in respect of the proposed development of

London Gateway

Appendix S: Sub-bottom Profiling

January 2003

Draft and Confidential

in respect of the proposed development of

London Gateway

Appendix S: Sub-bottom Profiling

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Draft and Confidential

Version: 1.0 Reference: 49575 Date: 15 January 2003

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Version: 1.0 Reference: 49575 Date: 15 January 2003

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Stuart Leather prepared this report, with the assistance of Martin Bates. Antony Firth managed the project.

in respect of the proposed development of

London Gateway

Appendix S: Sub-bottom Profiling

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1. INTRODUCTION

- 1.1. Wessex Archaeology was commissioned by Faber Maunsell to undertake sub-bottom profiling in connection with the London Gateway project at Shellhaven, Essex. The area of study extended from Hole Haven Creek to the southern end of Lower Hope (see Drawing J.1.02.0476.01).
- 1.2. The works were undertaken to enhance the palaeo-geographic mapping and deposit model. The enhanced deposit model, reflecting both the results of the sub-bottom profiling and investigations on land, is presented elsewhere.
- 1.3. The sub-bottom profiling was undertaken by Emu Ltd., comprising data acquisition and geological interpretation. Their report is appended to this document.

BACKGROUND

- 2.1. Palaeo-geographic mapping indicates that deposits corresponding to terraces on land fall within the horizontal and vertical extents of proposed dredging. However, the corresponding terraces are reported to be relatively late in the Lower Palaeolithic and Middle Palaeolithic, which are not currently regarded as being rich in archaeological material. Some earlier channels have been identified that may be of greater archaeological potential, apparently lying below proposed dredging depths.
- 2.2. Palaeo-geographic mapping also confirms the presence of peat deposits within the horizontal and vertical extents of proposed dredging. The presence of peat deposits suggests potential for the survival *in situ* of archaeological material, and both the peat and associated alluvium contain palaeo-environmental and dating evidence of archaeological importance.

- 2.3. The model of sea-level change developed in the course of palaeogeographic mapping suggests that the Study Area may have comprised extensive terrestrial and intertidal areas until the later Mesolithic and possibly into the Neolithic, but thereafter the Study Area would have become predominantly marine in character.
- 2.4. In general terms, the area is underlain by Tertiary London Clay and then by Quaternary gravel deposits in terrace formations. The latest deposit associated with terrace formation is the Shepperton Member laid down in the Late Devensian, at the base of the current channel of the Thames. In the course of sea-level rise, further deposits have been laid down on the margins of the channel, including the peaty and other alluvial deposits referred to above. As the environment developed from riverine to estuarine and fully marine conditions, so further deposition and reworking in the channel is likely to have occurred.
- 2.5. The sub-bottom profiling was intended to clarify the presence and relationship between these deposits in the channel area in order to extend the dryside deposit model.

AIM AND OBJECTIVES

- 3.1. The aim of the sub-bottom profiling was to inform the assessment of effects on the cultural heritage of the London Gateway proposals.
- 3.2. The objectives of the sub-bottom profiling were to facilitate the extension of the dryside deposit model by:
 - identifying geological units within and on the margins of the channel;
 - clarifying the form of geological units and the relationships between them;
 - commenting on their archaeological interpretation.

4. METHODOLOGY

- 4.1. The methodology applied in acquiring survey data and in geological interpretation are detailed in the appended report by Emu Ltd. The methodology included a seismic source trial to optimise the penetration and resolution that could be achieved.
- 4.2. The area surveyed encompasses the channel immediately off London Gateway, plus areas up and down-stream to provide sufficient context to correlate results with the regional geology.

- 4.3. Wessex Archaeology attended fieldwork and contributed to the geological interpretation. A meeting was held between Emu Ltd., Wessex Archaeology, Martin Bates and Richard Bates on 18 December 2002 to discuss interpretation, and a further meeting was held with Martin Bates on 10 January 2003 to discuss the results and their archaeological implications.
- 4.4. Heights derived from the sub-bottom profiling data are being incorporated in the deposit model.

5. RESULTS

- 5.1. As detailed in the appended report by Emu Ltd., five lines and 21 crosslines were surveyed using a surface tow boomer profiler. The trackplot is reproduced on drawing J.1.02.0476.01.
- 5.2. Seven units were distinguished. It should be noted that these are units that are distinct from each other seismically, i.e. in terms of their acoustic properties. Their geological attribution is by inference.
- 5.3. All the data was interpreted. Lines and crosslines representing the area surveyed and showing notable features were selected for presentation (J.1.02.0476.03-04). Depths to units, and isopachs of selected units relative to OD, are presented in J.1.02.0476.05-08.
- 5.4. Generally the data were very good. However, the survey coverage was limited by water depth restricting navigability, and also by acoustic masking in inshore areas.
- 5.5. The source of acoustic masking is debatable. While the cause is likely to be shallow biogenic gas, it is not clear whether this gas has originated in the course of decay of modern sediments, or whether it originates from older organic sediments and has migrated upwards. If of older origin, acoustic masking may indicate the presence of peaty horizons (see Appendix L). However, if the gas is of recent origin it is simply an inconvenience to the application of seismic methods. To further complicate the matter, shallow gas of both origins could be present in the area surveyed. On balance, shallow gas in inshore areas seems more likely to be of modern origin, whereas shallow gas in the channel may indicate the presence of older organic deposits.
- 5.6. The seven units identified in the geological interpretation are summarised below:

Unit 1	The basal unit underlying the whole area, interpreted as the basal	
	London Clay.	

Unit 2	Overlying Unit 1 throughout the majority of the site, It has been interpreted as comprising sand and gravels and is associated with terrace formations.	
Unit 3	Occurs in discrete areas. Interpreted as sedimentary in nature, most probably channel infill. Probably fine sand and clays due to its low seismic reflectivity.	
Unit 4	This unit has been interpreted as sand. It represents the oldest layer of a sequence of Units prograding from the south of the area.	
Unit 5	This represents a later unit in the sequence of prograding layers from the south. It has been interpreted as comprising sand and gravels.	
Unit 6	This has been interpreted as sand and gravels. It overlies Unit 2 and has similar seismic characteristics. It also overlies Unit 3 uncomformably in certain locations.	
Unit 7	This unit has been interpreted as predominantly sand and forms the majority of the seabed from chainage 6700m to the east of the area. It is, therefore, thought to be the result of modern sediment deposition or reworking.	

5.7. It is worth noting that the data obtained are capable of further interpretation and review as additional evidence (e.g. borehole logs, palaeo-environmental assessment and dating) becomes available, and as interpretations of the regional geology develop.

6. DISCUSSION

- 6.1. The evidence suggests that at least two phases of erosion are present into the top of the London Clay surface (Unit 1). The height of the surface of the London Clay in Route 2 shows a change from approximately –15m O.D. at +5900m to –25m O.D. at +6700m with a sharp break at +6650m. This difference of up to 10m suggests that the higher surface was cut in an earlier episode to cutting of the lower surface, and that a phase of general downcutting along the profile of the Thames occurred between these two episodes.
- 6.2. Gravels of Unit 2 are present above the erosion surface of Unit 1. The surface elevation of these gravels reflects the form of the underlying erosion surface, i.e. there are marked changes in the height of the top surface of Unit 2. This suggests that at least in Route 2, Unit 2 comprises two gravel bodies of differing ages. However, the relationship between the overlying gravel bodies is less clear in Line 11 where a single gravel body associated with the younger, lower gravel unit in Route 2 may be present.
- 6.3. The implications of the evidence obtained from the study of Units 1 and 2 is that the notion of a single gravel body (i.e. the Shepperton Member) existing beneath the area surveyed is erroneous. A complex history of gravel deposition and erosion is apparent from the subbottom profiling data. While it is not possible to assign ages to these events it is likely that the deposits span large parts of the last cold

- stage (Devensian) and may extend into the penultimate cold stage (i.e. before the Ipswichian warm stage).
- 6.4. It should be noted that a number of the gravel units that have been mapped in the Middle Thames disappear below the floodplain downstream of East London because of the downstream dip on the gravel bodies within the Thames. Consequently, units identified in the Middle Thames have not previously been readily apparent to geologists in the region. As a result, there is scope in the area surveyed to identify different gravel units that can be associated with units previously mapped upstream.
- 6.5. The sub-bottom profiling has produced no evidence from within Unit 2 of fine-grained sediments. Consequently the potential for recovering in situ stratified archaeology and palaeoenvironmental material from Unit 2 appears to be low. However, the possible presence of pre-Devensian gravels suggests that the potential for derived Palaeolithic artefacts may be higher than thought previously.
- 6.6. The interpretation of the seismic units overlying Unit 2, and their possible importance, is difficult to determine at present. The evidence clearly shows that fine grained clays exist in places (Unit 3) and that locally these either fill channel-like features cut into or superimposed on the surface of Unit 2, or are present as discontinuous sheets of material across the surface. The fine-grained nature of these sediments suggests that any archaeological remains associated with these deposits may have suffered only minimal post-depositional movement. Although this suggests that the archaeological potential may be relatively high, it is unclear whether Unit 3 is Holocene (i.e. Late Upper Palaeolithic/Mesolithic) or Pleistocene (i.e. Middle Palaeolithic) in date (see discussion of Unit 5, below).
- 6.7. Similar sediments, although at higher elevations, are noted within the (Holocene) wedge of sediments both to the north and south of the channel. For example, Unit 4 resting in places on the surface of Unit 2 and/or on the surface of Unit 3, consists of sand units that are comparable to deposits noted within the area to the south of the Thames beneath Cooling and Shorne Marsh.
- 6.8. Unit 5 appears to be of major importance. This unit is considered to consist of sand and gravel and forms an extensive deposit along parts of Route 2 and as a wedge of material thinning to the north in Line 19. The surface of Unit 5 outcrops between -10 and -13m O.D. at elevations similar to those considered typical of the top of the Shepperton Member and is likely to have been considered to be the upper part of the Shepperton Member by the BGS. If the attribution of this deposit to the Pleistocene is correct, the implication is that the

sediments of Units 3 and 4 are also of Pleistocene date. Attribution of these fine-grained deposits to a Late Pleistocene (Middle Palaeolithic) warm stage is plausible. The notion that such sediments are of relatively low archaeological potential because Britain is suspected not to have been inhabited at this time is currently under review. However, if Unit 5 is Pleistocene in date then it suggests that very little Holocene sediment exists within the channel. It would follow that the Late Upper Palaeolithic/Mesolithic potential of the channel (as compared to floodplain deposits) is low, which accords with the model of sea-level change set out in Appendix L.

- 6.9. An alternative explanation is that Unit 5 (and indeed all overlying units) are of relatively recent date and reflect marine gravel deposition on the base of the modern channel. If so, then the fined grained deposits of Unit 3 are likely to be late Devensian/early Holocene in date, potentially containing in situ material of Late Upper Palaeolithic/early Mesolithic date.
- 6.10. Deposits exist at the south end of Line 11 (Units 6 and 7) that occur at levels equivalent to the Holocene sediments of the Shorne/Cooling Marshes. These appear to be the only deposits clearly identified that may correlate with the dry side deposits. Their archaeological potential is considered to be high.

7. CONCLUSION

- 7.1. By way of conclusion, the following key points should be noted:
 - The BGS mapping indicating a simple sequence consisting of the Shepperton Member with overlying Tilbury Member is incorrect.
 - At least two phases of gravel aggradation appear to be present beneath the area surveyed.
 - Evidence exists for the presence of finer grained sediments infilling channel-like features.
 - It remains unclear whether significant thicknesses of Holocene deposits occur within the channel. The presence of thick Holocene deposits on the channel sides is confirmed, but their internal structure is unclear, partly due to acoustic masking by shallow gas.
 - Two alternative models can be constructed to account for Units 3-5. Interpretation of Unit 5 as of Pleistocene date indicates that the channel like feature associated with Unit 3 is of Late Pleistocene (Middle Palaeolithic) age. Alternatively if Unit 5 is of Holocene date then the channel-like feature is of late Devensian/early Holocene (Late Upper Palaeolithic/early Mesolithic) date.

- Irrespective of the dating of the deposits, this set of sediments represents a situation in which archaeological material, if present, may be in situ or minimally modified. Furthermore fine-grained sediments of this type are likely to contain palaeo-environmental material for landscape reconstruction.
- This evidence collaborates the information obtained from the dry side areas suggesting that the interpretation of the subsurface stratigraphy as well as the inferred archaeological and palaeoenvironmental potential is complex.

Shell Haven Archaeological Geophysical Survey

For

Wessex Archaeology

Report No. 02/J/1/02/0476/0336

January 2003

Job No. J/1/02/0476

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EXECUTIVE SUMMARY

Emu Ltd was commissioned by Wessex Archaeology to undertake seismic, sidescan sonar and magnetometer surveys of the approaches to the proposed port development at Shell Haven, on the north bank of the Thames. The survey was commissioned to give information to assist in determining the likely impact on the archaeology of the area during construction and dredging for the port development.

The project consisted of two tasks:

- to determine the location and nature of features on the seabed that may be of archaeological importance such as wrecks, in the approaches to Shell Haven. These were located using a sidescan sonar and magnetometer towed from the survey vessel contemporaneously, along 4 parallel lines extending from Shell Haven, eastwards along the centre of the existing shipping channel to a point approximately 32km to the east.
- To conduct a high resolution seismic survey of the Thames in the vicinity of the proposed port development to determine the sub-seabed geology which can be tied in to data collected on land to give a comprehensive view of the archaeological importance of the area.

This report covers the seismic survey only.

The survey was conducted between 18^{th} to 22^{nd} November 2002, using the vessel 'Saint David of London'.

A series of trials were undertaken across the site with three different seismic energy sources (boomer, pinger and chirp profilers) to determine which source would give the optimum data for this site. It was determined that a boomer system gave the best results and this was used for the survey.

The data show that underlying the whole of the site is a seismic unit which is likely to be London Clay, overlain by a series of terrace gravels. Two paleochannels have been determined which cut in to the terrace gravels and are infilled with predominantly clay. To the east of the survey area a sequence of prograding sedimentary horizons have been identified along with several periods of erosion. To the west of the area the terrace gravels are intermittently overlain by a unit likely to comprise sand and gravel.

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1.0 INTRODUCTION AND OBJECTIVES

1.1 Introduction

This report describes the high resolution marine seismic survey undertaken on the River Thames, in the vicinity of the planned port development at Shell Haven, on the north bank. The survey was commissioned to give information to assist in determining the likely impact on the archaeology of the area during construction and dredging for the port development.

This survey was part of a larger project that also included a sidescan sonar and magnetometer survey along the approaches to Shell Haven, designed to provide information on the location and nature of objects on the seabed such as wrecks, which may be of archaeological importance.

The seismic survey was undertaken between 18th and 22nd November 2002. The location of the survey area is shown in Figure 1.1.

Previous geophysical and geotechnical surveys, commissioned by P&O to give information primarily to aid planning of engineering aspects of the proposed port development, have indicated that the site is underlain by a sequence of unconsolidated sediments over rock.

The seismic survey was commissioned to give detailed information regarding the unconsolidated sediments.

1.2 Scope of Work

The scope of work for this element of the project was to collect high resolution seismic data particularly of the sedimentary sequences that other data sets indicate overlie the solid geology in this area.

2.0 METHODOLOGY

This section includes a brief factual description of the methods used to achieve the project objectives. More detailed descriptions of specific survey techniques and procedures are contained within Emu Ltd Method Statement, numbers 8 and 9 (a component part of the Company's QA Manual - details of which can be inspected on request).

2.1 Horizontal Positioning

POSITIONING				
Requirement		Application		
To provide navigation information to on board sensors with an accuracy of 3-5m.		A Leica MX412 DGPS Navigation System was used. This receives corrections from a network of differential beacons located around the British coast, and uses the data to correct positions in real time. This enables the location of seabed information collected by on board sensors to be determined with a high degree of accuracy.		
Data Collection				
Equipment Used:		412 Navigation DGPS		
	Trimble HY	YDRO <i>Pro</i> navigation software.		
Vessel:	Vessel: Saint David of London			
Methodology				

Methodology:

The survey was undertaken in accordance with the standard Emu Environmental Survey Methods and Procedures Numbers 8 and 9 (details are contained within the Company QA Manual and can be inspected on request).

The DGPS receiver was configured to receive corrections from North Foreland.

The transformation from WGS84 to OSGB36 undertaken during the survey used the following Cartesian transformation parameters:

δX	+369.50
δY	-112.50
δZ	+434.50

The vessel position was continuously updated and logged at regular intervals using Trimble HYDRO*Pro* navigation software.

Outputs			
• Drawing No. J.1.02.0476.01	Trackplot (Boomer position)		

 Table 2.1
 Summary of Horizontal Positioning System

2.2 Single-channel Seismic Survey

SINGLE-CHANNEL SEISMIC SURVEY Requirement **Application** Surface tow boomer profilers typically provide To determine the structure of the sub seismic images in the top 50 metres of the seabed seabed geology, particularly fine detail within the sediments above rockhead. (although they can often penetrate much deeper), with the actual depth of penetration being dependent upon the nature of the seabed sediments. The boomer system emits a high frequency (1-5kHz), low energy pulse. On meeting a boundary separating material of different density some of the sonar energy is reflected back to the receiver thus providing an indication of the depth at which the signal was reflected. The remaining energy then penetrates subsequent layers and the same process continues until all of the sonar energy is dissipated. Sharp changes in the reflector profile at any point in a record may indicate the presence of a sub-surface obstruction or abrupt change in the geology. **Data Collection** 18th – 22nd November 2002

Survey Dates:

Equipment Used: Applied Acoustics AA200 boomer plate mounted onto CAT200 Catamaran, AH150/8 hydrophone streamer, Applied Acoustics CSP1500 power supply, Octopus 360 Seismic Processor, Ultra 120 3-Channel thermal paper recorder, Triton Elics Digital Acquisition and Processing System.

Vessel: Saint David of London

Methodology: The survey was undertaken in accordance with the standard Emu Ltd Survey Methods and Procedures Numbers 8 and 9 (details are contained within the Company QA Manual and can be inspected on request).

The survey grid used for this survey consisted of 5 lines approximately parallel to the river channel and 21 crosslines perpendicular to the axis of the river channel. At the start of the survey trials were undertaken with a Geochirp system, Geoacoustics pinger system and the boomer system described above, to determine the most appropriate source. Throughout the survey the seismic source was towed at a distance of approximately 40m from the stern of the vessel.

Comments: At the start of the survey numerous towing arrangements, operating frequencies and power output configurations were tried to determine the optimum arrangement for the survey. As conditions varied parameters were adjusted and these changes were recorded in relevant survey logs.

Outputs

- Thermal paper seismic records
- Digital seismic records
- Drawing Nos. J.1.02.0476.01-8

Table 2.2 **Summary of Seismic Survey Methodology**

3.0 RESULTS

3.1 Data Quality

Throughout the survey vessel positioning was of a high quality with an estimated horizontal accuracy of 2.0 to 4.0m. Navigation checks were carried out at a known location at Gravesend pier on each survey day, these co-ordinates were noted in the Daily Log (Appendix A).

The quality of seismic data obtained during the survey was generally good, with penetrations in excess of 10-15 metres achieved over the majority of the site. This was reduced in areas of acoustic masking (caused by the presence of biogenic gas) where seismic penetration was completely prohibited in places. This was particularly the case towards the west of the site and in data collected along the one survey line across Blyth Sands to the south of the site.

The depth to which meaningful seismic data was obtained was also reduced in shallow areas such as the Blyth Sands by the presence of a seabed multiple across the records at twice the water depth. This effectively prevented seismic data from deeper depths being interpretable.

However, across the rest of the site seismic data quality was of a high standard.

3.2 Data Interpretation

3.2.1 Seismic Source Trials

At the start of the survey several survey lines were run across an area of known geological conditions with each of three seismic systems. These were:

Geoacoustics pinger system Geochirp system Applied Acoustics Boomer system

The pinger system gave high resolution data of the top 1-2m of the seabed but beyond that penetration was restricted. Data collected with the Geochirp system was of a lower resolution than the pinger system and penetration was similar. By setting the filters on the boomer system to the higher frequencies (1500-3000kHz) the data collected was of only slightly less resolution than the pinger and geochirp system but good penetration was achieved. Therefore, this system was used for the survey.

3.2.2 Seismic Data Interpretation

The following drawings should be viewed with this section of the report:

Drawing No J.1.02.0476.01	Trackplot (Boomer Position)
Drawing No J.1.02.0476.02	Interpolated Bathymetric Contours
Drawing No J.1.02.0476.03	Seismic Profile of Centre Line (Route 2)
Drawing No J.1.02.0476.04	Seismic Profiles of Cross-Lines (Lines 11, 14 and 19)
Drawing No J.1.02.0476.05	Depth to Seismic Unit 1
Drawing No J.1.02.0476.06	Depth to Seismic Units 2 and 3
Drawing No J.1.02.0476.07	Depth to Seismic Unit 5 + Isopachs of Seismic Unit 6
Drawing No J.1.02.0476.08	Isopach of Seismic Unit 7

Throughout the site many seismic units have been identified. The interpretation described below has not attempted to put the seismic units in to an archaeological context as this is beyond the remit of Emu Ltd's input in to the project.

Seismic Unit 1

Underlying the whole of the site is a unit, which generally has low levels of seismic reflectivity. Where internal reflectors are identified these are parallel to sub parallel and generally dipping to the southeast. The upper surface of this unit is not marked by a strong, distinct reflector but by a gradual increase in seismic reflectivity. This indicates that there is not a sharp change in density between the two units.

The upper surface of Seismic Unit 1 is between 2 and 22m below the river bed and generally shallows towards the west.

Other sources of geological information for this area and comparison with other seismic data collected by Emu Ltd in the Thames area indicate that this unit is likely to be London Clay.

Seismic Unit 2

Overlying Unit 1, throughout the majority of the site, is a unit exhibiting significant levels of seismic reflectivity and little sedimentary structure. This unit is likely to be composed of predominantly sand and gravel and is between 2 and 6m thick throughout the majority of the site but can reach up to 14m thick in places.

To the east of the site, the top of the unit is up to 11m below seabed (-20m O.D.) and becomes closer to the surface with distance towards the west. Between chainage 4540m and 6050m this unit outcrops at the seabed. Further to the west the unit is exposed intermittently at the river bed and is overlain by up to 8m of sediments in places.

To the east the surface of this unit is marked by a strong reflector as there is a strong contrast with the unconformably overlying seismic unit (Unit 6) which has a lower level of seismic reflectivity and pronounced sedimentary structures. To the west of the region where it is at outcrop at the seabed Unit 2 is overlain by a unit with similar levels of seismic reflectivity and more sedimentary structure (Unit 6). Due to a lack of sedimentary structures in Unit 2 it cannot be determined whether this interface is unconformable or not.

Unit 2 is also occasionally exposed at the seabed on both the north and south sides of the river where overlain by more recent sediments towards the centre of the channel.

At two locations a paleochannel feature can be determined and traced between adjacent survey lines. The channels cut in to Unit 2 and trend approximately NNW-SSE. Both features are filled with a seismic unit which is fine grained and exhibits little sedimentary structure, likely to be predominantly clay (Unit 3).

The eastern most paleochannel is centred on a line running from approximately 300m west of the west side of the entrance to Hole Haven to a point approximately 700m to the west of Egypt Bay. This paleochannel is up to 400m wide and 8m deep, being deepest towards the west.

The second paleochannel, located approximately 3500m further west is up to 200m wide and 4m deep.

The seismic character of this unit together with other geological information obtained in this area suggest that Unit 2 is likely to be part of a sequence of terrace gravels. Drawings J.1.02.0476.03 and

06 show that the level of the upper surface of this unit varies quite significantly across the site, suggesting that the unit represents several terraces.

Seismic Unit 3

The predominant seismic characteristics for this unit are that it has low seismic reflectivity and little identifiable sedimentary structure suggesting that this unit is fine grained and likely to be predominantly clay. The unit lies unconformably above Unit 2 on an erosional surface and is present in the vicinity of the two paleochannels described above, predominantly as channel infill. These features can be clearly seen in Drawing No. J.1.02.0476.03.

In the area of the eastern paleochannel the unit is present as paleochannel fill only beneath the middle of the present river channel and its lateral extents are predominantly bounded by the edges of the paleochannel with an upper horizontal erosional surface. At the base of this channel infill is an area of high seismic reflectivity, approximately 3m thick and 120m wide which consists predominantly of gravel. Further to the north this unit is not bound by channel edges and extends to within 0.5m of the river bed over an area approximately 650m wide and is up to 4.5m thick. It unconformably overlies Unit 2 and the upper surface dips shallowly to the west below more recent sediments (Unit 5) which conformably overlie it. To the west and north its relationship with other units cannot be determined due to acoustic masking and edge of survey extents, respectively.

In the vicinity of the western paleochannel it is present as channel fill only.

To the south of the centre of the current river channel the nature of this unit cannot be determined, again because of the presence of biogenic gas causing acoustic masking.

Seismic Unit 4

On the south side of the river a sequence of seismic units can be identified in the eastern most crosslines (19, 20 and 21), which unconformably overlie Units 2 and 3 and pinch out towards the north. To the south they increase in thickness but cannot be determined at the southern most extremes of the lines due to biogenic masking. These units exhibit sedimentary structures in the form of subparallel seismic reflectors which dip to the north suggesting that this is a prograding sequence with sediment movement from south to north over an erosional surface, which marks the top of Units 2 and 3.

The oldest/deepest of these units has been labelled Unit 4. This Unit is up to 3.5m thick and can be identified over a distance of approximately 200m in a south-north direction. It has moderate levels of seismic reflectivity and contains parallel to sub-parallel reflectors that dip towards the north. It lies unconformably above Unit2 and Unit 3 (where present) and below Unit 5. The interface with Unit 5 is indistinct and is marked by a gradual transition to a unit which has a higher level of seismic reflectivity and has less distinct sedimentary structures. To the west this unit pinches out as Unit 5 directly overlies Unit 3 on crossline 18.

Unit 4 is likely to represent a prograding sequence of predominantly sand.

Seismic Unit 5

This unit is another in the prograding sequence identified in the southeast of the site and overlies Unit 4 as described above. Where Unit 4 pinches out to the north it lies unconformably above Units 2 and

3. The thickness of this unit ranges from 0 towards the north where it pinches out to over 5m towards the south of the survey area.

As it has a reasonably high level of seismic reflectivity and limited sedimentary structures evident it is likely to be a coarse grained lithology probably containing sand and gravel.

To the north this unit extends beyond survey line Route 2, and to the east it is still evident beyond crossline 21 although at this point it does not extend as far north as Route 2. On Route 2 it pinches out between crosslines 20 and 21 and appears to be conformably overlain by Unit 7, suggesting a continuation in approximate predominant direction of sediment movement but a change in grain size.

To the west Unit 7 decreases in thickness to the point where Unit 5 forms the river bed between chainage 6050m and 6700m. At chainage 6050m Unit 5 pinches out as Unit 2 reaches the river bed.

Seismic Unit 6

This unit has relatively high levels of seismic reflectivity and exhibits little sedimentary structure, suggesting that this unit consists of predominantly sand and gravel. It occurs as the river bed material intermittently to the west of the site. At nearly all locations it overlies Unit 2 and has a reasonably similar seismic character. It also overlies Unit 3 where it is present and at these locations the boundary between the two units is a distinct unconformable surface likely to have been an erosional plane.

Where present this unit occurs as highs in the river bed profile and its lateral extents are truncated by troughs in the river bed profile, which cut through in to Unit 2 below.

Seismic Unit 7

From chainage 6700m to the east this Unit forms the riverbed and generally increases in thickness to the east to reach a maximum depth of approximately 10.5m at the eastern extents of the survey area. In the east, this unit conformably overlies Unit 5 where present, otherwise it unconformably overlies Unit 2. In the west it occurs on the banks to the south and overlies Units 6 where present, otherwise Unit 2.

The seismic character of this unit consists of low to medium seismic reflectivity with distinct parallel to sub-parallel reflectors. These internal reflectors are sub-horizontal over most of the survey area and dip down-slope (northwards) on the banks to the south of the river. To the north this unit tends to be absent.

This unit is likely to be predominantly sand.

3.2.3 Seismic Data Interpreted Sequence of Events

In this section an attempt is made to draw all the information described in the section above, in to a likely sequence of events.

Units 1 and 2 are the only units which can be identified throughout the majority of the site. Above this the site can be divided in to two broad regions; East and West Regions, which can be divided by the area at which Unit 2 reaches the river bed.

A possible sequence of events is as follows:

Unit 1 was deposited in a low energy environment and lithified. As the top of this unit is gradational with that above it is likely that the upper part of Unit 1 has been weathered or this part has not lithified to the same extent.

Unit 2 is likely to be a series of terrace gravels that were deposited above Unit 1, throughout the site. As the height of Unit 2 relative to Ordnance Datum varies significantly across the site, this Unit probably represents a series of terrace gravels. As the upper surface of this Unit is unconformable with those above it is likely that there was a period of erosion prior to deposition of the younger sequences identified from data collected during this survey.

Two paleochannel features have been identified cutting in to Unit 2, which have been infilled with Unit 3 which is likely to be predominantly clay. At all locations where identified the upper surface of Unit 3 indicates a period of erosion following it's deposition. The paleochannel to the east has an area of coarse material at the base which may indicate a period of high energy deposition subsequent to erosion of the paleochannel and prior to the deposition of Unit 3 identified in these data.

In the eastern region Units 4 and 5 are located to the southeastern part of the site. These are likely to represent a prograding sequence which can be divided in to two units (4 and 5) with predominant direction of sediment movement from south to north. Unit 4 is limited in its extents and was overlain by a conformable sequence of more coarse sediments (Unit 5).

In the western region the geology is more simple. Unit 2 is overlain by another unit of sand and gravel (Unit 6) which has been eroded in places to expose Unit 2 at the river bed.

To the east Unit 5 was overlain by up to 10.5m of parallel bedded sand (Unit 7) which thins to the west, occurring only on the banks on the south side of the river.

4.0 CONCLUSIONS

A good quality and comprehensive set of seismic data was collected for this project. The detail obtained was high but would require further analysis to derive a comprehensive understanding of the geological processes involved in this area during the depositional period the sediment sequences identified. This report gives an overview of the main components of the seismic information obtained.

Towards the banks of the river and to the west of the site, seismic penetration has been restricted by the presence of biogenic gas. In the rest of the site the data show that the whole area is likely to be underlain by London Clay with several sequences of sediment deposition above. Throughout the site the London Clay is overlain by a seismic unit, likely to be terrace gravels in the top of which two NNW-SSE trending paleochannels have been observed.

In the eastern part of the site several more seismic units have been identified including a prograding sequence in the southeast of the area. In the western part of the site the geology is more simple as localised areas of another seismic unit likely to contain sand and gravel have been identified overlying the terrace gravels. On the banks on the south side of the river Unit 7, consisting predominantly of recent sand deposits, can be seen at the river bed.

5.0 AUDIT INFORMATION

Title: Shell Haven Archaeological Geophysical Survey			
Report No : 0	2/J/1/02/0476/0336		
Job No : J	/1/02/0476		
Client Contact:	tuart Leather		
Project Manager	Angela Proctor		
Main Report written by	Richard Cooke		
Report checked by	Angela Proctor		
Report authorised by	Simon Shaw		

APPENDIX A Daily Logs

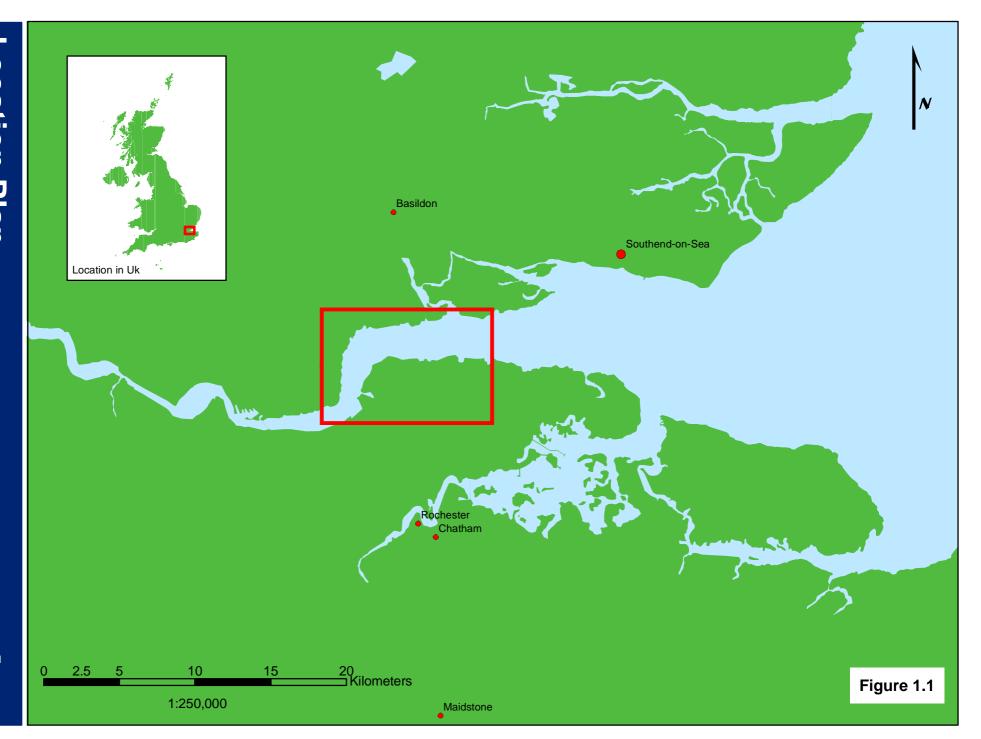
APPENDIX B DRAWINGS

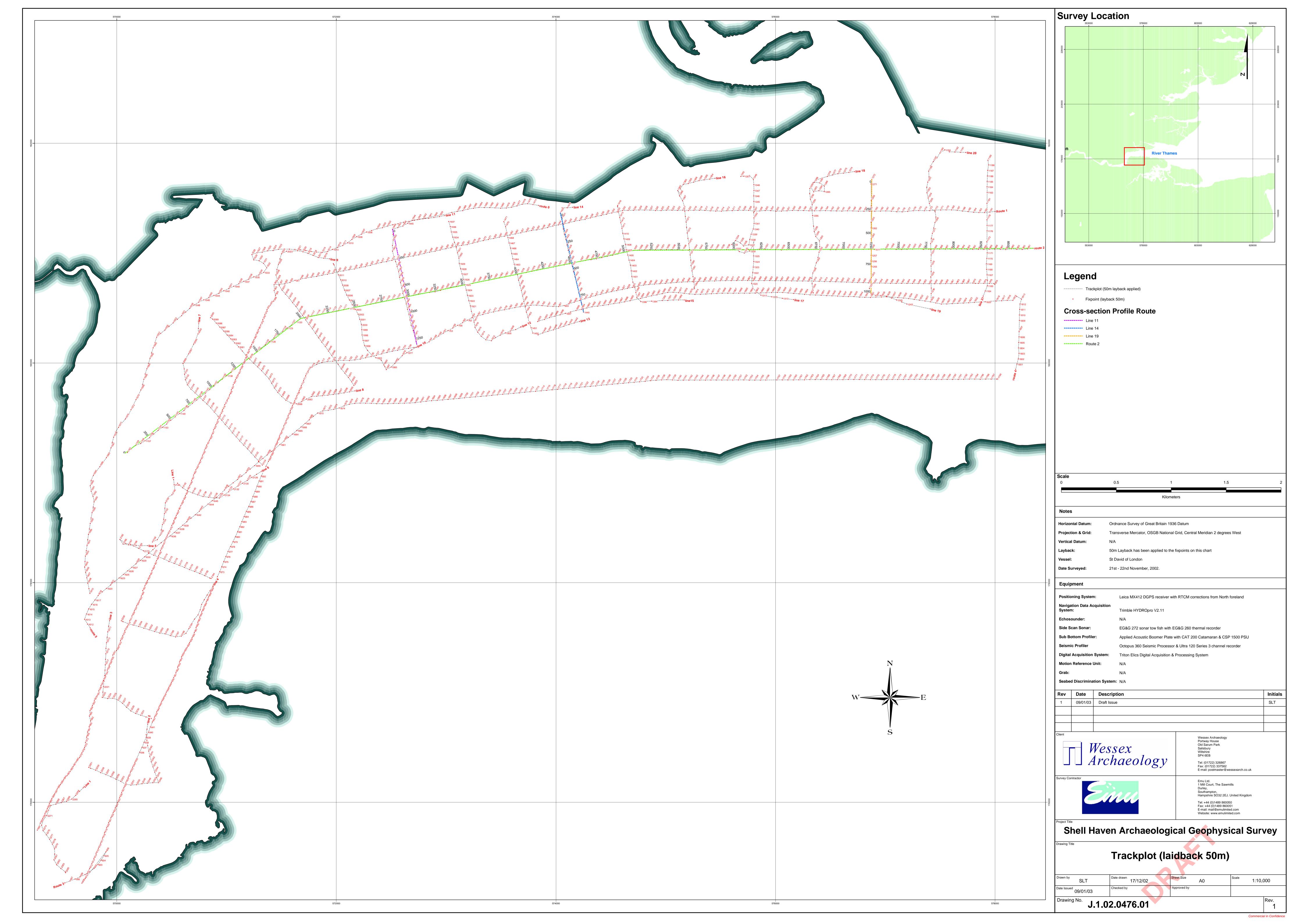
Shell Haven Archaeological Geophysical Survey ocation Plan

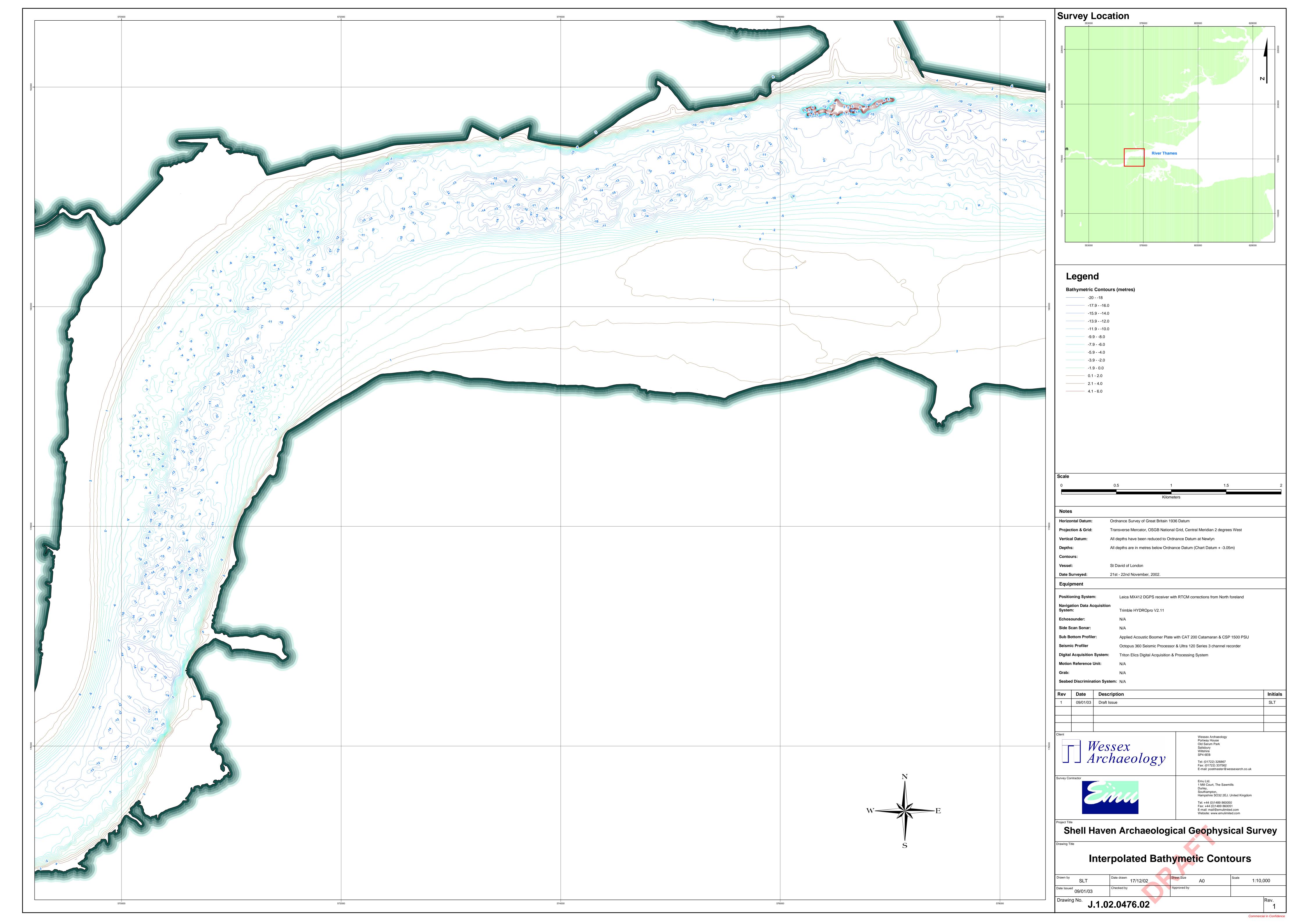
Emu Limited 1 Mill Court The Sawmills Durley Southampton, SE32 2EJ UK

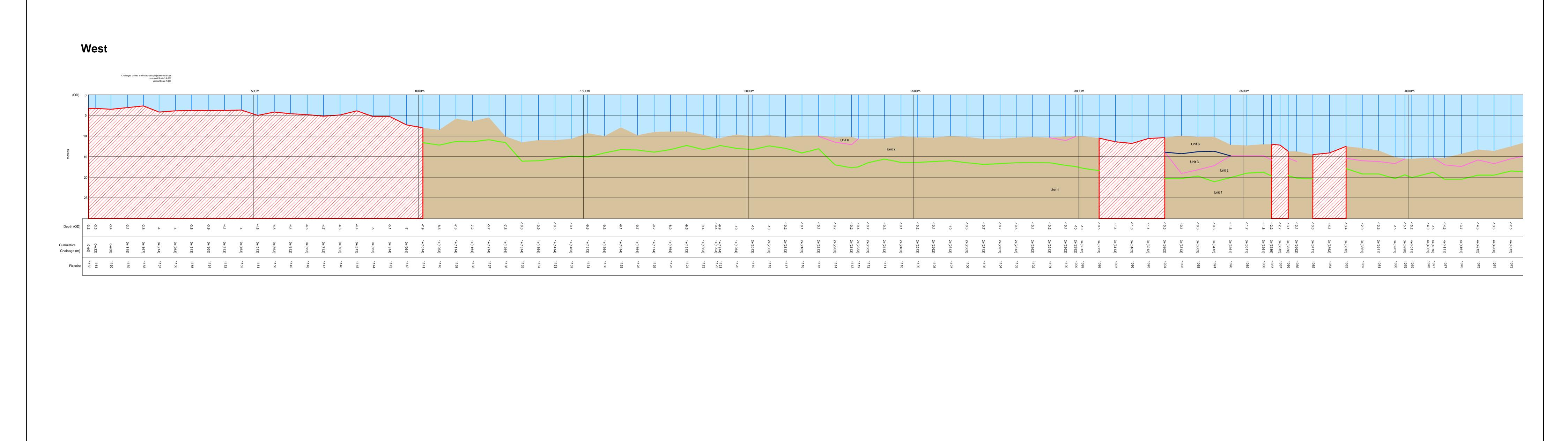
Tel: (44) 1489 860050 Fax: (44) 1489 860051 www.emulimited.com

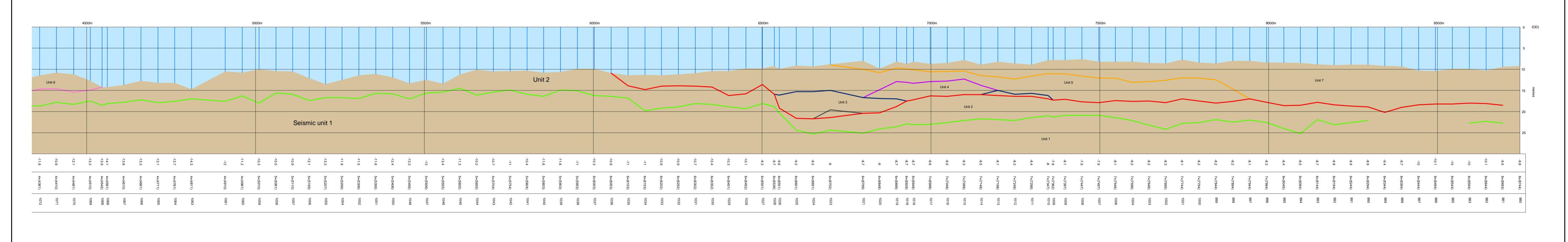


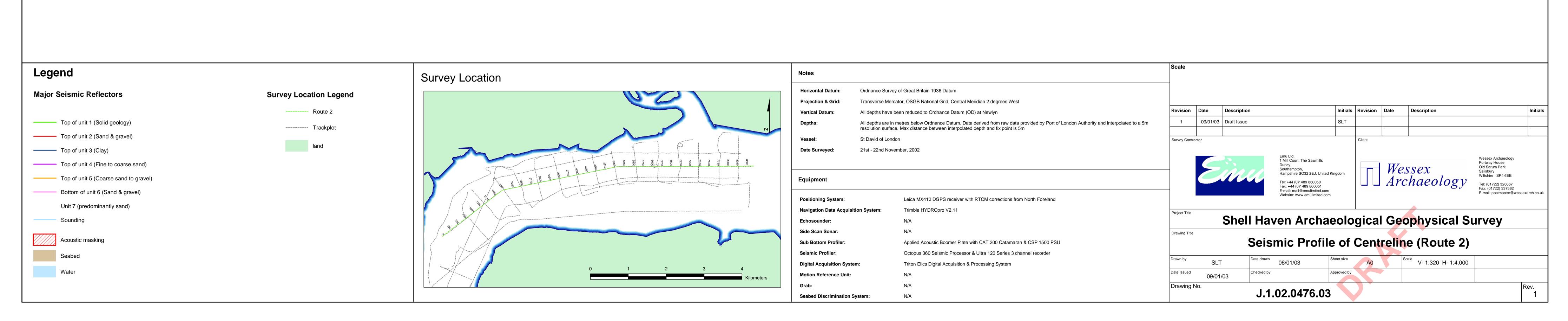





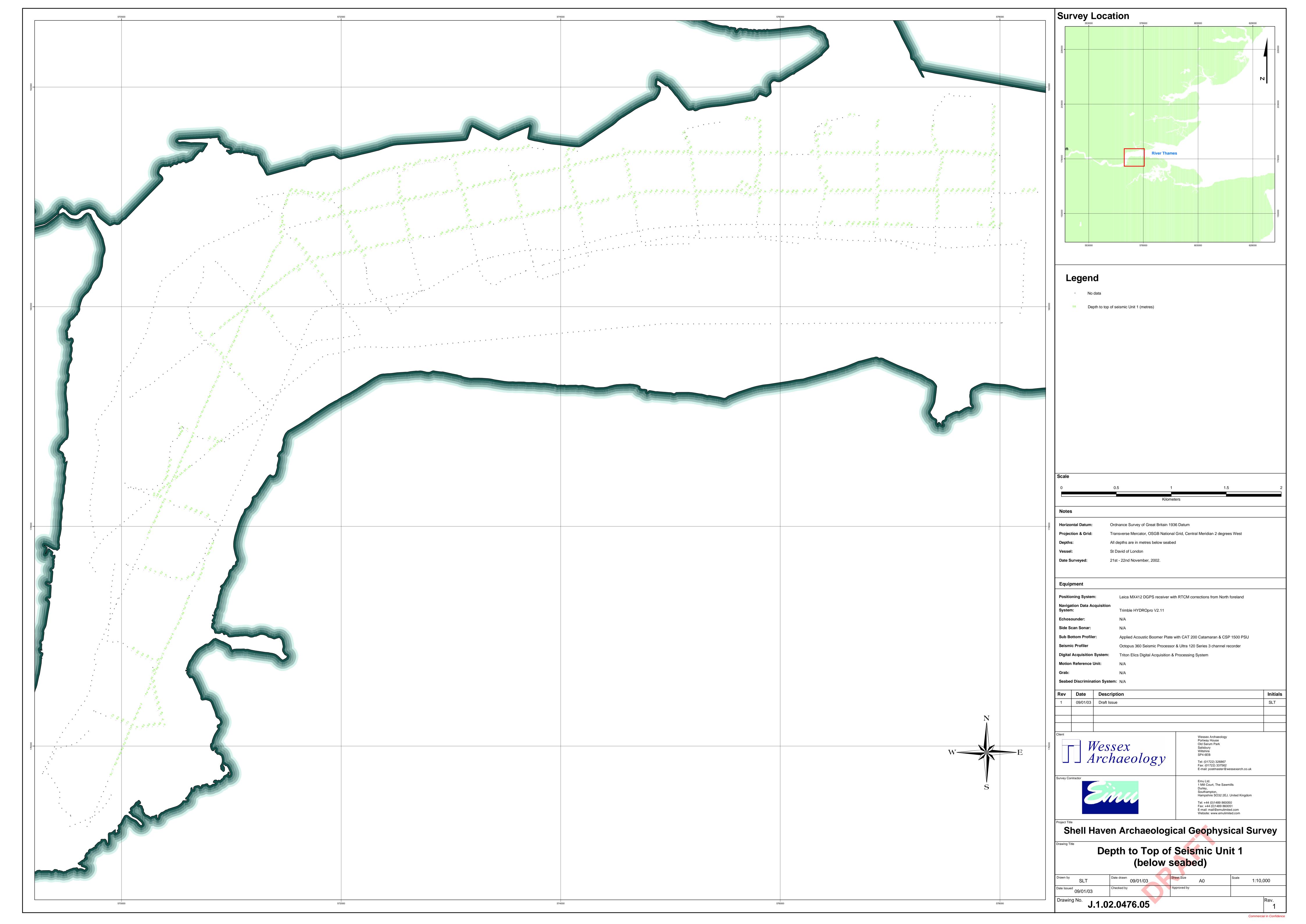


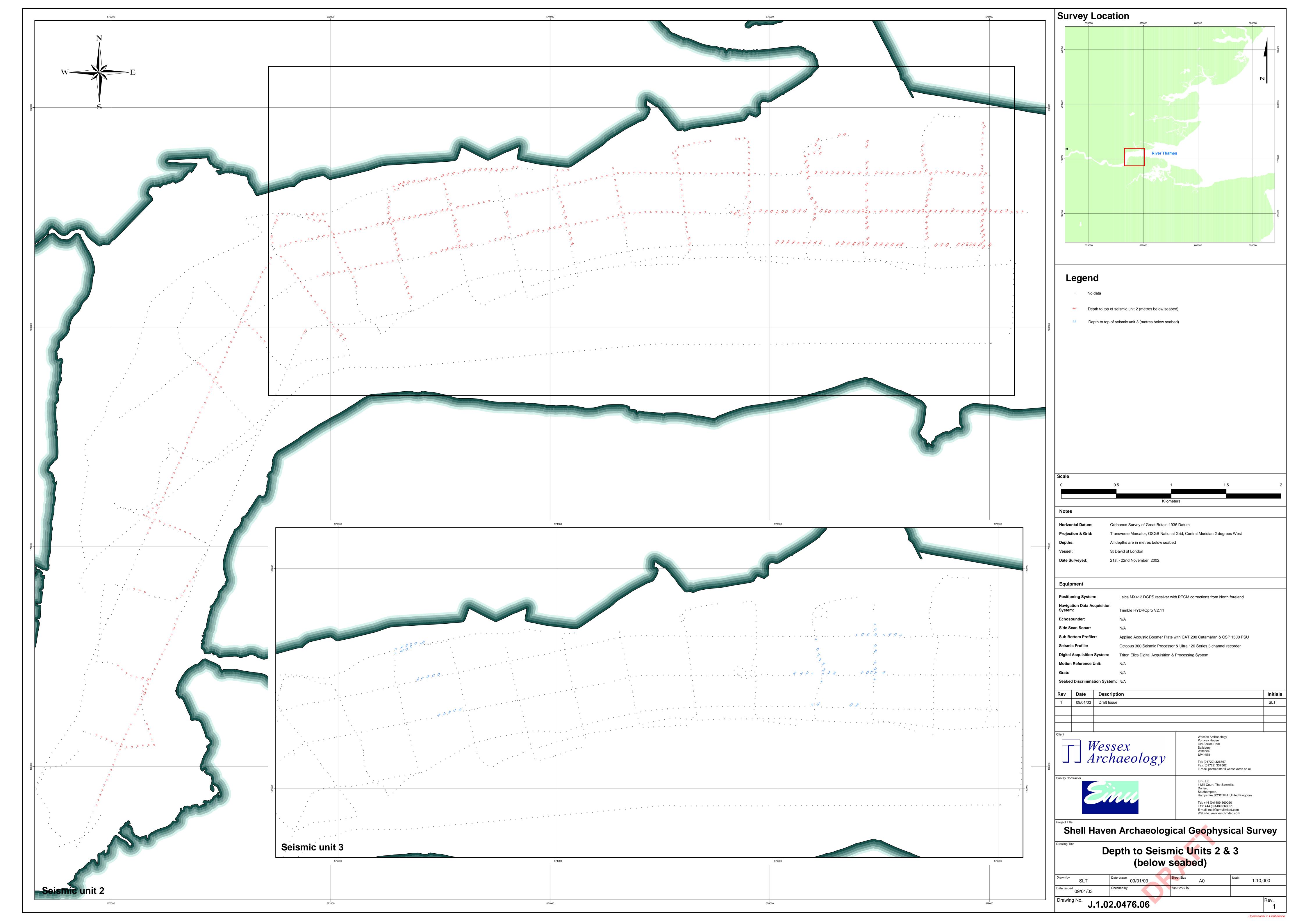


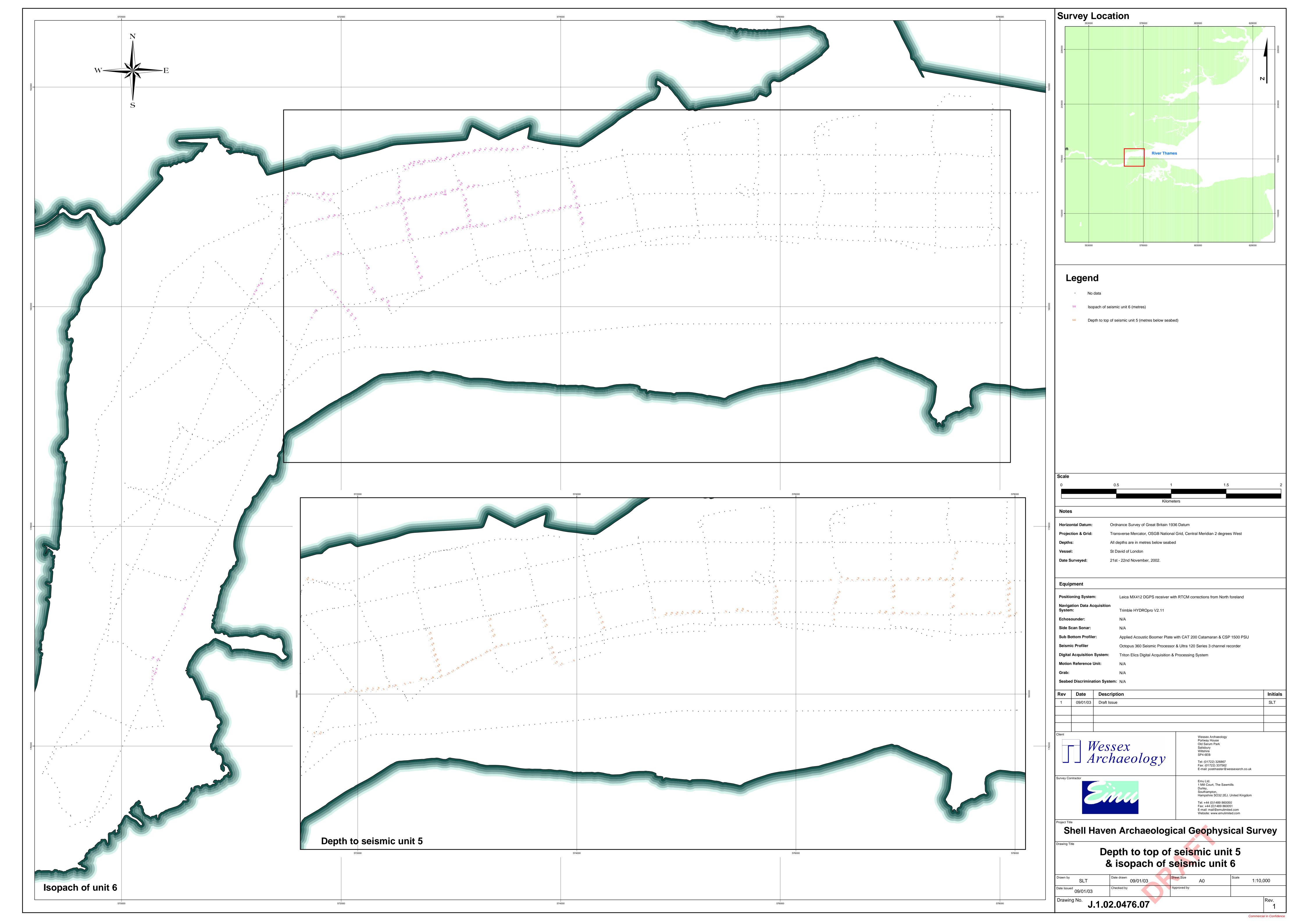


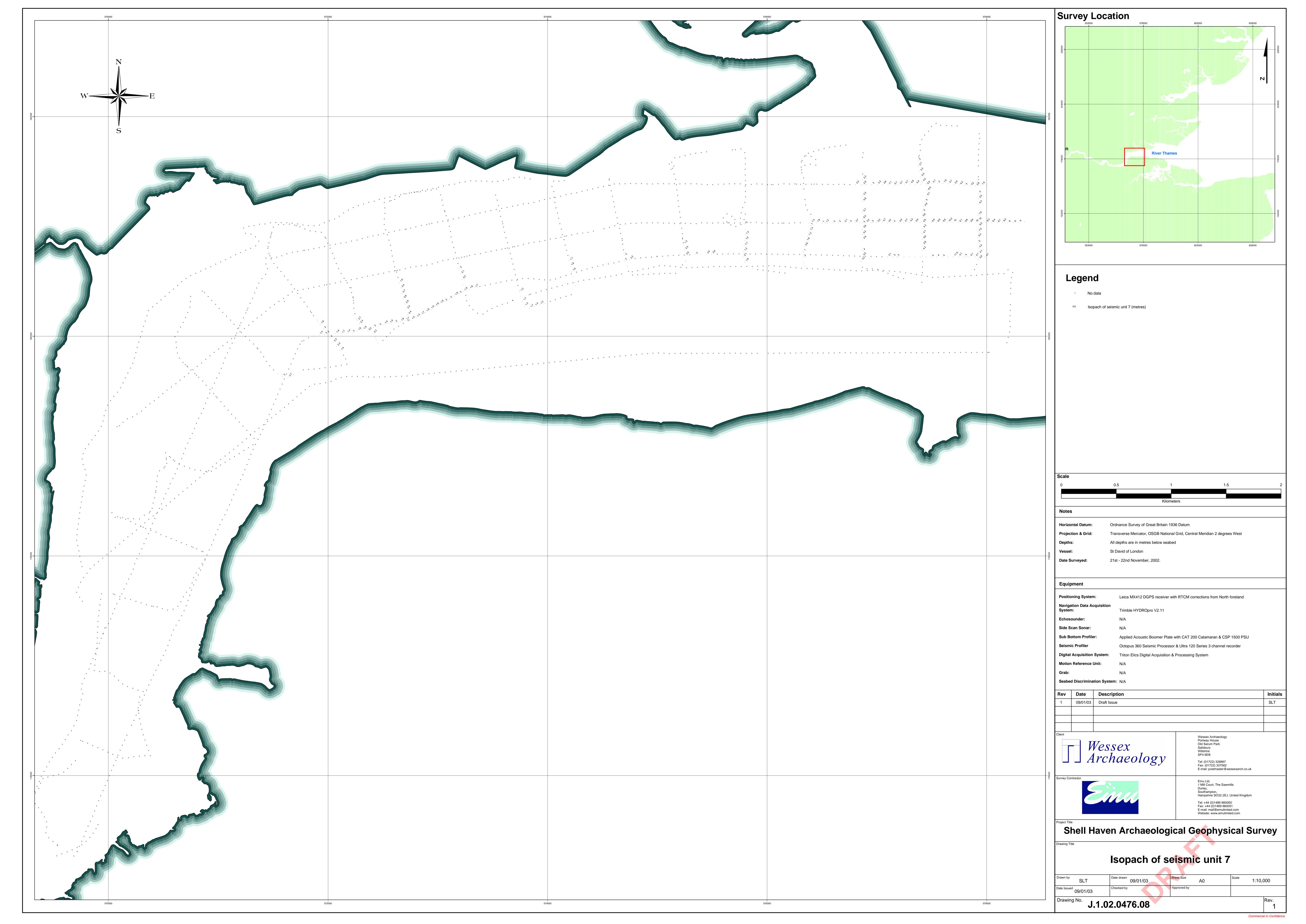












in respect of the proposed development of

London Gateway

Appendix Q: Enhanced Wreck Site Identification

March 2003

Draft and Confidential

in respect of the proposed development of

London Gateway

Appendix Q: Enhanced Wreck Site Identification

Prepared by Stuart Leather

Approved by Antony Firth

Head of Coastal and Marine Projects

Draft and Confidential

Version: 1.3 Reference: 49575 Date: 7 March 2003

in respect of the proposed development of

London Gateway

Appendix Q: Enhanced Wreck Site Identification

Version: 1.3 Reference: 49575 Date: 7 March 2003

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London Gateway

Appendix Q: Enhanced Wreck Site Identification

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Stuart Leather prepared this report. The illustrations are by Rob Goller. Antony Firth managed the project for Wessex Archaeology.

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Appendix Q: Enhanced Wreck Site Identification

Version: 1.3 Reference: 49575 Date: 7 March 2003

BACKGROUND

1.1. INTRODUCTION

- 1.1.1. Further investigations were proposed to enhance the Environmental Assessment of London Gateway, to include *Task 5: Enhanced Wreck Site Identification*.
- 1.1.2. Task 5 comprised two elements, a review of existing sidescan survey, and additional sidescan and magnetometer survey. For the purposes of Task 5, the Survey Area comprised the Limit of Deviation (LOD) and an area of proposed dredging extending 2.77km eastwards along the channel from the Sea Reach No.1 navigation buoy (Figure 1). The potential for archaeological material in proposed Dredging Areas beyond this Survey Area is not addressed in this report.
- 1.1.3. Wessex Archaeology was instructed to undertake Task 5 by Faber Maunsell in October 2002.

1.2. REVIEW OF EXISTING DATA

- 1.2.1. The existing sidescan data was collected on 29-30 March 2001 by Emu Ltd in the course of geotechnical investigations (see Emu Environment Ltd., June 2001). Although the sidescan data was acquired, no processing occurred until the present study.
- 1.2.2. In addition to the sidescan data, Wessex Archaeology was provided with a copy of a database of seabed features maintained by the PLA.
- 1.2.3. Both the existing sidescan data and the PLA data extend beyond the area addressed in the review. Accordingly, both datasets were filtered to include only those sites within the Survey Area.

1.3. 2002 SIDESCAN AND MAGNETOMETER SURVEY

1.3.1. The additional sidescan and magnetometer survey was carried out between 14th - 18th November 2002. Emu Ltd. were contracted to undertake the survey under the supervision of Wessex Archaeology.

AIMS AND OBJECTIVES

- 2.1. The aim of the work was to enhance the assessment of the effects on the cultural heritage of the London Gateway proposals.
- 2.2. The objectives of the survey were:
 - to review wreck data held by the PLA;
 - to identify anomalies recorded by the 2001 sidescan survey;
 - to acquire new, higher resolution, sidescan data and magnetometer data:
 - to correlate the results of the above work with the earlier results of deskbased assessment.

METHODOLOGY

3.1. REVIEW OF PLA DATABASE AND EXISTING SIDESCAN DATA

- 3.1.1. The PLA data, comprising a revision dated 2002, was supplied via Halcrow. Until the present study, WA had been aware of the PLA data only through extracts in Halcrow reports. Data is exchanged between PLA and UKHO, which was a principal source for WA's earlier desk-based assessment. Consequently, the main expectation was not that 'new' sites might be identified from the PLA data, but that further information could be added to records of wrecks and anomalies already known to the LG project. Data from the PLA and from Wessex Archaeology's earlier desk-based assessment that fall within the Survey Area are shown on Figure 2.
- 3.1.2. As noted above, the existing sidescan data was collected on 29-30 March 2001 by Emu Ltd.in the course of geotechnical investigations (see Emu Environment Ltd., June 2001). The survey was undertaken from the vessel Wessex Explorer and the equipment comprised a EG&G 272 side scan sonar fish with a EG&G 260 thermal recorder interfaced to a Triton Elics digital acquisition and processing system operated at 100KHz and a range setting of 150m per channel. Navigation data was supplied through a Leica MX420 Differential Global Positioning System (DGPS) receiver integrated with Trimble Hydro pro survey software. Two survey lines were run giving total coverage of the proposed dredge channel (see Fig. 3). Overlap was obtained in the central 100m corridor.

- 3.1.3. The existing sidescan data was processed by Wessex Archaeology and Emu Ltd.on 23-28 October at WA's offices. The data was analysed in Delphmap software, using different gain settings to optimise target recognition. Anomalies were observed, their co-ordinates obtained, and images captured as non-georeferenced. tif files.
- 3.1.4. Anomalies within the Survey Area were reviewed in conjunction with the results of WA's earlier desk-based studies and the PLA data between 28 October and 8 November. The three datasets were mapped using MapInfo, which also enabled access to background mapping, charts and scheme details. The review was essentially geographical, in that records that coincided when mapped were assumed to relate to a single wreck/anomaly.

3.2. 2002 SIDESCAN AND MAGNETOMETER SURVEY

Aquisition

- 3.2.1. The 2002 survey was carried out by Emu Ltd. on behalf of Wessex Archaeology from the survey vessel *Avanti* between 14th 18th November 2002. A member of Wessex Archaeology staff was on board the vessel throughout the survey.
- 3.2.2. The sidescan sonar equipment comprised a EG&G 272 side scan sonar fish with a EG&G 260 thermal recorder interfaced to a Triton Elics digital acquisition and processing system. The survey was generally undertaken at 500KHz and a range setting of 75m per channel.
- 3.2.3. A Geometrics G881 caesium magnetometer was interfaced into the navigation computer where the magnetic field strength was recorded. Magnetometers record data corresponding to an area directly below the towfish. The area of detection depends on the density of ferrous material in the anomaly and its proximity to the sensor, as the field strength is proportional to the distance from the source.
- 3.2.4. Navigation data was supplied through a Leica MX420 Differential Global Positioning System (DGPS) receiver integrated with Trimble HydroPro survey and navigation software.
- 3.2.5. Four survey lines were run at a spacing of 100m in the main channel, with the sidescan sonar and the magnetometer operating concurrently. Total coverage of proposed Dredging Areas within the Survey Area was achieved by the sidescan sonar, with overlap in the central 100m corridor (see Fig. 4).

- 3.2.6. In the area adjacent to the proposed jetty construction, lines were run at a spacing of 100m. However, the magnetometer was not used in this area in order to facilitate the movements of the survey vessel.
- 3.2.7. In the area proposed for the channel turning circle, lines were run at a spacing of 150m. The sidescan sonar and magnetometer were run concurrently. The sidescan sonar was operated at 100kHz to allow for the increased line spacing.

Processing

- 3.2.8. The sidescan sonar data was processed in Triton Elics' Isis and Delphmap software using different gain settings to optimise target recognition. Anomalies were observed, their co-ordinates obtained, and images captured as non-geo-referenced tif files. Anomalies of high archaeological potential, or areas showing scatters of material, were recorded as geo-referenced tif files.
- 3.2.9. The magnetometer data was processed to give an x,y,z file comprising NGRs (x,y) and magnetic field strength (z). The difference between consecutive values for magnetic field strengths was calculated to minimise the effect of the diurnal variation in the ambient magnetic field. If left unfiltered, such variation would mask local rapid changes in the data indicating magnetic anomalies. The data were plotted with the values represented by graded colour bands to show changes in the magnetic field.

Interpretation

- 3.2.10. Anomalies from the 2002 sidescan and magnetometer data were incorporated into a Geographical Information System (GIS) where they were compared, in terms of their character and proximity, to sites arising from the desk-based assessment (DBA), from the PLA database, and from the 2001 sidescan survey. The GIS also enabled all the datasets to be reviewed in conjunction with background mapping, charts and scheme data. This layering is illustrated in Figure 5. As a result it was possible to identify correspondences between DBA/PLA sites and anomalies, new sites, and sites recorded in the DBA/PLA sites with no corresponding features on the seabed.
- 3.2.11. The consolidated list of sites arising from this process was then assessed in terms of their possible archaeological interest. Sites were rated according to their proximity to recorded sites, size and shape, correspondence between 2001 and 2002 sidescan data, and correspondence with magnetic anomalies.
- 3.2.12. Ratings were ascribed as follows:

High

Ascribed when several datasets coincide with the site description in the PLA or DBA suggesting an archaeological origin or sidescan data warrants definite further investigation. Examples are shown in Figure 7.

Medium

A sidescan sonar target with a possible archaeological origin, or a weak sidescan target with a magnetometer deflection in close proximity. An example is shown in Figure 8 (top).

Comprised an ephemeral or small sidescan sonar target with no corroborating data. An example is shown in Figure 8 (bottom)

Target unlikely to be of archaeological origin.

3.2.13. It should be emphasised that the identification of a site on the basis of sidescan, magnetometer or previous hydrographic survey does not imply that the site is necessarily of archaeological interest. Many of the sites so identified may prove to be of modern origin, or to be – for example – geological exposures, features attributable to sediment movement, or scars from fishing gear. Some of the sites are, however, clearly of archaeological interest. The form, size and/or extent of anomalies need not enable easy discrimination; a single small but prominent anomaly may comprise all that is present, or it 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 as a result of past impacts from dredging or fishing, for example. The application of a rating system is, therefore, a means of prioritising sites to inform mitigatory investigations.

4. RESULTS

4.1. A total of 453 sites fall within the Survey Area. The resulting list is set out in Appendix I of this report. The list includes the rating ascribed to the possible archaeological interest of the site, and cross-refers to the data sources. The distribution of resulting sites in shown in Figure 6. The sites have been rated as follows:

Rating	Total
High	25
Medium	112
Low	306
0	10
	453

4.2. Information about 62 of the sites in the Survey Area arises from Wessex Archaeology's previous desk-based assessment. The gazetteer arising from the desk- based assessment is set out in Appendix B of The (London Gateway Port) Harbour Empowerment Order 2002: Assessment of Effects Cultural Heritage in Respect of the Proposed

- Development of London Gateway Port Development (CD/HEO/15.1/FINAL).
- 4.3. Information about 70 of the sites in the Survey Area arises from the PLA database. Relevant sites from the PLA database are set out in Appendix II of this report. PLA and DBA sites falling within the Survey Area are shown on Figure 2.
- 4.4. Ninety-seven sites in the Survey Area are represented by anomalies in the 2001 sidescan data. Sites from the 2001 sidescan survey falling within the Survey Area are set out in Appendix III of this report (see Fig. 3).
- 4.5. Altogether, 335 anomalies were identified from the 2002 sidescan and magnetometer survey, as set out in Appendix III of this report (see Fig. 4).

5. DISCUSSION

- 5.1. The quality of the 2002 sidescan data was good, enhancing and expanding data from the 2001 survey. A far greater number of anomalies were observed, indicating the value of the higher resolution survey. Issues arising in respect of the data and their archaeological implications are raised in the following paragraphs.
- 5.2. Anomalies were identified from the 2002 data that were not identified from the 2001 data, but which are corroborated by the PLA data. An example is WA 5026, which corresponds to a PLA record of the remains of a wartime submarine defence (see Fig. 9). Figure 9 also shows clearly the presence of bedforms indicating movement of the seabed. Such movement could cause sites to be periodically covered and uncovered, and explain why some sites appear in the 2001 sidescan data but not the 2002 sidescan data. Further
- 5.3. Although the proposed Dredging Areas received comprehensive cover, some areas within the Limit of Deviation fell outside the coverage of both the 2001 and 2002 surveys. One site where this was the case is that of the London (5029). The desk-based assessment described the wreck of the London as a 64 gun ship dating to 1665. The PLA database describes the site as the Cannon Wreck but contains very little information. As the site fell outside the cover of the 2001 and 2002 surveys, an sidescan image of the wreck was acquired by the PLA on behalf of Wessex Archaeology. The image clearly shows a large anomaly, proud of the seabed at the reported location of the London (Figure 10).

- 5.4. The Dovenby (5010; 5012) was a barque that sank in 1919 with a cargo of guano from South America. The ship broke in two after a collision and sank in the channel. The accident is well documented in the records of the PLA and UKHO. The ship is represented on the current Admiralty Chart as two distinct areas. Both areas have been swept to confirm the navigable depth of the channel. The sidescan survey undertaken in 2001 clearly shows the two areas of wreckage with the more distinctive 'ship-shape' to the north (Figure 11). The 2002 sidescan and magnetometer survey shows the two sites highlighted in 2001 but in considerably greater detail; individual features and elements of structure are apparent. Also shown is an area containing wreckage (7369) between the two sites that also has a very high magnetometer deflection. This additional area of debris is not apparent in the 2001 sidescan data, or in the PLA or desk-based assessment information.
- 5.5. The information provided in the DBA and the PLA describes the wreck of the King (5019) as an historic wreck. A cannon was recovered from the site in 1962 and dated to 1636. The PLA suggest that the true name of the vessel is not the King but no other information is given. The existence of a substantial anomaly at the reported location of the King was confirmed by the 2001 sidescan data (see Fig. 12, top). However, the character and extent of the site are more readily apparent in the 2002 sidescan data. There are two apparently discrete areas of wreckage linked by scour and sediment plumes. One area appears auite broken; the other contains a substantial (c. 30m) section of coherent structure likely to be either the base of the hull, or a side. This section is associated with a further area of relatively coherent structure. It is assumed at resent that these areas of structure all have their origin in a single vessel, but it is possible that the remains of more than one vessel is present.
- 5.6. Far less prominent are the remains of the 'iron bar' wreck (5020) recorded in both the desk-based assessment and the PLA database. The vessel was located in 1978 and is reported to be wooden and carrying a cargo of iron bars. The wreck was 'swept clear', though the officer in charge of dredging 'stated that it could not be guaranteed that all remains of this old vessel had been cleared' (PLA 686). Both the 2001 and 2002 sidescan data show anomalies in the vicinity, confirming that some remains of this vessel appear to have survived (see Fig. 13).
- 5.7. A similar case is presented by the 'ancient wreck' (5185) identified by the desk-based assessment but reported to have been salvaged. Both the 2001 and 2002 sidescan surveys indicate anomalies in the vicinity that may suggest that some remains of the vessel may survive (see Fig. 14). It is worth noting that without corroboration from the desk-based

assessment, these anomalies are likely to have been rated as of 'low' archaeological interest. It follows that sites currently rated as 'low' or 'medium' may yet prove to be of archaeological interest.

- 5.8. In addition to 'maritime' anomalies comprising wreck or other ship-related debris, sidescan also has potential to identify anomalies of possible prehistoric interest. Figure 15 shows the two ends of a long linear anomaly (7509; 7510) that is interpreted as a geological exposure, possibly of a horizon of dense clay or even peat. Given the depth and location of this horizon on the southern side of the channel opposite Shell Haven, it is possible that the anomaly represents a layer that is of palaeo-environmental interest laid down in the Holocene.
- 5.9. It is worth noting that not all sites identified from the desk-based assessment or PLA data are confirmed by the sidescan surveys. In particular, there is not trace of one of the aircraft (5041) recorded in the desk-based assessment and in the PLA database. Some material may have been removed or otherwise lost as a result of previous clearance or dredging. Other examples may have been covered by mobile sediment at the time of the survey. Further, there remains the possibility that some material of archaeological interest is not susceptible to detection using the methods employed, even if present on the surface of the seabed.

6. CONCLUSION

- 6.1. This study has correlated several datasets and acquired new data that have enhanced the identification of sites of archaeological interest within the Survey Area. A total of 453 sites fall within the Survey Area. The presence, extent and character of some sites of archaeological interest has been confirmed, including the London (5029), Dovenby (5010; 5012), and King (5019). Anomalies have also been confirmed at the reported locations of the 'iron bar' wreck (5020) and 'ancient wreck' (5185). Anomalies and other data indicative of the presence of further sites of archaeological interest have also been detailed, though it should be emphasised that the identification of a site on the basis of sidescan, magnetometer or previous hydrographic survey does not imply that the site is necessarily of archaeological interest. The further possibility of the presence of archaeological material not identified in the present study – due to burial, sediment movement or insusceptibility to the techniques employed – has also been raised.
- 6.2. This study considerably enhances knowledge of the archaeological potential of the Yantlet channel and will facilitate implementation of the Archaeological Mitigation Framework.

APPENDIX I: RESULTING LIST OF SITES

WA	NGR	PLA	2001target	2002 target	Rating
5007	601499 180605	17	88		М
5009	600884 180646	109			L
5010	597736 180652	717	40	415;289	Н
5012	597665 180831	716		518	Н
5012	597754 180693	716	91	288	Н
5014	598667 181061				L
5019	589852 180959	706	98	314;369;524	Н
5020	589083 181079	686	99	318	Н
5021	576822 181181	596	124	448	М
5023	577362 181478	604	125		М
5024	576189 181024				М
5025	596152 180470	713			М
5026	596150 180553	712		297	Н
5027	578476 181182	593			М
5028	587819 181066	681		239	Н
5029	590283 180961	707			Н
5030	575635 180980	599			L
5033	573812 181448				L
5035	571750 180110	583	3	209	L
5038	593097 180321	766			М
5039	593447 180339			299	L
5040	593369 180270			388	Н
5041	601412 180241	18			М
5044	582981 181166				L
5045	598663 180827	728			М
5046	599115 181000	729	90	513	М
5049	579633 181363	699			L
5050	580547 181526	698		337	Н
5051	576540 181289	592	123	221	М
5148	574719 181033	581		218	М
5149	573144 180797	582			L
5150	578381 181137	591			L
5178	578025 181472	598			L
5180	578477 181209				L
5181	576291 181061	602			L

WA	NGR	PLA	2001target	2002 target	Rating
5183	581186 181135	614			L
5185	572660 180610		117;116	214	L
5185	572660 180610		117;116	214	L
5186	587661 181138				L
5189	578915 181045				М
5190	580330 181058	610			L
5191	581282 181060	615			L
5193	596637 180433	791			L,
5195	596181 180348	794			М
5196	591675 180150				М
5197	592690 180148	785			М
5198	595125 180237				L
5201	596189 180245				М
5202	596092 180236				L
5203	595997 180215				L
5204	593856 180124	793			L,
5208	595902 180197	742			L
5213	594405 180111				L,
5220	593516 180031				L
5221	593863 180042				L
5222	593921 180041				L
5223	593849 180034				L
5229	584391 181079	637		452	L
5230	591475 180321				L
5534	587024 181471				L
5588	585582 180984				L
5860	591901 180197				L
6595	602777 180075	26	87		М
6596	572700 181400				L
7101	572446 180464		1	212	0
7102	572012 180333		2		L
7103	573522 180791		4		L
7104	573789 180756		5		L
7105	575378 181180		6		L
7106	575678 181253		7	275	М

WA	NGR	PLA	2001target	2002 target	Rating
7106	575362 181085		7	275;219	М
7107	578329 181436		8;18	274	М
7107	575685 181195			8	L
7108	575629 181199		9		L
7109	572684 180705		10	211	М
7110	576162 181178		10		L
7111	576162 181178		10		L
7112	576415 181094		11		L
7113	577195 181257		12	449	М
7114	577269 181137		13		L
7115	577467 181179		14		L
7116	577715 181152		15		L
7117	577946 181157		16		L
7118	578191 181315		17		L
7120	578507 181275		19		L
7121	578851 181208		20		М
7122	579904 181340		21		L
7123	580773 181115		22		L
7124	581794 181315		23	233	М
7124	581622 181124		23		L
7125	571663 181029		120		L
7126	590049 180740		25	311	М
7127	590496 180623		26		L
7128	591643 180302		27	475	Н
7129	592330 180242	803	28		L
7130	592717 180262		29		L
7133	593481 180196		32		L
7134	595667 180382		33		L
7135	596375 180407		34		L
7136	596526 180601		35	294;408	0
7137	597062 180537		36		L
7138	597353 180569		37		L
7139	597499 180555		38		L
7140	597597 180634		39	414	Н
7141	597993 180541		41		L
7142	598054 180646		42		L
7143	598537 180534		43		М
7144	598799 180526		44		L

WA	NGR	PLA	2001target	2002 target	Rating
7145	598984 180673		45	_	L
7146	599174 180685		46		L
7147	599415 180698	Ī	47		L
7148	599644 180749		48		L
7149	599754 180817		49		L
7150	599749 180779	Ī	50	489;430;431	0
7151	600164 180740		51		L
7152	600165 180725	Ī	52		L
7153	600208 180552		53		L
7154	600742 180370		54		L
7155	600780 180383	Ī	55		L
7156	601041 180427		56		L
7157	601863 180075		57		L
7158	602345 179870		58	494	L
7159	599762 180915		89		L
7160	594338 180555		92		L
7163	592769 180315		94		L
7164	590723 180670		95		L
7165	590706 180812		96		L
7166	589999 180923		97		L
7167	588588 181134		100	320	L
7169	587213 181317		102		М
7170	585046 181464		103		L
7171	581812 181343		24;104	265;260;261	L
7172	584883 181501		105		L
7173	584403 181485		106		L
7174	583605 181347		107	257	М
7175	583369 181346		108	258	L
7176	583199 181396		109	259	М
7177	581371 181594		110		L
7178	577506 181508		111		L
7179	575957 181390		112		L
7180	573754 180838		113		L
7181	573658 180866		114	279	L
7182	573600 181040		115	208	L
7183	573254 181431		121		L
7184	572482 181249		122		L
7213	573468 181054	588		206;207	М

WA	NGR	PLA	2001target	2002 target	Rating
7214	576338 181071	595			L
7215	576872 181151	606			L
7216	581257 181310	613			М
7216	581257 181310	613			М
7217	581708 181310	619		232	М
7218	581865 181436	702			L
7219	582981 181166	694			L
7220	584113 181411	802		329	М
7221	584650 181414	697			L
7222	585125 181485	652			L
7223	589443 181077	797			L
7224	591581 180310	806			L
7225	596650 180455	753			L
7226	597431 180476	792			L
7227	601470 180240	136			L
7301	574021 181434			200	L
7302	573216 181262			201	М
7303	572240 180923			202	L
7304	572231 180940			203	L
7305	572743 181055			204	L
7306	573671 181138			205	L
7307	572034 180327			210	L
7308	572251 180428			213	L
7309	572936 180662			215	L
7310	573735 180796			216	L
7311	574550 180988			217	М
7313	575297 181084			220	L
7314	577469 181315			222	М
7315	577534 181321			223	L
7316	577566 181293			224	L
7317	577742 181313			225	М
7318	578190 181344			226	L
7319	579530 181285			227	L
7320	579929 181288			228	М
7321	580102 181319			229	L
7322	580737 181279			230	М
7323	582161 181308			231	L
7324	581784 181310			234	L

WA	NGR	PLA	2001target	2002 target	Rating
7326	585806 181262			236	М
7327	586244 181202			237	L
7328	586169 181170			238	L
7329	588015 181025			240	М
7330	588496 180971			241	L
7331	588617 180915			242	L
7332	589187 180822			243	L
7333	589546 180763			244	М
7334	589737 180736			245	L
7335	590051 180745			246	0
7336	589370 180926			247	L
7337	589071 180981			248	L
7338	588880 181026			249	L
7339	588592 181070			250	L
7340	588195 181097			251	L
7341	587986 181183			252	L
7342	586895 181239			253	L
7343	586913 181276			254	L
7344	585044 181319			235;255	L
7345	584291 181387			256	Н
7346	582380 181355			262	L
7347	581971 181412			263	L
7348	581883 181363			264	L
7349	580540 181387			266	0
7350	580374 181410			267	М
7351	579969 181366			268	М
7352	579975 181417			269	L
7353	578740 181383			270	L
7354	576324 181387			271	L
7355	576203 181341			272	М
7356	576013 181309			273	L
7357	575484 181260			276	М
7358	574651 181052			277	L
7359	573928 180973			278	М
7360	573424 180861			280	М
7361	600541 180735			281	L
7362	600215 180861			282	L
7363	600148 180816			283	L

WA	NGR	PLA	2001target	2002 target	Rating
7364	600045 180860			284	L
7365	599939 180918			285	L
7366	599841 180837			286	L
7367	598090 180745			287	L
7368	597717 180720			290	Н
7369	597659 180705			291	Н
7370	597552 180678			292	Н
7371	597521 180725			293	Н
7373	596351 180563			295	L
7374	596321 180584			296	L
7375	593694 180366			298	Н
7376	592927 180367			300	L
7377	597950 180738			301	L
7378	591690 180397			302	L
7379	592810 180311			303	L
7380	592638 180414			304	L
7381	592395 180469			305	М
7382	591987 180444			306	L
7383	591829 180487			307	L
7384	591117 180576			308	L
7385	590540 180660			309	L
7386	590385 180709			310	L
7387	589993 180933			312	L
7388	590011 180883			313	L
7389	589690 180964			315	L
7390	589521 180960			316	L
7391	589164 181092			317	L
7392	588930 181070			319	Н
7394	588548 181188		101	321	М
7395	586553 181427			322	М
7396	586417 181418			323	L
7397	585667 181433			324	L
7398	585486 181446			325	L
7399	585339 181488			326	L
7400	585136 181496			327	L
7401	584886 181482			328	М
7403	584120 181497			330	М
7404	583617 181470			331	L

WA	NGR	PLA	2001target	2002 target	Rating
7405	583384 181445			332	М
7406	582174 181506			333	М
7407	582039 181461			334	L
7408	581045 181471			335	М
7409	580981 181516			336	L
7410	580230 181513			338	Н
7411	579943 181477			339	L
7412	579731 181532			340	L
7413	579761 181469			341	L
7414	579327 181526			342	L
7415	579027 181532			343	L
7416	578356 181532			344	L
7417	578198 181551			345	L
7418	578201 181529			346	L
7419	577334 181502			347	L
7420	576335 181460			348	L
7421	576173 181463			349	Н
7422	575336 181359			350	L
7423	575666 181360			351	М
7424	574533 181205			352	М
7425	572986 180845			353	М
7426	571796 180514			354	L
7427	589758 180693			355	М
7428	589870 180720			356	L
7429	590071 180718			357	L
7430	590103 180688			358	0
7431	590189 180682			359	L
7432	590214 180662			360	L
7433	590232 180660			361	L
7434	590296 180662			362	L
7435	590471 180614			363	М
7436	590195 180824			364	L
7437	590067 180740			365	L
7438	590040 180855			366	L
7439	589961 180859			367	L
7440	589908 180835			368	L
7441	589705 180956			370	L
7442	589684 180956			371	L

WA	NGR	PLA	2001target	2002 target	Rating
7443	589136 181081			372	L
7444	589255 180972			373	L
7445	589735 180917			374	L
7446	590086 180742			375	L
7447	590468 180640			376	L
7448	590942 180513			377	М
7449	591128 180504			378	L
7450	591200 180481			379	L
7451	591486 180423			380	М
7452	591650 180453			381	М
7453	592303 180281			382	М
7454	592536 180255			383	L
7455	592743 180307			384	L
7456	592783 180294			385	L
7457	592812 180303		31	386	0
7458	592861 180288			387	L
7460	593342 180296			389	L
7461	593363 180239			390	L
7462	595004 180391			391	L
7463	595012 180430			392	L
7464	595092 180421		İ	393	L
7465	595930 180504			394	L
7466	595981 180490			395	L
7467	595932 180496		İ	396	L
7468	595972 180461			397	L
7469	595976 180473			398	L
7470	595969 180436			399	L
7471	596027 180458			400	L
7472	596044 180483		İ	401	L
7473	596067 180494			402	L
7474	596137 180552			403	L
7475	596135 180474		İ	404	М
7476	596187 180463			405	М
7477	596219 180475			406	М
7478	596374 180532		j	407	L
7480	596680 180502			409	L
7481	596683 180540		İ	410	L
7482	596728 180527			411	L

WA	NGR	PLA	2001target	2002 target	Rating
7483	596854 180575			412	Н
7484	596961 180585			413	L
7485	598744 180717			416	М
7486	598787 180753			417	L
7487	598960 180768			418	L
7488	598942 180725			419	L
7489	599062 180740			420	L
7490	599157 180780			421	L
7491	599163 180731			422	L
7492	599196 180798			423	L
7493	599210 180743			424	L
7494	599226 180798			425	М
7495	599326 180747			426	L
7496	599486 180782			427	М
7497	599560 180840			428	L
7498	599860 180767			429	L
7500	599969 180809			432	М
7501	600047 180752			433	М
7502	600160 180787			434	М
7503	600186 180755			435	М
7504	600180 180717			436	L
7505	600233 180708			437	М
7506	600333 180702			438	L
7507	571630 179923			439	L
7508	572422 180447			440	L
7509	572515 180391			441	Н
7510	573226 180547			442	Н
7511	573066 180568			443	L
7512	573060 180591			444	L
7513	573540 180709			445	L
7514	573523 180689			446	L
7515	576358 181092			447	L
7517	577757 181178			450	L
7518	577776 181154			451	L
7519	578722 181189			453	М
7520	579027 181192			454	М
7521	580117 181177			455	L
7522	580375 181219			456	L

WA	NGR	PLA	2001target	2002 target	Rating
7523	581533 181207			457	М
7524	581608 181199			458	М
7525	582710 181173			459	М
7526	582771 181215			460	М
7527	582909 181166			461	М
7528	583354 181210			462	М
7529	585280 181143			463	М
7530	587822 180911			464	L
7531	588644 180814			465	Н
7532	589061 180750			466	М
7533	589202 180762			467	М
7534	589476 180728			468	L
7535	589440 180657			469	L
7536	589604 180691		İ	470	L
7537	589594 180613			471	L
7538	590442 180500			472	L
7539	590837 180414			473	L
7540	591525 180329			474	М
7541	591824 180271			476	L
7542	592311 180241			477	L
7543	592865 180151		30	478	L
7544	596161 180376			479	М
7545	596356 180409			480	L
7546	596371 180440			481	М
7547	596410 180433			482	М
7548	596800 180590			483	М
7549	598955 180664			484	М
7550	599333 180727			485	L
7551	599298 180641			486	L
7552	599343 180657			487	М
7553	599456 180673			488	М
7554	600185 180637			490	L
7555	602051 180040			491	L
7556	602130 180005			492	L
7557	602152 180005			493	L
7558	602139 180050			495	L
7559	597065 180683	İ		496	L
7560	597363 180726			497	М

WA	NGR	PLA	2001target	2002 target	Rating
7561	597965 180752		_	498	М
7562	598061 180736			499	М
7563	599689 180894			500	L
7564	600281 180799			501	L
7565	600518 180730			502	М
7566	601341 180412			503	L
7567	602172 180232			504	М
7568	601714 180451			505	L
7569	600630 180824			506	М
7570	600135 180997			507	L
7571	600134 180958			508	L
7572	599979 180958			509	L
7573	599697 181032			510	М
7574	599542 181019			511	М
7575	599461 181016			512	L
7576	598847 180984			514	L
7577	598407 180866			515	L
7578	598169 180853			516	М
7579	597917 180873			517	М
7581	597314 180809			519	М
7582	593416 180530		93	520	0
7583	592515 180466			521	L
7584	590689 180813			522	L
7585	589980 180930			523	L
7586	596569 180526			525	0
7587	595736 181490			526	М
7588	595299 181506			527	М
7589	595282 181458			528	М
7590	571900 181033			529	0
7591	571097 180577			530	L
7592	571094 180598			531	М
7593	571544 180558			532	L
7594	571832 180522			533	L
7595	571710 180525			534	L
7596	573046 180352	587			L
7597	573565 180507	584			L
7598	572470 181498	589			L
7599	572873 181416	585			L

WA	NGR	PLA	2001target	2002 target	Rating
7600	573174 181347	586			L
7601	585205 181594	703			L
7602	593889 180076	795			L

APPENDIX II: PLA DATA RELATING TO THE SURVEY AREA

WA	PLA	PLA History of Feature
5009	109	Located by PLA in 1967. Original report of further details not available, this info. taken from PLA Wreck sheet.
		Retained for record purposes.
5010	717	This is the south part of the Dovenby last swept by Maplin, close sounded by Chartwell during the 1990 main survey.Remains charted as swept
		12.2. See 343-11, north part of wreck.
		Posn 597733mE 180633mN.
		Re-examined 4 December 96 Posn 597734mE 180659mN least depth 12.8 scour 18.4 bed 13 to 15m. This search found less water than on the
		previous examination but still deeper than the swept depth. Wreckage covers and area 75 x 65 mtrs E/W, N/S, full extent of the scour not
		determined. See drawing 113-343-019.
		H.O. Chart as 12.2m swept in new fixed position.
		Wreck Book 3/281 Rpt 5/79,E8/90, 46/96, ***SEE PREVIOUS RECORD FOR ADDITIONAL HISTORICAL INFORMATION***
5012	716	North part of the Dovenby sunk in 1919. Last swept by Maplin in 1981. Close E/S search during 1990 main survey gave least depth 12.0m. Remains
3012	710	charted at 11.7m. Posn 597653mE 180799mN
		Following a visit to the Guildhall Library, Lloyds Register of 1897/8 was being inspected in respect of the HAWKSDALE PLA 209/1, when it was found
		that her owners/managers were also that of the Dovenby. Lloyds Register lists as follows:
		Off. No 99313 Code L. MHDK Steel Barque 1653 T Gross 1547 T Net Port of Reg. Liverpool Built 1891 by W Pickersgill of Sunderland Dimensions L
		256' B 38.1' D 22' Raised quarter deck Focstle. Bar keel 9.5" Owner P Iredale & Porter of Mersey Chambers, Old Church Yard, Liverpool.
		Re-examination 15 October 96 Posn 597642mE 180809mN least depth 12.1 scour 17.0 bed 14 to 15m - wreckage 50 x 10 mtrs NNW/SSE direction,
		wreckage fragmented in a well defined scour.
		H.O. Chart as 11.7 swept wk in new position.
501.4	700	Wreck Book 3/280 & 3/311 Rpt 4/79,1/81,E7/90, 43/96,
5014	720	Comments in 1979, "Difficult to sweep in a small scour hole, about same level as surrounding sea bed." In 1990 close E/S search deepest water
		within 10 metres of previous position is 13.5,general depth 13m. Considered to have covered, charted as foul - hatch symbol.
5019	706	Wreck Book 3/292 Rpt 16/79,E11/90 * This is not the real name. Wreckage identified on charts as "K".
3017	700	Apparently located by E.S. in 1962. A cannon dated 1636 was salvaged from this wreck.
		Close sounded 15 Feb 1999, least depth in position 589844mE 180955mN - to be swept.
		Wreck book 4/405
		Rpts. HS/1/79,E1/90,8/99,
		8/99, 23/99, 28/99: Close sounding confirmed former position - see 113-343-024
		An awkward sweep made on both flood and ebb before satisfactorily concluded.
		HO: chart as 10.4m swept wreck

WA	PLA	PLA History of Feature
5020	686	From past records recorded as an unknown wooden vessel containing a cargo of iron bars. Wreck apparently first located durign periodic survey on Jan.'78, and then swept clear 11.2, bed 12.0 scour 12.4 E/S 11.6m on 10th May '78. Posn 589068mE 181085mN, examined from Havengore 10 Sept 85, Rept:- The remains of this wreckage shown on Admiralty chart 1185 as #, and by PLA as foul on previous 342. Close sounded within radius of 50 mtrs of the above posn. revealed no signs of wreckage. However as the report from the Salvage Officer in charge of the dredging stated that it could not be guarenteed that all remains of this old vessel had been cleared, plus the fact that some signs of debris were evident on the E. Record on subsequent channel surveys 'PLA 125' immediately after the salvage ops. It is recommended that the '#' remains. No least depth, scour or bed level info. reported. H.O. Agreed. Rpt. HL4/78, 5/85,
5021	596	Charted # examined as part of 341 main survey October 1998 position examined 576820mE 181183mN. Originally located 1971 and allocated Admiralty Wreck No 0033A obstruction 9.1m. Rept. HS6/80 position 576820mE 181174mN least depth 9.7m - a small obstruction not considered dangerous. H.O. Chart as #. Re-examined 12 Jan 88 least depth 9.8m position 576817mE 181184mN . Rpt HL2/88. Oct 98: An isolated object standing 0.3m above the bed with some minor scour to the NW. Position located 576823mE 181181mN least depth 9.8 bed 10.1m. Drawing 113-341-073 H.O. Chart as # symbol in new position. Rpt. HS6/80, HL2/88,56/1998,
5023	604	An unknown obstruction located 45 mtr south of the north channel edge of LCOW Canvey in 1980, least depth 13.8 bed 14.5m 577368mE 181485mN a small obstruction not considered dangerous. Echo record shows a whispy spike standing above the bed. Report dated 21 Nov.80. H.O Chart as #. 11 January 88, after extensive search, not found. H.O. Delete from chart. Rpt.: HS7/80, HS3/88, Admiralty wreck card 0028A circa 1971 REMAINS OF MINEFIELD OFF HOLEHAVEN, previous foul confirmed still to exist, 19 August 1971. Information retained for record purposes.
5024	597	Examined as part of 341 main svy, position shown on chart as 576183mE 181032mN. A small obs with perhaps a shallow scour sitting 0.3m proud of the bed in position 576190mE 181024mN. Least depth 9.1 bed 9.6m. Drawing 113-341-072 H.O. Chart as # in new position. Subsequently found earlier reports:- Aircraft lost 26/12/69, located 4/5/78 while looking for Mid Blyth Buoy, Divers positively identified, part salvaved, some pieces fell off during lifting operations. Least depth 9.6m Report HS12/1980. Re-examined 11 Jan 88 when least depth found at 8.7m. This obstruction is now 0.9m shallower than when last sounded! Position 576186mE 181032mN. Rpt.HS12/80, HS4/88, 55/1998,
5025	713	Originally located by Maplin, a very small obstruction considered to be part remains of boom. H.O. Chart as #. Rpt. HSR5/81

WA	PLA	PLA History of Feature
5026	712	This obstruction was located during the normal channel surveys. It has awaited a divers inspection since 1981. An attempt was made by divers but not located. However they did bring to surface what may have been part of the wartime submarine defence hardware, which was located
		in the vicinity. Posn 596150mE 180555mN.
		Re-examination 4 December 96 confirms the existence and nature of previous findings. Although marginally deeper this search, there is not sufficient evidence to warrant increasing the charted depth, it is recommended to remain at 10.8m. Additionally Shivering Sand tides not available. Posn 596152mE 180552mN least 10.8 scour 12.5 bed 12.1m.
		H.O. Agreed-leave charted as 10.8m in new position.
		(Oct. 98 Original obstruction report located in old file. Originally found by sidescan, but only located after extremely close sounding.)
		Re-examined prior to publishing 343 in 1999. Leasty depth 10.8 remains but found in position 3 mtrs west on a line run E/W. Posn 596149mE
		180552mN.
		Rpt. Ob.HSR4/81, 45/96, 7/99,
5027	593	South side of the fairway off NTGB Jetty Canvey , obs is situated 20 mtrs south of the south channel edge, echo shows a spike protruding out of the bed on the cant edge.
		Original report dated 9 Dec 82, when position given as 578472 181185, least depth 12.1 acour 13.5 bed13.3m but current ISO Survey Instructions give position as 578471mE 181183mN, hence has there been an updated search in the interim of which the record is missing?
		Following above comments missing report subsequently found which shows 2 obs standing ourt of the bed in 578473mE 181180mN and 578477mE 181210mN.
		HO's instruction of 1982, chart as # remains in force 1998.
		Re-examined 7 October 98 an isolated object standing 0.5m above the bed with a slight scouring to the SE. Position 578476mE 181181mN least depth 13.1m bed 13.6m
		Drawing 113-341-071
		HO Chart as # in new position.
		Rpt: 1HL/1982, 53/1998,
5028	681	Posn 587822mE 181082mN The 1985 report - this very small obstn is no longer detectable by E/S. It was never significant, no longer shown on 342 or 125. Sonar contact No 13 of the Main Svy. is close SSW and is probably all that remains.
		Retained for reference and information.
		On 14 April 97 sounding 417 obstruction clearly visible in a scour. Search undertaken on 21st and the area bottom swept to ensure no stray bits are standing up. The sweep was clear at 11.8m, weep was collected at 12m although no fouling of the bed was detected. The result of sounding shows top of obstruction at 12.8m, scour 14.6m bed level 11.6 to 12.4m in the area.
		H.O. This non dangerous obstruction was swept to ensure that nothing extended above least depth by E/S. This being so , it should be charted as
		#. However due to its sensitive position, it should be re-confirmed at each annual 417 survey and properly re-examined after 5 years or when a 417 survey indicates significant change.
		(October 98, original search report found in old file, this small obstruction found by sonar and verified by E/S 13 Oct. '81. Its scour hole is easily found 'UNLIKE THE OBJECT ITSELF'.)
		Rpt Ob HS6/81, 9/85, 7/97,
		*******NOTE PERIOD REDUCED TO 5 YEAR IN THIS SENSITIVE AEA*******

WA	PLA	PLA History of Feature
5029	707	* Name "Cannons" is pseudonym - real name unknown.
		Reported as an unnatural looking feature 23/11/79. Salvage ops from Yantlet 3/9/80. Divers recovered 2 cannons. "No further salvage work
		anticipated. Area swept 7th November 1981
		Wreck Book 4/406 HSR 2/81 Rpt E2/90
5030	599	Reference goes back to circa 1980 rpt. HS9 1980, When least depth 10.6m bed 11.3m. Small obstruction shown as # on PLA 118.
		Search 12 Jan 88 position 575635mE 180992mN least depth 9.0 bed 11.0 scour 11.8m previously charted as # this survey shows it to be more
		significant with a scour.
		Other comments to hand : firm base 1m high with a 1.5m wispy tail (equals 2.5m from bottom of scour to top)
		HO Chart as suggested 9.0 Obstn.
		Rpt. HS9/80, HS11/88,
5035	583	From HS Gunfleet F.V. Shepherd Lad fast to the bottom. PLA divers summoned to release nets from this snag. Reported as concrete with re-
		inforcing rods similar to the recent findings at 7-6 Sea Reach.
		No sign from recent Havengore survey in this position. Unfortunately Havengore working close by was not informed at the time.
		Position 571746mE 180077mN
		HO Attached to the report in this section the comment "Recovered by Salvage, no sign of remaining debris.
		This record is entered into DB for historical information in case there is more debris present which later uncovers; no other action required for the
		present.
		21 September 1998, Admiralty Chart is still showing 9.5 obstn PA, a search undertaken to disprove this charted information. Nothing was found and area is considered clear. Drawing 113-340-031
		Rpt: 42/1993, 47/1998,
		22 July 1993, Bow section of Rustringen recovered from 571746mE 180077mN . This is the bit that dropped off while in transit from the Mid Blythe
		Area to Tilbury: did she have a cement box and re-inforcing in her forepeak?
5038	766	From records this unknown wreck appears to date from 1923 and then was not shown on charts from 1934. Retained on wreck sheet
0000	700	for information.
5041	18	An unknown obstruction fouled by fishermen April 1984 who described it as a 40 foot length of aircraft fuselage. A sonar search of the area and
		close E/S by Maplin located the obs.
		1991 search could not locate the obstruction- 12.9 depth is that in the charted position. H.O No action, include soundings in data base. Not
		disproved, continue charting as 11.9 obstn hope to disprove next time. Position 601411mE 180242mN.
		Re-examined by Chartwell 6 April 98. No evidence of the previous wreck found. Area considered insonified with coverage at 5m spacing. The
		bed was relatively smooth and shallow sloping over the area with no obvious sign of objects above the bedlevel.
		HO This obstruction is now considered disproved. Leave in DB for future reference.
		Drawing 113-201-164
		Wreck Bk 3/336 Rpt 1/84, 14/1991, 6/1998,
5045	728	This was located by sonar in the channel between Nos.1 & 2
		Sea Reach. Close E/S search indicated a small ridge which is considered to have given the soncon. Not charted but retained on file for future
		sonar identification.
		Wreck Book 4/413 Rpt E21/90

WA	PLA	PLA History of Feature
5046	729	Located by sonar,E/S search found 3 small obstructions and scour. The most significant is plotted - does not alter navigational depth but could be
		a problem to fishermen.
		Wreck Book 4/414 Rpt E22/90
5049	699	Located by Chartwell in the channel 2 km west of No 7 Sea Reach near the edge of the 15m contour, described as a small obstruction standing
		0.7m above the bed. Likely to foul fishing gear being used in the vicinity. Least depth 15.4m scour 16.5m bed 16.0m posn 579633mE 181363mN.
		H.O. Chart as # .
		Rpt. 4/95 ,
5050	698	Found April 1995 by Chartwell during main svy what appears an obstruction standing 1m proud of the immediate seabed. Least depth 14.0m
		general bed level 14.5m posn 580554mE 181524mN
		H.O. Search
		Examined July least depth 13.3m nil scour bed 15m posn 580542mE 181527mN - search showed evidence of a sizeable feature or wreckage on
		the river bed, the main part stands 1.5m proud of the bed, measuring 30 by 10 mtrs in a WxS to ExN direction.
		H.O. Sweep required. Swept by Chartwell 11 April 96 Sweep cleared at 13.1 fouled 13.4, swept in mirror like conditions with little swell, sweep did not part when fouled,
		but weed present on . This was not resounded during this operation.
		HO Chart as Swept 13.0 Obstn in position 580542mE 181527mN
		Rpt. 26/95, 69/95, 5/1996,
5051	592	25 april 1996 FV Dudley from Holehaven fouled her trawl, and whil still fast to the bottom Chartwell obtained a position fix.
		The following search found an area 25 mtrs E/W by 20 mtrs N/S with some spikey returns on the echo.
		The Dudley confirmed there to be traces of rust on her gear when it was recovered.
		The location is some 40 mtrs south of mid-channel, and close to an isolated 12m sounding on the preceding survey, indicating the obstruction
		was in situ then. A divers inspection is considered worthwhile.
		Position 576552mE 181298mN least depth 11.4m
		HO Chart as bed feature 11.4m until proven otherwise, agree divers inspection.
		21 May 1996 divers inspected and found a collection of old timber, reinforced concrete and other debris protruding from the sand, thus
		indicating that the metre high mound is of some age. It does not resemble recent fly dumping, a suggestion as a possible cause, this being on
		the route of various demolition contrator's route to the Medway with barges of debris.
		HO Show as # symbol on 341 and 410 and allocate DB number.
		Re-examined 7 October 98 as part of main survey 341 least depth 11.5m bed 12.6 in position 576555mE 181296mN.
		As this was previously fixed with gear attached, and as divers have been sat directly on it previous position is retained for charting.
		HO Chart as #. Drawing 113-341-074
		Rpt: 6/1996, 22/1996, 57/1998,
		NP1. 0/ 1770, 22/ 1770, 37/ 1770,

WA	PLA	PLA History of Feature
5148	581	This is one of those classical Fisherman's Snags, frquently reported, investigated and nothing found. Documentation on this one dates from 1991, probably reported even before then, when nothing could be found on the echo. Early part of 1997 Chartwell received several reports of vessels with gear fouled in this vicinity. The sidescan was deployed, and a possible return passed to the Yantlet on 30th April. On 1 May Yantlet ran lies at 4m centres and an obstruction was found in the area identified. There is no scour. Obstn is approx 0.5m above bedlevel. Least depth 11.7 posiion 574743Me 181037mN HO Chart as # symbol on 340 and 409.
5149	582	Rpt: 11/1997, 1st May 97 FV James Gary reported she was fast to an obstruction in the channel off Shellhaven. Yantlet in locality went alongside and fixed position then ran over the obstruction. E/S return 12.4 in Position 573142mE 180804mN showed a small spike in a very slight scour. If the gear had not been attached, under normal sounding conditions such a return would not have been identified as an obstruction. HO This 'snag' has no navigational significance. Chart as # symbol (for the fishermen's sake) on chart 340 and 408. Rpt: 10/1997, ***********Good luck to whoever tries to locate this again !!!**********************************
5150	591	Located by Chartwell while sounding south of the south channel edge opposite the Gas Jetty Canvey a small obstruction at the bottom of the bank. Position 578385mE 181140mN Fixing Microfix HO: Enter in WIS so we don't lose track of it and chart as # Rpt. 48/1993,
5178	598	First report found is dated 21st Nov 80, a small obstruction not considered dangerous. 12 Jan 88 close examination of the area revealed 2 very whispy signs of debris. 16.0m at 578028mE 181477mN and 16.3m at 578021mE 181465mN bed level 16.8m HO Chart as #. # Mark on charts to disprove in position 578020mE 181472mN. Examined 7 October 1998 when no obstruction was observed within 15 mtrs of the charted position, but two bed features are apparent. Drawing 113-341-070 H.O. There being no sign of any debris in this area the # is no longer to be charted. Maintain in DB for record pyurposes. Rpt. 52/1998,

WA	PLA	PLA History of Feature
5181	602	25 November 1980 report HS13/80 position 576290mE 181062mN least depth 9.2 bed 0.4 scour 9.7m Small obstruction shown on PLA 118 (now
		409) . DIFFICULT TO FIND.
		Very small obstruction standing a half metre proud of the cant edge 100 mtrs outside the channel.
		Possn 576290mE 181062mN
		H.O. Chart as #.
		Rpt. HS13/80,HS9/88,
		MAIN SURVEY 1998
		Drawing 113-341-075
		H.O. There being no sign of any debris in this area the # is no longer to be charted. Maintain in DB for record purposes.
5183	614	Rpt. 58/1998,
3103	014	Posn given as 581189E 181136N , information given as having been a small unknown obstn. least depth 11.1 scour 11.9 bed 11.6 under 1980 report. In 1985 not located; complete insonification of 37 mtr radius nothing found. Obs considered disproved, # symbol will no longer be shown
		on charts 341/342
		Rpts OB HS4/80, 7/85,
		Retained for information.
5189	594	South fo the south channel edge opposite the Scars Elbow Buoy, report of 14 Oct 81 records position 578910mE 181050mN least depth 11.3 scour
0.07	07.	14 bed 13.2m, : this obstruction is of no navigational significance adn is shown as # on PLA chart 120.
		Echo record indicates a substantial spike protruding out of the bed.
		HO Chart as # symbol.
5190	610	Very close sounding finally revealed very slight evidence of this small obstruction first found during periodic channel survey. It is not considered
		worthy of inclusion on either 342 or 120.
		Posn 580342m 181017m least 8.9 bed 9.1 scour 9.3m.
		H.O Agreed.
		It is not charted by PLA yet is shown by the Admiralty on 1185 as foul hatch symbol. Re-examined main svy 95 , search revealed a 9m shoal patch some 15 mtr round 35mtrs NNW of the charted foul symbol. No evidence of an
		obstruction. Least depth 9m scour 10.5(?) bed level 9.3m posn 580324mE 181052mN.
		Existense or otherwise of obstr not disproved.
		Rpt. 12/95,
5191	615	Found in 1980 during an interim dredging survey and confirmed as an obstn Oct '80 - posn 581306E 181047N least depth 9.2 bed 10.4m.
		In 1985 posn 585272E 181047N least depth 9.6 scour 10.2 bed 10.0m. Very close sounding reveals more than one piece of wreckage in this area.
		All are small without significant scour, largest piece found 32 mtrs from previous reported posn. A small circle 'Foul' inserted on 342 (says the
		report!)
		Charting: Admiralty have not shown as covered by 342/2. Nothing shown at all on 342 printed copy!
		Re-examined 95 main svy least depth 9.9m bed 10.4m posn 581284mE 181060mN - reported as a small area of fragmented debris lyign on a flat
		river bed prior to the bed shelving to the south.
		H.O. Chart as # .
		Rpt HS5/80, 11/85, 68/95,

WA	PLA	PLA History of Feature
5193	791	49/99 sounded by Yantlet 28/10/99 investigating channel move
		See also 343/50 which close by- the two to be searched.
		62/99 21/12/99 - chart as 11.2 obstruction.
		The #343/50 to be sterilised - this new object to be charted as 11.2 obstn (see drawing 113-343-028)
5195	794	Newob 52/99 - discovered during sounding 28-10-99
		Search 61/99 21/12/99 - found obstruction in scour
		HO: this obstruction is another on the line of the old boom - it is only
		40 m south of the S channel edge and so will need to be swept before the channel may be moved south as is proposed. Chart as # (see 113-343-
		027)
5196	733	A small obstruction on the cant edge to the south side of the channel between 3 & 4 Sea Reach. Not investigated closely but charted as hazzard
		to fishermen.
		Position 591675mE 180150mN depth 6.7m.
		Re-examined 25Mar 98 The examination confrimed previous findings but depth improved to 7.4m Position 591675mE 180151mN bed 8.0
		H.O. Chart as #.
		Wreck Book 4/419 Rpt EO3/90, 32/98,
5197	785	Located by Chartwell during routine survey of 4-3 Sea Reach on 18th March 97.
		Divers inspection on 14th May found an object approx 8m long standing some 0.7m above bed, descibed as a spar/wire 100mm dia. looping up
		and down in the mud. An eyebolt was retrieved, this having the wire leading through it. The obstruction would appear to require further
		investigation and salvage retrieval.
		H.O. This debris might be part of boom defences. Although it is only 38mtrs clear of the channel it does not pose any threat to surface navigation. Ideally it would be removed, but this can hardly be considered economic. Chart as #. No action for the time being.
		Confirmed during sounding for possible channel extension to south 8/10/99 ('NEWOB 52/99) least depth 10.2. If the channel is to be moved this will
		need to be lifted
5198	784	Located initially by Chartwell while sounding 3-2 S.R. on 24th July 96, clear of the southern fairway.
3170	704	Further exmination 30 July posn 595126 mE 180240 mN least depth 10.2m scour 11 bed level 10.7m. The obstn. is 10 mtrs in area, possibly Nore
		Fort debris and an ideal target for the local fisherman to get hooked on when they seasonly work the area.
		H.O. Chart as 10.2 Obstn.
		Rrpt. 24/96, 32/96,
5201	714	Located by Maplin, a small obstruction considered to be part remains of the boom.
		October 98 original Obs report located in old file: located 11 Sep '81 least depth 9.2 bed 10.4 scour 10.8m, similar echo to roll of wire found in this
		area previously.
		HO Chart as #.
		Rpt OB HSR3/81
5202	746	Foul bed not charted but retained on wreck sheet. Close to 343/42.
		Wreck Book 4/432 Rpt EO16/90
5203	743	The bed is foul in this locality. It has not been charted but retained on wreck sheet for record purposes.
		Wreck Book 4/429 Rpt EO13/90

WA	PLA	PLA History of Feature
5204	793	Found by Yantlet during channel extension survey 28/10/99
		Rept 51/99 - Investigate further
		21-12-99 close sounded by Chartwell 113-343-029. Confirmed 10.1 in 10.5 plus 2 more minor obstructions with have bee logged at 343/95 & 96
5208	742	A small obstruction which could be a problem to fishermen-charted as an obstruction.
		Wreck Book 4/428 Rpt EO12/90
5220	735	Debris on bed which is retained for records. Noted on wreck sheet but not charted. Wreck Book 4/421 Rpt EO5/90
5221	796	Another of the many obstructions in this area of wartime defence debris. Found during the serach for 343/93 (113-343-029) HO chart as #
5222	736	A small scour to the south of the fairway. Not charted but retained on wreck sheet for record purposes. Wreck Book 4/422 Rpt EO6/90
5229	637	Svy rpt 12/85:- Previously chated unknown obstn could not be located within a 50 mtr radius. Deleted from charts.
		Retained for information.
		Rpt. 12/85,
6595	26	Located by Maplin on sidescan - close search showed a lump with signs of a scour yet no signs of wreckage. Considered to be a bed feature.
		Least depth 14.0m, Posn 602786mE 180078mN. Re-examined by Chartwell 30/11/93 posn 602777mE 180075mN least depth 14.2 scour 16.3 bed 15.0m.; it is a hard target with a considerable
		scour, stands 2m from the bottom of the scour. It covers an area 30 x 15 mtrs in an E/W direction, scour runs ESE/SW. See drawing No. 113-201-
		123.
		H.O. Consider as bed feature chart now at 14.2m.
		Wreck book 3/357 Rpt SR27/83,69/93,
7129	803	Found during Periodic survey SR3-4, divers inspection requested 8/7/02
		Rpt 1/02
7213	588	17 October 1995 report of a fishing vessel snagged on iron? Position 573404 E181095N
		In July 99 FV KALISTO was fast to the bottom on the ebb. Search on 1 September 99 found a scour of 3mtrs deep when run east/west with signs of
		apparent debris in bottom of scour. Just below bed level on the west side opf the scour is evidence of further debris, and it is assumed this is
		what the nets were caught on. The suggested area of debris is less than 10 mtrs. The position is some 35 mtrs west of the fixed position of the F
		Vsl's stern.
		HO There is very little evedinece of an obstruction associated with this snag, which is located right on the edge of the the Thameshaven anchorage and some 80 mtrs to the north of the North Channel Edge. It should be included in the database but not charted.
		Retained for record and information (purposes.
		Rpt .42/99;
7214	595	Uncharted obstruction. No other information.
7215	606	Position 576872mE 181151mN on 12 Jan 88 Rpt HL2A/88 search HL2 was extended 57 mtrs ESE. No further evidnece of obstructions was found and
		it is considered disproved.
		H.O. Delete from chart.
		No other reference is quoted with the report. The inference therefore that a second obstruction charted close to 341/6 must be assumed.
		Information retained for reference and information.

WA	PLA	PLA History of Feature
7216	613	Information obtained from the 1986 wreck sheet which shows Obstn. Divers reported as lump of concrete - charted as a sounding.
		No report found and the posn 581257E 181310E is taken from the wreck sheet.
		Retained here for information.
7217	619	Report H\$1/81 - posn 581718E 181305N least depth 9.8 scour nil bed 11.0m shoal sounding which latterly gained the appearance of an obstruction. Defied dredging by "GEOPOTES V". Divers awaited. Nov 81 -Divers report a very hard lump of concrete like material with evidence of dredging close by. 13 Sept '85 Posn 581715E 181315N least depth 10.2 scour nil bed 10.9m - This obstn has been searched for at each 2500 survey since it was first discovered. At first it was easy to find, then it got deeper and became less obvious, until about 2 years ago it could not be found.
		Now close sounding reveals the least water in the vicinity to be a 10.2m shoal sounding 12 mtr NNW of former posn. On H.O.'s instructions it has never been designated and obstn. on 121 (2500 svy of area then). However it has defied dredging once soon after its discovery and could so do again.
		Re-examined during 1995 main survey 342 posn found 581750mE 181311mN least depth still 10.2m bed level 10.8m Applying new examination criteria, this is at dredging depth for the area, examine every 5 yrs.
		H.O. Chart as 10.2m sounding.
		Rpt. 14/95
7010	700	Rpt OB H\$1/85, 6/85,
7218	702	16 July 1991 FV Twilight Star picked up a girder 6"x6"x20" and lost 150 yds NE of No 7 Sea Reach.
		Info retained for reference.

WA	PLA	PLA History of Feature
7219	694	A bed anomaly was first detected in June 1989. It was further investigated on subsequent periodic surveys and was finally completly insonified on 25/6/90. Divers investigated from HOOKNESS on 1/8/90. A mound of ballast or similar was reported, and it was charted as a 9.3m sounding. A periodic survey dated 25/2/92 again revealed signs of debris. Divers again went down. This time a 6.7 mtr long concrete pile weighing 2 tons was recovered on 27/4/92. The area was swept on 10/4/92 at 9.2m just 7 mtrs south of the south channel edge. Swept posn 582791mE 181167mN. Re-investigation 8/12/94, least depth 9.8m, wreckage covers area 30 by 20 mtrs, which depict small bits of debris. Bed level 10/11m. H.O. Re-sweep please. Swept by Chartwell 23/6/94 Posn 582965mE 181168mN clear 9.6 foul 9.7 bed 10 to 11 E/S 9.8m There were no definate fouls of the sweep, numerous times weed was brought to the surface. A sounding lead deployed fouled debris at 10.2m. Consider the 9.2m charted depth disproved. H.O. Chart as 9.6m swept. In October the dredger JETSED worked this area with the aim of trying to improve the depth on this area of debris. The post dredge survey of 30th October 95 found least water of 10.2m nil scour bed level 10.4m. A search report was not created for this work. Drawing 113-414-021 Re-swept by Chartwell 11 April 96, swept in mirror like conditions with very little swell. Sweep parted at 10.3 fouled at 10.1 and cleared with no indication of touching at 10.0 although weed was present on the sweep. Position 582965mE 181168mN. H.O. This area of debris currently charted as swept 10.0m. It was improved from 9.6m by Jetsed in October 1995. It may be assumed that some siltation has now occurred. However it would be prudent to re-sweep the new high spot to test for snags. Re-sweep when C'well has completed refit. Ryts: Search 4/90, diver's rpt 1/8/90, search 28/92, diver's rpt 30/4/92 (with photos.) sweep 41/92, 40/94, 41/94, 3/1996, 46/1998,
7220	802	24/99: Reswept - remains as clear at 10m 9th April 2001 fishing boat fouled nets on this small obstruction in the area of SR6. Divers inspection requested March 2002 Divers found 7T anchor - recovered. Area now considered clear Rpt 2/01
7221	697	An obstruction recorded as being located in 1989 searched for during 1995 Main Survey of 342 Least depth 11.6 m had been reported in 584650mE 181414mN This search found nothing of any significance on a gently sloping bed. H.O. No further action. Rpt. N. Ob.9/89, 53/95, Retained in WIS for future reference only.
7222	652	Information from the 1985/6 wreck sheet: 1967 Divers reported Granite Sets. The 1986 main svy, there was no evidence on sonar. Posn 585125E 181485N. Retained for information - not charted
7223	797	This shoal sounding discovered on a periodic survey 70m to the N of N channel edge was searched by Chartwell HO: It is not shown on either 342 or 343. Issue CCA and include in database
7224	806	Found during Periodic survey SR3-4, divers inspection requested 8/7/02 Rpt 2/02

WA	PLA	PLA History of Feature
7225	753	Located on the south side of the fairway below No 2SR this is a very small obstruction on the bed and only charted as it is in the channel.
		Wreck Book 4/439 Rpt EO23/90
		28/10/99 another obstruction traced at 596638 180432 - the two to be searched
		21/12/99 Search confirmed 343/91 but disproved this one - see drawing 113-343-028
		HO - DELETE ALL REFERENCES ON CHART
		24 / 12 / 99
7226	792	Minor obstruction discovered during channel extension investigation
		Rept 50/99
7007	10/	Database for future reference
7227	136	Fixed by Chartwell 2-10-92 after FV twilight star had fouled her trawl
		What appeared to be a bight of 6cm power cable was slipped.
7507	507	It is logged for information and remains uncharted
7596	587	South of the channel abreast D Jetty Shellhaven a suspected obstruction investigated 24 July 91 nothing found.
		H.O. Noted.
7507	EQ.4	Retained for reference and information. As a get of the Abelia Survey and broad 2. In a plast retire in a spitiar in F725/5755 is above and the Admiralty Chart year avaraginal and
7597	584	As part of the the Main Survey a charted 3.1m obstruction in position in 573565mE 180507mE is shown on the Admiralty Chart, was examined on
		21 September 1998 . Result of the search - nothing found and considered disproved. Drawing 113-340-032
		HO Noted.
		Rpt. 48/1998,
		This information logged to the data base for reference and information purposes only.
		Following the foregoing subsequently found previous report of 10th May 1989 - Position 573551mE 180503mN least depth 3.1 bed 3.8 scour 3.9m
		small obstruction standing at the top of the cant edge.
		HO. Chart as 3.1 Obstn, divers report required.
		16th May 89 Divers report old fishing gear which was not recovered.
		Rpt. OB4/89
7598	589	Report of an Obstn close west of W. Blythe Buoy, could be mooring?
		Retained as info and record purposes.
7599	585	Obstruction located in the vicinty of D Jetty depth 5.8, bed 7.2m position 572873mE 181416mN, apparently removed 18 December 1989, no
		other details recorded.
		Rpt OB 10/89,
7600	586	A small obstruction located 120 mtrs SSE of E Jetty in 1988 and relocated during the 1989 main survey, least depth 8.8m bed 9.3 scour 9.6m
		Position 573174mE 181347mN .
		HO. Make a note to close sound the area at the next Channel survey - if it is still there then chart as #. Dated 7-3-89.
		Rpt. SR1/88, 1/340/116/89,
		Not shown on either 240 or Admiralty chart, retained for reference and information.
7601	703	Found during a turn on a 415 periodic further investigated
		Area 65x30 see 113-342-053.

WA	PLA	PLA History of Feature
7602	795	Possible minor obstruction found during search for 343/93 see 113-343-029 Retain for reference

APPENDIX III: 2001 SIDESCAN ANOMALIES FROM THE SURVEY AREA

WA	Target	Description
5007	88	Anomaly
5010	40	Large rectangularr target with associated scour plume with linear debris to the east
5012	91	Ship wreck - upstanding anomaly. A large plume of coarse material is apparent to the east of the northern end of the target
5019	98	Large thin rectangular shaped anomally
5020	99	Linear anomaly two hard reflective edges in the along track direction
5021	124	Position corresponds to site 5021 - single point reflector
5023	125	Position corresponds to site 5023 very faint small target with other potential debris that may correspond to the description of foul ground-right on the fish track
5035	3	3 targets joined by a cable - 40m between the targets position is middle tgt
5046	90	Large feature with associated sediment plume - targets to the south west
5051	123	Position corresponds to site 5051 Faint impression on seabed in sand wave area
5185	116	Strong reflector with associated plume
5185	117	Linear cable like reflector
6595	87	Anomaly with shadow
7101	1	Dimensions taken to the centre of triangular outline - possible cables on the bed
7102	2	Dredging or trawl scars bed type sand or gravel
7103	4	Area of heavy scaring remains of furrows causing patches of bright reflectors - the seabed changes to courser material as proceed eastwards - many potential targets
7104	5	Furrow ridge with potential relief
7105	6	Anomaly with scour plume
7106	7	Anomaly with scour plume
7107	18	Ephemeral rectangular outline in the bed with a solid return forming a line along track
7107	8	Anomaly with scour plume
7108	9	Anomaly with scour plume
7109	10	Anomaly with scour plume
7110	10	Shadow coming from centre of target single spike
7111	10	Shadow from point within target
7112	11	Strong reflector with no shadow and radiating plume
7113	12	Rectangular shaped target with strong leading edge
7114	13	Ephemeral elliptical impression on the seabed
7115	14	Anomaly - first of a series potential cable radiating from it
7116	15	Small rectangular shaped target no leading edge
7117	16	Rectangular shaped target blob3 with strong leading edge with 20m cable type of lead in - single line reflector running towards the centre line
7118	17	Faint target in centre of ephemeral debris
7120	19	Two cables likw features crossing

WA	Target	Description
7121	20	Ridge like image with associated anomaly potential area of interest
7122	21	Small linear target - strong reflector
7123	22	Ephemeral patch encompassing small distinct reflectors
7124	23	Area of small distinct reflectors at end of trawl/dredge scar
7125	120	Anomaly with shadow
7125	24	Target long with reflectors at each end
7126	25	Linear reflector in the along track direction with pronounced reflectors at each end and an associated plume of courser material
7127	26	Group of linear reflectors possibly cable
7128	27	Long drawn out elliptical shape with associated anomalies at the western end - may well be a large wreck
7129	28	Target with associated shadow in front and behind with a 70m linear tail running along track to the west possibly cable
7130	29	Very small target with shadow
7133	32	Scallop impression on the seabed
7134	33	Ephemeral outline
7135	34	Lineartarget
7136	35	Strong reflector with no shadow
7137	36	Elliptical impression on the seabed
7138	37	Anomaly
7139	38	Area encompassing several features in close proximity position centred on the strongerst reflector
7140	39	Anomaly with thin ridges or spurs eminating from the epicentre - possibly cable
7141	41	Single small anomally with associated linear reflectors eminating to the west - There is also linear debris or feature in the visinity to the south east
7142	42	Large ephemeral target
7143	43	Position of the western point of an ephemeral outline puntuated with strong reflectors at the nodes - encompasses 150m radius and contains
		many small anomalies
7144	44	Linear anomaly
7145	45	Small strong reflector possibly anchor
7146	46	Small strong point reflector with associated plume
7147	47	Small strong point or speckled reflectors forming a cluster with other similar anomalies in the area
7148	48	Linear target on the track line
7149	49	Linear target with shadow
7150	50	Parallel hard reflectors
7151	51	One in a pair of small reflectors
7152	52	Second small reflector
7153	53	Large anomaly, unclear in nature
7154	54	Small anomaly with scour
7155	55	Small anomaly
7156	56	Line reflector
7157	57	Two anomalies with associated scour
7158	58	Rectangular linear target scour and shadow with an associated anomaly 5m to the east (wreck)

WA	Target	Description
7159	89	Linear reflector with possible associated debris
7160	92	Long cable like anomaly
7163	94	Islolated anomaly
7164	95	Isolated anomaly
7165	96	Isolated anomalies
7166	97	Small anomally centre of group
7167	100	Cable like target
7169	102	Boat shaped impression in sand waves
7170	103	Ephemeral linear target
7171	104	Anomaly
7172	105	Cable like anomaly with a small coherent reflector at the western end
7173	106	Bright reflectoer on a ridge
7174	107	Ephemeral rectangular impression
7175	108	Group of small point targets
7176	109	Faint target on featureless seabed
7177	110	Point target with ephemeral outline
7178	111	Isolated anomaly with a sediment plume to the north west other small anomalies to the south east
7179	112	Target to the south west - large depression in the seabed
7180	113	Cable like anomaly possible dredge scar
7181	114	Small linear reflector
7182	115	Point anomalies in a group
7183	121	Series of discreet reflectors with evidence of scour - vessel turning
7184	122	Anomaly
7394	101	Small linear target
7457	31	Rectangular linear target
7543	30	Group of linear reflectors
7582	93	Islolated anomaly

APPENDIX IV: 2002 SIDESCAN AND MAGNETOMETER ANOMALIES

WA	Target	Description
5010	289	Wreck corresponds to 716 WA 5010 - the wreck of the Dovenby (northern part)
5010	415	Eastern part of the Dovenby. Mag high, max reading 276nT.
5012	288	Wreck corresponds to PLA 717 WA 5012 - the wreck of the Dovenby
5019	524	King same orientation as the 100KHz good comparison
5019	369	Image of the King WA 5019 position of the first anomaly with linear sides must be offline 11 at this point and on line 14 on a loop. Mag hit 45 m to
		the south east.
5019	314	Wreck of the King WA 5019
5020	318	Group of anomalies not clearly defined possible other targets in the vicinity corresponds to PLA 686 (wooden vessel - iron bars recovered) and
		WA5020. Mag high 9m to the south Max 3nT.
5021	448	Anomaly with shadow - corresponding to PLA 596 (Obstructions)
5026	297	Anomaly corresponds with PLA 712 WA5026 - possible submarine boom
5028	239	Target with shadow and scour associated debris in the viscinity corresponds to PLA 681 WA 5028 and WA 5589. Very high mag over target- pos
		high-low anomally.
5035	209	Area coinciding with Emu 2001 WA 5035 and in the viscinity of pla 583 (Concrete with reinforcing rod) no object observed - area of mobile
		sediment sand waves in mega ripples in the viscinity
5039	299	Blank area of seabed at the point of WA5039 MTB106
5040	388	Two point reflectors joined by ephemeral outline
5046	513	Corresponds to PLA 729 (obstruction located by echosounder) WA 5046/5842 and Emu 2001 target 90 wreck shaped object with associated
		anomalies in the area
5050	337	Ephemeral outline on the seabed corresponding to PLA 698 WA 5050 (Obstruction 1m high)
5051	221	Strong reflector no height corresponds to PLA 592 WA 5051. High 15m to the east near PLA target Max 2.7nT.
5148	218	Target diamond shaped coincides with PLA 581 and WA 5148
5185	214	No distinct objects - the area coinciding with Emu 2001 WA 5185 evidence of the scour scars from the 2001 image
5529	452	Linear target with other associated debris in an area of prominent seabed features - corresponds to WA5529 PLA 593 (Obstruction)
7101	212	Block on the bed with associated cables coincides with Emu 2001 WA 7101 - West Blythe Buoy
7106	275	Ephemeral outline in the seabed corresponds to Emu 2001 WA 7106
7106	219	Large ephemeral outline on the seabed - disturbed seabed in the same area as Emu 2001 WA 7105 - 7108 (no objects found at these positions)
7107	274	Ephemeral shape in the seabed corresponding to Emu 2001 WA 7107
7109	211	Long rectangular target approximately coinciding with Emu 2001 WA 7109
7113	449	Area of disturbed seabed group of small anomalies - corresponds to Emu 2001 WA 7113 although not similar signature
7124	233	Linear object with attched cable like feature corresponding to Emu 2001 WA 7124
7126	311	Block shaped object with linear reflector eminating from its centre - mooring block - coincides with Emu 2001 WA 7126 - other debris in the
		area
7128	475	Long flat elliptical anomaly with a hard defined edge. No shadow - low profile to bed. Associated debris to the west. Corresp. to Emu 2001
		7128

WA	Target	Description
7136	294	Block with cable like feature - mooring tackle corresponds to Emu 2001 WA 7136 sea reach No.2
7136	408	Large block shaped anomaly with cable like linear feature - possible block for navigation buoy
7140	414	Wreck of the Dovenby Emu 2001 WA 7140 large associated debris scatter second section to the east
7150	431	Strong block reflector with associated cable like feature - Sea Reach No. 1
7150	489	Reflector with cable like feature - Sea Reach No1 associated with 431 430 Emu 2001 WA 7150
7150	430	Strong reflector with shadow - main feature in a cluster of targets Very high mag, max 242nT 24m to the north of SR1.
7158	494	Corresponds to Emu 2001 WA 7158.Linear reflector scour and shadow at the eastern end defined anomaly
7167	320	Long linear feature
7171	261	Rectangular shape in the seabed with associated scour and sediment plume to the west- other associated debris in the area - corresponds to Emu 2001 WA 7171
7171	265	Block with cable corresponds to emu 2001 WA 7171
7171	260	Area of ephemeral outlines on the seabed corresponding to Emu 2001 WA 7171
7174	257	Ephemeral outline in the seabed corresponds to Emu 2001 WA 7174
7175	258	Large area of disturbed seabed with single point reflectors corresponding to Emu 2001 WA 7175
7176	259	Target in megaripples with ephemeral outline corresponding to Emu 2001 WA 7176
7181	279	Ephemeral reflector corresponding to Emu 2001 WA 7181
7182	208	Area coinciding with Emu 2001 WA 7182 no object observed - area of mobile sediment sand waves in mega ripples in the viscinity
7213	206	Ephemeral target with scour coincides with PLA 588 WA 7213 (Fishing vessel snagged on iron)
7213	207	Target with scour coincides with PLA 588 WA 7213 approx
7217	232	Disturbed seabed corresponding to PLA 619 WA 7217 (obstruction area has been dredged)
7220	329	Small reflector corresponding to PLA 802 WA 7220 (fishing boat foul)
7301	200	Debris scatter with navigation pile
7302	201	Strong reflector with scatter or associated debris
7303	202	Small reflector with associated debris
7304	203	Small reflector with scour plume
7305	204	Ephemeral heart shape could be cable with an associated strong reflector
7306	205	Ephemeral shape on the seabed
7307	210	Target in amongst course bedforms
7308	213	Elongated target with posible scour plume
7309	215	Small discreet target with shadow
7310	216	Small target possibly sinker with cable
7311	217	Linear target adjacent to a depression in the seabed - plumes at either end. Mag high 35m to the south east, max 5.4nT.
7313	220	Cable like anomaly
7314	222	Small anomaly - proud of the seabed. Mag high 15m to the north 4.3nT.
7315	223	Anomaly with shadow
7316	224	Linear anomaly with shadow
7317	225	Debris scatter with bright targets. Mag 5m to the north, max 1.5nT.
7318	226	Small reflector with shadow

WA	Target	Description
7319	227	Cable within an area of strong seabed features
7320	228	Strong reflector with shadow
7321	229	Reflector in area of disturbed seabed
7322	230	Debris field - linear reflectors. Mag high 12m to the north.
7323	231	Anomaly with shadow and scour
7324	234	Single reflector - no height
7326	236	Box shape section with either plume or cable like feature eminating to the north west - anomalies at regular intevals 80m apart to the east
7327	237	Small area of shadow with surrounding debris
7328	238	Linear impression on the seabed - cable
7329	240	Area showing some form of drag scars with numurous small targets. Mag 50m to the east small descreet mag hit covering distance of 10m.
7330	241	Semi circular cable like object with other cable like debris to the north
7331	242	Small anomaly with shadow and scour
7332	243	Linear cable like reflectors with strong reflective nodes - features to the north and to the east
7333	244	Cable or edge structure forming open rectangular outline on the seabed
7334	245	Cable like reflector with shadow
7335	246	Block with cable - Sea Reach No.4 buoy
7336	247	Cable like amomalies forming a triangular shaped impression on the seabed
7337	248	Small anomaly with shadow and scour
7338	249	Debris field with potential targets
7339	250	Small target with shadow
7340	251	Linear reflector
7341	252	Three point reflectors joined by a semi circular linear impression on the seabed
7342	253	Block with associated cable like structure
7343	254	Small object with scour (or sharp edge of a sand wave)
7344	235	Linear cable like reflector
7344	255	Block with associated cable - mooring tackle position corresponds to 235 in a debris field with small strong reflectors
7345	256	Large area of debris or linear target - disturbed seabed - high potential
7346	262	Ephemeral impression on the seabed
7347	263	Linear impression on the bed
7348	264	anomaly with scour possible debris /disturbed seabed 40m to the north
7349	266	Target or cluster of targets - debris field stretching north east
7350	267	Line of posts - joined by depression
7351	268	anomaly with associated scour and shadow
7352	269	Bright reflector with shadow and scour
7353	270	Area of disturbed seabed containing strong reflectors
7354	271	Area of disturbed seabed - debris field
7355	272	Strong reflector with scour. Mag high 23m to the north max 3.0nT.
7356	273	Linear reflector most probably cable

WA	Target	Description
7357	276	Strong reflector with shadow
7358	277	Anomaly
7359	278	Ephemeral rectangular impression on the seabed with a raised tail to the north
7360	280	Large trapezoidal outline on the seabed with a bright outline and a sediment plume to the west. Mag high 40m to the north, max 6.3nT.
7361	281	Anomaly in homogeneous seabed
7362	282	Bright reflector with shadow and scour to the front
7363	283	Bright reflector with shadow and scour to the front
7364	284	Reflector with cable like features - mooring tackle
7365	285	Ephemeral rectangular impression on the seabed
7366	286	Block like structure with cable - mooring tackle
7367	287	Streak of disturbed seabed
7368	290	Block shaped object associated with the wreck of the Dovenby. Mag high-medium, max 4.7nT.
7369	291	Eastern extent of long linear feature. Mag high, mMax4.7nT.
7370	292	Western extent of long linear feature
7371	293	Elliptical anomaly. Mag high.
7373	295	Block with faint cable like features eminating east and west
7374	296	Small block with cable like feature eminating to the east
7375	298	Elliptical shape on the seabed no shadow or scour associated debris to the north east
7376	300	Ephemeral anomaly with shadow
7377	301	Anomaly on the seabed (block in character) in two parts
7378	302	Anomaly
7379	303	Anomaly mooring block in character with chain/wire associated
7380	304	Area of seabed features of a curious nature. Scallop pattern on the seabed with well defined edges. Detritus also appears in the tiff to the
		south
7381	305	Line of two groups of three posts with impressoin of third set of posts lying opposite
7382	306	Small anomaly - no shadow
7383	307	Small anomaly with shadow
7384	308	Small anomaly
7385	309	Small anomaly ver distinctive edges in area of well defined sand waves
7386	310	Small refector with shadow with two linear impressions eminating from the reflector
7387	312	Area of disturbed seabed
7388	313	Two small anomalies with shadow indicative of a hollow in the bed
7389	315	Small target with shadow other small targets in the vicinity.No mag anomaly.
7390	316	Small target with shadow
7391	317	Streaky type anomaly no shadow - possibly seabed or thick cable like object
7392	319	Group of ephemeral linear targets shadow possibly associated
7394	321	Linear reflector with shadow associated debris at each end
7395	322	Linear reflector with shadow to the west a continuation of the linear reflector 321

WA	Target	Description
7396	323	Ephemeral rectangular outline on bed with possible plume
7397	324	Reflector with sediment build up to the west associated disturbance in the seabed to the south and a cable like feature to the north west
7398	325	Linear reflector with shadow other less prominent objects in the area
7399	326	Reflector with shadow in area of prominent sand waves
7400	327	Area of disturbed seabed in region of prominent sand waves
7401	328	Area comprising many targets including long linear feature and prominent targets with shadow
7403	330	Box shaped reflector
7404	331	Large rectangular feature with associated artefacts extending to a 60m across track dimension
7405	332	Large rectangular feature with associated artefacts extending to a 60m across track dimension. Mag high 30m to the north, max 5nT.
7406	333	Area of disturbed seabed two reflectors with shadow
7407	334	Small liner target with cable like feature eminating to the east
7408	335	Well defined area of shadow no strong reflector delineating edges
7409	336	Small strong reflector with shadow
7410	338	Strong linear reflector in large debris field comprising many targets. Mag high 30m to the south east, 2.8nT.
7411	339	Small reflector
7412	340	Cable like reflector
7413	341	Cable like reflector
7414	342	Reflector and associated small items of debris in area of sand wave activity
7415	343	Small reflector with some shadow
7416	344	Reflector with some small targets to the north
7417	345	Ephemeral linear target with shadow
7418	346	Ephemeral elipse on seabed
7419	347	Group of small targets with shadow on crest of sandwave
7420	348	Linear reflector in area with sand waves and many possible small targets
7421	349	Strong linear target with some shadow. Mag high 6m to the south Max 5.9nT.
7422	350	Small reflector
7423	351	Group of linear targets. Possilbly another target on the starboard channel
7424	352	Circular reflector - possible targets/debris to the west
7425	353	Strong reflector with shadow and scour
7426	354	Reflector - probably mooring block with associated chain
7427	355	Rectangular outline with shadow debris in the surrounding area
7428	356	Group of anomalies
7429	357	Small reflector
7430	358	Box shaped reflector with shadow other scattered debris on the tiffs in the viscinity of sea reach No.4. Mag high 13m to the north west.
7431	359	Anomaly with associated cable like features
7432	360	Anomaly
7433	361	Small strong reflector with shadow
7434	362	Small strong reflector with shadow

WA	Target	Description
7435	363	Two small long linear reflectors forming an indicative rectangular pattern
7436	364	Small anomaly
7437	365	Anomaly with cable like feature
7438	366	Small linear reflector
7439	367	Small linear target
7440	368	Small target
7441	370	Linear target on the seabed with shadow. No magnetic anomaly.
7442	371	Strong reflector with shadow. No magnetic anomaly.
7443	372	Ephemeral large elliptical outline
7444	373	Lineartarget
7445	374	Group of linear reflectors
7446	375	Large linear anomaly with cable like feature - other linear targets to the south
7447	376	Anomaly with cable like feature - mooring tackle
7448	377	Ephemeral shape in an area of disturbed seabed with other smaller targets
7449	378	Small target other small targets in the area
7450	379	Target with shadow.
7451	380	Anomaly with scour and a smaller anomaly to the west
7452	381	anomaly with shadow ephemeral shape 15m to the east
7453	382	Group of small refectors
7454	383	Small reflector in an 40mx100m area of sand waves with other small targets
7455	384	Small target
7456	385	Small target with shadow
7457	386	Target with cable like features - navigation buoy
7458	387	Small reflector with shadow
7460	389	Group of 2 small reflectors with shadow in a line
7461	390	3 reflector with shadow in line with 389
7462	391	Small reflector with shadow Mag passed over target no hit.
7463	392	Small reflector
7464	393	Small reflector
7465	394	Small ephemeral reflector
7466	395	Small reflector with some scour
7467	396	Small reflector with shadow
7468	397	Small reflector with shadow
7469	398	Small reflector with shadow in a line with 397
7470	399	Small reflector in a line with 397 and 398
7471	400	Strong reflector with shadow
7472	401	Target with shadow
7473	402	Target with shadow

WA	Target	Description
7474	403	Small anomaly with linear appendage
7475	404	Large block shaped anomaly with scour and shadow
7476	405	Large linear grouping of reflectors with scour and shadow
7477	406	Large block shaped anomaly with scour and shadow
7478	407	Anomaly comprising three points with linear cable like feature with scour - other smaller targets in the area
7480	409	Small reflector
7481	410	Small reflector
7482	411	Small refector with shadow other small anomalies in the area
7483	412	Anomaly with scour and shadow. Mag high Max reading 12nT.
7484	413	Anomaly with scour
7485	416	Anomaly with shadow
7486	417	Cable like feature
7487	418	Group of point reflectors
7488	419	Linear target in area of sand waves and general disturbance
7489	420	Circular outline
7490	421	Cable like feature
7491	422	Reflector with shadow
7492	423	Cable like feature
7493	424	Cable like feature
7494	425	Box shaped target with shadow
7495	426	Small refelctor with shadow in an area of disturbed seabed
7496	427	Anomaly 2 x reflectors with shadow joining them (box shaped)
7497	428	Small reflector
7498	429	Anomaly with four small anomalies to the north
7500	432	Strong target in a area of disturbed seabed with associated anomalies - debris scatter
7501	433	Irregular shaped anomaly evidence odf scour and shadow to the east 20ther strong smaller targets
7502	434	Anomaly with associated anomalies to the east
7503	435	Group of three targets with scour
7504	436	Cluster of four anomalies with a cable like anomaly running to the east
7505	437	Close group of three strong targets with shadow
7506	438	Area of disturbed seabed forming an ephemeral outline
7507	439	Row of three anomalies
7508	440	Block shaped anomaly with associated cable like feature - mooring block for navigation buoy
7509	441	Linear reflector - outcropping geology
7510	442	Linear reflector - outcropping geology
7511	443	Anomaly with shadow
7512	444	Anomaly with shadow
7513	445	Linear reflectors

WA	Target	Description
7514	446	Closely grouped anomalies with features to the North
7515	447	Mooring block with cable - navigation buoy
7517	450	Long linear anomaly - cable
7518	451	Long linear anomaly - cable
7519	453	Linear target running parallel to the track
7520	454	Long linear anomaly in an area of prominent seabed features
7521	455	Area of disturbed seabed
7522	456	Long linear anomaly with shadow with a cable like feature to the north
7523	457	Strong reflector with shadow and small sediment plume
7524	458	Strong reflector with shadow and small sediment plume
7525	459	Strong target in area of linear features. Mag L/M 55m to the east.
7526	460	Area of disturbed bed with linear targets. Mag L/M 50m to the north.
7527	461	Strong linear target with other debris in the area
7528	462	Strong parallel linear features
7529	463	Anomaly with shadow
7530	464	Cable like anomaly
7531	465	Area of anomalies. High mag on top, possibly 2nd mag target over 85m span.
7532	466	Anomaly
7533	467	Circular anomaly with scour
7534	468	Linear double parellel reflector - possible pipe
7535	469	Long linear reflector - cable
7536	470	Small anomaly with similar anomaly to the west and east 40m
7537	471	Small mooring block with cables
7538	472	Anomaly with linear cable like feature
7539	473	Anomaly with cable like feature running to the south east
7540	474	Small reflector with shadow associated with 475
7541	476	Small anomaly with cable like feature.
7542	477	Small reflector with shadow with cable
7543	478	Cluster of small anomalies
7544	479	Confused area of anomalies with shadow. Other smaller targets to the north. Mag high 6m to the north, max 2.17nT.
7545	480	Linear cable like anomaly
7546	481	Tight cluster of three reflectors with shadow. Mag high 13m to the south, max 2.44nT.
7547	482	Anomaly. Mag high 6m to the south, max -3.18nT.
7548	483	Area of many small anomalies dimensions less than 2m x 2m
7549	484	Two ball shaped anomalies in close proximity with shadow possibly partly submerged. With partially buried cable running tot the east
7550	485	Small reflector with possible scour
7551	486	Linear reflector
7552	487	Reflector with shadow.

WA	Target	Description
7553	488	Ephemeral shape surrounded by point reflectors
7554	490	Area of disturbed seabed
7555	491	Small reflector with shadow
7556	492	Small reflector
7557	493	Small reflector
7558	495	Cable like anomaly
7559	496	Anomaly with shadow
7560	497	Target with shadow other target to the west and east. Mag high, concentrated area.
7561	498	Anomalous linear target
7562	499	Linear target or group of two targets
7563	500	Anomaly covering large area of seabed - defined linear feature to the south west
7564	501	Cable like reflector
7565	502	Two anomalies corresponds to 281, the eastern target has shadow the western target is a bright linear reflector
7566	503	Group of two small targets with shadow
7567	504	Ephemeral boat shaped impression in the bed
7568	505	Area of disturbed seabed
7569	506	Group of anomalies in line with targets to the east and west
7570	507	Linear anomalyt with associated scattered targets 20m to the west
7571	508	Pair of anomalies
7572	509	Two small reflectors with shadow other debris in the vicinity
7573	510	Disturbance in the pattern of sand waves causing a 50m sediment plume - other targets In the area
7574	511	Bright linear reflector. Mag high, max 1.7nT 24m to the south west.
7575	512	Mooring block with cable
7576	514	Anomaly or group of two anomalies with scour and a cable like feature
7577	515	Small reflector
7578	516	Cluster of point reflectors forming a patch on the seabed
7579	517	Linear reflector with shadow in area of disturbed sediment with other targets in the vicinity of the Dovenby
7580	518	North section of the Dovenby with associated debris to the Mnorth note the plume from the obstruction. Mag high.
7581	519	Small box shaped anomaly. Mag anomaly to the east.
7582	520	Mooring block corresponds to the SE Leigh navigation marker buoy
7583	521	Cluster of point anomalies
7584	522	Small bright linear cable like reflector
7585	523	Small anomaly
7586	525	Anomaly position corresponds to Sea Reach No.2. Mag anomally 30m to the north in the vicinity of SR.
7587	526	Linear anomaly with scour
7588	527	Anomaly with scour
7589	528	Anomaly with scour
7590	529	Anomaly corresponds to the dolphin

WA	Target	Description
7591	530	Group of linear anomalies
7592	531	Anomaly H shaped
7593	532	Small linear anomaly with shadow
7594	533	Bright reflector with cable like appendage
7595	534	Small linear reflector with other targets in the vicinity