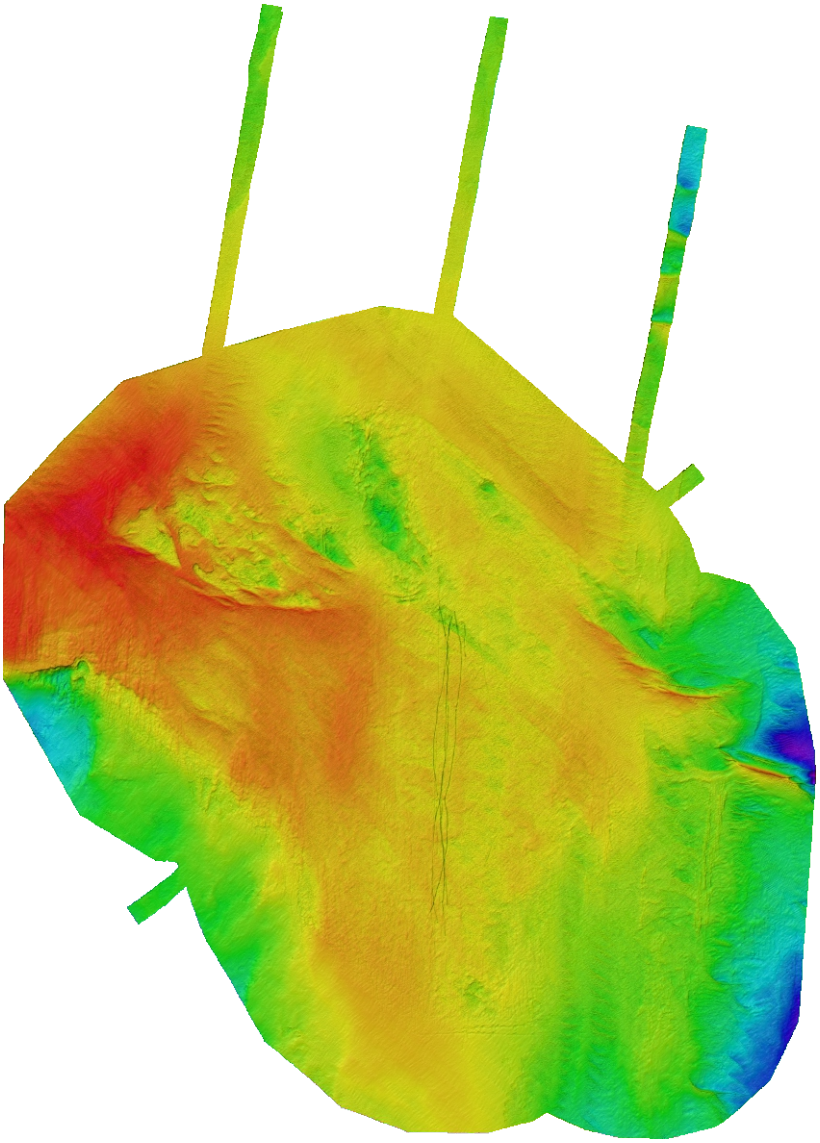
making sense of heritage

Area 430
Marine Aggregate Extraction

Archaeological Assessment of Geophysical Data
Archaeological Monitoring Report



Ref: 65223.01
July 2016

geoservices

Area 430

MARINE AGGREGATE EXTRACTION

Archaeological Assessment of Geophysical Data
Archaeological Monitoring Report

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July 2016

Report Ref. 65223.01

Quality Assurance

Project Code	65223	**Accession Code**		**Client Ref.**	
Planning Application Ref.		**Ordnance Survey (OS) national grid reference (NGR)**			

Version	Status*	Prepared by	Checked and Approved By	Approver's Signature	Date
v01	E	*A Mynett*	*L Tizzard*		07/07/2016
File:	65223_Area_430_Archaeological_Monitoring_Report_ 20160707.pdf				
V02	F	*A Mynett*	*L Tizzard*		14/07/2016
File:	W:\Projects\65223_Reports\65223_Area_430_Archaeological_Monitoring_Report_20160720.pdf				
File:					
File:					
File:					

* I = Internal Draft; E = External Draft; F = Final

Area 430

Archaeological Assessment of Geophysical Data

Archaeological Monitoring Report

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Summary

Wessex Archaeology was commissioned by CEMEX UK Marine Ltd and Tarmac Marine Ltd to undertake an archaeological assessment of geophysical survey data as part of the heritage impact monitoring process implemented for aggregate extraction Area 430.

The overall aim of this report is to provide an archaeological review of the effects of dredging on known archaeological sites and previously identified geophysical anomalies that may be of potential archaeological interest, and to assess the areas for new sites of potential archaeological interest.

The assessment consisted of a review of sidescan sonar and multibeam bathymetry data acquired by GEOxyz in 2014. In addition to this, the results of the previous monitoring reports undertaken by Wessex Archaeology in 2011 and 2015 were reviewed, the 2006 desk-based assessment and 2007 reports on aircraft debris previously found from within Area 430 during dredging were also considered.

In total 20 anomalies from the 2014 geophysical survey and previous investigations have been identified as being of possible archaeological potential within the Archaeological Study Area, eight of these are located within the aggregate licence area. These are all classified as anomalies of uncertain origin of possible archaeological interest and were not deemed to require exclusion zones.

No new mitigation strategies have been recommended for the area, though it is suggested that the present Managed Dredging Zone and Archaeological Exclusion Zones remain in place, and that any artefacts recovered during dredging activities continue to be reported through the Marine Aggregate Industry *Protocol for Reporting Finds of Archaeological Interest*.

Area 430

Archaeological Assessment of Geophysical Data
Archaeological Monitoring Report

Acknowledgements

This assessment was commissioned by CEMEX UK Marine Ltd and Tarmac Marine Ltd. Wessex archaeology would like to thank Joe Holcroft, Samantha Bevan (CEMEX UK Marine Ltd.) and Dr Andrew Bellamy (Tarmac Marine Ltd.) for their assistance.

Abby Mynett carried out this assessment and compiled the report, with quality control provided by Dr Louise Tizzard. Kitty Foster prepared the illustrations and the project was managed for Wessex Archaeology by Dr Louise Tizzard.

Area 430

Archaeological Assessment of Geophysical Data
Archaeological Monitoring Report

1 INTRODUCTION

1.1 Project background

1.1.1 Wessex Archaeology (WA) was commissioned by CEMEX UK Marine Ltd (CEMEX) and Tarmac Marine Ltd (Tarmac) to undertake an archaeological assessment of geophysical survey data as part of the heritage impact monitoring process implemented for aggregate extraction Area 430.

1.1.2 Area 430 is licenced by CEMEX and Tarmac and is an aggregate extraction area located approximately 25 km east of Southwold, Suffolk. As part of the Marine Licence conditions for the dredging area, geophysical monitoring surveys are reviewed for changes to the archaeological baseline. This report details the most recent archaeological monitoring investigation.

1.1.3 The assessment was to consist of an archaeological review of sidescan sonar and multibeam bathymetry data within the licence boundary area and a 500 m buffer, referred to hereafter as the Archaeological Study Area (ASA) (**Figure 1**).

1.1.4 In addition to the ASA, the three longer geophysical survey lines extending north-northeast from Area 430 (known as the 'northern extension lines') were also assessed for anomalies of archaeological potential.

1.1.5 The assessment comprised a review of sidescan sonar and multibeam bathymetry geophysical survey data acquired by GEOxyz in 2014 (Geoxyz 2014). WA also reassessed the locations of features identified in the previous monitoring reports undertaken in 2011 and 2014 (WA 2011; 2015) and data covering the locations of existing Archaeological Exclusion Zones (AEZs) for Area 430 (WA 2007a; 2007b) (**Figure 1**).

1.2 Previous work

1.2.1 In 2006 WA undertook a desk-based assessment (DBA), which included the archaeological assessment of geophysical survey data, in advance of the dredging licence renewal applications for Area 430 (WA 2006). This DBA included both the eastern area and a western area which, at the time, had not been dredged. The assessment included known and suspected archaeological sites, in addition to the sites identified during the interpretation of marine geophysical data.

1.2.2 Further work was undertaken by WA in 2007 in light of the recovery of numerous pieces of aircraft wreckage during dredging works. This resulted in a second DBA being undertaken, involving analysis of the wreckage discovered alongside existing geophysical data, and a new geophysical survey and associated report undertaken by WA (WA 2007a; 2007b).

1.2.3 The DBA established the presence of a number of geophysical anomalies of possible archaeological potential, and the designation of the eastern portion of Area 430 as a Managed Dredging Zone (MDZ) with AEZs placed around certain identified anomalies.

1.2.4 WA undertook a monitoring report for Area 430 in 2011 (WA 2011). The report identified five geophysical anomalies of possible archaeological potential within the ASA, two of which were located within the area expected to be impacted by dredging. None of the anomalies previously identified during the aircraft crash site survey were observed in the 2011 geophysical data. It is recommended that the MDZ and AEZs remain in place.

1.2.5 In 2015 WA undertook a targeted assessment monitoring report of 23 geophysical anomalies identified by MESL in 2014 geophysical survey data as well as reassessing anomalies identified in the previous reports. Thirteen of the anomalies identified by MESL were interpreted by WA as being natural in origin. Ten of the anomalies identified by MESL and three from the 2011 assessment were interpreted as being of possible archaeological potential within the ASA. Of these, six were located within the aggregate licence area. These were all classified as anomalies of uncertain origin of possible archaeological interest and were not deemed to require exclusion zones. This report includes a re-assessment of the entire geophysical dataset acquired in 2014 and incorporates the results of the 2015 anomaly assessment.

1.2.6 A total of 31 finds have been reported through the Marine Aggregates Industry *Protocol for Reporting Finds of Archaeological Interest* within the ASA between 2005 and 2015 (**Appendix I**).

2 METHODOLOGY

2.1 Data sources

2.1.1 The sidescan sonar and multibeam bathymetry data used for this assessment were acquired by GEOxyz in April 2014 onboard survey vessel *Geosurveyor XI*. Further background information was obtained from the DBAs and previous monitoring surveys as detailed in **Section 1.2.** Technical specifications accompanied the data provided by GEOxyz (GEOxyz 2014).

2.1.2 The geophysical survey data comprised sidescan sonar and multibeam bathymetry datasets. Each of these were assessed for their quality and rated using the following criteria.

Table 1: Criteria for assigning data quality rating

Data Quality	Description
Good	Data which are clear and unaffected by weather conditions or sea state. The dataset is suitable for the interpretation of standing and partially buried metal wrecks and their character and associated debris field. These data also provide the highest chance of identifying wooden wrecks and debris.
Average	Data which are affected by weather conditions and sea state to a slight or moderate degree. The dataset is suitable for the identification and partial interpretation of standing and partially buried metal wrecks, and the larger elements of their debris fields. Wooden wrecks may be visible in the data, but their identification as such is likely to be difficult.

Data Quality	Description
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.

2.1.3 The sidescan sonar data have been rated as 'Good' using the above criteria table. Overall the data quality, coverage and positioning was found to be of high standard for archaeological assessment.

2.1.4 The multibeam bathymetry data have been rated as 'Good' using the above criteria. The data quality, coverage and resolution of 2 m was found to be of a high standard and suitable for the archaeological assessment of seabed objects and debris over 2 m.

2.2 Geophysical data – technical specifications

2.2.1 The geophysical survey was undertaken by GEOxyz between 1 and 2 April 2014 and 10 and 11 April 2014 (GEOxyz 2014). The survey vessel used to acquire the data was the *Geosurveyor XI*.

2.2.2 The survey was conducted using multibeam bathymetry and sidescan sonar geophysical survey equipment over an area that included the licence boundary area and a 500 m buffer zone. A line spacing of 80 m was planned for the survey, however the data recorded used a line spacing of 40 m for survey lines 1 – 30 and a double spacing of 80 m for lines 31 – 92. In addition to the geophysical coverage of the main area, three longer geophysical survey lines extending north-northeast from Area 430 were also surveyed.

2.2.3 Full coverage of the ASA was achieved with the multibeam bathymetry system and at least 120 % coverage was attained with the sidescan sonar equipment.

2.2.4 A Kongsberg EM3002 multibeam swathe bathymetric system was deployed which used a 2 x 256 beam swathe view setting. The data were collected using QINSy acquisition software and provided to WA as a 2 m gridded *.xyz* file.

2.2.5 The sidescan sonar data was acquired using an Edgetech 4200 dual frequency system using both high and low frequency acquisition settings and a range of 95 m. The line spacing intervals of 40 m and 80 m provided sufficient coverage to match the 120 m specification. The data were digitally recorded and provided to WA as high and low frequency *.xtf* files.

2.2.6 For this survey all positions were recorded and expressed in WGS84, UTM Zone 31N.

2.3 Geophysical data - processing

2.3.1 The high frequency *.xtf* sidescan sonar data files were processed by WA using Coda Geosurvey software. This allowed for the data to be replayed with various gain settings in order to optimise the quality of the images. The data were initially scanned to give an understanding of the geological nature of the site and were then interpreted for any objects of possible anthropogenic origin. This involves creating a database of anomalies within Coda by tagging individual features of possible archaeological potential, recording their positions and dimensions and acquiring an image of each anomaly for future reference.

2.3.2 A mosaic of the sidescan sonar data is produced during this process to assess the quality of the sidescan sonar towfish positioning. The survey lines are smoothed, and the navigation corrected. This process allows the position of anomalies to be checked between different survey lines and for the layback values to be further refines if necessary.

2.3.3 The form, size and/or extent of an anomaly is a guide to its potential to be an anthropogenic feature and therefore of archaeological interest. A single small but prominent anomaly may be part of a much more extensive feature that is largely buried. Similarly, a scatter of minor anomalies may define the edges of a buried but intact feature, or it may be all that remains as a result of past impacts from, for example, dredging or fishing.

2.3.4 The multibeam bathymetry data were analysed to identify any unusual seabed structures that could be shipwrecks or other anthropogenic debris. The data were provided as 2 m gridded data and analysed using Fledermaus software, which enables a 3-D visualisation of the acquired data and geo-picking of seabed anomalies.

2.4 Geophysical data – anomaly grouping and discrimination

2.4.1 The previous section describes the initial interpretation of all available geophysical datasets which were conducted independently of one another. This inevitably leads to the possibility of any one object being the cause of numerous anomalies in different datasets and apparently overstating the number of archaeological features in the ASA.

2.4.2 To address this fact, the anomalies were grouped together along with the results of the DBA and previous monitoring reports that fall within the current ASA. This allows one ID number to be assigned to a single object for which there may be, for example, a UKHO record and multiple sidescan sonar anomalies.

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

Table 2: Criteria discriminating relevance of seabed features to proposed scheme

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

2.4.4 Records of wrecks and obstructions within the ASA and surroundings were obtained from the United Kingdom Hydrographic Office (UKHO) for the DBA (WA 2006) and were incorporated into this assessment.

2.4.5 The results of this assessment have been compared and added to the results of the previous geophysical assessments as described above. These results are presented in **Figure 2**, **Appendix II** and are discussed below. Those anomalies previously identified have retained their original identification number.

2.4.6 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 RESULTS

3.1.1 The DBA undertaken in 2006 (WA 2006) listed a dead obstruction just out within the ASA at 435437 mE 5789730 mN. However, no anomaly was observed in the 2014 data or in any previous interpretation.

3.1.2 In the previous assessment 13 of the 23 anomalies identified by MESL and provided to WA to interpret archaeologically were deemed not of anthropogenic origin and classified as natural features. The remaining anomalies were grouped together and in total ten MESL targets were identified as being of possible archaeological potential within the ASA, none of which corresponded with features identified in previous investigations. Five anomalies identified in previous surveys were revisited in the most recent dataset, one of these (**7004**) was identified in the 2014 data (WA 2015).

3.1.3 The results of the most recent assessment has identified seven anomalies of possible archaeological potential not identified in any of the earlier datasets. These are collated with the results of the previous assessments and are detailed in **Appendix II**. Below is a summary of the number and types of features identified within the ASA for Area 430. The anomalies have then been divided into their classifications and described accordingly.

3.1.4 The archaeological assessment of geophysical data has identified a total of 20 anomalies of archaeological potential, eight of which are located within the current aggregate licence area (**Figure 2**). All of the anomalies have been given an archaeological potential rating of A2 (**Table 3**).

Table 3: Anomalies of archaeological potential within the ASA

Archaeological Discrimination	Quantity	Interpretation
A1	0	Anthropogenic origin of archaeological interest
A2	20	Uncertain origin of possible archaeological interest
Total	**20**	

3.1.5 Furthermore, these anomalies can be classified by probable type, which can further aid in assigning archaeological potential and importance.

Table 4: Types of anomaly identified

Feature Classification	Quantity
Debris	10
Bright Reflector	3
Dark Reflector	7
Total	**20**

3.1.6 WA **7001** is a bright reflector located within the aggregate licence area and was only identified in the 2011 survey data. This feature is visible as a distinct bright reflector measuring approximately 5.3 m x 3.6 m and could possibly represent a piece of debris

composed of material that absorbs acoustic waves, such as saturated wood. This feature may have since been covered by sediment and as such has retained its A2 archaeological discrimination.

3.1.7 Five pieces of debris have been identified within the aggregate licence area (**7000**, **7008**, **7009**, **7010** and **7011**). WA **7000** is visible as an elongate dark reflector with a bright shadow with dimensions of 8.8 m x 2.4 m x 0.5 m and possible scour associated. This debris was not visible in the most recent dataset and may have since been covered by sediments.

3.1.8 WA **7008** is a distinct but thin dark reflector with a bright shadow and dimensions of 6.7 m x 3 m x 0.8 m. The debris appears anomalous to the surrounding seabed located within an area of sand waves and with scouring orientated north and measuring 15.5 m length (**Figure 3**).

3.1.9 WA **7009** has dimensions of 6.8 m x 1 m x 1.1 m. This is visible as a distinct curvilinear dark reflector with a bright shadow located within sand waves and has distinctive scouring coming from it orientated north and measuring 9.3 m length.

3.1.10 Two dark reflector features have been identified in the most recent dataset within the aggregate licence area. WA **7014** is a short and disjointed linear dark reflector with a bright shadow and dimensions of 1.7 m x 1.3 m x 0.6 m. WA **7013** is a right-angled dark reflector with a short and bright shadow located on the crest of a sand wave and has dimensions of 1.9 m x 0.7 m x 0.3 m. This anomaly has not been previously identified and is situated 80 m east of the western boundary of the MDZ (**Figure 2**).

3.1.11 Twelve anomalies have been identified outside of the aggregate licence area but within the ASA (**Appendix II**). WA **7004** has been identified in both the 2011 and 2014 geophysical datasets. This is visible as a small dark reflector interpreted to be a possible partially buried piece of debris or natural feature. The dark reflector has dimensions of 0.8 m x 0.3 m x 0.6 m and is surrounded by a possible small area of seafloor disturbance. The anomaly has some scouring visible in the most recent geophysical data orientated north and measuring 11.2 m.

3.1.12 Debris **7012** is visible as a medium sized feature with a set of uniform long, thick and dark reflectors, some with shadows and some without (**Figure 3**). In the sidescan sonar data this has a rectangular profile and dimensions of 16.5 m x 6 m x 0.7 m. Based on the nature of the anomaly this debris could possibly represent a small wreck. This feature has not previously been interpreted and further investigation would be required to understand the nature of the feature.

3.1.13 Bright reflector feature **7016** has dimensions of 2.8 m x 1.8 m and is visible as a rectangular shaped bright reflector on an otherwise featureless seabed. This is located outside of the aggregate licence area but within the ASA (**Figure 3**).

3.1.14 WA **7017**, **7018** and **7019** are all located within 50 m of one another and classified as dark reflectors with similar rectangular shaped dark reflector profiles in the sidescan sonar data. The largest of these is **7019** with dimensions of 14.5 m x 10.9 m x 0.4 m. It is possible that these features are modern disturbances, however the rectangular nature could indicate a partially buried feature (**Figure 3**).

3.1.15 No anomalies have been identified within the three current AEZs which were put into effect after the aircraft crash site survey reports (WA 2007a; 2007b) in the most recent assessment. It is possible that a changing sediment distribution has taken place

potentially covering the anomalies. One anomaly (**7013**) has been identified within the MDZ.

4 MITIGATION

4.1 Mitigation strategies

4.1.1 With regards to mitigation of archaeology, the marine planning authority, working with the relevant regulator and advisors, takes account of the desirability of sustaining and enhancing the significance of heritage assets and adopts a general presumption in favour of the conservation of designated heritage assets within an appropriate setting (HM Government 2011; DCALG 2012).

4.1.2 In total 20 anomalies from the 2014 geophysical survey and previous investigations have been identified as being of possible archaeological potential within the ASA, eight of these are located within the area expected to be impacted by dredging. These were all classified as A2 anomalies of uncertain origin of possible archaeological interest and were deemed not to require exclusion zones, though their positions should be noted, particularly the features identified within the active licence area.

4.1.3 Three AEZs and a MDZ are in place within the ASA. Similarly to the results of the 2011 and 2015 monitoring reports no new anomalies were identified within the AEZs in the current assessment. One anomaly has been identified 80 m east of the western boundary of the MDZ.

4.1.4 No new mitigation strategies have been recommended for the area, though it is recommended that the present MDZ and AEZs remain in place, and that any artefacts recovered during dredging activities continue to be reported through the Marine Aggregate Industry *Protocol for Reporting Finds of Archaeological Interest* (BMAPA and EH 2005).

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APPENDIX I: BMAPA DISCOVERIES WITHIN THE ASA

Report ID	Description	Date	Material	Licence Area	Wharf/Vessel	Easting	Northing	Year
UMD_0061	Aluminium aircraft wreckage and engine fragments	Modern	Metal; Aircraft	430	Greenwich (City of London)	437255	5791035	1 (2005 - 2006)
UMD_0062	Rudder pedal from a P-51 Mustang fighter of B-25 Mitchell bomber	Modern	Metal; Aircraft	430	Greenwich (City of London)	436466	5791570	1 (2005 - 2006)
UMD_0062	Aluminium and glass lamp, possibly from WWII aircraft	Modern	Metal; Aircraft	430	Greenwich (City of London)	436466	5791570	1 (2005 - 2006)
UMA_0080	4 pieces of riveted aluminium from a crashed aircraft	Modern	Metal; Aircraft	430	Erith	437683	5790038	2 (2006 - 2007)
UMA_0081	c. 20 pieces of riveted aluminium and engine parts from a crashed aircraft	Modern	Metal; Aircraft	430	Erith	437517	5790429	2 (2006 - 2007)
UMA_0081	Saddle magazine with ammunition from a German MG 15 machine gun, date stamped July 1940	Modern	Metal; Ordnance	430	Erith	437517	5790429	2 (2006 - 2007)
UMA_0083	Human right upper arm bone (humerus)	Modern	Bone; Human	430	Ridham	437700	5789826	2 (2006 - 2007)
UMA_0083	87 pieces of aircraft wreckage including engine components, structural elements and internal fittings, probably from a Junkers Ju 88	Modern	Metal; Aircraft	430	Ridham	437700	5789826	2 (2006 - 2007)
UMA_0083	199 undiagnostic fragments of aircraft wreckage	Modern	Metal; Aircraft	430	Ridham	437700	5789826	2 (2006 - 2007)
UMA_0083	Conical lead object, probable sounding lead	Unknown	Metal; Maritime	430	Ridham	437700	5789826	2 (2006 - 2007)
UMA_0091	Cannonball	Medieval; Post Medieval	Metal; Cannonball	430	Ridham	437698	5789821	2 (2006 - 2007)
UMA_0100	Cannonball	Medieval; Post Medieval	Metal; Cannonball	430	Ridham	436641	5790698	2 (2006 - 2007)
UMA_0101	Cannonball	Medieval; Post Medieval	Metal; Cannonball	430	Ridham	436641	5790698	2 (2006 - 2007)
UMA_0102	Cannonball	Medieval; Post Medieval	Metal; Cannonball	430	Ridham	436085	5790581	2 (2006 - 2007)
UMA_0129	Cannonball	Medieval; Post Medieval	Metal; Cannonball	430	Ridham	435482	5790878	3 (2007 - 2008)
UMA_0142	2 Cannonballs, possibly for an 18 pounder cannon, 17th century	Post Medieval	Metal; Cannonballs	430	Ridham	436479	5790932	3 (2007 - 2008)
UMA_0143	Concreted chain and ring	Unknown	Metal; Maritime	430	Ridham	436641	5790698	3 (2007 - 2008)
UMA_0144	Bone, partial articular surcafe of mammal distal humerus, possibly bovid	Unknown	Bone; Bovid	430	Ridham	436641	5790698	3 (2007 - 2008)

Report ID	Description	Date	Material	Licence Area	Wharf/Vessel	Easting	Northing	Year
UMA_0146	2 Cannonballs, one for a saker and the other for a 9 pounder, 17th century	Post Medieval	Metal; Cannonballs	430	Ridham	436330	5791045	3 (2007 - 2008)
UMA_0161	Cannonball, 4.5 in diameter, 17th century	Post Medieval	Metal; Cannonball	430	Ridham	436446	5791044	3 (2007 - 2008)
UMD_0259	Brass spoon engraved 'MAPPIN', 1774 to mid-19th century	Post Medieval	Metal; Domestic	458	Erith	436640	5790696	4 (2008 - 2009)
Tarmac_0315	2 iron fastenings	Unknown	Metal	430	Erith	436640	5790696	5 (2009 - 2010)
Tarmac_0354	Mammoth Tooth	-	Bone: Mammoth	430	Erith	436642	5790697	6 (2010 - 2011)
Tarmac_0355	Two chisels	-	Metal: Iron	430	Erith	436642	5790697	6 (2010 - 2011)
Tarmac_0361	Bar Shot	-	Metal: Cannonball	430	Greenwich	436642	5790697	6 (2010 - 2011)
Tarmac_0423	Electrical device	-	Metal	430	Ridham	437421	5790687	7 (2011 - 2012)
LTM_0495	Cannonball	Post-med	Metal	430	City of Westminster	436791	5790611	8 (2012-2013)
LTM_0505	Cannonball	Post-med	Metal	430	Greenwich	436899	5790302	9 (2013-2014)
LTM_0506	Brass key with art deco design	Modern	Metal	430	Greenwich	437066	5790546	9 (2013-2014)
CEMEX_0508	Possible treenail	Unknown	Wood	430	Northfleet	435419	5791582	9 (2013-2014)
LTM_0618	Steel spindle with two brass cogs		Metal	430	Greenwich	435341	5790714	10 (2014-2015)

1. Co-ordinates are in WGS84

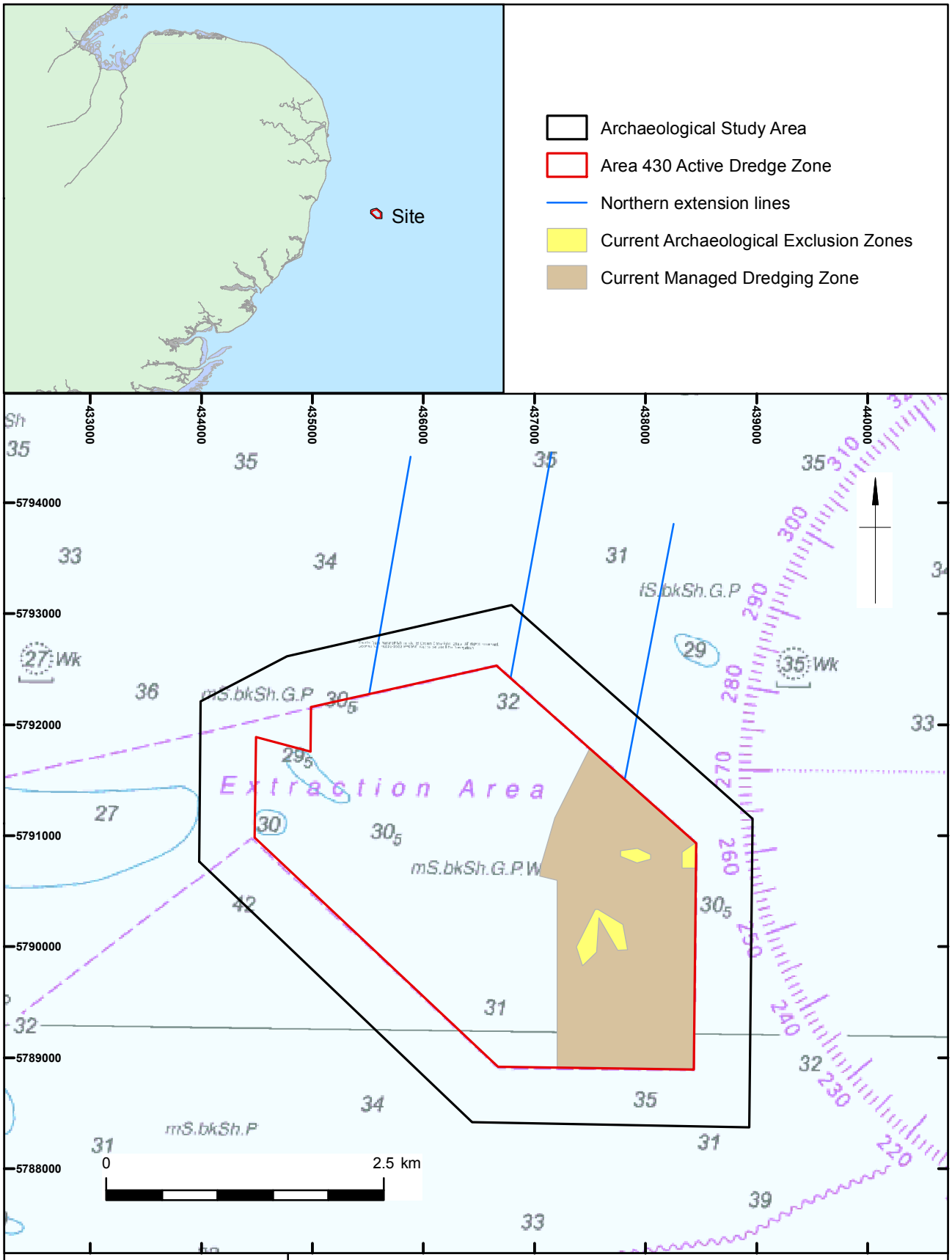
APPENDIX II: ANOMALIES OF POSSIBLE ARCHAEOLOGICAL POTENTIAL

WA ID	Classification	Easting	Northing	Archaeological Discrimination	Length (m)	Width (m)	Height (m)	Description	Sources	Area
7000	Debris	436247	5792323	A2	8.8	2.4	0.5	Elongate dark reflector with shadow and small possible scour. Located in an area of mega ripples and possibly a piece of partially buried debris. Not identified in the most recent survey, may have since been covered by sediment	-	Inside aggregate licence area
7001	Bright Reflector	435957	5790625	A2	5.3	3.6	0.0	Distinct bright reflector in an area of mega ripples with possible small associated scour. Possible piece of debris. Not identified in the most recent survey, may have since been covered by sediment	-	Inside aggregate licence area
7002	Debris	438946	5790408	A2	44.1	14.1	0.0	Area of dark reflectors, possibly debris though located in a depression next to a large sand wave so could be an accumulation of coarse sediment. Not identified in the most recent survey, may have since been covered by sediment. Close to another anomaly 7006 but not part of same feature	-	Outside aggregate licence area
7003	Debris	436136	5789375	A2	12.9	5.8	0.0	Two short, parallel linear dark reflectors. Possibly partially buried debris, or could represent a localised deep section of a dredging scar. Not identified in the most recent survey, may have since been covered by sediment	-	Outside aggregate licence area
7004	Dark Reflector	438222	5788841	A2	0.8	0.3	0.6	Small dark reflector with shadow and a possible small surrounding area of seafloor disturbance. Could be a boulder or a small piece of partially buried debris. Very thin right-angled feature with a scour orientated N and measuring 11.2m. Identified in both surveys	-	Outside aggregate licence area
7005	Debris	437955	5791658	A2	3.8	2.7	1.2	V shaped and thin distinct dark reflector with a bright shadow located in sand waves and its full extent possibly hidden. Possible small amount of scouring to the N measuring 11.7m, possibly debris	MESL (2015): L7H; L8H	Outside aggregate licence area
7006	Debris	438948	5790423	A2	6.4	0.6	0.5	Hard edged and thin linear dark reflector with a bright shadow located perpendicular to the sand waves. Distinct and anthropogenic looking anomaly, possibly debris. Not covered by the multibeam data	MESL (2015): L16H	Outside aggregate licence area
7007	Bright Reflector	438740	5789742	A2	10.2	1.3	0.0	Long and tapered bright reflector anomaly likely to be noise or incorporated into the sand waves	MESL (2015): L29H	Outside aggregate licence area

WA ID	Classification	Easting	Northing	Archaeological Discrimination	Length (m)	Width (m)	Height (m)	Description	Sources	Area
7008	Debris	436157	5791946	A2	6.7	3.0	0.8	Distinct and thin dark reflector with a bright shadow. Anomalous to the surrounding seabed and located within sand waves, scouring is present to the north measuring 15.5m	MESL (2015): L30H	Inside aggregate licence area
7009	Debris	436116	5791925	A2	6.8	1.0	1.1	Possible debris, medium sized hard edged curvilinear dark reflector with a bright shadow and located on sand waves, feature has a distinctive scour mark coming from it orientated N and measuring 9.3m	MESL (2015): L33H	Inside aggregate licence area
7010	Debris	437177	5790400	A2	5.3	3.4	0.4	Possible debris, made up of two thin and long parallel dark reflectors with a short shadow located in sand waves, discreet anomaly that is anomalous to the surrounding seabed. Not tagging trawling scars	MESL (2015): L43H; L45H	Inside aggregate licence area
7011	Debris	434979	5790716	A2	5.2	3.7	1.0	Thin but distinctive possible debris, with a diffuse outer edge and a bright curvilinear shadow, located on a sandy and even area of the seabed, isolated and anomalous	MESL (2015): L73H	Inside aggregate licence area
7012	Debris	437190	5788496	A2	16.5	6.0	0.7	Possibly debris or small wreck Made up of a thick but diffuse set of aligned/rectangular long and dark reflectors, some with shadows and some without, looks highly anomalous and distinct on a sandy and sand wave rich area of the seabed	MESL (2015): L81H	Outside aggregate licence area
7013	Dark reflector	437288	5790353	A2	1.9	0.7	0.3	Very small dark reflector with a short shadow. Situated on the edge of a sand wave, possibly rock but anomalous to the surrounding seabed	-	Inside aggregate licence area
7014	Dark reflector	435684	5791648	A2	1.7	1.3	0.6	Distinct and disjointed short linear dark reflector with a bright shadow, located in a sandy, gravelly and uneven area of the seabed. Possible rock but could be anomalous	-	Inside aggregate licence area
7015	Dark reflector	438757	5788711	A2	1.5	1.2	0.7	Small but distinct angular dark reflector with a short but bright shadow in an area of mega ripples, possibly rock though more anthropogenic looking than surrounding seabed features	-	Outside aggregate licence area
7016	Bright reflector	436537	5788903	A2	2.8	1.8	0	A right angled bright reflector feature distinct on a sandy and gravelly area of the seabed	-	Outside aggregate licence area

WA ID	Classification	Easting	Northing	Archaeological Discrimination	Length (m)	Width (m)	Height (m)	Description	Sources	Area
7017	Dark reflector	436075	5789386	A2	9.6	6.2	0	Large rectangular shaped dark reflector, appears to be three similar features within a 50 m radius. Possible modern disturbance, however the rectangular nature could indicate partially buried feature.	-	Outside aggregate licence area
7018	Dark reflector	436066	5789373	A2	8.6	7.8	0	Large and indistinct dark reflector in a slight depression. Possible modern disturbance, however the rectangular nature could indicate partially buried feature.	-	Outside aggregate licence area
7019	Dark reflector	436032	5789379	A2	14.5	10.9	0.4	A large and rectangular shaped dark reflector with a small internal shadow, indistinct feature. Possible modern disturbance, however the rectangular nature could indicate partially buried feature.	-	Outside aggregate licence area

2. Co-ordinates are in WGS84 UTM31N
3. Positional accuracy estimated ±10m

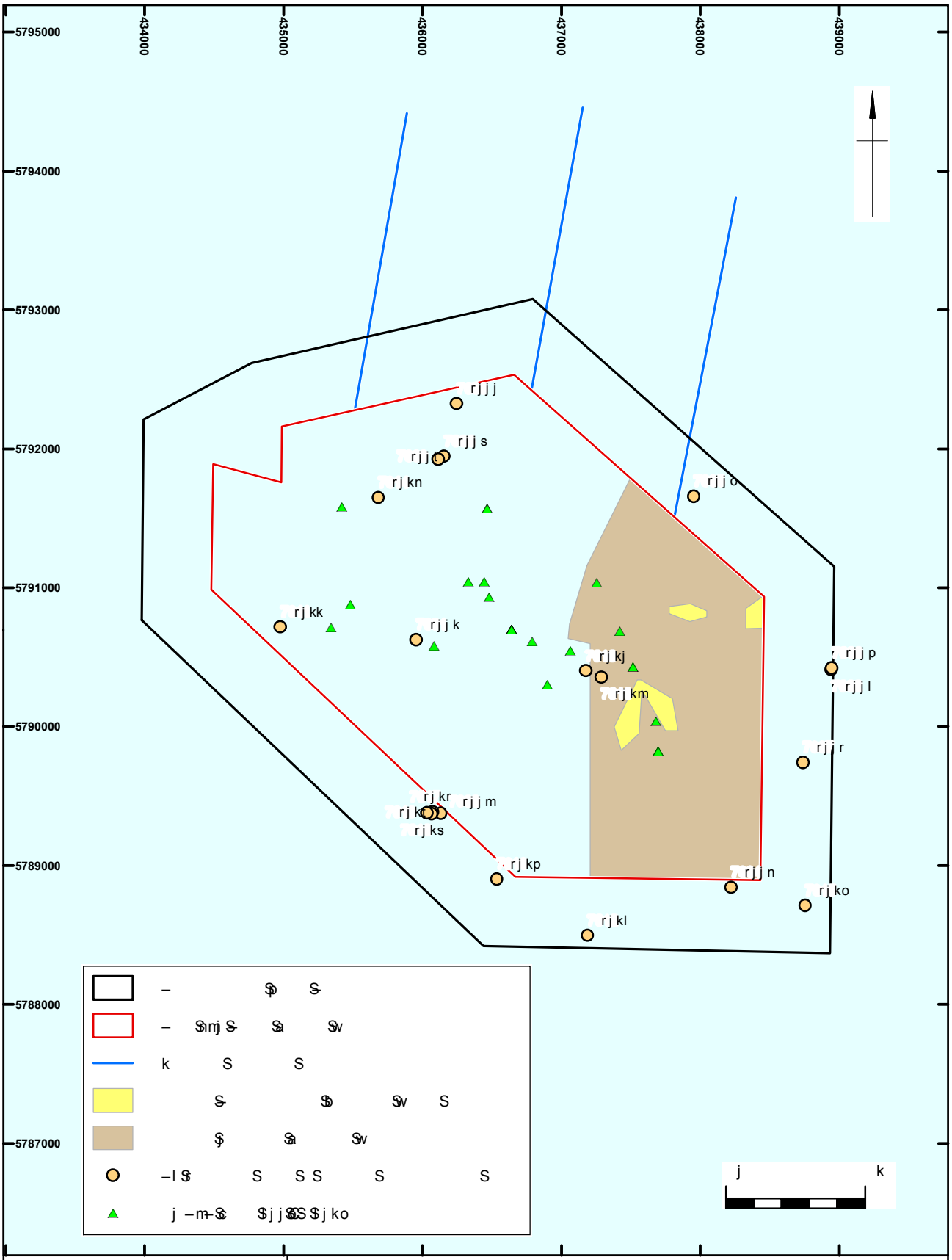


Admiralty Chart 1543 (dated 2015)
Drawing projection: UTM WGS84 z31N

Date:	20/07/2016	Revision Number:	1
Scale:	1:50,000 at A4	Illustrator:	KL/KJF
Path:	W:\Projects\65223\GIS\FigsMXD\Monitoring\2016-07-20		

Archaeological Study Area

Figure 1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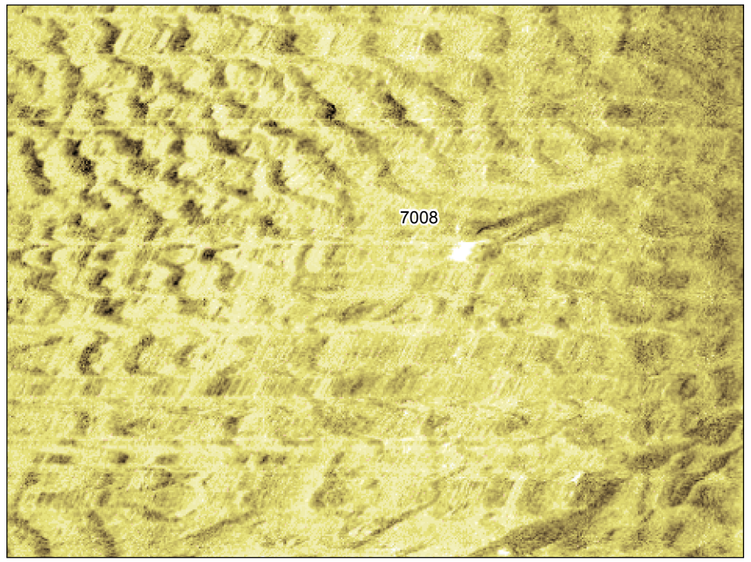
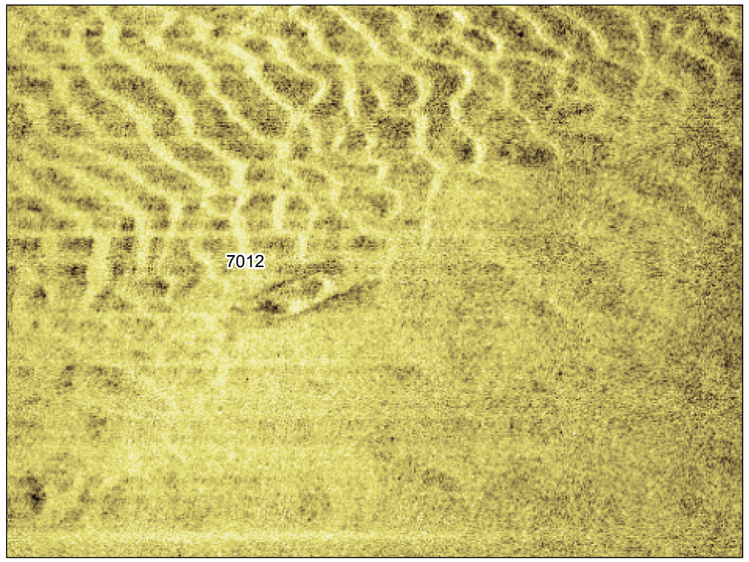
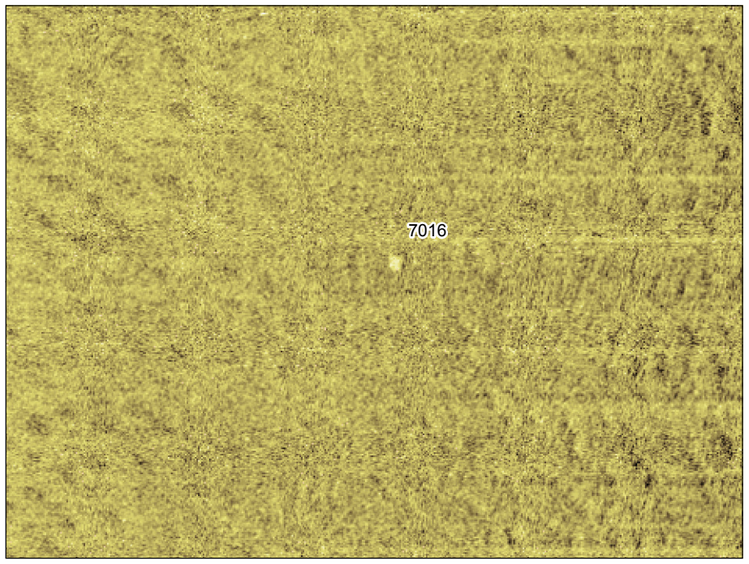


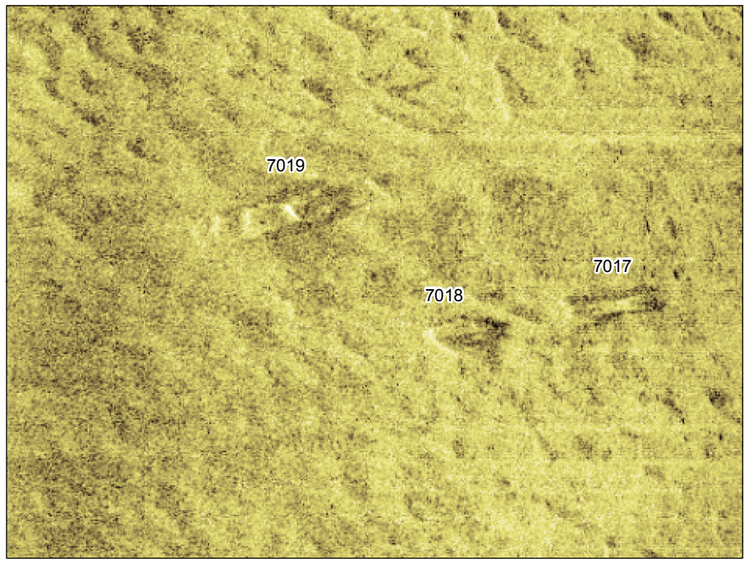
A. Sidescan sonar waterfall image of debris 7008, 6.7 m x 3 m x 0.8 m



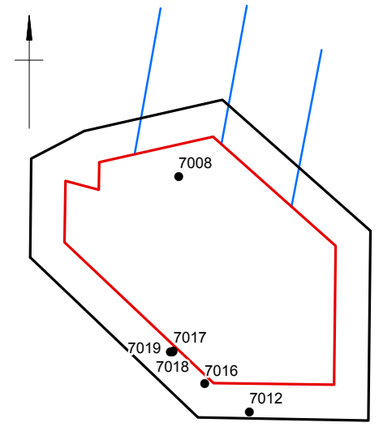
B. Sidescan sonar waterfall image of debris 7012, 16.5 m x 6 m x 0.7 m



Sidescan sonar image of bright reflector 7016, 2.8 m x 1.8 m



Sidescan sonar image of dark reflectors 7017 (9.6 m x 6.2 m), 7018 (8.6 m x 7.8 m) and 7019 (14.5 m x 10.9 m x 0.4 m)



Archaeological Study Area

Area 430 Active Dredge Zone

Northern Extension Lines

Drawing projection: UTM WGS84 z31N

Date:	20/07/2016
Revision Number:	1
Scale:	n/a
Illustrator:	KJF
Path:	W:\Projects\65223\GIS
	\FigsMXD\monitoring\2016-07-20

Sidescan sonar data examples

Figure 3

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