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Archaeological Services in Relation to Marine Designation

# UB-31 Folkestone, Kent

Archaeological Report



Ref: 83803.32  
December 2014



**ARCHAEOLOGICAL SERVICES IN RELATION TO MARINE DESIGNATION**

***UB-31***  
**FOLKESTONE, KENT**

**ARCHAEOLOGICAL REPORT**

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# **UB-31 Folkestone Kent**

## **ARCHAEOLOGICAL REPORT**

### **Contents**

Summary .....	iii
Acknowledgements.....	iv
<b>1 INTRODUCTION.....</b>	<b>1</b>
1.1 Assessment Background.....	1
<b>2 ASSESSMENT AIMS AND OBJECTIVES.....</b>	<b>1</b>
<b>3 METHODOLOGY.....</b>	<b>2</b>
3.1 General .....	2
3.2 Stage 1: Geophysical Survey .....	2
3.3 Stage 2: Diving Survey.....	5
<b>4 RESULTS .....</b>	<b>6</b>
4.1 Summary of Progress Against Objectives .....	6
4.2 Seabed Features Assessment .....	7
4.3 Data Audit .....	8
4.4 Site position.....	10
4.5 Operational Summary .....	10
4.6 Seabed and Ecology .....	11
4.7 Archaeological data.....	11
4.8 PH Sampling .....	14
<b>5 DISCUSSION.....</b>	<b>14</b>
5.1 Type and Size of Site .....	14
5.2 Identification .....	15
5.3 Overall Characterisation.....	16
5.4 Circumstances of Loss .....	21
<b>6 RISK ASSESSMENT .....</b>	<b>21</b>
<b>7 ASSESSMENT AGAINST THE NON-STATUTORY CRITERIA FOR SCHEDULING.....</b>	<b>22</b>
7.1 Assessment Scale (BULSI) .....	22
7.2 Non-Statutory Criteria.....	22



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8	RECOMMENDATIONS.....	26
9	ARCHIVE.....	26
10	REFERENCES.....	26
11	APPENDICES.....	27
	APPENDIX I: ANOMALIES OF ARCHAEOLOGICAL POTENTIAL.....	27
	APPENDIX II: DIVE LOG .....	32
	APPENDIX III: SITE RISK ASSESSMENT.....	33

**Figures**

Figure 1:	Site Location
Figure 2:	Side Scan Sonar and Gridded Magnetometer Data
Figure 3:	Anomalies of Potential Archaeological Interest
Figure 4:	Wreck Sheet - WA 7013 - <i>UB-31</i> (UKHO 13482)
Figure 5:	Sidescan Sonar Data Example of 7000
Figure 6:	Sidescan Sonar Data with dive tracks and archaeological anomalies
Figure 7:	Dover Strait: Locations of First World War U-boats

**Plates**

Plate 1-3:	Archaeological features
Plate 4:	Anomaly 7014



# ***UB-31*** **Folkestone, Kent**

## **ARCHAEOLOGICAL REPORT**

### **Summary**

Wessex Archaeology was commissioned by English Heritage (EH) to undertake an Undesignated Site Assessment of the possible wreck site of *UB-31*, lost off Folkestone on 2<sup>nd</sup> May 1918. The work was undertaken as part of the Heritage at Risk (HAR) contract for archaeological services in relation to marine designation.

The assessment of the site was undertaken as part of a two stage investigation. Stage one consisted of a geophysical survey and stage two consisted of a diver survey of the site.

The geophysical survey aimed to locate the wreck and inform the diving investigation, whilst the diving investigation resulted in a video survey of the wreck site. The survey informed an assessment of the current state and condition of the submarine and the identification of prominent features. The assessment confirmed the identification of the wreck off Folkestone as an example of the German submarine type UB II and circumstantial evidence supports its identification as the U-boat *UB-31*.

The site has been assessed against non-statutory criteria for scheduling and has not been recommended for designation. The boat was observed as being in good condition with the pressure hull complete abaft the conning tower but damaged by the explosion that sunk it forward of the deck gun. The two propellers are missing.

Risk is assessed as low. Natural decay and corrosion are expected and constitute the main risks to the site.

No management actions are recommended.



# **UB-31**

## **Folkestone, Kent**

### **ARCHAEOLOGICAL REPORT**

#### **Acknowledgements**

The investigation was commissioned by English Heritage, and the assistance provided by Mark Dunkley, Terence Newman and Alison James of English Heritage is gratefully acknowledged.

Fieldwork was carried out by a Wessex Archaeology team comprising Graham Scott, Andrea Hamel, Peta Knott, Michael Murray and Paolo Croce. Graham Scott and Paolo Croce supervised the diving. David Howell and Rachel Chester (both Wessex Archaeology) carried out the acquisition of geophysical data.

This report was compiled by Paolo Croce, with assistance from other members of the dive team. Dave Howell provided additional advice concerning the geophysical data interpretation and Kitty Foster prepared the illustrations. The project was managed for Wessex Archaeology by Toby Gane, who also carried out quality assurance.



# **UB-31**

## **Folkestone, Kent**

### **ARCHAEOLOGICAL REPORT**

## **1 INTRODUCTION**

### **1.1 Assessment Background**

- 1.1.1 Wessex Archaeology (WA) was commissioned by English Heritage (EH) to carry out a geophysical survey and associated archaeological assessment of the reported wreck site of *UB-31* (UKHO No. 13482). The wreck is believed to be that of a German submarine from World War I (WWI), and is recorded as being lost on 2<sup>nd</sup> May 1918.
- 1.1.2 The work was undertaken as part of the NHPP Heritage at Risk (HAR) Contract for archaeological services in relation to Marine Designation and consisted of a geophysical survey, diving survey and associated archaeological assessment of the wreck site.
- 1.1.3 The work was conducted in accordance with a written brief and agreed scope of work (EH 2013).
- 1.1.4 The geophysical data consisted of sidescan sonar and marine magnetometer data acquired by WA during July 2014 and the diving operation was undertaken between the 3<sup>rd</sup> and 7<sup>th</sup> August 2014.
- 1.1.5 The text of this report should be understood strictly as read and contains no implied meanings or judgements. Reporting of third party actions, statements and intentions is based upon the information available to WA at the time of drafting. Use of the phrase “It is reported that...” means that WA has received a report from a third party that appears to be credible but which cannot be confirmed as fact from the available evidence.

## **2 ASSESSMENT AIMS AND OBJECTIVES**

- 2.1.1 The overall aim of the project was to carry out an undesignated site assessment. This was broken down into the following primary and secondary objectives (EH 2014):

### **Primary Objectives**

- Contact the Receiver of Wreck to gain a list of droits relating to the site;
- Obtain documentary evidence of the *UB-31*;
- Undertake geophysical survey (side-scan & magnetometer only) to assess the presence/absence of heritage assets, and to establish extent, stability and character;
- Undertake a diver survey of the exposed remains. Confirm position, extent, stability and character (plotted by tracked diver survey) of the site;
- Locate and accurately position (plotted by tracked diver survey and probing as appropriate) any additional archaeological material;
- Produce a structured record of field observations; preferably including a photographic record of the site and a basic site plan. Key artefacts are to be subject

to detailed examination and recording (position by tracked diver survey, taped measurements, photographs and video and written database entries);

### Secondary Objectives

- Supplement the recording of the core of the site by recording profiles across the main axis of the site;
- Establish links with local divers, dive groups and skippers to enable future site management options.

2.1.2 The objective of geophysical survey were as follows:

- To acquire and interpret high resolution marine geophysical data suitable for archaeological interpretation of the survey area;
- To assess the current condition of the possible wreck of *UB-31*, and identify any surrounding material of possible archaeological potential in order to inform possible further studies;
- To identify whether a wreck, or any other significant structure, is located at the position of UKHO 13486;
- To cross-reference the results of the geophysical survey with any documentary evidence and information from any previous surveys at the site;
- To inform the archaeological dive investigation of the site scheduled to follow the geophysical investigation.

2.1.3 The level of site investigation required by English Heritage was defined using WA's proprietary Level of Recording system. A Level 3a approach was requested (diagnostic).

## 3 METHODOLOGY

### 3.1 General

3.1.1 All fieldwork procedures and standards complied with the relevant guidance produced by the Institute for Archaeologists (IfA).

### 3.2 Stage 1: Geophysical Survey

3.2.1 The geophysical data consisted of sidescan sonar and marine magnetometer data acquired by WA during July 2014 using the survey vessel *MV Assassin*. The data were acquired by WA as part of a survey program which also included the acquisition of geophysical data at the site of the wreck of the submarine *HMS B2*, located off Dover (WA report ref. 83803.32).

3.2.2 A survey area was based on two 200 x 200m boxes centred on each location, then orientated NNW - SSE and joined together (see **Figure 1**). The main survey lines were orientated NE-SW into the tide to aid with any equipment positioning problems due to the strong currents present within the Area. Cross lines were orientated NW-SE (**Fig 1-2**).

#### Geophysical Data – Technical Specifications

3.2.3 The sidescan sonar data were acquired using a Klein 3900 system. The system was operated at 445kHz with a range of 40m per channel. An initial line spacing of 30m was used, with additional lines run if necessary to provide full data coverage. Towfish positioning information was provided by manual layback during processing. Data was recorded digitally using SonarPro software as *.xtf* files.



- 3.2.4 The marine magnetometer data were acquired using a Geometrics G-882 Caesium Vapour magnetometer operating at a frequency of 10Hz, towed directly behind the sidescan sonar fish on a 10m cable. The data was digitally logged in Geometrics MagLog Lite software as .GEOMAG files, and later converted to .txt files for processing and interpretation.
- 3.2.5 Positioning for the survey was provided by a Hemisphere R131 dGPS Receiver system, with the navigation data recorded using HyPack navigation software. All positions for the survey were recorded and expressed as WGS84 UTM31N.

#### **Geophysical Data - Data Quality**

- 3.2.6 The geophysical data were collected by WA on board the survey vessel MV *Assassin* on the 27<sup>th</sup> July 2014. The survey involved the acquisition of sidescan sonar and marine magnetometer data. The data were acquired as part of a survey program which also included the acquisition of geophysical data at the site of the wreck of the submarine HMS *B2*, located off Dover (WA report 83803.32).
- 3.2.7 The geophysical data used for this report were assessed for quality and their suitability for archaeological purposes, and rated using the following criteria:

<b>Data Quality</b>	<b>Description</b>
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.

**Table 2: Criteria for assigning data quality rating**

- 3.2.8 The sidescan sonar data have been rated as “Average” using the above criteria. Some snatching due to tidal currents and weather are visible within the data, but does not detrimentally affect the data to a large degree. The positioning accuracy of the sonar towfish was relatively poor due to a combination of strong tidal currents experienced during the survey and the length of towed cable used (itself a function of water depth and current strength). Positioning errors were rectified during data processing.
- 3.2.9 The marine magnetometer data have been rated as “Good” using the above criteria. The data were clear with very little spiking or background noise, however, some of the positioning uncertainties affecting the sidescan sonar also applied to the marine magnetometer. Again, these were rectified during processing.

#### **Geophysical Data – Processing**

- 3.2.10 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 interpreted for any objects of possible anthropogenic origin. This involves creating a database of anomalies within Coda by tagging individual features



of possible archaeological potential, recording their positions and dimensions, and acquiring an image of each anomaly for future reference.

- 3.2.11 A mosaic of the sidescan sonar data is produced during this process to assess the quality of the sonar towfish positioning. The survey lines are smoothed, and the navigation corrected by applying individual fixed laybacks as recorded during the survey. This allows the position of anomalies to be checked between different survey lines and for the layback values to be further refined if necessary.
- 3.2.12 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.
- 3.2.13 The magnetometer data were processed using Geometrics MagPick software in order to identify any discrete magnetic contacts which could represent buried metallic debris or structures. The software enables both the visualisation of individual lines of data and gridding of data to produce a magnetic anomaly map.
- 3.2.14 The data were loaded into MagPick and laybacks added as with the sidescan sonar data. The data were then smoothed, a trend fitted to the results, and then the trend values subtracted from the smoothed values. This was carried out in an attempt to remove natural variations in the data (such as diurnal variation in magnetic field strength and changes in geology). The processed data were then gridded to produce a map of magnetic anomalies, and individual anomalies tagged and images taken in a similar process to that undertaken for the sidescan sonar data.
- 3.2.15 The form and size of a magnetic anomaly is a guide to its potential to be an anthropogenic feature. Generally single magnetic amplitudes of over 5nT identified along a short distance are interpreted to be of anthropogenic origin.

**Geophysical Data – Anomaly Grouping and Discrimination**

- 3.2.16 The previous section describes the initial interpretation of all available geophysical data sets. 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 around the wreck sites.
- 3.2.17 To address this fact, the anomalies were grouped together, allowing one ID number to be assigned to a single object for which there may be, for example, a magnetic response and multiple sidescan sonar anomalies.
- 3.2.18 Once all the geophysical anomalies 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:

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

**Table 3: Criteria for discriminating archaeological importance of features**

- 3.2.19 All the anomalies that have been identified from around the wreck sites are presented in **Appendix I** and discussed in this report.
- 3.2.20 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 for further evaluation should more information become available.

### **3.3 Stage 2: Diving Survey**

- 3.3.1 The WA's Surface Supplied Dive (SSD) team was deployed from *Assassin*, a 30 ton/13m MCA coded workboat, operating out of Dover Harbour. A two point anchor system was used to position the vessel on site. The US Navy Standard Air Decompression Tables (Rev. 6) and associated diving procedures were used.
- 3.3.2 All diving operations complied with the Diving at Work Regulations 1997 and the associated Scientific and Archaeological Approved Code of Practice (ACOP). Diving operations were conducted during daylight hours only, on a single shift system by a four person team.
- 3.3.3 The survey methods employed on site consisted of general and close visual inspection with integrated on-site recording, acoustic tracking and video survey. The video system consisted of a hat mounted single chip Colourwatch Digital Inspection Camera recording onto MiniDV tape. Ambient light levels were low and therefore a helmet mounted light and two LED torches were used.
- 3.3.4 After the survey the video data were digitised and all observations were compared with the plans for identification of the significant features and evaluation of the condition and processes affecting the wreck.
- 3.3.5 Diver and surface descriptions and measurements of archaeological features, operational actions and environmental features were recorded in real time using a proprietary MS Access Database called 'DIVA', linked to ArcGIS 9.3 using a system of 'observation points' to record survey work.
- 3.3.6 The SSS tiled image produced during Stage 1 was used as a background map for the diver tracking display to navigate the diver around the site. Positions for all environmental and archaeological features and dive events recorded during the survey and navigational information for the divers were generated using USBL acoustic positioning system (internal instruments) and Hemisphere R101 dGPS system, linked to the DIVA database. The positional data recorded has been used to improve the positioning of the SSS mosaic and provide an accurate averaged site position.
- 3.3.7 All archaeological material located was recorded using video, together with selected measurements. Positions were to be recorded using either a USBL system or a GPS buoy and/or by distance and bearing to a shot position.

#### **Existing data**

- 3.3.8 The Deutsches U-boot Museum in Germany had been contacted before the operation and plans and photographs relating to the submarine had been obtained in order to inform the survey.

3.3.9 Other sources used to inform the investigation prior the diving survey included:

- UKHO record
- NRHE monument report
- Historical photographs
- Dive guides and other secondary sources

**4 RESULTS**

**4.1 Summary of Progress against Objectives**

<b>Primary Objectives</b>	<b>Progress</b>
Contact the Receiver of Wreck to gain a list of droits relating to the site.	Contacted by email on 18 <sup>th</sup> November 2014. No reply received at the time of writing.
Undertake a diver survey of the site.	Partly achieved, a visual inspection was carried out on the conning tower, gun mount, the area fore of the conning tower, part of the portside and stern of the submarine.
Locate any additional material.	Partly achieved. Geophysical survey identified five anomalies of anthropogenic origin of archaeological interest and 15 of uncertain origin of possible archaeological interest. Of these anomalies <b>7012</b> and <b>7014</b> were located through diver tracking and positively identified. Priority was given to ascertain the nature of the anomalies of anthropogenic origin close to the site.
Produce a structured record of field observations	Achieved.
Review the site against the non-statutory criteria for scheduling under the Ancient Monuments and Archaeological Areas Act 1979.	Achieved.
<b>Secondary Objectives</b>	<b>Progress</b>
Assess the likely depth of deposit	Partly Achieved. Although no complete mud-line survey was carried out the diving inspection ascertained that the submarine is almost completely exposed with the bilge lying on a deposit of gravelly sand and silt.
Record profiles across the site	Not achieved due to lack of survey time.
Record pH values at seabed level	Achieved.

**Table 4: Summary of Progress Against Objectives**

## 4.2 Seabed Features Assessment

4.2.1 A total of 97 sidescan sonar and 13 magnetic anomalies were identified within the geophysical data. Following the grouping and discrimination procedure outlined in **Section 3.2**, these were grouped to produce a list of 21 sites of potential archaeological interest within the Study Area which were characterised as follows:

Archaeological Discrimination	Number of Anomalies	Interpretation
A1	5	Anthropogenic origin of archaeological interest
A2	15	Uncertain origin of possible archaeological interest
A3	1	Historic record of possible archaeological interest with no corresponding geophysical anomaly
<b>Total</b>	<b>21</b>	

**Table 5: Sites of potential archaeological interest within the Study Area**

- 4.2.2 Wreck *UB-31* is located in approximately 20m depth of water and has been identified approximately 15m NNW of the UKHO recorded location (assuming the interpreted conning tower as the surveyed position). Subsequent diver survey has indicated that the bow is located to the north. The main body of the wreck (**7013**) appears relatively intact and upright, and has been found orientated approximately NNW-SSE and measuring approximately 40.7 x 8.6 x 4.6m (**Fig 2-3**). A large shadow in the centre suggests the conning tower is intact and in place. However, the forward starboard side of the wreck appears damaged, with a significant bend (or possible hole) in the hull being easily visible in the data (**Fig 4 - Sheet**). This again has been confirmed as significant damage to the hull by diver survey. The wreck is associated with a very large (13,161nT) magnetic anomaly.
- 4.2.3 This damage to the hull has been previously recorded at the site, and is consistent with the report of the vessel being sunk after detonating a mine or being depth charged (English Heritage 2012) by surface vessels.
- 4.2.4 A distinct scour has been identified extending ENE from the eastern side of the wreck (**Fig 3**), presumably along the dominant tide direction of the area. A possible small scour is visible on the opposite side, though this is less certain. The seabed sediment is reported by BGS as being less than 1m thick and comprising gravelly sand, which is reinforced by the current observations (BGS 1990). Only occasional small, localised accumulations of sediment were identified, suggesting the wreck is always exposed and is unlikely to become buried.
- 4.2.5 Since the wreck structure appears generally intact, relatively little debris has been identified within the vicinity. A small debris field (**7012**) has been identified around the bow and continuing approximately halfway down the port side, which appears to contain a relatively small number of small, scattered pieces of debris. An individual, rounded dark reflector with a large shadow, measuring approximately 2.3 x 1.1 x 0.3m (**7016**), has been identified approximately 15m SSE of the stern and is interpreted as a separate piece of debris. A third distinct piece of debris, located within the scour on the eastern side of the wreck, has also been identified (**7014**). This is a short, linear dark reflector with large acoustic shadow at one end and is very likely associated with a possible admiralty pattern anchor located by the divers (**Plate 4**). Its association with *UB-31* and date of deposition is unclear although it is possible that the anchor was used for either buoying the wreck or mooring a boat over the site.

- 4.2.6 Moving away from the immediate vicinity of the main structure of *UB-31*, a small number of other anomalies have been identified. Five further pieces of possible debris (**7007**, **7008**, **7010**, **7015** and **7017**) have been interpreted from within 100m of the wreck. These are irregular dark reflectors with acoustic shadows, though only one (**7010**) has been associated with a magnetic anomaly. However it is likely that the large magnetic anomaly associated with the wreck itself has masked smaller anomalies from individual features within the vicinity.
- 4.2.7 Anomaly **7006** is a large, curvilinear dark reflector trending approximately NW-SE with a larger anomaly at the south-eastern end (the position given is for this larger anomaly). This is interpreted as a length of rope or chain, possibly with an attached anchor, and is of unknown date.
- 4.2.8 Anomalies **7009**, **7011** and **7019** are all interpreted as dark reflectors, and are individual features without associated magnetic anomalies that are uncertain in nature. These could either be small pieces of debris, or natural features such as boulders. Anomaly **7018** is a magnetic anomaly of 34nT in amplitude identified without any associated sidescan sonar contact. This is possibly a piece of buried ferrous debris, though the interpreted thin sediment cover indicates any object is unlikely to be substantial.
- 4.2.9 Analysis of the data at the given location of UKHO 13486 (**7020**) has indicated that no wreck or other structure is situated at this position. The magnetometer data returned no significant anomalies, and the thin sediment cover suggests it is unlikely that a structure is fully buried.
- 4.2.10 A few scattered anomalies were identified within the wider vicinity of the provided location. Anomalies **7003** and **7004** are interpreted as being possible small pieces of debris, though the lack of any associated magnetic anomalies suggests any debris at these locations is non-ferrous in nature. Anomalies **7001**, **7002** and **7005** have been classed as dark reflectors which, as described above, are individual features without associated magnetic anomalies that are uncertain in nature, and could either be small pieces of debris, or natural features such as boulders.
- 4.2.11 Of greater potential interest is anomaly **7000**, identified approximately 65m NNW of the recorded location of UKHO 13486, interpreted as a possible debris field. This feature is characterised by three short, linear, parallel bright reflectors within a small area of possible disturbed seabed sediment (**Fig 4**). This could be three parallel pieces of non-ferrous debris, such as wood, and as such could represent the remains of a degraded structure. However, it could also be an isolated natural accumulation of seabed sediment.
- 4.2.12 Despite the presence of **7000** relatively close to UKHO 13486, the identified anomaly and description within the record do not match. The record for UKHO 13486 suggests the height of the feature is “possibly as much as 6.3m”, which is very different to the dimensions of **7000**. It is, however, closer to the height of *UB-31*, suggesting it could be a poorly positioned record for this wreck. However, it could also represent a wreck located beyond the boundaries of the acquired geophysical data.

### 4.3 Data Audit

- 4.3.1 The NRHE records for monuments no.: 1490040, 901777 and 901790 were accessed through Pastcape in August 2014.
- 4.3.2 The record 901790 was formerly attributed to *UB-31* and it is now thought to be *UB-109*, also lost in the Folkestone-Gris Nez minefield. The record was discarded as a possible

candidate for *UB-31* as in September 2014 Wessex Archaeology investigated the remains at the position indicated for 901790 and confirmed its identification with an UB III type U-boat, possibly *UB-109* (WA report ref 83803.34).

- 4.3.3 The location for the possible remains *UB-31* in the UKHO record (wreck no 13482) and NRHE record (monument no. 901777) were confirmed as being the location of the remains of a UB II type boat. The records also mention that the wreck was dived in 1985 and it was observed lying with a list to port, mostly intact but with a large hole in the hull forward of the gun. In 1996 the wreck is reported by the UKHO as 4.5m high, 38m long and 30 m wide (sonar dimensions) and oriented at 90/270 degrees. These observations were confirmed by WA's survey 2014 survey.
- 4.3.4 NRHE record no. 1490040 reports the account of the loss and reiterates the previously published caveat that that *UB-31*'s loss may be interchangeable with *UC-78*'s because they disappeared on the same day in the same area one being attacked by drifters at 51° 01' N 001° 16' W and the other lost near on the south side of Le Colbart bank.
- 4.3.5 It was suggested In 1978 that the UKHO record no. 13686, in the proximity of UKHO wreck no. 13486, could represent the remains of a probable wreck buried in sand. The record is chartered as foul ground.
- 4.3.6 As with many of the U-boats wrecks of the Dover Straits, a team of divers led by the Royal Navy diver Lt. Cdr. Guybon Chesney Castell Damant C.B.E. dived the wreck. The date of the salvage operation is not clear. According to submarine historian Robert Grant (Grant 2003: 73) it took place on 15<sup>th</sup> July 1918 whilst the divers were searching for another U-boat that supposedly sunk five days earlier. It was reported that "a submarine was found, extensively damaged aft, with weed and marine growth on her, evidently a very recent case. She was only located at the end of slack water, so time did not admit of a detailed examination being made". Grant states that location and circumstances suggest that the remains were those of *UB-31*. It must be noted that the wrecksite investigated by WA (UKHO 13482) is damaged fore to the conning tower and not aft as described above it is possible that the submarine dived by the RN divers was a different one. It is also possible that Grant made a mistake as submarine experts McCartney, Young and also Grant himself, in another book, date Damant's operation on *UB-31* to August 1918 (McCartney 2002, Young 2006, Grant 2002: 95).
- 4.3.7 For McCartney the evidence produced by the RN divers proves that the wreck located off Folkestone was a UB type submarine and for Young the RN divers confirmed the identity of *UB-31* in 1918 (Young 2006: 299; NARA: T-1022, Roll 56, PG 61780). It is unclear whether the identification occurred at the time of the discovery or at a later stage. McCartney states that the wreck (UKHO 13482) was identified by the number stamped on both her propellers (McCartney 2002) and Grant (Grant 2003) mentions McCartney's reports that the wreck was not identified by the markings on the propellers until recently.
- 4.3.8 While German archives have not been directly accessed for this research, credible summaries of this information have been accessed through the publication *Verschollen* (Messimer 2002) and through the Deutsches U-boot Museum. The Deutsches U-Boat Museum provided copies of their archive relating to *UB-31* which consisted of: plans of U-Boat Type UB II series 30-41; an assortment of records relating to *UB-31*; excerpts of a document about the construction of submarines in German shipyards; a casualty list; and a photo of *UB-31*. While most of the text was in German, WA's Jens Neuberger, a native German speaking WA staff member, provided translations of relevant archives.

#### 4.4 Site position

- 4.4.1 The possible wreck site of *UB-31* (UKHO 13482) is located in the English Channel, approximately 5.2km SSW of Folkestone harbour, Kent. The location of the conning tower is used here as the position of the wreck. The positions were provided to WA as Latitude and Longitude co-ordinates, and then projected by WA to UTM Zone 31N:

<i>UB-31</i> CO-ORDINATES WGS 84			
UTM z31N		DDM	
<b>Easting</b>	371708	<b>Lat.</b>	51°02'.066 N
<b>Northing</b>	5655247	<b>Long.</b>	001°10'.216 E

**Table 1: Position of the Conning Tower**

The recorded historic position (McCartney 2002) for *UB-31* is 51° 01' N 01° 16' E.

- 4.4.2 A second possible wreck location (UKHO 13486), situated approximately 260m NNW of the *UB-31*, was also investigated as part of the same survey (**Fig 1**). This is recorded as 'foul ground', originally detected in 1977, although it is uncertain whether a wreck is present at the recorded location. The wreck location for UKHO 13486 is:

Site	Latitude (WGS 84)	Longitude (WGS 84)	Easting (UTM 31N)	Northing (UTM 31N)
UKHO 13486	51°02'.184 N	001°10'.098 E	371575	5655469

**Table 2: Wreck locations provided in WGS84 and projected to UTM Zone 31N**

#### 4.5 Operational Summary

- 4.5.1 A total of eight dives were undertaken between the 3<sup>rd</sup> and 7<sup>th</sup> of August 2014. The operation achieved a total of 208 minutes of bottom time at maximum depth of 28m (**Appendix II**). Due to the bad weather the diving was suspended on 6<sup>th</sup> of August 2014. Visibility was poor to average ranging from less than 1m to 2m.
- 4.5.2 The area searched was subject to general visual inspection, recorded using helmet mounted video camera and diver commentary, with positions provided by USBL tracking and recording in DIVA. Due to time limitations and the size of the search area, close visual inspection and measured survey was not possible.
- 4.5.3 The survey was carried out as follows:
- The wreck was located and subject to general visual inspection to establish its extent, character and survival. On average visibility was poor to average (c. less than 1 to 2 m) and particulate was present in the water column hindering the navigation of the diver and the capture of high quality still and video images. The quality of the video captured is assessed from poor to good, meaning that single features are generally recognisable but their relative position is not immediately evident from the video.
  - The limited operational time available due to slack water windows resulted in the prioritisation of the inspection to the areas of the conning tower, the stern, the area of damage fore of the conning tower and the gun mounting.



- Two anomalies of anthropogenic origin of archaeological interest were located and positively identified during the survey.
- The survey was non-intrusive and no finds were moved or recovered. Entry through the conning tower was not attempted.

4.5.4 PH sampling was taken on two different occasions, the first of these from the end of the gun muzzle. As this position was thought not to be representative of the overall structure of the wreck the sample was discarded and a second sample was taken from the portside aft quarter mudline. The PH tester used was a HI-98128 Pocket pHep4 Water Resistant pH Tester by Hanna Instruments.

#### **4.6 Seabed and Ecology**

4.6.1 Ecological assessment was not set as an objective and therefore no specific survey was carried out. However, limited comment can be made based upon general observations during diving, supplemented by available literature.

4.6.2 The seabed consists of sand and silt with shell. Possible exposures of bedrock were observed along with thin deposits of chalky cobbles with a thin veneer of slightly gravelly sand and silt with shell inclusions. A shallow sand wave has built up around the port side amidships, but this is scoured away next to the hull of the submarine.

4.6.3 The wreck is covered in a thin turf of marine growth, with anemones and soft corals in places. Large mature lobsters, schools of fish, and starfish and crabs were observed by the divers.

#### **4.7 Archaeological data**

4.7.1 The submarine is lying on its port side at an angle estimated to be approximately 45 degrees from vertical and is orientated approximately NNW (bow) - SSE (stern) (**Fig 6**).

4.7.2 The deck and deck casing is missing from the entire area inspected, together with the casing between the deck and the saddle tank. The pressure hull appears to be largely intact. The starboard saddle tank survives, although the shell plating is missing from the deck gun forward and there are small holes elsewhere, which may be the result of damage and/or corrosion, but which may also be consistent with as-built openings.

4.7.3 Although it appears well preserved aft of the conning tower with the pressure hull still intact, the structure is severely damaged forward of the deck gun showing damage consistent with the kinetic effects of a mine or depth charges impacting the fore deck and disintegrating the pressure hull at the bow. The torpedo tubes, once contained within the hull, are now exposed.

4.7.4 For clarity the following paragraphs that outline the data gathered during the diving inspection are divided into six separate sections: bow, forward section, conning tower, aft section and stern.

##### **Bow**

4.7.5 At the bow forward of the deck gun the diving inspection found damage consistent with a large explosion that impacted the submarine.

4.7.6 As shown by the SSS image (**Fig 6**) the bow is slightly displaced, the plating is missing and the pressure hull damaged. On the starboard side just fore of the gun mount there is

the southern edge of the damaged area corresponding with a large cavity further forward with considerable amounts of debris and twisted metal (**Plate 1 – 1023**).

- 4.7.7 Forward of the deck gun the damage becomes more evident and the bow is broken off across the torpedo-room. Here the submarine has been ripped open and the upper pressure hull is missing down to the waterline level.
- 4.7.8 One of the torpedo tubes, possibly the upper one, survives within the remains of the torpedo room. Attached to the tube is a long shaft of smaller diameter covered by white anemones (**Plate 1 – 1013, 1031**). This shaft is interpreted as the connecting rod for opening the external torpedo hatch. The hinge that pivoted the hatch onto the rod end is still attached to the end of the rod (**Plate 1 – 1007**). As the external torpedo hatch seems to be closed the presence of a torpedo within the tube cannot positively be discounted (**Plate 1 – 1006**).
- 4.7.9 Lying alongside the torpedo tube, on the portside, some geared machinery with two small pillars and a drum is consistent with a windlass/winch mechanism that was located immediately above the torpedo tubes below the outer deck, as shown in the plans for the UB 30-31 series (**Plate 1 – 1030, 1029**).

#### **Forward section**

- 4.7.10 Forward of the conning tower is a deck gun roughly consistent in size with the 88mm shown on the type's plans (**Plate 1 – 1008,1034,1036**). It is intact on its mount, which consists of a two part bolted pedestal attached to the pressure hull, with knee stiffeners. The gun is trained forward and the barrel is approximately +30 degrees from horizontal. The type of gun is consistent with the UB 30-41 series plan.
- 4.7.11 As stated previously, forward of the gun signs of severe damage that compromise the pressure hull are visible and are consistent with an explosion. The torpedo loading hatch was not located and considering that the area forward the gun deck is severely damaged it is possible that it had been displaced at the time of the sinking. However, the hinge of the crew deck hatch just above the torpedo loading hatch is visible in the diver's footage and appears to be closed (**Plate 1 – 1037**).
- 4.7.12 On the centreline immediately forward of the conning tower and conceivably attached to it is a complex feature that may be the remains of a possible communications tube from the sail deck to the control room helm shown on the type's plans. It is plausible that this feature also contains part of a aiming mechanism for the deck gun (**Plate 2 – 1016, 1018**).
- 4.7.13 On the portside, immediately fore to the conning tower, fixed onto the pressure hull is a compressed air cylinder and various pipework found nearby is believed to be associated with it.

#### **Conning Tower**

- 4.7.14 The conning tower of the submarine survives attached to the pressure hull. On top the upper hatch is closed (**Plate 2 – 1003, 1004**). Slots for stanchions or railings are visible around the hatch (**Plate 2 – 1034, 1027**).
- 4.7.15 The tube of the conning tower's forward periscope survives to full height and the periscope shaft is within, although it appears to have snapped off at the lip of the tube (**Plate 2, 1001, 1017**). The periscope tube appears to be tightly bolted to the top of the conning tower.

- 4.7.16 Immediately aft of the conning tower is the control room periscope tube and shaft, which is mounted to deck level and survives to about half the height of the conning tower (**Plate 2 – 1005, 1015**). The periscope appears to be retracted although the possibility that has been broken off cannot be entirely discounted. The outer cladding and deck plating from the conning tower has all fallen away and no trace of the binnacle and steering mechanism was found.
- 4.7.17 Around the base of the conning tower is displaced pipe work from the air tanks housed within the deck casing, together with what may be the remains of deck stanchions and rails and/or control linkages.
- 4.7.18 The forward pointing recesses for the port and starboard bridge navigation lights survive, together with deadlight slots aft. These were not closely examined. No trace of either the fuel or air inlet masts or their fittings were found aft of the tower

### Aft Section

- 4.7.19 Aft of the conning tower the pressure hull of the engine room retains its shape and it is substantially intact but for small holes which either may be consistent with as-built openings or be the result of corrosion. The pressure hull is fairly complete although the diver reported the hull aft of the conning tower as being very fragile and crumbled upon touch during examination. From the base conning tower to the stern the pressure hull measures c. 16 m.
- 4.7.20 The starboard side also appears largely complete with the saddle tank still attached. On top of the curved plating a series of regularly spaced openings are interpretable as flooding vents on the outer casing.
- 4.7.21 Aft of the conning tower is the cylindrical engine room hatch with a two hinge lid opening forward. The hatch is shut and could not be moved (**Plate 3 – 1021**). Immediately to port is a displaced air cylinder (**Plate 3 – 1019**). There is various pipe work and possible stanchions/rails/control rods for the air cylinders and pipe valves, including an *in-situ* flanged pipe with a 90 degree bend that seems to pass through the pressure hull between the engine room hatch and the control room periscope (**Plate 3 – 1022**). The feature is consistent with the type's plan and it is possibly associated with the air or emergency flooding system of the engine room. A loose object resembling a double pipe valve was lying on the pressure hull forward of the hatch.
- 4.7.22 On the pressure hull at the centreline toward the stern, remains of the exhaust system of the two 142ps Benz diesel engines can be found. They consist of pipework of c. 120mm diameter attached to a large cylinder with one flat face whilst the other appears to be flanged to a conical tube. The exhaust piping and terminal are covered by white anemones (**Plate 3 – 1024, 1025, 1026**).

### Stern

- 4.7.23 The inspection of the stern revealed it to be largely complete and well exposed with the aft hydroplanes *in situ* and in diving position at a 45 degree angle (**Plate 3 - 1032, 1033**). It is unclear if the position of the hydroplanes is the position selected at the time the boat sunk or due to disturbances post-deposition. The port hydroplane is partially buried and modern debris such as a rope was found nearby. No other debris was found further to the south.
- 4.7.24 The plating of the rudder itself is gone and the shape of the rudder is indicated only by three horizontal braces that are still in place and pivoting on the rudder post. The rudder post appears to be good condition and the upper pintle that attached the rudder block onto the stern was observed (**Plate 3 – 1012**).

- 4.7.25 The two bronze propellers were not found and the stub of the shaft of the starboard propeller suggests that they are likely to have been salvaged (**Plate 3 – 1010, 1011**). The lateral fin that protected the propeller is damaged. The survey for locating the portside propeller was inconclusive due to lack of visibility during the dive but it is very likely that it had been salvaged as well.
- 4.7.26 An anchor was found E of the wreck. The extant shank measures *c.* 1m and from the video footage it seems to have a rounded section; the exposed curved arm is estimated *c.* 700mm long. The remaining arm is buried in the seabed and no stock was found attached to the shank although it is unclear whether the shank is surviving on its entirety or it is damaged. The anchor was not positively identified although the fluke is similar to an Admiralty Pattern anchor fluke (**Plate 4**). It is very likely that the anchor corresponds to the anomaly **7014** as their positions coincide.

## 4.8 PH Sampling

- 4.8.1 A pH sample considered to be representative of the site was acquired at end of dive from the port side of wreck. The diver was diving in slack water during neap tides between 16:08 and 16:30 on 5<sup>th</sup> August 2014. The sample tested as pH 7.76.

## 5 DISCUSSION

### 5.1 Type and Size of Site

- 5.1.1 The submarine appears to be in generally good condition although the structure is damaged and dispersed forward of the gun mount where a large void in the pressure hull at the level of the waterline attests to the events that led to its sinking. Aft of the damaged area the submarine is fairly intact with the conning tower still attached to the pressure hull. The hull is upstanding a minimum of *c.* 2 m. from the seabed and the stern is exposed. The overall structure lists *c.* 45 degrees to port but the damaged bow appears to be slightly further twisted to port and it is not clear to what extent due to the damage to this section. The pressure hull at the bow is open and the torpedo room exposed showing the upper torpedo tube with deck machinery and other fittings that are fallen amongst debris to the portside.
- 5.1.2 From the conning tower to the stern the wreck is *c.* 16 m long with no apparent significant damage or interruption and the lateral side tanks are still attached to the main body. The pressure hull is largely intact but with some holes which may be the result of damage and/or corrosion or which may be consistent with as-built openings. Most of the plating has been lost forward of the conning tower whilst in some places it is still *in situ* aft. The deck casing is gone and some of the fixtures once under it are now visible and exposed. The casing between the deck and the saddle tank is also missing but the starboard saddle tank survives.
- 5.1.3 The gun is well preserved and still stands on the central column reinforcement mount. Other than short pieces of rope attached to the gun shaft and some others loose on the seabed the wreck is clear of nets and is exposed.
- 5.1.4 There is extensive concretion of the wreck. Some evidence was seen of enlargement of openings in the plating as a result of corrosion. No recent damage or active corrosion product was seen, although no close inspection was carried out for that purpose.
- 5.1.5 The port side at the mud line was not inspected due to time limitations, although an inspection from the stern to the starboard quarter established that the submarine is exposed above the level of the bilge.

5.1.6 The features observed during the dive inspection are generally related to a First World War submarine and specifically consistent with type plans relevant to UBII type series 30-41.

## 5.2 Identification

5.2.1 The wreck site was identified from historical sources as an UB type boat (Grant 2002) and very likely to be *UB-31*.

5.2.2 Wessex Archaeology believes that the material evidence recorded during the survey supports this identification. The general arrangement of the submarine's features and dimensions closely match those illustrated in the original plans for the UB II type series 30-41.

5.2.3 Moreover, secondary sources report that the wreck was conclusively identified by the markings on the propellers but WA could find no material evidence to positively confirm this identification, although the diving investigation ascertained that at least one of propellers had been salvaged.

5.2.4 Although not conclusive, the identification of the remains of the UB II type boat believed to be *UB-31*, is supported by circumstantial evidence, including:

- The wreck's relative proximity to the recorded historical location for the underwater explosion observed during the U-boat hunt on 2nd May 1918.
- The damage found on the hull that it is consistent with a mine/depth charge explosion, as reported by the RN drifter *Ocean Roamer*.
- The wreck corresponds to a UB II type submarine and the features are consistent with the 30-41 series build.
- *UB-31* left Zeebrugge on April 1918 and was operating in the Channel when the explosion occurred.

5.2.5 Whether the submarine dived by Cmdr. Damant's Naval Diving Team in August 1918 proved that the wreck located off Folkestone is *UB-31* is unclear. The RN diver report mentioned by Grant suggests that the damage is located aft rather than towards the bows, as the archaeological survey ascertained, and therefore cannot be considered a very reliable source in this instance (Grant 2003: 73; ADM137/2100). Nonetheless Grant (2002: 95) appears to be very confident when he writes: "Later in August, it would appear, a tenth wreck was found, for Keyes stated that in the area off Folkestone where a U-boat was depth charged and probably mined on May 2, divers found a wreck of a UB-boat. Though it was not identified, the submarine was undoubtedly *UB-31*".

5.2.6 Although there are many U-boats wrecks in the Dover Straits, only four UB II type U-boats are believed to have been lost in the Folkestone-Gris Nez minefield area (Messimer 2002). These are *UB-31*, *UB-33*, *UB-38* and *UB-39*.

5.2.7 *UB-33* sailed from Zeebrugge in April 1918 and was operating in the Channel so it could have been involved in that explosion of the 2<sup>nd</sup> May 1918 if it were not for the fact that it was positively identified in another position by a RN dive team that salvaged important documents and recovered the commander's body from the conning tower (Messimer 2002).

- 5.2.8 *UB-38* departed from Zeebrugge on 29<sup>th</sup> January 1918, exchanged recognition signal with *UB-33* on 8<sup>th</sup> February at 12:30 and disappeared. It is connected with a triple explosion on 8<sup>th</sup> February 1918 heard at 22:45 near the north end of Le Colbart. Although the presence of submarine remains at the location was confirmed by RN diver on 14<sup>th</sup> July the wreck remained unidentified (Grant 2003: 73) until submariners picked up from other U-boats gave the *UB-38*'s name during interrogations. The presence of a submarine at this location is also confirmed by local divers (McCartney 2002).
- 5.2.9 The fate of *UB-39* is unclear (although some sources suggest it was lost east of the Sandettié Bank (uboa.net)), but it left Zeebrugge in May 1917 and it cannot be associated with the explosion of 2<sup>nd</sup> of May 1918. Messimer (2002) and McCartney (2002) suggest that *UB-12* reported an underwater explosion in the Folkestone-Gris Nez barrage near the 'no. 3 buoy' and the researchers associate it with *UB-39* possibly hitting a mine.
- 5.2.10 There are two more UB II class submarines that possibly sunk in the Dover area: *UB-32* and *UB-29*. Although the locations of the remains are still unknown, both could not be crossing the Dover barrage on May 2<sup>nd</sup> 1918 since they were lost before 1918. *UB-32* is believed to either have been depth charged in the English Channel or bombed east of the Dover Straits in 1917. *UB-29* left Zeebrugge for operations in the English Channel and was recorded as lost in December 1916 possibly destroyed as she negotiated the Dover barrage.
- 5.2.11 Two U-boats sunk on the 2<sup>nd</sup> May 1918 on the Folkestone-Griz Nez barrage and are believed to be *UB-31* and *UC-78*. *UC-78* was lost the same day on the other side of Le Colbart Bank and was a UC (minelayer) boat rather than UB boat.

### 5.3 Overall Characterisation

- 5.3.1 The overall character of the exposed material on the seabed can be summarised as follows, using the Build/Use/Loss/Survival/Investigation (BULSI) method of 'shipwreck biography'.

Build	<p>The <i>UB-31</i> was a UB II coastal torpedo attack boat built by Blohm and Voss, Hamburg for the <i>Kaiserliche Deutsche Marine</i> (German Imperial Navy), during the First World War. Ordered on 22<sup>nd</sup> July 1915 as part of batch UB 30-41, the boat was laid down at Yard No. 255 and launched on 16<sup>th</sup> November 1915 (Young 2006: 293; uboa.net website).</p> <p>The UB II class was designed to be significantly larger than UB I (c. 270 tons surface displacement) with saddle tanks attached to the sides of the pressure hull that allowed greater fuel storage area, two-shaft propulsion and increased armament, by using 50cm G torpedoes with four to six reloads and by fitting a 5cm or 8.8cm gun for surface use, they were intended to overcome the main disadvantages of UB I class. Also the torpedo tubes were fitted one above the other in order to provide better bow lines and a second periscope, manned from the central control room, a two-masted aerial and forward hydroplanes were fitted in order to correct other weakness of type UB I (Rössler 2001: 50). The improvements resulted in a more effective unit with greater surface speed and greatly increased surface range.</p> <p>Initially in 1915 only 12 boats were ordered: AG Weser could only build 6 boats (UB24-29) so the remaining six were given to Blohm &amp; Voss (UB18-23) which had never built submarines before. In July 1915 as it was clear that the war was going to continue and in 1916 more UBII type U-boat contracts were awarded to</p>
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Blohm & Voss (UB30-41) and then AG Weser (UB42-47).

The UB II type series showed some differences amongst groups and subgroups. The Blohm & Voss's UB II type U-boats diving time was longer than the AG Weser's ones, 45s compared to 30s, and the UB 24-29 series and UB 30-47 had one 88 mm deck gun in place of the 50mm deck gun. Other modifications were applied when necessary: *UB-21*, *UB-22*, *UB-27*, *UB-34*, *UB-35* and *UB-41* were retrospectively fitted for minelaying and rearward torpedo tubes (Batchelor 2006).

The UB II class had the following specifications (from secondary sources - Rössler 2001; Herzog 1990; Young 2006; uboat.net website). Where sources differ, both specifications have been given. The data audit did not indicate that evidence had been found to suggest that the design or fitting out of *UB-31* differed significantly from this standard specification:

Specification	Progress
Displacement, surfaced	274 tons
Displacement, submerged	303 tons
Length, overall	36.9 m (27.9 m pressure hull)
Beam	4.37 m (3.85 m pressure hull)
Draught	3.69 m
Height	7.34 m
Engines	2 x 270/284 hp Benz diesels
Electric motors	2 x 280 hp Siemens Schuckert Werke
Shafts/Propellers	2 / 2 x bronze
Fuel capacity	24 + 32 tons
Batteries	Type 20 MAS 820/5
Speed, surfaced	9.06 knots
Speed, submerged	5.71 knots
Range, Surfaced	8,150 nautical miles at 5 knots
Range, submerged	45 nautical miles at 4 knots
Armament	2 x bow 50cm torpedo tubes; 88 mm deck gun
Torpedoes carried	4-6 x 50 cm
Ammunition (Gun)	120 rounds
Diving	c. 50 m
Design complement	21 ( 2 officers)

Use

When it sank, *UB-31* was assigned to the *Unterseebootsflottille Flandern 2* that took orders from the Flanders command of *U-boats des Marinekorps* and operated off the east coast of Britain and in the Dover Straits, the English Channel and the Irish Sea.

Initially assigned to the Baltic *U-Flottille* at Libau under the command of Karl Vasper *UB-31* achieved no successes during the first patrols (March-August 1916) in the Baltic. Later in August 1916 Thomas Bieber assumed the command *UB-31* still did not sink any tonnage. The situation changed on 20<sup>th</sup> February 1917 when he was ordered to leave the Baltic for transfer to Flanders to join the *Flandern U-Flottille*. From the Flanders base of Zeebrügge *UB-31* sunk or damaged a total of 30 ships in 1917. These include the 12,358 ton ocean liner RMS *Medina* torpedoed off Start Point, Devon on 28<sup>th</sup> April 1917.

On February 1<sup>st</sup> Bieber was transferred to *UB-104* where he sunk c. 15,000 tons

of enemy shipping before his boat went missing. Oblt.z.S der Reserve Wilhelm Braun assumed command of *UB-31* from *UB-12* where he had achieved no combat victories. Braun was the last commander of *UB-31* and commended it for three patrols sinking three small ships and damaging one.

*UB-31* carried out a total of 25 patrols with 33 ships hit in the channel from the launch of the unrestricted U-boat offensive on 1<sup>st</sup> February 1917, of which 27 sunk (72,730 tons) and 7 ships damaged (34,284 tons) (from U-Boat Archiv).

*UB-31* departed Zeebrügge on 16 April 1918 for operations in the English Channel and never returned. It passed through the Dover Strait and sunk two small sailing boats on 23<sup>rd</sup> and 24<sup>th</sup> April.

The following list contains all the ships either sunk or damaged by *UB-31* (from Young 2006: 300):

Area	Vessel	Flag	Tons	Date	Location
North Sea	<i>Kittiwake</i>	GBR	1866	09/04/1917	25 miles NW Maas Light Vessel
English Channel	<i>Medina</i>	GBR	12358	28/05/1917	3 miles ENE Start Point
English Channel	<i>City of Corinth</i>	GBR	5870	21/05/1917	12 miles SW Lizard
English Channel	<i>Teesdale</i>	GBR	2470	15/06/1917	Damaged 2m off Bolt Head
English Channel	<i>Stanhope</i>	GBR	2828	17/06/1917	7 miles WSW of Start Point
English Channel	<i>Ocean Swell</i>	GBR	195	05/07/1917	15m SE of Start Point
English Channel	<i>Adriane Christine</i>	GBR	3550	06/07/1917	Damaged off Start Point
English Channel	<i>Bellucia</i>	GBR	4368	07/07/1917	2 miles SSE of the Lizard
English Channel	<i>Hildegard</i>	USA	622	10/07/1917	10 miles SE of Start Point
English Channel	<i>Brunhilda</i>	GBR	2296	11/07/1917	7 miles S of Start Point
English Channel	<i>Alcyone</i>	GBR	149	01/08/1917	45 miles NNW of Roches Downes
English Channel	<i>Laertes</i>	GBR	4541	01/08/1917	1¼ miles SSW of Prawle Point
English Channel	<i>Newlyn</i>	GBR	4019	02/08/1917	2 miles S of Prawle Point
English Channel	<i>Renee Marthe</i>	FRA	50	03/08/1917	Sunk W of Start Point
English Channel	<i>Algerie</i>	FRA	3386	08/08/1917	Damaged 2 miles SW of Portland Bill
English Channel	<i>Elizabeth</i>	GBR	49	08/09/1917	12 miles ESE of Start Point
English Channel	<i>Pluton</i>	NOR	1449	09/09/1917	Approx. 6 miles ESE of Start Point
English Channel	<i>Waikawa</i>	GBR	5666	19/10/1917	4 miles ENE of Start Point
English Channel	<i>Colorado</i>	GBR	7652	20/10/1917	1½ miles E of Start Point
English Channel	<i>Lepanto</i>	GBR	6389	23/10/1917	Damaged 3-4 miles off Dartmouth
English Channel	<i>Farn</i>	GBR	4393	19/11/1917	5 miles ENE of Start Point
English Channel	<i>Britannic</i>	GBR	92	13/12/1917	12 miles NNW of Les Hanois



Channel					lighthouse
English Channel	<i>Sachem</i>	GBR	5354	14/12/1917	Damaged off Start Point – reached Plymouth
English Channel	<i>Riversdale</i>	GBR	2805	18/12/1917	1 miles S of Prawle Point
English Channel	<i>Alicie Marie</i>	GBR	2210	20/12/1917	6 miles ENE of Start Point
English Channel	<i>Eveline</i>	GBR	2605	20/12/1917	9½ miles S ½ W of Berry Head
English Channel	<i>Warsaw</i>	GBR	608	20/12/1917	4 miles ESE of Start Point
English Channel	<i>Greatham</i>	GBR	2358	22/01/1918	3 miles SE of Dartmouth
English Channel	<i>Victor de Chavarry</i>	SPA	2958	22/01/1918	Sunk west section of Channel
English Channel	<i>Elsa</i>	NOR	3581	24/01/1918	5 miles ESE of Dartmouth Harbour
English Channel	<i>Heenvliet</i>	NLD	492	28/02/1918	15 miles SW of Swartebank Light Vessel
English Channel	<i>Boorara</i>	GBR	6570	20/03/1918	Damaged 2½ miles S 25 E of Beachy Head
English Channel	<i>Frances</i>	GBR	56	23/04/1918	6 miles S of the Lizard
English Channel	<i>Joseph</i>	FRA	42	25/04/1918	Sunk N of Cherbourg

It not ascertained whether the vessels *Victor de Chavarry* and *Algerie* were sunk by *UB-31* (U-boot archiv). The sinking of the steamer *Skaraas* of 992 tons on 23<sup>rd</sup> May 1918 is in some sources attributed to a torpedo launched by *UB-31* (Maw 1999: 31). WA believes this attribution not to be correct as the *UB-31*'s patrol was long due at the time of the sinking.

The following table contains the list of patrols carried out by *UB-31* (from U-boot Archiv):

No	Commander	Set sail	Operation	Return	Tons sunk
1	Vesper	20/05/1916	Baltic Sea	27/05/1916	
2	Vesper	18/06/1916	Baltic Sea	25/06/1916	
3	Vesper	29/06/1916	Baltic Sea	06/07/1916	
4	Bieber	11/09/1916	Baltic Sea	20/09/1916	
5	Bieber	30/09/1916	Baltic Sea	07/10/1916	
6	Bieber	14/10/1916	Baltic Sea	23/10/1916	
7	Bieber	02/11/1916	Baltic Sea	10/11/1916	
8	Bieber	20/02/1917	Baltic Sea, -Flanders	24/02/1917	
9	Bieber	01/03/1917	Antwerp	05/03/1917	
10	Bieber	12/03/1917	Schouwen Bank	18/03/1917	
11	Bieber	05/04/1917 Zeebrügge	North Sea, Hoofden	12/04/1917 Zeebrügge	1866
12	Bieber	15/04/1917 Zeebrügge	North Sea, Hoofden	18/04/1917 Zeebrügge	
13	Bieber	22/04/1917 Zeebrügge	English Channel, Western approaches	03/05/1917 Zeebrügge	12350
14	Bieber	14/05/1917 Zeebrügge	English Channel, Western part	25/05/1917 Zeebrügge	5870
15	Bieber	07/06/1917 Zeebrügge	English Channel, Western approaches	19/06/1917 Zeebrügge	2854
16	Bieber	02/07/1917 Zeebrügge	English Channel, Lizard	13/07/1917 Zeebrügge	7481
17	Bieber	28/07/1918 Zeebrügge	English Channel, Portland, Start Point	11/08/1917 Zeebrügge	8758
18	Bieber	30/08/1917 Zeebrügge	English Channel	12/09/1917 Zeebrügge	1498
19	Bieber	15/10/1917 Zeebrügge	English Channel, Start Point	25/10/1917 Zeebrügge	12831
20	Bieber	10/11/1917	English Channel, Start	21/11/1917	4393

		Zeebrügge	Point	Zeebrügge																																																							
21	Bieber	08/12/1917 Zeebrügge	English Channel and French Coast	22/12/1917 Zeebrügge	8320																																																						
22	Bieber	15/01/1918 Zeebrügge	English Channel, Western Part	27/01/1918 Zeebrügge	5919																																																						
23	Braun	24/02/1918 Zeebrügge	Hoofden, English West Coast, Orfordness	06/03/1918 Zeebrügge	492																																																						
24	Braun	18/03/1918 Ostende	English Channel, Isle of Wight	01/04/1918 Zeebrügge	/																																																						
25	Braun	16/04/1918 Zeebrügge	English Channel Western approaches	/	98																																																						
Loss	<p>During its third patrol under Braun's command <i>UB-31</i> went missing.</p> <p>At 8:05 am on 2<sup>nd</sup> May 1918 a U-boat, possibly <i>UB-31</i> returning from operations in the English Channel, was sighted by RN drifter <i>Lord Letrim</i> between the Varne and Folkestone. The presence of a German submarine was confirmed when, after laying a drop charge over the site, oil and air bubbles and debris were brought to the surface. The submarine then was then hunted down by the combined efforts of the armed drifter <i>Lord Letrim</i>, <i>Loyal Friend</i> and <i>Ocean Roamer</i>, guided by British airship SSZ29 and French airship VZ 2. The U-boat was forced to dive into a minefield and HM drifter <i>Ocean Roamer</i> dropped a depth charge, which in turn triggered a mine.</p> <p>The submarine never made its way back to Zeebrügge and it is assumed that the full complement of 26 submariners died.</p> <p>The presence of a UB type submarine close to the location of the explosion was confirmed by Cdr Damant's 'U boat Flying Squad' in the summer of 1918.</p> <p>The following submariners lost their life in UB31 (U-boot Archiv) and the site should be considered as their last resting place for commemorative purposes:</p> <table border="1"> <thead> <tr> <th>Name</th> <th>Grade</th> </tr> </thead> <tbody> <tr><td>Braun, Wilhelm</td><td>Kommandant Oberleutn.z.S.d.R</td></tr> <tr><td>Praß, Gerhard</td><td>Wachoffizier Leutnant z.S.d.R</td></tr> <tr><td>Beinder, A.</td><td>T.Ob.Heizer</td></tr> <tr><td>Becken,Hugo Decker</td><td>Masch.Mt.</td></tr> <tr><td>Fuls, Karl</td><td>Ob.Mtr.</td></tr> <tr><td>Göntgen, Hermann</td><td>Heizer</td></tr> <tr><td>Hoffman, Josef</td><td>Mtr.</td></tr> <tr><td>Hoppe, Rudolf Hopper</td><td>Mtr.</td></tr> <tr><td>Jacob, Johann</td><td>Ob.Masch.Mt.</td></tr> <tr><td>Kühne, Paul</td><td>Masch.</td></tr> <tr><td>Mahler, Hermann</td><td>Ob.Mtr.</td></tr> <tr><td>Matthes, Hermann</td><td>Ob.Mtr.</td></tr> <tr><td>Müller, Albert</td><td>Mtr.</td></tr> <tr><td>Müller, Karl</td><td>Masch.Mt.</td></tr> <tr><td>Olschory, Martin</td><td>F.T.Gast</td></tr> <tr><td>Rüßler, Hans</td><td>Heizer</td></tr> <tr><td>Schlor, Bruno</td><td>Ob.Btsm.Mt.</td></tr> <tr><td>Schminke, M.</td><td>F.T.Gast</td></tr> <tr><td>Schwentke, A.</td><td>Mtr.</td></tr> <tr><td>Ströbel, Friedrich</td><td>Ob.Btsm.Mt</td></tr> <tr><td>Thalman, F.</td><td>Ob.Mtr</td></tr> <tr><td>Weidermann, Fr.</td><td>Masch.Mt.</td></tr> <tr><td>Weiß, Johann</td><td>Btsm.Mt.</td></tr> <tr><td>Winkler, Otto</td><td>Masch.Mt.</td></tr> <tr><td>Wodrich,Alfred</td><td>Masch.Mt.</td></tr> <tr><td>Woest,Friedrich</td><td>Hrz.</td></tr> </tbody> </table>					Name	Grade	Braun, Wilhelm	Kommandant Oberleutn.z.S.d.R	Praß, Gerhard	Wachoffizier Leutnant z.S.d.R	Beinder, A.	T.Ob.Heizer	Becken,Hugo Decker	Masch.Mt.	Fuls, Karl	Ob.Mtr.	Göntgen, Hermann	Heizer	Hoffman, Josef	Mtr.	Hoppe, Rudolf Hopper	Mtr.	Jacob, Johann	Ob.Masch.Mt.	Kühne, Paul	Masch.	Mahler, Hermann	Ob.Mtr.	Matthes, Hermann	Ob.Mtr.	Müller, Albert	Mtr.	Müller, Karl	Masch.Mt.	Olschory, Martin	F.T.Gast	Rüßler, Hans	Heizer	Schlor, Bruno	Ob.Btsm.Mt.	Schminke, M.	F.T.Gast	Schwentke, A.	Mtr.	Ströbel, Friedrich	Ob.Btsm.Mt	Thalman, F.	Ob.Mtr	Weidermann, Fr.	Masch.Mt.	Weiß, Johann	Btsm.Mt.	Winkler, Otto	Masch.Mt.	Wodrich,Alfred	Masch.Mt.	Woest,Friedrich	Hrz.
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Survival	<p>The submarine lies on the seabed with a 45 degree list to portside.</p> <p>The deck and deck casing are missing from the entire area inspected, together with the casing between the deck and the saddle tank. The pressure hull appears to be largely intact. The starboard saddle tank survives, although the shell plating is missing from the deck gun forward and there are small holes elsewhere, which may be the result of damage and/or corrosion or which may be consistent with as-built openings.</p> <p>Although it appears well preserved aft of the conning tower with the pressure hull still intact, the structure is severely compromised forward of the deck gun showing damage consistent with a large explosion that impacted the fore deck and compromised the pressure hull at the bow. The torpedo tubes, once contained within the hull, are now exposed.</p>
Investigation	<p>WA investigation is the first archaeological survey undertaken, although the wreck off Folkestone was first dived by the RN diver team in the summer 1918 and identified as a UB type boat.</p> <p>The identification of the wreck as <i>UB-31</i> was put forward by Keyes (ref) and confirmed by Grant (Grant 2002 &amp; 2003) using historical sources. The wreck was possibly re-discovered by avocational divers in 1985 and it is now a well-known dive site of the Dover Strait. McCartney (2002) reports that the remains were identified from the markings on the propellers as <i>UB-31</i> although WA was not able to ascertain this claim as the propellers had been salvaged before the investigation took place.</p>

## 5.4 Circumstances of Loss

- 5.4.1 Considering that the damage found during the diving inspection is located in the torpedo room area it is possible that the second submerged explosion heard aboard the *Ocean Roamer*, historically interpreted as a mine triggered by the depth charge, was the result of secondary explosions from the submarine's torpedoes that were stored at the bows.
- 5.4.2 The Site lies within the proximity of Folkestone-Gris Nez minefield barrage. Set in December 1917, this formidable and effective defence was a long minefield laid across the Dover Strait from Folkestone to Cape Gris Nez in France and was aimed exclusively at interdicting enemy U-boats at the entrance to the Channel. It consisted of a deep belt of c. 3,500 mines laid in a ladder pattern at depths of 12, 18, 22 and 25 m. and antisubmarine nets. It was heavily patrolled and illuminated by flares and searchlights so that approaching U-boats were forced to dive and were very likely to hit the barrier.
- 5.4.3 Depth charges and mines were the principal anti-submarine weapons of the First World War but the mines were unreliable until the end of 1917, before the introduction of H2 mines, and depth charges were initially issued only in small numbers to selected vessels (Messimer 2002).

## 6 RISK ASSESSMENT

- 6.1.1 Site condition and 'risk status' has been assessed in line with Protected Wreck Sites at Risk: A Risk Management Handbook (EH 2008). The results are set out in **Appendix III**. This broadly considered: condition; vulnerability and trajectory.

## 7 ASSESSMENT AGAINST THE NON-STATUTORY CRITERIA FOR SCHEDULING

### 7.1 Assessment Scale

7.1.1 For each criterion, one of the following grades has been selected. This has been done in order to help assess the relative importance of the criteria as they apply to the site. The 'scoring' system is as follow:

- Uncertain – insufficient evidence to comment;
- Variable – the importance of the wreck may change, subject to the context in which is viewed;
- Moderately valuable – This category make the site more important than the average wreck site;
- Highly Valuable – this category gives the site a high degree of importance. A site that is designated is likely to have at least two criteria graded as highly valuable;
- Extremely Valuable – this category makes the site exceptionally important. The site could be designated on the grounds of this category alone.

### 7.2 Non-Statutory Criteria

7.2.1 The Site has been assessed against the non-statutory criteria for scheduling under the Ancient Monuments and Archaeological Areas Act (AMAAA) 1979. The wording of the criteria used has been derived from the relevant EH Designation Selection Guide (EH 2012: 9-10).

#### Period

7.2.2 *UB-31* was launched in November 1915 and sunk in May 1918 and it is one of 44 First World War German submarines sunk in English territorial waters (Cotswold Archaeology 2014).

7.2.3 The First World War saw the emergence of the submarine as a potentially decisive strategic weapon. In order to stay operationally effective, it had to evolve rapidly in terms of design and equipment. Nothing better epitomises this than the development of the various types of U-boat, of which the UB II represents the response to the new and increasing demands made on U-boats as the war progressed. Whilst there is nothing to suggest that *UB-31* is technologically exceptional as an individual vessel, it is a representative example of its type. In addition, the damage evident to the *UB-31* indirectly provides evidence of other maritime weapons that came of age and evolved in the First World War; the sea mine and the depth charge.

7.2.4 The Site should be considered of special interest in the light of the anniversary of World War One as part of the commemoration of the German submariners who died trying to cross the Dover barrage and the war effort of the Dover Patrol.

7.2.5 As there is a considerable focus on WWI at the current time with the centenary, the Site is assessed as **Moderately Valuable** for the above criteria as its remains offer a tangible connection with the First World War submarine and Anti-submarine Warfare and the wreck constitutes by itself a monument to the fallen.

**Rarity**

- 7.2.6 Boats of the UB II class are well represented within English Territorial waters, with six examples. These are *UB-29*, *UB-30*, *UB-31*, *UB-33*, *UB-38* and *UB-41* although *UB-29*'s position and identification is doubtful. Another example of UB II type, *UB-35*, sunk in the Dover barrage area but it is excluded from the list as believed to be within French Territorial waters.
- 7.2.7 30 U-boats of UB II type were commissioned by U-boat Inspectorate. Six for the UB 13-23 series built during 1915, six for the UB 24-29 and UB 42-47 built during 1915-1916, twelve of the series UB 30-41 built during 1915-1916. Therefore the *UB-31*'s U-boat subgroup is well represented within English Waters. Moreover two other boats of the same subgroup, *UB-33* and *UB-38*, also sunk in the same Folkestone-Gris Nez minefield area.
- 7.2.8 The site is assessed as **Moderately Valuable** for the above criteria as not uncommon in English Territorial Waters.

**Documentation**

- 7.2.9 As there were no survivors there is no direct account of the sinking. Information can be inferred from the accounts of the RN drifters that chased the submarine and witnessed the underwater explosion that is thought ended its mission. Further documentary evidence regarding the work of the RN 'Tin Opener' is also available.
- 7.2.10 The National Archives at Kew hold records of the Submarine's Logs (ADM173), ASW Operations and Intelligence (ADM137) and plans of UB 18-47 class and U-boats photos (ADM186/407).
- 7.2.11 The National Archives of the United States also holds records of the German Naval Archives microfilmed by the US Navy at the Admiralty, London (NA Microfilm Publication T1022: PG62017-PG62022, War Diary of High Sea Fleet U-Boat Forces, Rolls 94-95; PG62061-PG62065, War Diaries of Flanders U-Boat Forces, Roll 153).
- 7.2.12 Several secondary sources are available and most of them are published. Particularly informative are the work of Grant, Messimer and Young that consists of modern historical investigations of First World War U-boats losses.
- 7.2.13 In addition there is substantial linked documentation available related to the wider historical and maritime landscape context, including records of the Dover Patrol and barrage, records relating to the ships it sank, (possibly) additional German records relating to both boat and crew and secondary works. There is currently no indication that this documentation will revolutionise our archaeological understanding of this type of vessel or their activities.
- 7.2.14 The Site is assessed as **Moderately Valuable** for the above criteria as the existence and study of the available documentary evidence contextualises the loss and the archaeological record in the Folkestone-Nez Gris barrage area and provides a plausible identification of the remains of the wreck off Folkestone as *UB-31*.

**Group Value**

- 7.2.15 The story of the Dover Patrol and Barrage and its efforts against Germany's submarines demonstrate that it had a decisive role on the Allied victory of the First World War and the Strait of Dover holds significant remains connected with that point in history. It is estimated that 20-22 U-boats of the First World War (McCartney 2002) sunk in the area of the Dover and Folkestone to Gris Nez barriers (the Dover Barrage). The Dover Strait

constitutes one of the highest, possibly the highest, concentration of submarine wrecks in the world and is an important maritime landscape for that reason.

- 7.2.16 The range of types of U-boats represented in this 'U-boat graveyard' is varied. It comprises U-boats, UB-boats (UB II and UB III type) and UC-boats (UC II) mostly sunk from 1915 to 1918 with the highest number of casualties sunk in 1918, as a consequence of the developments of British anti-submarine tactics during the war and the need to defeat the U-boat threat.
- 7.2.17 Although *UB-31* is not particularly significant, the wider landscape across the strait from Dover to Folkestone constitutes a nationally/internationally significant maritime landscape historically characterised by the activities of the Dover Patrol, the Folkestone-Gris Nez and Dover barrages and the physical remains of U-boats. And even though the individual U-boat wrecks might not be worthy of designation in their own right, the circumstances of their loss and the association with the other U-boats in the Dover Strait help define a historically unique place that played a crucially significant role during the First World War.
- 7.2.18 Another thematic approach that could be taken is driven by the consideration that in the Channel many wrecks that are appreciated by the diving community were lost in the First World War as consequence of the effective U-boat campaign. 27 vessels torpedoed by *UB-31* sunk in the Channel and at least four of these vessels, *Greatham*, *Medina*, *Riversdale* and *Bellucia* were located by and are routinely visited by the diving community. Amongst these, the 12,350 ton P&O liner RMS *Medina* torpedoed by *UB-31* off Start Point on 28 April 1917 is one of the largest shipwrecks in the Channel and it is often rated as one of the most spectacular wreck dive in the UK ([www.divernet.com](http://www.divernet.com)). The *Medina's* story is closely linked to *UB-31* and constitutes on its own an important reminder of the successes of the U-boat war against British shipping.
- 7.2.19 Therefore, the Site is assessed as **Highly Valuable** for the above criteria as its importance is significantly strengthened by its association with c. 20 FWW U-boats that sunk in similar circumstances in the Dover Strait and this allows not only comparative studies across the different type of FWW U-boats within a limited stretch of water but defines a wider context that contributes to the history of the Dover Strait marine landscape and helps understanding both Allies and Axis struggles to win the U-boat campaign. Such landscapes are commemorative as well as archaeological and their importance can be easily communicated during the ongoing 1914-18 Centenary commemorations.

#### **Survival/Condition**

- 7.2.20 It is estimated that between the 60% and 75% of the Site survives although no detailed examination of the condition of the wreck has been carried out and issues such as plate thinning and structural integrity remain uncertain or unknown. A limited inspection ascertained that in some places at the stern the outer plating is very fragile, crumbling when touched.
- 7.2.21 The wreck is almost completely exposed and extensive debris can be found lying at the portside towards the bow. The bow appears severely damaged as consequence of the explosion that sank the boat and internal features contained within the pressure hull are now exposed. Parts of the boat that are missing, such as the deck casing, conning tower external plating, parts of the saddle tanks and the propellers are commonly absent from submarine of this period.
- 7.2.22 Therefore the Site is assessed as **Not Valuable** for the above criteria as the U-boat is considered in fairly average condition for a 100 years old wreck.

### Potential

- 7.2.23 The study of the wrecksite and its wider context could benefit from further research and help confirm the identity of the wreck and for further characterising the Site. As the hatches of the conning tower and aft deck were found closed it is reasonable to expect that the engine and control room are sealed, although it is not clear if the access to these compartments is restricted by the debris at the bow end and if the watertight doors between the rooms were closed at the time of the sinking. In any case, it is extremely likely that human remains and contemporary artefacts with high historical potential are contained within the pressure hull. The submarine is therefore to be considered a War Grave.
- 7.2.24 Although *UB-31* clearly has some potential for further study as a representative example, its main potential appears to lie in its potential contribution to the wider battlefield environment of the Dover Barrage. Within this battlefield lie the wrecks of a significant number of U-boats and patrol vessels and possibly evidence of the barrages themselves. Research for this study suggests that the vital defence of the Dover Strait during the First World War has not been the subject of the thematic archaeological study that it surely deserves, so the potential of *UB-31* to contribute to knowledge in this respect is clearly reasonable.
- 7.2.25 Site is assessed as **Moderately Valuable** for the above criteria.

### Summary

- 7.2.26 The *UB-31* wreck site is considered highly valuable in the category of Group Value, moderate value in Period, Documentation, Rarity and Potential; and Not Valuable for Survival. Therefore, according to the non-statutory criteria assessment and the recommendation that sites demonstrating high value in two criteria or more (English Heritage 2012), the *UB-31* wreck site does not represent a candidate for scheduling under the Ancient Monuments and Archaeological Areas Act 1979.
- 7.2.27 It must be noted that the *UB-31* wreck site demonstrates Highly Valuable in the category of Group Value and in this respect it is suggested that a thematic approach that considers the entire group of First World War submarines sunk within the Strait of Dover should be taken into consideration so that potentially the entire group could be designated for its extraordinary historical and archaeological group value. As previously stated, the submarines in the Strait of Dover are a resource that not only fundamentally defines the maritime landscape of the Dover Strait as a battleground, but also make it an important place of cultural 'memory' and cultural heritage, representing one of the main symbols of the defeat of U-boat menace.

## 7.3 The Importance of Submarine Wrecks as Monuments

- 7.3.1 The wider public focus on the submarines used in the first half of the 20th century tends to be more commemorative in nature, with the principal interest in them as monuments, lying in their association with the events and people of the First and Second World Wars. There is therefore a case to be made that assessment of the value of individual submarine wrecks should be more event and personality driven. Examined in that context, the significance of the *UB-31* lies in its status as one of the victims of the Dover barrage, and as one of a group of heritage assets in that 'landscape'. It would therefore follow that its principal interest lies not in its design, but in its status as part of an important battlefield and as a more general symbol of the vital and bloody defeat of the U-boat menace in the First World War.

- 7.3.2 That battlefield, in the context of a wider project, has been explored in recently published PhD research (McCartney 2014). It can be seen in **Figure 7** which shows some of the marine heritage assets linked to the *UB-31*, as they are also First World War U-boats lost in the Dover Straits area. This battlefield was arguably just as important in terms of the eventual outcome of the war as any of those on land on the Western Front or further afield and is worthy of further study.

## 8 RECOMMENDATIONS

- 8.1.1 WA recommends that the entries of NRHE archive for the *UB-31* records (monuments no. 1490040, 901777) are enhanced based on the finding of this report.

## 9 ARCHIVE

- 9.1.1 The project archive consists of hard copy file and computer records and is currently stored at WA under project code 83803. The project will be transferred to EH on completion.

## 10 REFERENCES

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## 11 APPENDICES

### APPENDIX I: ANOMALIES OF ARCHAEOLOGICAL POTENTIAL

WA_ID	Classification	Easting	Northing	Archaeological Discrimination	Length (m)	Width (m)	Height (m)	Magnetic Amplitude (nT)	Notes
7000	Debris Field	371565	5655532	A1	13.3	8.5	0.0	-	Distinct area containing three short, parallel linear bright reflectors. No associated magnetic anomaly. The reflectors appear to be depressions though there is no reason why three such depressions should exist in such a discrete area, and no similar natural features have been observed on the surrounding seabed. They could also represent three pieces of non-ferrous debris, such as wood, and could be the remains of a small wooden structure or wreck.
7001	Dark Reflector	371487	5655454	A2	1.6	0.6	0.4	-	Elongate dark reflector with shadow but no associated magnetic anomaly. Could be a natural feature or a piece of non-ferrous debris.
7002	Dark Reflector	371647	5655532	A2	1.3	1.0	0.4	-	Distinct dark reflector with shadow but no associated magnetic anomaly. Could be a natural feature or a piece of non-ferrous debris.
7003	Debris	371580	5655392	A2	1.6	1.4	0.4	-	Irregular dark reflector with distinct shadow and possible small associated scour, though no associated magnetic anomaly. Identified on a number of survey lines, and possible piece of non-ferrous debris.



WA_ID	Classification	Easting	Northing	Archaeological Discrimination	Length (m)	Width (m)	Height (m)	Magnetic Amplitude (nT)	Notes
7004	Debris	371595	5655405	A2	1.7	0.8	0.6	-	Distinct angular dark reflector with shadow but no associated magnetic anomaly. Possible piece of non-ferrous debris.
7005	Dark Reflector	371682	5655443	A2	1.2	0.3	0.4	-	Elongate dark reflector with poorly defined, possibly detached, shadow. No associated magnetic anomaly. Could be a natural feature or a piece of non-ferrous debris.
7006	Rope / Chain	371719	5655293	A2	118.0	0.7	0.4	30	Dark reflector with distinct shadow and associated magnetic anomaly. A long, intermittent, curvilinear dark reflector extends from the main anomaly to the NNW. Probably anchor with attached length of rope or chain. Given position is of the anchor location, dimensions include the length of rope or chain.
7007	Debris	371704	5655298	A2	1.3	0.3	0.4	-	Dark reflector with shadow but no associated magnetic anomaly. Identified on a number of survey lines, and possibly non-ferrous debris associated with rope/chain <b>7006</b> .
7008	Debris	371717	5655300	A2	1.2	0.5	0.5	-	Dark reflector with shadow but no associated magnetic anomaly. Identified on a number of survey lines, and possibly non-ferrous debris associated with rope/chain <b>7006</b> .



WA_ID	Classification	Easting	Northing	Archaeological Discrimination	Length (m)	Width (m)	Height (m)	Magnetic Amplitude (nT)	Notes
7009	Dark Reflector	371716	5655333	A2	1.2	0.2	0.4	-	Dark reflector with shadow but no associated magnetic anomaly. Only identified on one survey line, and could be a natural feature or non-ferrous debris.
7010	Debris	371732	5655316	A2	7.3	0.4	0.0	14	Short, linear bright reflector with associated magnetic anomaly, though possibly could be very thin dark reflector with shadow. Possible piece of ferrous debris.
7011	Dark Reflector	371672	5655262	A2	1.6	0.1	0.5	-	Elongate, relatively poorly defined dark reflector with shadow but no associated magnetic anomaly. Could be a natural feature or a piece of non-ferrous debris.
7012	Debris Field	371695	5655274	A1	24.3	6.1	0.0	-	Area of disturbed seabed at the northern edge of the wreck of <i>UB-31</i> ( <b>7013</b> ) and partially along the western side. Contains a number of small, irregular dark and bright reflectors, and possibly represents a small scour containing a debris field associated with the wreck.



WA_ID	Classification	Easting	Northing	Archaeological Discrimination	Length (m)	Width (m)	Height (m)	Magnetic Amplitude (nT)	Notes
7013	Wreck	371702	5655261	A1	40.7	8.6	4.6	13161	Wreck of the submarine <i>UB-31</i> , identified approximately 15m NNW of the recorded UKHO position orientated approximately NNW-SSE. Appears relatively upright and intact, with the conning tower seemingly still in place and exhibiting significant height. A large hole in the hull appears present on the northeast edge, possibly the result of hitting a mine, though this is uncertain. The northern tip of the vessel appears to have deteriorated and is more debris than coherent structure, with a small debris field extending from here partway down the western side ( <b>7012</b> ). A small adjacent anomaly ( <b>7014</b> ) could be associated debris or fishing equipment. Associated with a very large magnetic anomaly. Position given is interpreted as being of the conning tower.
7014	Debris	371711	5655260	A1	3.3	0.9	1.2	-	Elongate dark reflector with distinct bright reflector coming from one end, could be a shadow or an associated separate piece of debris. No distinct magnetic anomaly, though any anomaly is likely to be masked by the adjacent wreck of <i>UB-31</i> ( <b>7013</b> ). Possible debris associated with the wreck, though could be fishing gear snagged on the structure.



WA_ID	Classification	Easting	Northing	Archaeological Discrimination	Length (m)	Width (m)	Height (m)	Magnetic Amplitude (nT)	Notes
7015	Debris	371718	5655254	A2	1.5	0.3	0.5	-	Distinct dark reflector with shadow but no distinct magnetic anomaly, though any anomaly would be masked by the nearby wreck of <i>UB-31</i> ( <b>7013</b> ). Possible piece of debris, possibly associated with the wreck though this is uncertain.
7016	Debris	371710	5655230	A1	2.3	1.1	0.3	-	Distinct, rounded dark reflector with shadow but no definite magnetic anomaly, though any anomaly would be masked by nearby wreck of <i>UB-31</i> ( <b>7013</b> ). Possible piece of debris associated with the wreck.
7017	Debris	371628	5655188	A2	1.0	0.5	0.6	-	Collection of at least three closely spaced dark reflectors with shadows, associated with a very small possible scour but without a magnetic anomaly. Possible non-ferrous debris.
7018	Magnetic	371766	5655191	A2	-	-	-	34	Medium, distinct magnetic anomaly away from the main wreck site and without an associated sidescan sonar contact. Possible small piece of buried ferrous debris.
7019	Dark Reflector	371794	5655184	A2	1.0	0.4	0.3	-	Irregular dark reflector with shadow and possible small associated scour, but no associated magnetic anomaly. Could be a natural feature or non-ferrous debris.



WA_ID	Classification	Easting	Northing	Archaeological Discrimination	Length (m)	Width (m)	Height (m)	Magnetic Amplitude (nT)	Notes
7020	Recorded Obstruction	371575	5655469	A3	-	-	-	-	Recorded location of a foul ground. Originally detected in 1977 and described as a wreck, subsequent surveys have not identified the feature and it was not visible within the current data set. The original recorded height of 'as much as 6.3m' suggests the record actually references <i>UB-31</i> approximately 240m to the southwest and it was originally poorly positioned.

#### Notes

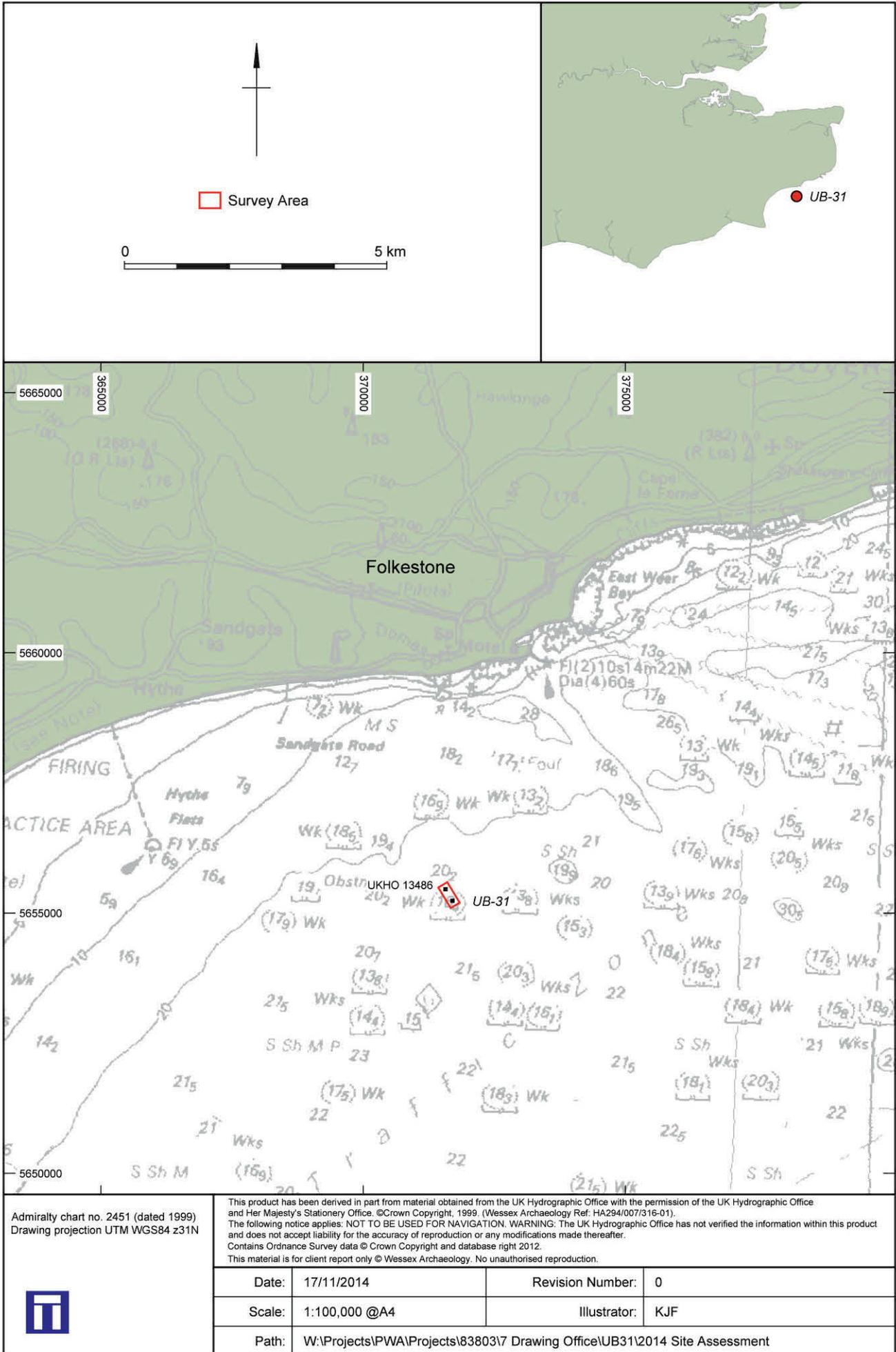
1. Co-ordinates are in WGS84 UTM31N
2. Positional accuracy estimated  $\pm 10\text{m}$

#### APPENDIX II: DIVE LOG

Dive	Date	Start Time	Duration	Depth (m)	Diver
1	03-08-2014	08:07	27	26	Croce
2	03-08-2014	09:08	24	25	Hamel
3	04-08-2014	08:55	26	25.5	Murray
4	04-08-2014	10:07	27	25	Knott
5	04-08-2014	15:27	14	27	Scott
6	05-08-2014	16:08	28	26.5	Scott
7	07-08-2014	12:30	31	24.5	Croce
8	07-08-2014	10:24	31	24	Murray

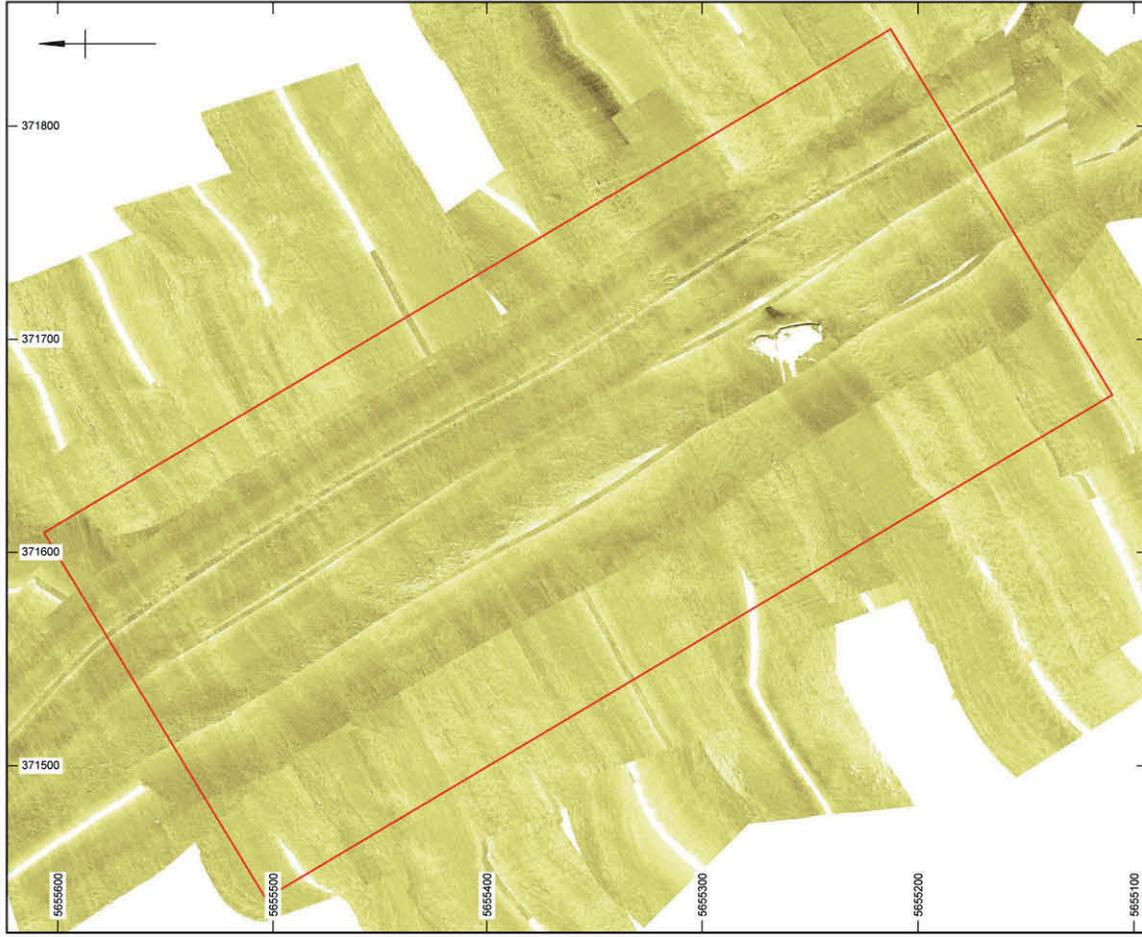
**APPENDIX III: SITE RISK ASSESSMENT**

<b>Wreck/Site Name</b>	<b>UB-31</b>		
NRHE /UKHO No.	EH Region	Restricted Area	Principal Land Use
901777/13482	South West	N/A	Coastland 1: Marine
Latitude (WGS84)	51 °02'.066 N		
Longitude (WGS84)	001 °10'.216 E		
Class Listing	Period	Status	
Submarine	WWI	Non-designated site	
Licensee	Nominated Archaeologist	Principal Ownership Category	
N/A	N/A	C: MoD	
Seabed Owner	Navigational Administrative Responsibility		
Crown Estate	Dover MRCC		
Environmental Designations			
G: NONE			
Seabed Sediment	Energy		
(g)mS, slightly gravelly muddy sand	Medium		
Survival			
Good			
Overall Condition	Condition Trend	Principal Vulnerability	
C: Generally Satisfactory	B: Declining	NAT	
Amenity Value: visibility			
A			
Amenity Value: physical accessibility		Amenity Value: intellectual accessibility	
A: Full		C: no interpretation	
Management Action	A: no action required		
Management Prescription	M: no management prescription required		
Notes:			
<p>The wreck is almost completely exposed and extensively damaged forward of the deck gun. Apart from natural decay and corrosion that cannot be prevented, no specific risks were detected. There is a high potential for debris material in the proximity of the area of the damage at the bows. The damage was caused at the time of the sinking; it consists of a large void in the pressure hull.</p> <p>Although there is a history of limited salvage on <i>UB-31</i>, propellers had been savaged in the past, at the time of the survey there were no indications that the surviving features such as the 88mm gun are currently at risk. The wreck it is very likely to contain human remains therefore should be treated as war grave.</p> <p>Risk is assessed as LOW. Data source is by diving survey.</p>			
<b>Risk is assessed as:</b>	<b>Low</b>		
Data Source	CON/OT	Date & Initials	Wessex Archaeology, October 2014



Survey Area Location

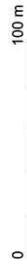
Figure 1



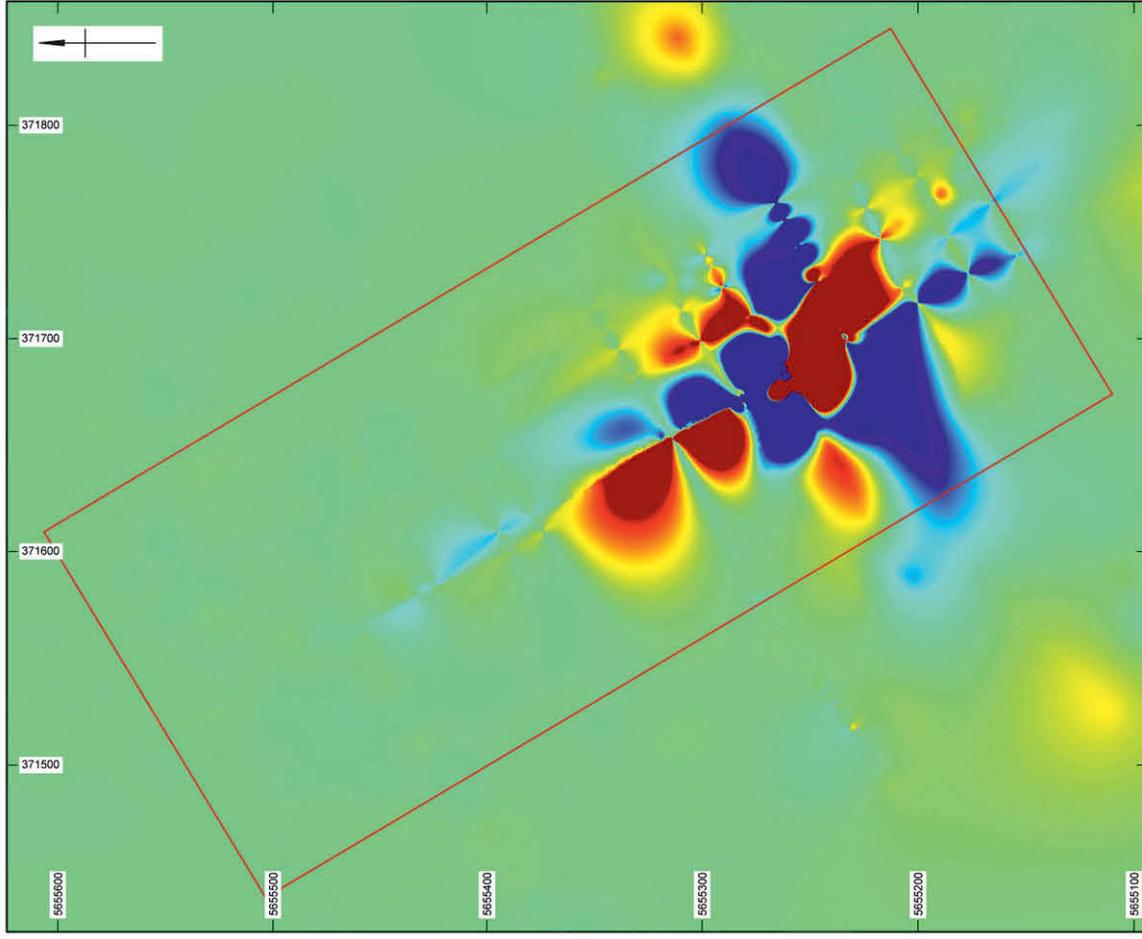
Sidescan Sonar Mosaic



Survey Area



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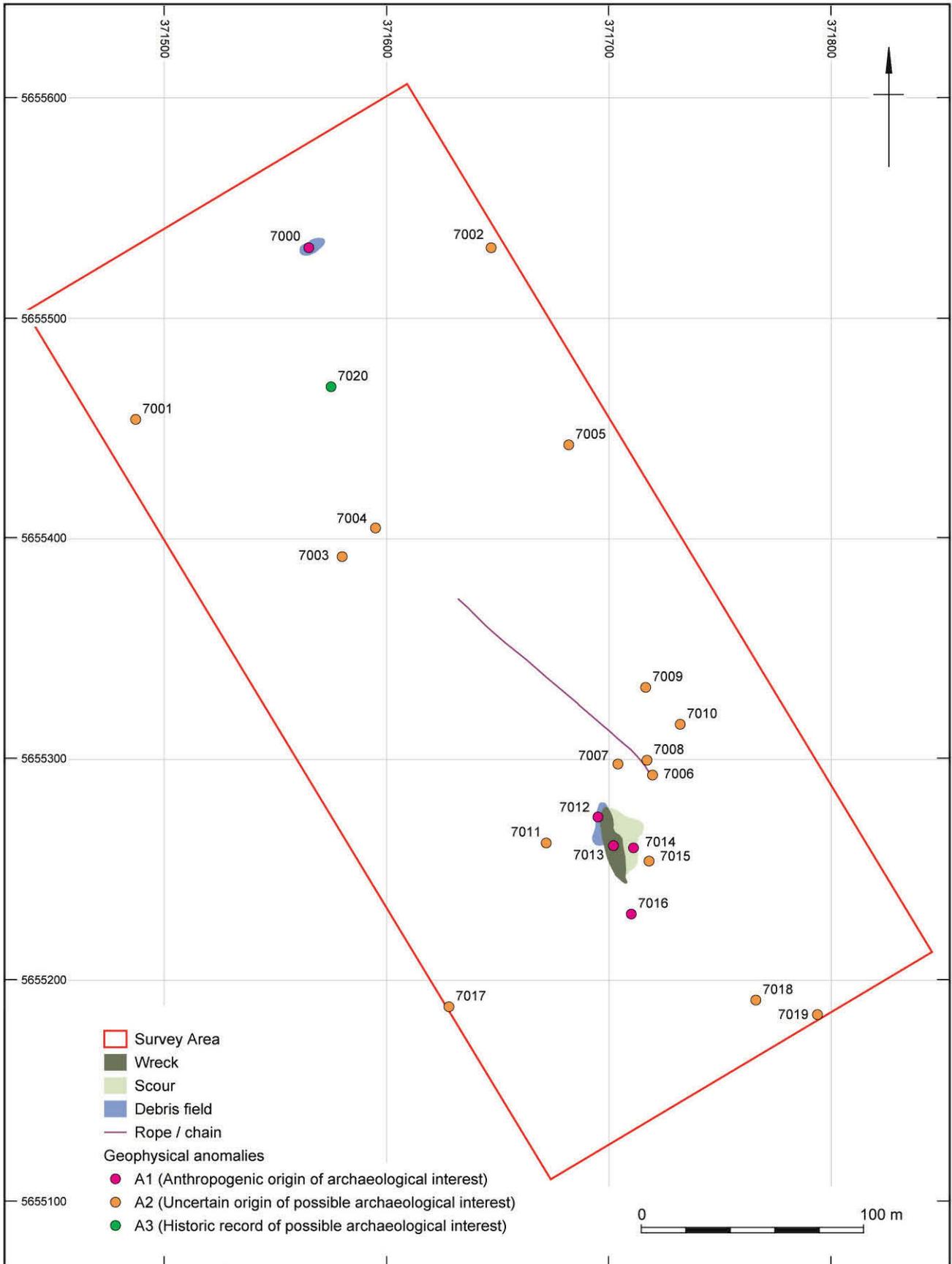


Gridded Magnetometer Data (+/-50nT)

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Sidescan Sonar Mosaic and Gridded Magnetometer Data

Figure 2

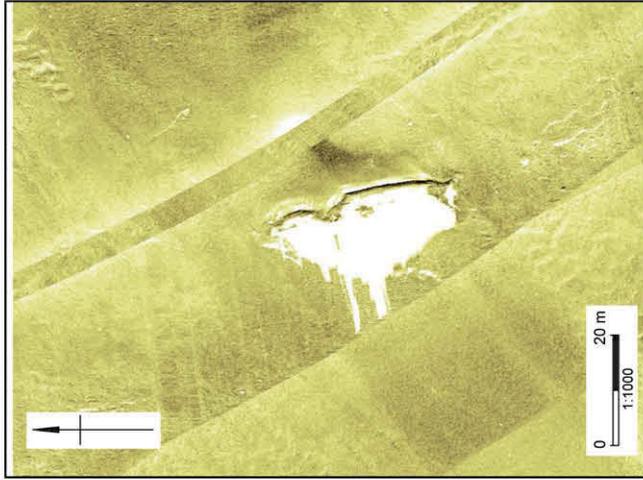
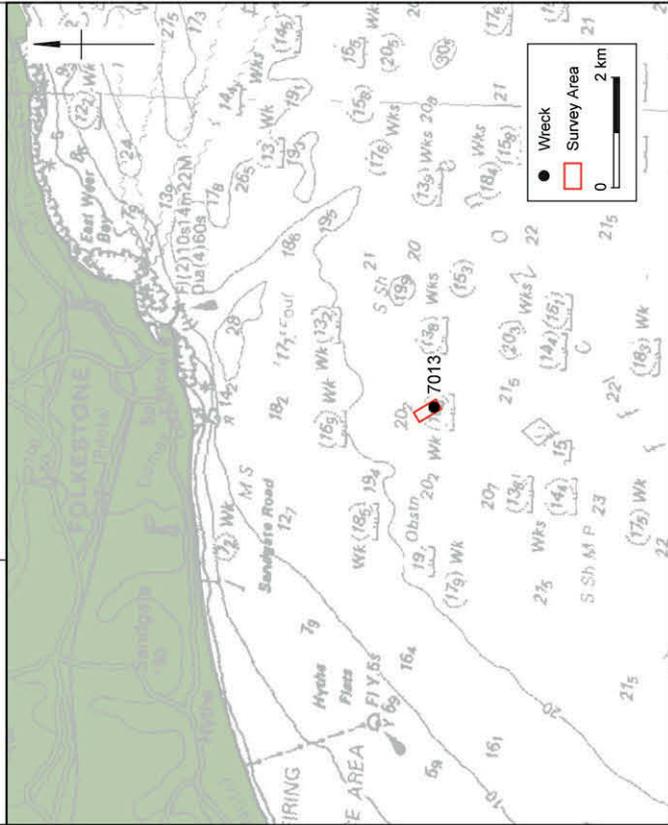


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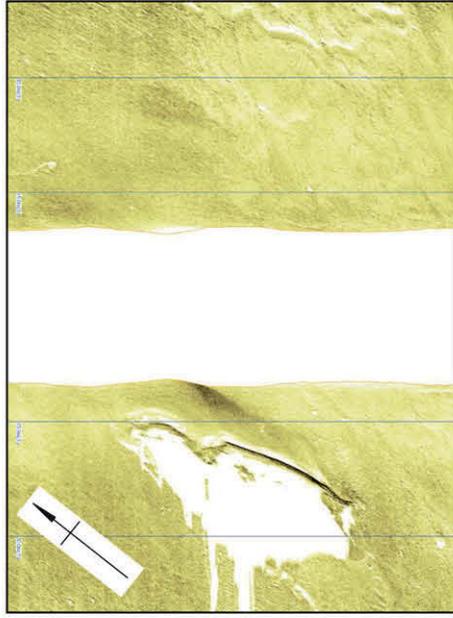
Anomalies of Potential Archaeological Interest

Figure 3

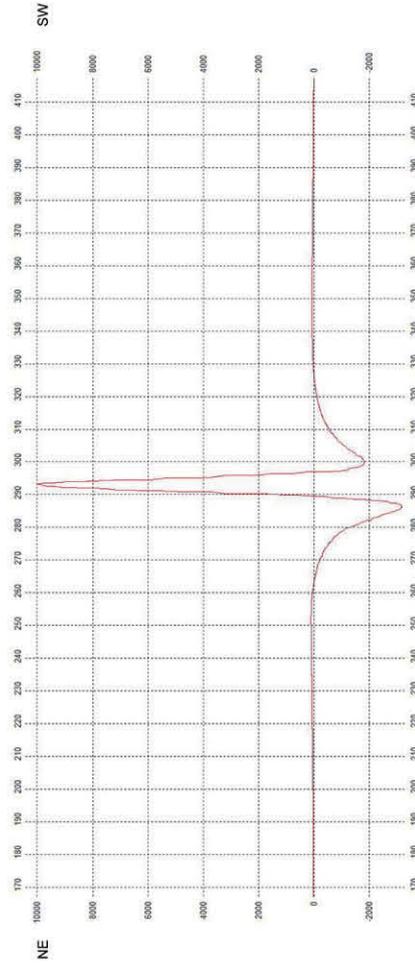
<b>Location</b>		371702 E, 5655261 N (UTM31N) 51° 02.074' N, 001° 10.211' E (WGS84)
<b>Geophysical survey dimensions and notes</b>		Dimensions: 40.7m x 8.6m x 4.5m. Distinct outline of a mainly coherent structure, exhibiting significant height. Appears relatively intact, though a large bend/hole in the hull visible on one side. Little associated debris, and very little sediment scouring. Associated with a very large (13161nT) magnetic anomaly.
<b>Build</b>	<b>Type</b>	Submarine
	<b>Construction</b>	
	<b>Dimensions</b>	
	<b>Shipyard</b>	
<b>Loss</b>	<b>Cause</b>	Reportedly lost after being depth charged and then detonating a mine whilst on patrol in the Straits of Dover in 1918
<b>Extent of Survival</b>		The UKHO record this wreck with a minimum depth of 16.6m, last surveyed in 1997. The wreck is noted to be generally intact but listing to port and with a large hole in the hull forward of the conning tower. Wreck is interpreted as being the UB-31, though it has not been definitively identified.



7013: Sidescan sonar mosaic



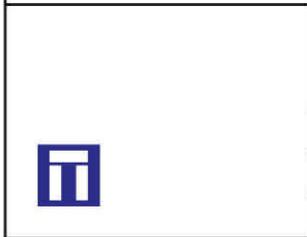
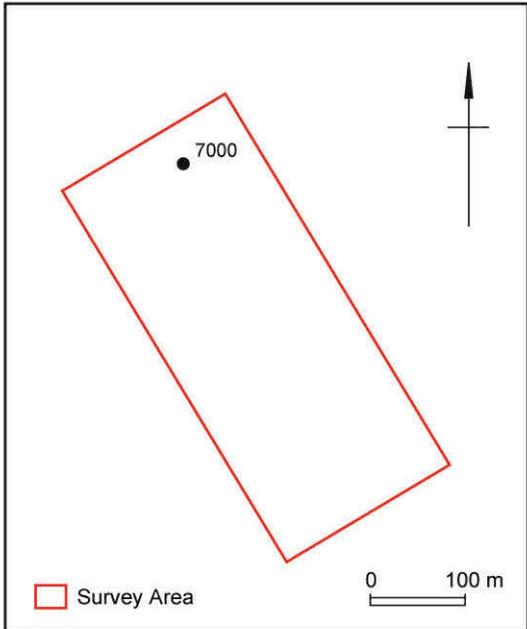
7013: Sidescan sonar waterfall



7013: Magnetometer profile over UB-31, 13161nT

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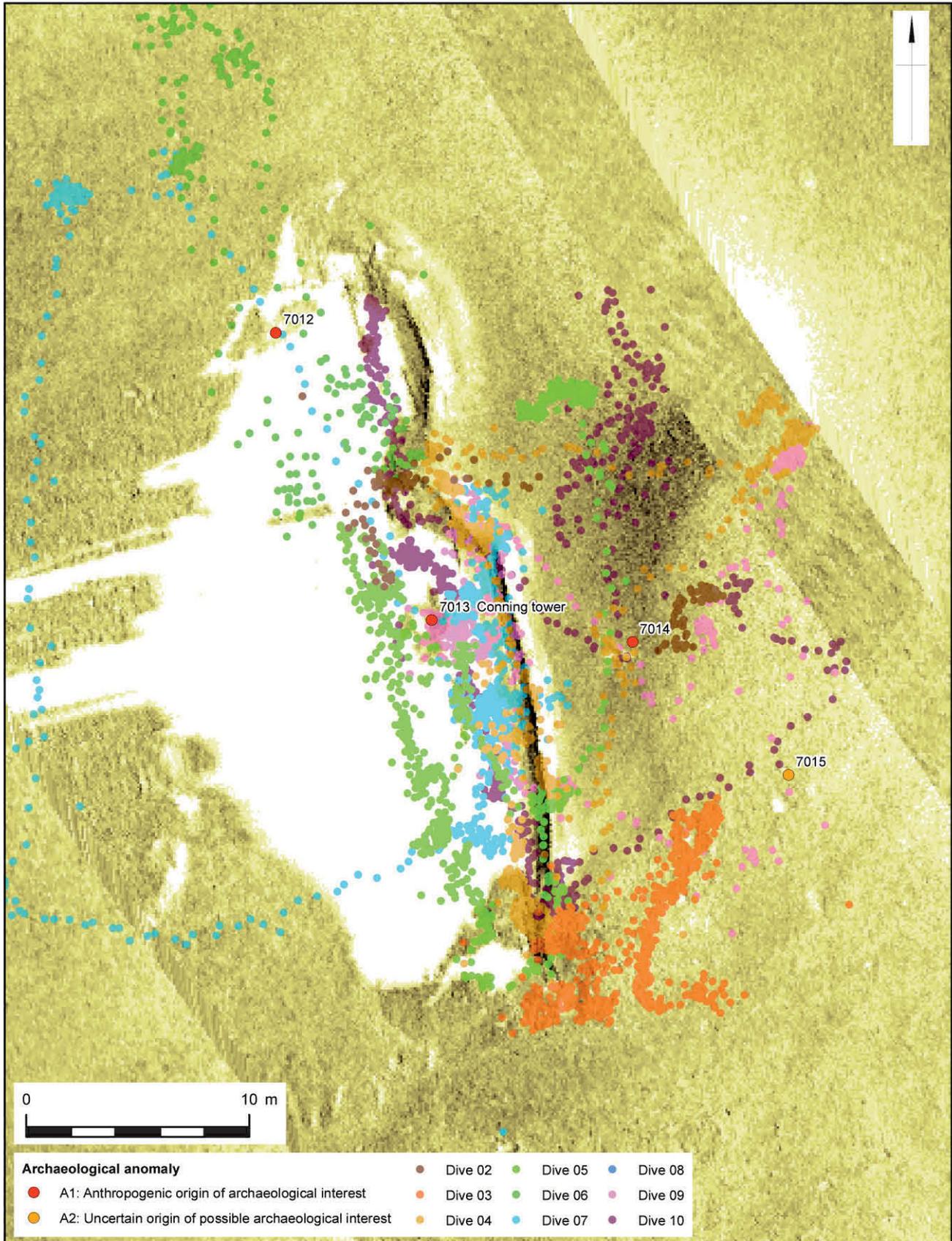


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Sidescan Sonar Data Example of 7000

Figure 5



Archaeological anomaly		Dive 02	Dive 05	Dive 08
● A1: Anthropogenic origin of archaeological interest	● Dive 03	● Dive 06	● Dive 09	
● A2: Uncertain origin of possible archaeological interest	● Dive 04	● Dive 07	● Dive 10	

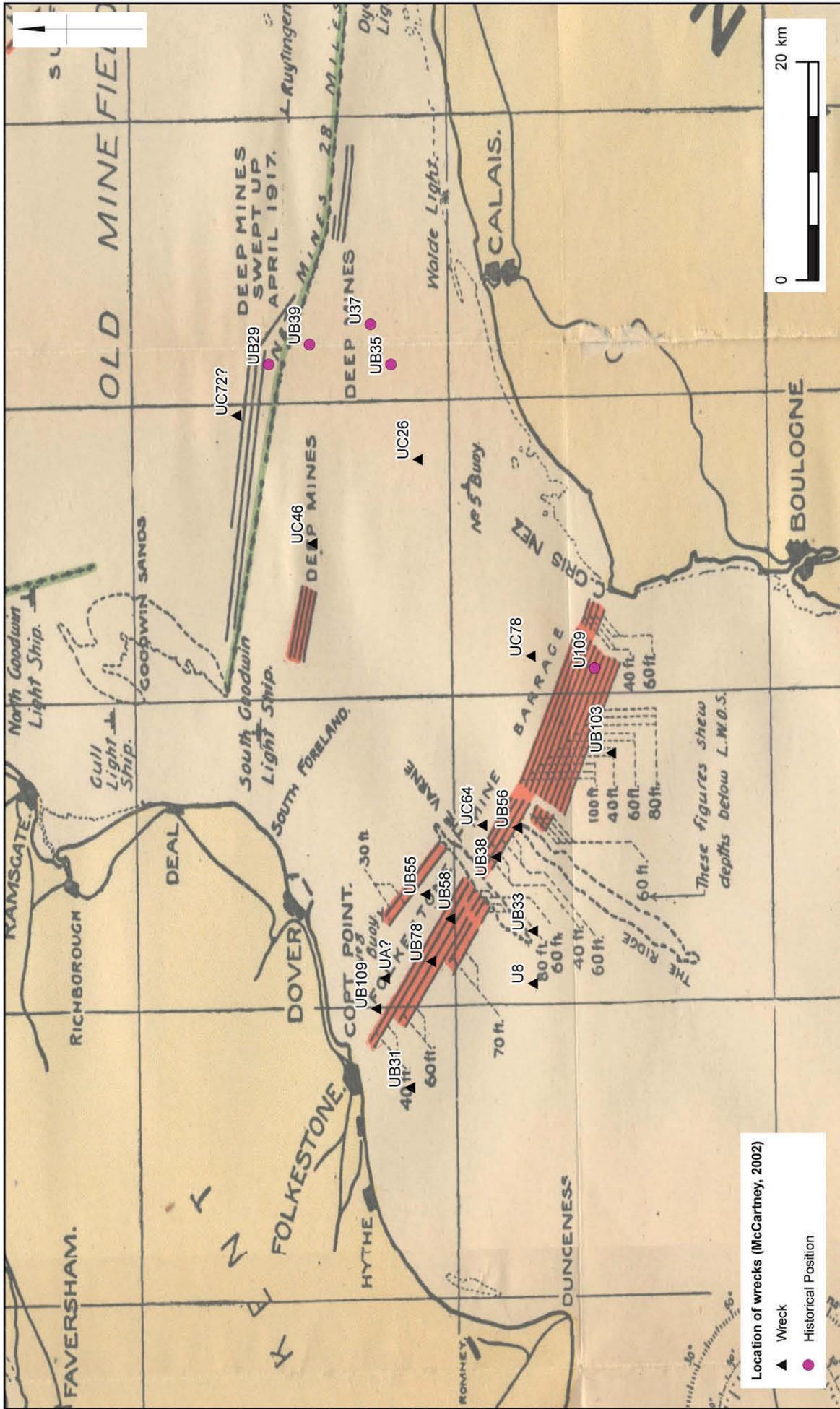
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Sidescan sonar with dive tracks and archaeological anomalies

Figure 6

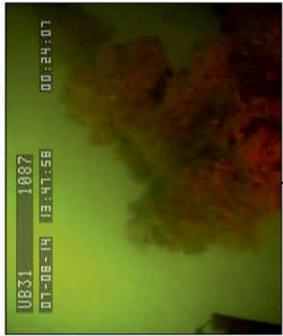


	Drawing projection: WGS1984 Location of wrecks taken from McCartney 2002. Basemap: Dover Patrol, Mines and Net Barrages December 31st 1917 from Admiral Sir Reginald Bacon, THE DOVER PATROL 1915-1917, Volume II. This material is for client report only © Wessex Archaeology. No unauthorised reproduction.		Date:	05/12/2014	Revision Number:	0
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Dover Strait: Locations of First World War U-boats Figure 7



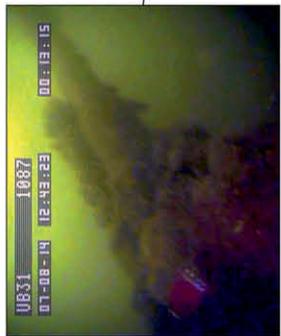
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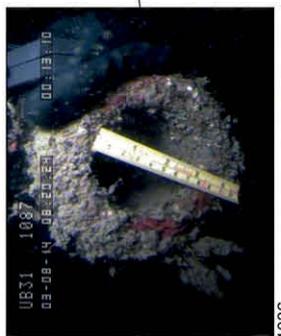
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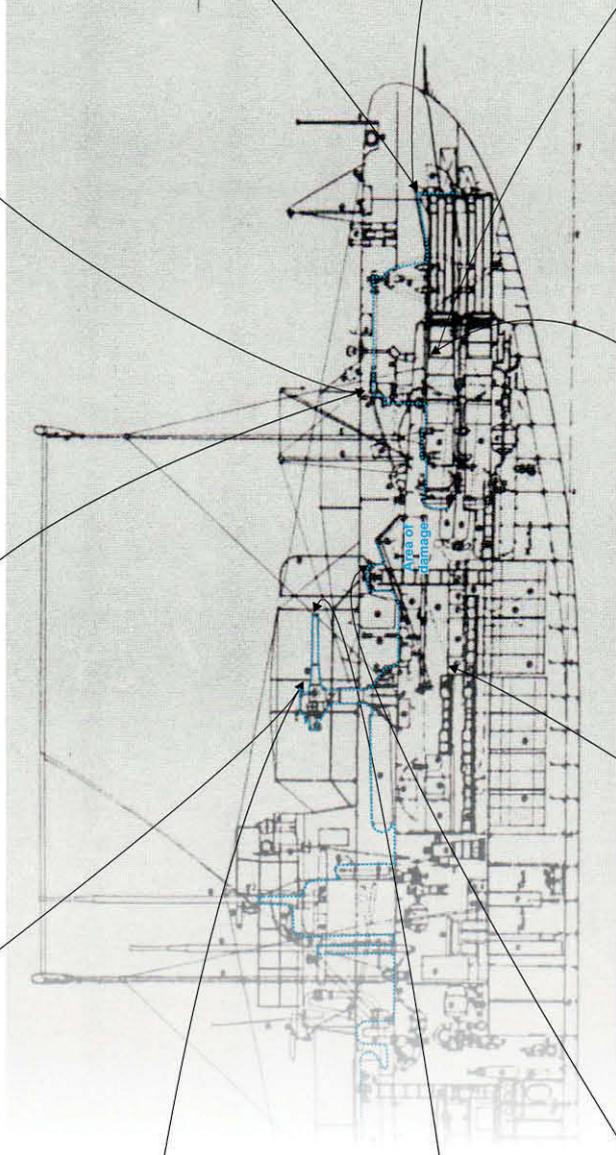
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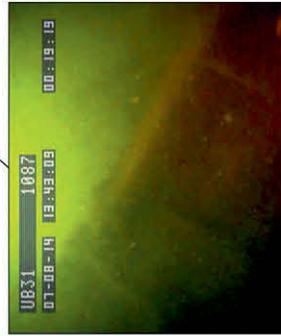
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1013



1031



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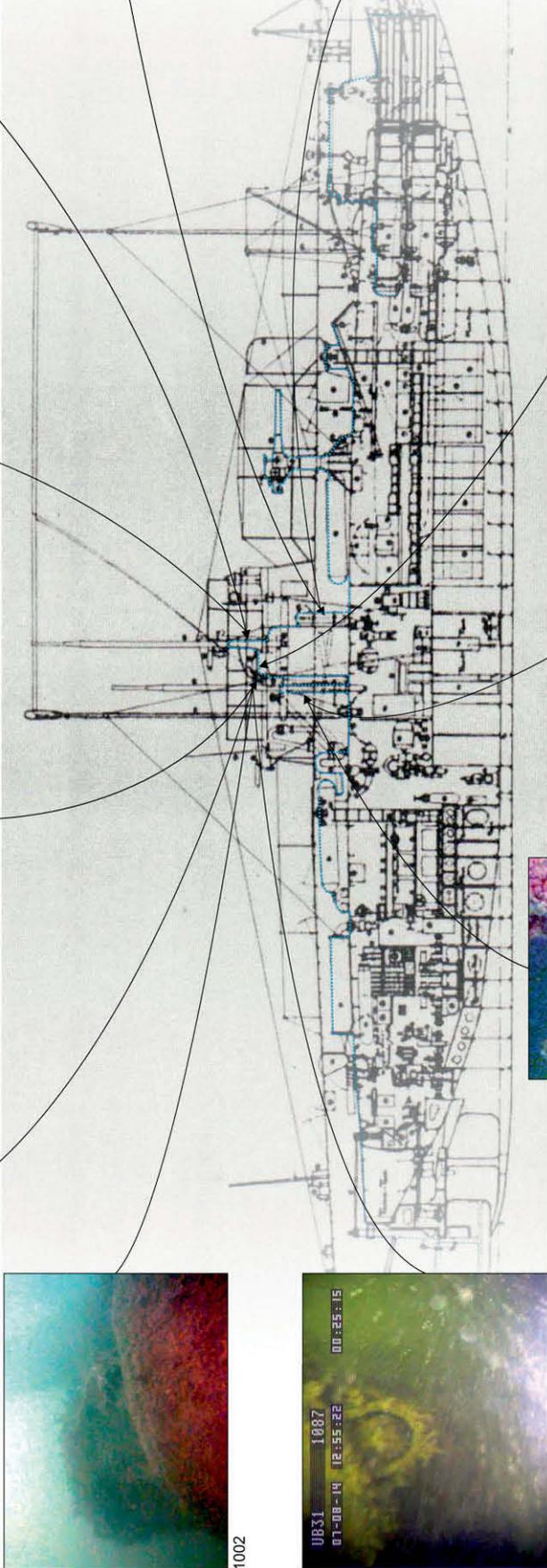
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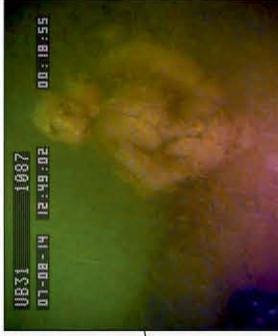
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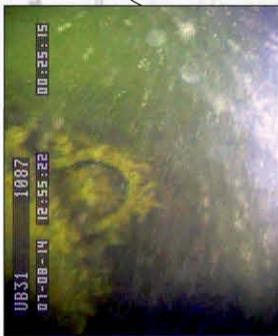
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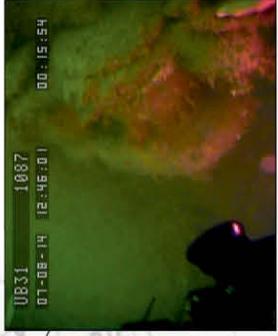
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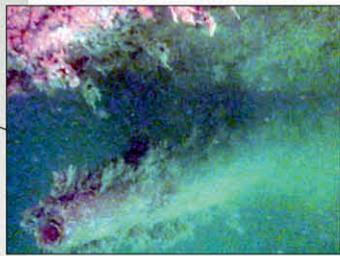
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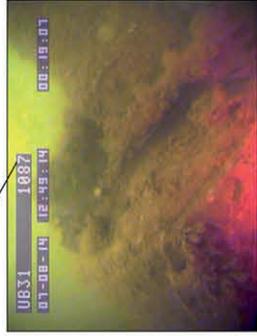
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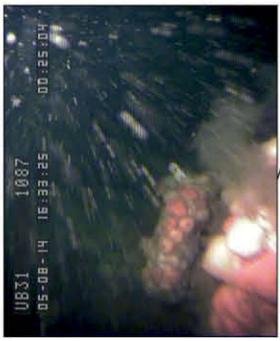
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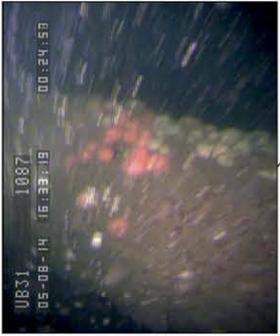
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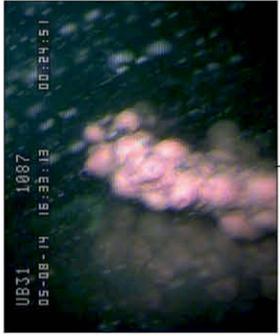
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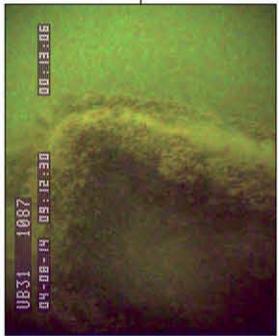
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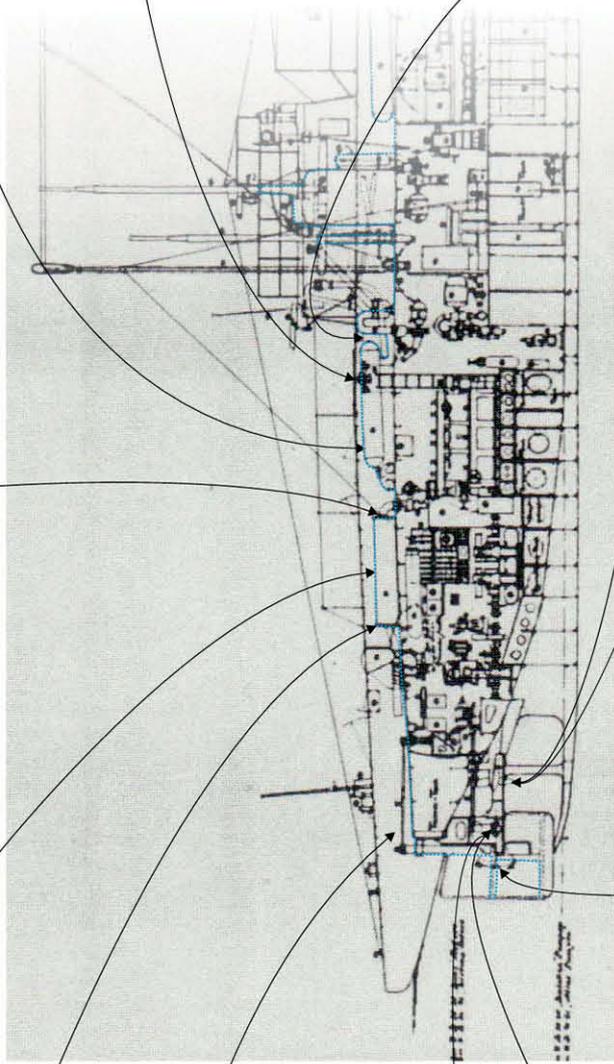
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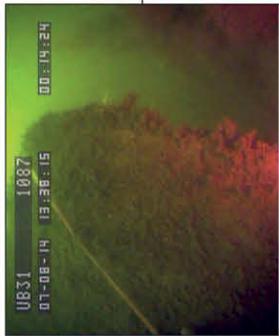
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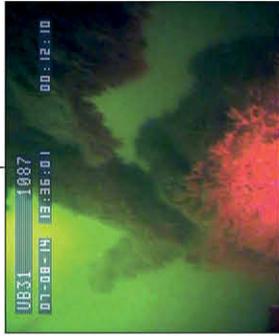
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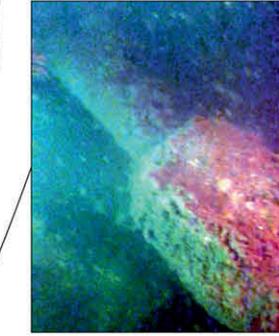
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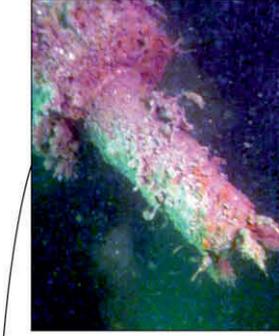
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Plate 4: Anomaly 7014 – Anchor

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