were split longitudinally using an angle grinder and carefully prised open with a knife in order to preserve sedimentary structure. One half of each core was cleaned where necessary and photographed.

3.6.4 Each of the 10 vibrocores were then geoarchaeologically recorded and the descriptions are given in full in **Appendix III** in **Volume II.** The vibrocore descriptions provided details to the depth to each sediment horizon and the character of the sediment. Sedimentary characteristics were recorded including texture, colour, stoniness and depositional structure (*cf.* Hodgson 1976).

3.6.5 The 92 core logs generated on board by the geotechnical contractor during vibrocore sampling provide basic sedimentary detail noted whilst the vibrocores were cut into 1 metre lengths. These basic core logs have been compared to the interpreted sub-bottom geophysical data in order to gain further detail upon the interpreted sedimentary sequence. The 92 vibrocore logs confirm the geophysical interpretation of sedimentary units detailed in **Section 4.4**.

## 3.7 Impact Assessment

3.7.1 This section sets out the method of Environmental Impact Assessment used to determine the significance of the effects of the installation and operation of the Project Nemo cable system. There is no specific archaeological guidance that refers to laying power interconnector cables, however, as cable laying is a routine part of offshore wind farm construction, the impact assessment refers to guidance developed for the Offshore Renewable Energy sector (COWRIE 2007, 2008, 2010). This methodology has been applied in similar cable laying situations, such as for the BritNed Interconnector on the Isle of Grain, Kent. In addition, development impacts on the terrestrial archaeological resource have been assessed using the guidance on the assessment of the impacts of road projects (DoT 2007). The assessment has also been based on professional archaeological judgement and best practice that has been applied to numerous consented offshore wind farms and cable routes. This situation stands for England Exclusive Economic Zone, but there is not similar type of guidance for France and Belgium.

**Nature of Effect**

3.7.2 The magnitude of the effect is assessed using the following criteria (**Table 3.4**):

**Table 3.4: Nature of Effect**

| Effect Factor | Classification | Definition | Score |
|---|---|---|---|
| Likelihood | Certain | Will occur as a result of the project | 100 |
| | Possible | Likely to occur | 10 |
| | Unlikely | Not likely to occur | 1 |
| Spatial Extent | Regional | Regional to national/international (e.g. entire English Channel | 100 |
| | Local | Within range (few km) of the source of impact | 10 |
| | Immediate vicinity | At source of impact only | 1 |
| Level of Change | High | Large change compared to natural variations in baseline | 100 |
| | Medium | Change will or may be noticeable/measurable against the natural variation in the baseline | 10 |
| | Low | Change will not be noticeable or measurable against natural variation in baseline | 1 |
| Duration | Long-term | Effect will occur for >5 years | 100 |
| | Medium-term | Effect will occur for between 6 months and 5 years | 10 |
| | Short-term | Effect will occur up to 6 months | 1 |

These effects are defined as:

- Likelihood – the probability of the impact occurring
- Spatial Extent – the spatial extent over which the impact may occur
- Level of Change – the potential level of change from baseline conditions, taking into account known information on natural variation

- Duration – the length of time over which the impact may occur

3.7.3 Using these criteria, an impact is given a value of magnitude using the scoring system below (**Table 3.5**). For example, for a long term effect that will definitely occur, at a regional scale with a large change from the baseline, the score is 400. The Magnitude (Severe, Moderate or Low) of the effect is determined using the thresholds below (the magnitude of the impact described above would be Severe):

**Table 3.5: Magnitude of Effect**

| Magnitude of Effect | Score Threshold |
|---|---|
| Severe | 400 - 211 |
| Moderate | 202 - 22 |
| Low | 13 – 4 |

**Description of Receptor**

3.7.4 In order to identify the level of impact on each receptor or feature, the following will be described (**Table 3.6**):

- Sensitivity – the sensitivity or tolerance of the receptor to the effect
- Recoverability – how rapidly the receptor recovers to baseline state following effect
- Importance – receptor's importance in terms of its occurrence in the UK, its national/international significance and its conservation or commercial value.

**Table 3.6: Description of Receptor**

| Receptor Aspect | Classification | Definition |
|---|---|---|
| Sensitivity | High | Receptor or feature is highly sensitive to effect and will be detrimentally damaged (in ecological terms killed/destroyed) by effect |
| | Moderate | Some damage may occur to the receptor or feature |
| | Low | Some minor damage to receptor or feature |
| Recoverability | Low | No recovery |
| | Moderate | Recovery to baseline conditions within years |
| | High | Recovery to baseline conditions within weeks or months |
| Importance | High | Receptor is either rare, and/or significant in conservation or commercial terms |
| | Low | Receptor is neither rare or significant in conservation or commercial terms |

3.7.5 Using the criteria above, a Receptor Value has been determined. The definition of Value (High, Medium, Low) has been defined by reference to the three aspects of Sensitivity, Recoverability and Importance (**Table 3.7**).

**Table 3.7: Receptor Value**

| Receptor Value | Definition |
| --- | --- |
| High | Damage or loss to the structure/integrity of an archaeological receptor (terrestrial sites and material, submerged prehistoric archaeological material, shipwreck, aircraft crash site or associated material) identified as being of high importance. Feature will not recover. |
| Medium | Damage or loss to the structure/integrity of an archaeological receptor (terrestrial sites and material, submerged prehistoric archaeological material, shipwreck, aircraft crash site or associated material). Small-scale, peripheral disturbance to sites identified as being of moderate archaeological importance. |
| Low | No measurable direct or indirect impacts that would affect an existing archaeological receptor (terrestrial sites and material, submerged prehistoric archaeological material, shipwreck, aircraft crash site or associated material). |

**Impact Assessment**

3.7.6 The impact significance is a function of the Magnitude of the effect and the Value of the receptor, as illustrated below (**Table 3.8**):

**Table 3.8: Impact Assessment**

| | Value of Receptor | | |
| --- | --- | --- | --- |
| Sensitivity | High | Medium | Low |
| High | Significant | Significant | Moderate |
| Moderate | Significant | Moderate | Minor |
| Low | Moderate | Minor | Minor |

3.7.7 The significance of each impact is assessed as being minor, moderate or major. Impacts of 'major' or 'moderate' significance' are considered to be 'significant' in EIA terms. Potential impacts may be positive (beneficial) or negative (adverse).

3.7.8 The effects of impacts on known and potential archaeological receptors are complex and subjective, and therefore do not generally fit neatly into tables of value or significance. Because of this, a subjective scale based on professional judgement and good practice guidelines has also been used, and to provide transparency, the **Impact Assessment** section further discusses the reasoning behind the assessment of effect, value and significance.

# 4 REGIONAL ARCHAEOLOGICAL OVERVIEW

## 4.1 INTRODUCTION

4.1.1 The Study Area extends between England and Belgium, crossing the French EEZ. There has been hominin (humans and our ancestors) presence in the area for almost a million years: in the Palaeolithic and early Mesolithic, populations occupied, when habitable, vast plains that extended between England and the Continent, and since the inundation of the Southern North Sea and English Channel, people have travelled across the waters in a variety of ever increasingly technologically advanced watercraft. Since the Neolithic, settlements on both sides of the Channel have flourished. Although both landfalls and each area of territorial sea and EEZ will be examined individually in the following sections, providing details about the specific known and potential archaeological receptors of each area, the data needs to be seen within a wider context, where the historic environment of the Kent coast, Belgian coast and waters in between are viewed as more of a continuum, since the activities that shaped the cultural heritage land and seascape are intertwined. This Regional Archaeological Overview not only provides context for the known archaeological receptors, but also indicates archaeological potential, by examining land use patterns, trade routes, military conflicts and the ideologies that governed human activity.

## 4.2 CHRONOLOGIES

4.2.1 Archaeological material is generally studied within a framework of 'Periods' or 'Ages' which reflect the activities and cultural changes taking place over time. However, because of geographical and cultural differences, the chronologies are defined slightly differently by each country. The following table provides a rough overview of the chronologies (**Table 4.1**). Note that for archaeological studies of the Palaeolithic period, dates are expressed in terms of years Before Present (BP), whereas from the Mesolithic period onwards, absolute (or calendar) dates are used, either in Before Christ (BC) or *Anno Domini* (AD).

**Table 4.1: Chronologies**

| | England | France | Belgium |
|---|---|---|---|
| Palaeolithic | ~900,000 BP-9500 BC | 1,000,000 BP – 10500 BC | 500,000 BP -11500 BC |
| Mesolithic | 9500-4000BC | 10500 BC – 7000 BC | 11500 BC – 8200 BC |
| Neolithic | 4000-2200 BC | 7000 BC – 2500 BC | 8200 BC – 2300 BC |
| Copper Age | | 2500 BC – 1800 BC | |
| Bronze Age | 2200-700 BC | 1800 BC – 1100 BC | 2300 BC – 900 BC |
| Iron Age | 700 BC – AD 43 | 1100 BC – 52 BC | 900 BC – 52 BC |
| Romano-British/Gallo-Roman | AD 43- AD 410 | 52 BC – AD 476 | 52 BC – AD 476 |
| Anglo-Saxon | AD 410-1066 | | |
| Medieval | 1066 – 1500 | 476 – 1492 | 476 - 1600 |
| post-medieval | 1500 – 1800 | 1492 – 1789 | 1600 - 1800 |
| Modern | 1800 – present | 1789 - Present | 1800 - present |

## 4.3 OVERVIEW

### Palaeolithic

4.3.1 The occupation of the Study Areas by hominins (humans and early ancestors) during the Palaeolithic was dependent on sea level fluctuations, and the numerous glacial and marine transgressions and regressions that determined when the area was habitable. There were several periods during the Lower and Middle Palaeolithic (1,000,000 BP to 18,000 BP) when the Study Areas would have been dry land, areas that are now submerged would have been part of a vast plain, and the temperatures would have been moderate enough to be habitable (Panels A, B, C **Figure 2**). The glaciations and sea level changes also affect whether archaeological evidence survives, as glacial outwash and rising sea levels cause erosion or deposition of sediment, which often moves artefacts from their primary (original) locations to secondary locations.

4.3.2 The Lower Palaeolithic begins with the earliest hominin occupation of an area: in Britain, evidence from the site at Happisburgh suggest that it could have begun over 900,000 years ago (Parfitt *et al*. 2010, Roberts and Grün 2010); in the northern tip of France (Nord-Pas de Calais), the first attested known appearance of hominins is dated from 700,000 BP and was found in the vicinity of present day Wimereux (Region NPC website); and in Belgium the earliest evidence dates to around 500,000 BP from the Belle-Roche cave at Sprimont.

4.3.3 The Happisburgh site, in Norwich, Norfolk, was revealed by coastal erosion. The analysis of plant and animal remains, as well as knapped flint artefacts, indicate that hominins occupied a forest-fringed estuary of the ancient River Thames. The climate during this warm interglacial period was similar to Britain today, indicating that hominins could live in the cooler-than-Mediterranean climes previously thought to be uninhabitable (Roberts and Grün 2010). The site joins a list of sites dating to around a million years ago in Germany and northern France (Roberts & Grün 2010). Closer to the Study Area, there is extensive evidence for Lower Palaeolithic activity in Kent, particularly from the Thames gravels and other rivers, where artefacts were deposited as glaciers melted forming high energy meltwater rivers that deposited enormous spreads of gravel in their lower courses from which much of the evidence of the activities of Palaeolithic people have been recovered (Scott 2004: 7). The commonest surviving material from this period is worked flint from the Acheulean tradition, including flake production and hand-axe manufacture. At Swanscombe, the remains of an early hominin were discovered close to a series of Acheulian worked flint tools (Wymer 1982: 9).

4.3.4 The discoveries near Wimereux, France, like Happisburgh, were also from a present day coastal location with high cliffs. They represent the oldest Acheulean industry within the Septentrional part of France, where unifacial and bifacial flint tools as well as bones have been recovered (Somme & Tuffereau 1978).

4.3.5 The stone tools from the cave of Belle-Roche at Sprimont, Belgium, are the earliest example of tools within the whole Benelux regional complex, and are thought to have been made by *Homo Erectus*.

4.3.6 Although the ice sheets of the Anglian or Elsterian Glaciation (478,000 – 423,000 BP) did not reach as far south as the Study Area, major changes to the landscape were caused as the Thames and its tributaries were diverted southwards, and the Yser and Leie were also redirected (Quaternary Palaeoenvironmental Group website). A massive ice-dammed lake formed in the southern North Sea (Marine Isotope Stage 12), and the overspill of this lake initiated the Dover Straits and greatly enlarged the Channel River System (*ibid*).

4.3.7 At the end of the glaciation, as temperatures had begun to rise, there is evidence for hominin occupation in Kent, as three pieces of skull were found in the Upper Middle Gravels at Swanscombe (dated to c. 423,000 BP) (Scott 2004: 7).

4.3.8 According to Somme & Tuffreau (1978), it is important not to separate the remains of lithic industries from the North of France from those of the Picardy region, because during the Lower and Middle Palaeolithic, the Septentrionale regions of France (located on the north side of the River Seine) present a certain unity, and informative sites from the River Somme valley in the vicinity of the city of Amiens have been used to develop the Palaeolithic chronology and classification of the region. This unity helped the identification of the transition period showing a degree of contemporaneousness between Acheulean and Levallois industries.

4.3.9 The emergence of *Homo neanderthalensis* (Neanderthals) in the Middle Palaeolithic (around 300,000 – 40,000 BP) led to European-wide changes in technology and the emergence of 'Levallois' flaking (Scott 2004: 7) and the Mousterian tool traditions.

4.3.10 Middle Palaeolithic deposits dating to around 320,000 BP have been found at the site of Biache-St-Vaast, France (Biache-St-Vaast website), which revealed Levallois tools and an animal bone assemblage made by hunting, not scavenging, implying a greater social cohesion within the group. Also in France, Neanderthal skull fragments have been discovered, dating to approximately 250,000 BP). The presence of Neanderthals in Belgium is attested by the cave of Scladina and Spy. In Kent, assemblages of 'Levallois' tools found during quarrying are some of the most prolific in Britain (Scott 2004: 7).

4.3.11 In Picardy, France, lithic remains have been found underwater (Scuvee & Verague, 1988), and represent important but not well known examples of the presence of submerged prehistoric remains along the French coast of the English Channel. Located on the North side of the Cotentin Peninsula (Normandy, France), from the Anse de la Mondree at Fermanville near Cherbourg, the finds comprised more than 2000 Levallois-Mousterian lithic artefacts discovered at a depth of 20m. The finds date to around 45,000 BP, and indicate that Neanderthals had developed strategies that enabled them to endure a harsher climate – thus extending the window of opportunity for exploitation of other nearby areas. At the date of occupation, the site strategically overlooked the confluence of the extension of the Seine River and the Great Channel River, which met 15 km to the north. The site is unique in Europe, as it contains primary context archaeological material embedded in peat and clay within a submerged location that pre-dates the last glacial maximum. Not only did it survive the periglacial worsening conditions as the climate deteriorated, but the artefacts survived the rising sea level around 7-8,000 BP and modern oceanographic conditions of coastal currents and waves. The site demonstrates both the potential of the prehistoric archaeological resource within the area and the ability for such sites to withstand climatic changes and transgressive/regressive events witnessed during past glacial cycles.

4.3.12 The Upper Palaeolithic (roughly 40,000 BP to 10,500 BP) provides evidence for the emergence of *Homo Sapiens* in northern Europe. Traces of *Homo Sapiens* in France have been recovered in Nord Pas de Calais dating to approximately 40,000 BP. In Belgium, evidence of the Aurignacien culture has been found in caves such as La Princess, and the Gravettian culture, which spread all over Europe with only small regional variations, is visible at the rich site of Maisieres-canal.

4.3.13 During the Devensian glacial maximum (roughly from 20,000 - 15,000 BP), sea levels in Belgium were approximately 120 m lower than today (Pieters *et al.* 2010: 81). However, although the ice sheets did not reach as far south as the Study Area, the cold climactic conditions would have rendered the area difficult to occupy; at this time, the landscape in Britain would have resembled Arctic tundra. As glaciers began to melt, the area would have been impacted by major changes to river systems as a result of meltwater. However, as soon as climatic conditions ameliorated, humans reoccupied the landscape.

4.3.14 In Belgium, the Magdalanian culture flourished from 14,000 BP to the Mesolithic period, and although most of the Upper Palaeolithic discoveries have been localised around the Meuse valley and in the Hainault and Hesbaye regions, evidence from Flanders to Gent suggest that Neanderthals occupied the wider region. In Britain reoccupation appears to have begun around 13,000 BP (Scott 2004: 8). The similarity of 'Cresswell' and 'Cheddar' points to the Magdalenian industries on the Continent and illustrates the geographic continuity of the region (Scott 2004: 8). However, some of the differences between the assemblages may reflect limited sharing of ideas and techniques.

4.3.15 Considerable quantities of flint artefacts have been recovered from the beach at Raversijde and at neighbouring Mariakerke (Pieters *et al.* 2010: 182). Flint artefacts have also been recovered from the beaches at Westende, Middlekerke, Oostende, Bredende, Wenduine and Blankenberge, although the assemblage from Blankenberge and the mouth of the River Zwin has been called into question and may be natural (*ibid*: 183). Although difficult to date, the finds appear to date to the latest stages of the stone ages, and similar finds to the east of the Belgian border have been dated to the Middle Palaeolithic (*ibid*).

**Mesolithic**

4.3.16 At the beginning of the Mesolithic, sea levels were still considerably lower than present with the sea level in Kent thought to be 40-65 m lower (Young 2004: 3; BGS 1992: 116). As a result of these lower sea levels, the Southern North Sea was a vast plain which comprised a habitable landscape, intersected by strongly flowing rivers (Scott 2004: 9). However, as sea levels rose the landscape became increasingly difficult to traverse, and human groups in Britain became increasingly isolated. By around 6700 BC, sea levels reached around 25 m lower than present, and the North Sea and the Channel flooded, breaching the Dover Straights. Britain was finally isolated from Europe around 6300 BC.

4.3.17 A considerable amount of this now-drowned landscape is preserved underwater, and has been explored through projects such as Doggerland (Gaffney *et al.* 2009). No such intensive investigation has taken place in the Study Area, however, geological assessments suggest considerable potential, and Mesolithic sites located on the present coast or further inland have been explored in greater detail.

4.3.18 Many coastal sites in northern Europe are marked by shell-middens, the accumulated rubbish from many generations. In addition to gathering shell fish, line fishing and fishing nets were used, and evidence of the nets has survived. The period corresponds to the last hunter-gatherers in northern Europe, with the lithic tools and weapons becoming increasingly smaller and more suitable for the new forest environment (Scladina website). With the increasing management of woodland and its wildlife and the concentration in coastal areas on marine resources, some settlements seem to have become more permanent. At the site of Verrebroek in Belgium, several small huts, supported by wooden poles at the corners and with hollowed out floors, have been found in the same location.

4.3.19 In Belgium, the most well known occupation site is located at the Remouchamps cave. In France, additional work has been undertaken in the Somme Bassin area of northern France, where Mesolithic settlement sites have been identified on silt formation plateaux as well as at the bottom of slopes or valleys, and although most of the sites were located well inland, some sites have also been identified under the coastal sand dunes of Equihen and Hardelot (Dutertre, 1936). In Kent, find types include stone, antler and bone tools possibly for tree felling and woodworking, however, there is little direct evidence for hunting and gathering activities (such as bone assemblages or plant remains). Although, further work in marshy areas such as east Kent could increase the body of evidence (Scott 2004: 9).

4.3.20 At the end of the Mesolithic period, there are further signs of permanent settlement in the form of pottery. Because pottery is cumbersome to transport, it is normally associated with settled farming communities. The pottery is perhaps the first indication of the transfer of new ideas from farming populations in southern and central Europe.

4.3.21 By the end of the Mesolithic, the majority of the cable route would have been completely submerged, and further human activity would have been of a maritime nature. The southern part of the Kent Landfall would also have been submerged, as part of the Wantsum Channel, which was not reclaimed until the post-medieval period. However, the northern part of the Kent Landfall (on the historic Thanet Island) remained dry land, and at the Belgian Landfall, the habitable land surface would have extended quite some ways seawards beyond the present Mean Low Water.

4.3.22 Although there is no direct archaeological evidence for seafaring during the Mesolithic, the technologies in place would have been sufficient for the construction of skin boats made of hides and bent small-wood (Cunliffe 2009: 81).

**Neolithic**

4.3.23 The Neolithic saw a fundamental shift across Europe in the way people lived. Over the period, agriculture and the domestication of animals spread across the continent and beyond the sea to England; most of the population slowly stopped relying on hunting and gathering and instead invested in farming as their main form of subsistence. Regional variations appeared as each area adopted farming, however, broad patterns appear indicating the development of long distance trade networks.

4.3.24 In Belgium, the earliest evidence for agriculture comes from around 8200 BC (Scladina website). At this time, the first communities gathered in villages, with massive collective houses such as the one found in the site of Darion. The late Neolithic (starting around 6300 BC) is mainly characterised by the presence of megaliths which could be seen in many locations, such as the site of Weris. By about 5000 BC, the large scale cultivation of cereal crops the herding of domestic animals had become widespread on the Continent by about 5000 BC.

4.3.25 Flint tools were still dominant. In some areas, such as Grimes Graves in England, mines were dug to exploit the resource, while in other areas, such as at Grand Pressingny, Indre-et-Loire in France, flint closer to the surface could be quarried from outcrops. In Belgium, flint mines appear around 7,500 BC, and the site of Spiennes is one of the most well known examples in Europe. Material from these quarries could then be traded, as flint does not naturally occur in all areas across the region, and communities unable to obtain it locally acquired raw materials as well as finished goods through trade and exchange networks. Some flint is very distinctive, and it is often possible to trace how far an object has travelled from its source. The flint from Grand Pressigny has a particular honey colour and was distributed over hundreds of kilometres, in some areas it was evidently preferred to the local materials.

4.3.26 During the Neolithic, there is considerable evidence for cross channel traffic, such as the transport of material (including the many species of plants and animals that were used for food production but were not native to Britain) as well as the ideas of farming and animal domestication. It is not surprising that Kent was one of the first regions in England to undergo the economic, technological and social changes associated with the Neolithic period, as its proximity to the Continent was no doubt a great influence. The Neolithic period began in England around 4000 BC, and evidence includes particular styles of earthworks, causewayed enclosures, long barrows, evidence for pottery and the emergence of henges. There is evidence for pottery and a causewayed enclosure near Ramsgate (Ashbee 2004: 11).

4.3.27 During the Neolithic, maritime transport was characterised by log boats and skin boats which are likely to have continued in use. Some of the oldest archaeological examples of logboats in Europe are from Noyen-sur-Seine, France, and date to c. 7190-6540 BC, and other examples of early logboats have been found from Denmark, through north-west Germany and the Low Countries to north-west France (McGrail 2004: 173). These early logboats are from a time when sizeable trees and appropriate tools were just becoming available. The earliest logboat in Britain dates to the fourth millennium BC (Delgado 1997: 438).

**Copper Age (Chalcolithic) and Bronze Age**

4.3.28 The Copper Age, or Chalcolithic, is characterised by the use of early copper tools alongside the use of stone tools and the first appearance in Europe of unequal, hierarchical societies (Carozza & Mille 2007: 195). A few early metal finds have been discovered in the northern half of France, with the oldest recovered from the Paris Basin, dating to the second half of the fourth millennium BC. However, metal use appears to have been relatively localised, with the use of metal in the Paris Basin remaining a secondary phenomenon which had little or no effect on the mutation of the local cultural groups.

4.3.29 The Bronze Age is characterised by more widespread use of metal tools and social change, as well as the expansion of trade networks. From the beginning of the Bronze Age, the expansion of trade in metals involved cultural contact through a system of sea routes which connected a network of rivers and roads used as the dominant way of transporting goods and people (Philippe, 2009, Lebecq, 1994). By the late second and early first millennia BC, active trade networks focussed on the transport of bronze implements (Cunliffe 2009, Muckelroy, 1981; O'Connor, 1980).

4.3.30 Possibly as a result of this exchange, there was cultural continuity from Normandy to Flanders with strong connections on both sides of the Channel and North Sea (Bourgeois & Talon, 2005, 2009; Marcigny & Guesniere 2003), and cultural similarities include pottery styles and decoration, and architectural similarities in dwellings and funerary enclosures (Samson, 2006; Bourgeois & Talon, 2005). In addition to metalwork, the archaeological evidence from ceramics confirms maritime trade and the movement of goods across the Dover Straights area and the southern North Sea (Piningre, 2005). For example, pottery from the River Canche and its estuary displays characteristics of an original British tradition and indicates a close relationship with the British Isles. The settlement where the pottery was discovered dates to between 2000 and 1800 BC, and may have been a centre of Bronze Age maritime trade, playing an important role in the route across the Southern North Sea, within the established trading relations between the coastal settlements of the Continent and the British Isles.

4.3.31 The archaeological evidence from Kent shows that there were clear advantages to being on the western side of this 'outward looking world', as the eastern and southern shorelines dominated both coastal and cross-Channel traffic, leading to strong long-distance alliances (Yates 2004:13). The coastal communities in Kent benefited directly from contacts as far west as Cornwall and from trade and the movement of people along the Thames valley and with mainland Europe. Settlements in Kent were focussed on coastal locations, major river valleys and estuary foreshores, particularly on either side of Wantsum Channel, which would have been a key navigation route for regional exchange (Yates 2004: 14). Concentrations of deliberately placed finds recovered from the Wantsum Channel and Great Stour valley, including a wide variety of weapons and ornaments originating from the great river communities of North West Europe (particularly along the Seine and the Somme) suggest close relationships between peoples on either side of the Channel.

4.3.32 Trade across the Channel was accomplished using boats such as the Dover boat (Clark 2004), a 3000 year old sewn plank boat capable of crossing the channel while carrying a substantial cargo of supplies, livestock and passengers. Such watercraft were especially adapted to the coastal and riverine environment of this area (Pomey & Rieth, 2005). However, the hazardous nature of these journeys is represented by the Langdon Bay wreck, which is thought to have been carrying a cargo of scrap metal from France to Britain. The cargo comprised a collection of bronze artefacts, including the types of tools, weapons and ornaments made in France but rarely found in Britain, dating to around 1100 BC.

4.3.33 The study of Bronze implements in the Low Countries, an area that was far removed from copper and tin sources, shows that trade networks were even further reaching, with copper and bronze implements being imported not only from Britain but also from other sources on the Continent, and that trade was established by at least 2300 BC (Fontijn 2009: 130). In Belgium, finds in the intertidal zone from the period include worked flints discovered along the beach between Westende and Knokke. Additionally, a possible Bronze Age paddle or shovel has been found underwater, although this seems more likely to have been a baker's shovel, maybe re-used as a paddle (Pieters *et al.* 2010).

4.3.34 At the end of the Bronze Age, cross-Channel exchange appears to have collapsed, resulting in widespread social dislocation, which reflects wider European disruption (Yates 2004: 15).

**Iron Age**

4.3.35 The Iron Age is characterised by the spread of iron making and iron tools, which gradually replaced bronze as the preferred material, and was accompanied by a significant growth in population and the introduction of wheel made pottery and coinage. Although some cross-Channel trade networks continued into the Early Iron Age (between the 8th and 6th centuries BC), the decreasing numbers of elite exchange items found in Britain suggests that the intensity of cross-Channel traffic had slowed down by the Middle Iron Age. However, by the Late Iron Age, contact between Britain and the Roman Empire had increased (Parfitt 2004: 16). The distribution of Late Iron Age Gallo-Belgic coins type A&B around the Thames Estuary illustrates contact between the Continent and Britain.

4.3.36 As maritime trade increased, so did the importance of settlements along the Kent coastline, and there was a concentration of Late Iron Age settlements in the east of Kent and on the Isle of Thanet (Parfitt 2004: 17). Settlements at sheltered inlets would have provided convenient ports of entry and access, with major rivers providing further access inland (Parfitt, 2004: 17). Finds of Italian amphorae on Late Iron Age settlements in Kent, which indicate wine imports, illustrate trade links with the Mediterranean (Parfitt, 2004:17). While the numerous coastal creeks and inlets would have provided conditions suitable for saltmaking (*ibid*). In Belgium, coastal sites were also important, and the rim of an Iron Age pot was discovered on the beach at Bredene (Pieters *et al.* 2010: 186).

4.3.37 In 55 and 54 BC, Julius Caesar led Roman expeditions to Kent, and provided one of the earliest written accounts of the native population (Parfitt 2004: 16). In addition, the historical record indicates that during one of the expeditions, many of the ships were lost during a storm, and possibly indicate the first recorded shipwrecks on the Kent coast.

**Romano-British/Gallo-Roman Period**

4.3.38 The Romano-British/Gallo-Roman period in each area began with Roman conquest. In Belgium, around Bruges, the first Roman fortifications were built after Julius Caesar's conquest in the first century BC. A Gallo-Roman colony developed, and the Roman military presence continued until the end of the 3rd century AD or the beginning of the 4th century AD (Bruges city website). Numerous Gallo-Roman artefacts have been recovered from the beaches of Raversijde-Mariakerke and Wenduine, and in both cases finds and features suggest the location of settlements that go back to the Flavian period (Pieters *et al.* 2010: 192). A wide variety of features have been identified at Raversijde-Mariakerke, including rubbish pits, a wooden trackway, ploughmarks, traces of saltings (including wooden construction in connection with a ditch system), features related to the production of iron (including slag filled pits) as well as an oven flue filled with limestone from Tournai (*ibid*). More isolated finds, predominantly scatters of pottery fragments, have been reported from the beaches at Nieuwport, Westende, Oostende, Bredende, Zeebrugge, Heist and Knokke, indicating Roman activity across the area. Discoveries of Roman finds made during the first half of the 20th century indicate that there had been peat banks along the coast, which some years were covered in sand. This, and the fact that A. Chocqueel has observed Roman artefacts and structures located 266 m seawards from the dyke of the church at Mariakerke demonstrates beyond a doubt that the Roman coastline in this area was considerably further seawards than at present (Pieters *et al.* 2010: 193). Furthermore, the potential for Roman military fortifications along the coast of Belgium must be considered.

4.3.39 In Britain, Claudius' invasion force arrived at Richborough in AD 43, and Kent rapidly became the industrial heartland of *Britannia*, producing a considerable quantity of iron with pottery and building tiles also important (Andrews 2004: 20). Estimates suggest that between AD 120 and the middle of the 3rd century, 400 tons of iron were transported each year from Britain to the continent (Seillier *et al.* 2004). In addition, towns emerged, coastal fortifications and new transportation infrastructure were built, and various religious centres developed (Andrews 2004: 20). The large concentration of fortifications around Kent's coast reflects its vulnerability to threats from the Continent and the need to secure the shortest Channel crossing routes, and Richborough comprised a major settlement with coastal fortification (Andrews 2004: 21).

4.3.40 In France, too, coastal settlements were the key to trade and defence. Following Roman conquest, the town of Boulogne-sur-mer (Nord Pas de Calais), known as *Bononia-Gesioracum*, became a trading centre and the main customs post of the Dover Straits area (Phillipe 2009), and hence a compulsory stop en-route to Dover and Richborough. It was a port of call for the Roman military fleet *Classis Britannica*, (City of Boulogne website) and until AD 85, the fleet participated in combat missions in the adjacent area, and later, in logistic missions such as the control of coal transportation from the mines of the Weald.

4.3.41 The shortest travelling distance between the Continent and Britain was between Wissant or Boulogne and Dover, and likely became the most used sailing route. Although the two terminal areas were probably more the focus of military activities than commercial ones, the stretches of coastline to either side had landing places which would have satisfied the seamen, traders and political authorities (Mc Grail 1987). While the locations of settlement sites in the terminal areas can only be tentatively identified, the locations of landing places associated with international trading settlements are even more difficult to determine (*ibid*).

4.3.42 Roman finds have been recovered from the sea point to Gallo-Roman and Romano-British trade. In Belgian waters, an intact amphora from the Westhinderbank (Pieters *et al.* 2010) and fragments of a pottery bowl from Kwinte Bank (Wessex Archaeology 2008) have been discovered. The pottery bowl fragments were recovered during dredging operations on the Kwinte Bank, and were reported through the BMAPA/EH Protocol. The fragments are Rheinzabern ware, a type of Samian ware, stamped with 'CATULLUZ' which suggests they were made by Catallus V between AD 170 and 260. Samian ware was manufactured in central Gaul from the Augustan period onwards, and the height of the industry was during the 2nd century AD, when products were widely distributed across Gaul, the Danube provinces, and across the English Channel to Britain. The fact that these two pottery fragments are similar in form and bare identical stamps may suggest that they come from the same cargo. Both the amphora and the pottery finds could indicate the presence of yet-to-be-discovered Roman shipwrecks.

4.3.43 In addition to international trade, there was considerable traffic along the coast as well, for example Ragstone, a building material quarried in the Maidstone area (Kent), was not only widely used locally, but also transported by barge to *Londinium* for the construction of its walls in the 3rd century (Andrews 2004: 20). Kent's marine resources were also exploited probably by small local fishing and oyster dredging boats, and salt production was undertaken in coastal areas by evaporating seawater in large shallow reservoirs of unfired clay (*ibid*).

4.3.44 The remains of a Roman shipwreck were discovered near Bruges in 1899, during the construction work for Bruges' seaport and were radiocarbon dated to the 2nd or early 3rd century AD (Marsden 1976, Pieters 2010). The boat is representative of regional Romano-Celtic shipbuilding characteristics of the west of the Rhine (*ibid*): with close spaced framing, large nails and sewn planking laid flush, edge to edge, but not joined together (McGrail 2004). While the designs of some of the Romano-Celtic vessels likely restricted them to use in estuaries or other sheltered waters, others, such as 'Blackfriars I' from London and 'St Peter Port I' from Guernsey are thought to be have been seagoing (*ibid*). Boats of the 1st century BC are described by Julius Caesar in an account of the Venetic fleet as solidly built with high sided and square rigged sails of raw hide, and representations of such vessels can been seen on coins of Cunobelin, suggesting the type was widespread (Cunliffe 2001). In addition, wooden fragments of watercraft discovered in 2005 on the beach of the Chatelet (Tardinghen, Nord Pas-de-Calais) are the only known remains of a watercraft from the antiquity conserved along the septentrional shore of France. This assemblage is dated from the 2nd century AD and, as it has evidence for paddles, it may represent the remains of a Roman galley from the Classis Britannicus fleet, based in Boulogne and having been involved in maritime traffic in the Channel and North Sea.

4.3.45 The shipwreck of Ploumanac'h is also relevant. It lies five nautical miles from the French coast, in front of Perros-Guirec (Côte d'Armor, Brittany). The wreck of Ploumanac'h has been studied by the Département des Recherches Archéologiques Subaquatiques et Sous-Marines (DRASSM) since 1983 (DRASSM website). The wreck lies at a depth of 10 m, and its cargo of lead ingots bears witness to the maritime trade of raw material in the English Channel during antiquity. An epigraphic study of the ingot's inscriptions has enabled the identification of some of the names of Celtic Tribes from Great Britain and date the wreck to a period between the High Roman Empire and the Late Roman Empire (between 2nd and 4th century AD).

**Anglo-Saxon & Medieval**

4.3.46 At the end of Roman rule, both Belgium and France entered the medieval period, however, in Britain, there was an intermediate period known as the Anglo-Saxon period. The Anglo-Saxon period was characterised by an influx of Anglo-Saxon peoples and material culture from Germany and southern Scandinavia in the 5th and early 6th centuries, followed by Viking raids and later settlement in the 8th and 9th centuries.

4.3.47 The traditional landing place of the Saxons in Kent is at Ebbsfleet, in Pegwell Bay, in AD 449. During the early part of the period, Anglo-Saxon activity in eastern Kent is identified through cemeteries and burials, with the majority of evidence confined to rivers and the coast (Riddler 2004: 25-28). In AD 597, St. Augustine and the Christian missionaries arrived. With the reign of King Aethelberht in the later 6th century, Kent emerged as a political entity. The distribution of luxury goods in Kent throughout the 6th and 7th centuries, including glassware and wheel-thrown pottery, suggests that of all the Anglo-Saxon kingdoms in England, Kent had a near monopoly on certain elements of Continental trade and exchange (*ibid*). The trade and production centres of Kent in the Middle-Saxon period (*c.* AD 650 – 850) are small and, in relation to comparable sites such as Southampton, have not been well excavated, although there is thought to be an Anglo-Saxon settlement at Sandwich, it is probably situated within the medieval and modern town, and little evidence has been uncovered.

4.3.48 The finds of ceramics in Kent highlight changes in maritime trade – in the 6th and 7th centuries, in addition to local ware, ceramics were also imported from north France, and around AD 750, Ipswich ware was being 'imported' (Riddler 2004: 28). Most of the sites where Ipswich ware has been found are coastal or have strong links with the coast, emphasising the importance of maritime trade. The ware itself reflects the importance of monasteries which appear to have formed a part of the same trading network (*ibid)*. The pottery could have been transported in boats similar to the 7th century clinker-built wooden boat discovered in the ship burial at Sutton Hoo near Ipswich.

4.3.49 The earliest Viking landings on the Kent coast took place by the end of the 8th centuries, and the first substantial raid took place in 835 on Sheppey (Lawson 2004: 23). For the next 30 years, the coast was under threat and monastic sites were pillaged, and in 851 and 865, the Vikings had a strong enough hold to overwinter on Sheppey and Thanet (*ibid*). However, in 851, the Anglo-Saxons won a victory against the Vikings in a seabattle in Sandwich Harbour. There were additional naval engagements around Stourmouth in 885, and Vikings plundered Thanet's Minster Abbey in 980 and 1009 (*ibid*). Scandinavian ships in the 9th and 10th centuries are represented by the archaeological discoveries at Gokstad, and comprise double-ended clinker built wooden boats (McGrail 2004: 216). But it appears that England may also have had a distinctive shipbuilding tradition in the 9th to 14th centuries, as indicated by the Graveney boat, excavated from a former tidal creek of the River Thames, east of Faversham Kent (McGrail 2004: 218). Similar to the Nordic or Scandinavian boats, the Graveney boat was a also a clinker-built, double-ended boat that possibly had a square sail however, she is almost flat-bottomed and much more heavily built, and was built with plank-fastening nails driven through treenails, demonstrating a mix of boat building traditions.

4.3.50 Viking activity on the Kent coast ceased in 1017, and the medieval period began with Duke William's Conquest in 1066. The Domesday Book from 1086 mentions that there were more than 200 households at Minster, and Sandwich, a port mentioned under the manor to which it was subordinate, had a population of around

2,500 (Lawson 2004: 36-38). There was a Carmelite Friary at Sandwich, and it was also a market town. By the 13th and early 14th century, local markets had begun to play a significant role in the development of the economy (Lawson 2004: 50). Stonar, to the north of Sandwich, was also a market town by 1350 (*ibid*: 51).

4.3.51 Around 1050, the Cinque Ports developed in Kent and East Sussex, and comprised Sandwich, Dover, Hythe, New Romney and Hastings. These were based on an informal coastal defence arrangement made in the reign of Edward the Confessor, where in return for substantial constitutional fiscal and trading privileges, the Ports were required to furnish, for limited periods, ships and crews for the King's service (Lawson 2004: 52). Dover port was by far the longest established, having begun in the Roman period, but their height of influence was in the period 1150-1350 when the Ports worked to suppress piracy and were on occasion called on to transport soldiers. Sandwich was a transhipment point for goods from the Mediterranean, and fishing also played an important economic role (Lawson 2004: 52). Some authors have described Sandwich in the medieval period as 'the principle port in the South East outside London (Bower 2004: 66). As a result of heavy French raiding on the English coast, the Ports themselves became vulnerable, but their greatest threat was due to coastal change: by 1500, all of the Cinque Ports had been seriously affected, as their harbours silted up or were cut off by the growth of shingle banks (Lawson 2004: 52).

4.3.52 In France, from the post-Roman period onwards, the history of maritime related activities and events in Nord Pas-de-Calais is best followed by the developments and engagements of the city of Dunkerque, which played a strategic role for the various sovereignties that governed this fortified place (City of Dunkerque website). The first settlement was set on the shore of a natural cove in the 7th century for the purpose of fishing. The place quickly became a mariner's community, from its origin and during the first centuries of its existence, it was under the Flanders rule. Because of its strategic location, the city needed defences, and a fortified wall was erected in 960. However, the sheltered and strategic position of Dunkerque contrasts with the fact that the population had to continually fight the natural elements with the development of drainage and tidal protection which were initiated in the 12th century. Progressively, Dunkerque became a privileged port for the interior lands as an essential access to Holland or across the Channel to England. The true commercial expansion of the city and in effect the whole region began during the second half of the 14th century. At this time shipping traffic involved in importation expanded rapidly, with goods being imported from England and Holland (such as beer), South of France (wine), Denmark and Sweden (wood and iron). This prosperity was symbolised in the construction of a new fortified wall of protection in the 15th century.

4.3.53 The City of Gravelines, France, also expanded rapidly due to an active herring fishery in addition to being the first location in the region to serve as a transit port for salt, fruits and wine. However, by the beginning of the 14th century, Gravelines predominance faded as a result of multiple and consecutive military attacks and the increasing importance of Dunkerque (City of Gravelines website).

4.3.54 Bruges may have been continuously inhabited during the transition period between the Roman period and the medieval period, and could have been the most important fortification in the Flemish coastal area by around AD 650, when St Eligius arrived to spread Christianity (Bruges city website). In the 8th and 9th century, a commercial relationship with Scandinavia began, and in fact, the name 'Bruges' comes from the old Norse 'Bryggia' which means landing stage (*ibid*). The city developed into an international port and was considered one of the main European business centres.

Around 1050, gradual siltation resulted in the city losing its direct access to the sea but, in 1134 a storm re-established access by creating a natural channel at the Zwin, and the city was linked to the coast until the 15th century by a canal. Outer harbours, such as Damme and Sluis developed at this time to cope with the quantity of commercial traffic (*ibid*). During the medieval period, Flanders was one of the most urbanised areas of Europe, with between 40,000 and 45,000 inhabitants in the sole city of Bruges. By the 14th century, Bruges was a rich port city, with merchants coming from all over Europe to engage in commercial negotiations. The city was famed for its high quality textiles, but it was also a centre for artisanal art. However, during the 14th century, the city suffered multiple crises, insurrections, epidemics, political instabilities and wars, which ended in 1384 with the start of the Burgundian era. The textile industry was gradually replaced by high value products, banking services and the artisanal industry, and Bruges reinforced its international economic power, developing impressive prosperity and wealth. The Burgundian era ended just before the turn of the 16th century, and was accompanied by diminishing presence of international merchants and the start of political instability and military violence.

4.3.55 On the coast, the village of Ostend became a city in 1265 when the construction of a market hall was allowed. In 1359, the city was relocated further inland, and was protected from threats of the North Sea by the establishment of large dykes. Fishing was a major source of income for coastal communities, such as Ostend as well as Heist, Bredene, Wenduine and Revrsijde-Mariakerke (Pieters *et al.* 2010). Blankenberge developed as a small fishing village on the coast and the Saint-Anthony church was established in the 14th century, although the church was destroyed during the religious troubles in the 16th and 17th centuries (Trabel website).

4.3.56 Medieval finds have been recovered from the beaches between Middekerke and Raversijde, largely as a result of coastal erosion. Finds have included a golden tremisses of the Byzantine emperor Justinian II (AD527-565) as well as fragments of Badorf-pottery and red-painted ware. Late medieval coastal settlements are indicated by archaeological finds, and were located on the beaches and adjacent areas of Walraversijde-Mariakerke, Bredene, Wenduine and Heist (Pieters *et al.* 2010: 195-196).

4.3.57 In the medieval period, there were former islands off the mouth of the River Schelde, and although no archaeological traces of them have been recovered, their location is indicated by coastline reconstruction (Pieters *et al.* 2010: 195).

4.3.58 Belgian medieval finds from the sub-tidal zone of the North Sea include a globular grey ware pot that has been dated to the 10th or 11th century, and its high level of preservation could suggest the location of a previously undiscovered shipwreck (Pieters *et al.* 2010: 195). Other finds include a late medieval tripod skillet caught by fishermen near Raversijde-Mariakerke, a mortar in purbeck marble, a sherd of red-ware pottery found by a fishing boat c. 1.6 km to the north of Mariakerke, a stoneware jar fished up between the Plate-diep and the buoy of de Geule and two metal pitchers and a bronze skillet discovered by a fishing vessel near Nieuwport (*ibid*). All of the medieval finds were recovered within 10 km of the coast, and these may suggest that medieval shipping was, to a large extent, characterised by coastal traffic.

4.3.59 The Nordic or 'Keel' tradition of boat building, with double-ended clinker built wooden vessels, continued into the later medieval period. Examples of ship's timbers have been recovered from re-use-locations such as waterfront structures in

London (McGrail 2004: 223). In addition, ships of this tradition are depicted on the 11th to 12th century Bayeux tapestry, and later on town seals. However, from the 13th and 14th centuries, vessels of the Nordic tradition become rarer.

4.3.60 The 'Cog' appears to have developed in the 9th century and early documentary examples are associated with Frisian shipping and trade (McGrail 2004: 232). References to cogs increase considerably in the 13th and 14th centuries; the vessels were widely used by the Hanseatic League in northern Europe and traded between Britain and Ireland and the Continent. The Bremen cog, discovered in Bremen, Germany, provides a famous example of this type of vessel, and ships similar to that cog appear on the 13th to 15th century seals from many ports, from Elbing in the east to Damm, near Bruges and possibly Ipswich in the west (McGrail 2004: 233).

4.3.61 In France, the EPI-Canche wreck was discovered within the River Canche approximately 5 km from the estuary where the port of Etaples-sur-Mer (Nord Pas-de-Calais) is located (Rieth, 2009). The remains of the wreck are those of a clinker-built boat that has been radiocarbon dated to 1426. According to its structures and shape, the boat seems to have been adapted to coastal and fluvial navigation, and could belong to a regional architectural group of cogs.

4.3.62 Two medieval Doel Cogs were discovered in 2000 on the left bank of the river Scheldt in Antwerp, during an excavation for a construction site (MUA website). The larger of the two measures 20 m in length and 7 m in width. Since historical information concerning Doel Cogs is rare, these examples are of great importance, and in addition, they symbolise the trading role these ships played across Europe throughout the medieval period.

**Post-medieval**

4.3.63 The post-medieval period is well documented historically, however, archaeological discoveries continue to provide additional information. The period encompassed rapid population growth, urban expansion, colonisation, intensification of international trade, and major political struggles.

4.3.64 As a result of English privateering against French and Spanish vessels and the ensuing diplomatic rows, the Elizabethan government conducted a national survey of ports in 1566 in order to assess the tonnages of shipping and maritime employment (Lawson 2004: 91). In 1566, the shipping tonnage of Sandwich was 500 tons, and in Ramsgate the shipping tonnage was around 200 tons and fishing employment around 50. Some 293 vessels were counted in the survey, most of which were fairly small (under 10 tons). At Dover, the largest vessel of the time was 120 tons, and of the 1,000 mariners, about 600 were employed in fishing and roughly 400 in cargo carrying (Lawson 2004: 91). In the 16th century, maritime trade in Sandwich began to decline, as Sandwich Haven was increasingly restricted by the silting of the Stour (Bower 2004: 68, Lawson 2004: 91), however, some trade did continue with the Low Countries and the Baltic through the 17th century (Bower 2004: 66). As Sandwich's port declined, the economy of Sandwich developed in new directions with the arrival of Flemish, Walloon and German immigrants (Bower 2004: 66, Edwards 2004: 86).

4.3.65 Around 1700, the merchant ships in service were still relatively small - ships in London averaged 150 tons, and those for Kent ports were considerably less (Killingray & Compton 2004: 129 onwards). However, by this time, Ramsgate and Margate had easily overtaken Sandwich in the tonnage of vessels based there, and in 1701, shipping tonnage in Sandwich had increased to around 1000 tons, while at Ramsgate it had increased to 2500 tons (Lawson 2004: 91). The ships from

Ramsgate were involved in the Baltic trade, bringing help and timber for the increasingly busy royal dockyards, and handled coal imports from the North East, while Margate was prominent for coastal trade (Lawson 2004: 91). Fishing also remained important with mackerel and herring the chief catches (Lawson 2004: 92). When trade with the Baltic began to decline in the 18th century, trade expanded to the Mediterranean, West Indies and the Americas (Killingray & Compton 2004: 129). Although it was generally the larger ships that made international journeys, occasionally even the smaller ships that were usually engaged in coastal trade would turn to deeper waters if economic conditions made it worthwhile (*ibid*). In the 18th century, fisheries in Kent operated on a small scale, and most boats operated in local waters, but some, principally from the Thanet ports worked the North Sea for herring and even Icelandic waters for cod (Killingray & Crompton 2004: 129).

4.3.66 Despite the difficulties at the end of the 15th century, Bruges succeeded in maintaining a regional commercial importance, with a multitude of foreign contacts and an expanding artistic sector. But the definitive split with the Netherlands precipitated the decline of Bruges. During the 16th century, Bruges' international importance decreased, and only a modest maritime function remained. However, in the 17th and 18th century, trade increased again, with local merchants trading mainly with the Spanish empire and the British West and East Indian colonies (Bruges city website).

4.3.67 The coastal location of Ostend had advantages as a strategic point, but was also seen as an easy access for conquering armies. Ostend was taken or destroyed on numerous occasions, such as the three year siege between 1601 and 1604. In the early 18th century, Ostend took advantage of the closing of the harbour of Antwerp by the Dutch in 1722 to provide an alternative route to the sea. The Austrian Emperor Charles VI granted a trade monopoly for the Ostend Trade Company with Africa and the Far East to found colonies overseas. But the Dutch and British pressure on international trade forced the city to put an end to this activity in 1727.

4.3.68 The small fishing village of Blankenberge continued to develop, and the oldest preserved civil building in the town is the Old Town Hall which was built between 1679 and 1680, and was constructed using materials from a former Spanish fortress (Trabel website).

4.3.69 At the end of the 16th century, the herring fishing fleet of Dunkerque was destroyed as a result of a Dutch revolt (Dunkerque city website), and fishing crews took up the 'course', also known as piracy or privateer activity for the Spanish crown from 1567 onwards. The strategy involved taking property of a seized ship's cargo in order to be sold. This new maritime activity became legalised by the Dunkerque's magistrate as a method of war in 1585, and regulated by the Spanish 'code of catches' in 1590. During the first half of the 17th century, between 600 and 1000 Dutch herring vessels were destroyed, and during the reign of Louis XIV (1643-1715) this type of war intensified.

4.3.70 In 1679, a royal arsenal was created in Dunkerque and further fortification developed under the lead of Vauban. During the early 18th century, the port of Dunkerque remained the first pirate port of France, and during the American War for Independence, Dunkerque was an American pirate base in order to conduct operations against England. However, piracy was not the only activity of the port, and mariners from Dunkerque were involved in commercial activity from Cap North to Sicily, and the Icelandic cod fishing industry developed rapidly, generating intense economic activity. In April 1792, the French Revolution declared war on the hostile

European monarchies, which disturbed the maritime relationships in the Dover Straits area.

4.3.71 The post-medieval period witnessed some major battles at sea – and many of them took place within the vicinity of the Study Area. For example: the English versus the Spanish in the Spanish Armada (1588); the English versus the French during the 100 years war in the Battle of Sandwich/Battle of Dover (1217) and the Battle of Damme (1213); and the English versus the Dutch in battles from the second Anglo-Dutch war, including the St. James Day Battle (1666) and the Four Days Battle (1666).

4.3.72 Three post-medieval sites in Belgian waters dating from the 16th to 18th centuries have been archaeologically investigated (Pieters *et al.* 2010: 196): the Zeebrugge site, the wreck of the *'t Vliegend Hert* and a wreck on the Buiten Ratel sandbank. All three sites have been examined by divers and a large number of finds have been recovered. Despite the lack of hull remains at the Zeebrugge site, many hundreds of finds have been recovered, most of which date to the late 15th to early 16th century. The most outstanding find is a wrought-iron bombard, which was found strapped to its gun-carriage with the original ropework. The *'t Vliegend Hert* was built in 1729 on the Dutch East India Company (VOC) wharf at Middelburg and sank, along with the *Anna Catharina*, on its second journey in the night of 3-4 February 1735, in the area of the 'Vlakte van de Raan. Shortly after the sinking, the vessel's cargo of barrels of ginever, beer and oil washed up on beaches at Blankenberge and Nieuwport. The day after the accident, a pilot boat reported that the masts were still sticking out of the water, and the VOC undertook a number of salvage attempts. The 18th century wreck on the Buiten Ratel sandbank likely carried a Dutch cargo, and has been archaeologically investigated since 1997.

4.3.73 In England, a carvel built vessel known as the 'Gresham Wreck' because of its possible connection with Sir Thomas Gresham (1518-1579), a successful merchant and entrepreneur who served Henry VIII, Edward IV and Elizabeth I, was discovered in 2003 in the Princes Channel in the Thames Estuary, and recovered in 2004 (Wessex Archaeology website). A small to medium sized ocean-going armed merchantman, the vessel was carrying a cargo of iron bars when it sank. Four cannons were recovered from the site. Another wreck site, with artefacts and bronze cannon that appear to date to the 16th century has been found in the Goodwin Sands.

4.3.74 The nearest archaeologically investigated shipwrecks of this period to the French Study Area were five vessels wrecked during the battle of la Hougue (DRASSM website). These vessels are associated with Louis XIV and his plans to regain his throne in 1692. The plan was to gather an invasion army, and admiral Trouville was asked to go to Saint-Vaast-la-Hougue with a 44 vessel squadron. It is there in the close vicinity of the Ile de Tatihou that 12 French vessels disappeared on the 3rd of June 1692, after engaging in a battle against the Anglo-Dutch fleet. The underwater excavation of the five shipwrecks of First Rate vessels revealed the characteristics of the French Navy vessels from the end of the 17th century. The detailed analysis of the ships' hulls showed a trend at the time for improvement and homogenisation of vessels' construction.

4.3.75 Also located along the French coast of the English Channel, is the site of the shipwreck of la Natiere (Adramar, 2010), a significant archaeological example from the post-medieval period. The site comprises two wrecks and is located on the immediate border of the main shipping channel accessing the port of Saint-Malo. It was discovered in 1995 by a spear fisher. The wrecks have been identified as two privateers' frigates from the beginning of the 18th century, *la Dauphine* from the port of Le Havre, lost on its return voyage from a campagne in 1704, and *l'Aimable Grenot* from Granville foundered in 1749 whilst on its way to Cadix. The abundance of information generated by the study of artefacts in context and the preserved hulls offers data relative to the naval construction techniques used, trades undertaken, and life on board these frigates that sailed in European waters at the beginning of the 18th century. The study of these vessels has put into perspective their role in the increasing commercial exchanges and the emergence of a common material culture for the entire Atlantic maritime area during the post-medieval period.

**Modern**

4.3.76 The modern period witnessed unprecedented change and development, driven by the Industrial Revolution, increased international trade and communication, and considerable upheaval and military action during the two World Wars.

4.3.77 During the first half of the 19th century, Bruges remained quiet and passive in the commercial context. Around 1850, Bruges was the poorest city in Belgium, and had not been reached by the Industrial Revolution. The rebirth of the city was initiated by the construction of the new maritime port of Zeebrugge, inaugurated in 1907 (Bruges city website).

4.3.78 Conversely, Ostend continued to grow. In 1810, Napoleon ordered the construction of a fort in the vicinity of Ostend, which was completed in 1814 after the fall of his empire (Ostend Tourisme website). The wall had been built in preparation of an anticipated English invasion which never happened. As a result of transportation improvements with the 1838 connection of Ostend to Brussels by rail, the harbour continued to expand, and in 1846, Ostend became a transit harbour for ferries from England.

4.3.79 The modern history of Dunkerque is representative of the main events that took place in the Nord-Pas-de-Calais region. The Icelandic cod fishing industry from Dunkerque and Gravelines reached its peak between 1850 and 1870, partly because of the use of a new and more rapid schooner (*Geolette Balaou*) derived from an American schooner, which became the emblematic boat of Dunkerque. During this time, more than 35,000 mariners worked at Dunkerque, however, soon after the traditional way of fishing was overtaken by more modern techniques, which from 1880 started the decline of the Dunkerque cod fishing industry. During this period, the region was central in industrial Europe, and with the development of railways in the second half of the 19th century, Dunkerque was rapidly connected to the metropolis of Paris. Additionally, the creation of modern shipyards in Dunkerque allowed the intensive construction of steel and steam ships, such as cargo ships, ferries and fishing vessels in great numbers until the start of World War I.

4.3.80 In the late 18th and through the 19th centuries in Kent, ports and harbours were constructed and improved and piers were built to facilitate sea-borne freight and passenger landings (Killingray & Crompton 2004: 129). In 1800, merchant ships and fishing boats were being built at Ramsgate and Sandwich, and although Sandwich ceased to build ships in the 1830s, construction at other ports increased between 1800 and 1860 (*ibid*: 130). Resorts developed along the north coast, and after 1820, steamships carried millions of passengers down the Thames to the resorts. The import of coal from Wales and the North East for domestic use, gas works and later the railways was a major focus of maritime trade in Kent. With the development of the railways in the 1830s, there were considerable changes to settlement patterns and the transport of people and goods (Andrews & Crompton 2004: 124). Dover developed as the main cross-Channel ferry point, with regular cross-Channel steamboat services from the 1820s, and became a major shipping centre in terms of tonnage. However, not all trade was with ports and harbours, and small ships continued to be beached at low tide on open beaches to discharge cargoes for local markets (Killingray & Crompton 2004: 129). The towns in East Kent provided numerous services to shipping: these included everything from gathering marine intelligence such as the news of arrivals and departures, to supplying able seamen or embarking passengers. The towns could also provide ships with supplies or repairs, and made available the pilots who navigated the ships past the Goodwin Sands and the shallows of the Thames Estuary. Fishing slumped during the Napoleonic Wars (1792-1815) and did not recover until after the 1850s when railways enabled fresh catches to be sent directly to the market (*ibid*: 130). By the 1850s, Ramsgate had a fishing fleet 147 boats strong, each 35 tons or more, many of them were engaged in deep-sea fishing. The typical trawlers were still sailing vessels, and in 1914, Ramsgate had 172 sailing smacks (*ibid*), however, steam trawlers grew in popularity after 1919. From Broadstairs to Sandwich, the main catch included cod, lobsters, herring, turbot, sole, cod and halibut. Faversham concentrated on oysters and had a brisk export trade with the Low Countries (*ibid*). The lifeboat station at Ramsgate attests to the potentially hazardous nature of the sea and the Kent coast. The village of Cliffsend, Kent, developed in the 20th century within 3 km of Ramsgate.

4.3.81 Kent's long sea coast facing France and many north shore inlets made it a popular place for smugglers, and smuggling was a regular occupation of Kent sailors and fishermen. In the 18th and 19th centuries, smuggling increased, and the government made concerted efforts to suppress it. From 1817-1831, a Royal Naval preventative force was stationed at regular points (Killingray & Crompton 2004: 130).

4.3.82 During the 19th century, ship technology underwent a revolution. The advent of steamships meant that ships were no longer at the mercy of wind and tide, and further advances such as the early steel-hulled ships meant that ships were stronger than ever.

4.3.83 Political conflicts continued to be played out on the seas, including the Napoleonic Wars (1803-1815). An archaeological example of a shipwreck from the American Civil War (1861-1865) has been located off Cherbourg: the CSS (Confederate State Ship) *Alabama* was built in 1862 at Birkenhead by the naval shipyard John Laird & Sons, and during the American Civil War (1861-1865), after having sunk 64 Union commercial and war vessels, the *Alabama* sank during a naval battle with the USS (United State Ship) Kearsarge. Discovered in 1985 at a depth of 58 m, the wreck, which is the property of the United States of America, is being excavated by a Franco-American team, and the work is being followed by the "Comité scientifique paritaire franco-américain de l'Alabama" (DRASSM website).

4.3.84 A wooden shipwreck was exposed on the beach of Knokke, Belgium as a result of changing currents on the beach (Pieters *et al.* 2010: 200). The wreck is thought to be the brig *Manning of London,* which was built in 1809 and which ran ashore in 1831. The ship was recorded while it was exposed, however, it was later re-covered by sand. The vast majority of known wreck sites from the Belgian part of the North Sea date to the 20th century (Pieters *et al.* 2010: 198). In the UK as well, the vast majority of known shipwrecks date to the modern period.

World War I

4.3.85 In World War I, trade was disrupted, but economic and social changes were accelerated, as wartime industries expanded rapidly (Smith & Killingray 2004: 140). A vast number of Belgian refugees arrived in Kent between 1914 and 1915.

Although aircraft were only just coming into their own, World War I saw the development of numerous airfields across Kent, such as at Ramsgate, Manston and Westgate (*ibid*: 141).

4.3.86 During World War I, the coast of the Nord Pas-de-Calais region escaped many of the direct effects of the war, but the front line was only 40 km away. Dunkerque, which was bombed over 200 times, became an English logistic rear base with 200 seaplanes and a fleet squadron in charge of maintaining the collaboration with the British navy in order to avoid the German U-boats and marine mines. All along the coast, defences were reinforced. The 'Dove Patrol', composed of requisitioned and armed fishing trawlers, monitored the Dover Straights and cruised along the Nord Pas-de-Calais coast. It is also important to mention that from the beginning of September 1914, boats of refugees coming from Belgium were arriving by the thousands to the French ports of the region. Additionally, since the coal mines of Belgium and Northern France were occupied by the Germans, coal had to be imported by maritime convoys.

4.3.87 During World War I, Zeebrugge port was the main German Navy base for U-boats in the southern North Sea region, which were a major threat to the Allied forces, especially in the English Channel. On 23 April 1918, the Royal British Navy made an attempt to neutralise the port entrance, by sinking three old cruisers to block the flow of traffic in and out of the port. However, the blockade ships only managed to stop the flow for two days.

4.3.88 A small number of German U-boats from World War I have been identified from Belgian waters, including *U-11, U-37, UB-13, UB-20, UC-3, UC-7, UC-14* and the *UC-62* (Pieters *et al*. 2010: 198). All of these vessels were lost as a result of enemy action, having either been mined, bombed or rammed. Other World War I wrecks in Belgian waters include the British destroyer HMS *Maori* which ran into a mine in 1915, and the German Torpedo boat *A10* which ran into a mine in 1918. The most documented shipwreck from World War I is the German outpost boat (*Vorpostenboot)* SMS *Prangenhof*. The ship was recovered and dismantled onshore. It provided a detailed example of the changes and adaptations made to the fishing vessel to convert it into a warship.

World War II

4.3.89 When war was declared in September 1939, Kent once again became the frontline against German attack or invasion. The front line comprised beach defences such as mines and scaffolding, pillboxes, gun batteries, trenches, and anti-tank obstacles. Piers were breached, and coastal hotels were commandeered. There were considerable coastal defences around Pegwell Bay, Richborough and Ramsgate.

4.3.90 A coastal defence battery was located in the north of Pegwell Bay, and there were anti-aircraft batteries at Pegwell Bay, near Broadstairs and at Manston (Smith & Killingray 2004: 141). The anti-aircraft gun batteries were situated to protect vital infrastructure targets inland, such as the industries in Thameside, and they defended the enemy air routes to London. During the war Ramsgate was one of the 'most-raided parts of England' by air attacks (Whyman 2004: 179). In addition to being intermittently shelled by German guns from 1940-1944, roughly 1000 High Explosive Bombs were dropped on the city between 1939 and 1946 (Smith & Killingray 2004: 144-145). Airfields that had developed in World War I were revived, and Manston, located just inland from Pegwell Bay, was one of the main airfields during the Battle of Britain.

4.3.91 The city of Ostende also suffered aerial bombardment during the war (Trabel website).

4.3.92 In France and Belgium, an extensive system of coastal fortifications was built by Nazi Germany between 1942 and 1944 in order to defend the coast against Allied attack and invasion. The 'Atlantic Wall' extended along the entire western coast of Europe and was comprised of pillboxes, marine and terrestrial minefields and antitank obstacles.

4.3.93 As a city of high strategic importance in World War II, Dunkerque was a prime target and was bombed during the Blitzkrieg (18-19 May 1940). As a response, the British initiated a gigantic rescue called 'Operation Dynamo' from the port of Dunkerque between 26 May and 4 June 1940, under the constant bombing of the Luftwaffe. An article in the *Scotsman* from the time wrote that an Admiralty communiqué stated that 222 naval vessels and 665 other British craft took part in the evacuation of the British Expeditionary Force from Dunkerque, and these numbers did not include the French naval and merchant ships that took part (4 June 1940). Shallow water, narrow channels and strong tides all made the operation more difficult. As the evacuation by sea took place, three swept navigational channels were maintained, these were located between Dover and Calais; north of the Goodwin Sands to west of Dunkerque; and north of the Goodwin Sands around Kwinte Buoy and south to Dunkerque (Devine 1959). Overall, 338,000 soldiers were rescued and sent to England. During the German occupation, the city remained a strategic point and was reinforced to the point of being a total fortress.

4.3.94 The long list of ships that took part in 'Operation Dynamo' can be found in Devine (1959) and in Pieters (2010: 199), and the Annuaire des Epaves de la Manche (2010) lists a vast number of vessels which were sunk during the operation. Mainly, the vessels were of French or English origin, and were either requisitioned civilian vessels or military ships. Most of the wreck sites are now known and are regularly dived recreationally. One example is the French torpedo ship *Bourrasque* that was hit by a German coastal gun on 30 May 1940, and sank in front of Nieuwpoort with 600 men on board. The site is of significance not only for its involvement in the World War II 'Operation Dynamo' but also for its graveyard status. A number of wrecks relating to 'Operation Dynamo' have been discovered in Belgian waters in addition to the *Bourrasque*, including, three British Destroyers: HMS *Wakeful*, HMS *Basilisk*, and HMS *Grafton,* and the French *Sirocco*. The vessels lost during the operation represent a snapshot of British and French military and non-military vessels: British and French destroyers, British paddle minesweepers, one British ferry, one French merchant vessel and a whole range of British trawlers.

4.3.95 Shipwrecks in Belgian waters also represent a number of ships of the Kriegsmarine, including sweepers, blockade runners (*Sperrbrecher),* outpost boats, minesweepers, tug boats and yachts. The end of the war is also represented, by landing vessels, so-called Liberty ships and other merchant vessels.

4.3.96 Wrecks of World War I and World War II are not limited to ships – many of the aircraft responsible for aerial bombardment were lost, often as a result of enemy fire from other aircraft or the strategically situated anti-aircraft gun batteries.

4.3.97 World War II airplane material has been recovered from the beach at Oostende (Pieters *et al. 2010: 200).*

4.3.98 A German Dornier 17 of the 'Blitz' Geschwader, KG3 crashed on the Sandwich Flats on 31 August 1940 after attacking Manston, and a photograph of the air craft crash site in Pegwell Bay has been uploaded onto flickr (www.flickr.com, http://forum.12oclockhigh.net). Locals have mentioned that the bent propeller blades used to be visible in the intertidal zone at low tide, and parts of the aircraft may have found their way to the Spitfire Memorial Museum at Manston. Another German Dornier 17 has been discovered in the Goodwin Sands (Wessex Archaeology in press).

## 4.4 Regional Marine Geological Assessment – from Sub-bottom Profiler and Geotechnical Vibrocore Data

4.4.1 A chirp system, a boomer and a sparker system were used by MMT to acquire the shallow seismic data from the survey area, with the boomer used for the near shore sections and the sparker used offshore. Of this data, only the centre line along the entire route was interpreted for this report. A towed chirp was used by MMT for the inshore sections of the survey, however, these data were not evaluated by WA.

4.4.2 102 vibrocore samples were also taken along the route. The location of 10 of these were chosen by WA and examined in detail, whilst the offshore logs from the remainder were also examined. The results from all of these core samples have been used as ground-truthing to aid the geophysical interpretation for this report.

4.4.3 The broad geological sequence across the entire survey area can be summarised as follows (**Table 4.2**) (interpreted from the current geophysical and core sample data, Cameron *et al*. 1992 and BGS 1992).

**Table 4.2: General geological sequence from the survey area**

| Unit | Description |
|---|---|
| 1 | Recent (Holocene) seabed sediments, gravelly shelly sand. |
| 2 | Post-Devensian terrestrial (UK sector) and estuarine (Belgian sector) clay, silt and fine sand with organic inclusions and peat layers |
| 3 | Eocene clay (**London Clay Formation**) |
| 4 | Palaeocene sand and sandy clay (**Thanet Formation**) |
| 5 | Campanian (Upper Cretaceous) chalk |

4.4.4 Not all of the sequence described above is present across the entire survey area, with some being only sporadically present. More detail about the geological sequence of each area is found in each the following sections on the individual cable route segments.

## 4.5 Regional Seabed Features Assessment – from Magnetometer, Sidescan and Multibeam Data

4.5.1 A total of 223 sidescan sonar anomalies plus 242 magnetometer anomalies and 12 bathymetric anomalies were individually identified within the geophysical survey area along the entire proposed route. These were grouped, together with any recorded wrecks and obstructions within the area covered by the geophysical data, to produce a list of 270 sites of potential archaeological interest. Additionally, 38 recorded wrecks or obstructions were found by UKHO, NMR, VIOE and SHOM searches to be located outside of the geophysical survey area. These were all assigned archaeological potential ratings as follows (**Table 4.3**):

**Table 4.3: Archaeological Potential Ratings**

| Archaeological Discrimination | Number of Anomalies | Interpretation |
|---|---|---|
| A1 | 46 | Anthropogenic origin of archaeological interest |
| A2 | 254 | Uncertain origin of possible archaeological interest |
| A3 | 8 | Historic record of possible archaeological interest with no corresponding geophysical anomaly |
| **Total** | **308** | |

4.5.2 Furthermore, these anomalies can be classified by probable type, which can further aid in assigning archaeological potential and importance (**Table 4.4**):

**Table 4.4 Anomaly Classifications**

| Anomaly Classification | Number of Anomalies |
|---|---|
| Recorded Wreck / Obstruction | 8 |
| Wreck | 4 |
| Debris | 50 |
| Seafloor Disturbance | 1 |
| Dark Reflector | 48 |
| Bright Reflector | 3 |
| Rope / chain | 13 |
| Magnetic | 143 |
| Recorded Wreck / Obstruction outside of geophysical survey area | 38 |
| **Total** | **308** |

4.5.3 The sites identified in the geophysical survey are discussed below, with full details provided in **Appendix V, VII, VIII** in **Volume II** and **Figures 8, 11, 13**. The data will be examined in more detail in the **English Waters Study Area, French Waters Study Area** and **Belgian Waters Study Area** sections that follow.

# 5 KENT LANDFALL, ENGLAND

## 5.1 INTRODUCTION

5.1.1 The Kent Landfall Study Area comprises a loosely-C-shaped polygon that covers a strip of coast between Ramsgate and the Sand Hills extending roughly 1 km inland from Mean High Water (**Figure 4, Figure 5**). It was designed to cover a range of potential landfall options and to provide additional detail about the local heritage resource.

5.1.2 The selected Nemo cable route Kent Landfall location is within a 200 m wide strip of land between the Service Station North and Service Station South potential landfall locations (PMSS 2010).

- Service Station North: This is the area to the north of the petrol station located at the west of Pegwell Bay on the A256. The Thanet Offshore Wind Farm cables make landfall in this area and therefore it is expected that installation of the cables is technically feasible using similar open cut trenching methods as used by the Thanet Offshore Wind Farm Project (Wessex Archaeology 2007).

- Service Station South: This is the area to the south of the petrol station located at the west of Pegwell Bay on the A256. Installation of the cables may require HDD underneath a standing pool of water in this area.

5.1.3 Because the intertidal data have not been received at the writing stage of this report, the later does not include such assessment, but once available these data will be archaeologically assessed and the results included in the present report.

## 5.2 GEOLOGY

5.2.1 The majority of the geology at the landfall comprises alluvium with some Thanet sand (Oxford Archaeological Unit 2001). These comprise Blackheath/Oldhaven/Woolwich and Thanet Beds, laid down between 65 to 45 Ma during the Palaeocene and Eocene, although a small area of the northern part of the Kent Landfall Study Area consists of Cretaceous chalk laid down between 140 to 65 Ma (Young 2004: 1).

## 5.3 COASTAL CHANGE

5.3.1 The historic environment at the Kent Landfall is intrinsically linked with the area's geography and coastal change. The northern two-thirds of the Kent Landfall Study Area are part of the historic Isle of Thanet, which was cut off from the mainland by the Wantsum Channel (Young 2004: 5). The southern third of the Kent Landfall Study Area is situated at the eastern mouth of the Wantsum Channel, where in the distant past a narrow shingle bank extended southwards from the Isle of Thanet towards the mainland. During the late medieval period, the Wantsum Channel began to silt up, and additional sea defences were constructed to reclaim the low lying marsh land, thus rendering the area suitable for occupation. By the 1700's, much of the former channel had been reclaimed, although further reclamation activities at the mouth of the River Stour, in the southern part of the Kent terrestrial area, are visible on the 1872, 1896, 1908 and 1938 Ordnance Survey maps (**Figure 4**).

## 5.4 HISTORIC LANDSCAPE CHARACTER

5.4.1 An Historic Landscape Character (HLC) assessment has been developed by Oxford Archaeological Trust (2001) and by Jacobs Babtie (2004) for Kent County Council. The Kent Landfall Study Area forms part of three Historic Landscape Character Areas defined by Oxford Archaeological Trust as 34 (Wantsum Coastal Belt), the edges of 18 (Isle of Thanet) and 19 (Wantsum Channel).

5.4.2 HLC area 34 is located immediately on the coast, and comprises a small distinct area of coastal land types, such as coastal wetlands, saltmarsh, salterns, reclaimed land, marshes, shingle and dunes, mudflats, wave-cut platforms and creeks, with significant expanses of recreational land use.

5.4.3 HLC area 18 comprises the Isle of Thanet, which is characterised by two Historic Landscape types: post-1801 settlement and irregular fields bounded by roads, tracks and paths. After Wantsum Channel silted up, the Isle of Thanet joined the mainland, however, it still retains an island feel, resulting from the way the landscape of Thanet rises out of the marshes. The sloping edge of the flat plateau runs around the south and west of the chalk outlier from Cliffsend and Minster onwards, and the slope and plateau top give long views over Pegwell Bay and the adjacent marshes.

5.4.4 HLC area 19 is slightly inland of 34, and is comprised of a well-defined area composed almost entirely of marshland reclaimed from the sea. Reclamation in this area began in the 12th or 13th century in connection with the ecclesiastical estates in the region.

5.4.5 The silted up course of the Wantsum Channel and the former mouth of the River Stour have formed marshlands, and the flat and open landscape continues around the coast to the Sandwich flats. The marshes around Sandwich have a more coastal influence, with views open to the sea. This area is bordered by the sand dunes and coastal mudflats of Sandwich Bay. Sandwich itself was an important port and still has a remarkably complete medieval town centre. Nearby Richborough has been strategically important since Roman invaders built a castle on a promontory within the marshes. Over the last 100 years, a major port has developed. Along the coast, a long barrier of Aeolian sand dunes lie between the marshes and the sea, forming a small but individual character area on the edge of the marsh, and are characterised by grasses and maritime influences. The coastal mudflats of Pegwell Bay and Sandwich Bay are designated within the Site of Special Scientific Interest (SSSI) which covers the Hacklinge marshes and the sand dunes.

### 5.5 KNOWN TERRESTRIAL SITES

5.5.1 The following section is only a preliminary examination intended to provide information on the archaeological potential of the intertidal zone. A complete terrestrial archaeological assessment is being undertaken by TEP and the results will form a separate report.

5.5.2 A complete gazetteer of terrestrial sites at the Kent Landfall can be found in **Appendix IV** in **Volume II**. The gazetteer is derived from information provided by the NMR and Kent HER, and the sites are numbered (**WA1001 – WA1069**) (**Figure 5**). The following section provides a brief synopsis to establish the known archaeological resource and to provide context for the identification and understanding of any potential components of the historic environment which may survive. The **WA** is not included on the figure to assist drawing clarity.

5.5.3 There are no Scheduled Ancient Monuments within the Kent Landfall Study Area, however, there are **2 listed buildings**:

- **WA1039:** 53 and 55 Foad's Lane
- **WA1040:** Saint Augustine's Cross

#### Prehistoric Period (Palaeolithic to AD 43)

5.5.4 The earliest known archaeological evidence in the Kent Landfall Study Area dates to the Neolithic. All of the sites are located on the historic Isle of Thanet, and many are clustered on areas of higher ground that would have been dry land throughout the period. The density and richness of sites indicates relatively intensive occupation of the area from the Neolithic onwards, probably as a result of this being a prime location for landing material and people from the Continent. This section will examine the known archaeological material from the Neolithic to the end of the Iron Age by site, starting from the north end of the Study Area, as many of the sites were either occupied continuously or reoccupied several times throughout the Prehistoric period.

5.5.5 A range of late Neolithic or early Bronze Age features and archaeological material have been discovered across the Kent Landfall Study Area, and include late Neolithic or early Bronze Age barrows (**WA1001 – WA1004**), a crouched inhumation (**WA1005**), a late Neolithic or Bronze Age settlement (**WA1006**), a Bronze Age enclosure and ring ditch visible as crop marks (**WA1007**) and two Bronze Age hoards (**WA1008-WA1009**). Sites **WA1002, WA1005** and **WA1007** may be associated, and they are situated within a wider landscape of barrows, enclosures and a system of field ditches indicating Neolithic and Bronze Age activity throughout the area. To the north-west of Hollins Bottom, post-holes and pits (**WA1011**) were located within a late-Neolthic / early Bronze Age barrow (**WA1004**).

5.5.6 The combined quarry working and funerary deposits encountered at the nearby Cliffsend Meadows development could be related to the possible settlement (**WA1006**). Remains indicating a possible long-lived domestic settlement, dating between the late Neolithic and medieval period, were discovered during an excavation at Oaklands nursery north of Cliffsend (**WA1061**). The late Neolithic material from the site included ditches, pits, flint objects and Late Neolithic Peterborough ware, and the site may have been part of a ditched enclosure. Finds include Late Bronze Age pottery sherds, and a curved ditch revealed an Iron Age pot. An Iron Age burial was discovered in Mount Green Avenue, Cliffsend, Ramsgate in 1959 (**WA1019**), and the site included skeletal remains and pottery. Archaeological excavations at Cliffs End Farm have revealed abundant evidence that the site was used for funerary and ceremonial purposes in the Bronze Age (**WA1062**). The evidence included four early Bronze Age round barrows; and a series of horseshoe shaped enclosures containing disarticulated skeletons and ritual deposits has been dated to the later Bronze Age.

5.5.7 Neolithic flakes and worked flints have also been recovered from farmed fields after ploughing, and rare prehistoric pottery was discovered in pits (**WA1023**).

5.5.8 Prehistoric pottery and worked flint were discovered during an excavation at Cottington Hill (**WA1059**). Cottington Hill remained an important site throughout the prehistoric period, and Iron Age and Romano-British artefacts have also been found (**WA1063,** Andrews *et al.* 2009: 104-105). Metal detectorists have discovered numerous Iron Age coins on the hill, representing a range of dates, from 100 BC to AD 20 (**WA1012 – WA1018**). To the south of Cottington Hill, a late Bronze Age or early Iron Age midden included pottery sherds and associated material (**WA1010**).

5.5.9 There has been occupation around the present-day Ebbsfleet farm since at least the Bronze Age, when the site would have occupied a coastal position on the edge of the Wantsum Channel. Finds at the site have included a Bronze Age founder's hoard (**WA1009**), comprising 181 weapons and implements, and excavations at the site have revealed another Late Bronze Age hoard, comprising five copper alloy objects and a range of other artefacts (**WA1060**). Nearby, two middens with Bronze Age pottery have been excavated (**WA1058**). Iron Age finds have also been recovered from the area around Ebbsfleet Farm. Excavations in 1990 revealed a Bronze Age beaker burial and Iron Age occupation site (**WA1064**). The Iron Age site comprised pits, ditches a possible hut and occupation layers dating to c. 200-50BC.

5.5.10 There are a number of undated, but possibly prehistoric, sites within the Kent Landfall Area, including the remains of possible late Bronze Age hut circles with a boundary ditch near Cliffs End Hall (**WA1065**). Other sites include an undated crouched inhumation burial found during a watching brief at Cliffsend (**WA1066**), ring ditch cropmarks identified from aerial photographs (**WA1067-WA1068**) and a large area of cropmark features also identified from aerial photographs (**WA1069**).

**Romano-British (AD 43-410)**

5.5.11 The Kent Landfall Study Area was also intensively occupied during the Romano-British Period. A large number of ditches in the vicinity of Ebbsfleet farm have been dated to the prehistoric, Romano-British and medieval periods, and are thought to be enclosure and boundary ditches (**WA1058**). The site was excavated as part of the Margate to Weatherlees Hill Wastewater Treatment Works Twin Pipeline. Other excavations at Ebbsfleet farm have identified remains and traces of a Romano-British or medieval structure (**WA1060**).

5.5.12 At Ebbsfleet farm, occupation of an Iron Age site appears to have continued into the Romano-British period (**WA1064**), and Iron Age occupational layers are overlain by a large Roman building dating to the late 2nd century AD. Surface finds from the surrounding area included Romano-British pottery, brick, tile, a coin, rotary quern and buckles. The site may be the same as or related to the find of a Romano-British building and associated pottery at Cottington Hill (**WA1063**). The remains of a Romano-British building and associated pottery, dating to the late 2nd century, were discovered at Cottington Hill, and they are located within a Romano-British landscape of ditches forming a rectilinear enclosure system (**WA1056**).

5.5.13 Three further Romano-British sites are located immediately to the east of Cottington Hill. Site **WA1020** comprised drainage ditches, a hearth and two inhumations, and excavations at the site revealed an area of rammed chalk and flint which is thought to have been used to consolidate an area of boggy ground, and excavations around the graves indicate that they were dug into an area of marshy ground (Andrews *et al.* 2009: 104-105), indicating that these relatively low-lying areas remained quite marshy prior to reclamation activities in the medieval and post-medieval periods. Site **WA1021** comprised pits and associated materials. An occupation site that could indicate a possible villa (**WA1022**) had evidence for building materials, Samian pottery and other fine wares, and the Belgic material that highlights trade links with the Continent during the Romano-British period. Romano-British ditches, a sunken featured building and two cemeteries (**WA1023**) were discovered less than 300 m to the north.

5.5.14 A sherd of Samian ware was recovered during excavations at Oaklands nursery north of Cliffsend (**WA1061**). A Romano-British grave and associated material including a nail, a Belgic sherd, animal bones and shells (**WA1024**) was discovered to the east of Cliffsend. Nearby, Romano-British coins, a brooch and key were recovered (**WA1025**).

5.5.15 The discovery of a Samian cup, dredged up in Pegwell Bay in 1902 (**WA1026**) probably represents material discarded in the bay from shore or thrown overboard from a Romano-British vessel, rather than evidence for a previously undiscovered shipwreck. However, the discovery of further material in the bay could represent a shipwreck, as often the hard finds, like pottery, are all that survive.

**Anglo-Saxon (410–1066)**

5.5.16 Pegwell Bay represents the traditional landing site of the Saxons in AD 449 (**WA1027**), according to the Anglo-Saxon Chronicle, and it is thought that St Augustine may also have landed there in AD 597. A natural spring marks the traditional spot where St Augustine camped with his monks on reaching England (**WA1028**). Although the shape of the bay has changed considerably since the

Saxon period as a result of land-reclamation activities, these traditions indicate that the bay has historically been an optimal spot for landing the typical boats of the time.

5.5.17 Anglo-Saxon archaeological evidence has also been discovered in the Kent Landfall Study Area. Finds include an Ipswich Ware pot dated to AD 700-900, discovered during excavations at Oaklands nursery, north of Cliffsend (**WA1061**). The excavations also revealed pits, postholes, animal bone, pottery, comb fragments and building material, possibly suggesting a domestic settlement. Excavations at Cliffs End Farm have revealed 24 Saxon burials and more than 60 pits dated to the Middle Saxon period (**WA1062**).

**Medieval (1066-1499)**

5.5.18 On the eastern side of the Kent Landfall Study Area, around Little Cliffsend farm, there are a number of medieval features, including two well-shafts (**WA1029 – WA1030**), with **WA1030** associated with a small cave entrance leading northward into a complex system of tunnels reputed to be smugglers caves. A possible medieval wall (**WA1031**) and medieval remains dating to the 13th and 14th century which were discovered when a pipe trench was being excavated (**WA1036**), were located nearby.

5.5.19 A domestic settlement, with evidence for occupation dating back to the Neolithic, was located at Oaklands nursery, north of Cliffsend (**WA1061**). Medieval finds from the site include a dyke/bund of flint pebbles and cobbles, which has been interpreted as a possible revetment or seawall or 'boarded groin'. This indicates that the medieval coast could have been as much as 500 m further inland than at present.

5.5.20 To the south of Cottington Hill, there are a number of other sites, including an early medieval pit (**WA1032**), a possible medieval farmstead indicated by infilled ditches and pottery sherds (**WA1033**), a possible sunken medieval building with associated 12th to 13th century pottery and shellfish remains (**WA1034**), and the remains of a ditch enclosing a 13th and 14th century farmstead (**WA1035**).

5.5.21 During the medieval period, the land at the Kent Landfall Study Area was being reclaimed from the sea, and a seawall (**WA1037**) was built as the result of an inundation of the sea between Cliffsend and Stonar in 1365. The remains of boarded groin structures and earthen embankment extend over 1.5 km, and are located between the eastern extent of Minster parish on the border with Thanet and the northern area of Sandwich parish. Although the seawall is no longer continuous, it is recorded to be in reasonable condition where it survives.

**Post-Medieval (1500-1800)**

5.5.22 The Ordnance Survey maps record a number of former landscape features, such as a post-medieval chalk pit to the north of Cliffsend (**WA1038**) and areas of saltings located on either side of the mouth of the River Stour (**WA1057**).

5.5.23 A pair of cottages built in 1737 in Cliffsend are Listed (**WA1039**).

5.5.24 Post-medieval material, including the remains of flint wall foundations, iron-working artefacts and 16th-17th century pottery has also been recovered at excavations at Cottington Hill (**WA1059**).

**Modern (1800 – present)**

5.5.25 Ordnance Survey maps illustrate that even in the modern period, the coastline was continuing to change. Slight changes to the main channel of the River Stour are visible around No Man's Island in the southern part of the Kent Landfall Study Area on the 1877, 1898, and 1908 Ordnance Survey maps. However, by 1946, the river channel had changed considerably: its course had been straightened, with relict channels infilled, and No Man's Island along with a considerable area of intertidal area had been reclaimed and joined the mainland.

5.5.26 In addition, the landscape was transformed by military activities during the two World Wars. The majority of sites and monuments in the modern period relate to the two Wars, with a single exception: a carved celtic cross that was erected in 1884 to commemorate the landing of St Augustine in AD 597 (**WA 1040**).

5.5.27 Military sites likely related to the two World Wars, but without date ranges specified in the Kent HER include the Richborough RAF Salvage Yard (**WA1055**) and an area of slit trenches (**WA1054**) identified from aerial photographs.

5.5.28 During World War I, a train ferry dock (**WA1043**) located on the banks of the River Stour was part of a secret 'Q' port, the starting point of a ferry service for troops and munitions sent to France and Flanders (www.open-sandwich.co.uk).

5.5.29 During World War II, a vast array of coastal defences blanketed the landscape. The Kent HER records numerous pillboxes (**WA1041-WA1051**) that dotted the coast and surrounded Cliffsend. In addition, there was a coastal battery (**WA1052**), gun emplacements (**WA1053**), slit trenches (**WA1055**), a possible World War II anti-aircraft station at Cottington Hill (**WA1056**) and a minefield on the coast at the mouth of the River Stour (**WA1057**). In addition, the South East Rapid Coastal Zone Assessment Survey (Wessex Archaeology, in progress) has identified and mapped numerous other defences, including lines of anti-tank cubes, barbed wire obstructions, additional gun pits and gun batteries, lines of posts representing anti-landing obstacles in the intertidal zone, possible beach scaffolding, bomb craters, and to the south of the River Stour, there was a rifle range and fields of anti-landing obstructions.

5.5.30 Aerial photographs taken in the 1940s illustrate the extent of the World War II beach defences (**Figure 6**) at the immediate terminus of the cable route landfall, including lines of anti-tank cubes immediately to the south-east of the petrol station buildings, as well as lines of beach scaffolding extending across the intertidal zone. In addition, the aerial photographs illustrate that the intertidal marsh area has developed since the 1940s, as in the aerial photographs, the area comprises a sandy beach that is covered at high tide.

5.5.31 The walkover survey for the landfall of the Thanet Offshore Wind Farm cable route (Wessex Archaeology 2007) followed the A256 between the north side of Pegwell Bay and the disused Richborough Power Station. The survey identified a number of archaeological features, including World War II coastal defences including a line of anti-tank pimples, an earthen bank and a pillbox.

**Walkover Survey**

5.5.32 A walkover survey was conducted in November 2010. The walkover survey started at the carpark on the A256 (Sandwich Road) south of the Jet petrol station, and continued north-east towards the cliffs at the northern side of Pegwell Bay. Access to the foreshore around the petrol station is prohibited by Kent Wildlife Trust as it is a Sensitive Wildlife Area (**Plate 1**). However, limited access was gained to the area on a concrete footpath. The area comprises overgrown marshland mudflats (**Plate 2, Plate 3**). No archaeological material was readily visible, however, it could be obscured by vegetation or buried in the mudflats. An area marked 'danger unstable ground' is located in the marshland immediately to the north-east of the petrol station (**Plate 4**).

5.5.33 The walkover survey continued to the former hoverport, in order to photograph the site from the north (**Plate 5, Plate 6**), and continued along the cliffs. A line of posts was visible leading up to the cliff (**Plate 7**).

5.5.34 The walkover survey then returned along the coast and continued following the coastal path beyond the car park to the south until the path turned to the west. No further material was discovered, however, the remains of the World War I train ferry were photographed across the estuary (**Plate 8**).

### 5.6 POTENTIAL

5.6.1 As illustrated in the **Regional Archaeological Overview** and highlighted by the known sites in the area, there is high potential for discoveries of archaeological finds, sites and deposits. Many of the known sites were discovered through development activities: out of the 69 sites and findspots identified in the Kent HER and NMR records, 23 (about a third) are attributed to development.

5.6.2 In the northern part of the Kent Landfall Study Area, there is potential for the discovery of material dating from the Palaeolithic to the modern period. Although no Palaeolithic or Mesolithic material has previously been discovered on this part of the coast, finds of these periods have been recovered from other sites on the Isle of Thanet. The density of sites and findspots from the Neolithic to the Romano-British period also emphasises the potential for sites from these periods, and there is also potential for Anglo-Saxon, medieval, post-medieval and modern material.

5.6.3 In the southern part of the Study Area there is also potential for Palaeolithic or Mesolithic material, and any evidence from the Neolithic to medieval period would likely be of a maritime nature. There is also potential for post-medieval and modern material in the area of the in-filled Wantsum Channel and adjacent to the now settled course of the River Stour.

## 6 ENGLISH WATERS – KNOWN AND POTENTIAL ARCHAEOLOGY

### 6.1 INTRODUCTION

6.1.1 The English Waters Study Area extends roughly 48 km in an irregular linear corridor surrounding the cable route between Mean Low Water and the French Waters Study Area (**Figure 7, Figure 8**). It comprises English Territorial Waters (within 12 nm) and the UK EEZ.

### 6.2 SUB-BOTTOM PROFILER AND GEOTECHNICAL ASSESSMENT

6.2.1 The basement geology across the entire UK sector of the cable route is expected to comprise Campanian Chalk (**Unit 5**) (**Figure3** & **7**). This basement is also the shallowest geological unit along a large portion of the route, and is often directly overlain by only the superficial seabed sediments (**Unit 1**) (Section 4.4.3 and **Table 4.2**).

6.2.2 **Unit 4** (**Thanet Formation**) is restricted to the near shore section of the route, where it forms an offshore extension of the same formation observed on land (Cameron *et al.* 1992). The unit is expected to comprise sand and sandy clay and to directly overlay **Unit 5**, though no ground truthing has yet been undertaken along this section of the route, so this is unconfirmed. In this area, **Unit 4** is directly overlain by **Unit 1**. As the **Thanet Formation** is Palaeocene (Thanetian) in age, it is considered to be too old to be of possible archaeological importance.

6.2.3 **Unit 3** (**London Clay Formation**) has only been observed at the far eastern end of the UK sector. The unit is characterised on seismic records by numerous sub-parallel internal reflectors, and has been observed as a relatively thin unit which steadily thickens towards the east. Ground truthing has confirmed the unit to comprise stiff clay. In this area, **Unit 3** is directly overlain by **Unit 1**. As the **London Clay Formation** is Eocene (Ypresian) in age, it is not considered to be of possible archaeological importance.

6.2.4 **Unit 2** in the UK sector of the cable route comprises a sequence of terrestrial deposits located directly west of the Lobourg Channel (see below). A complex of under filled palaeochannels has been observed in this area on both the multibeam bathymetry and sub-bottom profiler records (**WA7500** and **WA7501**) (**Figure 7**). Samples from core **VC WA VC7** have confirmed the presence of sandy clay with organic inclusions, and at least one peat layer containing fresh water molluscs, directly overlying the chalk bedrock within channel **WA7500**.

6.2.5 This unit is interpreted as being a fluvial/flood plain deposit, probably of post-Devensian (early Holocene) age, overlain by possible estuarine sediments (**Appendix II, III** in **Volume II**). These deposits therefore have the potential to contain both *in-situ* and derived archaeological material, alongside preserved organic remains of potential importance to palaeoenvironmental studies.

6.2.6 Although the Lobourg Channel marks the eastern most edge of **Unit 2**, the basal reflector is very poorly defined and inconsistent (**WA7502**) (**Figure 7**) and the western extent of the unit could not be identified. Coring has not yet been carried out along this portion of the route to aid with the interpretation.

6.2.7 **Unit 1** is present across most of the UK Waters Study Area of the proposed cable route, where it generally comprises shelly gravelly sands and sandy gravels. It is of varying thickness along the route, ranging from a thin veneer to sand waves and banks a few metres in height. Of particular note is the South Falls, a large sand bank approximately 30 m in height which crosses the proposed route at the eastern edge of the Lobourg Channel. The seabed sediments are not considered of archaeological importance in themselves, though where they form large sand waves and banks they can potentially cover archaeological sites such as shipwrecks.

6.2.8 A final feature of note is the Lobourg Channel (**Figure 7**), a large, broad, roughly north-south trending channel that cuts across the proposed route. The western edge of this channel is marked by a large, rapid bathymetry change, with water depths suddenly increasing by approximately 30 m whilst the eastern edge is tentatively marked by the South Falls bank. This is a large, under filled palaeochannels feature which is interpreted as being intermittently active throughout the Pleistocene. It is a major bathymetric feature, though the sub-bottom profiler data and core samples indicate there are no surviving terrestrial deposits at the base of the channel and so it is of limited archaeological interest.

### 6.3 Known Wrecks and Obstructions in English Waters

6.3.1 Records of wrecks and seabed obstructions within the UK Territorial Waters Marine Study Areas were collated using information provided by the UKHO, the NMR, and through the archaeological interpretation of geophysical survey data (**Table 6.1**)

(**Figure 8**). A total of 129 sites of possible archaeological potential were identified along the UK section of the proposed cable route. Of these, five were classified as A1 sites, 123 classified as A2 and 1 was classified as A3.

**Table 6.1: Sites in English Waters**

| Description | Number |
|---|---|
| 'A1' previously unrecorded wreck | 1 |
| 'A1' geophysical anomalies of anthropogenic origin and of archaeological interest - observed in geophysical data | 4 |
| 'A2' geophysical anomalies of possible anthropogenic origin and archaeological interest observed in geophysical data | 123 |
| 'A3' wreck recorded as 'Live' by the UKHO but not observed in geophysical data | 1 |
| 'A3' wrecks recorded as 'Live' by the UKHO, outside of the geophysical survey area | 8 |
| 'A3' wrecks recorded as 'Lift' by UKHO, outside geophysical survey area | 2 |
| 'A3' obstructions recorded as 'Live' by UKHO, outside of the geophysical survey area | 8 |
| 'A3' obstruction recorded as 'Dead' by the UKHO, outside geophysical survey area | 1 |
| **TOTAL** | **148** |

6.3.2 A complete list of wrecks and obstructions (**WA7000 – WA7128, WA7270 – WA7288)** can be found in **Appendix V** in **Volume II**.

**Geophysical Survey Data**

6.3.3 Only one definite wreck, site **WA7024**, was observed along within the English Waters Study Area. The wreck was identified by all of the geophysical equipment, and appears as a mostly buried structure measuring 31.4 m x 4.8 m x 0.8 m with a 66nT magnetic anomaly. The wreck itself is orientated approximately NNE – SSW, and is located on the edge of a large sand wave within a scour measuring approximately 30 m x 11 m x 0.4 m. The wreck appears to be previously unrecorded, and its location on the edge of a sand wave suggests it is periodically buried and exposed as the sand waves in the area move. Due to the wreck being mostly buried little can be said about its structure, though the magnetic anomaly observed suggest it is at least partially ferrous in construction. The wreck is illustrated on **Figure 9**.

6.3.4 The *Pisces* (**WA7017**) was a British motor fishing vessel that sunk on the 8$^{th}$ December 1995. The single crew member was recovered alive. The UKHO record indicates that there were plans for a salvage attempt. The *Pisces* measured 5.5 m by 2.4 m. Diver reports have indicated that the hull lies flat on the seabed in sand, and the engine block lies in a trench by a chalk ridge. However, although site **WA7017** is the given location of the wreck of the fishing vessel *Pisces*, the wreck was not identified by any of the geophysical survey equipment during the archaeological geophysical assessment. As with wreck **WA7024**, a number of large sand waves were observed at the site indicating the structure could be in the correct location but completely buried at the present time. Given that the UKHO report the wreck to be very small (5.5 m x 2.4 m), this is considered to be possible.

6.3.5 A total of 30 sites have been classified as debris within the UK sector of the proposed route. Most of these have been classified as A2 sites, though four (**WA7027**, **WA7047**, **WA7049** and **WA7098**) have been designated as A1. Site **WA7027** is an area of dark reflectors with shadows measuring 21.9 m x 17.6 m, and associated with a 59nT magnetic anomaly. The site is located in an area of sand ripples, indicating a larger, at least partially ferrous, structure could be buried beneath the seabed.

6.3.6 **WA7047** is an area of angular bright reflectors approximately 22.2 m x 10.7 m and associated with a 43nT magnetic anomaly (**Figure 10**). This has been interpreted as a debris field, which potentially represents the remains of a degraded wreck or other structure. The magnetic anomaly suggests the debris is at least partially ferrous in nature.

6.3.7 **WA7049** is a large dark reflector with a large shadow measuring approximately 7.2 m x 6.5 m x 0.9 m and associated with a 6nT magnetic anomaly (**Figure 10**). Multibeam bathymetry data indicate the structure to be located within a large depression measuring 22 m x 15 m x 0.5 m. The site is at the location of a known obstruction recorded as foul ground, though the results from the data here indicate it could be the remains of a wreck or other anthropogenic structure.

6.3.8 **WA7098** has been identified as two short, parallel, linear alignments of dark reflectors with shadows measuring 9.3 m x 9.4 m x 0.6 m and associated with a 16nT magnetic anomaly. This has been interpreted as an area of debris or potentially a partially buried, badly degraded structure of an at least partially ferrous nature.

6.3.9 Of the remaining debris sites, 17 (**WA7010**, **WA7016**, **WA7029**, **WA7030**, **WA7034**, **WA7041**, **WA7044**, **WA7051**, **WA7057**, **WA7075**, **WA7079**, **WA7080**, **WA7088**, **WA7091**, **WA7102**, **WA7109** and **WA7116**) appear as individual large, angular dark reflectors with large acoustic shadows and are interpreted as possible individual pieces of debris rather than debris fields or structures. **WA7075**, **WA7079**, **WA7088** and **WA7091** are associated with small magnetic anomalies and so are probably ferrous in nature, whilst the rest are interpreted as being non-ferrous. **WA7080** is also associated with a mound identified on the multibeam bathymetry data and so is probably a substantial feature, though its appearance in the data and lack of a magnetic anomaly mean that it may not represent a wreck site.

6.3.10 Five of the debris sites (**WA7031**, **WA7035**, **WA7043**, **WA7059** and **WA7067**) comprise relatively short, linear alignments of closely spaced dark reflectors with shadows, and could represent separate pieces of debris or the same piece of linear, partially buried debris. None have been found associated with a magnetic anomaly and so all are interpreted as non-ferrous in nature.

6.3.11 **WA7038**, **WA7045**, **WA7061** and **WA7074** are small areas containing numerous irregular dark reflectors, and are interpreted as small debris fields. Only one (**WA7038**) is associated with a magnetic anomaly and so is interpreted as being ferrous in nature, whilst the rest are interpreted as areas of non-ferrous debris.

6.3.12 Eight of the sites (**WA7022**, **WA7052**, **WA7053**, **WA7054**, **WA7058**, **WA7066**, **WA7089** and **WA7092**) comprise curvilinear dark reflectors, generally with small shadows, and have been interpreted as lengths of rope or chain. **WA7022**, **WA7089** and **WA7092** are associated with magnetic anomalies, and so are likely to be chains, whilst the remainder are more likely to be non-ferrous in nature. **WA7052** has a large dark reflector located at one end, possibly indicative of an anchor.

6.3.13 Sites **WA7056** and **WA7070** are both relatively small, elongated bright reflectors without any associated magnetic anomalies. These are of an uncertain origin, and could be either natural features or non-ferrous debris composed of a material that absorbs acoustic waves rather than reflects them.

6.3.14 A total of 20 sites (**WA7011**, **WA7019**, **WA7020**, **WA7037**, **WA7042**, **WA7050**, **WA7055**, **WA7060**, **WA7063**, **WA7064**, **WA7073**, **WA7077**, **WA7085**, **WA7086**, **WA7087**, **WA7090**, **WA7100**, **WA7108**, **WA7120** and **WA7127**) have been classified as dark reflectors, which are contacts of uncertain origin which could be either natural features or pieces of debris. None of the sites have been found associated with a magnetic anomaly, so any debris is either non-ferrous in nature or has a magnetic field which was too small to be detected by the survey.

6.3.15 The remaining 67 sites (see **Appendix V** in **Volume II** for full list) are the locations of magnetic anomalies that have not been attributed to any sidescan sonar or multibeam bathymetry contacts. These could represent natural variations in the seabed sediments or shallow geology, bathymetric changes, or pieces of buried ferrous debris. Most are relatively small in size, but 16 (**WA7002**, **WA7004**, **WA7014**, **WA7025**, **WA7033**, **WA7040**, **WA7046**, **WA7072**, **WA7082**, **WA7084**, **WA7094**, **WA7095**, **WA7096**, **WA7107**, **WA7125** and **WA7126**) are considerably larger and more likely to represent pieces of buried ferrous debris than natural features. **WA7002**, **WA7004** and **WA7094** are particularly large (87nT, 140nT and 80nT respectively) and suggest the presence of large pieces or scatters of debris buried within the seabed sediments.

**Live and Lifted Wrecks not observed in the Geophysical Data**

6.3.16 Additional live and lifted wrecks recorded in the UKHO, NMR and HER records, but not observed in the geophysical data, are detailed below. Many of these wrecks were not observed because they lay outside of the geophysical survey area. Although wrecks recorded as 'Lifts' by the UKHO have been salvaged, they are included here because material from the wreck may still be located on the seabed.

6.3.17 The *Harvest Moon* (**WA7270**) was a British Blockship, formerly a trawler, recorded in the Kent HER for UKHO wreck data. It was lost 9 September 1940. The record indicates that the wreck was largely intact apart from a broken stern, and that it showed at low water, partially buried in mud. The wreck of the *Alfred Colebrook* is also thought to be located nearby. Wrecksite website records the vessel as 'dead'.

6.3.18 **WA7271** is an abandoned four wheel drive vehicle, largely reclaimed by the mud. It was surveyed in 2007. Despite the possibility of the vehicle being recovered, it has been charted as an obstruction.

6.3.19 **WA7272** is an unknown wood and iron wreck mostly buried in sand. First surveyed in 1959, the vessel dries at 11 feet (3.4 m). A survey in 1974 indicated that the vessel measured 42 feet (12.8 m) in length, and a survey in 1995 indicated that the wreck was spread over an area 20 m by 10 m, with three distinct structures protruding up to 0.6 m above the seabed.

6.3.20 **WA7273** is a steel tank sunk into the seabed that was discovered during a 1974 geophysical survey and examined by divers. The tank measured 7.3 m by 7.3 m. A geophysical survey in 1982 did not locate the tank, and there are local reports of the tank having been salvaged. However, a geophysical survey in 1995 rediscovered the tank.

6.3.21 *LCP 586* (**WA7274**) was a British landing craft that broke away from alongside SS *Asa Lothrop* and sunk in 1946. The craft measured 11 m by 3 m with a draught of 0.9 m. The LCP (Landing Craft Personnel) were wooden assault craft or sometimes also used for ferry work and ancillary services (Royal Marines Museum website). Landing craft were flat-bottomed and designed to be able to run up onto suitable beaches. Geophysical surveys in 1960, 1969, 1974 and 1995 revealed no trace of the wreck, and it is thought to have either broken up or become buried in sand.

6.3.22 The *Bravore* (**WA7275**) was a Norwegian merchant steamship that struck an aerial mine 4 nautical miles off Ramsgate on 22 April 1940. The *Bravore*, previously named the *Belibrook, Polberg* and *Bergvik*, was built in 1916 by Kockums Mekaniska Verkstads A/B in Malmo Sweden (Wrecksite website). The vessel had a triple expansion engine of 156 HP for a maximum speed of 9 knots, two boilers and single screw propulsion. It measured 71.63 m in length by 11.49 m in width with a draught of 4.97 m. At time of loss, the *Bravore* was operated by A/S Vore, and was en-route from Tyne to Rouen as part of a convoy, carrying a cargo of 1993 tons of coal. At the mouth of the Thames, the convoy split up with some of the ships heading for London, while the *Bravore* and four other vessels continued to The Downs. Four passengers and 14 crew were lost. Geophysical surveys undertaken by the UKHO indicate that the wreckage is dispersed over an area 100 m by 55 m with its highest point roughly 1 m above the seabed. A geophysical survey in 1991 indicated that the scattered wreckage lay just proud of the seabed.

6.3.23 The *Rydal Force* (**WA7276**) was a British steamship collier with a gross tonnage of 1101. The *Rydal Force* was built in 1924 by Caledon Shipbuilders in Dundee, a company that throughout the 1920s built large cargo-liners, tankers, coastal steamers and ferries (British Coastal Shipping website, Grace's Guide website). The vessel was owned by Kennaugh W.S. & Co (Wrecksite website), a company that began owning steamships in 1883, moved to Liverpool in the 1890s, and was consolidated into West Coast Shipping Ltd. in 1905 (Fenton 1979: 3). Their ships continued to be registered at Whitehaven, and many of the names of the ships were taken from the Lake District, followed by 'Force', a North Country name for waterfall that derives from Old Norse (*ibid*). The *Rydal Force* was mined on 24 April 1940 while carrying 1250 tons of coal. The vessel was on passage from Sunderland for Cowes when it was lost, and 11 men lost their lives. Geophysical surveys have indicated scattered wreckage in a seabed depression measuring 65 m by 38 m with a shadow height of 1.7 m. The wreck was wire swept in 1950 and 1961. Surveys in 1968 and 1971 did not locate the wreck, however, surveys in 1974, 1981, 1986, 1991, 1995 and 1997 located the wreck, noting that it was a small, dispersed wreck sitting in an area of scour that only just showed above the general seabed level.

6.3.24 **WA 7277** is a Dutch schooner that was sunk 30 May 1940. Surveys in 1940 did not locate the wreck, however, it was located in 1949 and swept clear. In 1959 the survey indicated a pronounced scour extending at least a mile roughly north-south. Survey in 1979 indicated a wreck measuring 69 m in length with a height of 6.31 m. The wreck was swept clear again in 1995, and the survey indicated that the wreck had a length of 58 m, width of 11 m and that it lay in pronounced scour that extended 500 m south and 100 m north. The wreck has a strong magnetometer deflection.

6.3.25 An abandoned Suzuki Jeep (**WA7286**) surveyed in 2007. In August 2007, the vessel was located in the intertidal area in Pegwell Bay, and as it was submerged at Mean High Water, it posed a hazard to small craft operating in the Bay. Once the insurance claims were dealt with, the vehicle was removed. It had been salvaged by 14 September 2007, and is recorded by the UKHO as a 'Lift'.

6.3.26 A dredger hopper barge (**WA7287**) sunk 30 August 1986 while in tow of the tug *Influence*. A salvage attempt in October 1986 failed, however, the barge was raised in November 1986.

### 6.4 POTENTIAL

**Submerged prehistory**

6.4.1 There is potential for archaeological evidence of now submerged terrestrial deposits. The geophysical survey revealed a complex of palaeochannels directly to the west of the Lobourg Channel. Vibrocore **VC-WA-VC7 (Figure 3)**, taken from this area, contained the sedimentary **Unit 2** comprising at least one peat layer and interpreted as being a fluvial/flood plain deposit of probable post-Devensian (early Holocene) age. The presence of peat highlights the time when this area was dry land and suitable for human occupation, and its survival suggests high potential for the survival of other archaeological material. The deposits have the potential to contain both *in situ* and derived archaeological material, alongside preserved organic remains of potential importance to palaeoenvironmental studies.

6.4.2 However, as **Unit 2** directly overlaid bedrock eroded by glacial action, it is unlikely that earlier Palaeolithic material will be found *in situ*, although it could be discovered in secondary contexts.

**Shipwrecks**

6.4.3 There is high potential for archaeological remains of watercraft from the Mesolithic to the present. Near shore, the **Regional Archaeological Overview** has indicated the importance of maritime trade for the coast of Kent, and Pegwell Bay and Sandwich have been important landing places for goods for thousands of years. The mud flats of the bay present a considerable navigational hazard, but also provide an opportunity for high levels of preservation. Within the Bay, there are also numerous obstructions, posts and stakes across the Sandwich Flats and Pegwell Bay that may prove to be of archaeological interest (Admiralty Chart 1825 from 1965).

6.4.4 There are two Named Locations to which Recorded Losses have been ascribed, and details of the Recorded Losses can be found in **Appendix VI** in **Volume II**. Although the exact location of these wrecks is not known, they indicate the potential to discover previously unrecorded wrecks in the area. The first Named Location indicates the loss of 10 French fishing vessels that were stranded in Pegwell Bay during a hurricane in 1752. The second Named Location represents 25 Recorded Losses. The earliest date to the Roman period, when an unknown number of Roman transport vessels and warships were lost during a sudden storm during Caesar's first invasion in 55BC (**WA1201-WA1202**) (**Figure 8**). The three medieval wrecks were cargo vessels of English, French and Spanish nationality that were lost in the 14th century, illustrating the importance of European trade during the period (**WA1203 -1205**). The post-medieval wrecks indicate the wide variety of ships operating in the area, including a British Fourth or Fifth rate ship of the line, a Dutch East Indiaman, a brigantine and various cargo vessels (**WA1206 – 1226**). Their destinations also highlight important issues of the period, with expanding trade networks indicated by a wreck en-route from Jamaica to London, military activity denoted by the British warship, and the dangerous nature of shipping illustrated by a possible privateer and a prize of Ostend privateers. There is little information available about the wrecks from the modern period (**WA1227 – WA1234**), however, they include a galliot and a variety of cargo vessels. Across the periods, the most common causes for loss were due stranding/beaching and to weather events, such as the storm that sunk the Roman ships.

6.4.5 In addition, the wider area comprises a navigational route that provides a relatively short distance between England and Europe, and thus has been key in maritime trade since the Mesolithic. Once naval technology had improved to the level where battles at sea were truly a possibility, this area of sea became a battleground, witnessing, for example, the Spanish Armada (English vs Spanish 1588), the St. James Day and Four Days battles (Second Anglo-Dutch war, 1666), and the Battle off Sandwich / Battle of Dover (100 years war, English vs French, 1217).

6.4.6 The Goodwin Sands represent an area of very shallow mobile sandbanks that are a hazard to shipping of all types, and in English waters, it has one of the greatest reputations for ship losses (Bournemouth University 2007). Current work undertaken by Wessex Archaeology for English Heritage has revealed considerable quantities of shipwreck material dating from the medieval period onwards. The seabed in the Goodwin Sands area has a predominance of fine grained sediments indicating the area also has a high potential for preservation, and although the mobility of the sandbanks may counteract this to some degree, this area is considered to be an Area of Maritime Archaeological Potential (Bournemouth University 2007). In addition, the shifting sands also have the potential to reveal previously undiscovered wrecks.

6.4.7 In addition, the cable route will cross the South Falls, a large sand bank approximately 30 m high. Large sand waves and banks have the potential to cover archaeological material such as shipwrecks.

6.4.8 The geophysical survey has identified numerous geophysical anomalies of potential anthropogenic origin and archaeological potential, however, it must also be recognised that it is difficult to identify wooden shipwrecks, scattered shipwrecks or buried shipwrecks through geophysical survey methods, and therefore there is the potential to discover previously unidentified sites.

**Aircraft**

6.4.9 The **Regional Archaeological Overview** above has indicated the high potential for previously undiscovered aircraft crash sites in the Study Area. The skies over the Study Area saw considerable air-borne action during the two World Wars, and there were several important airfields in Kent.

6.4.10 One of the Recorded Losses is a British Spitfire MK IIA P7386 from 1940 (**WA1235**), and the distribution of World War II British Air/Sea Rescue Operations indicates hot spots of activity around the coast of Kent throughout the war (Wessex Archaeology 2008) (**Figure 8**). The locations of these lost aircraft are unknown, but they indicate the considerable potential for the discovery of other 20th century aircraft lost in the study area as a result of military activities during the two World Wars. Aircraft lost while in military service are automatically protected under the Protection of Military Remains Act (1986).

6.4.11 The Dornier 17 that is known to have crashed in Pegwell Bay is not recorded in the NMR, HER or UKHO records, and while material from this wreck could be encountered, it also underscores the potential for other unrecorded wrecks in the area.

6.4.12 The Goodwin Sands protect not only shipwrecks, but also aircraft, as attested by the discovery of an incredibly intact Dornier 17 (Wessex Archaeology). The South Falls sand bank could also protect aircraft material.

6.4.13 In addition, aircraft crash sites are notoriously difficult to identify through geophysical survey alone, particularly if the debris is scattered across the seabed, and therefore there is potential for the discovery of previously unreported finds.

# 7 FRENCH WATERS – KNOWN AND POTENTIAL ARCHAEOLOGY

## 7.1 INTRODUCTION

7.1.1 The French Waters Study Area extends roughly 20 km across the French EEZ in an irregular linear corridor surrounding the cable route across French Territorial Waters between the English and Belgian Waters Study Areas (**Figure 13**).

## 7.2 SUB-BOTTOM PROFILER AND GEOTECHNICAL ASSESSMENT

7.2.1 The French sector is the shortest section of the proposed cable route, and it is also the least complex geologically. The underlying basement of this section of the route is expected to be **Unit 5**, but, though it was identified on the sub-bottom profiler data, it is present at depth and was not sampled during the coring program in this area.

7.2.2 **Unit 3** directly overlies **Unit 5**, and is the dominant shallow geology type within this area. Identified on seismic records by numerous sub-parallel internal reflectors, the unit is relatively thin in the west but rapidly thickens to the east. Ground truthing has confirmed the unit to comprise stiff clay. As the unit is Eocene (Ypresian) in age, it is not considered of potential archaeological importance.

7.2.3 Recent seabed sediments (**Unit 1**) directly overlay **Unit 3**, and generally comprise shelly gravelly sands and sandy gravels. The sediments are of varying thickness across the route, ranging from a thin veneer in some areas to sand waves a few metres in height. The seabed sediments themselves are not considered of archaeological importance, though where they form large sand waves and banks they can potentially cover archaeological sites such as shipwrecks.

7.2.4 No geological features of possible archaeological potential were observed within the French sector of the cable route.

## 7.3 KNOWN WRECKS AND OBSTRUCTIONS IN FRENCH WATERS

7.3.1 Records of wrecks and seabed obstructions within the French Waters Study Area were collated using information from the UKHO and SHOM as well as the archaeological assessment of geophysical data (**Table 7.1**). The French sector is the shortest section of the proposed cable route and subsequently contains the smallest number of sites of potential archaeological interest. 47 sites have been identified along this section, with two being classified as A1 sites, 39 as A2, and six as A3 (**Figure 13, Figure 17**).

7.3.2

**Table 7.1: Sites in French Waters**

| Description | Number |
|---|---|
| 'A1' wrecks recorded by the UKHO and SHOM, observed in geophysical data | 2 |
| 'A2' geophysical anomalies of possible anthropogenic origin and archaeological interest observed in geophysical data | 39 |
| 'A3' Wreck recorded as 'Live' by the UKHO outside of the geophysical survey area | 1 |
| 'A3' Wreck recorded as 'Dead' by the UKHO outside of the geophysical survey area | 1 |
| 'A3' Obstructions recorded as 'Live' by UKHO, outside of the geophysical survey area | 2 |
| 'A3' Obstructions recorded as 'Dead' by the UKHO, outside geophysical survey area | 2 |
| **TOTAL** | **47** |

7.3.3 A complete list of wrecks and obstructions (**WA7129 – WA7171, WA7289 – 7291, WA7306**) can be found in **Appendix VII** in **Volume II**. Details about the live wrecks can be found below.

**Geophysical Survey Data**

7.3.4 Two known wrecks were observed by the geophysical equipment. Site **WA7141** (**Figure** 14) is the given location of the wreck possibly identified as the HMS *Westella*, which was only detected as a 149nT magnetic anomaly. Multibeam bathymetry data show large sand waves are currently located at the position of the wreck, indicating it is completely buried, but still present, at the given location. The wreck has previously been located by the UKHO, SHOM and VIOE through geophysical survey. The HMS *Westella* was a British steam trawler 36.6 m in length with a gross tonnage of 413. The vessel was built in 1934 by Cochrane & Sons Shipbuilders Ltd, a shipyard founded in 1884 that moved to Selby in 1898 (Uboat.net website; Wrecksite website). Cochrane & Son made their reputation building trawlers and coasters for the Hull and Grimbsy fishing fleets. In 1965, control of the yard passed to Ross Group Ltd. The *Westella* had a triple expansion engine by Amos Smith of Hull, a single boiler and single screw propulsion (Wrecksite website). The vessel was purchased as an anti-submarine trawler in August 1939. The HMS *Westella* sunk 2 June 1940, approximately an hour and a half after the *Blackburn Rovers* (**WA7289**), possibly having been hit by a torpedo from the same U-boat or having also hit a mine (Divine 1959: 215, Hulltrawler website). Survivors were recovered by the trawler *Saon* (Wrecksite website). Past geophysical surveys indicated that the steel wreck lies on a seabed of gravel, sand and shell, close to a large sandwave, which now appears to have covered the wreck.

7.3.5 **WA7151** is the location of the known but unidentified wreck (**Figure 15**). The actual UKHO location for this wreck lies outside of the geophysical survey area, but it was partially imaged by multibeam bathymetry data and associated with a 13nT magnetic anomaly. As it was only partially imaged, the provided position for this structure should be used with caution as the extent of the wreck is unknown, though a large NE – SW trending scour, measuring 74 m x 40 m x 2 m was clearly identified on the northern side of the structure. Wreck records from the UKHO indicate that **WA7151** was a freighter lost in 1940 that lies on its starboard side, with its stern badly damaged. Past geophysical surveys have suggested that the wreck site measures 130 m in length by 18 m in width. A survey in 1967 indicated that the wreck lies on a seabed of fine sand, gravel and shell, and it appears to be sanded in. That same year, the wreck was cleared at 73 feet (22 m). A geophysical and diver survey in 1971 indicated that the wreck was almost buried.

7.3.6 Two recorded obstructions (**WA7148** and **WA7162**) were not identified by any of the geophysical equipment. **WA7148** is recorded as an unidentified obstruction, and could either be covered by seabed sediments at the present time or was an ephemeral feature that now no longer exists.

7.3.7 **WA7162** is recorded by the UKHO as an 'unclassified non-sub contact', however, in the surveying details it is described as a 'probable wreck' with sonar dimensions 137.2 m in length with a shadow height of 1.8 m. The surveying details from 1945 indicate that the site had a moderate echo, and that the identification was 'rather woolly'. This description and the fact that geophysical survey data and the relative positional accuracy of the co-ordinates based on surveys in the 1940s suggest that this point may not, in fact, be a wreck, and/or that the wreck material could actually be located at some distance away. There are no records of later geophysical surveys in the area either proving or disproving the wreck, there is no record of a wreck or an obstruction at this location in the SHOM dataset, and the recent MMT multibeam bathymetry data show large sand waves at the site at the present time, so if any structure exists at this location, it is likely to be completely buried.

7.3.8 Six sites (**WA7143**, **WA7154**, **WA7156**, **WA7157, WA7163** and **WA7164**) have been interpreted as pieces of debris. All are isolated, angular dark reflectors with acoustic shadows, though none have been found associated with any magnetic anomalies so are interpreted as pieces of non-ferrous debris.

7.3.9 Site **WA7159** is characterised as a linear alignment of short, linear dark reflectors with small shadows. It is interpreted and classified as a length of rope or chain, periodically buried and exposed by a series of large sand ripples. The presence of an 18nT magnetic anomaly indicates it is possibly more likely to be a length of chain.

7.3.10 Twelve sites (**WA7129**, **WA7130**, **WA7134**, **WA7149**, **WA7150**, **WA7155**, **WA7165 – 7166** and **WA7168 – WA7171**) have been classified as dark reflectors, which are contacts of uncertain origin which could be either natural features or pieces of debris. None of the sites have been found associated with a magnetic anomaly, so any debris is expected to be non-ferrous in nature.

7.3.11 The remaining 20 sites (**WA7131**, **WA7132**, **WA7133**, **WA7135**, **WA7136**, **WA7137**, **WA7138**, **WA7139**, **WA7140**, **WA7142**, **WA7144**, **WA7145**, **WA7146**, **WA7147**, **WA7152**, **WA7153**, **WA7158**, **WA7160, WA7161** and **WA7167**) are the locations of magnetic anomalies that have not been attributed to any sidescan sonar or multibeam bathymetry contacts. These could represent natural variations in the seabed sediments or shallow geology, bathymetric changes, or pieces of buried ferrous debris. Most are relatively small in size, but **WA7146**, **WA7158** and **WA7160** are noticeably larger (54nT, 36nT and 45nT respectively) and more likely to represent pieces of buried ferrous debris than natural features.

**Live Wreck not observed in the Geophysical Data**

7.3.12 The wreck of the HMS *Blackburn Rovers* (**WA7289**) lies just outside of the French Waters Study Area. It has been included in this assessment because although it lies outside of the geophysical survey data area, its wreckage could extend into the French Waters Study Area. The British steam trawler measured 45.7 m in length and 422 gross tons. It was built in 1934 by Smiths Dock Co. Ltd (South Bank-on-

Tees, UK) for Consolidated Fisheries and was one of a group of trawlers known as the 'Football Fleet' (Uboat.net website, Wrecksite website). The vessel was requisitioned by the Admiralty in 1939 and was used as an anti-submarine trawler. The HMS *Blackburn Rovers* took part in the Dunkerque evacuation with a crew of 17, during which, on 2 June 1940, the vessel was torpedoed by a U-boat or mined (UKHO, Wrecksite website, Divine 1959: 214). One crew member died (Wrecksite website). At the time of sinking, the *Blackburn Rovers*' depth charges were primed, and many of the survivors were injured in the resulting explosion (U-boat.net website). Survivors were rescued by HMT *Saon*. Geophysical and diver surveys undertaken by the UKHO in 1971 and 1972 indicate a small steel wreck 45 m in length, with a gun on the fo'c'sle, laying on a seabed of fine sand and broken shell. French and Dutch surveys have also covered the wreck.

**Dead Wreck outside of the Geophysical Data survey area**

7.3.13 The *Saint Patrice* (**WA7306**) was a British steam tanker built in 1920 by Antwerp Engineering Co, Hoboken for Societe Navale de L'Ouset, Harve (Wrecksite website). It measured 87 m in length and 14 m in width, with gross tonnage of 1968 tons. The vessel had a triple expansion engine with single screw propulsion and a maximum speed of 11 knots. On the 17th June 1923, the vessel ran aground. In 1972, a small wreck in two pieces was found during survey work for a proposed cable route. Later surveys in 1972 and 1973 did not relocate the wreck, and the record was amended to 'dead'. In spite of this, a diver has reported that he has recovered the bell near the wreck's original location (Wrecksite website), suggesting that more wreckage could still remain on the seabed.

## 7.4 POTENTIAL SITES IN FRENCH WATERS

**Submerged prehistory**

7.4.1 This part of the Study Area was once dry land, with hominin occupation during inhabitable periods. However, the archaeological geophysical and geotechnical assessments did not reveal sediments of potential archaeological importance. Additionally there are no geological features of possible archaeological potential.

7.4.2 Any Palaeolithic or Mesolithic material discovered in the area would derive from secondary contexts having been transported in the shallow seabed sediments.

**Shipwrecks**

7.4.3 The Study Area has been crossed by ships from the Mesolithic to the modern period, and there is potential for previously undiscovered wrecks. The area is part of a major shipping route between England and the Continent, and as such has seen considerable levels of maritime activity. As this is an area of open sea with no known navigational hazards, the main causes of wrecking would be due to storm events, technical difficulties, collision, naval engagements or human error. The types of ships, levels of shipping, and maritime conflicts have been discussed in more detail in the **Regional Archaeological Overview** above. However, notable military events that could have caused wrecks in the area are detailed below:

- A number of post-medieval maritime battles took place in the area, including the Spanish Armada (English vs Spain 1588), and the St. James Day and Four Days battles (Second Anglo-Dutch war 1666).
- During World War I and World War II there was considerable maritime activity. All three of the known wrecks were lost during World War II, two as a result of direct military action including mines or torpedoes. Although there is

insufficient data to indicate the manner of loss of the third wreck, a military cause is likely.

7.4.4 In some areas of the Study Area, the seabed comprises sand waves up to a few metres in height. In these areas, the sand waves could potentially cover archaeological sites such as shipwrecks.

7.4.5 The geophysical survey has identified geophysical anomalies of potential anthropogenic origin and archaeological potential, however, it must also be recognised that it is difficult to identify wooden shipwrecks, scattered shipwrecks or buried shipwrecks, particularly in areas of sandwaves, through geophysical survey methods, and therefore there is the potential to discover previously unidentified sites.

**Aircraft**

7.4.6 The **Regional Archaeological Overview** has indicated the high potential for previously unidentified aircraft crash sites in the Study Area. Although there are no known aircraft crash sites or Recorded Losses of aircraft in the French Territorial Waters Study Area, the skies would have been full of activity during the two World Wars with aircraft crossing the Channel between England and the Continent. The proximity of Dunkerque, and the military aviation activities related to the city's strategic importance and attacks on the city indicate a peak in potential for aircraft losses in the vicinity.

7.4.7 In some areas of the Study Area, the seabed comprises sand waves up to a few metres in height. In these areas, the sand waves could potentially cover archaeological sites such as aircraft crash sites.

7.4.8 In addition, aircraft crash sites are notoriously difficult to identify through geophysical survey alone, particularly if the debris is scattered across the seabed, and therefore there is potential for the discovery of previously unreported finds.

# 8 BELGIAN WATERS – KNOWN AND POTENTIAL ARCHAEOLOGY

## 8.1 INTRODUCTION

8.1.1 The Belgian Waters Study Area extends roughly 60 km in an irregular linear corridor surrounding the cable route between the Belgian Landfall west of Zeebrugge and French Territorial Waters (**Figure 16, Figure 17**). It comprises Belgian Territorial waters (to the 12 nm limit) and Belgian EEZ.

8.1.2 The geophysical data for the Belgian Waters Study Area was not yet available when this report was written. However, as there has been no information from the Belgian authorities or curators regarding a requirement for the archaeological assessment of the Belgian intertidal geophysical data, it is unlikely that it will be archaeologically assessed.

## 8.2 SUB-BOTTOM PROFILER AND GEOTECHNICAL ASSESSMENT

8.2.1 The dominant shallow geology in the Belgian sector of the cable route is the **London Clay Formation** (**Unit 3**) (**Table 4.2**). It is expected that **Unit 5** lies at depth below this, but it is present beyond the depth of penetration of both the geophysical and coring equipment and so was not sampled. Ground truthing has confirmed **Unit 3** to comprise stiff clay. As the unit is Ypresian (Eocene) in age (between 56-48.6 Ma), it is not considered of potential archaeological importance.

8.2.2 One isolated cut and fill (**WA7503**) (**Figure 16**) has been identified cutting into the top of **Unit 3**, the fill of which has been found by coring (**VC-0046**) to comprise fine silty sand. This feature is possibly part of a terrestrial palaeochannels system created during a period of low sea level, and could potentially contain both *in situ* and derived archaeological material.

8.2.3 **Unit 2** is possibly present in two areas towards the eastern end of the Belgian sector. Features **WA7505** and **WA7508** are strong, sub-horizontal reflectors interpreted as erosion surfaces and the basal reflectors of **Unit 2**. In this sector, the unit has been found by coring to comprise well-sorted fine sand and is interpreted as a possible post-Devensian estuarine deposit. Above surface **WA7508** the unit appears complex, with obvious internal structure and a palaeochannels (**WA7507**, below) cutting into it, whilst above surface **WA7505** the presence of the unit is less certain and has not been confirmed by coring. Here, the reflector identified could just represent the base of the Holocene seabed sediments (**Figure 16).**

8.2.4 Two possible small channels (**WA7504** and **WA7506**) have been identified below surfaces **WA7505** and **WA7508** respectively. The nature of the features has not been definitively determined by coring, though they could represent palaeochannels cut into the surface of the **London Clay** and could therefore contain deposits of both archaeological and palaeoenvironmental potential. Their relatively deeper position within the stratigraphy, however, possibly places them beyond the vertical footprint of the proposed scheme.

8.2.5 Channel feature **7507** cuts into **Unit 2** above erosion surface **WA7508** and has been interpreted as a terrestrial palaeochannels deposit of post-Devensian age (**Figure 16**). Core samples have confirmed the channel fill to comprise silty fine sand and clayey silt with flood couplets and organic material (**VC WA VC3**) and an organic odour (**VC-0003**). The presence of organic material is supported by gas blanking within the channel identified on the sub-bottom profiler records.

8.2.6 Both feature **WA7507** and **Unit 2** are considered of possible archaeological and palaeoenvironmental potential.

8.2.7 Recent seabed sediments (**Unit 1**) form the uppermost unit over this entire sector, and generally comprise shelly gravelly sands and sandy gravels. The sediments are of varying thickness across the route, ranging from a thin veneer in some areas to sand waves a few metres in height. The seabed sediments themselves are not considered of archaeological importance, though where they form large sand waves and banks they can potentially cover archaeological sites such as shipwrecks.

### 8.3 Known Wrecks and Obstructions in Belgian Waters

8.3.1 Records of wrecks and seabed obstructions within the Belgian Territorial Waters Marine Study Area were collated using information from the UKHO and VIOE as well as the archaeological assessment of geophysical data (**Table 8.1**). A total of 93 sites of possible archaeological potential were identified within the geophysical survey coverage along the Belgian section of the proposed route (**Figure 17**). Of these, 1 was designated an A1 site, 92 were designated A2, and 4 were designated A3. An additional 16 sites were recorded outside of the geophysical survey area.

**Table 8.1: Sites in Belgian Waters**

| Description | Number |
|---|---|
| 'A1' wrecks and geophysical anomalies of anthropogenic origin and of archaeological interest - observed in geophysical data | 1 |
| 'A2' geophysical anomalies of possible anthropogenic origin and archaeological interest observed in geophysical data | 92 |
| 'A3' obstruction recorded as 'Dead' by UKHO and/or VIOE, not visible in geophysical survey data | 4 |
| 'A3' wrecks recorded as 'Live' by the UKHO and/or VIOE, **outside** of the geophysical survey area | 6 |
| 'A3' wrecks recorded as 'Dead' by UKHO and/or VIOE, **outside** geophysical survey area | 5 |
| 'A3' obstructions recorded as 'Live' by UKHO and/or VIOE, **outside** of the geophysical survey area | 2 |
| 'A3' obstruction recorded as 'Dead' by UKHO and/or VIOE, **outside** of geophysical survey area | 3 |
| **TOTAL** | **113** |

8.3.2 A complete list of wrecks and obstructions (**WA7163 – 7162, 7172 – 7269, WA7292 – WA7305, 7307**) can be found in **Appendix VIII** in **Volume II**. Details about the live and dead wrecks can be found below.

**Geophysical Survey Data**

8.3.3 Only one wreck (**WA7200**) was located along this section of the route. The structure was identified by all of the geophysical equipment at the known location of the wreck of the *Tringa*, data examples of which are illustrated in **Figure 18**. The wreck site measures approximately 90.7 m x 32.1 m x 4.4 m and is associated with a 64nT magnetic anomaly, and appears badly broken up with little coherent structure remaining, though still exhibits significant height. The structure is orientated approximately NE – SW, and is located in an area with very little superficial seabed sediment so no scour was identified. The *Tringa* was a British steamship measuring 88.7 m in length by 13.1 m in width, with a draught of 5.8 m and 1930 gross tons. The vessel was built in 1925 by Van Der Giesson & Zonen, and had a triple expansion engine of 335 NHP for a maximum speed of 11 knots. At the time of loss, the vessel was owned by British & Continental Steamship Co, and was carrying a cargo of potash and iron ore from Antwerp to Glasgow (Mercantile Marine website). On 11 May 1940, the *Tringa* was torpedoed and sunk by *U9*, with a loss of the Captain, 15 crew and a Belgian pilot. Six crew were rescued by the Destroyer HMS *Malcolm* and landed at Ramsgate. In May 1940, the wreck's position was estimated from floating wreckage recovered in the areas. In 1944, the wreck was swept clear at 42 feet (12.8 m).

8.3.4 **WA7259** is the recorded location of the wreck of a fishing vessel (also described as 'foul ground' by the UKHO and as a submerged wreck by the VIOE), though it was not identified by any of the geophysical equipment. The wreck is situated right at the edge of the geophysical survey area, so is possibly located just outside of the range of the equipment used. The wreck site was first surveyed in 1952, and again in 1956, 1958, 1979, 1990 and 1995, however, no additional details about the site are provided in the UKHO or VIOE records.

8.3.5 Four previously recorded obstructions (**WA7189**, **WA7206**, **WA7207** and **WA7242**) were also not identified by the geophysical equipment. All are recorded by UKHO as dead and so are probably either ephemeral features that no longer exist or inaccurately positioned obstructions that are actually located elsewhere.

8.3.6 Of the sites, 14 (**WA7177**, **WA7182**, **WA7183**, **WA7188**, **WA7191**, **WA7195**, **WA7225**, **WA7228**, **WA7234**, **WA7237**, **WA7256**, **WA7258**, **WA7263** and **WA7265**) have been classified as debris. Out of these, only **WA7195**, **WA7234** and **WA7237** have been found associated with magnetic anomalies and so are interpreted as at least partially ferrous in nature. The rest are likely to be non-ferrous. Most are isolated, angular dark reflectors with large acoustic shadows, many of which are present on the edges of sand waves and so are potentially only small parts of larger buried features. **WA7182**, **WA7237** and **WA7263** are short, curvilinear dark reflectors that could represent short sections of rope or chain or other linear debris. **WA7188**, **WA7191** and **WA7265** are small areas of angular dark reflectors, interpreted as small scatters of debris.

8.3.7 Four long, curvilinear dark reflectors with small shadows have been identified and classified as probable lengths of rope or chain. **WA7247**, **WA7248** and **WA7246** have all been found associated with magnetic anomalies, and so are likely to be lengths of chain, whilst **WA7230** has not and is therefore more likely to be non-ferrous in nature.

8.3.8 **WA7232** is a relatively small, elongated bright reflector without any associated magnetic anomaly. This is of uncertain origin, and could be either a natural feature or non-ferrous debris composed of a material that absorbs acoustic waves rather than reflects them. Similarly, **WA7257** is a small area of seafloor disturbance which could be natural or indicate the presence of buried debris. No magnetic anomaly has been identified associated with this site, so any debris present is likely to be non-ferrous in nature.

8.3.9 Some 16 of the sites (**WA7172, WA7173, WA7174, WA7175, WA7176, WA7178, WA7180, WA7181, WA7186, WA7193, WA7196, WA7199, WA7202, WA7203, WA7266** and **WA7268**) have been classified as dark reflectors, which are contacts of uncertain origin which could be either natural features or pieces of debris. None of the sites have been found associated with a magnetic anomaly, so any debris is expected to be non-ferrous in nature.

8.3.10 The remaining 56 sites (see **Appendix VIII** in **Volume II** for full list) are the locations of magnetic anomalies that have not been attributed to any sidescan sonar or multibeam bathymetry contacts. These could represent natural variations in the seabed sediments or shallow geology, bathymetric changes, or pieces of buried ferrous debris. Most are relatively small in size, but 17 (**WA7179**, **WA7185**, **WA7201**, **WA7209**, **WA7210**, **WA7211**, **WA7214**, **WA7215**, **WA7224**, **WA7226**, **WA7229**, **WA7233**, **WA7235**, **WA7240**, **WA7243**, **WA7244** and **WA7245**) are considerably larger and more likely to represent pieces of buried ferrous debris than natural features. **WA7226**, **WA7229**, **WA7243** and **WA7244** are particularly large (109nT, 93nT, 109nT and 83nT respectively) and suggest the presence of large pieces or scatters of debris buried within the seabed sediments.

**Live and Dead Wrecks in the Belgian Territorial Waters Study Area**

8.3.11 A wreck, possibly the *Mariner* (**WA7292**), sank 17 December 1979 after taking water during a storm while on its way home from a three week fishing trip. The *Mariner* was a Belgian motor stern trawler, built in 1969, with a length of 29.3 m, a beam of 7.3 m, a draught of 3.0 m and a gross tonnage of 150. The ship was powered by a 500 HP engine. The wreck was not found on the initial survey in 1980, however, subsequent surveys the same year located and identified the wreck. A note in 1980 indicates that there was no intention to salvage the wreck. The wreck has undergone further geophysical and diver surveys.

8.3.12 A wreck (**WA7293**) possibly identified as the *A-15* in the UKHO records, is recorded as a very small object, possibly a sunken buoy in the VIOE records. The *A-15* was a World War I German torpedo boat, measuring 41.8 m in length, with a beam of 4.6 m and a draught of 1.5 m. The vessel had a displacement of 137 tons. The *A-15* was an *A-1* class torpedo boat, built by Stettiner Oderwerke, Stettin, Germany, Ships number 668 (Wrecksite website). The vessel was armed with one 5.2 cm SKL/55, two 45 cm T.T., four mines and sweeping material. The vessel had a single propeller, 1.8 m in diameter. The torpedo boat was owned by the Imperial-Kaiserliche (the name for the German Navy between 1903 and 1919). The *A-15* was sunk on 23 August 1915, although the cause of sinking is disputed. The *Warships of World War I* (referenced in the UKHO Record) notes that the *A-15* was sunk by gunfire from British destroyers, however, other sources suggest that it was sunk by gunfire and torpedoes from the French destroyers *Oriflamme* and *Branlebas* (Worldwar1 website, R. Verpoorte, referenced in the UKHO Record). Nine crew were rescued near the Oostendbank by *A-12*.

8.3.13 The *Empire Path* (**WA7294**) was a British steam ship that measured 123.7 m in length, with a beam of 16.2 m, a draught of 10.1 m and was 6410 gross tons. The vessel was built by Readhead John & Sons Ltd (Readhead Standard Design), South Shields, as part of the Liberty EC2-S-C1 class (Wrecksite website). John Readhead started the shipbuilding company in 1865, and built the *Empire Path* in 1943 (John Readhead website). The ship had two oil-fired boilers, a triple expansion steam engine, single screw propulsion and 2,500 HP. The ship first operated for the Moller Line which was founded in 1882 in Shanghai (Wrecksite website). At the time of loss, the vessel was armed with a single stern mounted 4"/102 mm deck gun, and was owned by the Ministry of War Transport (MOWT) of London. From November to December 1944, the ship sailed from London through the Scheldt and arrived in Antwerp, Belgium and unloaded its cargo. On the 24th December 1944, the vessel left to return to the UK, but was mined by a ratchet mine in the Scheldt Estuary off Ostend while in ballast. Five people were killed. The survivors (44 crew and 10 DEMS gunners) were taken to Ostende and billeted in an army transit camp and on 27 December, they were taken by LST back to England (Gordon Mumford website). A book about the wrecking has been written by one of the survivors of the incident: *The Black Pit and Beyond* (Mumford 2000). The *Empire Path* had sunk almost on top of the *Boscobel* (**WA7302**), and initial survey reports in 1945 indicated that two masts were visible above high water. On 5 July 1945, the *Emeraude* collided with part of the wreckage and wrecked nearby. In order to prevent further accidents, the *Empire Path* wreck site was levelled with dynamite (Gordon Mumford website) and in 1953, the wreck was drift swept clear at 28 feet (8.5 m). The wreck lies on a seabed of even sand, and in 1953 there was no scour around the wreck. In 1961, salvage operations were completed and the wreck was swept clear at 15 m. A 1996 geophysical survey indicated that the wreck was in two pieces.

8.3.14 An unnamed wreck (**WA7295**) surveyed in September 2010 has recently been added to the UKHO wreck database. No other data is presently available.

8.3.15 The *Gold Shell* (**WA7296**) was a British motor tanker measuring 137.5 m in length with a beam of 8.9 m and a draught of 10.4 m. The *Gold Shell* was built in 1931 by Bremen Vulkan, a German shipbuilding company, and at the time of loss was owned by Anglo-Saxon Petroleum Co. (Shell/British Petroleum). The vessel had an oil engine of 714 NHP for a speed of 12.5 knots. The vessel had a gross tonnage of 8208 and was carrying 8300 tons of high octane fuel when it was mined or torpedoed on 16 April 1945. 35 men were lost. The tanker had been part of convoy ATM 126, consisting of 30 ships, en-route from England to Antwerp (Wrecksite website). During the war, tankers were priority targets for enemy attacks, and they were described as 'floating volcanoes' when transporting fuel (mercantile-marine.org website). The *Gold Shell* is just one of 44 British Petroleum tankers sunk during the war, and of the 44 British Petroleum tankers, 657 crew were lost and with 260 others taken prisoner of war (British Petroleum website). The wreck has been surveyed a number of times since 1945, and in 1960 a salvage operation was undertaken. It is now recorded as a live foul on Belgian charts, however, as wreck material likely still remains on the seabed, it is considered a live wreck for this assessment.

8.3.16 The following wrecks are considered to be 'dead' by the UKHO as they have not been discovered during recent surveys. However, as the wreck material could be buried or material could remain on the seabed from salvaged or dispersed wrecks, they are included here.

8.3.17 The record of the SS *Kilmare* & *West Hinder* LTV (**WA7299**) comprises the loss locations of two vessels. In 1905, records indicate that a vessel reported hitting an obstruction in the area, and in 1906 a wreck with mast still showing was reported, thought to be the SS *Kilmare*. The *West Hinder* LTV sunk in the area on 14 December 1912, and in 1913, the SS *Wiedand* reported hitting a wreck. There are numerous wrecks and obstructions known to exist in the vicinity, and the UKHO record was amended to 'several obstructions hereabouts'. In 1930 the record was amended to 'dead'.

8.3.18 The *FL5* German motor launch (**WA7300**) has been described as a remote controlled vessel that sank on the 25th September 1916 following a fire (R. Verpoorte referenced in UKHO record). The *FL5* had petrol engines of 420 HP capable of 30 knots and twin screw propulsion. The vessel measured 13.3 m in length, 1.8 m in breadth and had a 6 ton displacement. The area was surveyed in 1969 and the record was amended to 'for filing only'.

8.3.19 The *FL8* (**WA7301**) was a German motor launch 13.3 m in length, 1.8 m in width with 6 ton displacement. The vessel was described as a remote controlled vessel that was sunk by gunfire during an attack by a British monitor (R. Verpoorte, referenced in UKHO record). The launch had petrol engines of 420 HP capable of 30 knots and twin screw propulsion. The vessel sunk the 6th September 1917. In 1969, the record was amended to 'for filing only.

8.3.20 The *Boscobel* (**WA7302**) was a British Coaster of 232 gross tons carrying a cargo of pig iron or iron fence wire when it foundered on the 29th May 1937. It was lost near Wanelaar Lightship while on passage from Antwerp for London. The *Boscobel* was built as a steel steam trawler in 1906 by J. Duthie & Sons, Aberdeen for Tettenhall Steam Fishing Co of Fleetwood Ltd (Aberdeen Ships website; Fleetwood Trawlers website). The yard's output from the 1880s onwards was mostly trawlers, and the yard closed in 1907. In 1913 *Boscobel* was mortgaged to J. Marr & Son Ltd, Fleetwood, and in 1914, the tonnage was altered to 92.13 net under provision of the Merchant Shipping Act 1907. In 1915, the vessel was requisitioned and converted to a minesweeper. In 1918, *Boscobel* was sold to the Active Fishing Co Ltd, Fleetwood, then sold in 1928 to Thomas Walker & John Falconer, Aberdeen, and again in 1934 to John W. Johnstone, Aberdeen. In 1934 the vessel was converted to a cargo vessel. The record was charted in 1937, but was amended to 'dead' in 1962.

8.3.21 A yacht (**WA7303**) is recorded to have sunk in the vicinity – 285 degrees / 725 m from Promenade Pier, Blankenberge. The record was created in 1974 when the site was marked with a buoy.

## 8.4 POTENTIAL

### Submerged Landscapes

8.4.1 There is high potential for the discovery of submerged prehistoric material dating from the Palaeolithic to the Mesolithic. Palaeozoological remains have been discovered in Belgian waters, and are particularly frequent between the Brown Bank and the Deep Water Channel (Pieters *et al.* 2010: 181-184). Although there have not yet been any discoveries in Belgian waters of hominin remains or worked flints, a worked core dating from the Palaeolithic to Neolithic has been recovered from Dutch waters, and there are numerous finds of lithic artefacts on Belgian beaches.

8.4.2 The extent of the drowned landscape and evidence for palaeochannels has been revealed by archaeological assessment of geophysical and geotechnical data. Core **VC-0046** contained an isolated sedimentary unit cutting into the top of **Unit 3**, which has been interpreted as part of a terrestrial palaeochannels system created during a period of low sea level and could potentially contain both *in situ* and derived archaeological material. In addition, sedimentary **Unit 2,** (exhibited in **VC WA VC3**) which has been interpreted as a terrestrial palaeochannel deposit of post-Devensian age, is also considered to be of possible archaeological and palaeoenvironmental potential.

8.4.3 The archaeologically interesting material in core **VC WA VC3** was located relatively close to the surface of the seabed (0.29 m below seabed), indicating the high potential for the discovery of additional archaeological and palaeoenvironmental material along the cable route trench in this area.

8.4.4 Even within the historic period, the land surface extended into what is now the intertidal zone. Roman artefacts and structures have been observed 266 m into the intertidal zone, and indicate the potential for further discoveries of archaeological sites and material in a now drowned landscape.

### Shipwrecks

8.4.5 Searches of Belgian data did not reveal an easily accessible 'Recorded Losses' dataset indicating ships recorded as having been lost off the coast through history, and therefore, as the information would be costly and time consuming to obtain, it has not been included in this section. However, despite not having names and dates of ships lost off the coast, it is still possible to provide an overview of the types of ships, shipping hazards, and areas of potential for the discovery of shipwrecks.

8.4.6 These waters have been busy with shipping traffic from the Neolithic to present, as indicated in the **Regional Archaeological Overview** however, the majority of known wrecks in the area date to the modern period. It is difficult to discover post-medieval and earlier wrecks on the seabed, as they are generally made of wood and buried beneath the seafloor, making them difficult to detect by magnetometer, sidescan sonar or other means (Pieters *et al.* 2010: 197). However, the discovery of Roman pottery on Kwinte Bank (Wessex Archaeology 2008), Roman roof tiles from Wenduinebank or Smal Bank (Pieters *et al.* 2010: 187), and medieval pottery from Wenduinebank (*ibid:* 194), could indicate the presence of shipwrecks, and highlight the potential for further discoveries of all periods in the wider area.

8.4.7 Most of the known shipwrecks are modern, and have arrived on the seabed as a result of warfare, although it remains to be seen whether this conclusion can also be inferred for earlier periods (Pieters *et al.* 2010: 197). There were numerous losses during the two World Wars, and as Pieters notes, earlier maritime engagements in the area, such as the Battle of Damme (English vs French 1213), could have also resulted in a number of losses.

8.4.8 The intertidal zone comprises considerable tidal flats and the banks offshore could constitute navigational hazards. There are also likely hazards associated with the approaches to the Zeebrugge harbour. Additionally, the geology in these areas indicates that they could represent areas with high levels of preservation, and therefore much of the area can be considered an Area of Maritime Archaeological Potential.

8.4.9 The seabed in the Belgian Waters Study Area comprises areas of sand waves up to a few metres in height, which could potentially cover archaeological material such as shipwrecks.

8.4.10 Other material related to maritime activities, although not constituting actual shipwrecks includes an ammunition dump in an area off Zeebrugge called the 'Paardenmarkt' (the horse market).

**Aircraft Crash Sites**

8.4.11 There is considerable potential for aircraft crash sites relating to the two World Wars, as indicated by the **Regional Archaeological Overview**. Additionally, aircraft, like wooden shipwrecks, can be difficult to detect on the seabed through geophysical or other survey methods.

8.4.12 The seabed in the Belgian Waters Study Area comprises areas of sand waves up to a few metres in height, which could potentially cover archaeological material such as aircraft crash sites.

8.4.13 In addition, aircraft crash sites are notoriously difficult to identify through geophysical survey alone, particularly if the debris is scattered across the seabed, and therefore there is potential for the discovery of previously unreported finds.

# 9 BELGIAN LANDFALL – KNOWN AND POTENTIAL TERRESTRIAL ARCHAEOLOGY

## 9.1 INTRODUCTION

9.1.1 The Belgian Landfall Study Area comprises an irregular polygon surrounding the cable route landfall variations, and includes an approximately 6 km stretch of beach from Zeebrugge to just beyond Blankenberge and extending inland approximately 1 km from Mean High Water. (**Figure 19**).

## 9.2 GEOLOGY

9.2.1 The geography of West Flanders comprises a coast that extends along the Southern North Sea, with a flat polder landscape inland. The dune area and adjacent low polders at Wenduine-Uitkerke have been hydrogeologically and hydrogeochemincally investigated (Walraevens *et al.* undated). The dune belt between Wenduine and Blankenberge measures no more than 50 m in width. The polders inland are of two types: those which are located at former creeks where Dunkerque clay was deposited on the sand of the creek, and the lower clay-on-peat sediments also known as 'pool grounds' (*ibid*).

9.2.2 The Tertiary surface of the Polder of Uitkerke was originated by Early Pleistocene erosion (Saalian).

9.2.3 The Quaternary geology developed during the Eemian interglacial stage (130,000 – 114,000 BP), when the Oostende sediments were deposited, comprising gravel sand and shell. Late Pleistocene sediments include the deposit of Uikerke (sand) and the deposit of Wenduine (sand and gravel). The Pleistocene was followed by a period of peat growth that was later eroded during the Flandrian Transgression. Deposits from the Flandrian Transgression include the deposit of Calais, which comprises a sandy deposit of Houtave (base) and a deposit of Zuienkerke (top) which has a sandy character but also contains some clay.

9.2.4 The peat at Nieuwmunster formed behind the dune belt and was progressively removed by the Dunkerque Transgressions, in particular, the Dunkerque II transgression not only removed the peat, but formed creeks at Wenduine and Blankenberge The creek beds remain as 'creek ridges' (clay on sand), where formerly lower level sites are now higher than their surroundings. More recent changes to the local relief occurred from the medieval period through to the late 19th century as a result of peat digging, and clay digging for bricks. A practice which took place up to the middle of the 20th century.

9.2.5 Along the coast, the surface geology largely comprises dune systems which have accreted since the medieval period. Around the River Ijzer, on the west, deposition takes place and the coast builds up slowly, while on the east the coast gradually retreats (Pieters *et al*. 2010).

## 9.3 Known Sites

9.3.1 The known sites and findspots in the Belgian Landfall Study Area has been compiled using data from the CAI (Central Archaeological Inventory) database from the VIOE, and is summarised in **Appendix IX** in **Volume II**. In addition, findspots of archaeological material on the beaches have been derived from the 'De Noordzee' chapter in *Relicta 6* (Pieters *et al*. 2010: 177-218) (**Figure 19**).

### Prehistoric Period

9.3.2 Flint material has been recovered from the beaches at Wenduine and Blankenberge, although the find from Blankenberge could be natural (Pieters *et al*. 2010: 183). It is not known to what extent beach replenishment could be responsible for the location of finds on the beach, however, if beach replenishment is actively ongoing, some of the discovered finds could derive from the dredged or quarried sand and gravel deposits located elsewhere.

### Roman Period

9.3.3 The Belgian Landfall Study Area demonstrates a small but obvious occupation during the Roman Period. The most preponderant example is the remains of the floor of wooden building made of baked tiles (**WA1301**) at Harendjke in the county of Blankenberge. Other evidence of the Roman presence includes finds of fragments of pottery, which have been identified as Terra Sigillata (**WA1325, WA1326**) or contemporary with the Camp Esmeralda (**WA1301**), and a Roman fire place dated approximately from the 2nd century AD (**WA1302**).

9.3.4 Scatters of Roman pottery fragments have been reported from the beaches at Zeebrugge, and the recent find of a young man's jaw bone has been dated to the 4th century (Pieters *et al*. 2010: 193).

9.3.5 The beach of Wenduine is well known for discoveries of Roman artefacts, and these may indicate material from a Roman settlement going back to the Flavian period (Pieters *et al*. 193). It is thought that Wenduine had even developed into an important trade centre, and the finds from this area are notably richer than at other locations on the coast.

**Medieval Period**

9.3.6 The medieval period is well represented within the extent of the Belgian Landfall Study Area. This period is identified with the presence of several concentrations or isolated instances of pottery of the type Verhaeghe Group A (**WA1303, WA1325, WA1326, WA1327, WA1329**).

9.3.7 There is also evidence for medieval dykes (**WA1311**, **WA1312**, **WA1313**). The first dyke on the beach was constructed around 1200 (Administratie Waterwegen en Zeewezen information plaque). However, it was not strong enough to prevent flooding from the sea. A new dyke was constructed in the 14th century, however, this dyke was in danger of flooding as well. In the 15th century, the inhabitants of Polderland built a new dyke, 'Graaf Jansdijk', running parallel to the previous one. This formed a system of double dykes, consisting of a 'watcher' (the original sea wall) and a 'sleeper' (the new rear dyke). As a result of the construction of these dykes, dunes were established on the foreshore.

9.3.8 A series of sites with moats (**WA1306**, **WA1307**, **WA1308**, **WA1309**, **WA1310, WA1330**), and a flattened mound (**WA1320**) are also located within the Study Area. Additionally, occupation locations encompass sites of former medieval farms such as **WA1305**, **WA1314**, **WA1315**, **WA1331**, **WA1332**, and **WA1333**. The last two examples were still in use up to the post-medieval period.

9.3.9 Late medieval coastal settlements are also indicated by archaeological finds from the beaches and adjacent areas of Wenduine (Pieters *et al.* 2010: 195).

9.3.10 Other medieval structures within the study area consist of a mill (**WA1318**), a waste well (**WA1304**), a tannery craft place (**WA1316**), a footbridge (**WA1317**), a Motte Castrale (**WA1328**), a lock which continued to be used throughout the post-medieval period (**WA1334**), and a fortress associated with farm and a circular moat (**WA1328**). Small finds from the Belgian Landfall Study Area comprise medieval faience pottery (**WA1306**), roof tile (**WA1306**), Verhaeghe Group A pottery (**WA1325**, **WA1326**, **WA1327**, **WA1329**), Badorf type pottery (**WA1326**, **WA1327**).

9.3.11 A reconstruction of the Schelde Estuary around 1300 shows that the former coastline between Blankenberge and Knokke was located further seawards at present, and the 'Vlaakte van de Raan' northwest of Zeebrugge is likely to derive from this situation (Pieters *et al.* 2010: 195).

**Post-medieval Period**

9.3.12 The post-medieval period at the Belgian Landfall Study Area is sufficiently well represented. Several sites show the remains of occupation such as a homestead (**WA1321**), a 17th century non-walled farm (**WA1323**), and a 16th century farm (**WA1324**). Other structures include a brickyard (**WA1322**), a well (**WA1319**), and a flattened mound (**WA1320**).

9.3.13 Some isolated finds also show evidence of post-medieval activity such as fragment of Raeren Majolica stoneware (**WA1331**) and various fragments of pots, dishes, barrels, and faience (**WA1332**).

**Undated**

9.3.14 Known sites that do not have dates indicated in their records include a brickyard (**WA1335**), a water place (**WA1336**), and a farmhouse (**WA1337**).

9.3.15 Human bones of unknown date have also been recovered from the beaches of Zeebrugge (Pieters *et al.* 2010: 201)

**Walkover Survey**

9.3.16 A walkover survey was conducted in October 2010. The walkover survey started from the 20th century Belgian Pier of Blankenberge (**Plate 9**) in the NE direction towards to western side of Zeebrugge port. The walk was conducted on the sea shore first from west to east and then again on top of the dykes (sand dunes) from east to west.

9.3.17 During the course of the walk, apart from the 15th century dykes/dune systems (**Plates 10 - 14**), no other artefacts or monuments of archaeological interest were observed. The only features present are two low elevated stone and concrete longitudinal structures located in the intertidal zone (**Plates 15** & **16**) (approximately 200 to 300 m east of the Belgian Pier of Blankenberge), which have been identified by VIOE staff members as a breakwater from the 1960's, apparently very common all along the Belgian coast.

**Potential**

9.3.18 There is high potential for the discovery of archaeological sites and material dating from the Palaeolithic to the present, as illustrated in the **Regional Archaeological Overview**. Lithic finds are frequently discovered on Belgian beaches, and the Neolithic to Iron Age discoveries from Raversijde indicate that further finds could be expected (Pieters *et al.* 2010). Roman finds are also regularly discovered on the beaches near Raversijde-Mariakerke and Wenduine, and reports from the first half of the 20th century suggest that peat banks were visible in the intertidal zone or sometimes covered by sand (Pieters *et al.* 2010: 192), indicating the potential not only for the discovery of material, but also the potential for a high level of preservation.

9.3.19 There is also potential for medieval finds, as indicated by the discovery of medieval material in Middelkerke and Raversijde revealed by coastal erosion. Medieval material associated with the construction of the dykes could also be discovered. The potential for post-medieval and modern material relating to the use of the beaches, maritime trade and military activity to survive must also be considered.

9.3.20 From time to time, there have been discoveries of human remains on Belgian beaches, such as at Zeebrugge, Nieuwport, Middelkerke, Raversijde, and at sites such as Mariekerke, Bredene, and De Haan (Pieters *et al.* 2010:201). These finds suggest the possibility of additional discoveries during construction work.

# 10 IMPACT ASSESSMENT

## 10.1 DESCRIPTION OF POTENTIAL IMPACTS

10.1.1 The assessment of impacts has been based on the project overview (PMSS 2010 Version 1). There is potential for impact to the known and potential archaeological receptors from route preparation, construction, operation and decommissioning activities.

10.1.2 The possible impacts on known and potential archaeological receptors comprise damage or destruction to both archaeological material and the disturbance or destruction of relationships between material and the wider surroundings. Archaeological receptors include: known and potential terrestrial sites and findspots, submerged prehistoric archaeological material (including palaeoenvironmental evidence), shipwrecks, aircraft crash sites, associated material, and geophysical anomalies of possible anthropogenic origin.

10.1.3 The types of impacts can be described as direct, indirect, secondary and cumulative. Direct impacts are those that directly impact archaeological receptors on or under the seabed. Indirect effects are those beyond the primary footprint of the development, affecting archaeological sites or deposits that are located some distance away, for example as a result of changes to erosion/sedimentation regimes. Secondary impacts arise from activities that occur as part of the development process but might not be considered to be part of the development as such, for example from anchorages for construction vessels. Cumulative impacts include: impacts occurring over a wider area as a result of various development activities; impacts within the development that affect different environmental topics; and visual impacts / changes to setting.

10.1.4 The optimal cable route has been determined based on an initial feasibility assessment undertaken by Metoc in 2007, followed by an assessment of comparative cost analysis and a review of consenting requirements, and an engineering study. All known wrecks were avoided.

10.1.5 The most likely cable system configuration is the bipole system, where cables are installed in a bundled configuration in the same trench, with no separation between them (PMSS 2010).

**Construction**

10.1.6 There is potential for direct and secondary impact to archaeological receptors from route preparation activities, including:

- Use of grapnel hook dragged across the seabed to clear out-of-service telecommunications cables that cross the cable route;
- Construction of bridging and separation structures over any pre-existing cables and pipelines that the Nemo cable route crosses. Typically crossing designs involve placement of crushed rock on the seabed above the crossed asset by a specialist vessel that uses a fall pipe to precisely guide the rock to the seabed. Alternatively, 'link-lock' type mattresses could be used. The footprint of cable crossings will be circa 100 m by 30 m;
- Cutting trenches in areas of the seabed where bed rock (such as chalk) is present. It is possible that the trench can be cut during cable laying, alternatively a specialist rock cutting plough will be used. Archaeological receptors in the sediment above bedrock could be impacted;
- Pre-sweeping by dredging to reduce the height of sandwaves because they inhibit burial equipment and, if mobile, decrease the efficacy of burial. The pre-sweeping would normally be carried out by trailing suction hopper dredgers (TSHD) that shave off the crest lines of sandwaves and create a flatter path for a burial machine to move along. Sandwaves are areas of high archaeological potential, possibly covering wreck material. The width of the path would vary, but could be 10 m to 20 m. If adopted, pre-sweeping would be undertaken just a few days in advance of cable laying operations to ensure the dredged path remains open for the installation. The resulting spoil volumes from pre-sweeping are typical of dredging operations for channel or port maintenance and therefore relatively small. It is assumed that spoil will be deposited back on the seabed in the immediate vicinity.

10.1.7 There is also potential for direct and secondary impact to known or potential archaeological receptors during the intertidal and subtidal cable laying:

- Cables will be buried into the seabed either by a plough or trenching machine, with three generic types of equipment possibly to be used: ploughs (towed), jetting machines (towed, free swimming or tracked), and mechanical trenchers. Cable will be buried to a depth of circa 1 – 2 m. Based on current burial technology, it is estimated that the maximum footprint of the burial machine will be 10 m and the footprint of the trench will be between 1 – 5 m.
- Where joints are required between cable sections, the joints will be made on board the cable lay vessel or barge, during which time the vessel is likely to anchor in position.
- There is also potential for impact where the Cable Laying Vessel (CLV) has to anchor for other reasons. Cable laying in deep waters will be undertaken by a Cable Laying Vessel (CLV), likely employing simultaneous lay and burial. These vessels can operate between the 10 m depth contours on either end of the route.
- In shallower waters, there would be additional impact along the cable route, as the main CLV would not be capable of approaching close enough to the beach, so a shallow water spread would be needed. Shallow water spreads are normally based on flat-top pontoon barges that can be fitted with all necessary cable storage and working gear. A four to six point mooring system will be used to manoeuvre the barge during cable work.

10.1.8 At the landfall installation, activities that could impact the known or potential archaeological receptors are dependent on the type of method used for cable laying. The options are:

- Open cut, using mechanical excavators; which is often the most straightforward option;
- Coffer dam which is similar to open cut but with sheet piling used to support the trench walls; or
- HDD where a drill is used to install conduits from dry land to a point further down the foreshore. This would probably also require a cofferdam.
- Sometimes a combination of all three techniques is needed because of the physical conditions, environmental sensitivities or the preferences of regulators or curators. Based on previous work at Richborough by the Thanet Offshore Wind Farm operations, a marine burial cable will likely be possible between 1.5 - 2.0 km from the beach. Inshore of this, the Thanet cables were mostly buried using the land based spider plough, with the last 100-200 m being trenched with tracked excavators.

10.1.9 The construction of converter stations located onshore could also have direct, secondary and cumulative/visual impacts on the known and potential terrestrial archaeological receptors. Although the proposed location in the UK is likely to be the already existing disused Richborough Power Station, which would minimise impact, there would still be impact from the development of a cable route to the converter. In addition, the converter station in Belgium, and associated cable route link, is still being discussed.

**Operation**

10.1.10 Following installation, routine maintenance work to the cables is not anticipated, however, some work may be required to maintain the burial of the cable (PMSS 2010). Routine survey of the cables is not normally required as the subsea cables will be designed to require minimum maintenance. However, in areas of high seabed mobility, or if post-installation changes in the natural or manmade environment are perceived to have occurred (for example through nearby dredging activity), survey of specific areas of the Nemo cable route may be initiated.

10.1.11 Cable repairs are predicted to be infrequent, and the most common reason for repair will likely be due to damage caused by trawlers and commercial ship's anchors. A repair would typically be carried out by a single vessel. The phases of a repair operation that could impact on archaeological receptors are: cable de-burial, cable recovery, cable re-deployment onto the seabed and reburial.

10.1.12 Additionally, there is the potential for direct and secondary impact from the anchorages of repair vessels during operation.

10.1.13 Potential indirect impacts include changes to the erosion and sedimentation regime in the area. The majority of cable will be buried, so this will not be an issue, however, at cable crossings, the cable could be lifted far enough off the seabed to result in changes to local erosion and sedimentation regimes.

**Decommissioning**

10.1.14 Should decommissioning be required, the operation will be planned and conducted according to the standard industry protocol at the time (PMSS 2010). The objectives of the decommissioning process will be to minimise both the short and long term effects on the environment while making the sea safe for others to navigate. Based on current regulations and available technology, the following decommissioning is expected:

- Cable system – to be either removed or to be left safely *in situ*, buried to below the natural seabed level;
- Mattresses – to be left *in situ*;
- Scour protection material – to be left *in situ*

10.1.15 Should the cables be decommissioned, the following operations would typically take place. The cable would be exposed using a gripper or cable 'under-roller', and the cable recovery process would essentially be the reverse of the cable laying operation. After decommissioning, it is expected that the survey route would be surveyed to ensure all cable had been removed.

10.1.16 Potential direct/secondary impacts could result from the removal of the cable system and the anchorages of the cable removal vessels.

10.1.17 Onshore decommissioning operations have not yet been determined, however, they would also be planned and conducted according to the standard industry protocol at the time.

## 10.2 IDENTIFICATION OF EFFECTS

10.2.1 The assessment of effects is based on the methodology set out above. This section provides a detailed discussion of the impacts and effects, and a summary is provided at the end of the section in **Table 12.3**.

10.2.2 As a result of pre-construction, construction, operation and decommissioning impacts, the following effects are possible:

- Potential damage or destruction of known marine or terrestrial archaeological receptors (terrestrial sites and findspots; submerged prehistoric archaeological material; shipwreck; aircraft crash sites; associated material;

and geophysical anomalies of possible anthropogenic origin) from direct or secondary impacts;

- Potential damage or destruction of potential marine or terrestrial archaeological receptors from direct or secondary impacts;
- Potential damage or destruction of the relationships between known or potential marine or terrestrial archaeological receptors and their wider surroundings;
- Potential damage or destruction of marine archaeological receptors as a result of indirect impacts, in particular changes to erosion and sedimentation regimes;
- Potential negative effects resulting from the visual impact of the converter stations and impacts on the concept of setting;
- Potential cumulative effects from a combination of seabed developments being undertaken in the area (ie: other cable routes, offshore wind farm developments, port / harbour dredging, etc).

**Nature / Magnitude of Impact**

10.2.3 The nature or magnitude of the potential impacts has been assessed based on their likelihood, spatial extent, level of change and duration. Sensitivity, recoverability and Importance are dealt with in **Descriptor of Receptor** below.

Likelihood

10.2.4 The Nemo Project Design (PMSS 2010) has indicated that all known wrecks will be avoided. Therefore, the likelihood that known wrecks will be impacted by the cable route construction is unlikely.

10.2.5 However, archaeological interpretation of geophysical and geotechnical data has indicated a number of geological features of potential archaeological interest along the proposed cable route, including the submerged terrestrial/estuarine deposits and palaeochannels identified in the UK and Belgium sectors, and the likelihood of impact is possible to certain. In particular, the archaeologically interesting sedimentary unit identified in **WA VC3** was situated between 0.29 m and 5.6 m below the seabed, and therefore is certain to be impacted by cable installation. The archaeologically interesting material from **WA VC7** was located 4.28 m below seabed and is unlikely to be impacted by the cable route, however, shallower sediments could be impacted.

10.2.6 The likelihood for secondary impacts on the known archaeological receptors from anchorages of construction vessels or other ancillary development activities is possible.

10.2.7 In addition, many areas of the cable route have high potential for the discovery of previously unreported archaeological material, and therefore it is possible that previously unknown archaeological receptors could be affected by direct and secondary impacts.

10.2.8 It is possible that impacts could occur that would damage or destroy relationships between archaeological receptors and their wider surroundings.

10.2.9 Indirect impacts, resulting from changes to the sedimentation and erosion regimes are unlikely to occur, as any changes to the regimes are expected to be within the natural variation of the baseline.

10.2.10 There will be temporary visual impact during the construction phase, however, this is unlikely to be significant as the marine area comprises a busy shipping lane and both terrestrial landfalls are urban in character with modern developments and construction activities. The likelihood of more permanent visual impact at the Landfalls will depend on the location of the converter station. At the Kent Landfall, the reuse of the Richborough Power Station will be unlikely to impact the setting of terrestrial archaeological receptors in the area. However, as the converter station at the Belgian landfall has not yet been identified, it is not possible to comment on the likelihood of impact.

<u>Spatial Extent</u>

10.2.11 The proposed development plan involves the emplacement of a cable the length of a long section of the seabed, and although impact along the route will be extensive, there will be limited impact laterally and vertically.

10.2.12 The overall quantity of seabed impacted by the Nemo cable route is low when examined in a regional context, and the direct or secondary impacts are expected to be within the immediate vicinity.

10.2.13 There is a slight possibility that the construction of bridging and separation structures could result in changes to erosion and sedimentation regimes, but if these occur, they would be expected to be local.

10.2.14 The damage or destruction of the relationships between known or potential archaeological receptors and the wider environment would have a regional spatial extent. Archaeological receptors have relationships not only with material in the immediate vicinity, but also with receptors of a similar date range or site type across a much wider area – with regional, national, and sometimes even international connections.

10.2.15 As the proposed converter station at the Kent Landfall already exists, there would be no additional visual impact. However, as the converter station at the Belgian Landfall has not yet been determined, its impact could have a local spatial extent.

<u>Level of Change</u>

10.2.16 The level of change of known and potential archaeological receptors from direct and secondary impacts would be high, as any change would be considerably more than what is predicted as part of the natural baseline. In addition, as will be discussed below, the recoverability of the archaeological receptors is low, which increases the significance of the high level of change.

10.2.17 The damage or destruction of relationships between known or potential archaeological receptors would be medium to high. Many of the changes may only be noticeable or measurable against the overall archaeological baseline, however, for sites of high interest with strong relationships to other receptors, the change would be high.

10.2.18 Indirect impacts such as increased sedimentation or erosion are expected to be unlikely, however, even localised erosion could expose archaeological material and lead to degradation that would be large compared with the natural variations in the baseline. Increased localised sedimentation, from changes to sedimentation regimes or dredge plumes, could afford temporary additional protection to archaeological receptors

10.2.19 The level of change for the visual impact at the Kent Landfall will be low as a pre-existing building is being used, however, it is not yet possible to determine the level of visual impact at the Belgian Landfall, and depending on the selection of converter station location and building type, it could be anything from low to high.

Duration

10.2.20 The key consideration when examining the nature or magnitude of impact with regard to archaeological receptors is that all damage or destruction to archaeological receptors through direct, secondary or indirect impacts is permanent. The historic environment is a non-renewable resource, and once an archaeological receptor has been damaged or destroyed or its context altered, it is not possible to repair or reinstate the lost value. Hence, the impact from a temporary anchorage is of the same magnitude as the impact from cable installation.

10.2.21 The visual impact of construction activities would be short term, lasting for the length of the construction period. In contrast, the visual impact of the converter stations would endure for at least the length of the Nemo cable operational phase. For the pre-existing Richmond Power Station at the Kent Landfall, the impact has already occurred. However, structures built for the Belgian Landfall would last for the length of the Nemo cable operational phase and may not be removed during deconstruction. Therefore, the duration of impact at the Belgian Landfall would be long term.

Magnitude of Effect

10.2.22 The unmitigated magnitude of direct or secondary impacts on known or potential archaeological receptors during pre-construction or construction activities would be severe, as the level of change would be high and the impact permanent.

10.2.23 The visual impact of the construction activities is expected to be low, as the marine area is already a busy shipping channel and the landfalls are modern urban areas where modern construction activities are not unknown.

10.2.24 The magnitude of the long term visual impact on the terrestrial archaeology at the Kent Landfall will likely be low as the converter will likely be the disused Richborough Power Station. However, the magnitude of visual impact related to the converter at the Belgian landfall cannot yet be determined until further details become available.

10.2.25 The magnitude of the indirect impacts will likely be low to moderate. Any changes in scour or sedimentation will likely be very localised, and changes are probably likely to remain within natural variations. However, if scour or erosion resulted in damage or destruction to archaeological receptors, the effects could be severe. Increases in sedimentation could positively affect the archaeological receptors by providing additional protection.

10.2.26 The magnitude of direct impacts on known or potential archaeological receptors or the relationships between the receptors and the wider surroundings from repairs during operation or from decommissioning activities will likely be low to moderate, as any archaeological receptors within the immediate vicinity of the cable route will likely already have been affected.

10.2.27 However, the secondary impacts of anchorages of vessels during operation, repairs or decommissioning, on known and potential archaeological receptors and relationships between receptors and the wider surroundings has the potential to be severe.

**Description of Receptor: Sensitivity and Recoverability**

10.2.28 All archaeological receptors have the potential to be damaged or destroyed if they are exposed to direct or secondary impacts during seabed preparation, construction, operation or decommissioning activities associated with the Nemo cable route. As such, all sites and material should be regarded as vulnerable and of high sensitivity.

10.2.29 All damage to archaeological receptors would be permanent, and recovery is limited to stabilisation or re-burial limiting further impact. As such recoverability should be considered low. Additionally, any visual impact from the converters at the landfall would endure for at least the entire period of operation, and as structures could be left standing during decommissioning, the impact could be permanent. As such recoverability should be considered low.

**Description of Receptor: Importance**

10.2.30 The following section assesses the general importance of the archaeological receptors based on available guidance, as discussed in the methodology section.

<u>Statutory Restrictions</u>

10.2.31 Pegwell Bay is part of the Sandwich Bay to Hacklinge Marshes Natural England Site of Special Scientific Interest (SSSI), and is important not only for its biodiversity but also for its geological interest.

10.2.32 In the Kent Landfall Study Area, there are two Listed Buildings, **WA 1039** and **WA1040**.

10.2.33 There are no sites in the English Waters, French Waters, Belgian Waters or Belgian Landfall Study Areas that are currently subject to statutory protection.

10.2.34 However, there is a known report of a German World War II aircraft in the intertidal zone of Pegwell Bay, a Recorded Loss of a British World War II aircraft (**WA1235**) and considerable potential for the discovery of additional aircraft crash sites in the Study Areas. If the remains of any UK military aircraft were to be discovered, whether in English waters or in international waters, they would automatically be protected under the Protection of Military Remains Act (1986). These archaeological receptors would be of high importance.

10.2.35 British vessels in military service at their time of loss (such as **WA7141, WA7289,** and **WA7294**) could be considered for designation under the Protection of Military Remains Act (1986), whether in British waters or international waters.

<u>Importance of Known or Potential Terrestrial or Submerged Prehistoric Receptors</u>

10.2.36 Until recently in Belgium the integration of archaeological values in spatial planning legislation, guidelines and frameworks has been limited to those protected by legislation, such as protected archaeological zones or monuments (Meylemans *et al.* 2005), and there are no European Union (EU) directives covering cultural heritage or the historic environment with regards to establishing value. In 2006, recommendations were made for the development of consistent approaches and techniques for valuing cultural heritage assets (Jones *et al.* 2006: 46). In the UK, the criteria for scheduling ancient monuments is based on a site's period, rarity, documentation, group value, survival/condition, fragility/vulnerability, diversity and potential.

10.2.37 Although the majority of known sites at the Landfalls are not designated or scheduled, this does not mean that they lack importance, and they may in fact fulfil many of the criteria. The fact that they are included in the National Monument Record, Historical Environment Record, or Centrale Archeologische Inventaris indicates that they have at least some value as historic and archaeological resources.

10.2.38 Despite the fact that there are no known archaeological sites or material that date to the Palaeolithic, if any remains were to be discovered, they would be of considerable national and international importance, as finds from this period are relatively rare in the British and European records (English Heritage 1998). In Belgian waters, the discovery of palaeozoological remains are considered important, because although they do not demonstrate direct interaction between our human ancestors and animals, they are nevertheless considered part of the archaeological archive (Pieters *et al.* 2010: 182).

10.2.39 Finds from the Mesolithic would also be of importance because of their rarity. A number of palaeochannels of archaeological interest have been identified in the English Waters and Belgian Waters Study Areas. The discovery of peat (**WA VC7**) and evidence for an estuarine environment (**WA VC3**) highlights the potential of these palaeochannels to provide further palaeoenvironmental information, and in addition, they indicate the potential for additional archaeological material in the vicinity.

10.2.40 There are a wide range of known sites from the Neolithic to post-medieval period across the Landfall Study Areas. These sites provide details that enrich the historic environment resource and are locally, regionally, and nationally important. Further discoveries of sites or material from these periods also have the potential to be of local, regional or national importance.

10.2.41 The coast of Kent played a key role in defending Britain against attack during both of the World Wars, and therefore military material is likely to be of heightened importance. There is a wide range of known and recorded military sites at the Kent Landfall from World War I and World War II. English Heritage has produced guidance for evaluating 20th century sites (English Heritage 1998, 2003), based on their national importance or the presence of structures of special interest, as well as the site's survival or completeness, group value, rarity of building types and historic importance.

10.2.42 The coast of Belgium was also greatly impacted by the two World Wars, and military material from these periods and earlier is likely to be of heightened importance. The World War archaeology of Western Flanders is actively promoted by the Association for World War Archaeology in cooperation with VIOE (http://www.a-w-a.be/).

Importance of Known and Potential Shipwrecks

10.2.43 In the UK, criteria have been developed for the identification of the importance of shipwrecks, including the criteria for designating shipwrecks under the Protection of Wrecks Act (1973) (based on period, rarity, documentation, group value, survival/condition, fragility/vulnerability, diversity and potential), and the criteria outlined in *On the Importance of Shipwrecks* (Wessex Archaeology 2006) (based on the concept of 'ship biography' and covering: build, use, loss, survival and investigation).

10.2.44 Due to the recent development of Belgian legislation for the protection of maritime cultural heritage, there has been only a limited amount of investigation within Belgian territorial waters, and accordingly there is not a specially dedicated list of importance or of protection in place in Belgium. However, the potential for discoveries is substantial, particularly within the area of the sand banks, and all new sites being uncovered should be considered to be of high importance unless proved otherwise.

10.2.45 The French legislation on the protection of maritime cultural heritage specifies that all new discovered sites are of importance, and accordingly would become recognised as of great interest. More specifically, the section of the study area crossing French Waters has been subject to minimal archaeological investigation, and consequently could be of crucial interest, particularly in regards to the importance of the traffic in this region over centuries and millennia. Moreover, the presence of the two vessels within the French study area lost during 'Operation Dynamo' during World War II (**WA7141** and **WA7289**) would be of heightened importance based on their involvement with this operation.

10.2.46 Nine of the known wrecks in the Study Areas were lost due to acts of war (**WA7141, WA7200, WA7275, WA7276, WA7289, WA7293, WA7294, WA7296,** and **WA7301**), and four known wrecks had been in military use at some point in their careers (**WA7270, WA7274, WA7300, WA7302**). The military associations of all of these vessels would indicate high importance.

10.2.47 The *Saint Patrice* (**WA7242**) could also be of medium archaeological importance as a 1920s steam tanker. Although the wreck is considered 'dead' by the UKHO, the recovery of the ship's bell by divers suggests that more material could remain on the seabed.

10.2.48 The four relatively recent wrecks (**WA7017** (1995)**, WA7287** (1986), **WA7292** (1979), and **WA7303** (marked in 1974)) may be regarded as having low archaeological importance. Other 'wrecks' with low archaeological importance include **WA7271** (abandoned four wheel drive vehicle)**, WA7273** (steel tank), and **WA7286** (abandoned Suzuki jeep).

10.2.49 It is not possible to assess the importance of the seven wrecks with the limited information available (**WA7151, WA7162, WA7259, WA7272, WA7277, WA7295,** and **WA7299)**, or the wreck discovered through the archaeological assessment of geophysical data (**WA7024**). Nor is it possible to assess the importance of the known obstructions or the geophysical anomalies of possible anthropogenic origin. As such, the importance of each site must potentially be regarded as potentially high until further information becomes available.

10.2.50 It is also not possible to assess the importance of potential sites, however, there is general guidance available that indicates the likely importance of these sites, based on their age and rarity (Wessex Archaeology 2008c). So little is known about shipwrecks before the medieval period that any wrecks discovered are likely to be of considerable special interest, in addition, post-medieval shipwrecks are also rare and would be expected to be of special interest. There are more examples of boats and ships from the 19$^{th}$ century, so greater discrimination would be required to determine which ones are of special interest, but ship technology was rapidly changing as were the way vessels were used and any wrecks that make a distinct contribution to understanding and appreciating these changes could be regarded as having special interest. As mentioned above, ships lost during the two World Wars could have increased importance. However, a special case would need to be made for any vessels lost after 1945.

Importance of Potential Aircraft

10.2.51 The majority of aircraft losses in the 20th century have been related to military activity, and, as mentioned above, British aircraft lost while in military service are automatically protected by the Protection of Wrecks Act (1986).

10.2.52 However, aircraft are also important because they provide a tangible reminder of the development of aviation in the UK and on the Continent throughout the 20th century. Because of their recent history, aircraft crash sites also have significance as survivors and living relatives may be found, and they are important for remembrance and commemoration. They also have importance through their cultural value as historic artefacts and for the information they contain about the aircraft itself and its circumstances of loss (English Heritage 2002, Wessex Archaeology 2008b).

**Value**

10.2.53 There is no cohesive guidance for assessing the value of the archaeological receptors or historic environment resource in the context of developmental effects or in the wider environmental impact assessment process. The assessment in this report recognises that whilst within the known resource there are statutorily designated sites of national significance, there are also examples of well preserved sites and monuments which do not have statutory protection. In addition, there are sites which, while not suitable for statutory protection or particularly significant in isolation, combine to inform the wider understanding of past human activity in the region and have value as a sum of parts. The value of any one of these elements of the resource is entirely dependent on the context in which it is being assessed.

10.2.54 The assessment also considers the fact that archaeological receptors and the historic environment resource is both finite and non-renewable; of high sensitivity and low recoverability. In addition, there is often limited information available about each of the known or potential archaeological receptors, making it difficult to fully assess or analyse a site's individual or collaborative importance. Therefore, in terms of the value of the archaeological receptors, they are generally considered to be of high value unless proven to be otherwise.

**Significance of Impacts and Effects Assessment**

10.2.55 The significance of impacts and effects has been assessed in relation to the magnitude of effect and the value of the receptor. Although assessed as 'major', 'moderate' and 'minor', in terms of the EIA any 'moderate' significance will be considered 'major'.

10.2.56 Direct or secondary impacts to the late 20th century wrecks (**WA7017, WA7287**, **WA7292**, and **WA7303**) and other 'wrecks' of low archaeological importance (**WA7271, WA7273,** and **WA7286**) would cause effects of moderate negative significance.

10.2.57 Direct and secondary impacts to all other known and potential archaeological receptors (terrestrial sites and findspots, submerged prehistoric archaeological material, shipwrecks, aircraft crash sites, associated material, and geophysical anomalies of possible anthropogenic origin) or the relationships between receptors and the wider surroundings will result in significant negative effects. Although it is difficult to assess the significance of effects caused by the direct and secondary impacts to potential archaeological receptors, the damage or destruction of these sites will be permanent, and therefore the effects have been judged to be of major adverse significance.

10.2.58 As indirect impacts are expected to be minor and localised, the effects are likely to be of moderate to low significance. Localised erosion causing damage or destruction to known or potential archaeological receptors would be of low to moderate negative significance. Localised sedimentation affording additional protection to known or potential archaeological receptors would be of low to moderate positive significance.

10.2.59 The significance of the visual impact of the terrestrial converter stations will depend on their locations. At the Kent Landfall where pre-existing buildings are being re-used, the visual impact will be of low significance, however, at the Belgian Landfall, the significance could range between low and high negative significance depending on the selection of the location and building of the converter station.

# 11 MITIGATION AND MONITORING

## 11.1 MITIGATION

11.1.1 With regards to the archaeological resource, international best practice and government policy favours preservation *in situ*. As part of the Nemo cable route design, all known wrecks were avoided. This section identifies further mitigation measures or investigations required to address the additional data gaps identified in this report.

11.1.2 A number of geological features of potential archaeological and palaeoenvironmental interest have been identified along the proposed cable route, namely the terrestrial/estuarine deposits and palaeochannels identified in the UK and Belgian sectors. With regards to cores **WA VC7** (peat) and **WAVC3** (estuarine environment), a Stage 3 archaeological geotechnical assessment of the samples taken during Stage 2 would provide additional information about the palaeoenvironment and about changes that took place within this landscape. The Stage 3 assessment would comprise an assessment of the pollen, diatoms, foraminifera and ostracods within the sedimentary sequence and scientific dating and recommendations as to whether any further analysis is warranted.

11.1.3 Palaeoenvironmental work and scientific dating are standard archaeological techniques used as mitigation for deeply buried or submerged sedimentary sequences. This is a cost effective method, the alternative being a diver based visual survey and manual sampling/excavation of the identified terrestrial sediments for artefactual and ecofactual remains. These palaeoenvironental and dating techniques have the capacity to elucidate anthropogenic activity. For example, the successive arboreal flora known from Northern Europe has changed by both natural climatic and human activity from prehistoric times to today by activities such as deliberate woodland clearance. The evidence of such activity in the form of relative abundances of microscopic plant remains and charcoal can be found using these methods. Scientific dating is recommended in order to better understand the chronology of the sedimentary sequence and therefore the archaeological periods which they span which are impacted by the development. The scientific dating and palaeoenvironmental work should generate significant archaeological information which can be used to mitigate against the impact of the development.

11.1.4 No additional vibrocores are needed to complete the Stage 3 scientific dating and palaeoenvironmental work. Due to the waterlogged nature of the sediments this work should be undertaken before the environmental remains degrade. Removing the sediments from beneath the seabed begins this process of decay. Dating and palaeoenvironmental work should be undertaken ideally within 6 – 12 months of vibrocore retrieval although this period can be extended with specific storage methods.

11.1.5 If possible, extra care and vigilance should be taken where possible during works in the vicinity of the **WA VC3** core. In this case 'extra care and vigilance' indicates that in the vicinity of this core, any material that is recovered during development (such as during the pre-lay grapnel run) should be reported through the Archaeological Reporting Protocol. Not only has this area demonstrated its potential for the discovery of archaeologically interesting palaeoenvironmental material, the sedimentary unit it is derived from is located very close to the seabed surface, and therefore will definitely be impacted by the development.

11.1.6 However, due to the limited vertical and lateral impact expected to be caused by the emplacement of the cable, and the generally large size of these features as a whole, no further mitigation measures (such as exclusion zones) are deemed necessary. No further coring is expected to be undertaken, however, should future coring programs be undertaken in areas of high palaeo-archaeological potential, further archaeological advice will be sought, and the coring should be undertaken in line with the methodologies outlined in COWRIE 2010 (forthcoming), and access to core samples would be advantageous to further investigate the nature, age and archaeological potential of these features, especially ones of an ambiguous nature (*e.g.* **WA7505**).

11.1.7 To support the avoidance of known wrecks, particularly with regard to secondary impact activities such as the anchorages of vessels, Temporary Archaeological Exclusion Zones have been placed around the eight wrecks and geophysical anomalies of archaeological interest (A1s) identified during the archaeological assessment of geophysical survey data (**Table 12.1**) (**Figures 16, 17 and 18**). Exclusion zones prohibit development related activities within their extents and have been widely applied in offshore development contexts to sites and anomalies with known or potential archaeological significance.

**Table 12.1 – 'A1' wrecks assigned Temporary Archaeological Exclusion Zones**

| Class | WA_ID | Type | Name | Easting | Northing |
|---|---|---|---|---|---|
| A1 | 7024 | Wreck | - | 389786 | 5685532 |
| | 7027 | Debris | | 391279 | 5685143 |
| | 7047 | Debris | | 394777 | 5685245 |
| | 7049 | Debris | | 395957 | 5685445 |
| | 7098 | Debris | | 416527 | 5686440 |
| | 7141 | Wreck | HMS *Westella* | 438175 | 5686526 |
| | 7151 | Wreck | - | 446702 | 5685213 |
| | 7200 | Wreck | *Tringa* | 460851 | 5689298 |

11.1.8 For the known wreck sites (**WA7141, WA7151,** and **WA7200**) 50 m Temporary Archaeological Exclusion Zones are recommended around the known extents of the wreck sites, as part of impact mitigation strategies during development. This should especially be the case for **WA7141**, as the wreck is completely buried at the present time and its exact location and extent could not be confirmed.

11.1.9 For the previously unrecorded wreck site (**WA7024**), a Temporary Archaeological Exclusion Zone is also recommended and further work to fully ascertain the nature and archaeological potential of the site would be advantageous if it is deemed likely to be impacted.

11.1.10 Sites **WA7027, WA7047, WA7049** and **WA7098** are areas of ferrous debris of unknown origin and could represent the remains of badly degraded wrecks or other structures. Temporary Archaeological Exclusions Zones and further investigation are again recommended for these sites, especially since all but **WA7098** are relatively close to the proposed route.

11.1.11 For the wreck sites of archaeological importance that are recorded in UKHO, SHOM or VIOE data, but that were not identified in the geophysical data, buffers have been suggested (**Table 12.2**) (**Figures 16, 17 and 18**). As the extent of the wrecks is unknown, and as wreck material can be spread over a wide area in the vicinity of the wreck site, the buffers comprise a 100 m radius around the gazetteer points. Buffers do not limit development activities to the same extent as exclusion zones, but can assist in planning, for example, the location of anchorages. As the project progresses, the buffers can evolve, and if impacts to buffered areas cannot be avoided, measures to reduce, remedy or offset disturbance should be agreed.

**Table 12.2 - 'A3' wrecks assigned temporary buffers**

| WA_ID | Type | Name | Easting | Northing |
|---|---|---|---|---|
| 7259 | Recorded Wreck | - | 506371 | 5686959 |
| 7270 | Recorded Wreck | *Harvest Moon* | 386196 | 5685927 |
| 7272 | Recorded Wreck | - | 386928 | 5685054 |
| 7274 | Recorded Wreck | *LCP 586* | 389454 | 5685030 |
| 7275 | Recorded Wreck | - | 396314 | 5685228 |
| 7276 | Recorded Wreck | *Rydal Force* | 396458 | 5686183 |
| 7277 | Recorded Wreck | - | 404300 | 5687128 |
| 7289 | Recorded Wreck | HMS *Blackburn Rover* | 437854 | 5685881 |
| 7293 | Recorded Wreck | *A-15* (possibly) | 483250 | 5688250 |
| 7294 | Recorded Wreck | *Empire Path* | 488866 | 5689873 |
| 7295 | Recorded Wreck | - | 488905 | 5689964 |
| 7296 | Recorded Wreck | *Gold Shell* | 493001 | 5688721 |
| 7299 | Recorded Wreck | SS *Kilmare* & *West Hinder* LTV | 465186 | 5689793 |
| 7300 | Recorded Wreck | *FL5* | 476787 | 5688800 |
| 7301 | Recorded Wreck | *FL8* | 479108 | 5688790 |
| 7302 | Recorded Wreck | *Boscobel* | 489266 | 5689685 |
| 7303 | Recorded Wreck | - | 508791 | 5685728 |
| 7306 | Recorded Wreck | *St Patrice* | 454723 | 5687712 |

11.1.12 Buffers are not recommended for the remaining A3 records (representing recorded obstructions or those representing wrecks or wreckage of low archaeological importance), or for the further 254 geophysical anomalies, rated A2 (of possible anthropogenic origin and archaeological interest) that were identified (**Figures 16, 17 and 18**). However, some of the A2 or A3 anomalies could in reality represent features of high archaeological importance and would require further archaeological investigation if they are likely to be impacted by the development activities to confirm or deny their origin or importance. These sites should be assessed on a case by case basis. Once they have been assessed, appropriate action can be taken. If further assessment will not be undertaken prior to installation, these records indicate key areas to be aware of and where some form of monitoring may be appropriate.

11.1.13 Although site **WA7162**, has been described in the UKHO surveying details as a 'probable wreck', a buffer has not been assigned to this point. The site is recorded by the UKHO as an 'unclassified non-sub contact', there is no further record of any survey activities over the site since the initial 1945 survey, the SHOM database does not indicate an obstruction or wreck in this vicinity and the site was not identified during the recent geophysical survey. It is possible that the initial geophysical survey data were unclear or that the positional information was either vague or in error, or, if there is any material in the area, it is completely buried. Although a buffer has not been assigned to this record, the area should be monitored closely during installation activities.

11.1.14 Where preservation *in situ* is not practicable, disturbance of archaeological sites or material should be offset by appropriate and satisfactory measures, such as preservation by record, where the effects of the development can be remedied by carrying out excavation and recording prior to the impact occurring (Wessex Archaeology 2007). The impact of development may also be remedied by restabilising sites that have been destabilised but not destroyed, or by offsetting damage to a site by detailed analysis and safeguarding of otherwise comparable sites elsewhere.

11.1.15 In response to the Scoping Document, English Heritage has recommended the implementation of an Archaeological Written Scheme of Investigation, to be agreed with English Heritage that will support the delivery of any necessary mitigation measures (English Heritage 2010). The Written Scheme of Investigation would address pre-construction and installation activities, such as the grapnel run, and would probably also include a protocol to substitute for a watching brief offshore. A WSI would also be required onshore at the Kent Landfall covering intertidal and terrestrial works.

11.1.16 It is possible that previously unknown archaeological sites or material may be encountered during the course of the cable route trenching or installation, operation or decommissioning. For example, there is a high potential for the discovery of material from Goodwin Sands or the Kwinte Bank areas. Hence, measures should be taken to reduce the development impact in this instance. A formal Archaeological Reporting Protocol should be established and agreed with the appropriate statutory consultees and national heritage bodies to ensure that any finds are promptly reported to the correct authority, archaeological advice is obtained and any recovered material is stabilised, recorded and conserved.

11.1.17 Watching briefs may be appropriate at the landfalls or where seabed material is brought to the surface, for example during pre-lay grapnel runs and during trenching for the cable route.

11.1.18 Archaeological assessment is recommended for any further geophysical, geotechnical, dropdown camera, video or diver survey undertaken for the construction, operation or decommissioning of Project Nemo, and archaeological advice should be sought in designing the methodologies for these activities (English Heritage 2010). In this regard a new process should be put in place (WSI, Archaeological Reporting Protocol), in order for each discovered feature that the appropriate mitigation could be proposed (the later will depend on the nature, size, importance and location of the feature) and discussed between the client, contractor and curator. The reporting protocol needs to outline not just communications but also actions in regards of the responsibility in the instance of a feature being discovered.

11.1.19 A positive cumulative effect of offshore developments is the accumulation of archaeologically interpreted geophysical and geotechnical data regarding prehistoric land surfaces, palaeo-environmental evidence, wrecks on the seabed, and associated material. However, any positive effects must be demonstrated by the completion of studies to professional archaeological standards, and the results produced must be made publicly available.

11.1.20 English Heritage (now Historic England) has recommended (English Heritage 2010) that the developer ensure that a copy of any archaeological reports, agreed with English Heritage (now Historic England), are deposited with English Heritage's National Monuments Record (NMR) (now the National Record of the Historic Environment (NRHE)). To enable deposit of reports with the NMR, the developer must ensure that an OASIS (Online AccesS to the Index of Archaeological Investigations) form is completed for the whole consented project, and all copies of completed and agreed archaeological reports are attached as PDF files. All further advice on completing this condition is to be directed to English Heritage's NMR (oasis@english-heritage.org.uk). Notification of the completion of the OASIS form is also to be sent to Kent County Council for inclusion within the locally maintained Historic Environment Record (HER).

11.1.21 Similarly, it should be expected that any archaeological reports will also be agreed with and deposited with the French and Belgian authorities.

### 11.2 Monitoring

11.2.1 The project design (PMSS 2010) indicates that only limited monitoring will be undertaken during operation, basically determined by perceived changes to the environment in areas of high seabed mobility or as a result of the need for cable repairs, and no monitoring has been recommended post-decommissioning.

11.2.2 Monitoring may provide opportunities to assess the effect of any impact on archaeological receptors that may be due to the effects of cable installation. .

11.2.3 Additionally, once the cable is in operation, the main source of direct or secondary impact will be related to the need for cable repairs, so monitoring undertaken at these times will also benefit the management of the archaeological resource.

11.2.4 Archaeological assessment is recommended for any further geophysical, geotechnical, dropdown camera, video or diver survey undertaken for the construction, operation or decommissioning of Project Nemo, and archaeological input should inform the methodologies of these activities (English Heritage 2010).

## 12 RESIDUAL IMPACT

12.1.1 It is expected that the implementation of the above mitigation measures will mean that the residual effects of the development on any archaeological receptors will be minor.

**Table 12.3: Impact Assessment**

| Description of Impact | | | Nature of Effect | | | | | Description of Receptor | | | | Impact Significance | Consideration of Mitigation | After Mitigation | | | | | | Residual Impact Significance |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Project Phase | Activity | Potential impact | Likelihood of potential impact | Spatial Extent | Level of Change | Duration | Magnitude | Sensitivity | Recoverability | Importance | Value | | Identified Mitigation | Likelihood of potential impact | Spatial Extent | Level of Change | Duration | Magnitude | Residual Impact after mitigation | |
| Installation | Cable installation | Damage or destruction of submerged prehistoric material below the seabed | 100 | 1 | 100 | 100 | 301 Severe | High | Low | High | High | Significant (negative) | Geotechnical samples from the cable route area have been archaeologically assessed – and Stage 3 assessment could provide further information | 100 | 1 | 100 | 100 | 301 Severe | Shallow sections of the resource will still be impacted by development, however, information about the submerged prehistoric resource will be gained from geotechnical assessment (as explained in section 11.1.3) – and the area of impact on the feature is comparatively small. | Minor (negative) |
| Installation | Pre-sweeping of sandwaves, use of grapnel hook to clear obstructions, construction of bridging and separation structures, trenching for cables, cable laying, cable burial, use of anchors to maintain position of installation vessels | Damage or destruction of late 20th century wrecks (WA7017, WA7287, WA7292, and WA7303) and other 'wrecks' of low archaeological importance (WA7271, WA7273, and WA7286) | 1 | 1 | 100 | 100 | 202 Moderate | High | Low | Low | Low | Minor (negative) | None required, however, to prevent damage to cable laying equipment, wrecks should be avoided. | 1 | 1 | 100 | 100 | 202 Moderate | None | Minor (negative) |
| Installation | Pre-sweeping of sandwaves, use of grapnel hook to clear obstructions, construction of bridging and | Damage or destruction of other known archaeological receptors | 100 | 1 | 100 | 100 | 301 Severe | High | Low | High to Medium | High | Significant (negative) | All known wrecks and terrestrial sites have been avoided in the cable route design. Buffers have been | 10 | 1 | 100 | 100 | 211 Severe | Known wrecks, and terrestrial sites will be avoided, and therefore will not be impacted. | Minor (negative) |

| Description of Impact | | | Nature of Effect | | | | | Description of Receptor | | | | Impact Significance | Consideration of Mitigation | After Mitigation | | | | | | Residual Impact Significance |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Project Phase | Activity | Potential Impact | Likelihood of potential impact | Spatial Extent | Level of Change | Duration | Magnitude | Sensitivity | Recoverability | Importance | Value | | Identified Mitigation | Likelihood of potential impact | Spatial Extent | Level of Change | Duration | Magnitude | Residual Impact after mitigation | |
| | separation structures, landfall installation activities, trenching for cables, cable laying, cable burial, use of anchors to maintain position of installation vessels | | | | | | | | | | | | placed around A3 wrecks of archaeological potential, however, A2 geophysical anomalies of potential archaeological interest may still be impacted, and these will either undergo further assessment or will be considered during watching briefs and through the Archaeological Reporting Protocol. | | | | | | A2 geophysical anomalies of archaeological potential will be dealt with on a case by case basis. | |
| Installation | Pre-sweeping of sandwaves, use of grapnel hook to clear obstructions, construction of bridging and separation structures, landfall installation activities, trenching for cables, cable laying, cable burial, use of anchors to maintain position of installation vessels | Damage or destruction of potential archaeological receptors | 10 | 1 | 100 | 100 | 211 Severe | High | Low | High | High | Significant (negative) | Archaeological Reporting Protocol will ensure that any material discovered during the development will be reported, recorded, stabilised and conserved. | 10 | 1 | 100 | 100 | 211 Severe | Potential archaeological sites and material may still be affected by installation activities, however, reporting of discoveries through the Archaeological Reporting Protocol will considerably lessen impact | Minor (negative) |
| Installation | Pre-sweeping of sandwaves, use of grapnel hook to clear obstructions, construction of bridging and separation | Damage or destruction of relationships between known or potential archaeological receptors and the wider environment | 10 | 10 | 100 | 100 | 220 Severe | High | Low | High | High | Significant (negative) | Known sites will be avoided and discovered sites will be reported, therefore impacts to relationships will be lessened. | 10 | 10 | 100 | 100 | 220 Severe | Mitigation measures will considerably lessen impact | Minor (negative) |

| Description of Impact | | | Nature of Effect | | | | | Description of Receptor | | | | Impact Significance | Consideration of Mitigation | After Mitigation | | | | | | Residual Impact Significance |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Project Phase | Activity | Potential Impact | Likelihood of potential impact | Spatial Extent | Level of Change | Duration | Magnitude | Sensitivity | Recoverability | Importance | Value | | Identified Mitigation | Likelihood of potential impact | Spatial Extent | Level of Change | Duration | Magnitude | Residual Impact after mitigation | |
| | structures, landfall installation activities, trenching for cables, cable laying, cable burial, use of anchors to maintain position of installation vessels | | | | | | | | | | | | | | | | | | | |
| Installation | Construction activities | Visual impact or impact on setting of known terrestrial archaeological receptors | 100 | 10 | 10 | 1 | 121 Moderate | Moderate | High | Low to High | Low | Minor (negative) | The visual impact during construction will be temporary. The marine area is a busy shipping channel with consistent impact, and the terrestrial landfalls are urban areas with modern construction activities already taking place. | 100 | 10 | 10 | 1 | 121 Moderate | None expected | Minor (negative) |
| Installation and Operation | Location of conversion stations | Visual impact or changes to setting on terrestrial archaeological receptors | 100 | 10 | 100 | 100 | 310 Severe | High | Moderate to Low | High | High | Significant (negative) | The re-use of the existing Richborough Power Station will minimise impact – the location of the Belgian Landfall conversion station could also be selected to minimise impact | 10 | 10 | 10 | 100 | 130 Moderate | If Belgian Landfall conversion station is a pre-existing building, impact would be minor, however, construction of new buildings could result in moderate effects. | Minor to Moderate (negative) |
| Installation and Operation | Changes to erosion regimes at bridging structures | Indirect impacts on known or potential archaeological receptors and their relationships with the wider environment | 1 | 1 | 100 | 100 | 202 Moderate | High | Low | High | High | Moderate (negative) | Changes to erosion regimes are expected to be minimal – areas of high sediment movement will be monitored | 1 | 10 | 100 | 100 | 202 Moderate | Changes are expected to be minimal, monitoring in areas of high sediment movement will considerably lessen impact | Minor (negative) |

| Description of Impact | | | Nature of Effect | | | | | Description of Receptor | | | | | Consideration of Mitigation | After Mitigation | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Project Phase | Activity | Potential Impact | Likelihood of potential impact | Spatial Extent | Level of Change | Duration | Magnitude | Sensitivity | Recoverability | Importance | Value | Impact Significance | Identified Mitigation | Likelihood of potential impact | Spatial Extent | Level of Change | Duration | Magnitude | Residual Impact after mitigation | Residual Impact Significance |
| Installation and Operation | Changes to sedimentation regimes at bridging structures | Indirect impacts on known or potential archaeological receptors and their relationships with the wider environment | 1 | 1 | 100 | 100 | 202 Moderate | High | Low | High | High | Moderate (positive) | Changes to sedimentation regimes are expected to be minimal | 1 | 10 | 10 | 100 | 121 Moderate | Changes to sediment regimes are expected to be minimal | Minor (negative) |
| Operation and Decommissioning | Repair works on the cable route (cable de-burial, cable recovery, cable re-deployment) Removal of infrastructure: cable removal (cable de-burial, cable recovery) | Disturbance or destruction of known or potential archaeological receptors or the destruction of relationships between receptors | 1 | 1 | 1 | 100 | 103 Moderate | High | Low | High | Low | Minor (negative) | Any archaeological receptors in the immediate vicinity of the cable route will already have been impacted. | 1 | 1 | 1 | 100 | 103 Moderate | Any archaeological receptors in the immediate vicinity of the cable route will already have been impacted. | Minor (negative) |
| Operation and Decommissioning | Anchors used to maintain position of repair or decommissioning vessels | Disturbance or destruction of known and potential archaeological receptors or the destruction of relationships between receptors as a result of secondary impacts | 10 | 1 | 100 | 100 | 211 Severe | High | Low | High | High | Significant (negative) | Known sites will be avoided through the maintenance of temporary exclusion zones and buffers, and any material discovered will be dealt with through the Archaeological Reporting Protocol | 10 | 1 | 100 | 100 | 211 Severe | Although sites could still be impacted, the implementation of mitigation measures would greatly lessen impact | Minor (negative) |

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**Maps, charts and aerial photographs**

<u>Maps</u>

1872 Ordnance Survey map (1:2500, 1:10,560))

1896 Ordnance Survey map (1:2500, 1:10,560)

1908 Ordnance Survey map (1:2500, 1:10,560)

1938 Ordnance Survey map (1:2500, 1:10,560)

British Geological Survey ,1989, Thames Estuary Solid Geology, Sheet 51 N-00, 1:250 000 Series.

British Geological Survey, 1990, Thames Estuary Sea Bed Sediments and Quaternary Geology, Sheet 51 N-00, 1:250 000 Series

British Geological Survey, 1991, Ostend, Seabed Sediments and Holocene Geology, Sheet 51 N-02E, 1:250000 Series.

British Geological Survey,1992, Quaternary Geology Sheet 51°N - 02°E 'Ostend', 1:250,000 Series

Charts

Admiralty Chart: 1828, Dover to North Foreland (1965)

Admiralty Chart: 1828, Dover to North Foreland (1999)

Admiralty Chart 1873, Dunkerque to Oostende (1997)

Admiralty Chart 1874, Oostende to Westkappelle (1996)

Admiralty Chart: 2182, North Sea Southern Sheet (2000)

Vlaamse Hydrografie Chart D11, Vlaamse Banken Van Gravelines Tot Oostkapelle

Aerial photographs

NMR RAF/26J/BR267 L.2 22-FEB-1941

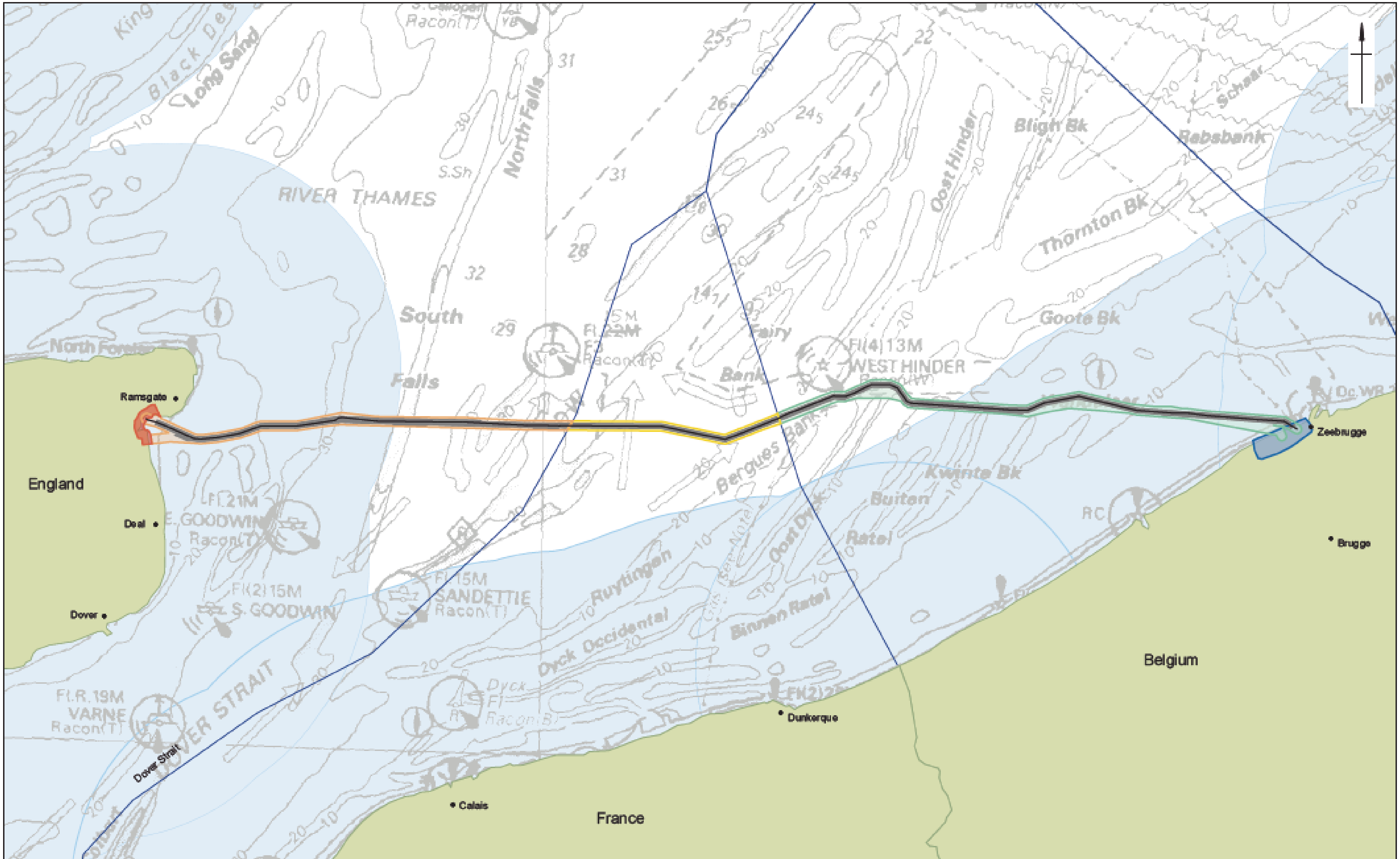
NMR RAF/HLA/540 6051-6052 17-MAY-1942

NMR US/7PH/GP/LOC286 5008 19-APR-1944

NMR RAF/106G/UK/1131 4004 17-JAN-1946

NMR RAF/106G/UK/1110 4077 10-JAN-1946

Google Earth imagery date: 2003, 21-APR-2007




| | |
|---|---|
| Kent Landfall Study Area | French Waters Study Area |
| English Waters Study Area | Belgian Waters Study Area |
| | Belgian Landfall Study Area |
| | Cable Route |
| | Territorial waters |

12 nautical mile limit (approximate location)
Geophysical Extent

0 10 20 km

Drawing Projection: UTM WGS84 Z31N. Admiralty chart 2182 (dated 2000)



| | | | |
|---|---|---|---|
| Date: | 12/07/2016 | Revision Number: | 2 |
| Scale: | 1:400,000 @A3 | Illustrator: | KJB/KMN |
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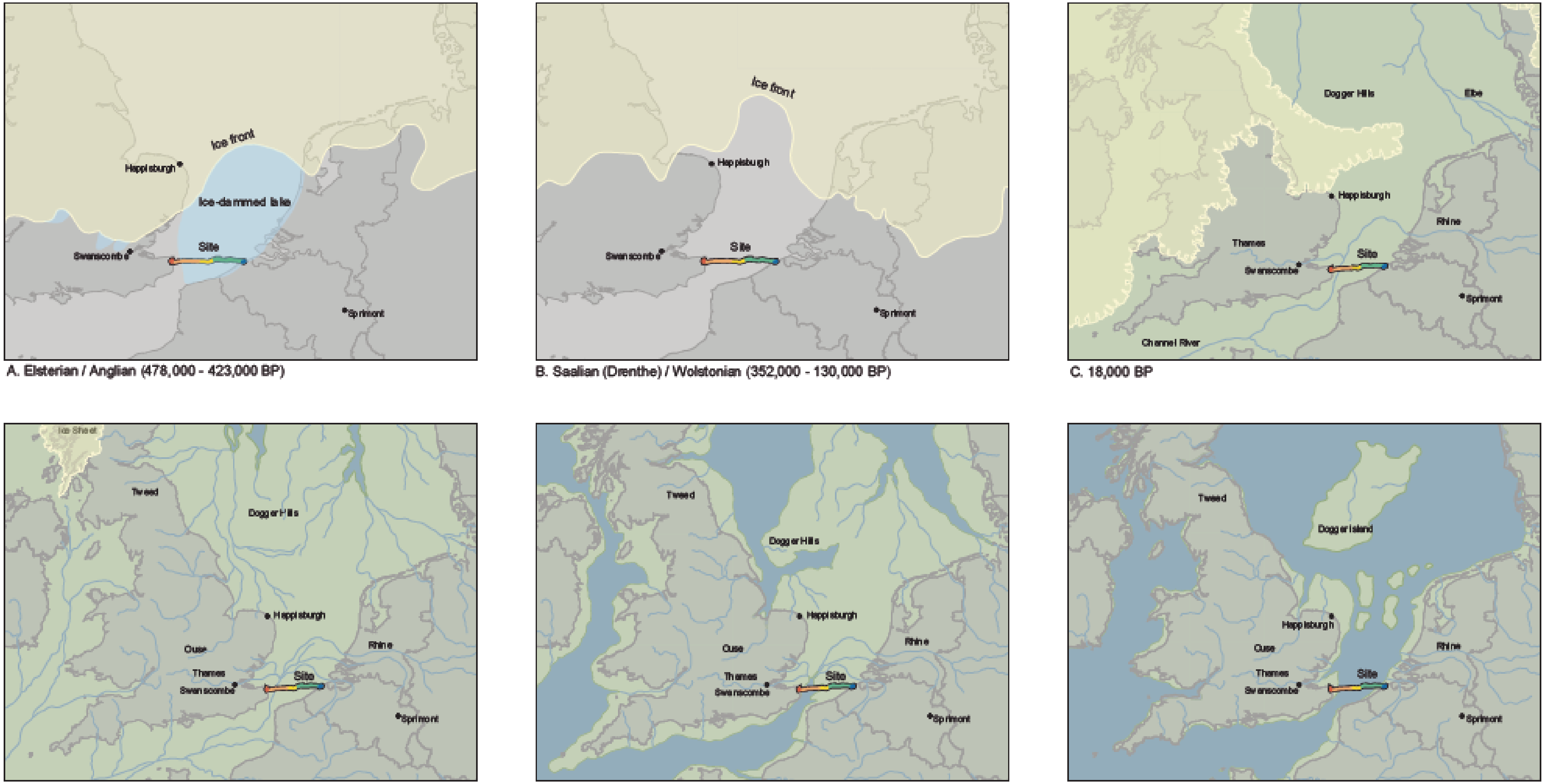
Study Area

Figure 1




A. Elsterian / Anglian (478,000 - 423,000 BP)

B. Saalian (Drenthe) / Wolstonian (352,000 - 130,000 BP)

C. 18,000 BP

D. 13,000 BP

E. 10,000 BP

F. 5,000 BP

A-B: After Quaternary Palaeoenvironments Group - University of Cambridge (http://www.qpg.geog.cam.ac.uk/research/projects/nweurorivers/#The_maps)

C-F: After Coles 1998

Kent Landfall Study Area
English Waters Study Area
French Waters Study Area
Belgian Waters Study Area
Belgian Landfall Study Area

A-B
Ice-dammed lake
Ice front
Current coastline

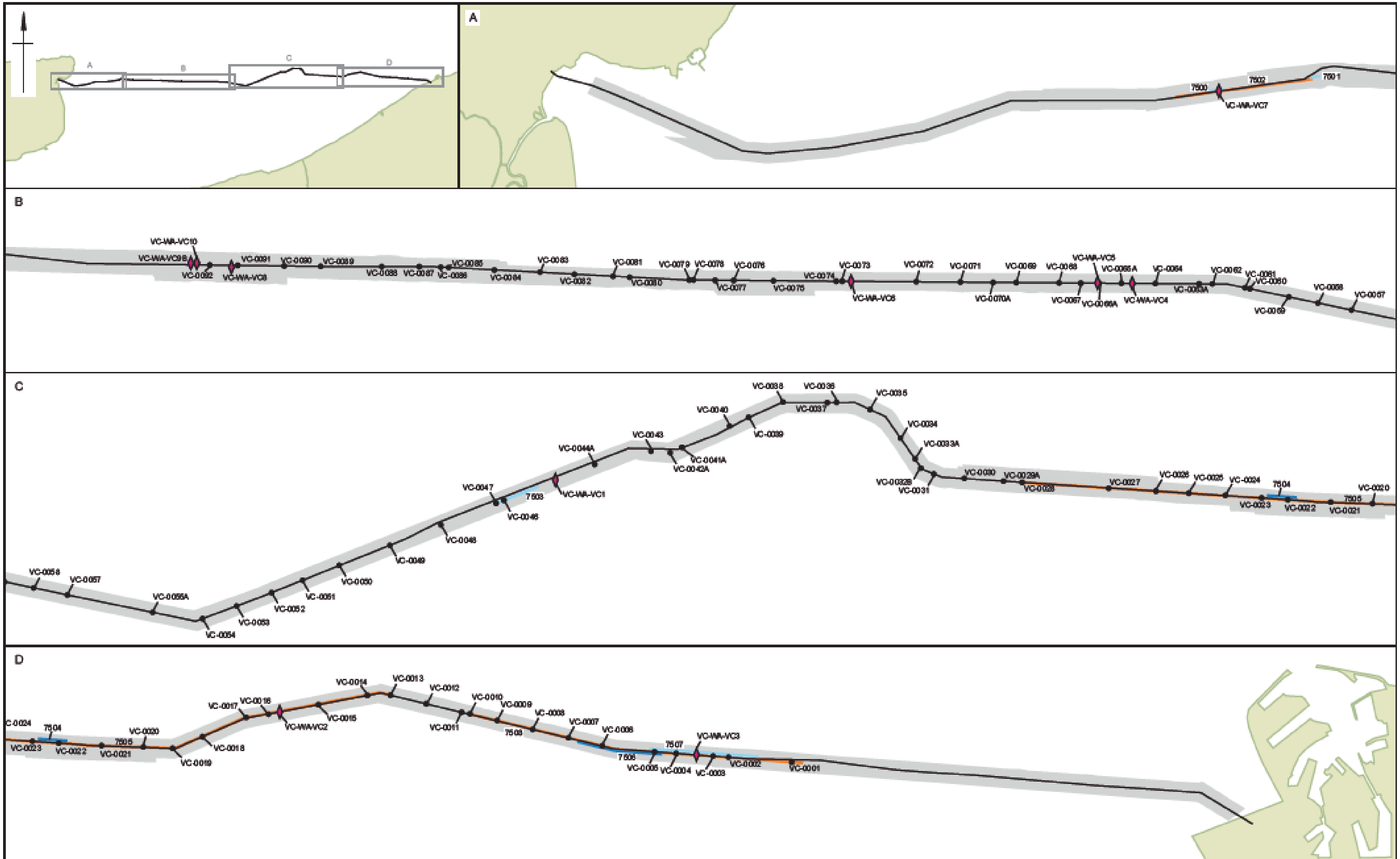
C-F
Sea
Land
Main rivers
Ice sheet
Current coastline

Drawing projection: A-B UTM WGS84 z31N, C-F OSGB National Grid.


| | | | |
|---|---|---|---|
| Date: | 12/07/2016 | Revision Number: | 2 |
| Scale: | A-B 1:4,000,000 C-F 1:10,000,000 @A3 | Illustrator: | KJB/KMN |
| Path: | W:\Projects\73390 Nemo\Drawing Office\Report Figs\DBA\16-07-12 | | |

Glaciation and sea level changes in the UK during the Palaeolithic and Mesolithic and changing coastline in response to sea-level from 18,000BP

Figure 2




Wessex Archaeology

- Geophysical Extent
- Cable Route
- Palaeochannel at surface
- Deeper palaeochannel
- Erosion surface
- Vibrocore locations
- Vibrocore assessed by Wessex Archaeology

Drawing Projection: UTM WGS84 Z31N

0 5km

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| | | | |
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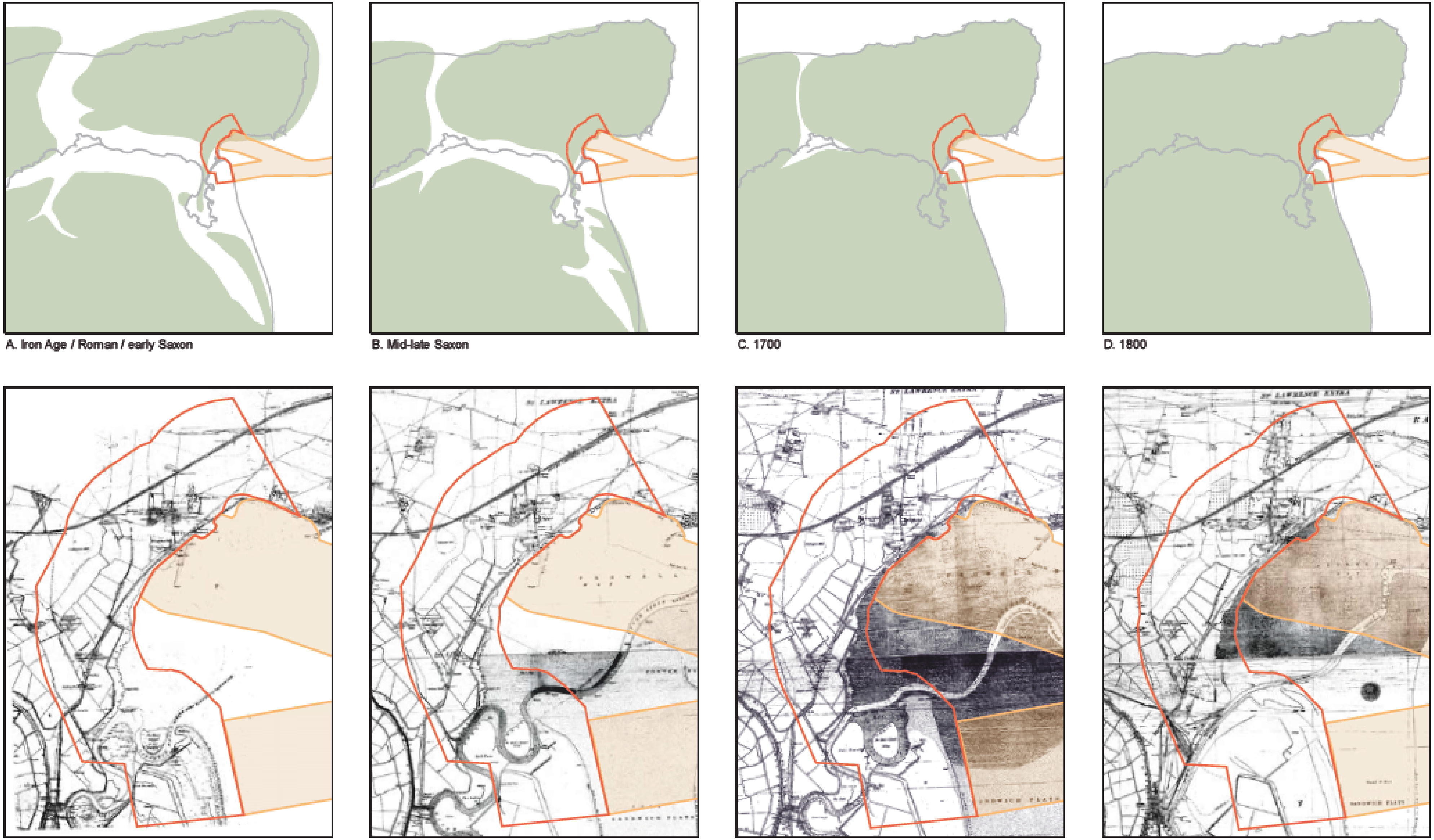
Map of the proposed cable route showing geological features of potential archaeological interest and vibrocore locations

Figure 3



A. Iron Age / Roman / early Saxon

B. Mid-late Saxon

C. 1700

D. 1800

E. Ordnance Survey map, 1872

F. Ordnance Survey map, 1898-9

E. Ordnance Survey map, 1908

E. Ordnance Survey map, 1938-46

Wessex Archaeology

Kent Landfall Study Area

English Waters Study Area

Drawing projection: OSGB National Grid

A-D: Coastline

Current coastline

A-D After an Historical Atlas of Kent (Lawson and Killingray 2004)

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| | | | |
|---|---|---|---|
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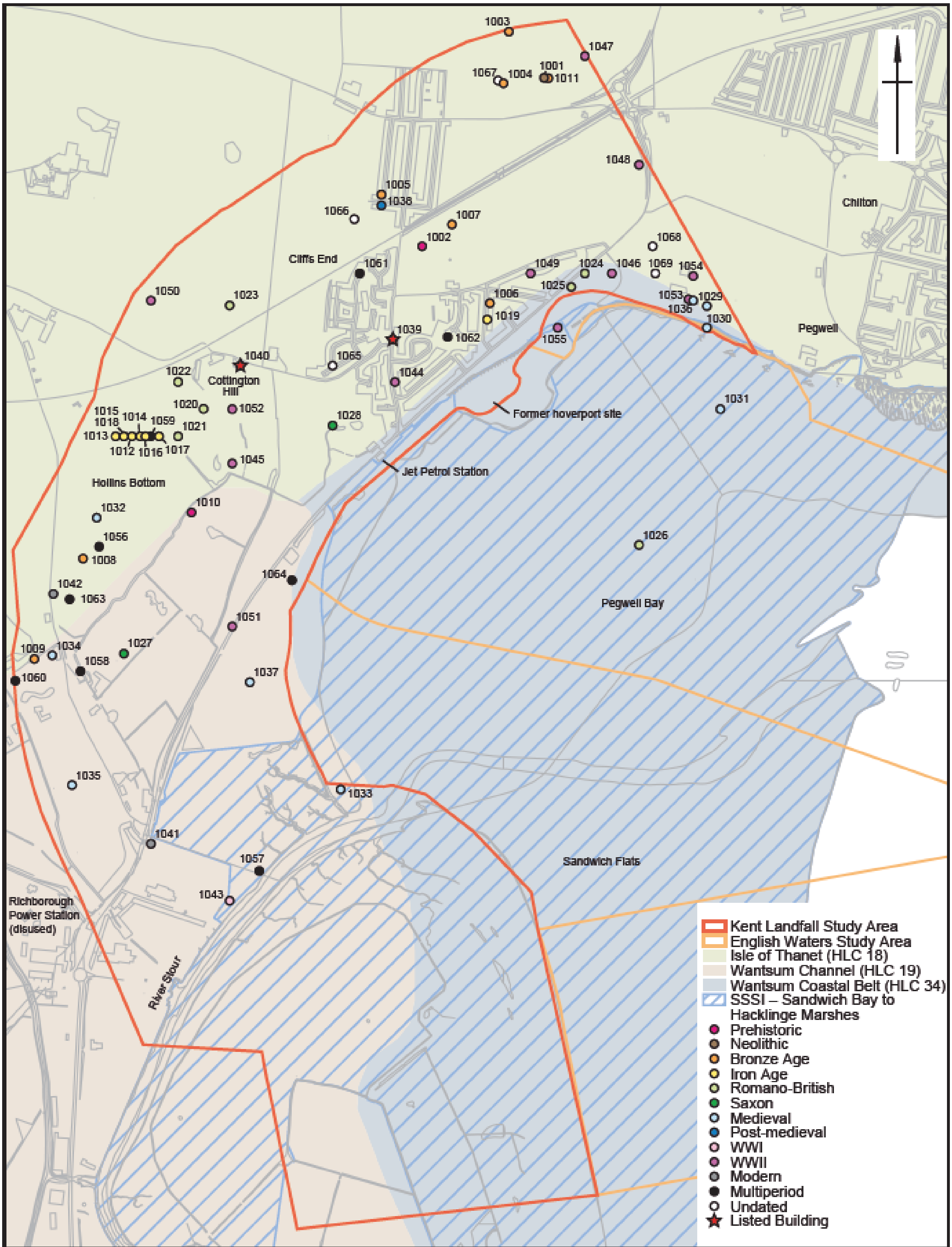
| Scale: | A-D 1:250,000 E-H 1:40,000 @A3 | Illustrator: | KJB |
| Path: | W:\Projects\73390 Nemo\Drawing Office\Report Figs\DBA\11_03_03 | | |

Kent Landfall map regression (BNG)

Figure 4




Drawing Projection: OSGB National Grid

0 1km

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|---|---|---|---|
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| Scale: | 1:2000 @A4 | Illustrator: | KJB |
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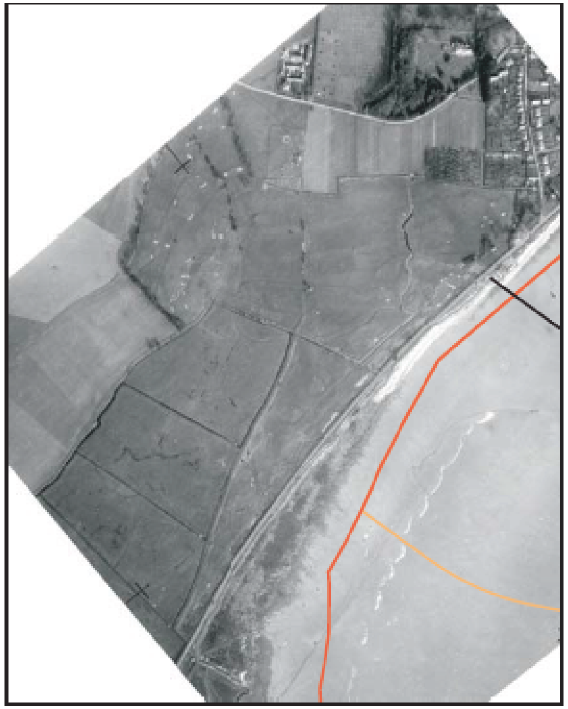
Wessex Archaeology

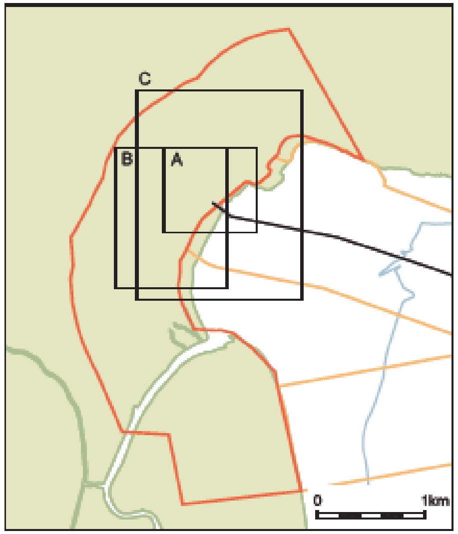
Known Sites in the Kent Landfall Study Area (BNG)

Figure 5

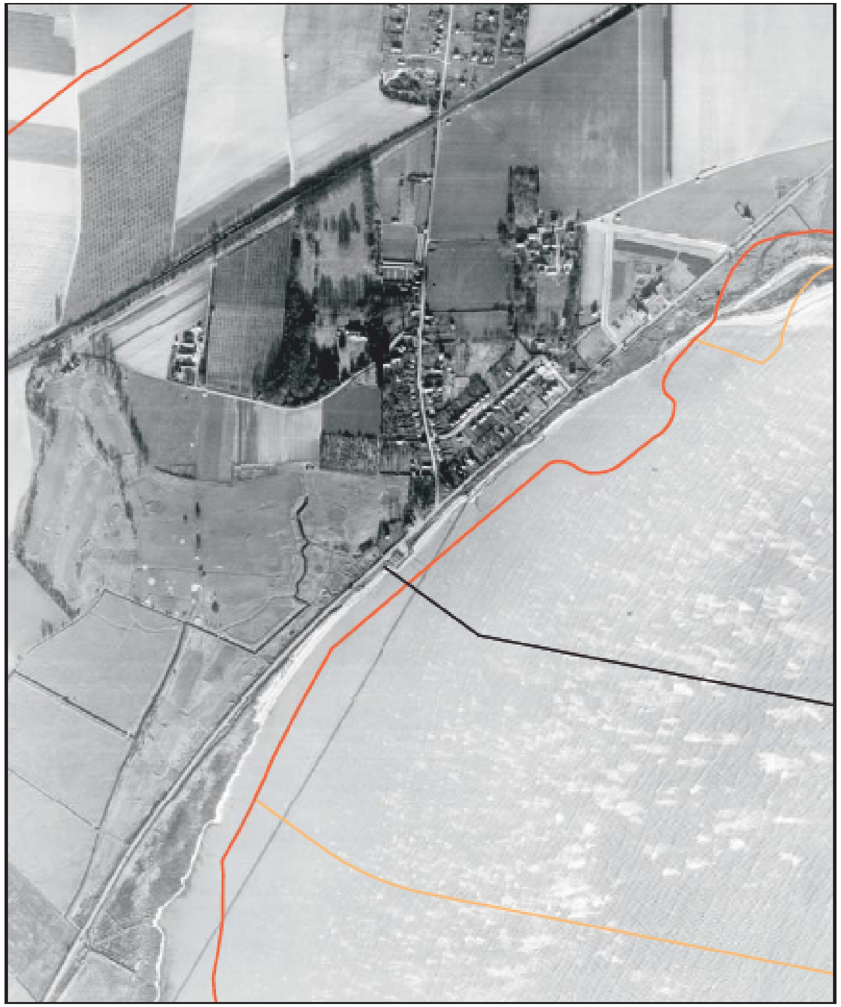
A. NMR RAF / 26J / BR267 L2 22-Feb-1941



B. NMR RAF / HLA / 540 6051 17-May-1942




C. NMR RAF / 106G / 1131 4004 17-Jan-1946



Wessex Archaeology

Kent Landfall Study Area
English Waters Study Area
Cable Route
Drawing Projection: OSGB National Grid

0 500m

Photographs courtesy of NMR.



| | | | |
|---|---|---|---|
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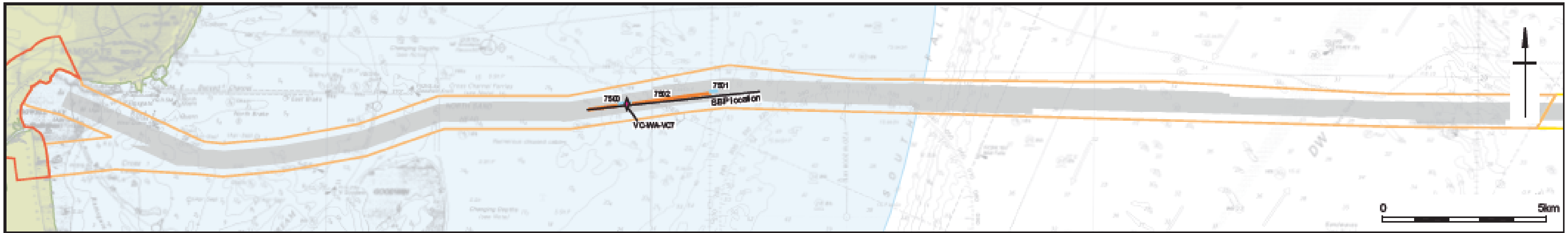
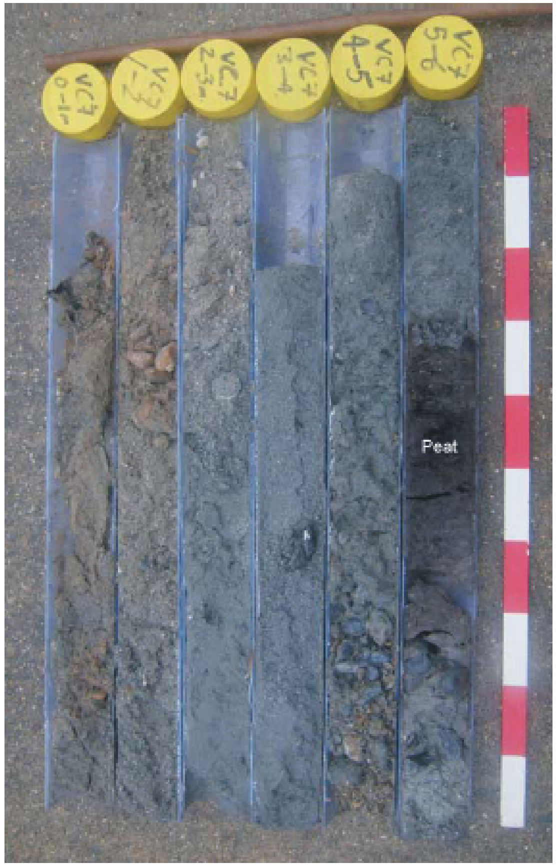
| Scale: | 1:10,000 (Inset 1:50,000) @A3 | Illustrator: | KJB |
| Path: | W:\Projects\73390 Nemo\Drawing Office\Report Figs\DBA\11_03_03 | | |

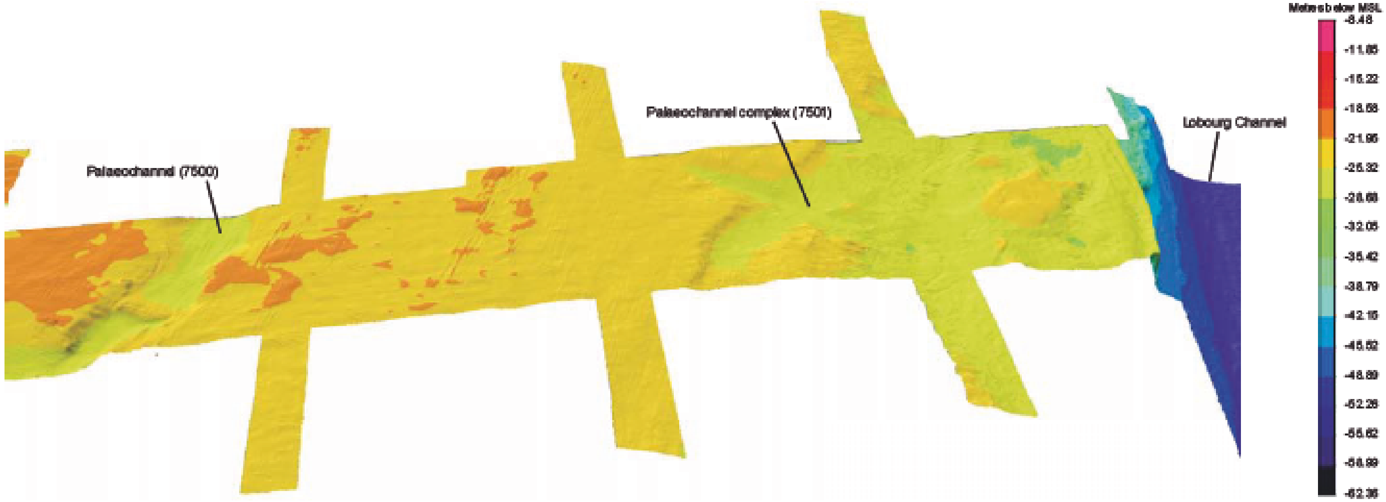
1940s aerial photographs of the Kent Landfall Study Area (Photographs courtesy of NMR)

Figure 6

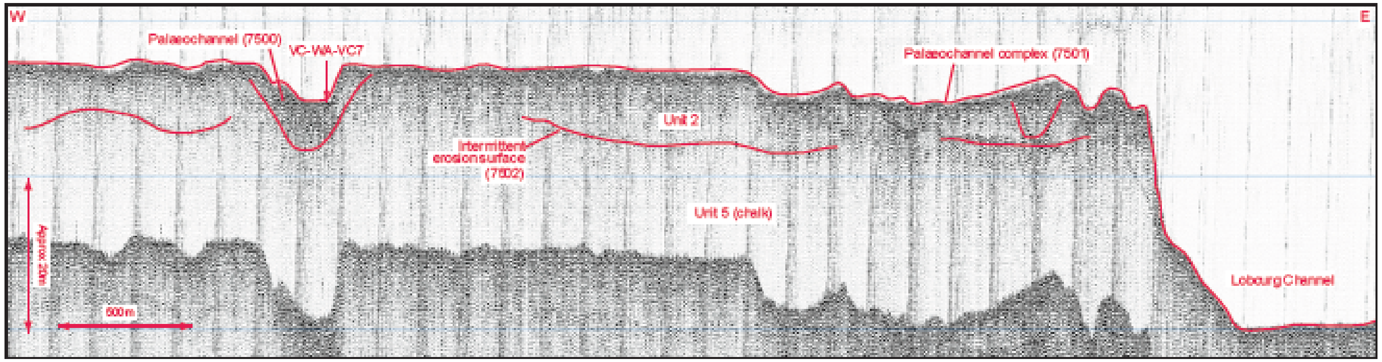



VC-WA-VC7




Multibeam bathymetry (facing north at x 10 vertical exaggeration)




Sub-bottom profiler data example

| | |
|---|---|
| Kent Landfall Study Area | Palaeochannel at surface |
| English Waters Study Area | Erosion surface |
| 12 nautical mile limit (approximate location) | Boreholes assessed by Wessex Archaeology |
| Geophysical Extents | Drawing Projection: UTM WGS84 Z31N<br>Admiralty Chart 323 (dated 2008) |

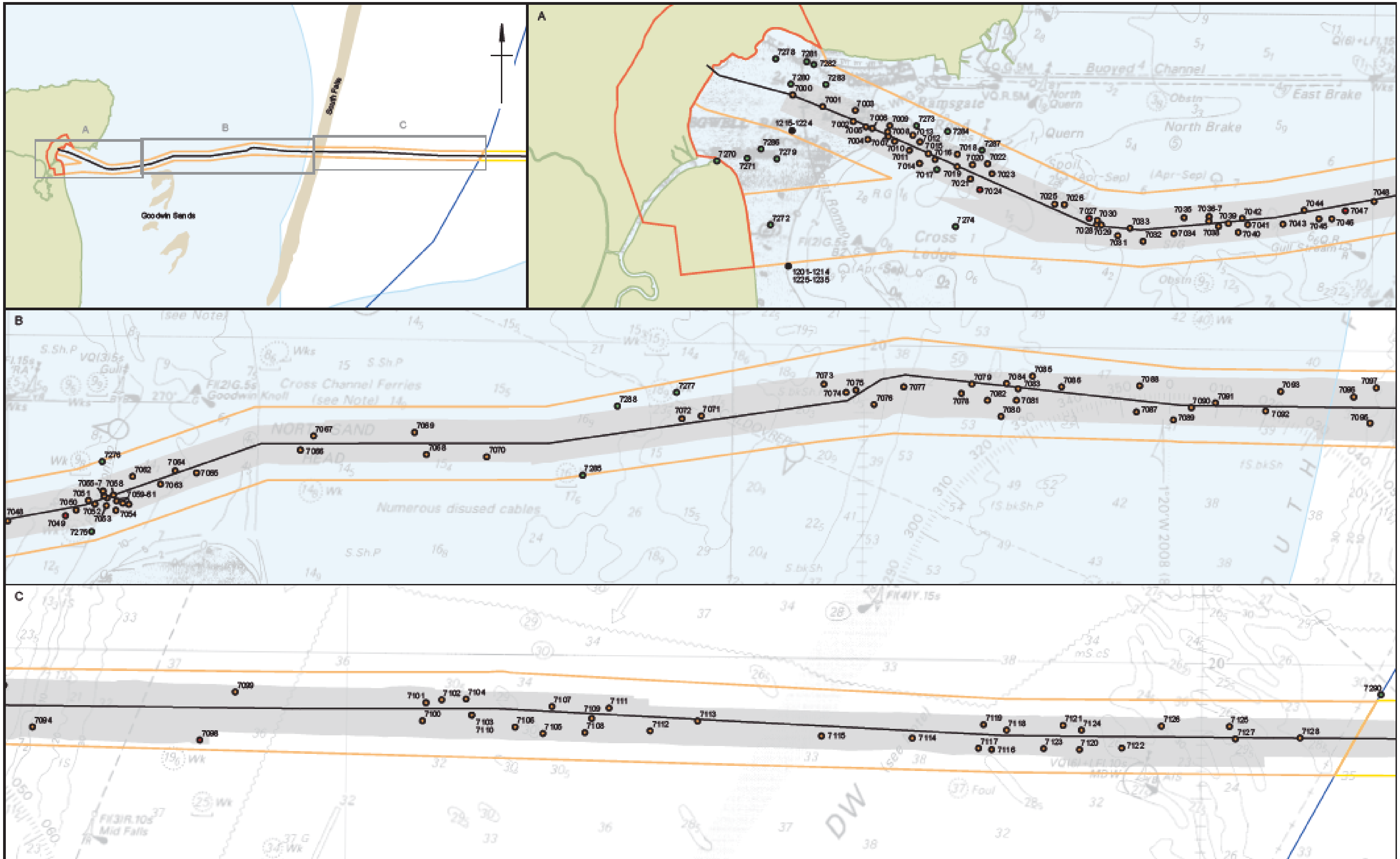
Wessex Archaeology



| | | | |
|---|---|---|---|
| Date: | 03/03/11 | Revision Number: | 1 |
| Scale: | SBP 1:20,000, Location inset 1:125,000 @A3 | Illustrator: | KJB |
| Path: | W:\Projects\73390 Nemo\Drawing Office\Report Figs\DBA\11-03-03 | | |

Sub-bottom profiler and multibeam bathymetry data examples illustrating palaeochannels in the UK sector

Figure 7




| | |
|---|---|
| Kent Landfall Study Area | French Waters Study Area |
| English Waters Study Area | Cable Route |
| | Territorial waters |
| | 12 nautical mile limit (approximate location) |

Geophysical Extents
- A1 - Anthropogenic origin of archaeological interest
- A2 - Uncertain origin of possible archaeological interest
- A3 - Historic record of possible archaeological interest
- Recorded loss

Wessex Archaeology

0 — 10km

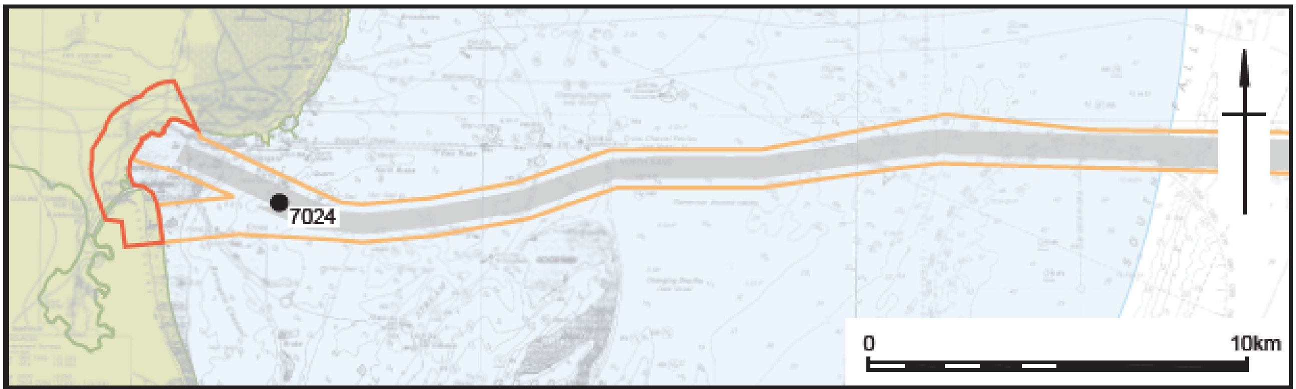
Drawing Projection: UTM WGS84 Z31N
Admiralty chart 323 (dated 2008)

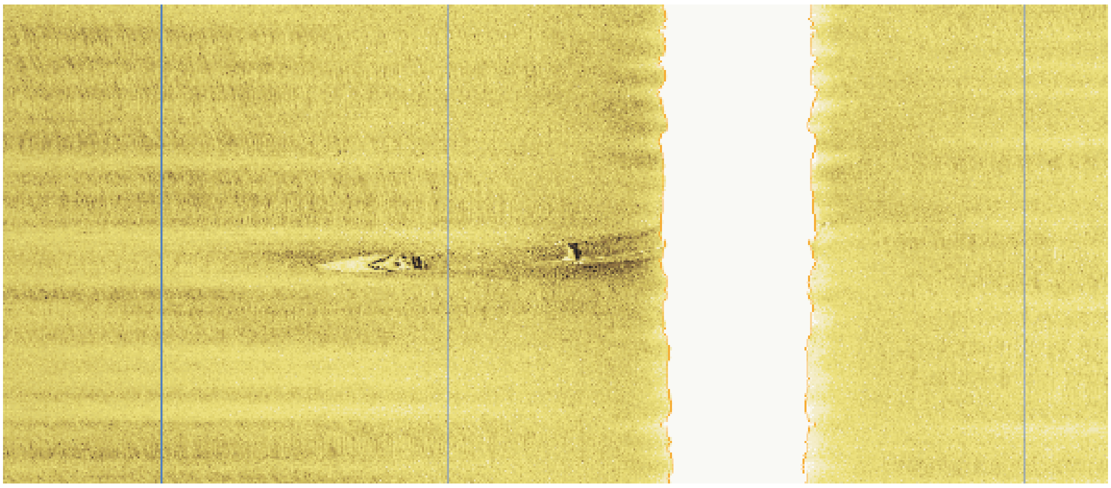


| | | | |
|---|---|---|---|
| Date: | 03/03/11 | Revision Number: | 1 |
| Scale: | 1:50,000 (inset 1:400,000) @A3 | Illustrator: | KJB |
| Path: | W:\Projects\73390 Nemo\DO\Report Figs\DBA\11_03_03 | | |

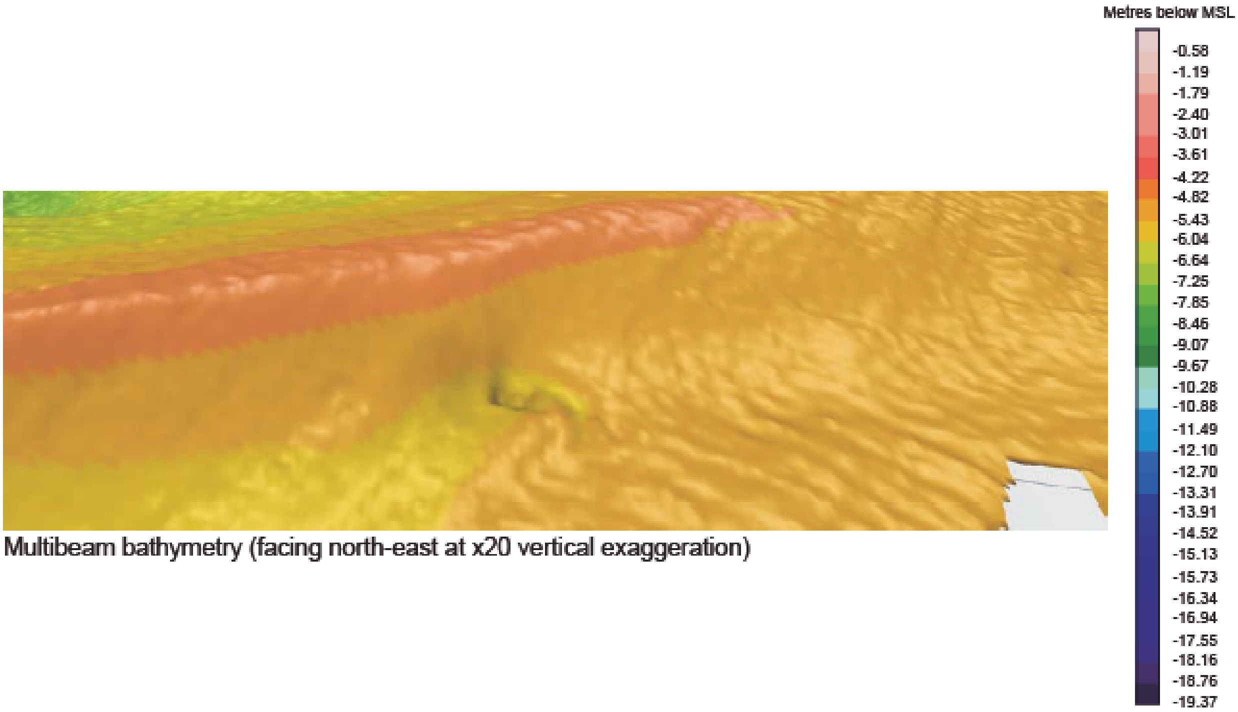
Known wrecks and geophysical anomalies of known or possible archaeological potential in the English Waters Study Area

Figure 8



Sidescan sonar mosaic




Multibeam bathymetry (facing north-east at x20 vertical exaggeration)

- Kent Landfall Study Area
- English Waters Study Area
- 12 nautical mile limit (approximate location)
- Geophysical Extents

Drawing Projection: UTM WGS84 Z31N
Admiralty Chart 323 (dated 2008)

Wessex Archaeology



| | | | |
|---|---|---|---|
| Date: | 03/03/11 | Revision Number: | 1 |
| Scale: | Inset 1:200,000 @A4 | Illustrator: | KJB |
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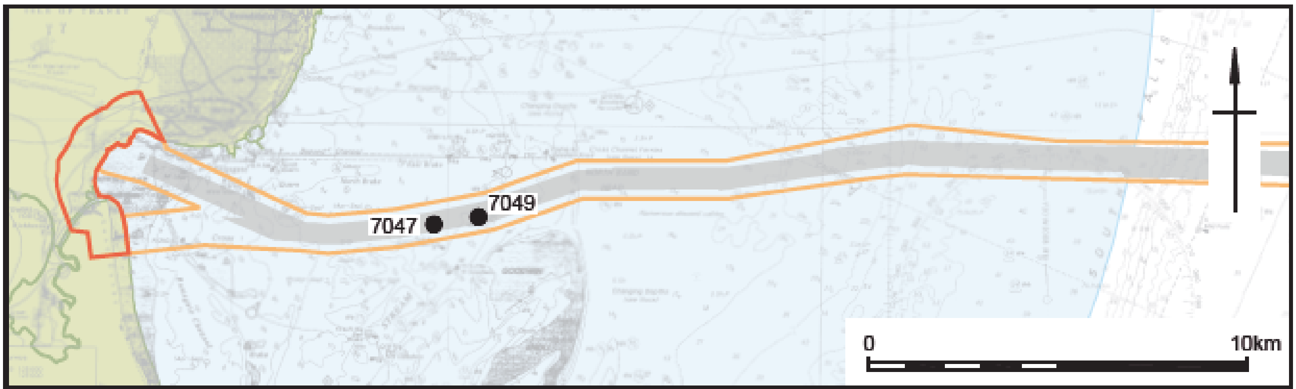
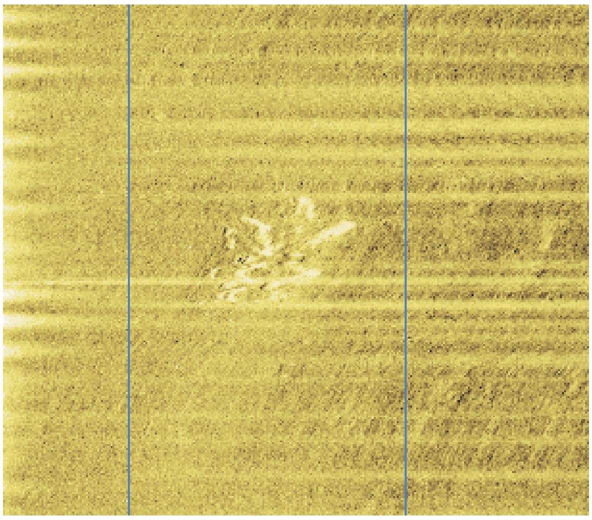
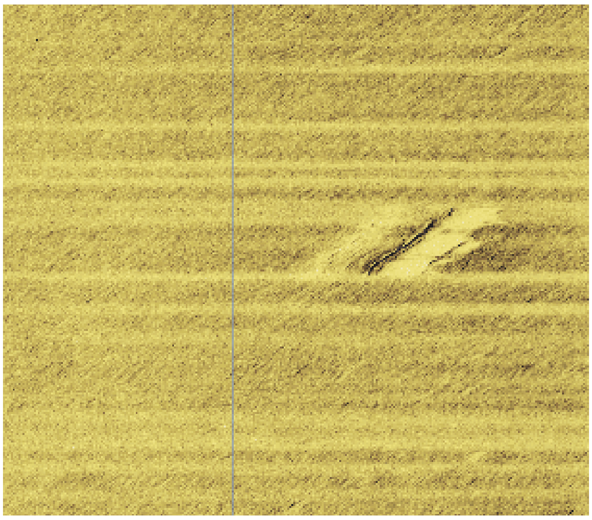
Sidescan sonar and multibeam bathymetry data examples illustrating wreck 7024 (UK Sector) — Figure 9



Sidescan sonar mosaic of debris 7047



Sidescan sonar mosaic of debris 7049

Kent Landfall Study Area
English Waters Study Area
12 nautical mile limit (approximate location)
Geophysical Extents

Drawing Projection: UTM WGS84 Z31N
Admiralty Chart 323 (dated 2008)

Wessex Archaeology



| | | | |
|---|---|---|---|
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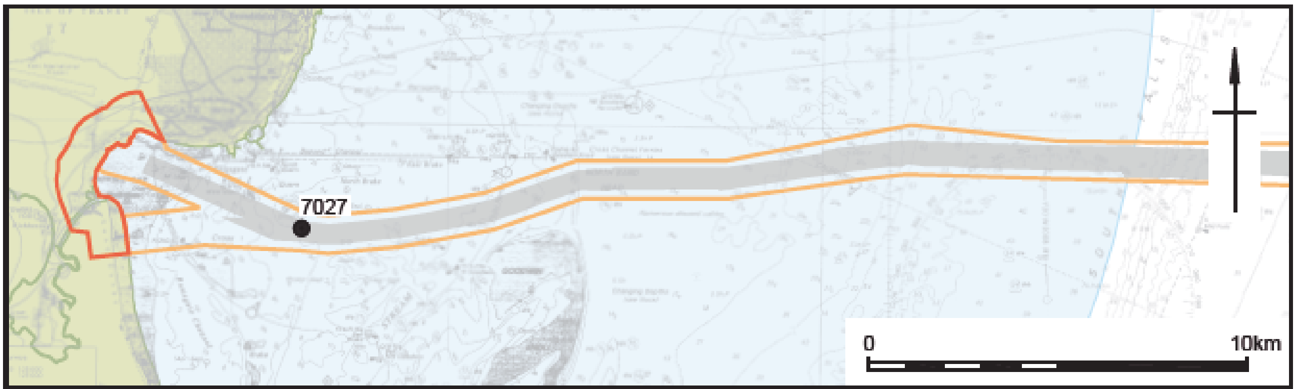
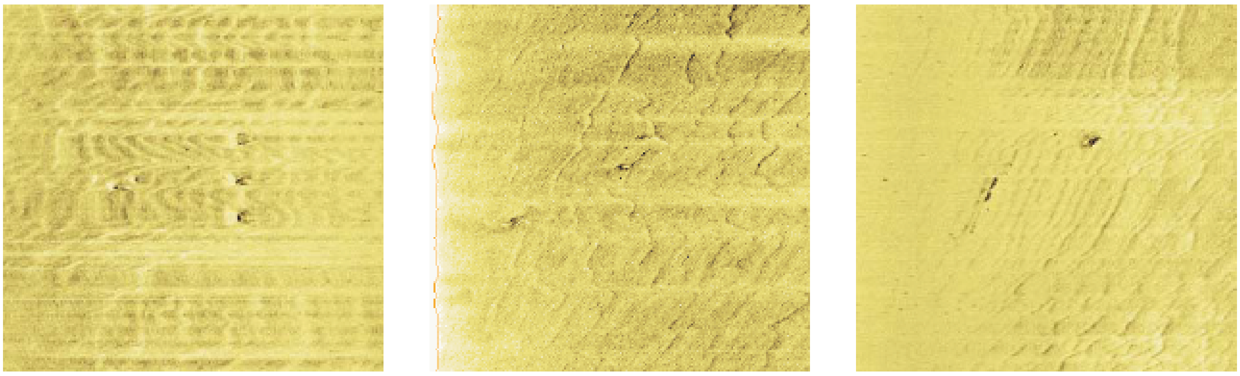
| Scale: | Inset 1:200,000 @A4 | Illustrator: | KJB |
| Path: | W:\Projects\73390 Nemo\Drawing Office\Report Figs\DBA\11_03_03 | | |

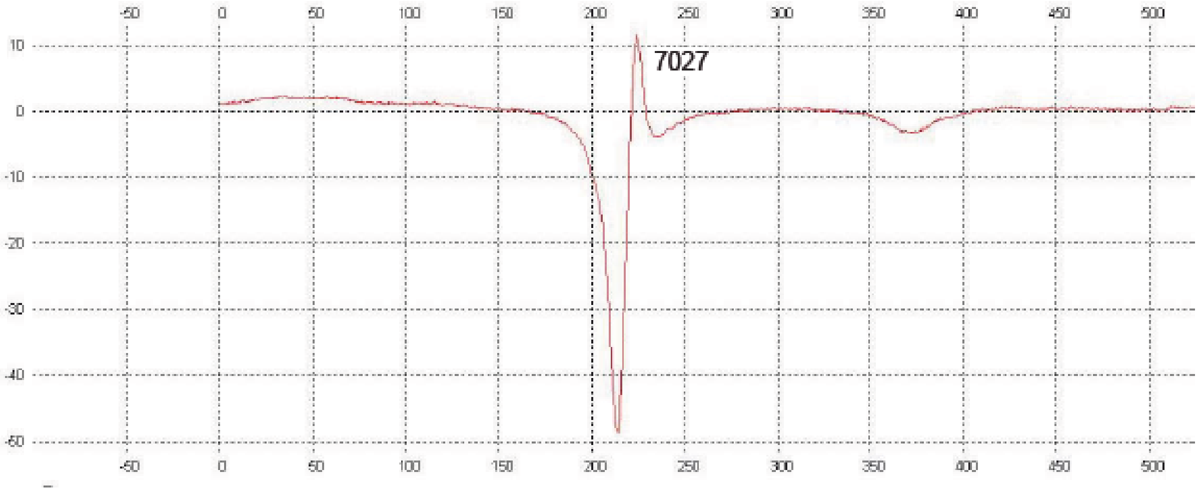
Sidescan sonar images illustrating debris 7047 (top) and 7049 (bottom) (UK Sector)

Figure 10



Sidescan sonar mosaics of debris 7027




Magnetometer profile of debris 7027

Kent Landfall Study Area
English Waters Study Area
12 nautical mile limit (approximate location)
Geophysical Extents

Drawing Projection: UTM WGS84 Z31N
Admiralty Chart 323 (dated 2008)

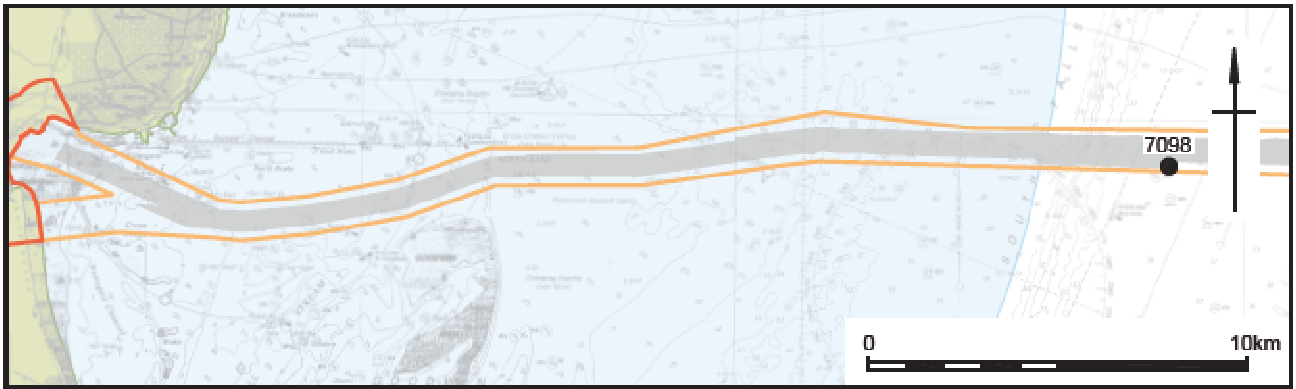
Wessex Archaeology

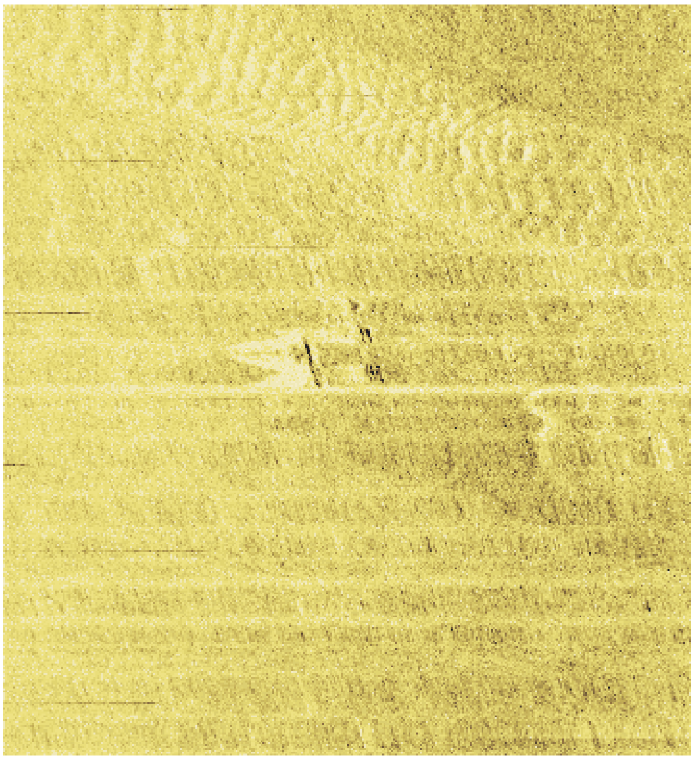


| | | | |
|---|---|---|---|
| Date: | 08/03/11 | Revision Number: | 0 |
| Scale: | Inset 1:200,000 @A4 | Illustrator: | KJB |
| Path: | W:\Projects\73390 Nemo\Drawing Office\Report Figs\DBA\11_03_03 | | |

Sidescan sonar images and magnetometer profile illustrating debris 7027 (UK Sector)

Figure 11



Sidescan sonar mosaic of debris 7098

Kent Landfall Study Area
English Waters Study Area
12 nautical mile limit (approximate location)
Geophysical Extents

Drawing Projection: UTM WGS84 Z31N
Admiralty Chart 323 (dated 2008)

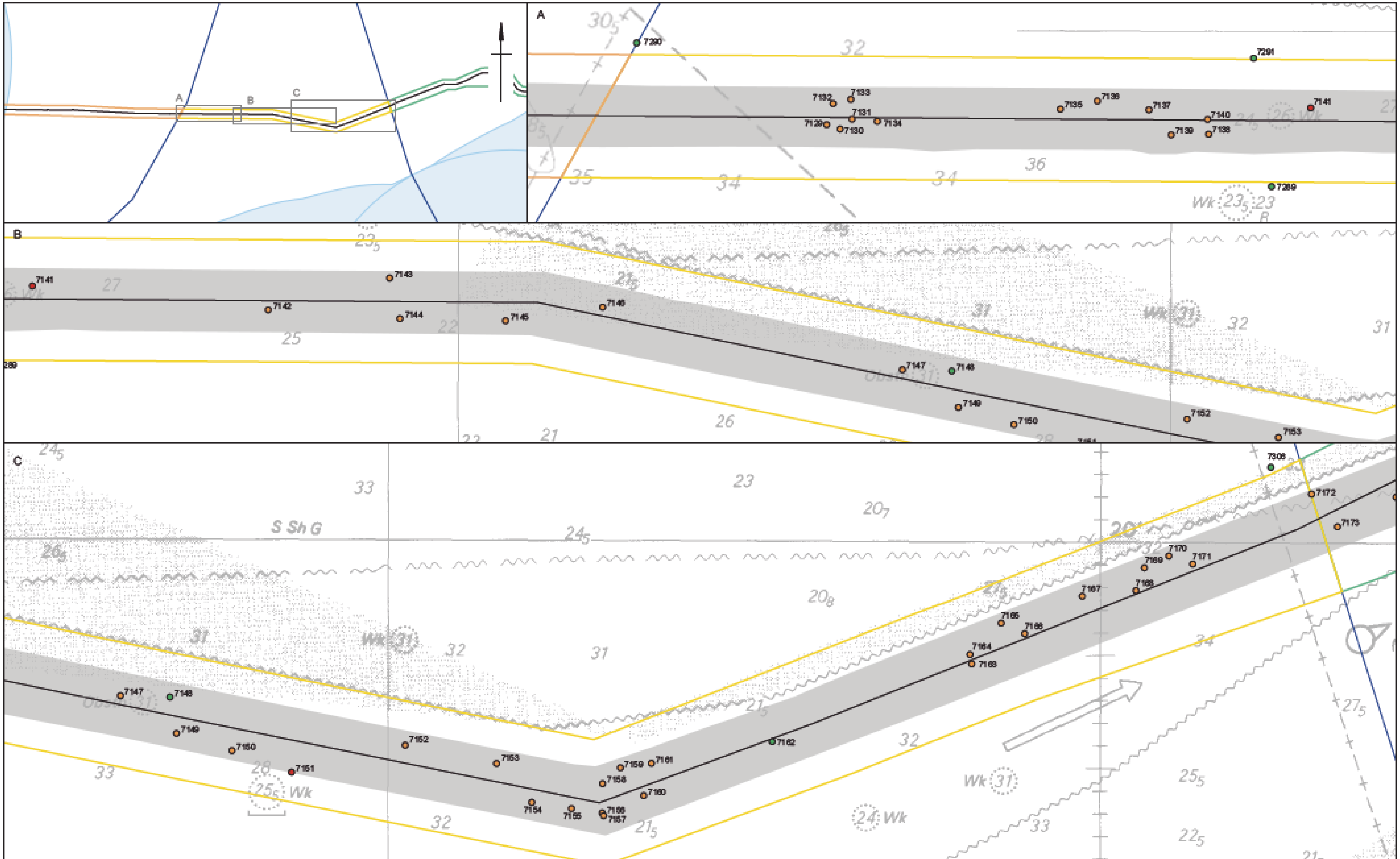
Wessex Archaeology



| | | | |
|---|---|---|---|
| Date: | 08/03/11 | Revision Number: | 0 |
| Scale: | Inset 1:200,000 @A4 | Illustrator: | KJB |
| Path: | W:\Projects\73390 Nemo\Drawing Office\Report Figs\DBA\11_03_03 | | |

Sidescan sonar image illustrating debris 7098 (UK Sector)

Figure 12




English Waters Study Area
French Waters Study Area
Belgian Waters Study Area
Cable Route
Territorial waters
12 nautical mile limit (approximate location)
Geophysical Extents
A1 - Anthropogenic origin of archaeological interest
A2 - Uncertain origin of possible archaeological interest
A3 - Historic record of possible archaeological interest

0 1 km

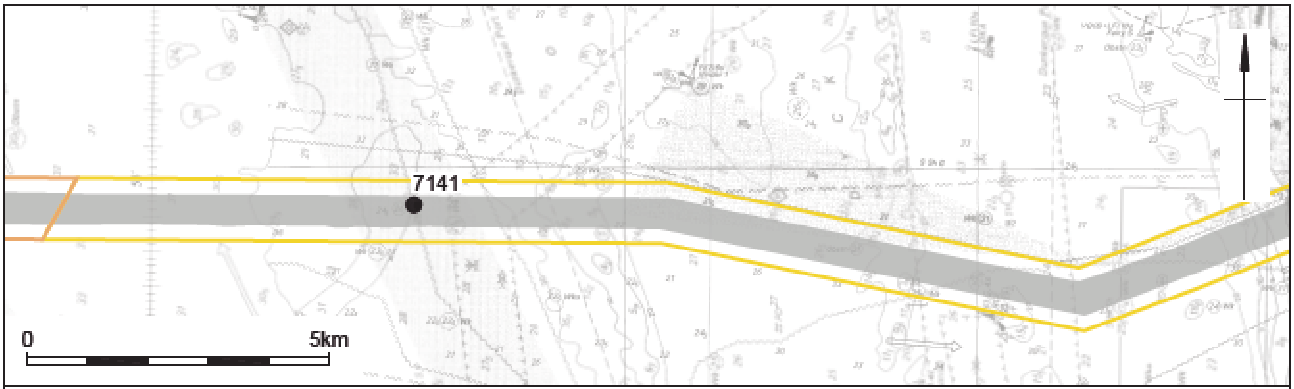
Drawing Projection: UTM WGS84 Z31N
Admiralty Chart 1873 (dated 2007) and 323 (dated 2008)

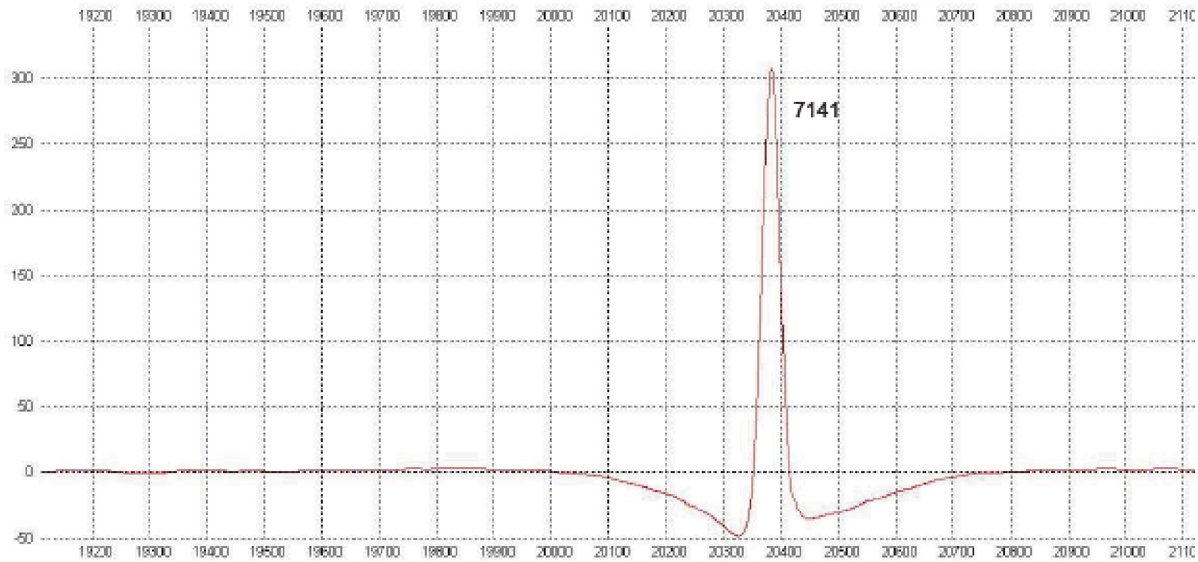


| | | | |
|---|---|---|---|
| Date: | 21/07/2016 | Revision Number: | 3 |
| Scale: | 1:30,000 (inset 1:400,000) @A3 | Illustrator: | KJB/KMN |
| Path: | W:\Projects\73390 Nemo\DO\Report Figs\DBA\16_07_20 | | |

Known wrecks and geophysical anomalies of known or possible archaeological potential in the in the French Waters Study Area

Figure 13




Magnetometer profile

- English Waters Study Area
- French Waters Study Area
- Belgian Waters Study Area
- 12 nautical mile limit (approximate location)
- Geophysical Extents

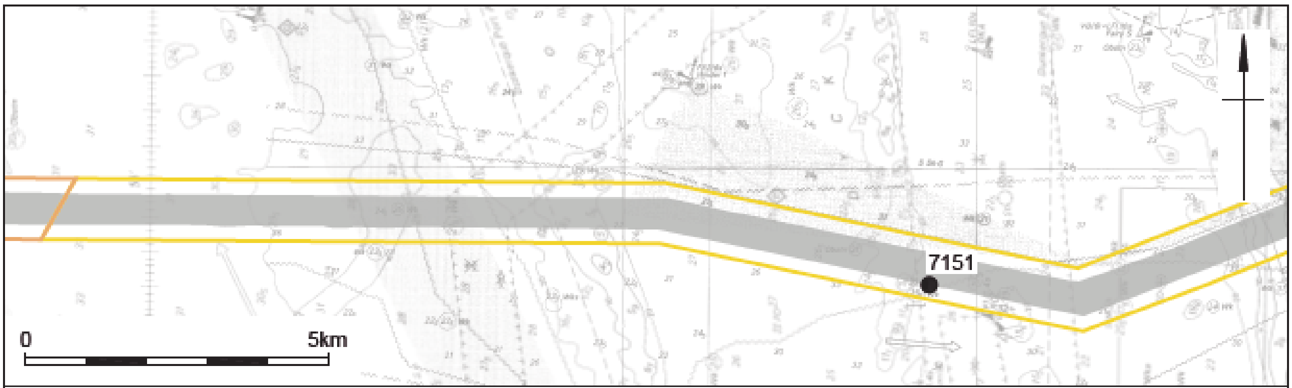
Drawing Projection: UTM WGS84 Z31N
Admiralty Charts 323 & D11 (dated 2008 & 2010)

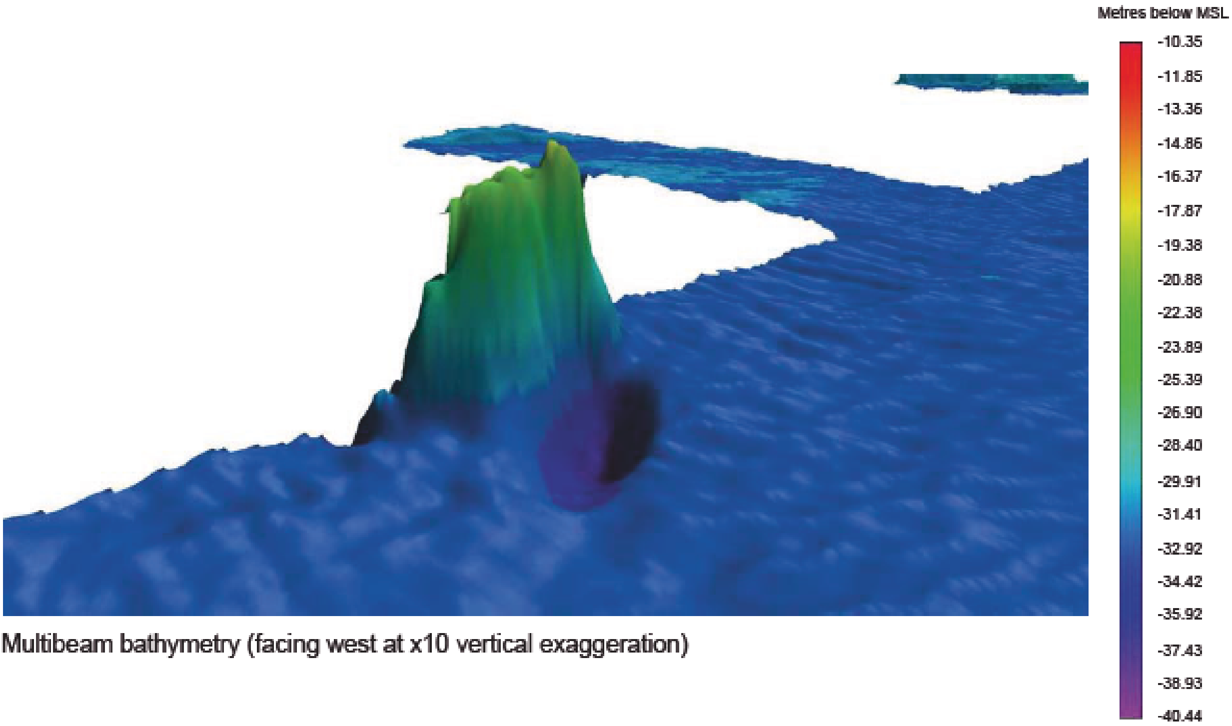


| | | | |
|---|---|---|---|
| Date: | 12/07/2016 | Revision Number: | 1 |
| Scale: | Inset 1:125,000 @A4 | Illustrator: | KJB/KMN |
| Path: | W:\Projects\73390 Nemo\Drawing Office\Report Figs\DBA\16_07_12 | | |

Magnetometer profile illustrating wreck 7141 (French Sector)

Figure 14




Multibeam bathymetry (facing west at x10 vertical exaggeration)

English Waters Study Area
French Waters Study Area
Belgian Waters Study Area
12 nautical mile limit (approximate location)
Geophysical Extents

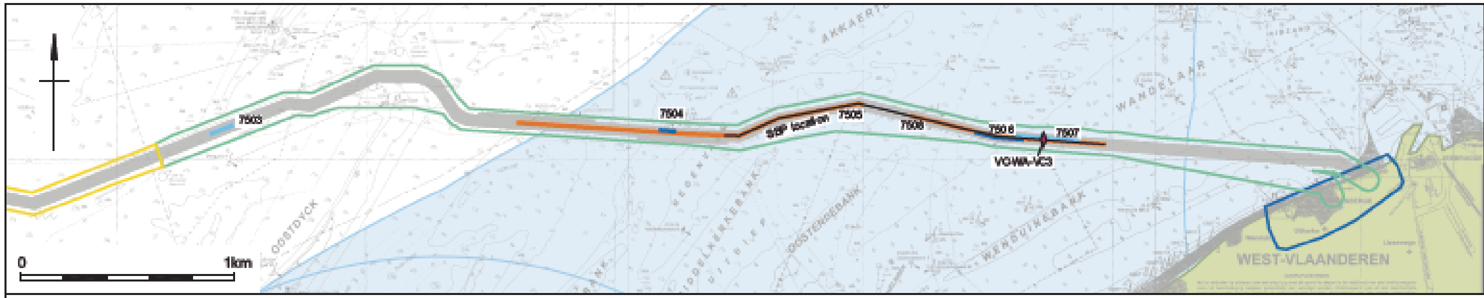
Drawing Projection: UTM WGS84 Z31N
Admiralty Charts 323 & D11 (dated 2008 & 2010)

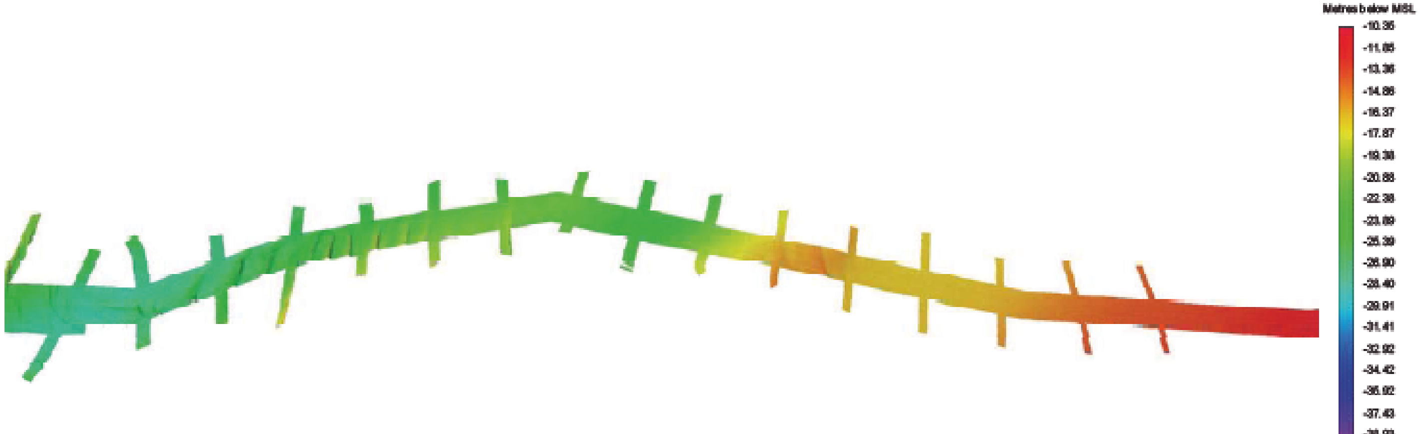


| | | | |
|---|---|---|---|
| Date: | 12/07/2016 | Revision Number: | 1 |
| Scale: | Inset 1:125,000 @A4 | Illustrator: | KJB/KMN |
| Path: | W:\Projects\73390 Nemo\Drawing Office\Report Figs\DBA\16_07_12 | | |

Multibeam bathymetry data example illustrating wreck 7151 (French Sector)

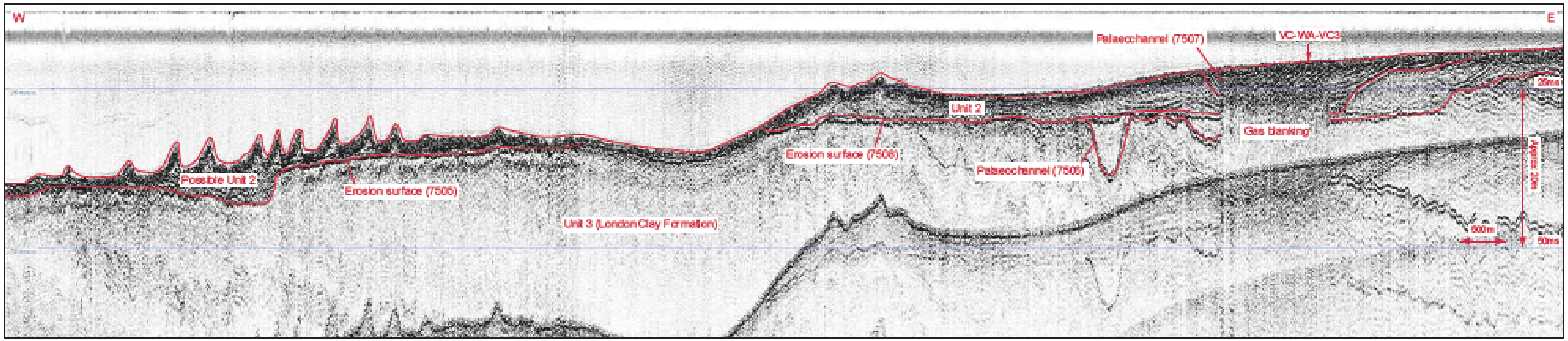
Figure 15




Multibeam bathymetry (facing north at x10 vertical exaggeration)

VC-WA-VC3




Sub-bottom profiler data example

Drawing Projection: UTM WGS84 31N
Admiralty Chart D11 (dated 2010)

- French Waters Study Area
- Belgian Waters Study Area
- Belgian Landfall Study Area
- 12 nautical mile limit (approximate location)
- Geophysical Extents
- Palaeochannel at surface
- Deeper palaeochannel
- Erosion surface
- Boreholes assessed by Wessex Archaeology



| | | | |
|---|---|---|---|
| Date: | 12/07/2016 | Revision Number: | 2 |
| Scale: | SBP 1:50,000, Location inset 1:250,000 @ A3 | Illustrator: | KJB/KMN |
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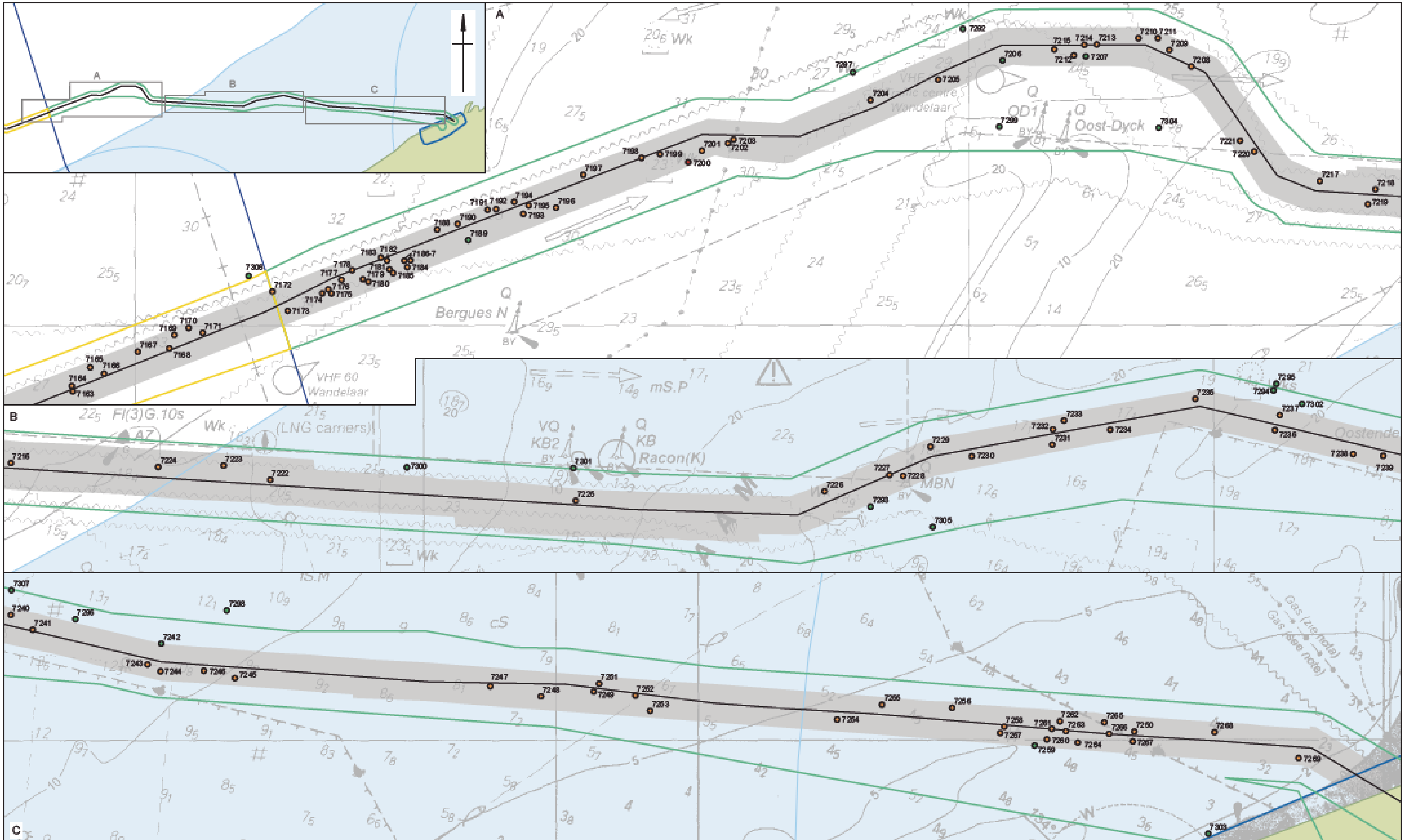
Sub-bottom profiler data example illustrating palaeochannels in the Belgian sector

Figure 16




French Waters Study Area
Belgian Waters Study Area
Belgian Landfall Study Area
Cable Route
Territorial waters
12 nautical mile limit (approximate location)
Geophysical Extents
A1 - Anthropogenic origin of archaeological interest
A2 - Uncertain origin of possible archaeological interest
A3 - Historic record of possible archaeological interest

0 10 20 km

Drawing Projection: UTM WGS84 Z31N
Admiralty Chart D11 (dated 2010)



| | | | |
|---|---|---|---|
| Date: | 22/07/2016 | Revision Number: | 3 |
| Scale: | 1:50,000 (inset 1:400,000) @A3 | Illustrator: | KJB/KMN |
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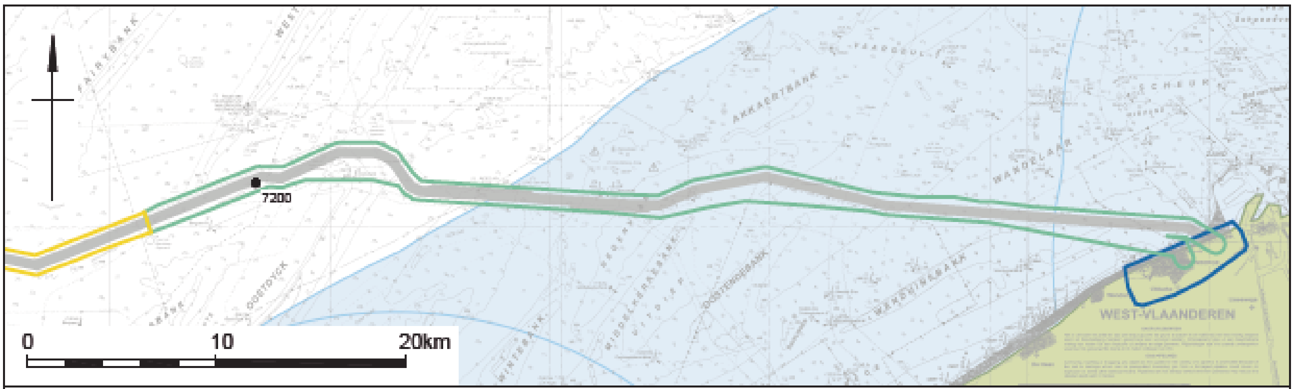
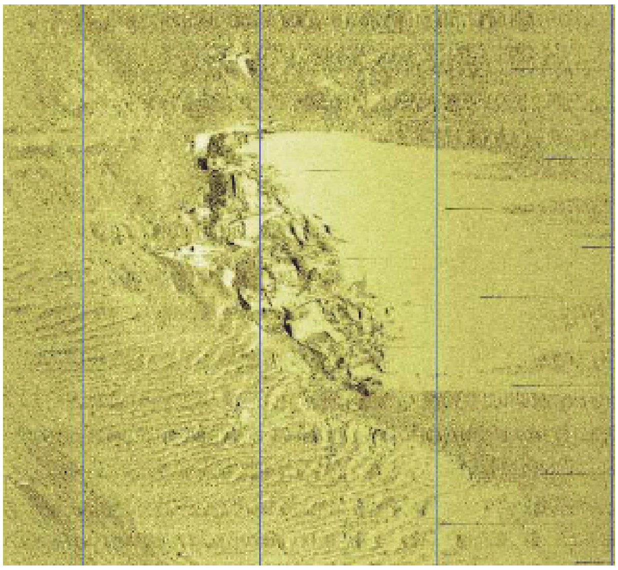
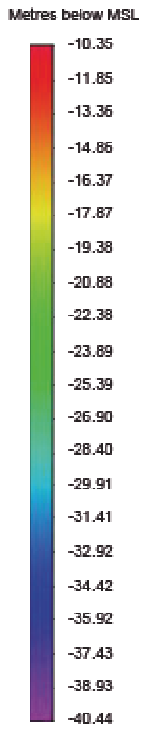
Known wrecks and geophysical anomalies of known or possible archaeological potential in the Belgian Waters Study Area

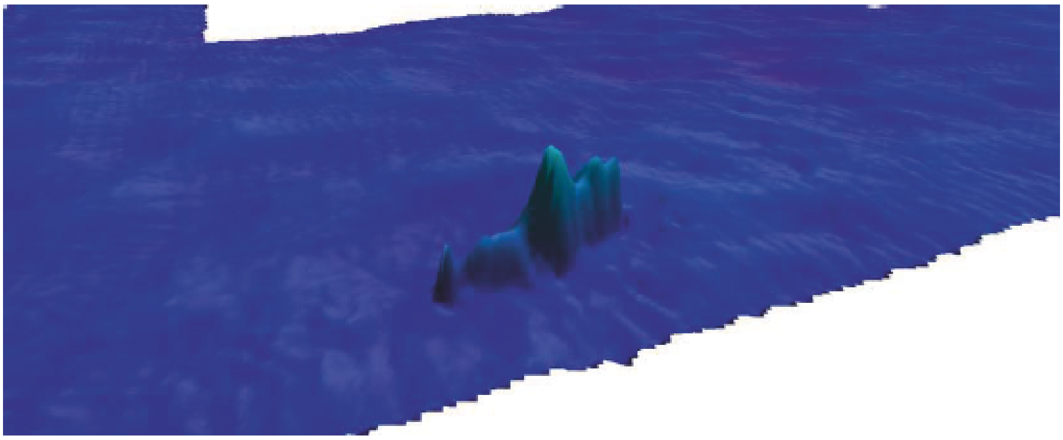
Figure 17



Sidescan sonar mosaic



Multibeam bathymetry (facing north at x10 vertical exaggeration)

French Waters Study Area
Belgian Waters Study Area
Belgian Landfall Study Area
12 nautical mile limit (approximate location)
Geophysical Extents

Drawing Projection: UTM WGS84 Z31N
Admiralty Chart D11 (dated 2010)



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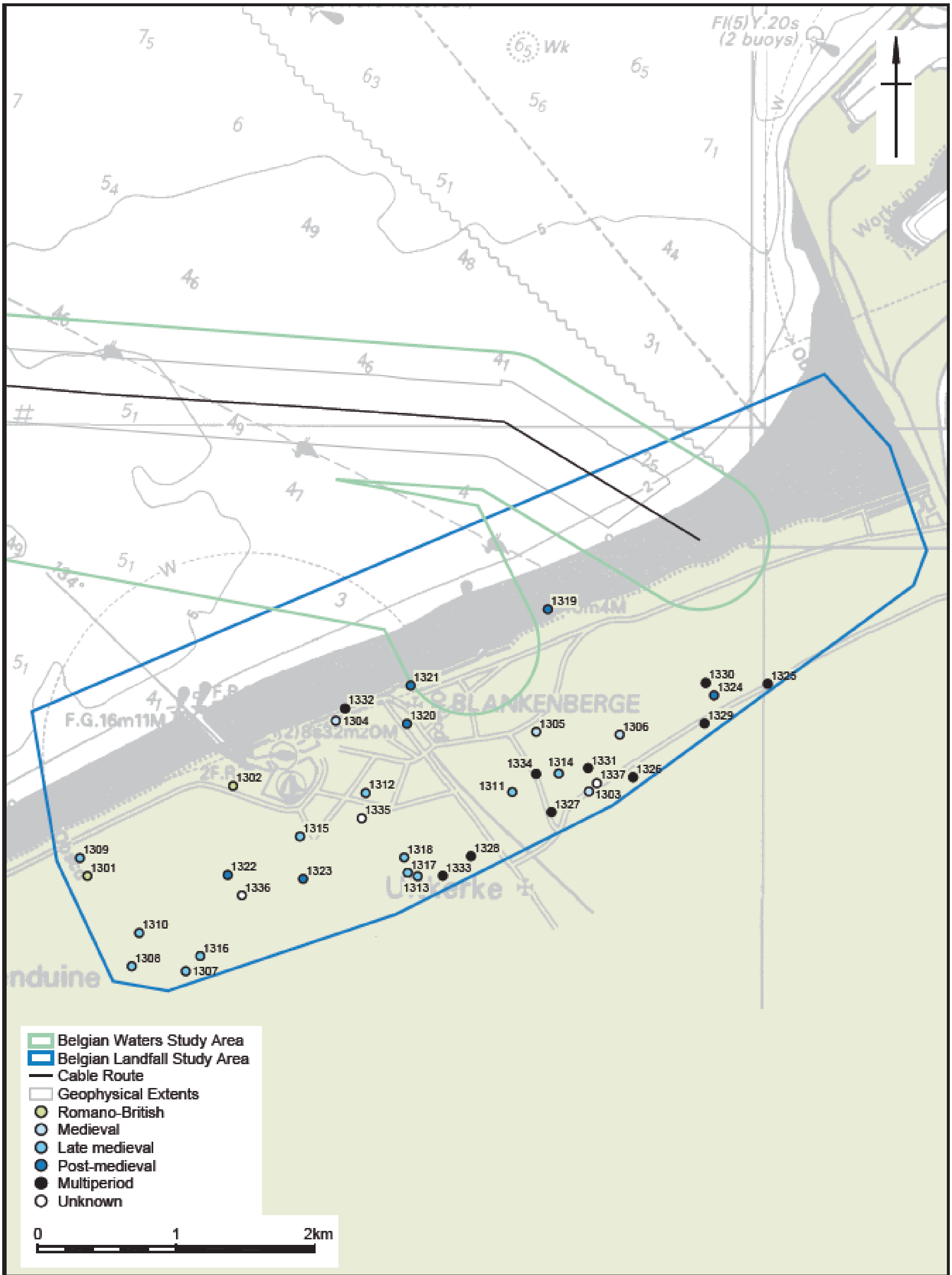
|---|---|---|---|
| Date: | 12/07/2016 | Revision Number: | 2 |
| Scale: | Inset 1:400,000 @A4 | Illustrator: | KJB/KMN |
| Path: | W:\Projects\73390 Nemo\Drawing Office\Report Figs\DBA\16_07_12 | | |

Sidescan sonar and multibeam bathymetry data examples illustrating wreck 7200 (Belgian Sector)

Figure 18






Drawing Projection: UTM WGS84 Z31N
Admiralty chart 1874 (dated 2007)

Wessex Archaeology

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| Scale: | 1:40,000 @A4 | Illustrator: | KJB |
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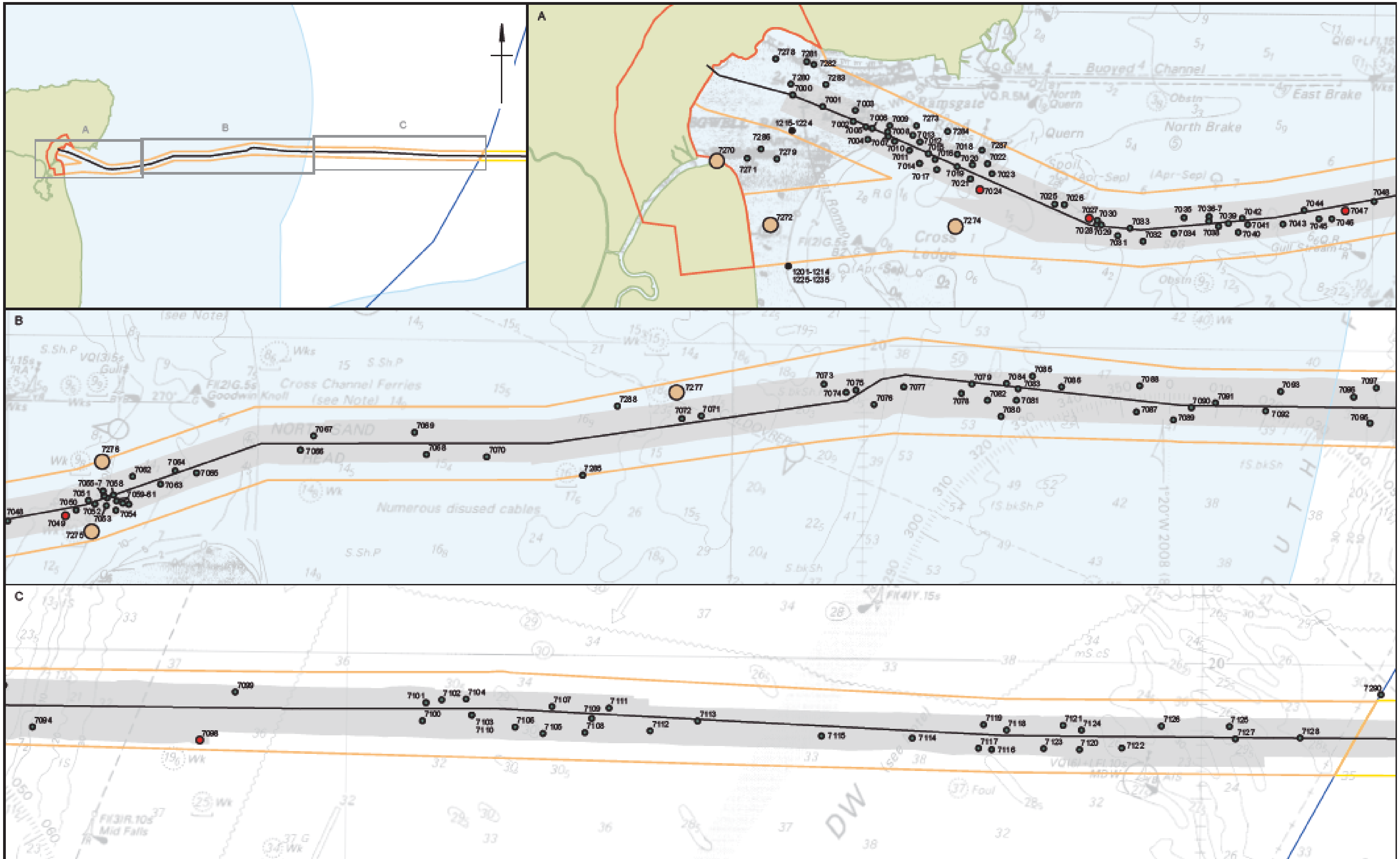
Known sites in the Belgian Landfall Study Area

Figure 19




Kent Landfall Study Area
English Waters Study Area
French Waters Study Area
Cable Route
Territorial waters
12 nautical mile limit (approximate location)
Geophysical Extent
Anomalies subject to 100m buffer
Anomalies subject to temporary exclusion zone
Anomalies of archaeological potential not subject to exclusion zone

Wessex Archaeology

0 10km

Drawing Projection: UTM WGS84 Z31N
Admiralty chart 323 (dated 2008)



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| Scale: | 1:50,000 (inset 1:400,000) @A3 | Illustrator: | KJB |
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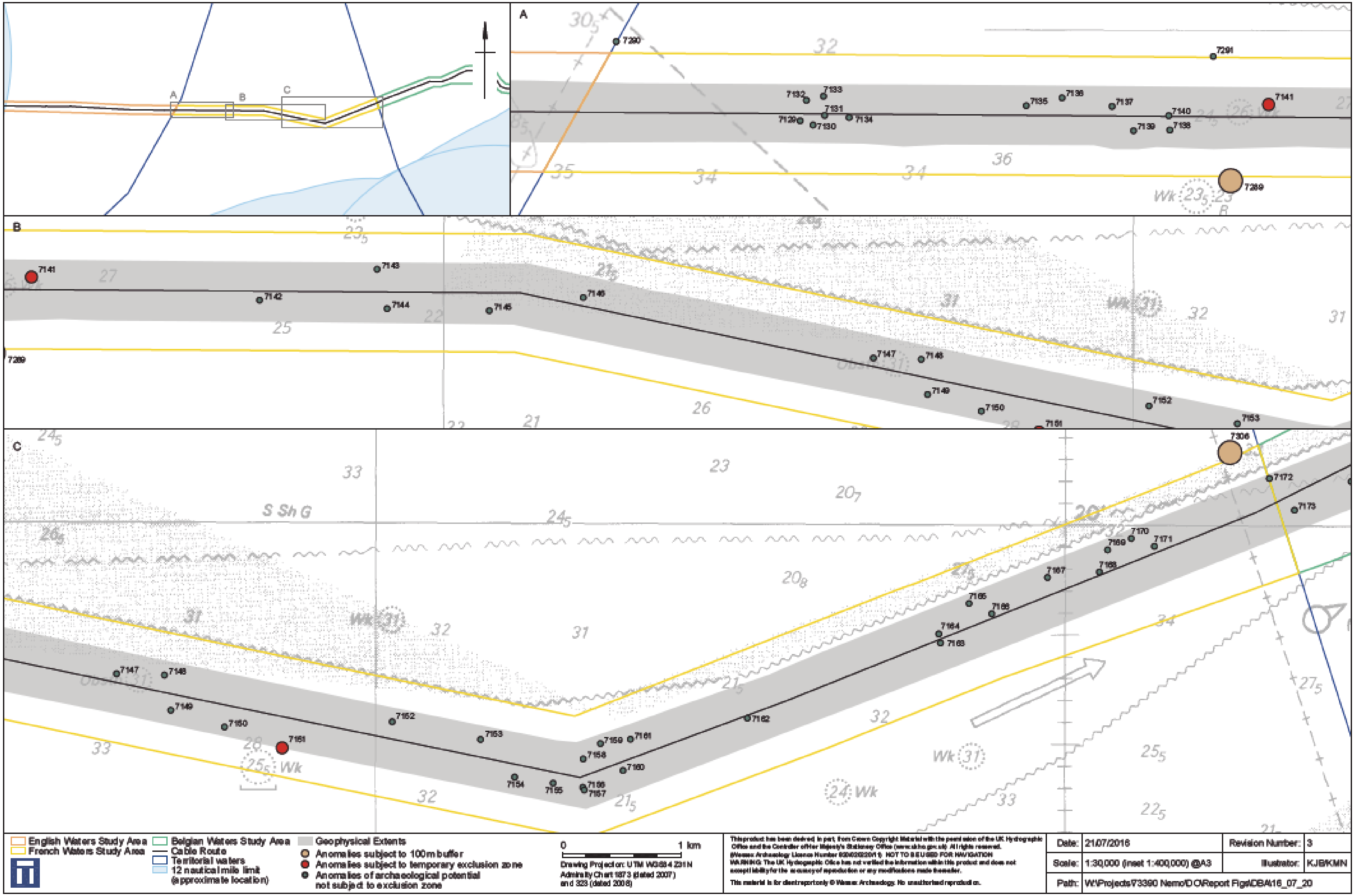
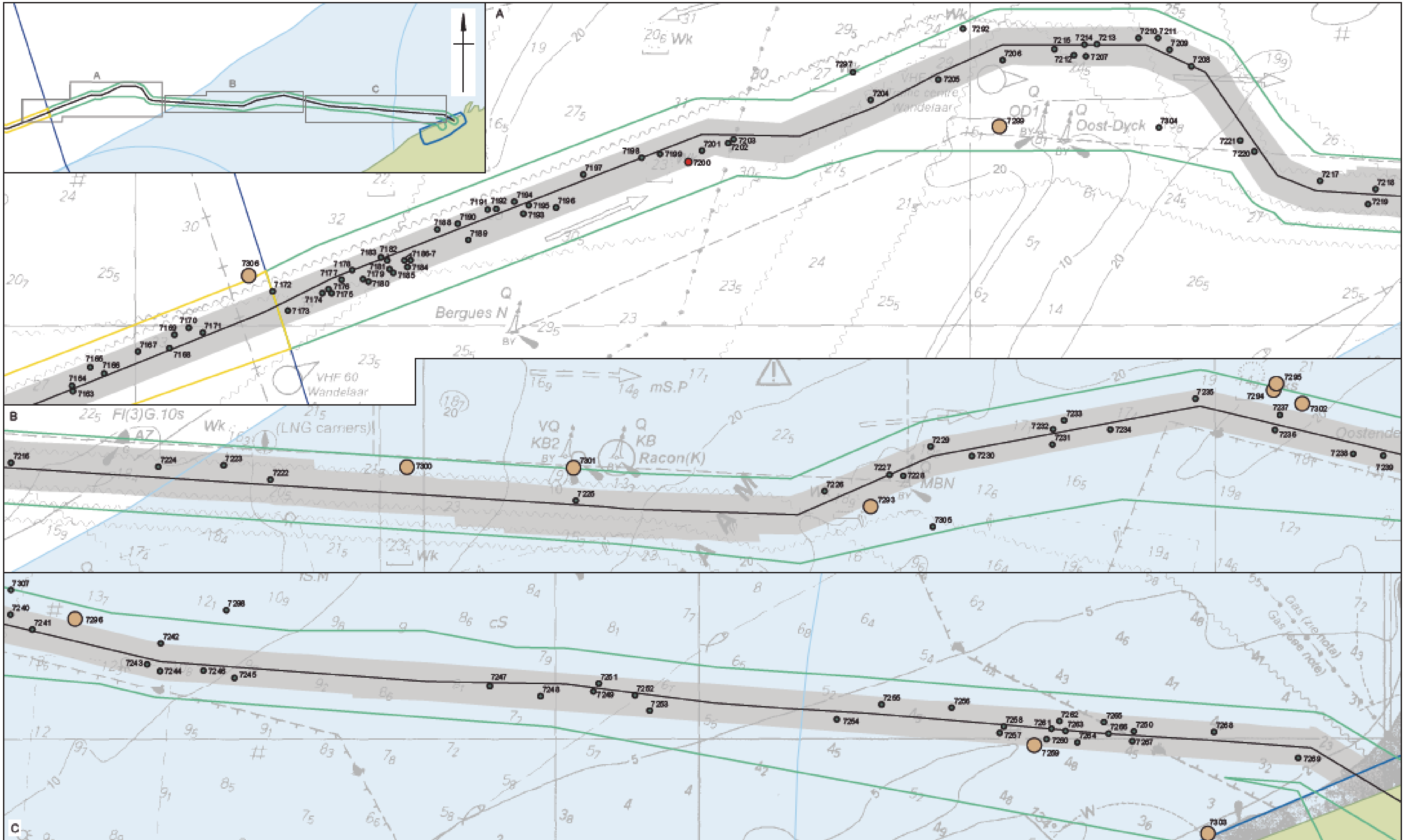
Mitigation – temporary archaeological exclusion zones and buffers (English Waters Study Area)

Figure 20




Mitigation – temporary archaeological exclusion zones and buffers (French Waters Study Area)

Figure 21

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|---|---|---|
| French Waters Study Area | Belgian Landfall Study Area | Geophysical Extent |
| Belgian Waters Study Area | Cable Route | Anomalies subject to 100m buffer |
| | Territorial waters | Anomalies subject to temporary exclusion zone |
| | 12 nautical mile limit (approximate location) | Anomalies of archaeological potential not subject to exclusion zone |

0 10 20 km

Drawing Projection: UTM WGS84 Z31N
Admiralty Chart D11 (dated 2010)



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Mitigation – temporary archaeological exclusion zones and buffers (Belgian Waters Study Area)

Figure 22


Plate 1: Access to foreshore prohibited as it is a Sensitive Wildlife Area

Plate 2: Kent Landfall looking north towards Jet Petrol Station



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Plate 3: Overview of Kent Landfall from Jet Petrol Station looking SE


Plate 4: Area of unstable ground immediately to NE of Jet Petrol Station



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Plate 5: Overview of Kent Landfall, looking SW from the former hoverport

Plate 6: Close-up of overview of Kent Landfall, looking SW from former hoverport



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Plate 7: Line of posts extending towards cliffs on NE side of Pegwell Bay

Plate 8: Remains of WWI train ferry (WA1043), photo taken facing south across intertidal area



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Plate 9: Blankenberge pier – photo taken from top of dunes

Plate 10: View of West-Zeebrugge port from top of dyke/dune systems



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Plate 11: Dyke / dune system taken from shore

Plate 12: Facing dyke / dune systems



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Plate 13: Beach access – facing dyke/dune systems

Plate 14: View of Zeebrugge port from the shore



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Plate 15: Example of a modern breakwater dating from the 1960's, near Blankenberge, facing NW

Plate 16: Example of a modern breakwater dating from the 1960's, near Blankenberge, facing dyke/dune systems



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