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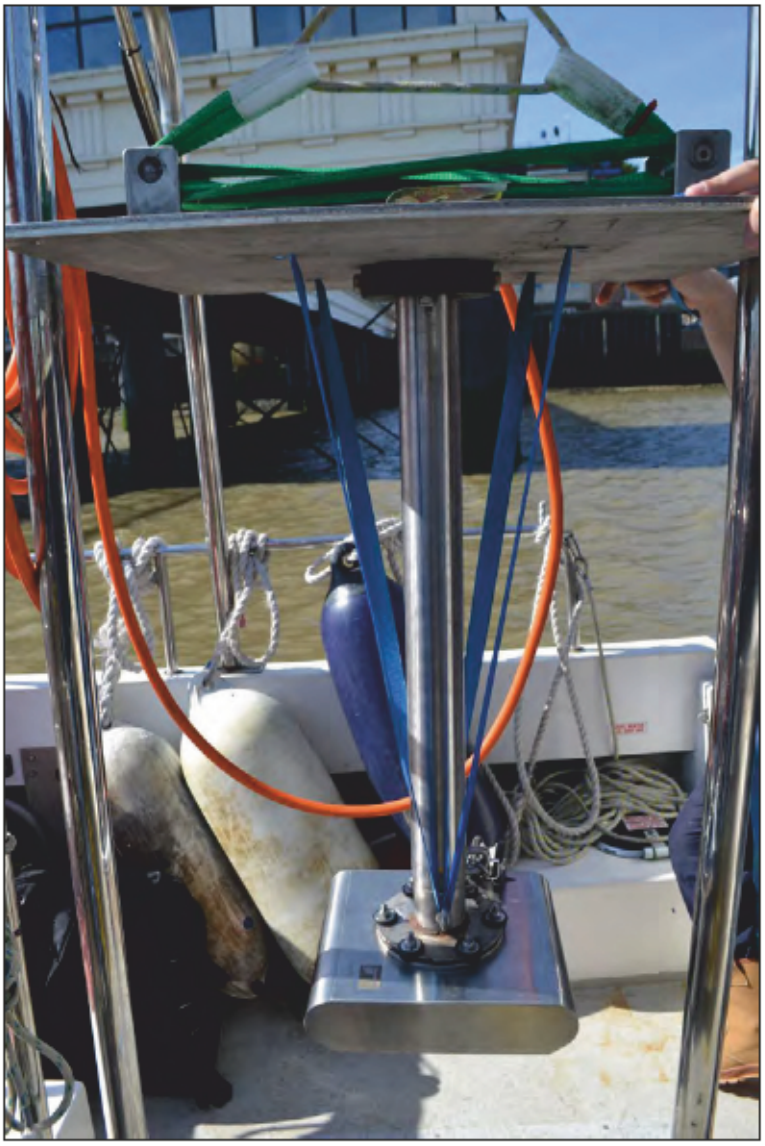
Thames Tideway Tunnel

Archaeological Interpretation of Parametric Sonar Data



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geoservices

Thames Tideway Tunnel

Archaeological Assessment of Parametric Sonar Data

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Summary

Wessex Archaeology were contracted by Atkins on behalf of Thames Tideway Tunnel to carry out marine parametric sonar surveys at 10 foreshore/intertidal Study Areas within the River Thames as part of ongoing evaluation associated with the proposed Thames Tideway Tunnel project.The geophysical data were collected by Wessex Archaeology on board the Port of London Authority vessel Galloper between the 9th and 14th June 2014. Good data coverage was achieved across most Study Areas, with the exceptions of the main western Study Area at Blackfriars Bridge Foreshore, the north end of Victoria Embankment Foreshore and a small area at Heathwall Pumping Station, due to obstructions such as permanently moored vessels, pontoons and piers.

It was found that most of the Study Areas, with the exception of Blackfriars Bridge Foreshore, contain at least some possible Pleistocene/Holocene sediment of unknown nature which could be of archaeological potential. Besides these blanket deposits, a number of specific features were also identified.

At Albert Embankment Foreshore and Chambers Wharf, previous studies have reported peat deposits and prehistoric finds, indicating these areas are of high archaeological potential. At Chambers Wharf especially, features have been identified within the data that suggest peat layers may be present.

At Putney Embankment Foreshore, Carnwath Road Riverside and Victoria Embankment Foreshore, a number of features of possible archaeological potential have been identified, including small cut and fill features, infilled depressions, seabed mounds and coarse sediment deposits. Some features present at Carnwath Road Riverside may relate to previous dredging associated with industrial activity, although a large mound feature likely relates to a known post-medieval barge bed.

At King Edward VII Memorial Park, no specific features of archaeological potential have been identified, though previous borehole surveys indicate preserved peat deposits may be present at a few metres below the current seabed, likely beyond the range of the parametric sonar. The same is true at Kirtling Street and Heathwall Pumping Station, though industrial activity and construction may have removed much of these deposits, so any surviving ones are likely to be scattered. At Heathwall Pumping Station, the presence of recent aggregate dumping may have reduced the penetration of the parametric sonar to detect these potentially deep peat deposits.

No individual features were observed at Chelsea Embankment Foreshore, though some Pleistocene/Holocene deposits were identified, the previously known Neolithic peat deposit was not identified within the data perhaps suggesting any surviving peat is likely to exist in patches.

No specific Pleistocene/Holocene deposits were identified at Blackfriars Bridge Foreshore, and it is interpreted that development and erosion is likely to have removed any deposits of archaeological potential. No specific features of archaeological potential were identified, bar a single mound likely to be natural, although very possibly anthropogenic in origin.

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Archaeological Assessment of Parametric Sonar Data

Acknowledgements

This investigation was commissioned by Atkins on behalf of Thames Tideway Tunnel, using geophysical data collected by Wessex Archaeology.

The geophysical data were acquired by David Howell of Wessex Archaeology, with positioning data acquired by Peter Durkin and Stuart Leakey of the Port of London Authority and assistance from the crew of the Port of London Authority survey vessel *Galloper*.

The geophysical data were processed, and this report written, by David Howell. Quality control was provided by David Norcott and Dr Louise Tizzard, and the figures were produced by Ken Lymer. The project was managed for Wessex Archaeology by David Norcott.

Thames Tideway Tunnel

Archaeological Assessment of Parametric Sonar Data

1 INTRODUCTION

1.1 Background

1.1.1 Wessex Archaeology (WA) were contracted by Atkins on behalf of Thames Tideway Tunnel (TTT) to carry out marine Parametric Sonar (PS) surveys at 10 foreshore/intertidal Study Areas within the river Thames as part of ongoing assessments associated with the proposed TTT project.

1.1.2 The 10 Study Areas were located on both banks of the Thames between Putney Embankment in the west and King Edward VII Memorial Park in the east as follows (**Figure 1**):

Study Area Name	Study Area Abbr.
Putney Embankment Foreshore	PEF
Carnwath Road Riverside	CRR
Chelsea Embankment Foreshore	CEF
Kirtling Street	KST
Heathwall Pumping Station	HWPS
Albert Embankment Foreshore	AEF
Victoria Embankment Foreshore	VEF
Blackfriars Bridge Foreshore	BBF
Chambers Wharf	CHW
King Edward VII Memorial Park	KEMP

Table 1: Study Area Names and Abbreviations used in the Text

1.1.3 As just one part of a larger project, the PS surveys were designed to supplement previous vibrocoring work undertaken at the Study Areas, and to help inform any future sampling strategies and walkover surveys.

1.2 Aims and objectives

1.2.1 The aim of this assessment was to carry out an archaeological interpretation of the PS data acquired from the 10 Study Areas. This was done through the following objectives:

- *Acquire high resolution PS data from the 10 Study Areas;*
- *Process and archaeologically interpret the acquired PS data to identifiy any sub-surface layers of possible archaeological potential;*

- *Cross reference the interpretation results with previous borehole/vibrocore surveys to extend the vibrocore interpretation over a wider area;*
- *Compare the interpretation results with the previously produced Historic Environment summaries for each Study Area;*
- *Use the interpretation results to inform any further work/sampling planned for within the Study Areas.*

2 METHODOLOGY

2.1 Data Sources

2.1.1 The geophysical data were collected by WA on board the Port of London Authority (PLA) vessel *Galloper* between the 9th and 14th June 2014. The survey involved the acquisition of PS data (acquired by WA) and the logging of associated positioning data (acquired by the PLA). The vessel was operated by the PLA.

2.1.2 The survey grids were planned to provide sufficient coverage of the Study Areas whilst also tying in previous sampling locations. Main lines were orientated approximately parallel with the shoreline and generally spaced 20m apart, though this varied due to the exact positions of previous sampling locations and the presence of moored vessels and other infrastructure (e.g. piers, bridges etc.) present at a number of sites.

2.1.3 Cross-lines were orientated approximately perpendicular to the shoreline and planned to coincide with previous sampling locations. Additional lines were run wherever deemed necessary to provide full data coverage. All lines were run twice and in opposite directions where possible, though cross lines were always run towards the shore.

2.1.4 Due to the intertidal nature of the Study Areas (many are exposed at low tide) the survey was planed around the tides, with lines furthest out into the main Thames channel run at a lower tide and the closest lines (and cross lines) run around high tide.

2.1.5 The geophysical data used for this report were assessed for quality and their suitability for archaeological purposes, and rated using the following criteria:

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

Criteria for Assigning Data Quality Rating

2.1.6 The PS data have been rated as "Average" using the above criteria. Equipment penetration was limited in a number of Study Areas, likely due to the hard substrate

(sands and gravels) identified during previous vibrocore surveys. The shallow depths of some of the Study Areas also meant some data are obscured at shallow depth by seabed multiples. These are both environmental limitations from within the Study Areas, and would affect the data in the same way regardless of the equipment used.

2.1.7 Alongside the acquired PS data, a number of other data sources were used during this assessment:

- *The original Environmental Statement (ES) produced for the TTT project, containing Historic Environment summaries for each Study Area (Thames Tideway Tunnel 2013);*
- *Borehole information and associated logs collected created by the Museum of London Archaeology Service (MoLAS) and provided to WA;*
- *Recent vibrocores acquired for the TTT project and provided to WA by TTT;*
- *Historic borehole logs avaliable through the British Geological Survey (BGS) online borehole records (BGS 2014);*
- *Previous geophysical (multibeam bathymetry, sidescan sonar and backscatter) interpretation undertaken at the Study Areas (WA 2013).*

2.2 Geophysical Data – Technical Specifications

2.2.1 The parametric sonar data were acquired by WA using an Innomar SES 2000 Compact Parametric Sub-bottom Profiler system, operated at a dual frequency of 10kHz/100kHz. The head was deployed through a moon pool on the back deck of the *Galloper* in the position where a multibeam bathymetry head is usually positioned. The PS data were recorded as both *.raw* and *.ses* files using Innomar's SESwin recording software.

2.2.2 Motion corrections for the PS were provided during recording by an Applanix PosMV Version 4 inertial system already installed on the *Galloper*.

2.2.3 Positioning data for the survey were provided by an Applanix PosMV Inertial navigation unit, also already installed on the *Galloper*. The data were logged by the PLA during the survey using HyPack, and recorded directly along with the PS data in Innomar's SESwin software.

2.2.4 All positions for the survey were recorded and expressed in WGS84 Lat and Long coordinates, and converted to British National Grid coordinates during processing.

2.3 Geophysical Data – Processing

2.3.1 The PS data were initially viewed and processed by WA using Innomar's ISE post-processing software. This software package enables data and track plot viewing and a certain amount of processing and interpretation. This program, along with the accompanying SES Convert software, was mainly used to convert the positioning data to British National Grid and the file formats to *.sgy* and *.xtf*. Images of the data acquired along each survey line were also taken.

2.3.2 The converted PS data were processed by WA using Coda Seismic+ software. This software also allows the data to be visualised with user selected filters and gain settings in order to optimise the appearance of the data for interpretation. The software then allows an interpretation to be applied to the data by identifying and selecting sedimentary boundaries of interest.

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

2.3.4 The PS data is acquired as a dual frequency data set, but Coda Seismic+ can only visualise single frequency data. Because of this, the original *.ses* PS files were first split and converted to single frequency *.xtf* files using Innomar SES Convert Data software before being loaded into Seismic+. The data were then interpreted using the lower frequency (10kHz) data within Seismic+, as this was found to produce better penetration, with comparisons back to the original dual frequency data set.

2.4 Geophysical Data – Anomaly Grouping and Discrimination

2.4.1 The sub-bottom profiler data interpretation was interpreted and integrated with the desk-based elements and available geotechnical data. A discrimination flag was then added to the record in order to discriminate against those which are not thought to be of an archaeological concern. For shallow geological features, these flags are ascribed as follows:

Non-Archaeological	U2	Feature of non-archaeological interest
Archaeological	P1	Feature of probable archaeological interest, either because of its palaeogeography or likelihood for producing palaeoenvironmental material
	P2	Feature of possible archaeological interest

Table 3: Criteria Discriminating Relevance of Palaeogeographic Features to Proposed Scheme

2.4.2 Within some of the Study Areas, small possible mounds were also observed on the seabed and recorded for possible future examination during walkover surveys. For anomalies on the seabed, the discrimination flags are as follows:

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

Table 4: Criteria Discriminating Relevance of Seabed Features to Proposed Scheme

2.4.3 All the identified features are presented in **Appendix I** and discussed in this report. Recommendations have been made for mitigation measures should the sites be impacted by the proposed development scheme.

2.4.4 The grouping and discrimination of information at this stage is based on all available information and is not definitive. It allows for all features of potential archaeological interest to be highlighted, while retaining all the information produced during the course of

the geophysical interpretation and desk-based assessment for further evaluation should more information become available.

3 PROJECT BASELINE

3.1 Geological Baseline

3.1.1 The 10 Study Areas are located within the River Thames in London between Putney and the Kind Edward VII Memorial Park, a distance of approximately 12.5km in a straight line, or approximately 15km following the course of the river. Despite this, the broad geological sequence of each Study Area is relatively similar, and is summarised below.

3.1.2 The basement geological unit across all of the Study Areas is the London Clay Formation (hereafter referred to as London Clay). This is a widespread unit of predominantly marine clay present across the London area and out into an extensive region of the southern North Sea. The unit is generally easily identified in sub-bottom profiling data due to the presence of numerous intra-formational faults which disrupt internal reflectors (Cameron *et al.* 1992).

3.1.3 The London Clay is Eocene in age, and as such is considered too old to be of archaeological potential. However, the upper surface often represents a significant unconformity directly overlain by Pleistocene and Holocene fluvial, estuarine and foreshore deposits. As such, the top London Clay horizon can be used as an estimate of the maximum depth of deposits of archaeological potential across the Study Areas.

3.1.4 The top London Clay horizon itself may also be of archaeological potential in some areas where it has been protected by thick deposits of more recent sediment, as it may have provided a land surface upon which artefacts may have been deposited This horizon is often associated with an overlying deposit of Pleistocene gravel, which can potentially contain lithic archaeologically artefacts, or in some places peat and buried soils, which could contain *in situ* artefacts and preserved material of palaeoenvironmental potential.

3.1.5 Directly overlying the London Clay across the Study Areas is a series of more recent deposits, ranging from Pleistocene sands and gravels to a complex sequence of Holocene alluvium and foreshore deposits. The exact sequence of these more recent deposits varies between the Study Areas, and is described area by area in **Section 4.2**.

3.2 Archaeological Baseline

3.2.1 The specific archaeological baseline varies between each site. Archaeological summaries have previously been provided for each Study Area in the original ES (Thames Tideway Tunnel 2013).

4 RESULTS

4.1 Introduction

4.1.1 As described in **Section 3.1**, the general geological sequence of London Clay overlain by Pleistocene and Holocene deposits is present across all of the Study Areas. However the specific details, and the associated archaeological potentials, do change.

4.1.2 Because of this, each Study Area has been treated as an isolated site and each are described in turn below, starting with the westernmost Study Area (Putney Embankment Foreshore) and moving east.

4.1.3 For each Study Area, the approximate extents of significant (approximately >0.5m thick) Pleistocene and Holocene deposits overlying the London Clay have been mapped. It is within these areas that any deposits of archaeological potential are most likely to be located; the sediments overlying London Clay outside of these areas are interpreted as being relatively thin and likely to comprise modern fluvial deposits.

4.1.4 Additionally, any specific individual palaeogeographic features of possible archaeological potential have also been mapped. These have been given individual ID numbers, which refer to the more detailed descriptions of individual features provided in **Appendix I**.

4.1.5 The archaeological potential of the shallow geological deposits differs greatly between the different Study Areas. Due to restricted penetration of the equipment in many areas, and the shallow water depth creating seabed multiples that obscure the data at shallow depth across others, not all shallow features of archaeological potential may have been identified.

4.1.6 Due to this, significant use has had to be made of associated vibrocore and borehole samples obtained from within the Study Areas to aid in the interpretation and fill in gaps where data could not be acquired due to obstructions with the Study Areas. Despite this, a number of features have been identified across the 10 Study Areas.

4.2 Putney Embankment Foreshore (PEF)

4.2.1 The PEF Study Area is located on the south bank of the Thames at Putney, and comprises two separate survey areas. The first covers an area between just downriver of Putney Bridge to just upriver of Putney Pier and the second covers a slightly smaller area just a little further upriver (approximately between Thames Place and Glendarvon Street on the shore) (**Figure 2**).

4.2.2 The presence of Putney Bridge, Putney Pier and a number of moored vessels within the Survey Areas created some obstacles to the survey, though full planned coverage of the Study Area was achieved (**Figure 2**).

4.2.3 Three recent vibrocores (**VB7001**, **VB7002** and **VB7003**) are located within the Study Area and were used to aid interpretation of the PS data. A historical BGS borehole (**TQ27NW33**, dated 1862) is located just outside the Study Area and was also used, albeit with a degree of caution due to the age of the record.

4.2.4 The top London Clay reflector, generally relatively well defined in other Study Areas, was difficult to determine at PEF. The furthest lines from the shore shows distinct reflectors interpreted as being part of the internal structure of the London Clay, though it is unclear which (if any) of these represents the top London Clay horizon.

4.2.5 Vibrocore **VB7001** sampled clay at approximately 1.9m below seabed (BSB), which is interpreted as London Clay, indicating there are significant Pleistocene and/or Holocene deposits close to the shore. Based on this, multibeam bathymetry data, the location of the low water mark and comparison with sediment distribution observed at the other Study Areas, the extent of the significant Pleistocene/Holocene deposits has been tentatively mapped as shown in **Figure 2**.

4.2.6 The nature of the Pleistocene/Holocene sediments overlying London Clay is uncertain. Very few shallow geological features have been observed within the PS sonar. Irregular reflectors within the top 1m of the data potentially indicate a heterogeneous series of

deposits, both vertically and laterally, the distinct layers within which cannot be traced with any confidence between survey lines.

4.2.7 Vibrocore **VB7002** sampled Pleistocene sands and gravels at a depth of approximately 1.8m BSB, though no evidence for this layer was identified within the PS data. This, combined with the layer only being identified within a single borehole, indicates the layer is either limited to a small area around **VB7002** or is present in small pockets throughout the Study Area. Pleistocene deposits such as these are of possible high archaeological potential, as they could contain both *in-situ* and derived archaeological artefacts.

4.2.8 This patchy nature of archaeological deposits correlates well with previous work and reported in the Environmental Statement (Thames Tideway Tunnel 2014, Vol. 7), which indicates significant natural erosion along this section of the Thames is likely to have removed most deposits of archaeological potential.

4.2.9 The remainder of the Pleistocene/Holocene sediments appear to comprise a mix of alluvium, fluvial sands and 'foreshore deposits' – recent mixed coarse sand and gravel containing brick fragments and shells. Two individual shallow features of possible archaeological potential (**7509** and **7510**) have been identified within the PS data. Both are small, poorly defined, possible cut and fill features cut into the underlying sediments. Their appearance and acoustic character suggest they could potentially contain sediments of archaeological potential (**Figure 2**). However, further sampling work would need to be undertaken to confirm this. Future sampling work is planned for the PEF Study Area, and it is recommended that the proposed sampling positions be changed to those shown in **Appendix II** in order for the identified possible features to be ground-truthed.

4.2.10 Additionally, two possible anthropogenic features were identified. One was a buried feature located outside of the Study Area in the vicinity of Putney Bridge. Buried at <1m BSB is could be a remnant of construction work at the bridge, though its location outside of the Study Area puts it beyond the scope of this report. A second, identified on the seabed within the Study Area, is interpreted as being a modern mooring block for vessels observed anchored within the Survey Area. A third similar, though less certain, feature was also identified and interpreted as a possible mound (**7516**). This is probably a natural feature though could be anthropogenic in origin. It is located above the low water mark, and so it should be possible to investigate the position during any subsequent walkover survey.

4.3 Carnwath Road Riverside (CRR)

4.3.1 The CRR Study Area is located on the north bank of the Thames just upriver from Wandsworth Bridge. The Study Area is clear of any significant obstructions (such as moored vessels), and so full data coverage was easily achieved during the survey (**Figure 3**).

4.3.2 Two vibrocores acquired by MoLA (**MoLA-VC6007** and **MoLA-VC6009**) and two recent vibrocores (**VB7005** and **VB7006**) are located within the Study Area and were used to aid interpretation of the PS data (**Figure 3**).

4.3.3 The top London Clay horizon was not definitely identified within the CRR Study Area. None of the four boreholes within the Study Area, the longest of which penetrated 3m BSB, sampled London Clay, suggesting the entire area is covered by Pleistocene/Holocene deposits >3m in thickness.

4.3.4 The nature of the Pleistocene/Holocene sediments overlying London Clay is uncertain. Very few shallow geological features have been observed within the PS data. Irregular reflectors within the top 1m of the data potentially indicate a heterogeneous series of deposits, both vertically and laterally, the distinct layers within which cannot be traced with any confidence between survey lines.

4.3.5 Despite this, three features of possible archaeological potential were identified within the CRR Study Area. Feature **7506** is a sub-horizontal reflector identified on a number of survey lines in the eastern section of the Study Area. The depth of this feature correlates with a deposit of Pleistocene sands and gravels identified with vibrocore **VB7005**, and the reflector possibly indicates the extent of this deposit (**Figure 3**).

4.3.6 The reflector becomes indistinct towards its edges, and so is either a localised deposit or is present beyond the penetration of the PS across the rest of the Study Area. Pleistocene deposits such as these are of possible archaeological potential, as they could contain both *in-situ* and derived archaeological artefacts.

4.3.7 The two other identified features (**7507** and **7508**) are relatively distinct, very shallow reflectors within the central and western sections of the Study Area and have been classified as erosion surfaces. Vibrocore data from across the site (though not from the features themselves) indicates these could be isolated surfaces overlain by intact alluvium deposits, though their age is uncertain.

4.3.8 Previous work recorded in the Environmental Statement (Thames Tideway Tunnel 2013, Vol. 10) identified previously dredged sections within the CRR Study Area, related to previous industrial use of the area, that are now filled with recent silt. It is possible that features **7507** and **7508** also represent such features, though this would only be confirmed by further sampling. A buried made ground deposit, identified in vibrocore **MoLA-VC6007** is further testament to the previous industrial development of this area.

4.3.9 A large mound feature identified within the intertidal area (**7517**) is likely to be a surviving post-medieval barge bed identified during previous work (Thames Tideway Tunnel 2013, Vol. 10). A second similar, though less certain, mound feature was identified within the Study Area (**7518**). This is probably a natural feature though could be anthropogenic in origin. Both features are located above the low water mark, and so it should be possible to investigate these positions during any subsequent walkover survey.

4.3.10 Although features of possible archaeological potential have been identified within the CRR Study Area, further sampling would need to be undertaken to ground truth the PS interpretation.

4.4 Chelsea Embankment Foreshore (CEF)

4.4.1 The CEF is located on the north bank of the Thames, just upriver of the Chelsea Bridge and along the bank of the Chelsea Royal Hospital South Grounds. No obstacles such as moored vessels were present within the Study Area, though this area contains some of the shallowest water depths encountered during the survey with mounds of sediment present along the embankment wall and around a large outfall pipe. Despite this, full data coverage of the Study Area was attained (**Figure 4**).

4.4.2 Two vibrocores acquired by MoLA (**MoLA-VC6002** and **MoLA-VC6003**) and three recent vibrocores (**VB7007**, **VB7008** and **VB7009**) are located within the Study Area and were used to aid interpretation of the PS data (**Figure 4**). An additional vibrocore acquired by

MoLA (**MoLA-VC6006**) is located just outside of the Study Area and was also used to aid interpretation.

4.4.3 The top London Clay horizon is relatively well defined at the CEF Study Area, and well-defined internal reflectors within the London Clay were observed along the survey lines further away from the shore.

4.4.4 There is very little sediment overlying the London Clay across much of the Study Area, as demonstrated by **MoLA-VC6002** and **MoLA-VC6003** which sampled London Clay at depths of 0.25m BSB and 0.6m BSB respectively. Significant Pleistocene/Holocene deposits are restricted to closer to the bank, where vibrocores **VB7007**, **VB7008** and **VB7009** penetrated up to 3m BSB without sampling London Clay (**Figure 4**).

4.4.5 The nature of the Pleistocene/Holocene sediments overlying London Clay is uncertain. No definite shallow geological features have been observed within the PS sonar. Irregular reflectors within the top 1m of the data potentially indicate a heterogeneous series of deposits, both vertically and laterally, the distinct layers within which cannot be traced with any confidence between survey lines.

4.4.6 Evidence from the acquired vibrocores indicates the sediments consist of a series of fluvial sands and gravels and 'foreshore deposits' (mixed sands and gravels with traces of brick and shells), the precise age of which is unknown.

4.4.7 However, an outfall pipe, built during redevelopment of the Chelsea Embankment in the 19th Century (Thames Tideway Tunnel 2013, Vol. 13) dominates the central section of the Study Area. Multibeam bathymetry data show a distinct scour at the southern end of the outfall, and sediment mounded up on either side.

4.4.8 Because of this, it is likely that a large amount of the Pleistocene/Holocene sediment is relatively recent and has accumulated since the construction of the outfall. Similarly, the construction of the outfall itself and the associated scour at the southern end is likely to have removed material of archaeological potential.

4.4.9 It has previously been reported that peat dated to the Neolithic has been found exposed on the foreshore, which may indicate the presence of preserved land surfaces deeper down in the sequence (Thames Tideway Tunnel 2013, Vol. 13). However, peat is light and easily eroded, transported and redeposited, and it is unclear whether the sample found was *in-situ* or originated elsewhere. No evidence for peat was identified within either the PS data or the vibrocores, suggesting any surviving peat is likely to exist in isolated patches.

4.4.10 No specific palaeogeographic features or buried anthropogenic objects of archaeological potential were identified within the CEF Study Area. Future sampling is planned for within the CEF Study Area (**Appendix II**), though the planned locations do not need to be altered to sample any features of potential interest.

4.5 Kirtling Street (KST)

4.5.1 The KST Study Area is located on the south bank of the Thames around Nine Elms Pier, just downriver from Battersea Power Station. The Study Area contains Nine Elms Pier itself, which obviously creates a significant obstruction, along with a number of permanently moored houseboats surrounding the pier ('Tideway Village'). Despite this, good coverage of the Study Area was obtained (**Figure 5**).

4.5.2 Two recent vibrocores (**VB7010A** and **VB7011**) are located within the Study Area and were used to aid interpretation of the PS data. Four historical BGS boreholes (**TQ27NE660, TQ27NE661**, TQ27NE658 and TQ27NE659, all dated 1945) are also located within the Study Area and were also used, albeit with a degree of caution due to the age of the records.

4.5.3 The KST Study Area is almost completely dominated by London Clay, which is present beneath a thin veneer of later sediment across much of the Study Area. Isolated patches of thicker sediment occur within the centre of the Study Area (**Figure 5**), and also may exist on the foreshore between the west end of Nine Elms Pier and the east end of the jetty at Cringle Wharf, though limited data coverage has been unable to identify the top London Clay horizon in this area. The nature of the Pleistocene/Holocene sediments within these thicker patches is uncertain, though based on the other Study Areas they potentially comprise a mixture of fluvial sands and gravels, alluvium and 'foreshore deposits'.

4.5.4 Vibrocores **VB7010A** and **VB7011** both sampled London Clay at depths of <1m BSB. This correlates with the PS data, though contrasts with the historic BGS boreholes which record a thick sequence of sediments, including up to 2m of peat, before London Clay was sampled at approximately 4.5m BSB.

4.5.5 The BGS borehole records indicate that these samples were acquired prior to the construction of Nine Elms Pier, and it is now likely that most of these overlying deposits have been removed during construction of the pier. Multibeam bathymetry data show a large deep area (approximately 3.5m deeper than the surrounding area), presumably dredged, in the vicinity of Nine Elms Pier that supports this interpretation.

4.5.6 However, since such thick terrestrial deposits have previously been acquired from the Study Area, it is possible that some still exist at depth in places that have been less developed, such as the foreshore between Nine Elms Pier and Cringle Wharf (though no evidence for such layers has been identified within the PS data). Based on the historic BGS records, any such peat deposits are likely to be between 1m and 3m BSB. Such deposits would be considered of high archaeological potential as they could contain *in-situ* archaeological artefacts and well preserved material suitable for palaeoenvironmental analysis, though further sampling would need to be undertaken to confirm their presence within the KST Study Area.

4.5.7 No specific shallow palaeogeographic features of archaeological potential were identified within the KST Study Area. However, a single seabed mound feature was identified within the Study Area on the foreshore area between Nine Elms Pier and Cringle Wharf (**7519**). This is probably a natural feature though could be anthropogenic in origin. It is located above the low water mark, and so it should be possible to investigate the position during any subsequent walkover survey.

4.6 Heathwall Pumping Station (HWPS)

4.6.1 The HWPS Study Area is located on the south bank of the Thames, almost immediately adjacent to, and downriver from, the KST Study Area (**Figure 6**). The area contains the remnants of an aggregate wharf, the land behind which is now being redeveloped, and so contains a jetty, a significant deposit of aggregate on the seabed, and two large outfall pipes. The western edge of the Study Area is also obstructed by the eastern end of Nine Elms Pier and associated moored vessels, including the Battersea Barge.

4.6.2 Despite this, good data coverage was obtained across most of the Study Area, with the exception of the vicinity of the remains of the pier associated with the aggregate wharf (**Figure 6**).

4.6.3 Two recent vibrocores (**VB7012A** and **VB7013**) are located within the Study Area and were used to aid interpretation of the PS data. Two historical BGS borehole (**TQ27NE633** and **TQ27NE634**, date uncertain on the records but likely to be 1950's) are also located within the Study Area and were also used, albeit with a degree of caution due to the age of the records.

4.6.4 In contrast to the adjacent KST Study Area, the top London Clay horizon has been identified within the HWPS Study Area and the majority of the area is interpreted as being covered with a significant thickness of Pleistocene/Holocene deposits. However, due to the relatively recent industrial use of the Study Area, the shallow geology is dominated by recent aggregate dumping and the two prominent outfall pipes. These have been observed in both the previous multibeam bathymetry data and the PS data, and significant associated disturbance and scour has been identified in both the northern and central parts of the Study Area.

4.6.5 Despite this, both vibrocores VB7012A and VB2013 sampled peat at approximately 3m BSB, suggesting preserved terrestrial deposits may be present within the Study Area. No evidence of such deposits was identified within the PS data, however, though this is possibly due to the depth of burial of this material and the dumping of aggregate in the area creating a relatively harder seabed and reducing the penetration of the PS. It is also likely that the construction of the outfall pipes will have removed a lot of material and, as such, it is expected that any surviving peat deposits are present in scattered pockets only.

4.6.6 Such deposits, should they be present, would be considered of high archaeological potential as they could contain *in-situ* archaeological artefacts and well preserved material suitable for palaeoenvironmental analysis, though further sampling would be needed to confirm their presence and the chances of an extensive deposit of such material is expected to be low.

4.6.7 No specific palaeogeographic features of archaeological potential were identified in the Pleistocene/Holocene sedimentary sequence, though the sediments are expected to comprise fluvial sands and gravels and alluvium topped with the recent aggregate deposits. No buried potential anthropogenic features, besides the outfall pipe, were identified within the Study Area.

4.7 Albert Embankment Foreshore (AEF)

4.7.1 The AEF Study Area is located on the south bank of the Thames, extending from just upriver of Vauxhall Bridge in the SW to approximately level with Glasshouse Walk on the shore in the NE. The Study Area is generally free of obstructions, with the exception of Vauxhall Bridge in the SW, and good data coverage was achieved at the Study Area (**Figure 7**).

4.7.2 Five recent vibrocores (**VB7014**, **VB7014A**, **VB7015**, **VB7027** and **VB7028**) are located within the Study Area and were selected to aid with the PS interpretation. Additionally, two vibrocores previously acquired by MoLA (**MoLA-VC6033A** and **MoLA-VC6034**) are located just outside of the Study Area and were also used (**Figure 7**).

4.7.3 The majority of the Study Area is exposed at low tide and as such contains a significant amount of Pleistocene/Holocene deposits, with the extent of these deposits approximately

correlating with the low water mark (**Figure 7**). The London Clay Formation is clearly visible towards the main Thames channel, and the Top London Clay horizon has been identified on a number of survey lines.

4.7.4 Previous foreshore surveys have identified peat deposits and possible associated Mesolithic artefacts along the low water mark (Thames Tideway Tunnel 2013, Vol. 16), suggesting the top London Clay may represent a preserved land surface in parts of the Study Area, though no peat has been recovered in any of the vibrocore samples. Should such deposits be present they would be of high archaeological potential, with the possibility to contain *in-situ* artefacts and preserved organic material suitable for palaeoenvironmental analysis.

4.7.5 The nature of the Pleistocene/Holocene sediments overlying London Clay is uncertain, though vibrocore data indicate they generally comprise foreshore deposits with small areas of alluvium. Irregular reflectors within the top 1m of the data potentially indicate a heterogeneous series of deposits, both vertically and laterally, very few layers within which can be traced with any confidence between survey lines.

4.7.6 Three possible specific features of archaeological potential have been identified within AEF. Feature **7500** is a sub-horizontal reflector within the Pleistocene/Holocene deposits identified on a number of survey lines though dipping beyond the limit of equipment penetration towards the shore. Vibrocore **VB7028** sampled Pleistocene sands and gravels at the same depth of this feature (approximately 2m BSB); therefore it is interpreted as a coarse sediment deposit.

4.7.7 Possible Pleistocene deposits such as these are of archaeological potential, as they could contain both *in-situ* and derived archaeological artefacts. Vibrocore **VB7014A** also sampled the same unit at approximately 3m BSB, indicating similar gravel deposits are present elsewhere within the Study Area that have not been imaged by the PS equipment.

4.7.8 Feature **7501** is interpreted as a complex cut and fill, and is characterised by a possible cut filled with two distinct phases of sediment (**Figure 7**). The upper sediment fill is potentially modern, and correlates with a foreshore feature identified on multibeam bathymetry data and visible at low tide. The lower fill, however, is uncertain in age and nature, and further sampling would need to be undertaken to fully interpret the feature.

4.7.9 Feature **7502** is a small infilled depression only identified along a single survey line. It appears as a depression in the top of the London Clay filled with later sediment, the age of which is unknown. Such infilled depressions potentially contain preserved older sediment, but this depends on the specific erosion/dredging history of the area.

4.7.10 Two small mounds, **7520** and **7521**, were also identified within the Study Area. Both potentially correlate with features visible in previous multibeam bathymetry data and are likely to be natural features, though they could be anthropogenic in origin. **7520** is located above the low water mark, and so could be investigated further during any future walkover surveys. **7521** is located just below the water mark, and so any future investigation would have to be undertaken by sidescan sonar (SSS) or multibeam echo sounder (MBES).

4.7.11 Further sampling is planned to be undertaken within the AEF Study Area, due to the previously recorded possible presence of peat. It is recommended that the proposed sampling strategy be altered to that outlined in **Appendix II** so that some of the identified features of possible archaeological potential can be ground-truthed.

4.8 Victoria Embankment Foreshore (VEF)

4.8.1 The VEF Study Area is located on the north bank of the Thames, just upriver from the Hungerford rail and footbridges, between the permanently moored RS *Hispaniola* and Whitehall Stairs. A number of obstructions are present within the Study Area, most notably the permanently moored PS *Tattershall Castle*, along with two additional floating mooring pontoons and associated moored vessels. Adequate data coverage was achieved across most of the Study Area, the exception being where access was obstructed at the northern end of the Study Area by the presence of the *Tattershall Castle* and associated walkways (**Figure 8**).

4.8.2 Two recent vibrocores (**VB7016** and **VB7017**) and five vibrocores acquired by MoLA (**MoLA-VC6631**, **MoLA-VC6631A**, **MoLA-VC6632**, **MoLA-VC6633** and **MoLA-VC6634**) are located within the Study Area and have been used to aid the PS sonar interpretation.

4.8.3 The top London Clay horizon was not definitively identified within the PS data. However, the vibrocore logs indicate London Clay is present at >1m BSB across the entire Study Area (**VB7017** especially penetrated 2.2m without sampling London Clay), and so a significant deposit of Pleistocene/Holocene sediments is interpreted as being present.

4.8.4 The nature of the Pleistocene/Holocene sediments overlying London Clay is uncertain, though vibrocore data indicate they comprise a mixture of alluvium, fluvial sands and gravels and foreshore deposits. Irregular reflectors within the top 1m of the data potentially indicate a heterogeneous series of deposits, both vertically and laterally, very few layers within which can be traced with any confidence between survey lines.

4.8.5 Multibeam bathymetry data suggests the seabed within the Study Area is very disturbed, and the presence of pontoons and other riverside infrastructure indicates the Study Area has been developed over time which could also have disturbed the seabed.

4.8.6 Despite this, five palaeogeographic features of possible archaeological potential have been identified within the Study Area (**Figure 8**). Features **7512** and **7514** are distinct cut and fill features located close to the embankment wall and identified on more than one survey line. The age and nature of the fill of these features is unknown, but information from vibrocore **VB7017** suggests they could contain alluvium.

4.8.7 Features **7511** and **7515** are similar in nature to **7512** and **7514**, though have only been identified on a single survey line and so are interpreted as being smaller, isolated cut and fill features.

4.8.8 Feature **7513** has been identified on a number of survey lines and is interpreted as an infilled depression. Such infilled depressions potentially contain preserved older sediment, but this depends on the specific erosion/dredging history of the area and the age of the surface within which the depression is located (in this case, the Pleistocene/Holocene deposits).

4.8.9 A number of mound features were identified within the VEF Study Area, though these were interpreted as being mooring points/chains from the surrounding vessels.

4.9 Blackfriars Bridge Foreshore (BBF)

4.9.1 The BBF Study Area actually comprises two separate survey areas, both situated on the north bank of the Thames. The larger, western area is located from Temple Pier to between the Blackfriars road and railway bridges. Significant obstructions are present in this area, including the Blackfriars road bridge, Blackfriars Pier, two pontoons connected

to the shore by walkways, and associated vessels including the River Bus service and the permanently moored HMS *President*. Due to this, only limited coverage of the main survey area at BBF was achieved (**Figure 9**).

4.9.2 The second, smaller, eastern study area at BBF is located downriver of the Blackfriars railway bridge, ending approximately where White Lion Hill turns away from the river on the shore. At the time of survey a large construction barge and associated coffer dam were located over the southern edge of this survey area, which restricted data coverage. Additionally, a floating rubbish collector is located within the survey area. Despite this, generally good data coverage was obtained (**Figure 9**).

4.9.3 Two recent vibrocores (**VB7019** and **VB7020**) and four vibrocores acquired by MoLA (**MoLA-VC6392**, **MoLA-VC6393**, **MoLA-VC6393A** and **MoLA-VC6394**) are located within the Study Area and were used to aid in the PS data interpretation. Eight historic BGS boreholes, ranging in date from 1894 to 1972, are also located in and immediately around the Study Area and were also used, albeit with a degree of caution due to the ages of the records.

4.9.4 The top London Clay horizon was not identified within the PS data, though numerous internal reflectors typical of this unit were clearly visible indicating it is present at the surface within the Study Area with little overlying superficial sediment. Vibrocores from within the western survey area sampled London Clay at approximately 0.5m BSB or less, indicating only a veneer of superficial sediment exists in this area which is likely to be modern.

4.9.5 This correlates with previous work which suggests development of the foreshore within the Study Area, including building of the embankment, bridges and pontoons, combined with natural fluvial erosion processes has likely removed any older sediments (Thames Tideway Tunnel 2013, Vol. 18). Evidence for this is seen in the multibeam bathymetry data, which shows a large dredged berthing pocket associated with one of the pontoons in the west of the Study Area.

4.9.6 The situation is similar in the eastern survey area, with London Clay interpreted as being present at shallow depth beneath a thin veneer of modern seabed sediment. Removal of sediment from this area is also likely, which is supported by historic BGS boreholes along the foreshore. These indicate there was once in excess of 7m of sediment overlying the London Clay in this area which has now been removed, and analysis of the plans associated with the borehole locations show the low water mark has migrated towards the shore since they were acquired.

4.9.7 Additionally, it is was reported from the PLA boat crew (pers. comm.) that immediately prior to the survey a second coffer dam was located in the centre of the eastern survey area, the works associated with which would likely have removed any sediments of archaeological potential.

4.9.8 No specific shallow palaeogeographic features of archaeological potential were identified within the BBF Study Area. However, a single mound feature (**7522**) was identified in the eastern survey area. This is likely to be a natural feature, although it could be anthropogenic in origin, and possibly correlates with a feature visible in previous multibeam bathymetry data. It is located above the low tide mark, and so could be investigated during any future walkover survey.

4.9.9 The likelihood for preservation of features such as peat layers within the BBF Study Area is considered low due to the amount of erosion and dredging that is interpreted to have occurred from within the Study Area.

4.10 Chambers Wharf (CHW)

4.10.1 The CHW Study area is located on the south bank of the Thames at the now disused Chambers Wharf site, between East Lane and Loftie Street on the shore. The Study Area was free of obstructions and good data coverage was obtained (**Figure 10**).

4.10.2 Two recent vibrocores (**VB7021** and **VB7023**) and two vibrocores acquired by MoLA (**MoLA-VC6573** and **MoLA-VC6579**) were located within the Study Area and used to aid the PS data interpretation.

4.10.3 Across most of the Study Area, London Clay is present at approximately 0.5m BSB overlain by a veneer of recent seabed sediment. This sequence thickens slightly towards the centre and foreshore section of the Study Area (**Figure 10**).

4.10.4 The nature of the Pleistocene/Holocene sediments overlying London Clay is uncertain, though vibrocore data indicate they comprise a mixture of alluvium, fluvial sands and gravels and foreshore deposits. Irregular reflectors within the top 1m of the data potentially indicate a heterogeneous series of deposits, both vertically and laterally, very few layers within which can be traced with any confidence between survey lines.

4.10.5 However, three features of possible archaeological potential have been identified cutting into the London Clay. Feature **7503** is a well-defined cut and fill feature identified on a number of survey lines. The main fill of the feature is unknown, but the high amplitude basal reflector strongly suggests the presence of organic deposits such as peat and/or organic clay at the base of the feature (**Figure 10**).

4.10.6 Previous work has indicated the discovery of peat deposits and numerous prehistoric finds within the Study Area, pointing to the presence of a possible settlement site on the foreshore (Thames Tideway Tunnel 2013, Vol. 20). Due to this, feature **7503** is considered of high archaeological potential, with the possibility to contain *in-situ* archaeological artefacts and palaeoenvironmental material. However, the feature would need to be ground-truthed by further sampling to confirm.

4.10.7 Multibeam bathymetry data from the Study Area indicates it is relatively undisturbed by development and/or dredging when compared with other Study Areas, indicating the deposits at CHW are potentially relatively undisturbed.

4.10.8 Feature **7504** is a small cut and fill feature cut into the London Clay. It is less well-defined than **7503**, though the fill is still potentially of archaeological interest. Feature **7505** has been interpreted as an infilled depression and has been identified on more than one survey line. It appears as a depression in the top of the London Clay filled with later sediment, the age of which is unknown. Such infilled depressions potentially contain preserved older sediment, but this depends on the specific erosion/dredging history of the area.

4.10.9 No mounds or other structures of possible anthropogenic origin were identified within the Study Area.

4.11 King Edward VII Memorial Park (KEMP)

4.11.1 KEMP is the most easterly Study Area and is located on the north bank of the Thames just east of Shadwell Basin, between Shadwell Dock Stairs and Free Trade Wharf. The Study Area was mostly free of obstructions, though three small moored vessels proved obstacles to the survey. Despite this, good data coverage was obtained (**Figure 11**).

4.11.2 No recent vibrocores have been acquired from KEMP, with only one historic BGS borehole (**TQ38SE76**, dated 1885) located within the Study Area. However, a number of other historic BGS boreholes of various dates are available from around the nearby Shadwell Basin.

4.11.3 The top London Clay horizon was not identified within the PS anywhere in the KEMP Study Area. Borehole **TQ38SE76** penetrated over 8m BSB without sampling London Clay, suggesting the top London Clay horizon is beyond the penetration of the PS equipment. Although **TQ38SE76** is an old borehole record, other boreholes from around Shadwell Basin indicate the presence of London Clay at similar depths.

4.11.4 This suggests a significant amount of Pleistocene/Holocene deposits survive below the seabed at the KEMP Study Area. Further information from the historic boreholes suggests 3m – 4m of preserved peat may be present at approximately 3.m BSB, possibly of Mesolithic age (Thames Tideway Tunnel 2013, Vol. 21). Deposits such as these have high potential to contain preserved organic material of importance to palaeoenvironmental studies. Any buried and preserved land surfaces also have the potential to contain both *in-situ* and derived archaeological material.

4.11.5 Despite being located within the old Docklands area of London, the KEMP Study Area itself appears to have experienced little in the way of foreshore development (besides the embankment wall). This lack of disturbance and apparent lack of fluvial erosion in the area (Thames Tideway Tunnel 2013, Vol. 21) suggests these deeper deposits identified within the historic boreholes are likely to have survived and still be present within the Study Area at the present day.

4.11.6 Only one distinct feature was identified within the PS data. This feature was identified outside and to the SW of the Study Area, and is characterised by a well-defined basal reflector and single phase of fill. The orientation of the feature relative to the Shadwell Basin indicates it is possibly the silted-up remnants of a dredged channel maintained to allow access to the Shadwell Basin during the period when it was a working dock. Due to its location outside of the Study Area, it has not been included in the gazetteer.

4.11.7 No individual shallow palaeogeographic features or possible anthropogenic anomalies of archaeological potential were identified within the KEMP Study Area. Though, as previously described, it is likely that deposits of palaeoenvironmental potential are preserved a few metres BSB across the entire Study Area.

5 REFERENCES

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6 APPENDIX I – FEATURES OF ARCHAEOLOGICAL POTENTIAL

PEF

WA ID	Name / Classification	Archaeological Discrimination	Description
7509	Simple Cut and Fill	P2	Small, poorly defined cut and fill feature identified on one survey line. Single phase of acoustically chaotic fill. Fill of unknown age or nature. Depth Range: 0.4m - 0.9m BSB.
7510	Simple Cut and Fill	P2	Small, poorly defined cut and fill feature identified on more than one survey line. Single phase of acoustically chaotic fill. Fill of unknown age or nature. Depth Range: 0.4m - 0.9m BSB.

WA ID	Easting	Northing	Name / Classification	Archaeological Discrimination	Description
7516	524150	175684	Mound	A2	Possible small, poorly defined mound located on the seabed. Possibly corresponds with a feature seen in the multibeam bathymetry data, though this is unclear. Likely to be a natural feature, though could be anthropogenic in origin. Located above the low water mark, so could be investigated during any later walkover surveys.

CRR

WA ID	Name / Classification	Archaeological Discrimination	Description
7506	Coarse Sediment Layer	P1	Poorly defined sub-horizontal reflector identified on a number of survey lines though exact extent uncertain. Correlates approximately with gravel identified within core VB7005, and possibly indicates a coarse sediment layer. Depth Range: 0.4m - 2.2m BSB.

7507	Erosion Surface	P2	Poorly defined, sub-horizontal shallow reflector. Possible erosion surface, possibly marking the base of the more recent foreshore/fluvial deposits though nature and age of sediments above and below the surface remain uncertain. Depth Range: 0.3m - 1.1m BSB.
7508	Erosion Surface	P2	Poorly defined, sub-horizontal shallow reflector. Possible erosion surface, possibly marking the base of the more recent foreshore/fluvial deposits though nature and age of sediments above and below the surface remain uncertain. Depth Range: 0.3m - 1.1m BSB.

WA ID	Easting	Northing	Name / Classification	Archaeological Discrimination	Description
7517	525607	175533	Mound	A1	Distinct mound feature which blanks out underlying data. Possible remains of a barge bed as identified during previous foreshore surveys. Located above the low water mark, so could be investigated during any later walkover surveys.
7518	525615	175522	Mound	A2	Possible small, poorly defined mound located on the seabed. Likely to be a natural feature, though could be anthropogenic in origin. Located above the low water mark, so could be investigated during any later walkover surveys.

KST

WA ID	Easting	Northing	Name / Classification	Archaeological Discrimination	Description
7519	529287	177640	Mound	A2	Distinct mound feature, possibly natural though could be anthropogenic. Located above the low water mark, so could be investigated during any later walkover survey.

AEF

WA ID	Name / Classification	Archaeological Discrimination	Description
7500	Coarse Sediment Layer	P1	Distinct sub-horizontal reflector identified on a number of survey lines, though reduced penetration in the area close to shore means the layer cannot be traced far. Possible layer of Pleistocene gravel, as seen at similar depth in core VB7028. Further information about this feature should be obtained during a planned sampling program. Depth Range: 1.4m - >2.0m BSB.
7501	Complex Cut and Fill	P2	Possible very shallow cut and fill feature containing two phases of fill, though feature was only identified on two survey lines and is uncertain. Depth to base of feature correlates with thin alluvium deposit identified in core VB7028. Possible alluvium deposit layer within foreshore deposits, though age unknown. Further information about this feature should be obtained during a planned sampling program. Depth Range: 0.2m - 1.2m BSB.
7502	Infilled Depression	P2	Small, possible Infilled depression in top of London Clay. Poorly defined and only identified on one survey line. Filled with sediments of unknown age. Depth Range: 0.1m - 0.7m BSB.

WA ID	Easting	Northing	Name / Classification	Archaeological Discrimination	Description
7520	530216	178165	Mound	A2	Large but poorly defined mound located on the seabed. Possibly corresponds with a feature seen in the multibeam bathymetry data, though this is unclear. Likely to be a natural feature, though could be anthropogenic in origin. Located above the low water mark, so could be investigated during any later walkover surveys.
7521	530290	178308	Mound	A2	Distinct mound located on the seabed. Possibly corresponds with a feature seen in the multibeam bathymetry data, though this is unclear. Likely to be a natural feature, though could be anthropogenic in origin. Located below the low water mark, so any future investigation would need to be undertaken by SSS or MBES.

VEF

WA ID	Name / Classification	Archaeological Discrimination	Description
7511	Simple Cut and Fill	P2	Small, simple cut and fill feature only identified on one survey line. Single phase of acoustically chaotic fill, age and nature unknown. Depth Range: 0.2m - 1.0m BSB.
7512	Simple Cut and Fill	P2	Possible poorly defined simple cut and fill feature, though appears more as an erosion surface on cross lines. Generally poorly defined basal reflector though is stronger in some places, with single phase of acoustically chaotic fill. Nature and age of fill unknown. Depth Range: 0.3m - 1.3m BSB.
7513	Infilled Depression	P2	Possible very poorly defined, very shallow cut and fill feature, though appears to be more of an infilled depression. Age and nature of fill is unknown. Depth Range: 0.1m - 0.7m BSB.
7514	Simple Cut and Fill	P2	Poorly defined possible cut and fill feature, identified on two survey lines. Basal reflector unclear, single phase of acoustically chaotic fill. Nature and age of fill unknown, though core VB7017 suggests possible alluvium. Depth Range: 0.4m - 1.1m BSB.
7515	Simple Cut and Fill	P2	Possible small, poorly defined cut and fill feature only identified on a single survey line. Basal reflector poorly defined, and could just be an internal reflector. Nature and age of fill unknown. Depth Range: 0.3m - 0.9m BSB.

BBF

WA ID	Easting	Northing	Name / Classification	Archaeological Discrimination	Description
7522	531951	180804	Mound	A2	Distinct mound located on the seabed. Possibly corresponds with a feature seen in the multibeam bathymetry data, though this is unclear. Likely to be a natural feature, though could be anthropogenic in origin. Located above the low water mark, so could be investigated during any later walkover surveys.

CHW

WA ID	Name / Classification	Archaeological Discrimination	Description
7503	Simple Cut and Fill	P1	Distinct cut and fill feature cut into London Clay, identified on a number of survey lines. Basal reflector is located deeper than the penetration of the equipment in the centre, but the edges are well defined. No borehole information is available from within the feature, but the high amplitude of the basal reflector in places suggests a possible organic-rich/peat layer. Depth Range: 0.3m - 3.0m BSB.
7504	Simple Cut and Fill	P2	Small, poorly defined cut and fill feature cut into London Clay, identified on more than one survey line. Fill of feature unknown. Depth Range: 0.2m - 0.8m BSB.
7505	Infilled Depression	P2	Possible poorly defined cut and fill feature, though appears more like a depression in the top of London Clay infilled with sediment of unknown age. Identified on more than one survey line. Depth Range: 0.2m - 0.9m BSB.

7 APPENDIX II – PROPOSED SAMPLING LOCATIONS

PEF

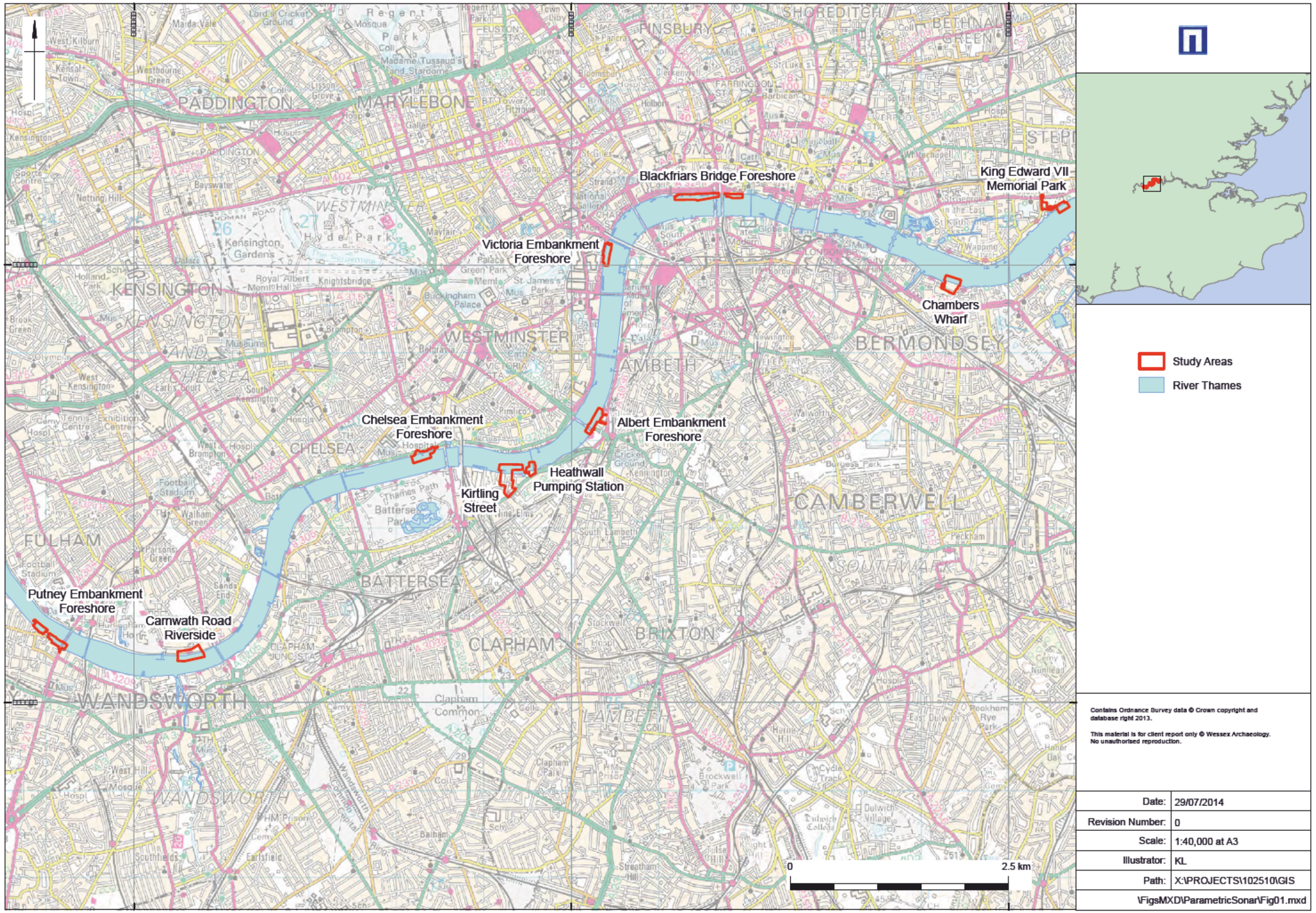
Core Number	Easting (BNG)	Northing (BNG)	Max. Depth
WA01	524071	175733	5m
WA02	524105	175716	5m
WA03	524119	175708	5m
WA04	524138	175680	5m
WA05	524163	175678	5m

CEF

Core Number	Easting (BNG)	Northing (BNG)	Max. Depth
WA06	528270	177804	5m
WA07	528288	177835	5m
WA08	528311	177842	5m
WA09	528315	177818	5m
WA10	528375	177841	5m

AEF

Core Number	Easting (BNG)	Northing (BNG)	Max. Depth
WA11	530222	178161	5m
WA12	530248	178200	5m
WA13	530260	178191	5m
WA14	530274	178208	5m



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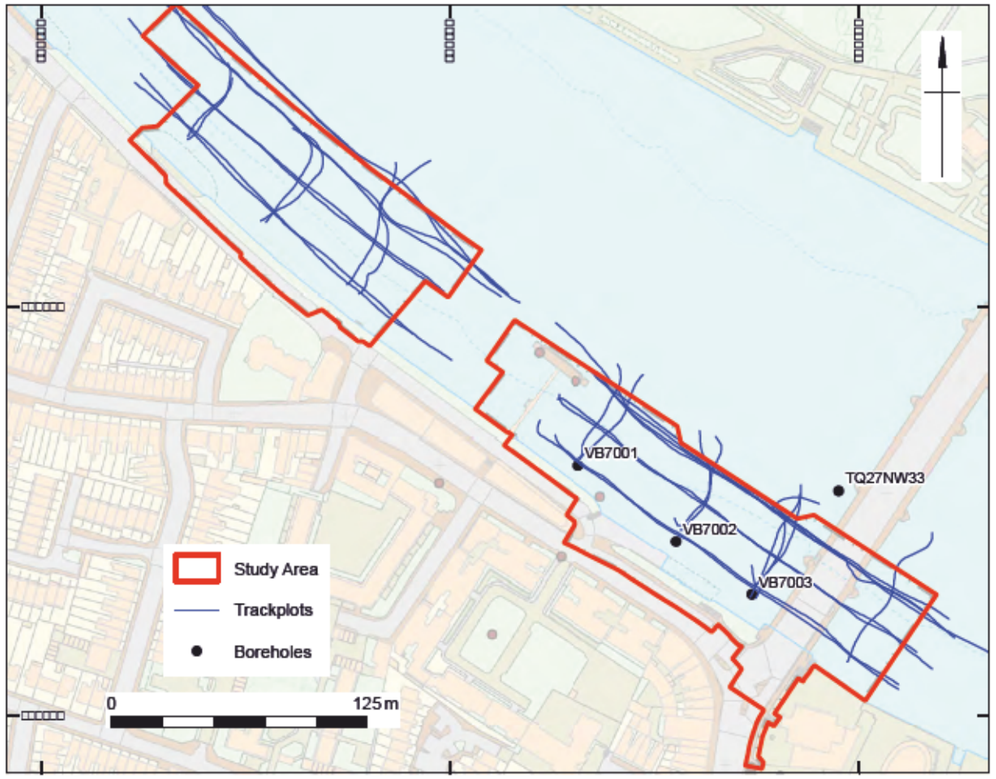
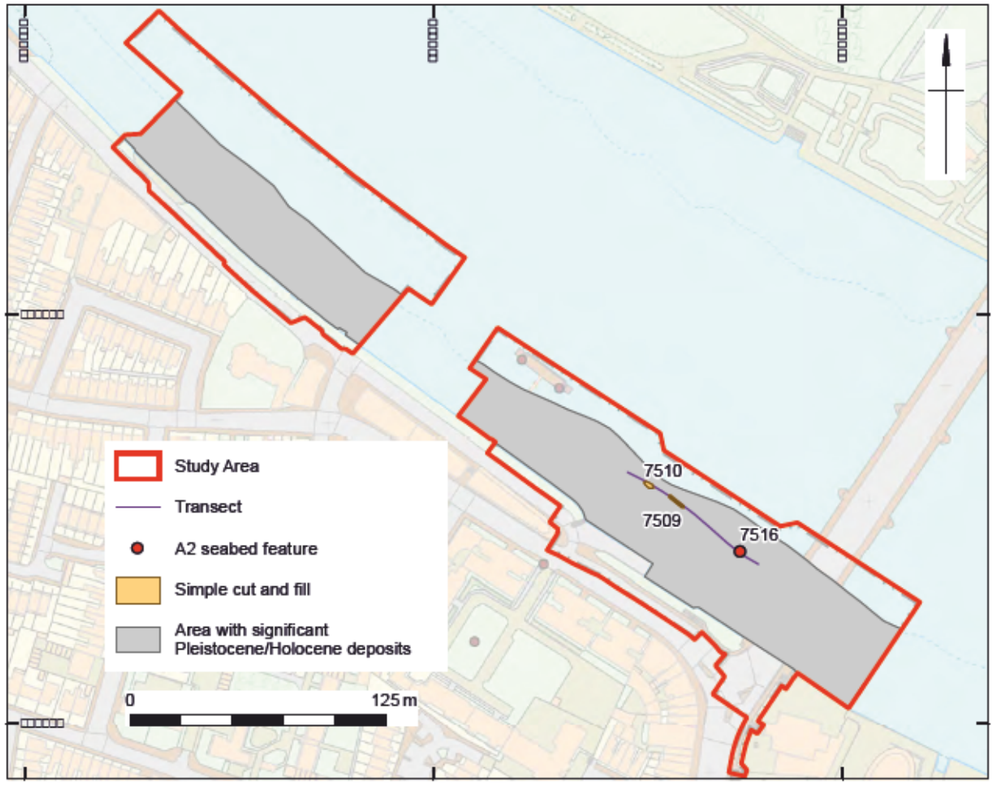
Study Area Location

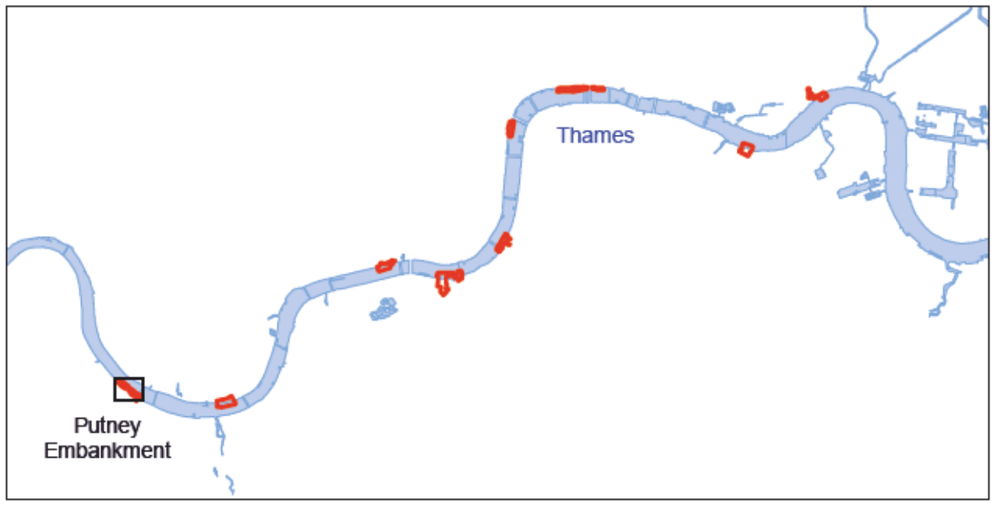
Figure 1



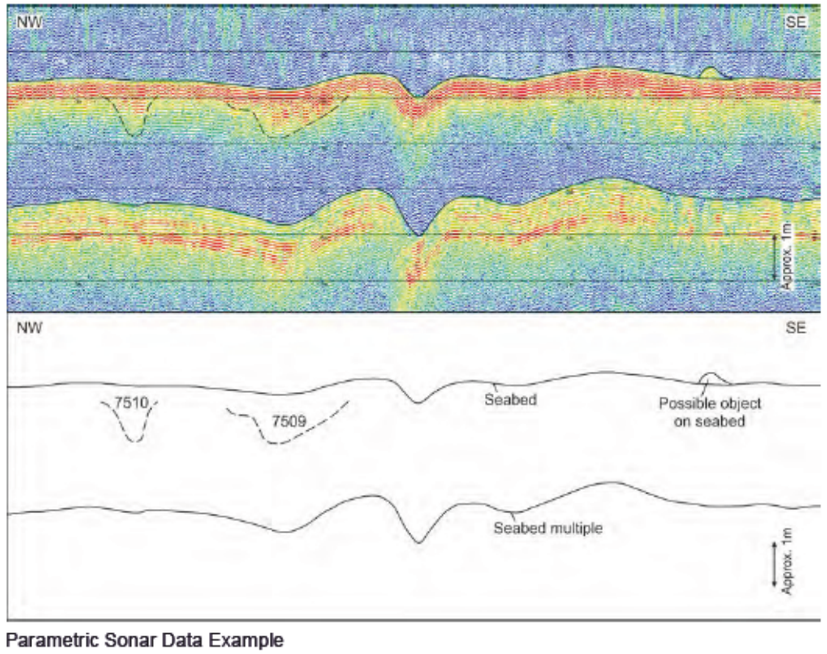
Parametric Sonar Trackplot



Parametric Sonar Interpretation

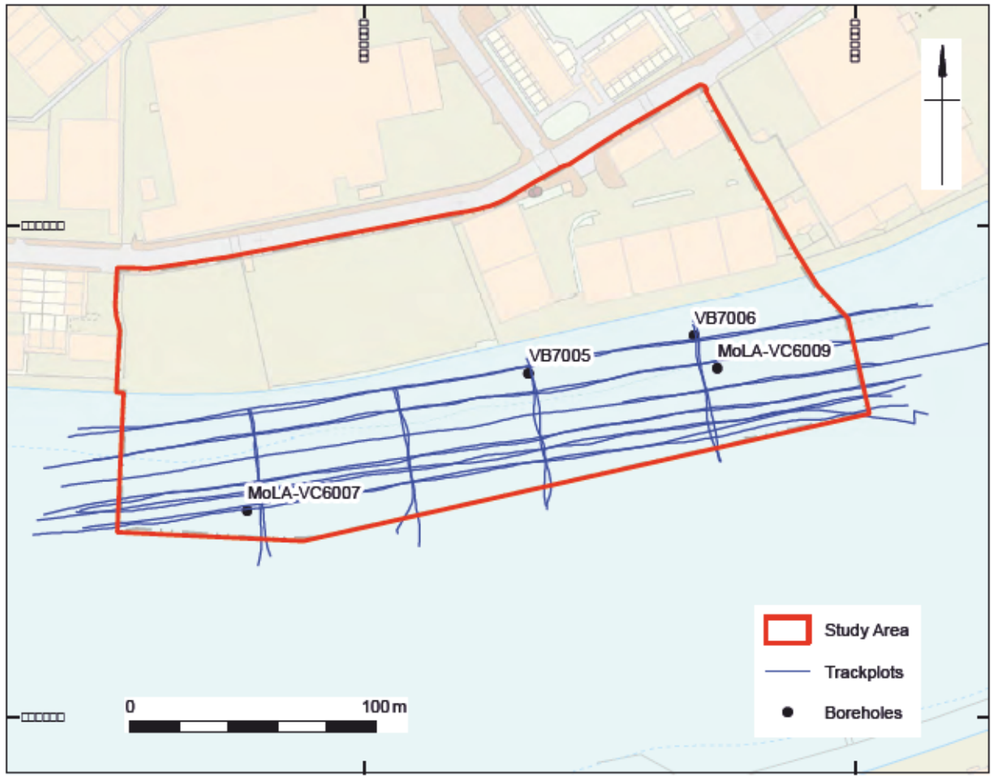


Site location



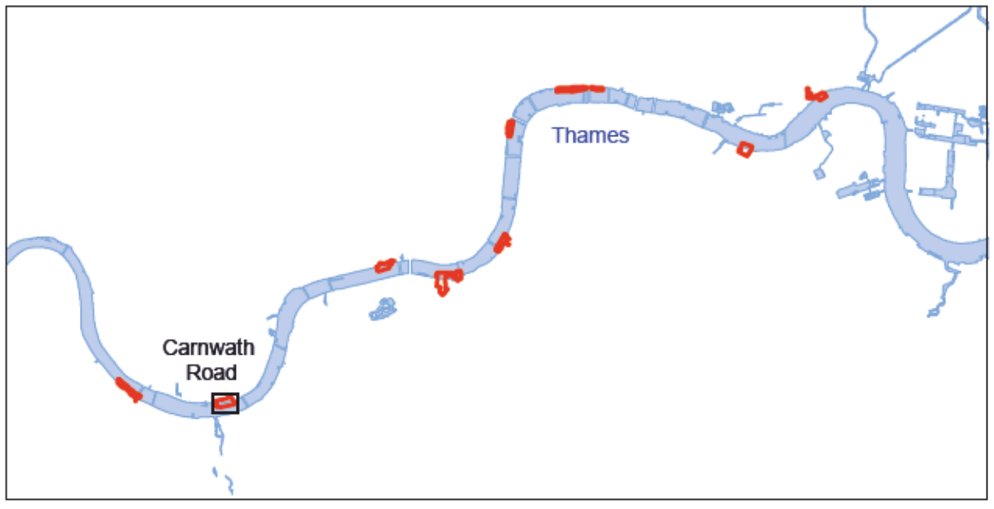
Parametric Sonar Data Example

Date:	20/10/14	Revision Number:	0
Scale:	Site plans 1:3000 at A3	Illustrator:	KL
Path:	X:\PROJECTS\102510\GIS\FigsMXD\ParametricSonar\Fig02.mxd		

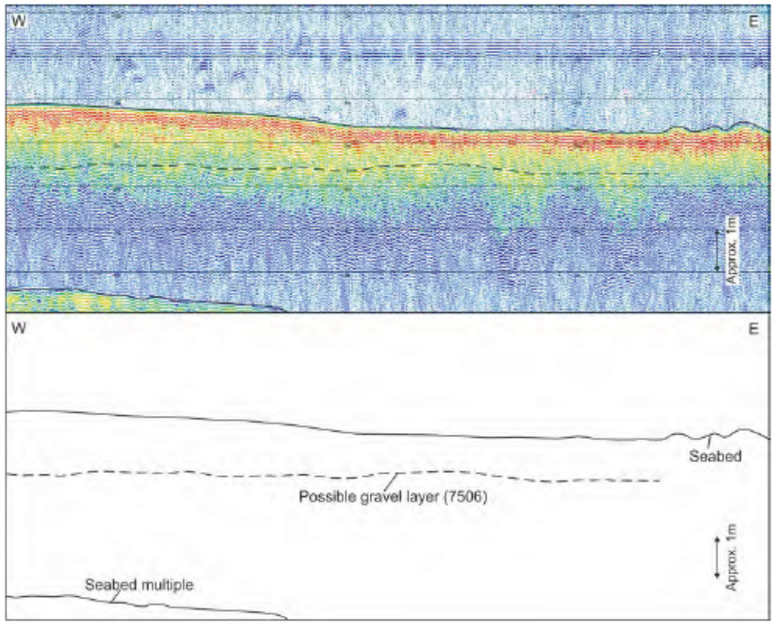


Parametric Sonar Trackplot

Parametric Sonar Interpretation

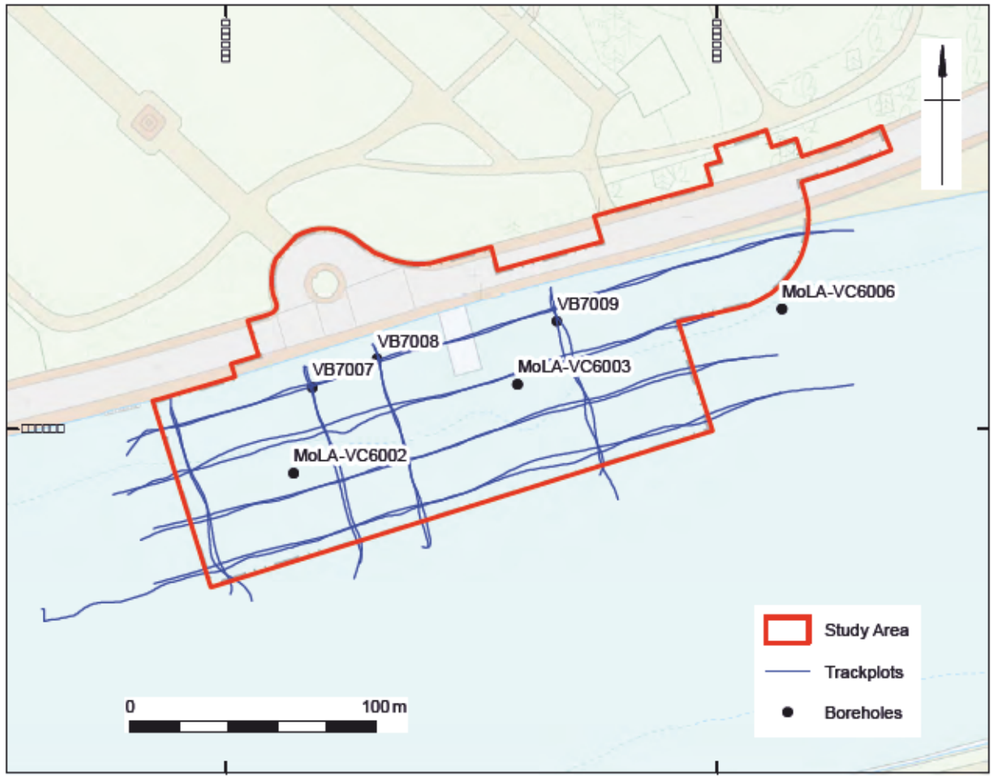


Site location

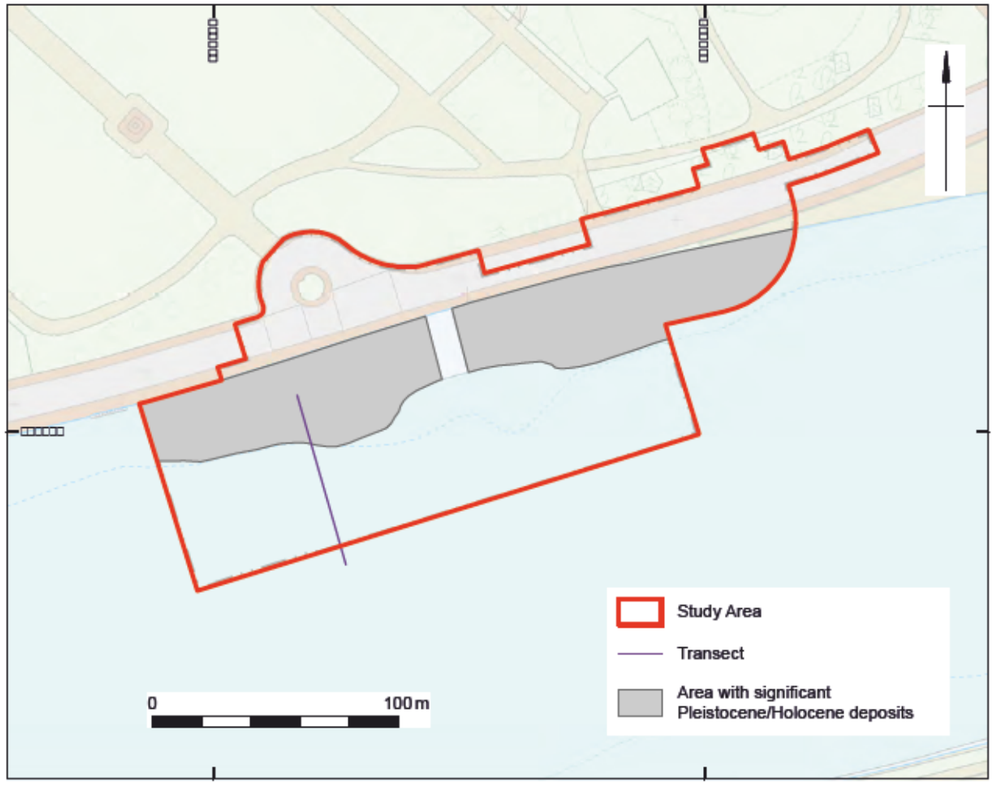


Parametric Sonar Data Example

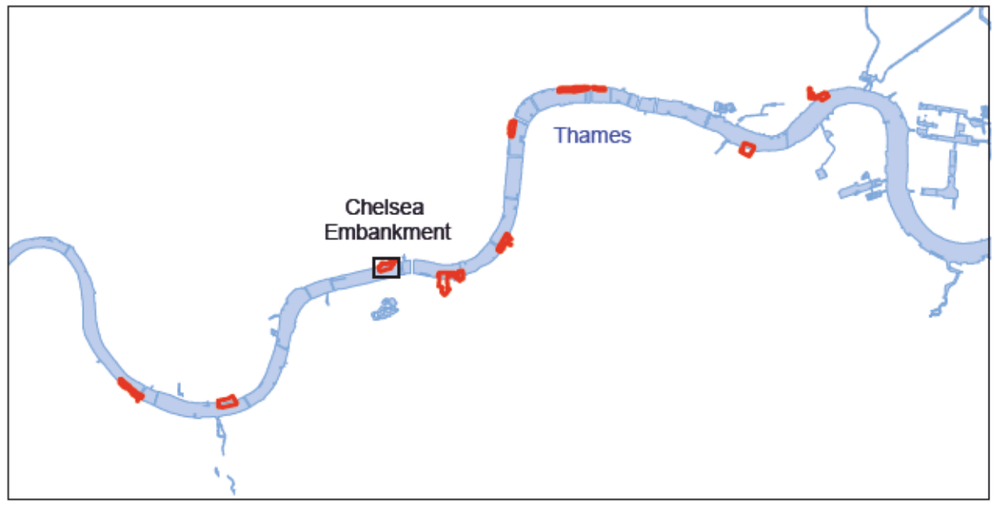
Date:	20/10/14	Revision Number:	0
Scale:	Site plans 1:2500 at A3	Illustrator:	KL
Path:	X:\PROJECTS\102510\GIS\FigsMXD\ParametricSonar\Fig03mxd		



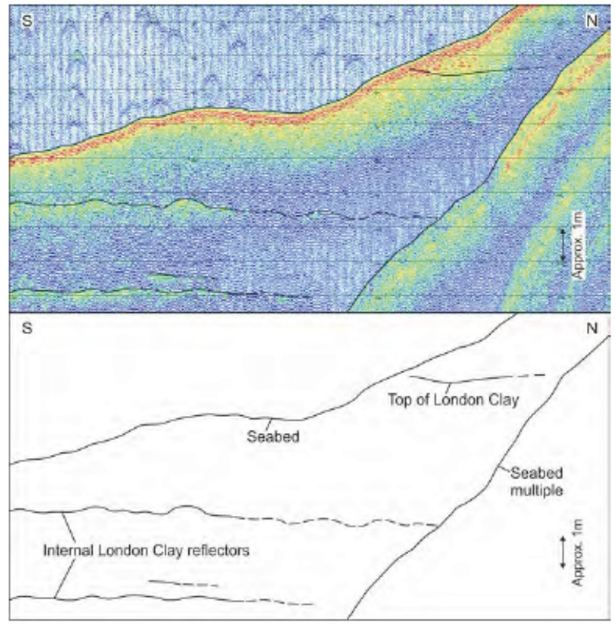
Parametric Sonar Trackplot



Parametric Sonar Interpretation

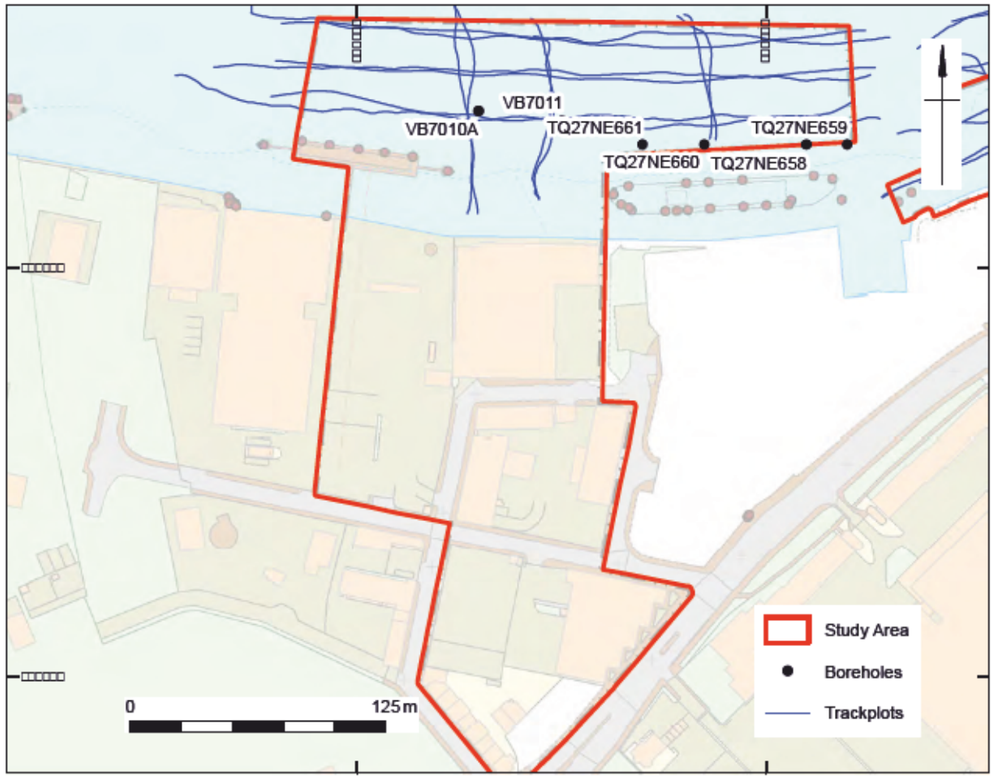


Site location

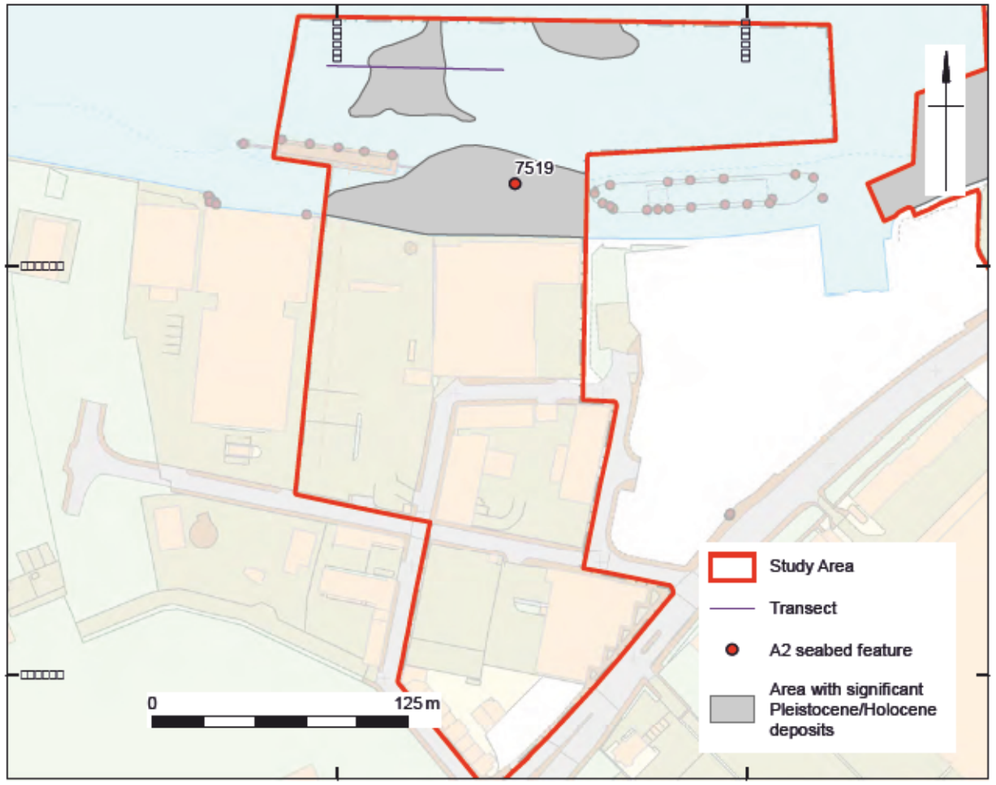


Parametric Sonar Data Example

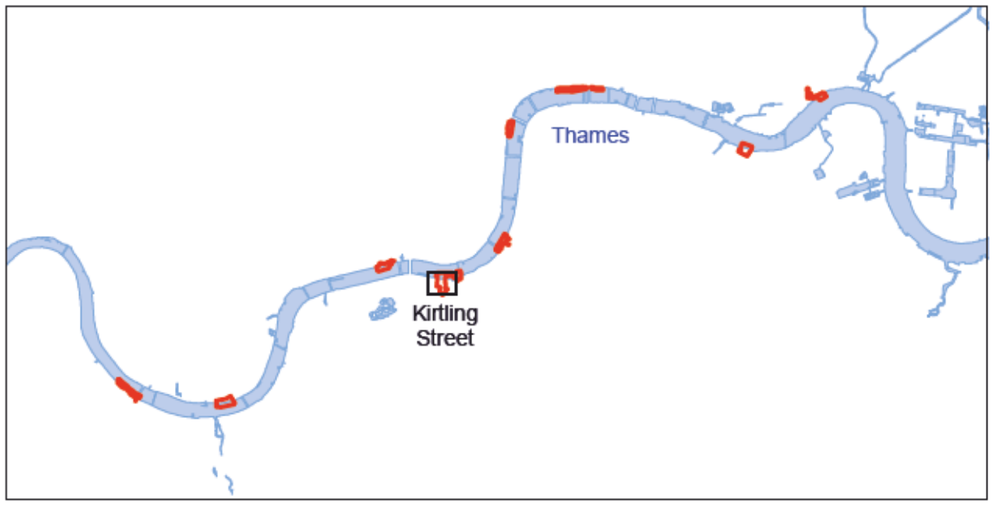
Date:	20/10/14	Revision Number:	0
Scale:	Site plans 1:2500 at A3	Illustrator:	KL
Path:	X:\PROJECTS\102510\GIS\FigsMXD\ParametricSonar\Fig04mxd		



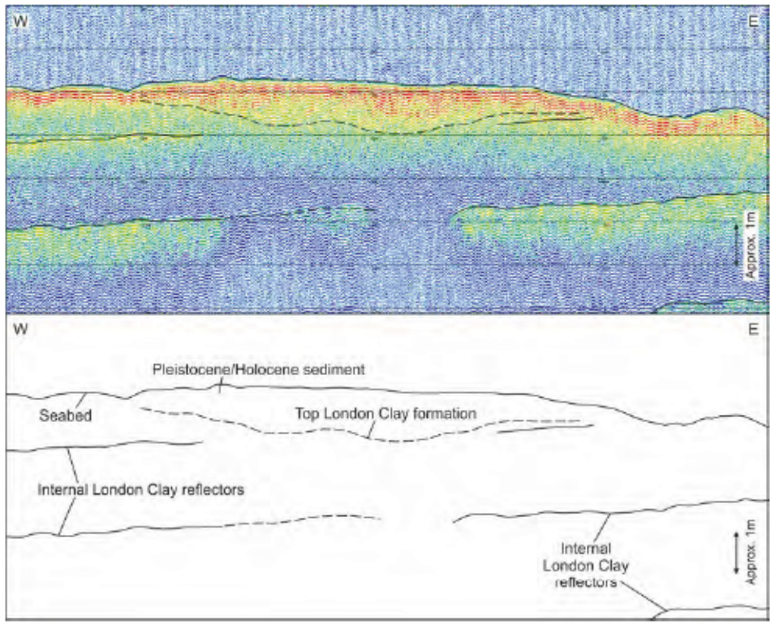
Parametric Sonar Trackplot



Parametric Sonar Interpretation

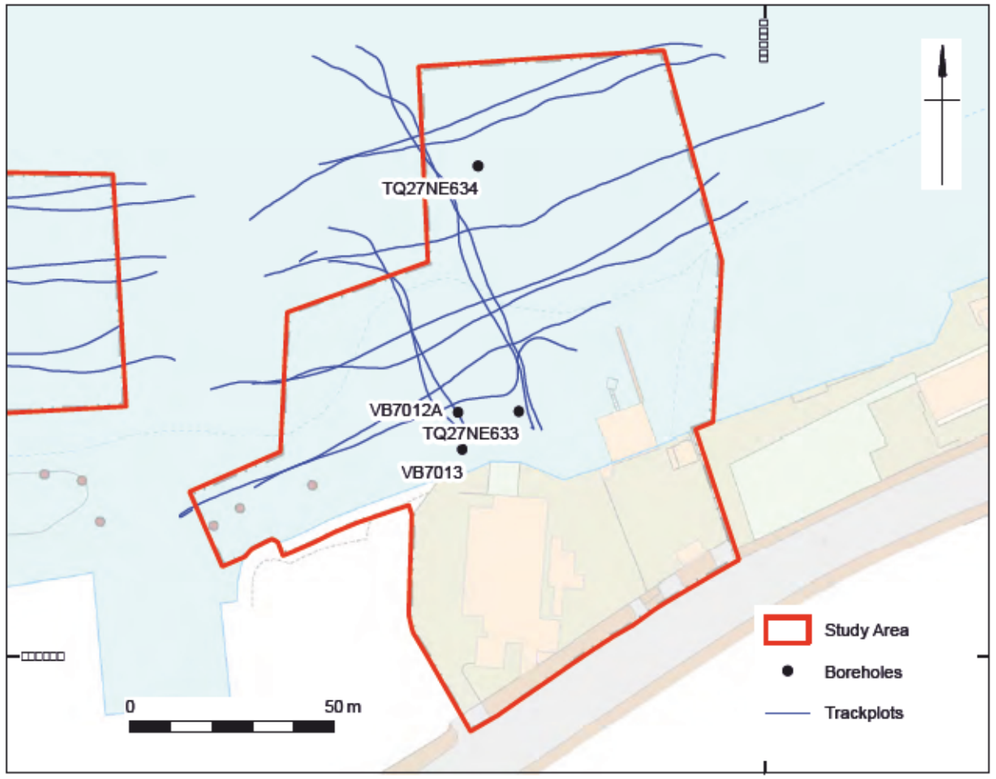


Site location

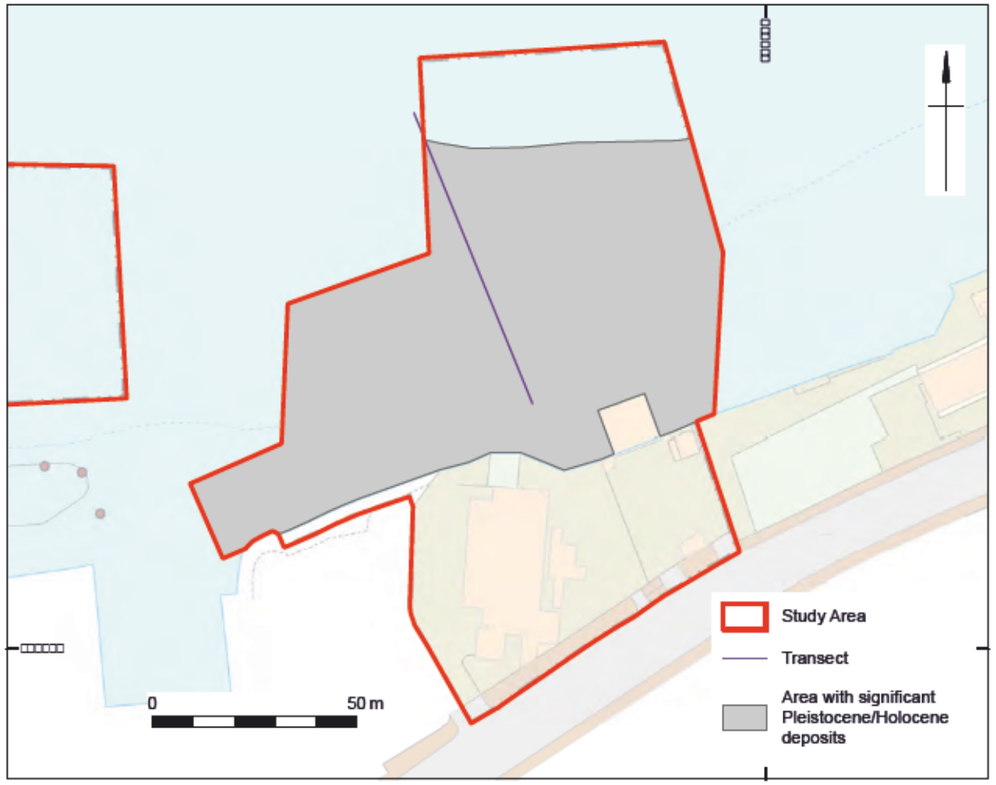


Parametric Sonar Data Example

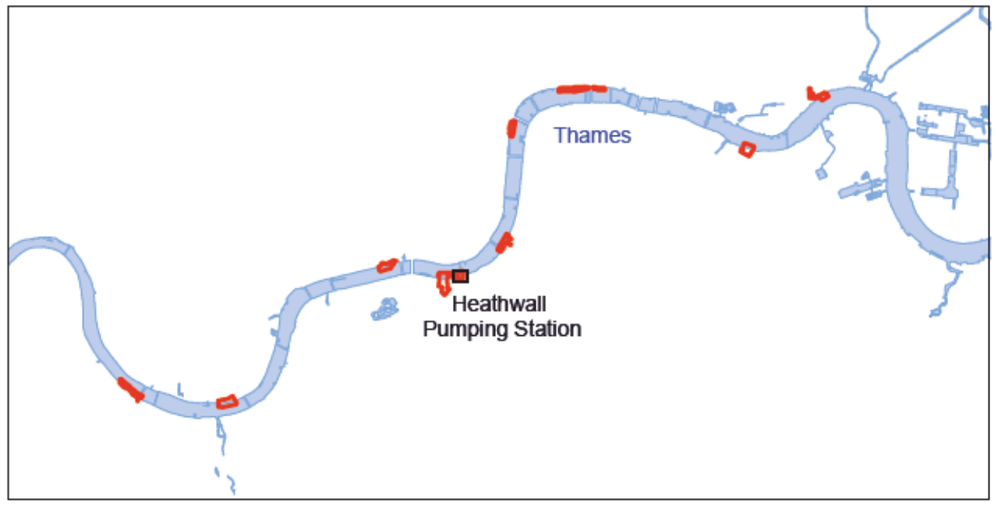
Date:	20/10/14	Revision Number:	0
Scale:	Site plans 1:3000 at A3	Illustrator:	KL
Path:	X:\PROJECTS\102510\GIS\FigsMXD\ParametricSonar\Fig05mxd		



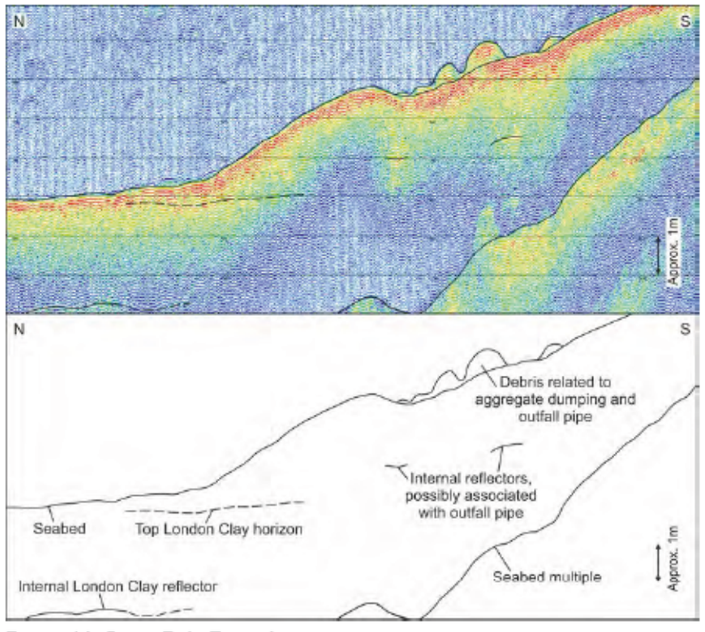
Parametric Sonar Trackplot



Parametric Sonar Interpretation

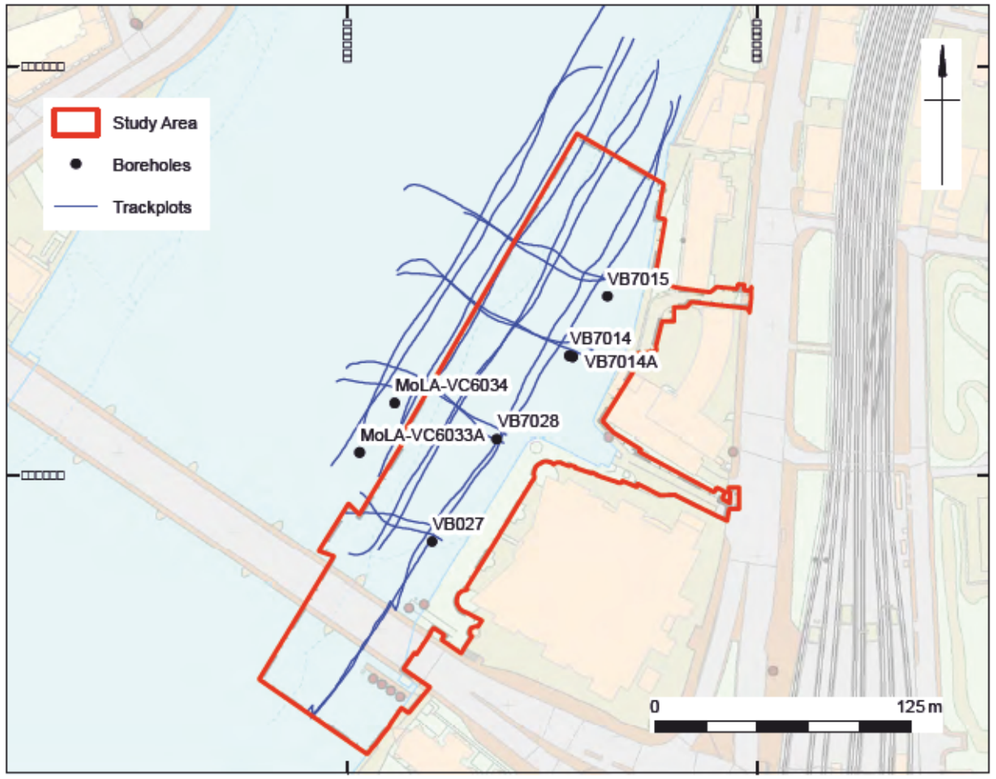


Site location

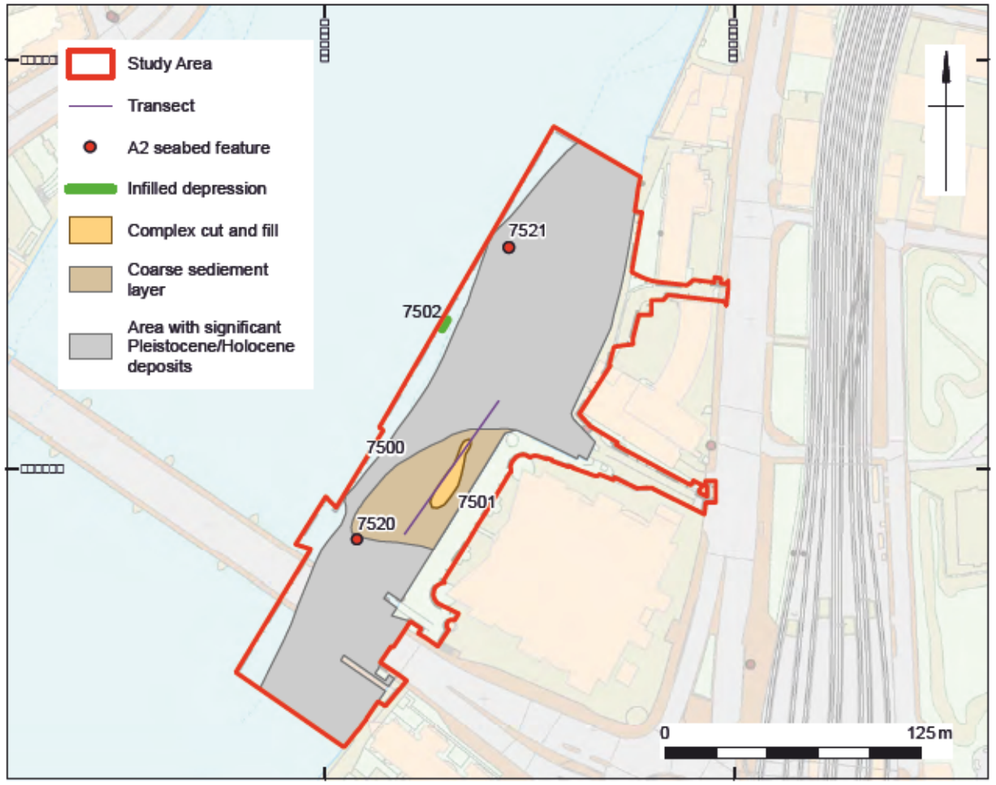


Parametric Sonar Data Example

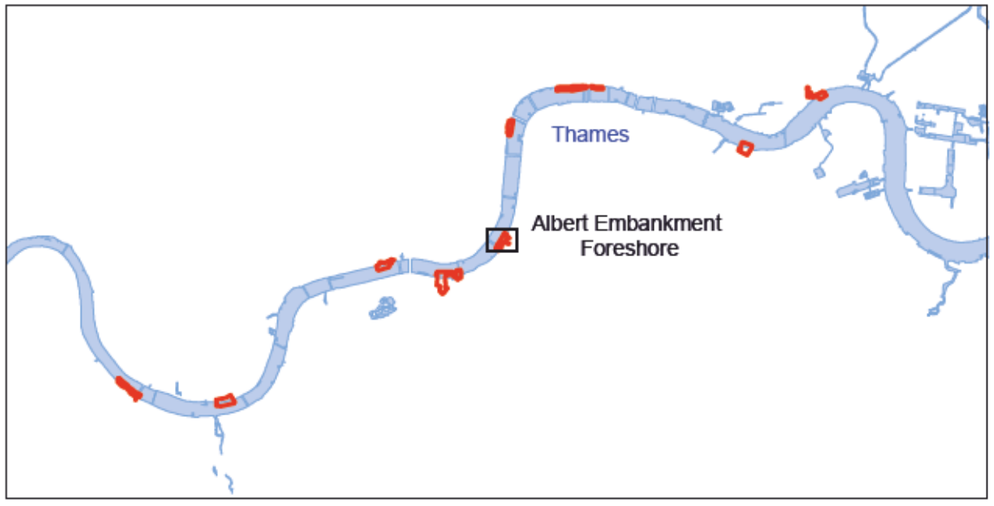
Date:	20/10/14	Revision Number:	0
Scale:	Site plans 1:2000 at A3	Illustrator:	KL
Path:	X:\PROJECTS\102510\GIS\FigsMXD\ParametricSonar\Fig06mxd		



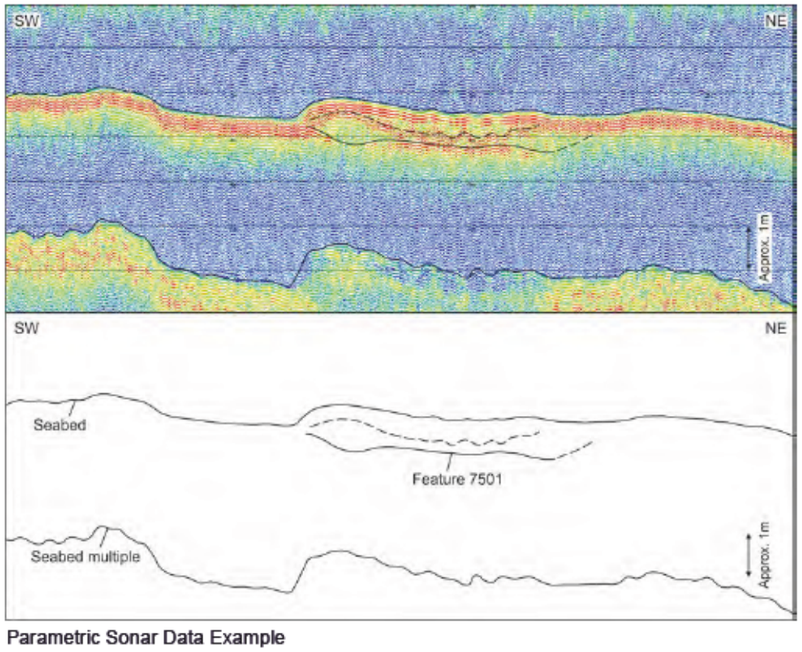
Parametric Sonar Trackplot



Parametric Sonar Interpretation

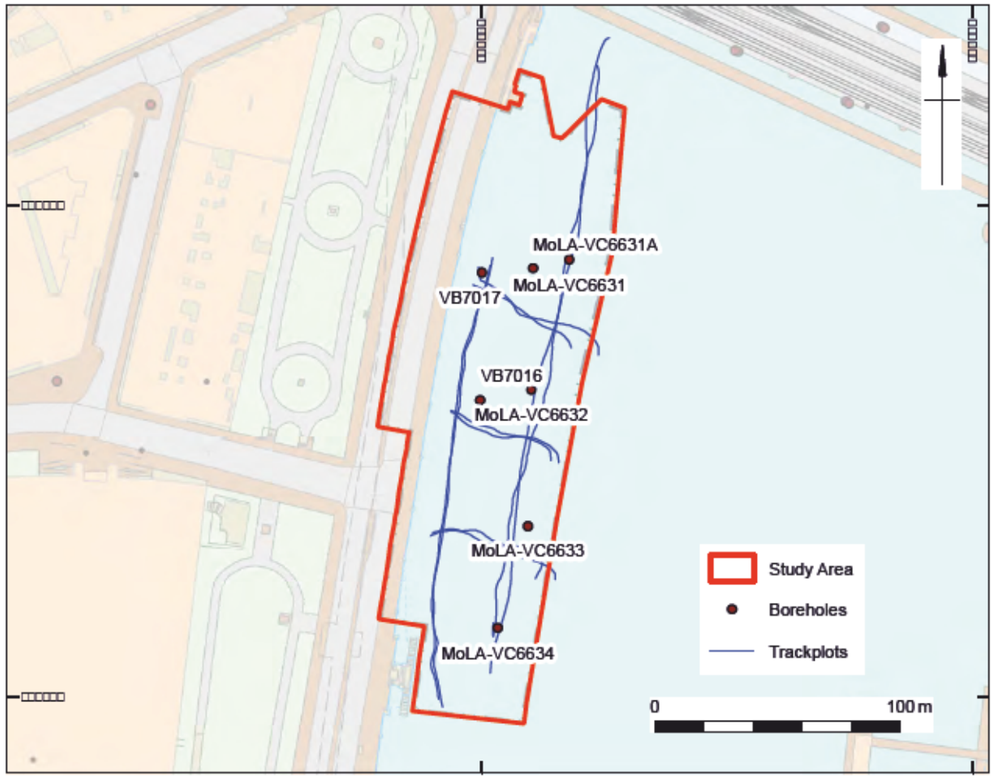


Site location

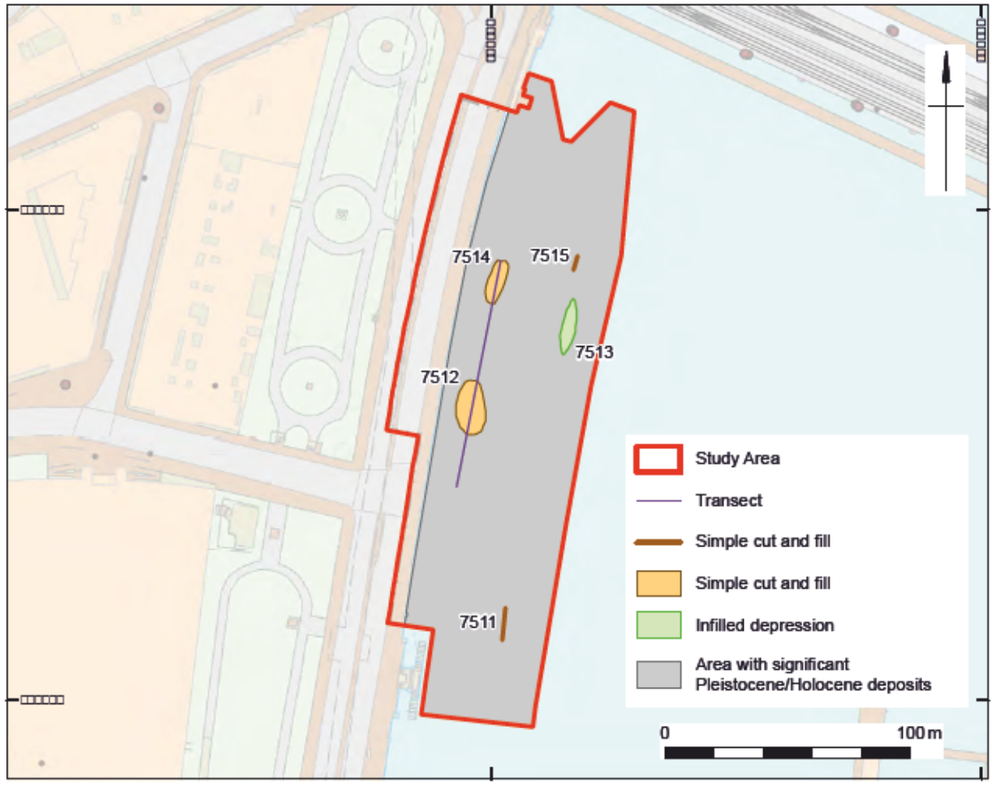


Parametric Sonar Data Example

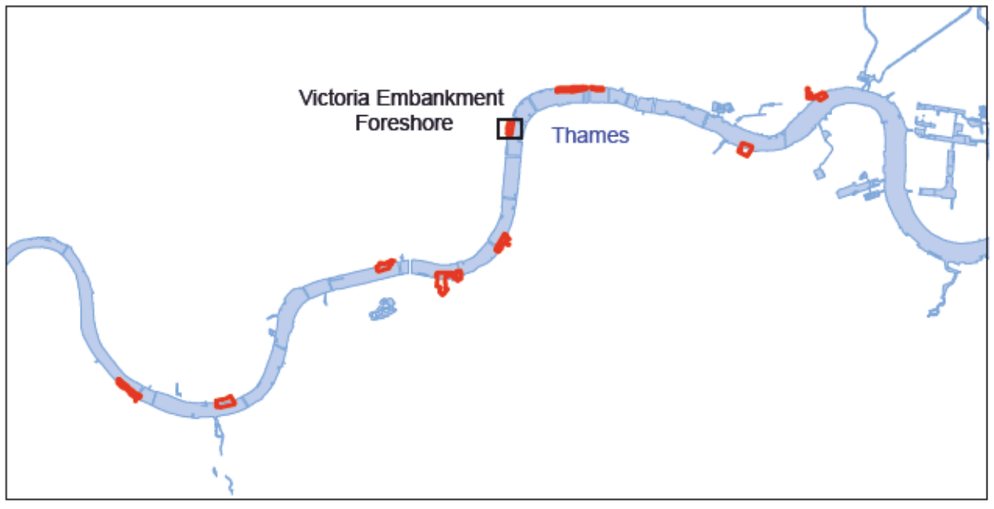
Date:	20/10/14	Revision Number:	0
Scale:	Site plans 1:3000 at A3	Illustrator:	KL
Path:	X:\PROJECTS\102510\GIS\FigsMXD\ParametricSonar\Fig07mxd		



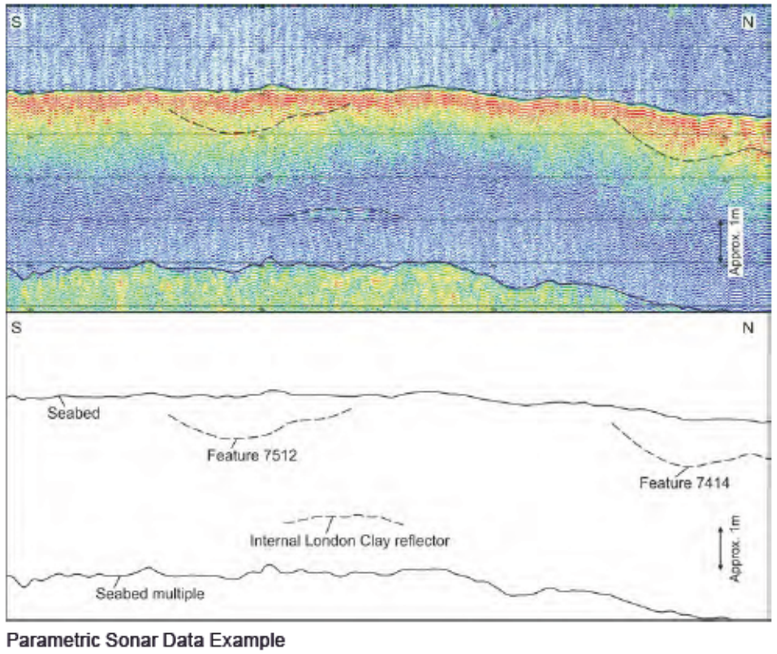
Parametric Sonar Trackplot



Parametric Sonar Interpretation

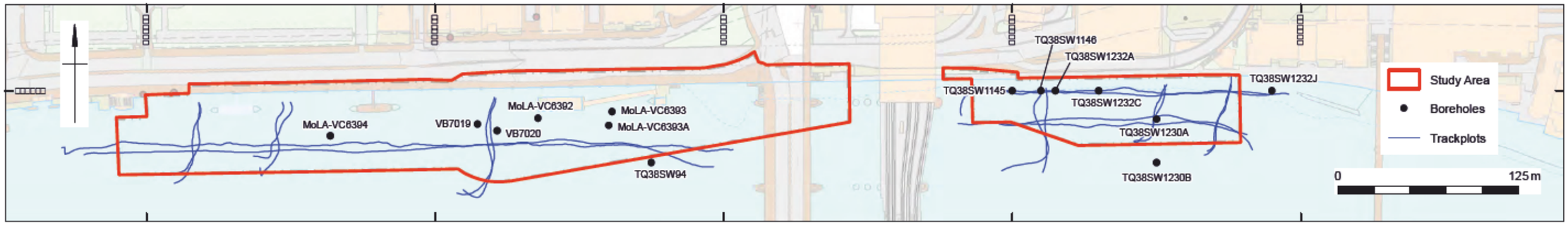


Site location

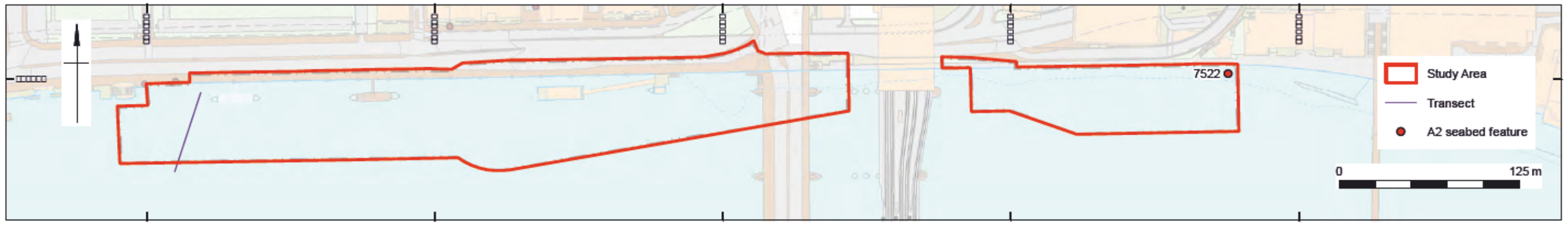


Parametric Sonar Data Example

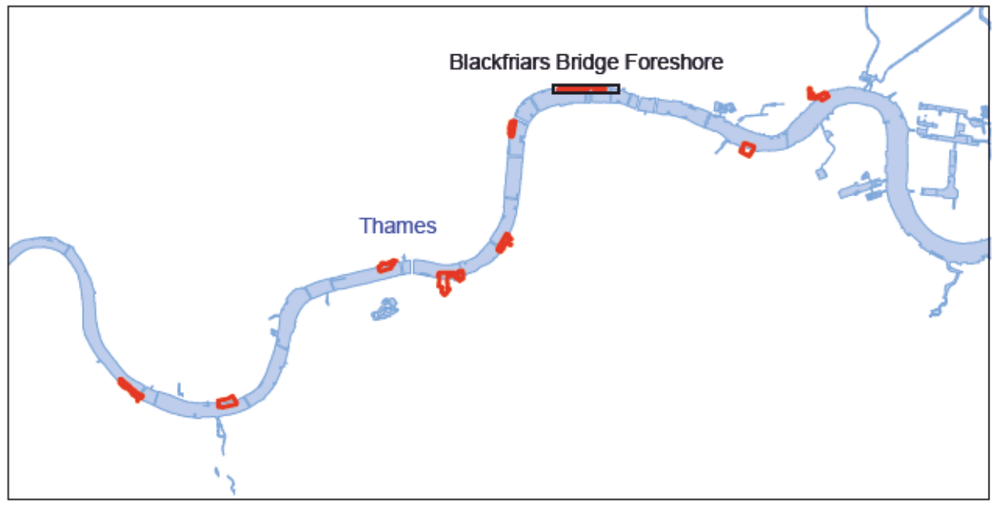
Date:	20/10/14	Revision Number:	0
Scale:	Site plans 1:3000 at A3	Illustrator:	KL
Path:	X:\PROJECTS\102510\GIS\FigsMXD\ParametricSonar\Fig08.mxd		



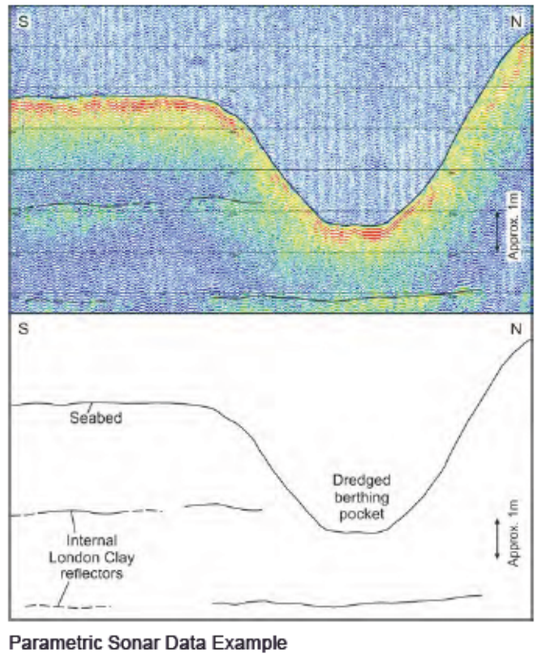
Parametric Sonar Trackplot



Parametric Sonar Interpretation

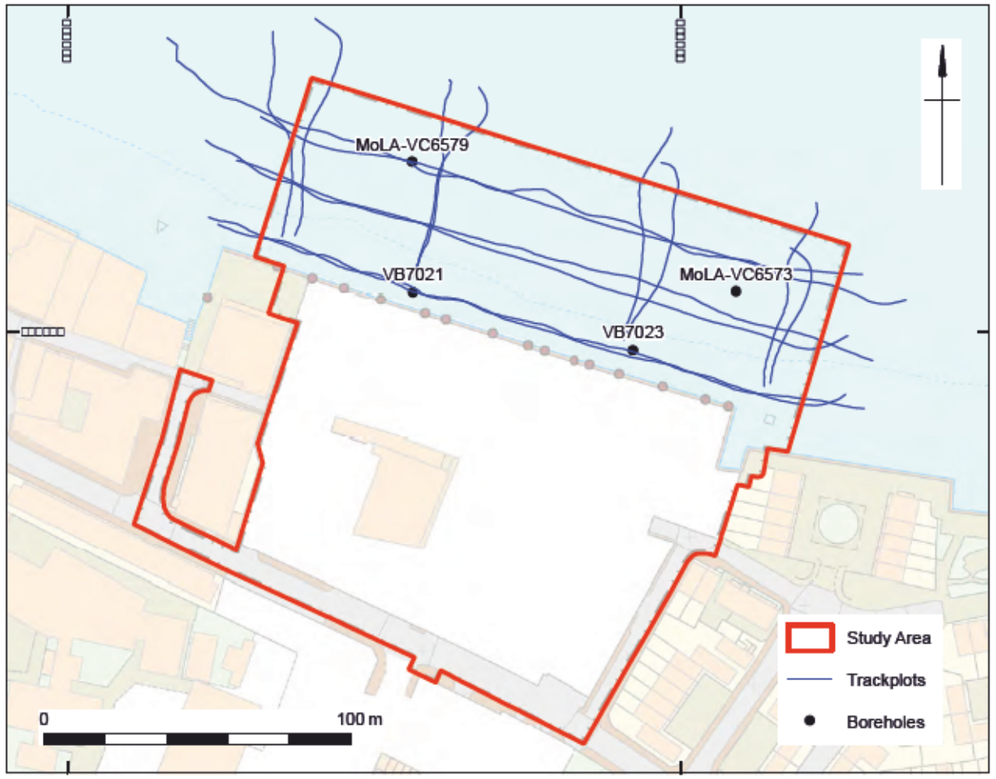


Site location

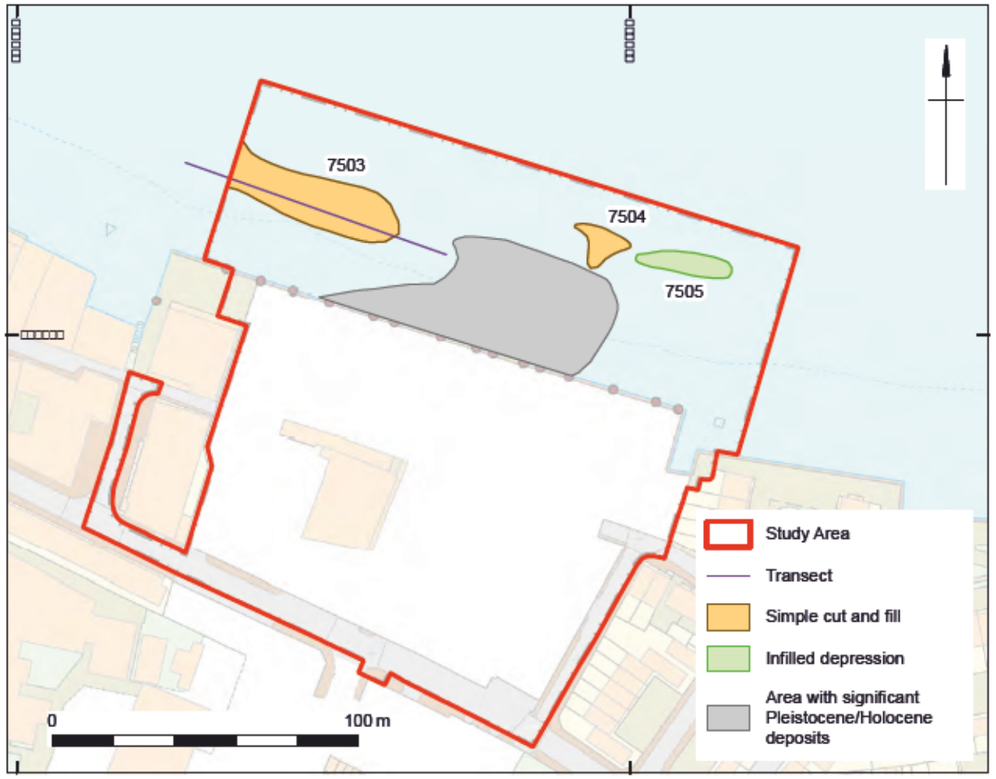


Parametric Sonar Data Example

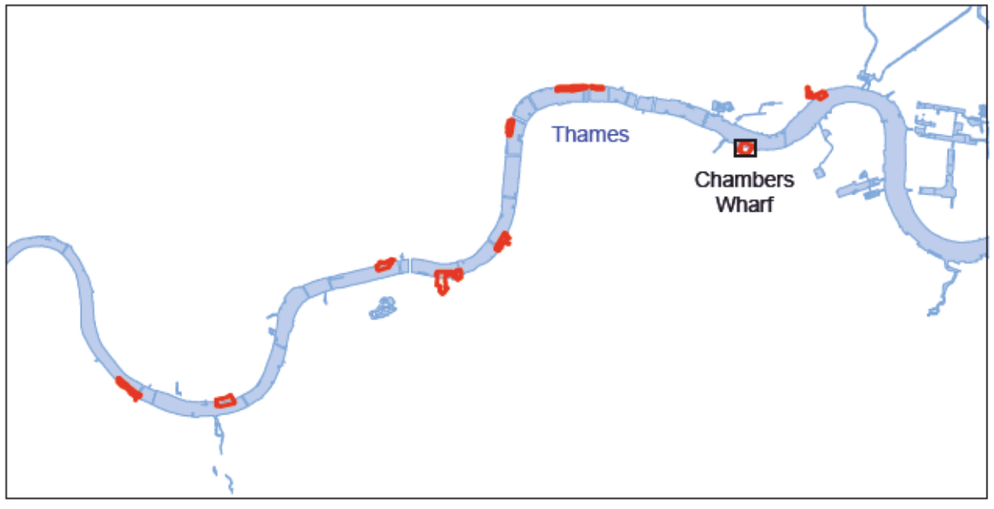
Date:	20/10/14	Revision Number:	0
Scale:	Site plans 1:3000 at A3	Illustrator:	KL
Path:	X:\PROJECTS\102510\GIS\FigsMXD\ParametricSonar\Fig09.mxd		



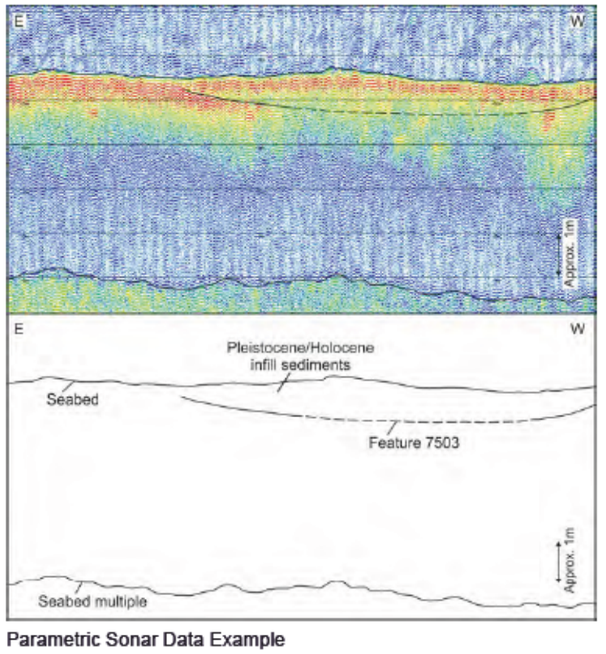
Parametric Sonar Trackplot



Parametric Sonar Interpretation

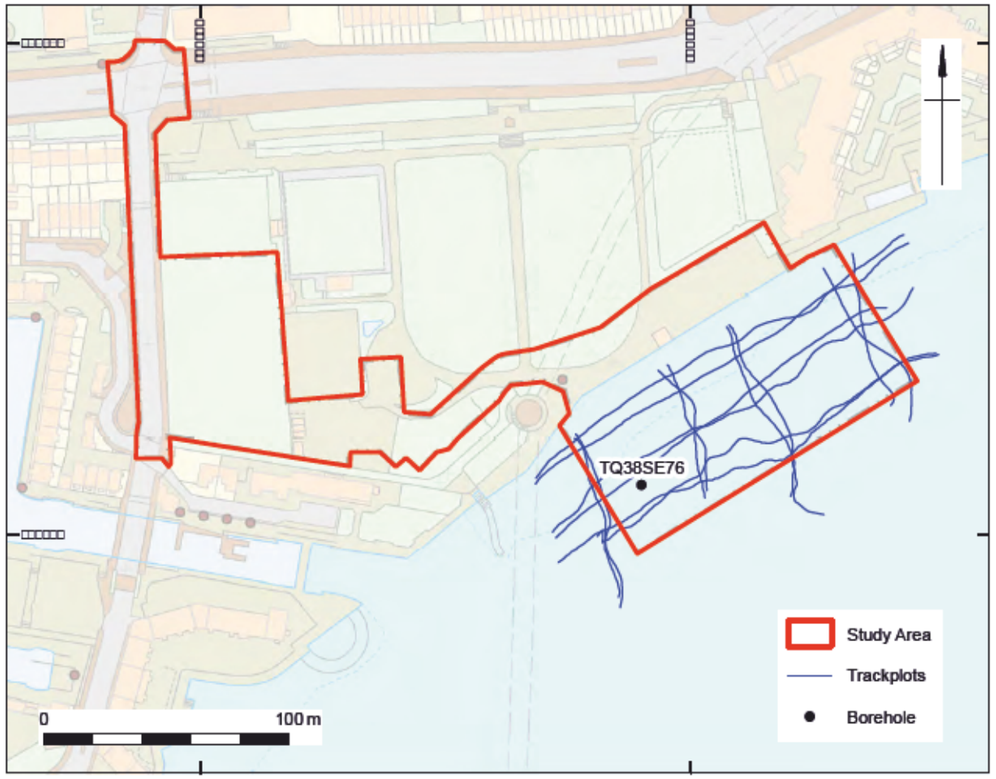


Site location

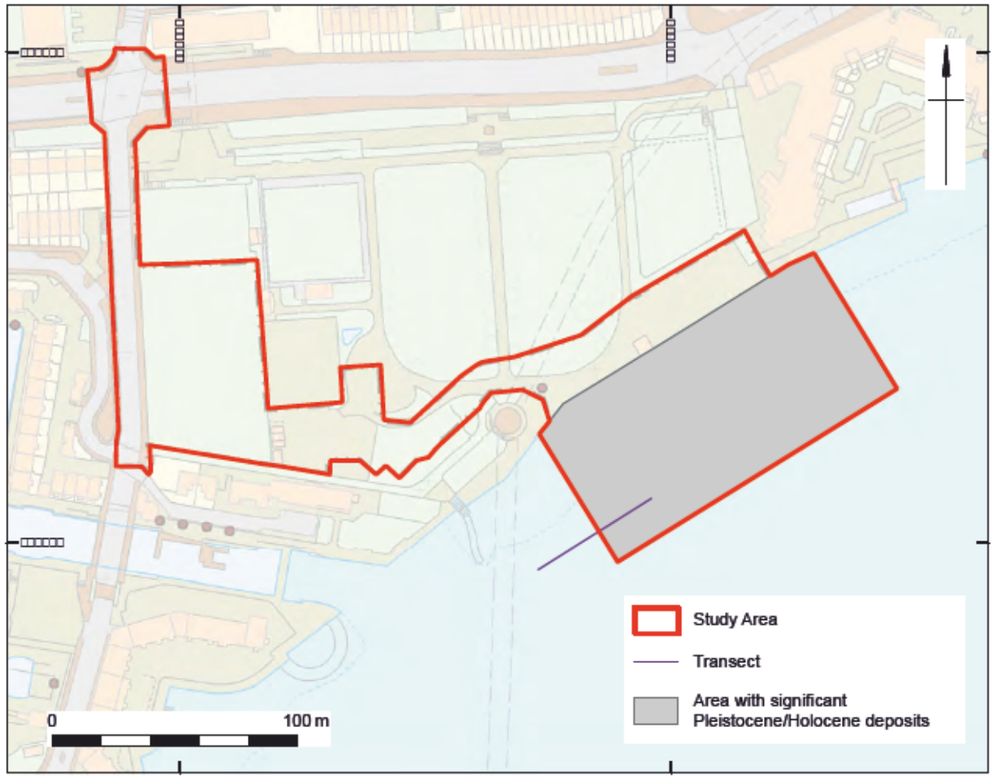


Parametric Sonar Data Example

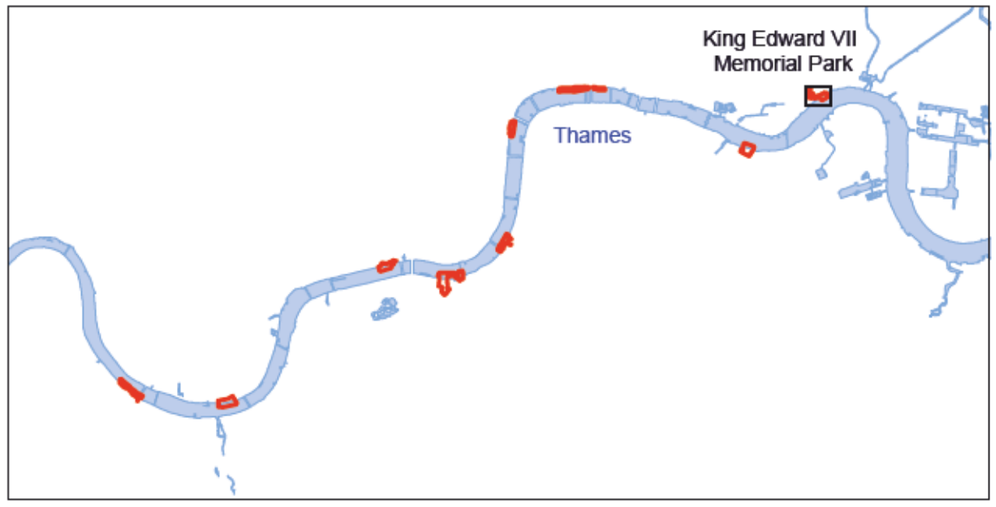
Date:	20/10/14	Revision Number:	0
Scale:	Site plans 1:2000 at A3	Illustrator:	KL
Path:	X:\PROJECTS\102510\GIS\FigsMXD\ParametricSonar\Fig10.mxd		



Parametric Sonar Trackplot



Parametric Sonar Interpretation



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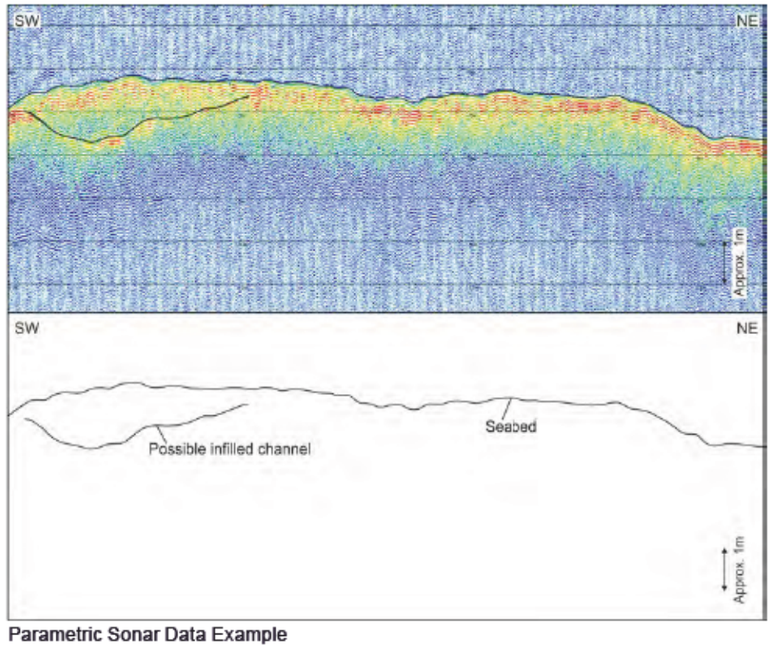

Parametric Sonar Data Example

Date:	20/10/14	Revision Number:	0
Scale:	Site plans 1:2000 at A3	Illustrator:	KL
Path:	X:\PROJECTS\102510\GIS\FigsMXD\ParametricSonar\Fig11.mxd		

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