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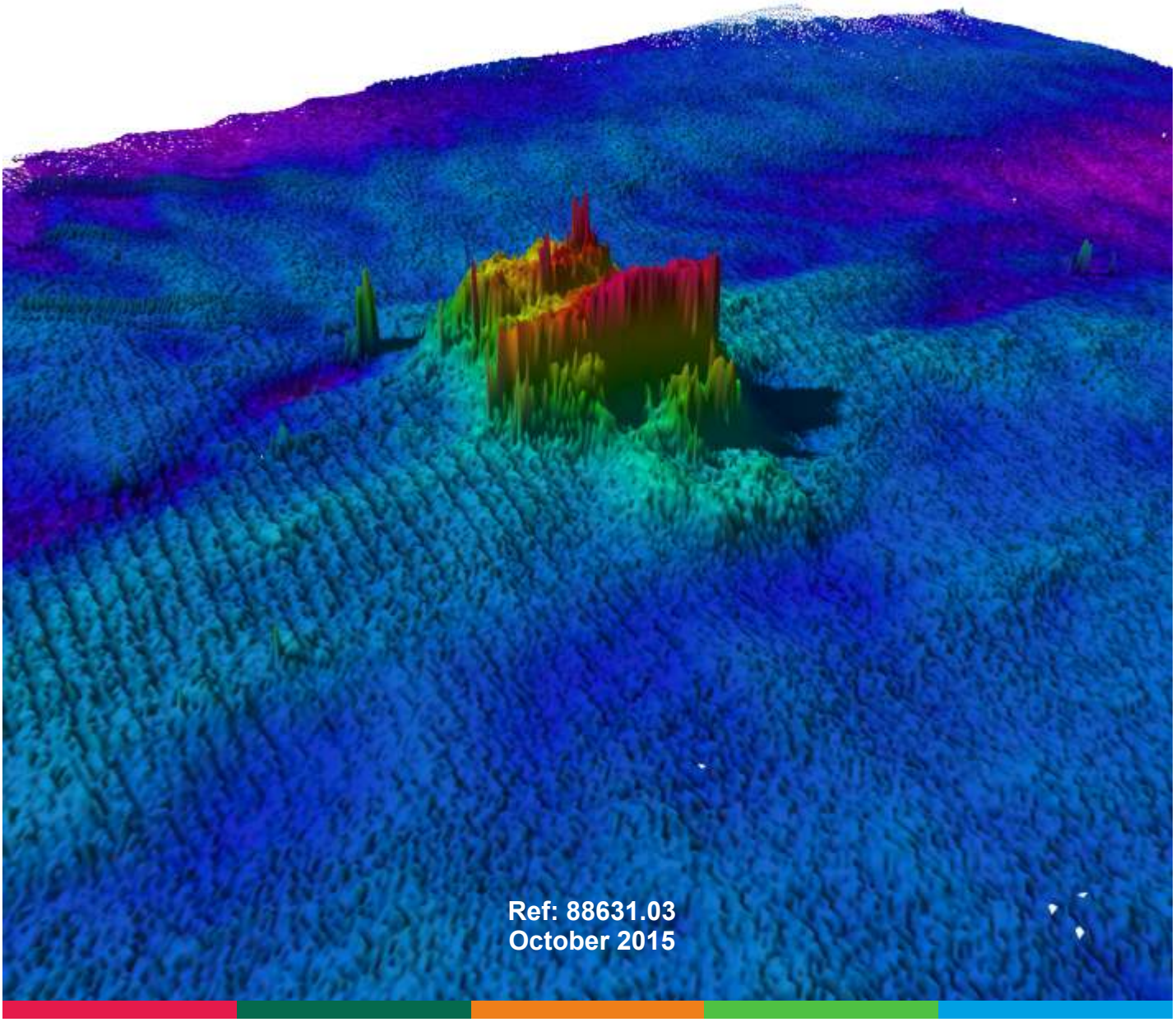
London Gateway Clearance Programme: Wreck Site of 19th Century Paddle Steamer, Sea Reach No. 1.

Post-clearance Assessment Report



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London Gateway Clearance Programme: Wreck site of 19th century Paddle Steamer Sea Reach No. 1

Post-clearance Assessment Report

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London Gateway Clearance Programme: Wreck site of 19th century Paddle Steamer Sea Reach No. 1

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Post-clearance Assessment Report

Summary

Wessex Archaeology was commissioned by DP World London Gateway Port Limited to monitor the removal of an obstruction on the seabed located close to Sea Reach No. 1 Buoy (Zone 38), at the eastern limit of the Yantlet Channel (UKHO obstruction No. 81149).

The watching brief, undertaken with archaeological supervision, was carried out from 31st March to 4th April 2014 onboard the self-propelled crane barge, *Atlantis*, operated by Herbosch-Kiere.

The clearance operation produced significant amounts of ship's structure, internal components and small finds, comprising at least the remains of one vessel along with other likely intrusive contemporary and later items. The variety and exceptional condition of the material provides an example of an assemblage belonging to a working vessel operating in the Thames during the mid to late 19th century.

A majority of the material removed from the riverbed as part of this clearance was analysed and identified as having originated from an iron paddle steamer powered by feathering side-wheels and driven by twin grasshopper steam engines, possibly built by a Tyne and Wear shipyard. This assessment reports on the fieldwork and post-clearance work that was undertaken as part of the clearance operations.

Post-clearance research has tentatively identified the vessel as that of *Admiral*, an iron paddle tug built in 1870. The *Admiral* sank off the Nore in February 1872 after colliding with the steam collier *Rajah*.

The site has now been at least partially recovered, and most of the remaining material is likely to be at a depth below that of any proposed navigational or maintenance dredging. Proposals for further analysis have been included with particular emphasis on documentary research, examination of remaining elements of the assemblage, and a post-clearance site assessment, along with their timescales and costing. Following these proposals, further decisions can be made regarding storage, curation, publication, and ultimately discard.

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- The crew of the recovery vessel *Atlantis*;
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- George Dickinson, Hon Sec of the MGSM Association; and
- Simon Green, Central Services Librarian at CBS Libraries, Gateshead.

This report was compiled by Victoria Lambert, with contributions by Lorraine Mepham, Quita Mould and Paolo Croce. Quality control was provided by Toby Gane. Kitty Foster prepared the illustrations and the project was managed for Wessex Archaeology by Toby Gane.

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Post-clearance Assessment Report

1 INTRODUCTION

1.1.1 Wessex Archaeology (WA) was commissioned by DP World London Gateway Port Limited (hereafter London Gateway) to undertake an archaeological watching brief during a planned obstruction clearance, by means of grab dredger, undertaken by the contractor Herbosch-Kiere on behalf of the Port of London Authority (PLA).

1.1.2 The obstruction was located in a central position within a busy dredging channel, and since the riverbed around the obstruction had been dredged to a depth of 2m, the obstruction was considered a danger to navigation and therefore the clearance works were proposed (**Figure 1**). The watching brief was commissioned because prior to any invasive investigation, the obstruction was unidentified without any existing accompanying documentary evidence to provide information regarding its extent or nature.

1.1.3 The obstruction was located in the Thames Estuary *c*. 33m north-west of the Sea Reach No. 1 Channel Marker, at the eastern limit of the Yantlet Channel (**Figure 1**). The co-ordinates of the obstruction used during the clearance were:

Table 1: Site co-ordinates

WGS 84			
UTM z31N		**DD**	
Easting	352543 E	**Latitude**	51.49118 N
Northing	5706588 N	**Longitude**	0.87595 E

1.1.4 An anomaly close to this location was first identified in pre-dredge sidescan sonar data taken in 2001 by Emu Ltd. (now Fugro EMU Ltd.). Analysis of the data by WA concluded it to be of possible archaeological interest. The obstruction was physically encountered over a decade later during routine dredging operations undertaken in December 2013 by the Trailing Suction Hopper Dredger (TSHD), *Victor Horta*.

1.1.5 A report on the archaeological watching brief undertaken during the clearance of the obstruction has been prepared by WA (2014). The report presents an overview of the watching brief operations together with an initial interpretation of the finds recovered during the clearance. Proposals and recommendations for further analysis and potential publication are also included.

1.1.6 A Clearance Mitigation Statement has also been produced that presents an overall history of the site since 2001 together with a summary of the clearance activities and proposed post-clearance mitigation (WA 2014b).

2 BACKGROUND

2.1.1 Pre-dredge sidescan sonar data was analysed by WA's geophysicists in 2001 and an anomaly, close to the position of the 2014 obstruction, was tagged as being of possible archaeological interest (anomaly **WA7149**).

2.1.2 An anomaly at this location was also identified by WA on sidescan sonar data from 2002 (anomaly **WA7618**, **Figure 2A**). **WA7149** and **WA7618** were later acknowledged as the same anomaly.

2.1.3 On 9th December 2013 the *Victor Horta*, a TSHD, struck an obstruction with its drag-head at 51 29' 28.002'' N, 0 52' 33.367'' E (Zone 38) and was unable to remove or dislodge it. The obstruction was notified to WA via the LORDI protocol (report 3414). London Gateway reported that the 'fairly substantial' obstruction was suspected to be a concrete sinker.

2.1.4 A diving investigation on the obstruction took place on 8th January 2014 by PLA divers and confirmed that it was not a natural feature. Upstanding steel plates and beams riveted together were observed approximately 1m proud of the sandy silt riverbed.

2.1.5 The obstruction was then re-surveyed by means of a bathymetric geophysical survey carried out by the PLA on 9th January 2014. The survey revealed that the wreck measures *c.* 22m long and *c.* 11.5 wide, and is positioned in an approximately north-south orientation, although no vessel outline was actually visible in the data (**Figure 1**). Some internal structure was visible from the data, including the tops of the boilers and upper engine elements. Two upstanding features were also identified within the wreck; the highest of which measures *c.* 1.9m, approximately 1.0m higher than the surrounding wreck material.

2.1.6 On 23rd January 2014 a second inspection was carried out by PLA divers during two dives. The recovery of a small number of loose finds from the riverbed and the fact that sections of plates rising out of the sandy bottom were not easily dislodged suggested that there was high potential for buried shipwreck material. Diver observations also suggested a possible boiler lying under a section of bent steel. The obstruction was subsequently reported to the United Kingdom Hydrographic Office (UKHO) and is now recorded as obstruction no. 81149.

2.1.7 The finds recovered were later identified by WA as a section of hull plate riveted to an L-shape frame and part of what is interpreted as a winch mechanism and balance weight - indicative of a possible 19th century wreck site. However, at the time of the recovery operation it was not known what date the wreckage may have been deposited on the riverbed, the extent of the wreckage or level of burial, or the type of vessel represented.

2.1.8 From 31st March to 5th April 2014 the salvage grab barge *Atlantis* undertook clearance activities at the site. As no documentary evidence existed regarding the feature, an archaeological watching brief was conducted by WA for the duration of the works (WA 2014a).

2.1.9 The PLA performed a series of interim multibeam bathymetry surveys of the site every day from the 1st to the 4th April 2014 in order to assess the extent of the clearance works and to confirm that the obstruction had been entirely removed to the required depth. Further details and images are presented in *Review of Obstruction Removal at Sea Reach No 1 for London Gateway Port Limited – Works Undertaken, March-April 2014* (PLA 2014). A sidescan sonar survey was also undertaken on 4th April in order to assess whether any debris still remained at the site. The data showed an irregular area of riverbed but no coherent wreck structure could be identified (**Figure 2B**), suggesting only small pieces of scattered debris are likely

to remain at the site following the clearance work. However it is possible that further material remains buried.

2.1.10 The recovery operation removed approximately 80 tonnes of material and achieved a least depth of 14.66m Lowest Astronomical Tide (LAT) over the site, substantially removing the wreck and dispersing the remains. The site is no longer considered a danger for navigation and remains are now below dredge depth of 14.5m (PLA 2014: 5).

3 METHODOLOGY

3.1.1 The full methodology of the archaeological watching brief is described in the *Obstruction Removal at Sea Reach No. 1* report (WA 2014a, section 4) and is only included here where relevant.

General

3.1.2 Clearance was undertaken in accordance with Appendix VII (Onboard Archaeological Observation and Recording) of the *Maritime Archaeology Methods and Procedures Document* produced by London Gateway Port Limited (2010). However, this document is specifically aimed at the methodologies for pre-clearance, clearance and dredging phases, and was considered not detailed enough to provide a methodology for previously unknown heritage assets within the Channel.

3.1.3 Therefore, the *Written Scheme of Investigation (WSI) for Recovery under Archaeological Supervision* (Wessex Archaeology 2012a) document was referred to in order to provide further detail to the methods employed, where necessary. This WSI had been successfully used for other clearance operations in the area, including that of the Ju 88 World War II German aircraft located in the Outer Thames Estuary (WA 2012b).

3.1.4 There is no standard methodology for clearance by grab of wreck sites on the seabed in the UK. Nevertheless, in so far as was reasonably practicable, the clearance and post-clearance archaeological assessment were conducted in compliance with standard archaeological methodologies and national guidelines (CIfA 2014; SMA 1993; SMA 1995).

Watching Brief

3.1.5 Clearance was undertaken using a 25 ton salvage grab (**Plate 1**) onboard the self-propelled marine working pontoon, *Atlantis*, which was able to hold position using dynamic positioning. Material was recovered to the vessel's deck where it was washed with seawater, recorded and then processed by a small shear cutter excavator for recycling.

3.1.6 The intention had been to record both the contents and position onsite of each recovered bucket of material. However the sheer volume, and often size, of material recovered made the search for relevant archaeological material and its subsequent recording impractical. In addition, personnel were limited in respect of time on deck due to safety restrictions imposed when the grab was operational, although this was later relaxed. Whilst some diagnostic elements were selected for further investigation and retained by WA, it is estimated that one-third of the recovered material was not recorded. Also the positional information was only partially successful, as the request by the onsite WA archaeologist for a written record of the grab positions during the clearance works was limited and included omissions.

3.1.7 Digital photographs and video were captured by the onsite archaeologist throughout the clearance operation, forming an integral component of the archive data. These files are stored on the WA network and are available on request.

3.1.8 Sidescan sonar survey data was obtained by the PLA towards the end of the clearance works to assess the remains of the wreck site on the riverbed post-clearance. This data was analysed by WA geophysicists (WA 2015, **Figure 2**).

Post-clearance Recordings and Interpretations

3.1.9 Immediate first aid conservation was carried out onboard *Atlantis* for small, vulnerable or potentially important items prior to their removal and transport to WA's storage facilities in Salisbury. For instance, leather and wooden finds were stored in water, and fragile artefacts including ceramic and glass were carefully supported during transport to WA storage facilities. Once the artefacts were stored at WA, they were individually examined and conserved, where necessary, by a WA specialist.

3.1.10 Larger diagnostic artefacts that were impossible to transport to WA were stored at Denton Wharf by the PLA; the present condition of these pieces is unknown.

3.1.11 Post-clearance recording was undertaken on material stored at WA Salisbury. Material stored at Denton Wharf still requires full archaeological recording; this is a recommendation presented in **Section 8**.

3.1.12 All of the recovered artefacts transported and stored at WA were initially catalogued and photographed using standard archaeological recording methods; subsequently generating a comprehensive Finds List (**Appendix 1** and **2**).

3.1.13 Wreck of an archaeological nature is subject to the procedures relating to wreck in the Merchant Shipping Act 1995, and as such must be reported to the Receiver of Wreck (RoW) within 28 days of recovery. An MCA report of wreck and salvage form with a list of the retained finds was sent to the RoW by WA on behalf of the PLA on 24th April 2014.

3.1.14 A majority of the material archive was analysed by internal finds specialists at WA providing further information regarding the assemblage, however the leather assemblage was assessed at WA by an external specialist, Quita Mould. Furthermore, digital images of the larger components of the assemblage were sent to external specialists for identification. Responses were received from: George Dickinson, volunteer and Honourable Secretary of the Markham Grange Steam Museum who provided information regarding the larger pieces of material recovered including the engine, cylinder, and boiler; and Simon Green, Central Services Librarian for Gateshead Libraries that supplied information regarding the Tyneside iron manufacturer, Robert Frazer & Sons.

3.1.15 Relevant contemporary records were also researched in order to help establish the identity of the wreck. Sources included a newspaper articles accessed from http://www.britishnewspaperarchive.co.uk (May 2014) and notices from https://www.thegazette.co.uk (May 2014), and various websites containing information about steam tugs.

4 FINDS

4.1.1 A total of 346 finds or sections of wreck were recovered and subsequently recorded as part of the clearance works. Of these a majority are associated with the wreck of at least one vessel constructed of iron. It is likely that a number of other finds were intrusive to the wreck site and therefore not directly associated with the main wreck.

4.1.2 A complete inventory of the finds recorded by WA is presented in **Appendix 1**. **Appendix 2** displays a list of the finds that are currently being stored and conserved at WA; 146 in total.

4.2 Engine

4.2.1 Parts of two engines and two boilers recovered from the site almost certainly constitute the most conspicuous and upstanding features of the obstruction identified during the PLA dive investigations on 9th January (**Figure 1**). For instance the radius of the side paddle wheel measured 1.92m and was 1.23m wide, whilst the length of the main drive shaft was 4.1m.

4.2.2 The vessel's propulsion system consisted of two feathering side paddle wheels propelled by two single cylinder 'grasshopper' beam engines. A total of sixteen constituent parts of the propulsion system were identified comprising:

- *Two identical horizontal double return flue boilers made of iron (**WA3007** and **WA3009**, **Plate 1**);*
- *Two single cylinder engines (**WA3044** and **WA3046**);*
- *Two parts of feathering side paddle wheel (**WA3017** and **WA3022**);*
- *Part of the main drive shaft including the engine crank shaft (**WA3012** and **WA3016**);*
- *The coupling wheel joining the engines with the engine frame (**WA3025**);*
- *Three engine beams (**WA3045** and **WA3048**);*
- *Two fragmented air/vacuum pumps (**WA3047** and **WA3050**); and*
- *Fragments of at least two engine bedplates (**WA3061**, **WA3196** and **WA3210**).*

4.2.3 Plates 1 - 3 of the archaeological watching brief report (WA 2014a) illustrate several of these items of the engine alongside contemporary plans of an engine and boiler (**Figure 3**).

4.2.4 No manufacturer marks were evident on any section of the above material. However, large quantities of firebrick and coal, recovered from within the boilers, were stamped with 'HEDDON' and 'RAMSAY' (**Plate 2**), relating to a mine and brickworks company respectively, located in the Newcastle upon Tyne area (http://www.penmorfa.com/bricks/ and http://www.scottishbrickhistory.co.uk, both accessed March 2015).

4.3 Hull

4.3.1 Large amounts of structural elements were recovered; although it is probable that they belonged to a single wreck, the general nature of the features on the seabed is unclear.

4.3.2 Five sections of hull were recovered (**WA3080**, **WA3119**, **WA3119b**, **WA3152** and **WA3216**) comprising various elements including shell plating, frames, floors, stringers, the keelson, two side keelsons, and wash plates among other components (**Plate 3 shows WA3152**). One section, **WA3080**, was temporarily stored on the deck to allow a detailed record to be made (see WA 2014a, section 5.2 for more details).

4.3.3 Other sections of material relating to the hull include:

- *Deck beams (**WA3004** and **WA3011**);*
- *Hatch door (**WA3014**);*
- *Extent of the prow where the port and starboard stringers meet (**WA3156**);*
- *Wooden gunwale (**WA3188**);*
- *Wooden beam, possible rubbing strake or gunwale (**WA3153**); and*

- *Two iron frames (**WA3086** and **WA9053**).*

4.3.4 The two iron floor frames mentioned above were imprinted with the names of two iron manufacturing companies, 'FRAZERS AND ROBERTS & CO LTD' and 'ABBOT'; both of which are located in Gateshead (**Plate 4A** and **4B**).

4.4 Anchors and Machinery

4.4.1 Two anchors were recovered during clearance works (**WA3068** and **WA3071**) and have been identified as Admiralty pattern anchors (**Plate 5A and B**). The larger of which is most likely a 28cwt (hundredweight) Admiralty anchor due to its dimensions (Curryer 1999), whilst the smaller example still retained the shackle and chain with studded links.

4.4.2 A wooden windlass with part of the chain still coiled on the barrel was also recovered during the clearance (**WA3145**). The wooden barrel (2.3m long and diameter *c.* 0.4m) is octagonal in shape in the centre and retains the iron whelps. The size of the chain links attached to the windlass are different from the anchor chain found.

4.4.3 A small bilge hand-pump made of brass was recovered and retained (**WA9031**, **Plate 6**).

4.4.4 An iron ladder (**WA3088**) was brought to the surface by the clearance vessel and photographed still in the grab bucket, however the ladder fell back into the water whilst the grab was being brought towards the deck.

4.4.5 The possible remains of two small manually operated crab winches are also recorded from recovered material (**WA3130** and **WA3187**), comprising two axles in between two uprights. The presence of two broken curved spars on **WA3187** might suggest that this winch was used as hoist device.

4.5 Pottery and Glass objects

4.5.1 A total of 72 pottery and 11 glass finds were recovered during the clearance of the site and are currently being stored at Wessex Archaeology. They were examined by WA finds specialist Lorraine Mepham.

Pottery

4.5.2 The pottery assemblage totals 72 sherds, which includes three complete vessels. The assemblage comprises four groups of material: blue and white transfer-printed flatwares; teawares with simple blue banded decoration; stoneware containers; and miscellaneous sherds. More information regarding each type is presented below.

4.5.3 *Blue and white transfer-printed flatwares in a single decorative pattern (one complete plate and 32 sherds):* the complete plate (**WA9121, Plate 7A**) is dinner plate size, and the other sherds all appear to belong to the same form (**WA9067**-**WA9069**, **WA9072**-**WA9080**, **WA9082**-**WA9086**, **WA9088**-**WA9090**, **WA9093**-**WA9095**, **WA9097**, **WA9098**, **WA9102**-**WA9107** and **WA9131**). The pattern is 'Albion' and was used by several different potters, but this variant, featuring a romantic river scene within a border of vignettes separated by foliage, was a common pattern popular in north-east England from at least the 1840s, and was used, for example, by Robert Maling of Newcastle upon Tyne (Coysh and Henrywood 1982: 18). Two backstamps, one on the complete plate and one other, are identical; they combine a transfer printed stamp (GRT within a circle, beneath a crown, and above a banner reading ALBION) with an impressed circular mark (TURNBULL STEPNEY POTTERY), and have been identified as the mark of G.R. Turnbull of Stepney Street, Ouseburn, Newcastle upon Tyne, working *c.* 1863-75 (ibid.: 371).

4.5.4 *Teawares with simple blue banded decoration (complete cup (**WA9108**), plus 14 sherds (**WA9066**, **WA9070**, **WA9071**, **WA9081**, **WA9087**, **WA9101**, **WA9109**-**WA9116** **(Plate 7C)**)):* these are utilitarian cups and saucers with simple decoration of three narrow blue bands around the rims. One of the saucers has an impressed backstamp (TURNBULL) thus indicating the same supplier for both teawares and dinner plates.

4.5.5 *Stoneware containers (13 sherds):* these are all in feldspathic-glazed stonewares (feldspathic of 'Bristol' glazes on stonewares were introduced in the 1830s), and some sherds show the orange-brown colouring of ochre dip, generally confined to the upper parts of vessels, above the shoulder. Two vessels are represented, a narrow-mouthed cylindrical flagon with a strap handle (**WA9055-63**); and a second cylindrical vessel, round-shouldered, but lacking any other diagnostic features, either a flagon or jar (**WA9126-9**). The flagon bears a proprietary mark on the shoulder (G SIMMONS Phoenix GRAVESEND). G Simmons is listed at the Phoenix tavern, Albion Street, in the 1851 Gravesend and Milton Directory, but does not appear in Kelly's 1882 directory (by which time the licensee at the Phoenix was Philip Smith).

4.5.6 *Miscellaneous sherds (one complete vessel, plus 10 sherds):* the complete vessel is a whiteware jug (**WA9122**, **Plate 7B**), of the kind used in washstand jug and bowl sets, with moulded decoration. A metal (tin or pewter?) trim has been added to the rim, and originally supported a metal lid that is now missing. On the base is a relief 'Staffordshire knot', with the monogram WB 24, possibly the mark of William Brownfield of Cobridge, Staffordshire, during the period 1850-71 (Godden 1964: 10).

4.5.7 Also amongst this miscellaneous group are two sponged ware vessels, a cylindrical mug (**WA9123**) and a wash-bowl (**WA9124-WA9125**). Sponging as a decorative technique was used from the early 19th century, but became more common in the 1830s and 1840s with the introduction of cut sponges; it was a cheap form of decoration, requiring minimal skill, and in the mid to late 19th century sponged wares were the cheapest decorated vessels available. Both vessels are in pearlware, a white-bodied earthenware developed by Josiah Wedgwood in the 1770s, and produced until the 1840s.

4.5.8 Two joining sherds from a whiteware cup (**WA9064-WA9065**) carry a stamped mark (COMMONWEALTH [DOMIN]ION LINE LTD). The Commonwealth and Dominion Line, a passenger and cargo shipping company, was formed in January 1914. In June 1916 it was taken over by the Cunard Line, and became the Cunard Line Australasian Service, Commonwealth & Dominion Line Ltd, but the company remained largely autonomous within the Cunard structure. Commonwealth and Dominion officially rebranded itself as 'Port Line Ltd' in November 1937. Finally, two more whiteware cups are represented in the assemblage (**WA9099** and **WA9100**).

4.5.9 Two other miscellaneous pottery sherds comprise one fragment from a glazed red earthenware vessel, possibly the lid from a bread crock (**WA9130**), and a fragment of probable sanitary ware (toilet bowl; **WA9132**).

Glass

4.5.10 A total of 12 glass artefacts were recovered during the clearance operation, comprising five complete bottles and two other bottle fragments; one complete drinking vessel and parts of two others; an oil lamp; and one miscellaneous fragment (**WA9092**).

4.5.11 Three of the complete bottles are soda bottles of a similar form; these are 'flat egg' bottles in pale greenish glass, with 'blob' tops (**WA9134**, **WA9145** and **WA9146**). The origin of the ovate 'egg' bottle is slightly obscure; it is sometimes referred to as a 'Hamilton' bottle after William Hamilton who took out a patent for the production of soda and other mineral waters

in 1809, using bottles of this form, although it is fairly clear that the form was in use prior to that date, probably at the end of the 18th century (Talbot 1974: 37-9). The 'flat egg', a variant with a flattened base, is thought to have been introduced around 1870, although there is no firm evidence for this, and the earliest reference appears to be in 1897; the form reached the height of its popularity during the Edwardian period (*ibid*.: 44). One of the flat egg bottles (**WA9134**) carries an embossed proprietary mark (BUSFIELD'S / SPECIAL SUPER / GUISELEY), from W Busfield & Company of Guiseley, West Yorkshire, a company in operation at least from the early 20th century (not found in 19th century trade directories) until very recently. A small fragment of another soda bottle (**WA9133**) has the embossed mark 'SUPER', and almost certainly represents a second Busfield's bottle. The other two flat egg bottles (**WA9145** and **WA9146**) are unmarked; they retain their corks *in situ*; the corks are marked WEBB & Co / LIMITED / [ISLI]NGTON GREEN / LONDON, a company founded by John Webb in 1818 (Hannon and Hannon 1976).

4.5.12 There are two complete wine (or possibly port) bottles (**WA9135** and **WA9144**); one is embossed with the mark IMPERIAL QUART on the base; this still has the cork *in situ*. A bottle base (**WA9091**) may represent a third bottle of the same type.

4.5.13 The three drinking vessels comprise a complete cylindrical tumbler (**WA9117**), and two partial wine glasses (**WA9118** and **WA9119**). The wine glasses are both of the same form, with faceted ogee bowls and double blade knops (**Plate 8**).

4.5.14 The oil lamp (**WA9141**, **Plate 9**) comprises a globular oil reservoir in an opaque white glass. It was found with a metal valve (**WA9142**) and suspension chain (**WA9143**).

4.6 Leather

4.6.1 There are a total of 28 leather objects within the assemblage, principally comprising fragments of a range of footwear (**WA9001** - **WA9025** and **WA9028**), along with the peak from a cap or visor (**WA9027**), and a plain fastening strap from a case or satchel (**WA9039**).

4.6.2 The leather was assessed by specialist Quita Mould on 3rd June 2014.

4.6.3 A minimum of fourteen individual items of footwear were recognised. All the footwear was noticeably worn and of adult male sizes ranging from size 5(38) to 9(43), with nearly half being size 8(42). No pairs were noted. No complete items of footwear were recovered but two boots, a top boot and a 'Wellington', were sufficiently well preserved.

4.6.4 A wide range of footwear was represented including tall 'leg' boots (a 'wellington' boot (**WA9001**) and a top boot of calf height (**WA9020**), **Plate 10A** and **10B**), practical, working footwear of types worn by labourers' ('derby' boot and a wooden soled shoe or clog) and dress shoes (oxford shoe, balmoral boots and elastic-sided boots of ankle height). The dress shoes of styles worn by men about town, office and shop workers etc. suggest that a variety of passengers are represented by this footwear rather than simply the working crew aboard ship. All the styles appear to have been made of bovine leathers with the majority having uppers made of leather with the grain side facing outward, known as 'ooze' leather at that time, but later termed 'suede' (Swann 1982: 55). One shoe, a balmoral boot of ankle height, had stitching from a repair patch that once covered a broken area at the great toe joint of the upper perhaps suggesting the wearer had suffered from a bunion.

4.6.5 The leather footwear was constructed using two principal construction methods: wooden pegs or small metal rivets (tacks). No hand stitched welted constructions were present that would have been used on expensive bespoke footwear at that time. The pegged and riveted constructions suggest a less expensive range of footwear. The two types of wooden pegged

construction found (Goubitz 1984, Figure 5 constructions 9 and 10) were both used during the 19th century. Riveted (nailed) constructions using either iron (steel) rivets or brass rivets were employed during the second half of the 19th century and were commonly used throughout the first half of the 20th century (Salaman 1986: 157). Wooden pegging had also been used to attach heels and repair soles to some shoe bottoms of riveted constructions. The D-shaped stacked leather heels were low (ranging between 1in and 1¾in in height). Several of the shoe bottoms survived intact with their individual components still adhering so that some details of their internal construction (such as the presence or absence of midsoles) were obscured. In addition, a wooden soled shoe, a clog, was also present with iron nails reinforcing the edge of the sole and badly deteriorated remains of an upper of ankle height (**WA9004**).

4.6.6 The constructions used, bottom shapes and upper styles all indicate a date in the mid-Victorian period, more likely the third quarter of the 19th century, with certain features suggesting a date in the 1860s-70s.

4.6.7 The remains of one shoe (**WA9005**), an oxford shoe, front-lacing through five pairs of lace holes, with a pointed/oval toe might be of slightly later date than the rest, possibly belonging to the late Victorian period (*c.* 1885+, Swann 1982: 51).

4.7 Miscellanea

4.7.1 Various other objects were also identified from the assemblage; further details are provided below.

4.7.2 **WA3180** - a cylindrical concrete mooring and long chain with studded links likely to be more than 15 m long. The remains are believed to be part of the old buoy that was located in a position close to where the clearance operation occurred.

4.7.3 **WA3059** and **WA3197** - two cylindrical drums of wood interpreted as pieces of a single mast or spar. They both measure 0.2m in diameter and a simple tenon joint is apparent on the end of one piece.

4.7.4 **WA9026** - a rubber vaginal douche dating to the first 40 years of the 20th century with 'Omega Spray Ingram' on the body (South Kensington Science Museum Inventory number A626910). The item was manufactured in England and a rubber patch indicates that it was repaired.

4.7.5 **WA9032** - a brass lock and door knob attached to a piece of wood, possibly recovered from the wheelhouse or one of the cabins.

4.7.6 Other items recovered during the clearance works include animal bone (**WA9029**, **WA9030** and **WA9120**), a brass button (**WA9136**), and a steel spanner (**WA9033**).

5 SAMPLES

5.1.1 A total of three samples were recovered and retained for further analysis (**WA8001** - **WA8003**), as presented in **Appendix 3**. All of the samples are currently stored at WA.

Bituminous substance

5.1.2 During the watching brief, it was noted that a bituminous substance, in varying quantities, was present on several elements of recovered material and a small find, as follows:

- *The internal shell of a long section of hull with riveted plating (**WA3152**);*

- *A small section of the keel and garboard (**WA3216**) where only traces have been recorded;*
- *The internal and external elements of the lower bilge (part of **WA3080**), where the substance appeared to be irregularly spread; and*
- *Coating a spanner (**WA3121**) and a small opening located within a section of hull (**WA3119b**).*

5.1.3 A sample of bituminous material was retained for further analysis.

5.1.4 It was common practice for the inside of a vessel's hull to be painted with pitch or asphalt in order to prevent corrosion on the iron plating caused by bilge water being present (Corbett 1990). This may account for the presence of the substance.

Rubber

5.1.5 A sample of plastic (**WA8002**) was retained in order for a potential date to be ascertained after further research. It is currently believed to be a gasket used to seal the junction between two surfaces.

5.1.6 The piece of rubber measures less than 20mm long and 10mm wide.

Concretion

5.1.7 A sample of concretion (**WA8003**) was retained for further analysis in order to identify the object sealed within it. The concretion measures 0.25m in length and 0.15m in width.

5.1.8 The concretion was X-radiographed by WA's specialist and the images were subsequently analysed. Two hollow cylindrical objects were identified within the concretion, thought to be of similar length and diameter (**Plate 11A** and **11B**). These items are tentatively thought to be sections of scuppers used to drain water away from the vessel's deck.

6 DISCUSSION

6.1 Vessel Type

Engines

6.1.1 Elements of the engines recovered are identified as parts of two single-cylinder 'grasshopper' side-lever engines. Engines of this type, a modified version of the side-lever engine, were fitted in small craft, generally tugs (Griffiths 1997). The engine arrangement, with a single cylinder and a jet condenser coupled below, is similar to the one described in the article *The Story of the Tyne Tugs* published in the Smith's Dock Journal in May 1933 (page 70, **Figure 3A**).

6.1.2 Similar engines were still being built and fitted at the beginning of the 20th century in vessels such as the *Reliant*, a paddle tug built in 1907, and in the *Eppleton Hall*, built in 1914. Although it cannot be excluded that this kind of engine was fitted in vessels other than tugs, it was a very common method of propulsion for paddle tugs because "*in disconnecting paddle wheel tugboats, gear was usually fitted to enable the wheels to be disconnected from each other, and each engine worked independently, to facilitate the manoeuvring of the vessel*" (Sennet and Oram 1911).

6.1.3 The large cylinders of the engines were set vertically on top of the jet condenser spraying river water into the exhaust steam to condense it (**Figure 3A**). The diameter of the cylinders is consistent with a 30''-33'' bore cylinder that could have been fitted in tugs of *c.* 100-150 gross tons (grt) (*c.* 30-40m long).

Boilers

6.1.4 All the manufacturer's marks visible on the recovered firebricks originate from the Newcastle upon Tyne and Gateshead regions, potentially indicating the area within which the boilers were constructed. Conversely, it is possible that these bricks were replacements made during each boiler's life time.

6.1.5 Boilers fitted in Tyne tugs match closely with the two recovered during the clearance works, as described in the article from Smith's Dock Journal (Robinson 1933). A sketch reproducing an original working drawing of a Tyne tug's boiler displays a single rivetted, double return flue boiler measuring 7ft 11in x 7ft 4in (*c.* 2.4 x 2.2m) at the fore end and with parallel sides measuring 11' (*c.* 3.3m) (*ibid*.: 71). The slight difference in dimensions could be explained by the fact that the shapes of the boilers of the Tyne tugs were adapted to the space available in the hull of the tug and "*consequently each boiler assumed a curious shape*" (*ibid.*) (**Figure 3B**). Furthermore, the two boilers of each Tyne tug were usually located aft of the engines (*ibid.*).

Hull

6.1.6 The hull of the recovered vessel has a shallow draft and is almost flat bottomed, allowing the vessel to be suitable for shallow water operations. The dimensions of the hull and construction technique adopted are consistent with a small vessel of 100-150grt.

6.1.7 The vessel's plate dimensions vary from 3.02 x 0.65m (riveting spacing 0.11m and 0.47m across) to 3.90 x 0.65m. In the 1840s the largest plates that could be rolled economically were 10ft (3.05m) long by about 2ft 9in (0.84m) wide (Corlett 1990). This would indicate an early construction date for the recovered vessel. Also the single riveted lap might be a further indication of an early construction as in larger vessels single riveting was abandoned for double riveting and became rare towards the end of the 19th century. Nonetheless, small vessels continued to be single riveted (McCarthy 2005).

6.1.8 The construction details of the section of hull plating (**WA3152**, **Plate 3**) and the small section with the keel still attached to the garboard plate (**WA3119B**) shows a similar arrangement (zigzag riveting with 1in rivets) to the amidships section detailed in the plans for the steel screw tug *Simla* that was built in 1898 (Thomas 1991).

6.1.9 With regards to the bituminous material found across the sections of hull it is possible that the inside of the hull was painted with pitch or asphalt in order to prevent erosion on the iron plating due to bilge water being present in the bottom of the vessel (Corlett 1990). Furthermore, it is possible that a barrel containing the bituminous substance was stored in the vessel's hold at the time of the sinking, giving credence to the fact that some artefacts were found covered by the substance and why it was not evenly spread.

6.1.10 Iron manufacturer's marks found on two of the vessel's floors (**Plate 4A** and **4B**) belong to two companies operating in the Gateshead area in the late 19th century; 'Frazers and Roberts' were based at Felling Shore and 'Abbot' at Gateshead Park. Both companies are present in the 'list of the mills and forges in the United Kingdom' and also the 'Mineral Statistic of the United Kingdom of Great Britain and Ireland for the year 1871'.

6.1.11 Frazers, Roberts & Co. formed a limited company of that name in 1866 (McQueen 2013). There is no mention of the firm amongst the Tyneside Industries in 1889 but a company with a very similar name, Robert Frazer & Son, is mentioned as having *"large transaction as iron and steel merchants"* and producing a very diversified output including bar and sheet iron, steel and iron rails and fastenings, bolts, nuts and rivets (Tyneside Industries 1889).

6.1.12 John Abbot & Co was founded in the 1820s and survived until the 20th century when the firm went into liquidation in 1909. In 1889 the company was described as *"iron manufacturers, boiler builders, anchor manufacturers, chain makers, hydraulic engineers, brass founders, brass finishers, coppersmiths, plumbers, gasfitters and smiths"* (Tyne and Wear Archives Service 2001-2014 ref. DX711 accessed online June 2014).

6.1.13 The evidence presented above suggests that the vessel may have been built at and launched from Gateshead, on the southern bank of the River Tyne, where the L-sections for the floors of the vessel were manufactured. Gateshead, along with North Shields and South Shields, was one of the principal centres for tug boat construction (Thomas 1991), although other shipbuilding centres in the north-east, such as Sunderland, should not be discounted.

6.1.14 If contemporary with the vessel, the evidence of personal items present on board at the time of the sinking suggests that a rather sudden episode led to the deposition of the wreck on the seabed. However due to the circumstances of the recovery it was difficult to identify any evidence of damage that may have occurred at the time of its sinking and as a result, the cause of the shipwreck, based on the evidence available, remains unclear.

Anchors

6.1.15 It is difficult to ascertain whether the anchors (**Plate 5**) are contemporary with the vessel recovered and can therefore be assessed as part of the same assemblage. Whilst a number of anchors, sometimes as large as 50 cwt (Thomas 1991), were stowed in large tugs it is unlikely that a 28 cwt was onboard a 100-150grt vessel.

6.1.16 Therefore it is more likely that the large anchor is related to another vessel that may or may not have been involved in the paddle steamer's sinking.

Pottery and Glass

6.1.17 Approximately 80% of the pottery and personal items were recovered during operations on 2nd April.

6.1.18 Material recovered from the same bucket loads as the pottery, such as a capstan and the actual bow of the vessel, seem to suggest that most of the pottery was located around the bow area of the vessel. However, it is essential to bear in mind that the grabbing process may have repositioned the archaeological deposits relating to the wreck.

6.1.19 The pottery and glass has revealed slightly conflicting evidence in terms of chronology. There are items which appear to belong to the early Victorian period (sponged pearlware mug and wash-bowl), to the later 19th century (dinner plates and teawares supplied by Turnbull of Newcastle upon Tyne), and to the early 20th century (flat egg soda bottles, Commonwealth & Dominion Line cup).

6.1.20 At least two of the identified suppliers (Turnbull, and Busfield of Guiseley) would fit with an origin for the vessel in north-east England, while others (Simmons of Gravesend, Webb of Islington Green) are clearly more local to its final position.

6.1.21 The overall character of the assemblage is utilitarian – a simple (and probably cheap) range of serving wares, a range of beverage containers, both for alcoholic and soft drinks, and a few other functional pieces.

6.2 Vessel Identification

6.2.1 The recovered ship is an iron riveted paddle steamer with feathering wheels, likely to be Tyne built, possibly a tug, dating to the second half of the 19th century.

6.2.2 It is suggested that a possible identification of the wreck is the iron paddle tug *Admiral* that sank in 1872 (**Plate 12**), but further documentary research and fieldwork is recommended to confirm this.

Documentary research

6.2.3 To date, the following sources have been consulted:

- *Clyde-built Ships Database (accessed from http://www.clydesite.co.uk, May 2014);*
- *Dictionary of Disaster at Sea during the Age of Steam (Hocking 1969);*
- *Gateshead Libraries;*
- *Markham Grange Steam Museum;*
- *Lloyd's Register;*
- *Newspaper articles (accessed from http://www.britishnewspaperarchive.co.uk, May 2014);*
- *Notices from the Gazette official public record (accessed from https://www.thegazette.co.uk , May 2014);*
- *National Record for the Historic Environment (NRHE);*
- *RoW;*
- *Thames Tugs website (accessed from http://www.thamestugs.co.uk, May 2014).*
- *Trinity house;*
- *Tyne Tugs & Tug Builder database (accessed from http://www.tynetugs.co.uk, May 2014); and*
- *UKHO.*

6.2.4 From preliminary documentary research a suitable candidate for the identification of the shipwreck is the paddle tug *Admiral*. This vessel is a Tyne built paddle steamer with engines that correspond well with the ones recovered during the clearance. The dimensions of the ships are also similar. Furthermore, this potential identification corroborates the date range and provenance of some of the pottery also recovered from the site.

6.2.5 Absence of a clear cargo supports the identification of the vessel as a paddle tug rather than as a coastal steamer or a collier of small dimensions but it is possible that the vessel had been salvaged after sinking. Paddle tugs were a common vessel type on the Thames since their introduction in 1830s; the first paddle tug to be seen in the Thames was the *Lady Dundas*, which also arrived from the Tyne and Wear area (Thomas 1991).

6.2.6 The *Admiral* was an iron paddle tug built by T. Hepple & Son of Low Walker, Newcastle upon Tyne, completed in January 1870. The tug was owned by Daniel S. Mitchell of Gravesend and was of *c.* 100grt, with the registration number 63555. A wooden half model of the *Admiral* is stored in the National Maritime Museum's archive of ship models (part of the Royal Museums Greenwich, Object ID SLR1019). The model dates to *c*. 1869, potentially a year before the ship itself was completed and may have been used to promote

the vessel in some way with potential investors. Further analysis of this model may yield information that could identify the remains of the recovered vessel.

6.2.7 According to the Shields Daily Gazette of Tuesday 13th February 1872, "*the screw steamer* Rajah*, for the north, was in collision below the Nore on Sunday, and sank the tug* Admiral *and afterwards fouled the ship* William Davis*, for Glasgow, doing damage to her bows, and carrying away her own mainmast and funnel. Both vessels returned to London for repairs*".

6.2.8 As reported by Freeman's Journal on 13th February 1872 (accessed online, May 2014) the accident was witnessed by Captain Dunne (of *Countess of Dublin*) who saw *"a serious collision had taken place between a large screw collier (*Rajah*) and the steam tug* Admiral *and a large ship (*William Davis*) bound for Glasgow which she had in tow. In the collision the* Admiral *was sunk and the bows cut clean off the ship"*. It is further suggested that from the position that he witnessed the incident (12 miles off the Nore) "*Captain Dunne put all steam on the* Countess*, and when near enough to render assistance lowered his boats. By this means he was able to save the crew of the* Admiral *(seven in number)*". The exact circumstances described in the article are unclear and it is possible that the distance of 12 miles reported was not the position he witnessed the accident from but the position where the collision took place, although the first interpretation would provide a better justification as to why Captain Dunne "*put all steam on*".

6.2.9 The position of the shipwreck is *c.* 1.2nm from the location of the Nore Light Vessel before the light was moved in 1925 to approximately two miles eastward, at a position close to that currently held by Sea Reach Buoy No. 1.

6.2.10 The reason why the Nore Light Vessel, so close to the accident, is not mentioned in any of the journals and did not intervene in the rescue of the survivors, is not explained. The Nore Light Vessel was administrated by Trinity House of London and it is possible that some information was recorded on the logbook of this ship. Unfortunately all the records pre-1940s were destroyed in a fire during World War Two.

6.2.11 The iron manufacturer's mark found on two frames indicates the banks of the river Tyne as the area where structural components of the hull were manufactured and possibly assembled. The mark 'FRAZERS AND ROBERTS & Co LTD' suggests 1866 as the *terminus post quem* for the construction of the vessel. There is the possibility that the floors with the markings were part of a repair made after the launch of the vessel, although this is unlikely and not supported by the available evidence.

6.2.12 The date range (later 19th century) and provenance (Newcastle upon Tyne) established for some of the pottery recovered (dinner plates and teawares supplied by Turnbull) are also consistent with the date and provenance of the *Admiral*. It is conceivable that the mug and wash-bowl belonging to the early Victorian period could have still been in use in the 1870s, but the later cup and bottles clearly post-date the sinking of the *Admiral* in 1872, and are therefore likely to be intrusive to the site.

6.2.13 The evidence from the leather shoes is broadly consistent with the date of the proposed identification of the *Admiral*. However, the number of persons reported as crew onboard the *Admiral* was seven and the number of individual items of footwear recognised within the assemblage is fourteen. It is conceivable that each member of the crew had a spare pair of footwear onboard at the time of the incident.

6.3 Site Formation

6.3.1 The material recovered during the clearance works comprises the remains of at least one vessel; the majority of which conclusively belongs to an iron riveted paddle steamer dating to the second half of the 19th century. The relatively contained area from which material relating to the vessel was recovered during clearance suggests that it was not a dispersed wreck.

6.3.2 Due to the manner by which the obstruction was recovered, the sections of wreck did not reveal the cause for the vessel's sinking.

6.3.3 Some of the objects and structural elements recovered were in excellent condition and it is thought that large parts of the vessel were preserved in deep fine-grained sediment prior to clearance. The finds were recovered in almost pristine condition showing no corrosion and almost no concretion, suggesting that most of the vessel was buried within the riverbed soon after the vessel wrecked, along with any objects intrusive to the vessel itself. These anaerobic conditions of deposition led to the survival of organic material that is relatively rare in the archaeological record, such as leather and wood.

6.3.4 Documentary research has tentatively identified the vessel as the *Admiral*, an iron paddle tug built by T. Hepple & Son of Low Walker, Newcastle in 1870.

6.3.5 Since the *Admiral* was built in 1870 and sank only two years later it is likely that its overall condition pre-collision would be good (i.e. few evident repairs or minimal corrosion), and if it was buried relatively quickly after its sinking then it could be expected that the remains recovered would be in a similarly good condition (not taking into account damage caused by the grab). This assumption has been verified by the excellent condition of the recovered remains examined during the watching brief, along with the small finds. To further support this assumption, the larger elements of wreck that are currently stored at Denton Wharf need to be fully analysed and recorded. Conversely, it was noted that the vessel's cause of sinking could not be identified from the remains due to the damage caused by the grab and therefore, the overall condition of the vessel pre-collision may also not be ascertained.

6.3.6 If accurate, the identification of the remains of at least one vessel has been relatively straightforward. However the intrusive and destructive manner by which the obstruction was cleared means that much information regarding the site formation, and in particular the vessel itself, has potentially been lost. Furthermore, clearance did not extend deeper than the required dredge depth and consequently the entire vessel was not recovered. It is assumed that the engines' accessories, pumps, parts of main frames and remaining engine bedplate, possible partial paddle and shaft and the keel are still remaining on the riverbed. Around 80 tons of material was recovered as a result of the clearance operation, lowering the obstruction by *c.* 2.2m; therefore it is conceivable that the remaining material has been disturbed and is no longer *in situ* in its original primary context, and may be scattered.

6.3.7 It is clear that several objects recovered from the site were intrusive to the wreck site, for instance one bucket load contained plastic bags and modern bottles together with archaeological remains associated with the vessel. It is also possible that some of the material had been washed in by the tide and consequently contained within and around the prominent seabed features comprising the wreck site. Furthermore, considering the high concentration of marine traffic along the Thames, it is plausible that some of the finds belong to other vessels, for instance the 28 cwt Admiralty anchor (**WA3071**). Consequently, it is important to stress that more than one wreck may be represented in the recovered assemblage.

7 STATEMENT OF IMPORTANCE

7.1 Historical Importance

7.1.1 Paddle tugs were a characteristic vessel type across the UK and in the Thames' and noted within their respective maritime histories. They were first invented in the north of England (Thomas 1991: 193) and their history and development is closely connected with the evolution of British maritime industries during the 19th century. The wreck represents an interesting example of a working boat not very often represented amongst merchant or naval maritime collections.

7.1.2 The engines and boilers of 19th century Tyne tugs were all fitted by hand and for most of these vessels builder's plans were not produced (Thomas 1991). Therefore, this example provides important information that might help to document the Tyne shipbuilding tradition.

7.1.3 The historical importance of the vessel is considered: **Medium**.

7.2 Archaeological Importance

7.2.1 Due to the presence of a significant percentage of the vessel still being present at the site, albeit in an unknown condition, the potential of the site to still impart important archaeological information considered to be relatively good. This potential is further emphasised by the condition of the material (structural elements relating to a vessel(s) and small finds) that have already been recovered as part of the clearance works. For instance, the bottle of port with intact cork (**WA9144**).

7.2.2 Since numerous objects were identified from the site that did not belong to the vessel itself, the limited potential for objects relating to other archaeological events or contexts also exists. However, the clearance exercise has compromised the vessel and has reduced the level of available information contained within the site.

7.2.3 The archaeological importance of the site is considered: **Medium**.

7.3 Site Characterisation

7.3.1 The character of the site is summarised in the following table, which focuses on seven topics for evaluating underwater wreck sites (based on Watson and Gale 1990: 183).

Table 2: Summary of site character

Area and distribution of surviving ship structure	Main site covers an area measuring 33m by 29m with scattered material covering a slightly larger area of *c*. 40m by 30m.
Character of the ship structure	Iron riveted hull and steam driven paddle wheels. Appears to have been relatively intact prior to clearance.
Depth and character of stratigraphy	Presence of buried material within the area. Unknown depth of stratigraphy, but likely to be in excess of 50% of vessel remaining as mostly upper elements cleared.
Volume and quality of artefactual evidence	Large amounts small artefacts were found within the site. This includes working and domestic assemblages.
Apparent date of the ship's construction and/or loss	Mid to late-19th century

Apparent function	Certainly a steam powered paddle driven vessel, probably a paddle tug.
Apparent origin	NE England - Tyne and Wear. A tentative identification has been suggested as the wreck of the *Admiral*, lost 1872.

7.4 BULSI Characterisation

7.4.1 The overall characterisation of the exposed material on the seabed can be summarised using the Build/Use/Loss/Survival/Investigation (BULSI) method for 'shipwreck biography' as presented within the ALSF project *On the Importance of Shipwrecks* (Wessex Archaeology 2006). The site characterisation of GAD 58 is as follows:

Build

7.4.2 The surviving structure together with the presence of propulsion machinery and wider assemblage suggest that the vessel was constructed of riveted iron, with the skeleton constructed first and the hull plating added later. The partial paddle wheel and side lever engine parts demonstrate that this vessel was a paddle steamer.

Use

7.4.3 No evidence of cargo was found. The tentative identification of the wreck with the paddle tug Admiral, built 1869 and lost in 1872, is supported by the archaeological evidence. The vessel was a common working type from the mid-19th century to the early 20th century, carrying out towage duties for larger vessels.

Loss

7.4.4 No evidence of the cause of loss has been found, but if the identification as the Admiral is correct, the vessel collided with the steamship Rajah whilst towing another vessel.

Survival

7.4.5 The archaeological material found on the site consists of ship's structure, steam engine parts, paddle wheel, and a selection of working and domestic assemblages consistent with a vessel of the later 19th century. The evidence suggests that prior to clearance, the site was remarkably complete. It is likely that the site is now mostly buried.

Investigation

7.4.6 The site and nearby locations have not previously been investigated, prior to clearance by the PLA. Wessex Archaeology produced a Clearance Mitigation Statement following the discovery and clearance in 2014 (WA 2014b). No evidence of previous disturbances were noted, and the site, although marked by WA in 2001 as having archaeological potential, was not previously known or charted.

8 PROPOSALS FOR ANALYSIS, PUBLICATION AND ARCHIVE

8.1 Aims and Objectives

Documentary Research

8.1.1 It is recommended that further documentary research be undertaken in order to confirm that the main component of wreck material recovered does indeed belong to the *Admiral*. For instance the vessel may have been subject to salvage operations, either contemporary or later, which may have resulted in documents being generated providing more information regarding the identification of the wreck site. However it is currently believed that the site lay comparatively undisturbed until its identification as a wreck in 2014.

8.1.2 With regards to the wooden half model of the starboard side of the *Admiral*, currently stored in the NMM archives (**Plate 12**), it is suggested that a photogrammetry image of the model could be generated and overlain with ship's plans of a similar vessel (perhaps *Old Trafford* built in 1907, later renamed *Reliant*) for a limited comparison on dimensions and construction.

8.1.3 Additional research into not only the *Admiral*, but also the other vessels involved in the collision, SS *Rajah* and SS *William Davies*, may reveal further information that will either confirm or refute its identification as the *Admiral*. Considering that SS *Rajah* caused damage to SS *William Davies*, but both vessels survived the collision with only repairs, there may be records describing the repair maintenance and the reason for its necessity.

8.1.4 Since it cannot be assumed that the wreck of the paddle steamer is that of the *Admiral*, further research should be undertaken relating to other paddle steamers that sank at or near to this location, as an alternative identification for the wreck material. Documentary sources may also provide a greater understanding of the character and importance of such a vessel and its use as a mid-late 19th century service vessel on the Thames.

8.1.5 Documentary evidence may be available from sources including: the NRHE; the UKHO; Lloyd's Register; the Public Record Office that is the repository of the national archive at Kew; the National Maritime Museum (NMM), Greenwich; the Tyne and Wear Archives; and websites dedicated to maritime traffic specifically on the Thames.

8.1.6 It was noted during the watching brief that one of the hull sections appeared not to be coherent with the rest of the material, suggesting either that this is from an entirely different vessel or that the paddle steamer was constructed using different techniques. Comprehensive analysis of all the sections of hull should occur along with further documentary research. If the remains do indicate one vessel constructed with differing techniques, this could also subsequently aid its identification.

Analysis of the Assemblage

8.1.7 At present only the material stored at WA Salisbury has been recorded and catalogued, however after the clearance operation, several larger diagnostic elements were transported to Denton Wharf for storage. It is recommended, as a priority, that these additional pieces are recorded to an equivalent standard. Analysis of these sections could provide further information regarding the cause of sinking, the identification of the vessel, and confirm whether there are more than one vessel accounted for within the assemblage.

8.1.8 The most prominent example of a steam tug was the *Old Trafford*, later *Reliant*, which was on display at the NMM, Greenwich until 1996. Due to its high preservation costs the vessel was broken up in 2001 and dispersed/disposed. The two engines, built by Hepple & Co., were retained and are now separately visible at the NMM and the Markham Grange Steam Museum, Doncaster (along with a paddle wheel and working feathering gear). Since the *Old Trafford*'s engines were constructed by the same manufacturer as the *Admiral*, and they share the same tonnage, it is believed that the two vessels are of a similar construction (**Plate 13**). It is recommended that one, or both, of these engines be visited in order for a direct comparison to be made with the examples recovered during the clearance operation and potentially provide more information regarding the wreck's identification.

8.1.9 Furthermore, images of engine plans for another paddle steamer constructed by Hepple in 1867, *Achilleus*, were taken from the Tyne and Wear Archives (**Figure 4**). Since *Admiral* and *Achilleus* are both built by the same manufacturer at a similar time, the plans could be used to compare with the recovered engine elements to potentially aid identification or merely gain more information regarding the recovered vessel itself.

8.1.10 It has been suggested by Q. Mould that the leather assemblage could be given to Cardiff University for their students to undertake organic conservation as part of the Archaeological Conservation course. It is recommended that this be investigated as a potential way to conserve this material especially as this could potentially provide further information regarding the total count of shoes within the assemblage, the styles of shoe present, identification of the five 'unallocated' items, and finally perhaps refining the date range of the shoe assemblage.

8.1.11 In order to ascertain a closer date range for the leather shoe assemblage, further research is recommended at the Northampton Shoe and Boot Museum and/or The Shoe Museum, Street, Somerset. This could also provide additional information regarding the leather cap peak/visor for instance the style of hat it represented, and also the type of case or satchel from which the fastening strap came.

8.1.12 Due to the advances in the use of multi-image photogrammetry with archaeological features, it is suggested that the assemblage of recovered material is subject to this technique. Multi-image photogrammetry is a versatile and cost-effective method for producing high resolution 3D surfaces in a short amount of time. Its utilisation on the assemblage will produce an extremely detailed digital archive which can then be manipulated and analysed further. WA has already used this technique to a high standard on various projects including small finds recording, historic building recording, underwater wreck survey, and aerial and terrestrial topography.

8.1.13 Finally, it is proposed that more information is derived from the samples taken (**WA8001**-**WA8003**), for example the date and identification of the plastic, the identification of the concreted objects, and a confirmation of the bituminous substance.

Post-Clearance Site Assessment

8.1.14 The condition of the remaining wreck material is likely to have been severely compromised by the clearance works, but there will undoubtedly be further archaeological material surviving.

8.1.15 A dive investigation of the site is proposed that could potentially enhance the knowledge gained from them with regards to the remnants on the riverbed. A dive investigation would also confirm that the required dredge depth has been attained from the clearance operation and therefore the remains of the wreck site will not be subject to further disturbance; as recommended by the PLA (2014). According to the PLA, this would also be consistent with other phases of wreck and obstruction clearance (*ibid*: 5).

8.1.16 It is to be noted that upstanding features identified from the January 2014 multibeam bathymetry survey may still exist on the site and could pose an issue of entanglement if a dive investigation were to be undertaken (WA 2015).

General objectives

8.1.17 Once the whole assemblage has been recorded to the same standard, further decisions can be made about storage, curation, publication and ultimately discard.

8.1.18 A record of the site has been made in the PLA Wreck Database and charted as appropriate. Further dredging in the vicinity of the site by London Gateway Port will be in accordance with the provisions set out in the Archaeological Protocol for dredging activities. Furthermore, it is recommended that any additional dredging activities within 50m of the wreck position should be undertaken alongside a programme of archaeological monitoring.

9 PROVISIONAL TASK LIST AND RESOURCES

9.1 Task List and Proposals

9.1.1 **Table 2** below presents the list of tasks and resources required to undertake the analysis proposals. Suggested personnel and their qualifications are listed in **Section 9.3**.

Table 3: Task list and resources

Tasks	Grade	Days	Completed?
Documentary Research			
Archival research relating to the *Admiral*, its crew and the other vessels involved with its sinking.	PO	3.5 days	No
Analysis of Assemblage			
Record wreck elements that are stored at Denton Wharf/LG (on site)	PO	2 days	Completed[1]
Comparison between wreck material and existing elements of *Old Trafford/Eppleton Hall*	PO	1 day	Completed
Conservation of leather assemblage	External	TBC	TBC
Multi-image photogrammetry processing of the entire assemblage (large items).	PO	5 days	Completed
Analysis of samples recovered.	PM/PO	1 day	Completed
Post-clearance Assessment Report (Paddle Tug)	PM/PO	10 days	Completed
Archiving			
Archiving and deposition	PO	7 days	No
Publication			
Popular booklet on the dredging phase finds including the Paddle Tug (estimate, inc. design, exc. printing),		TBC	No
Text and illustrations for Journal Article if required (dredging finds, inc paddle tug)	SPO/PM	7 days	No

9.2 Programme

9.2.1 The programme of recommendations and proposals will be pursued during the 2015-2016 financial year.

9.3 Personnel

9.3.1 It is currently proposed that the following WA core staff will be involved in the programme of post-excavation analyses:

[1] Recording now completed, see forthcoming Wessex Archaeology report: Detailed Recording of the Maritime Material Stored at London Gateway 2015.

Table 4: WA staff and grade

Grade	Staff
Project Manager	Toby Gane MPhil MCIfA
Finds Manager	Lorraine Mepham BA MCIfA
Senior Project Officer	David Howell MSc AMIMarEST
Project Officers	Paolo Croce MA PCIfA and Victoria Lambert MA ACIfA

9.3.2 Other external specialists will also be contacted regarding paddle steamers, in particular tugs with a Tyne and Wear provenance, along with finds specialists that may provide additional information on the assemblage of small finds.

9.4 Wessex Archaeology Quality Standards

9.4.1 WA operates an integrated project management system. Projects are assigned to individual Project Managers who monitor their progress and quality, and control budgets from inception to completion, in all aspects including Health and Safety. Projects are managed in accordance with Historic England (formerly English Heritage) guidelines outlined in the document MoRPHE Project Manager Guide (Historic England 2006).

10 STORAGE AND CURATION

10.1 Museum

10.1.1 The retained material worthy of preservation will be offered to a suitable museums service for display or for further analysis. If no repository can be found for it, agreement will be sought via Historic England and the RoW for the material to be discarded.

10.1.2 Q. Mould, leather specialist, advises that it is unlikely that the museum receiving the assemblage of objects will accept the leather items unless they are conserved beforehand. However they may contribute towards the cost of freeze-drying selected material worthy of display whilst the rest could be air-dried under controlled conditions.

10.2 Preparation of Archive

10.2.1 The complete archive, which will include predominantly digital records, photographic records, graphics, and artefacts, will be prepared following the guidelines for the deposition of archaeological archives in the Southend Museum Service Store, and in general following nationally recommended guidelines (Walker 1990; SMA 1995; Richards and Robinson 2000; Brown 2007).

10.2.2 All archive elements are marked with the WA project code and comprise the following:

- *Digital archive containing correspondence with external specialists, reports written by external specialists regarding the finds; contemporary documents relating to the* Admiral*, and sketches made during the watching brief;*
- *72 airtight plastic boxes of artefacts;*
- *1,232 digital photographs detailing the watching brief fieldwork (including recovered wreck material and screen shots of location of grabs) and post-excavation photography of the small finds; and*
- *75 videos taken during the archaeological watching brief.*

10.2.3 The archive listed above refers only to that stored and curated at WA Salisbury; further much larger elements of the recovered wreck are stored at Denton Wharf, overseen by PLA staff.

10.3 Conservation

10.3.1 No immediate conservation requirements were noted during the watching brief for any of the objects recovered. Items that have since been identified as being in an unstable condition, and therefore potentially in need of further conservation treatment, comprise the organic and wooden remains; at present these artefacts are stored in water within a dark environment.

10.3.2 Currently the recommendation is that all archaeologically recovered leather is conserved to permit safe storage and make it available for study (Historic England 2012). This is due to the relative rarity of the survival of organic materials in the archaeological record and the wealth of information that can be recovered from them.

10.4 Discard Policy

10.4.1 Wessex Archaeology follows the guidelines set out in Selection, Retention and Dispersal (Society of Museum Archaeologists 1993), which allows for the discard of selected artefact categories that are not considered to warrant any future analysis.

10.4.2 At present there is no proposal to discard any of the recovered material, however once it has all been recorded to a consistent level (specifically the material currently at Denton Wharf), this recommendation will follow.

10.4.3 The following categories will subsequently be proposed for discard:

- *Elements of the vessel that have been fully recorded and cannot be retained long term at Denton Wharf or WA Salisbury; and*
- *Small finds that are not procured by a relevant museum or university and will not offer any further information regarding the assemblage (in particular sherds of pottery and glass, animal bone, and leather items).*

10.4.4 The discard of environmental remains and samples follows the guidelines laid out in Wessex Archaeology's *Archive and Dispersal Policy for Environmental Remains and Samples*. The archive policy conforms to nationally recommended guidelines (SMA 1993; 1995; Historic England 2002) and is available upon request.

10.4.5 The discard policy for both finds and environmental material will be fully documented in the project archive.

10.5 Copyright

10.5.1 The full copyright of the written/illustrative archive relating to the wreck site will be retained by Wessex Archaeology Ltd under the Copyright, Designs and Patents Act 1988 with all rights reserved. Any recipient museum or university, however, will be granted an exclusive licence for the use of the archive for educational purposes, including academic research, providing that such use shall be nonprofitmaking, and conforms to the Copyright and Related Rights regulations2003.

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12 APPENDICES

12.1 Appendix 1: Finds List

See Appendix 2 for objects that are currently stored at WA.

Object No.	Description	Photo No.	Bucket No.	Date Recovered	Vessel's component part where known
WA3001	Plating with pan-head riveting	WA1020	1	31/03/2014	
WA3002	H-shaped steam pipe with copper flanging	WA1024	2	31/03/2014	
WA3003	Connecting rod	WA1025	2	31/03/2014	
WA3004	Transversal beam with smithed knees - possible room near boiler room	WA1027	3	31/03/2014	Hull
WA3005	Oarlock shaped connecting rod - not identified	WA1042	3	31/03/2014	
WA3006	Small four spoke wheel	WA1033	3	31/03/2014	
WA3007	Boiler #1, horizontal, double tubular, egg-shaped end	WA1034; WA1050 to WA1065	4	31/03/2014	Engine
WA3008	Curved plate with flanged pipe and possible manhole, flush riveting (possibly upper front part of the boiler)	WA1045	5	31/03/2014	
WA3009	Boiler #2 , horizontal , double tubular, egg-shaped end, hatches attached	WA1079	6	31/03/2014	Engine
WA3010	Firebricks	WA1088	6	31/03/2014	
WA3011	Floor/beam with curved seat possibly for boiler	WA1084	7	31/03/2014	Hull
WA3012	Shaft with crank and engine crossbeam connecting rod	WA1089, WA1096, WA1115, WA116	8	31/03/2014	Engine
WA3013	Copper terminal and ceramic fragment	WA1104	8	31/03/2014	
WA3014	Deck or bulkhead plate with inspection hatch – anti-slip surface	WA1106, WA1127	8	31/03/2014	Hull
WA3015	Firebrick	WA1114	8	31/03/2014	
WA3016	Shaft with rotation crank	WA1126	9	31/03/2014	Engine
WA3017	Wheel #1	WA1123, WA1134	9	31/03/2014	Engine
WA3018	Crank shaft detail	WA1120 ,WA 1121	9	31/03/2014	
WA3019	Hatch	WA1127	9	31/03/2014	
WA3020	Copper piping - discharge pipe	WA1131	9	31/03/2014	
WA3021	Feed valve	WA1141	9	31/03/2014	
WA3022	Wheel #2	WA1144 to WA1151, WA1337 to WA1350	10	31/03/2014	Engine
WA3023	Connecting rod	WA1153	10	31/03/2014	
WA3024	Hatch , possible injection valve slot	WA1155	10	31/03/2014	

Object No.	Description	Photo No.	Bucket No.	Date Recovered	Vessel's component part where known
WA3025	Coupling wheel to couple engines	WA1165, WA1174	11	31/03/2014	Engine
WA3026	Wooden beam with l shape, composite metal base and two connecting rods attached. Possibly engine room beam.	WA1169, WA1182, WA1188	11	31/03/2014	
WA3027	Eccentric strap details)	WA1168	11	31/03/2014	
WA3028	L shape	WA1198	12	01/04/2014	
WA3029	Curved plating with chain riveted butt plate	WA1202, WA1203	13	01/04/2014	
WA3030	Curved plating with l shape	WA1207	13	01/04/2014	
WA3031	Deck stanchion or paddle stay	WA1208	13	01/04/2014	
WA3032	Chain - studded links	WA1212	14	01/04/2014	
Appendix 2	Soda bottle	WA1215	14	01/04/2014	
WA3034	Plating x3	WA1218	15	01/04/2014	
WA3035	Coal		15	01/04/2014	
WA3036	Piping with flanged end	WA1221	16	01/04/2014	
WA3037	Timber fragment	WA1223	16	01/04/2014	
WA3038	Possible pump/piston fragment	WA1224	16	01/04/2014	
WA3039	Possible hull plank and frame	WA1225, WA1230	16	01/04/2014	
WA3040	Hull section with frames and plating and butt plate	WA1228	17	01/04/2014	
WA3041	Wire iron splice	WA1229	17	01/04/2014	
WA3042	Small copper cap	WA1233	17	01/04/2014	
WA3043	Shoe with nails	WA1234, WA1235	17	01/04/2014	
WA3044	Cylinder #1	WA1240, WA1242, WA1247, WA1476 to WA1485	18	01/04/2014	Engine
WA3045	Side levers	WA1249 , WA1235	18	01/04/2014	Engine
WA3046	Cylinder #2	WA1256 , WA1268, WA 1351 to WA1356, WA1486 to WA1490	19	01/04/2014	Engine
WA3047	Pump #1	WA1273, WA1277, WA 1359 to WA1364	20	01/04/2014	Engine
WA3048	Side lever	WA1285	20	01/04/2014	Engine
WA3049	Crosshead	WA1285	21	01/04/2014	
WA3050	Pump #2	WA1292, WA1460 to 1465	21	01/04/2014	Engine
WA3051	Possible piston from air pump/bilge pump #2	WA1289	21	01/04/2014	
WA3052	Possible piping cock	WA1295	21	01/04/2014	
WA3053	Plating	WA1303	22	01/04/2014	

Object No.	Description	Photo No.	Bucket No.	Date Recovered	Vessel's component part where known
WA3054	Wooden planks x2	WA1303	22	01/04/2014	
WA3055	Copper piping / possible copper strum box	WA1308	23	01/04/2014	
WA3056	Wooden plank and plating	WA1313, WA1311	23	01/04/2014	
WA3057	Porthole for possible injection valve	WA1312	23	01/04/2014	
WA3058	Box keelson (?)	WA1312	23	01/04/2014	
WA3059	Mast with scarf (?)	WA1318	24	01/04/2014	
WA3060	Section of hull	WA1320, WA1326	24	01/04/2014	
WA3061	Engine/pump base	WA1324	24	01/04/2014	Engine
Appendix 2	Brass hand pump still attached to plank	WA1376	25	01/04/2014	
WA3063	Long wooden plank	WA1379	25	01/04/2014	
WA3064	Numbers of wooden plank fragment - deck planking or ceiling	WA1378	25	01/04/2014	
WA3065	Brick	WA1381	25	01/04/2014	
WA3066	Wooden plank of different sizes , no fastening	WA1385	26	01/04/2014	
WA3067	Animal vertebra and ceramic fragments	WA1393	26	01/04/2014	
WA3068	Admiralty pattern anchor #1	WA1386, WA1452, WA1453	27	01/04/2014	Anchors and machinery
WA3069	Wooden ceiling or decking , iron plates	WA1390	27	01/04/2014	
WA3070	Shoes		27	01/04/2014	
WA3071	Admiralty pattern anchor #2	WA1396, WA1408, WA1466 to WA1468	28	01/04/2014	Anchors and machinery
Appendix 2	Ceramics, oil lamp	WA1406, WA1407	28	01/04/2014	
Appendix 2	Small decorated plank	WA1401	28	01/04/2014	
WA3074	Chain - studded links	WA1402	28	01/04/2014	
WA3075	Valve	WA1403	28	01/04/2014	
Appendix 2	Glasses and soda bottles x6	WA1409	28	01/04/2014	
WA3077	Brass gaskets	WA1410	28	01/04/2014	
WA3078	Plating	WA1411	28	01/04/2014	
WA3079	Paddle wheel float	WA1412, WA1469 to 1475	29	01/04/2014	
WA3080	Hull section with 3 frames and reversed frames, floors , keel , wooden ceiling still attached, bitumen in the bilge	WA1416, WA1429 to 1451	30	01/04/2014	Hull
WA3081	Brick	WA1420	30	01/04/2014	
WA3082	Frames	WA1422	30	01/04/2014	
WA3083	Coal wooden fragment and iron plates	WA1422	30	01/04/2014	
WA3084	Hull plating , single riveted (pan head rivets) , clinker built , chain riveted butt plate	WA1495	31	02/04/2014	

Object No.	Description	Photo No.	Bucket No.	Date Recovered	Vessel's component part where known
WA3085	Frame	WA1494	31	02/04/2014	
WA3086	Section of hull with four frames, butt plate	WA1503, WA1513, WA1514, WA1525	32	02/04/2014	Hull
WA3087	Curved rod	WA1501	32	02/04/2014	
WA3088	Iron ladder - fell into water	WA1500	32	02/04/2014	Anchors and machinery
WA3089	Hull plate small	WA1510	33	02/04/2014	
WA3090	Floor	WA1511, WA1512	33	02/04/2014	
WA3091	Head of hammer	WA1705	34	02/04/2014	
WA3092	Plate	WA1520	34	02/04/2014	
WA3093	Curved rod	WA1522	34	02/04/2014	
WA3094	Timbers		34	02/04/2014	
Appendix 2	Section of hull with butt plate and four floors	WA1526, WA1528	35	02/04/2014	
WA3096	Rod, squared section (curved metal bar ?)	WA1527	35	02/04/2014	
WA3097	Long hull plate x2	WA1531, WA1530,	36	02/04/2014	
WA3098	Fragment of timber with lead sheet	WA1532	36	02/04/2014	
Appendix 2	Ceramic pitcher entire	WA1707 to WA1709	36	02/04/2014	
Appendix 2	Ceramic bowl with sponge blue decoration	WA1541	36	02/04/2014	
WA3101	Floor	WA1550, WA1553,WA1554	37	02/04/2014	
WA3102	Two long hull plate	WA1549, WA1551	37	02/04/2014	
WA3103	Tapered long timber	WA1552	37	02/04/2014	
WA3104	Timber planks (ceiling), small and long	WA1557, WA1565	38	02/04/2014	
WA3105	Plates	WA1561	38	02/04/2014	
WA3106	Manhole door with handle	WA1561, WA1571	38	02/04/2014	
WA3107	Modern plastic rubbish bag	WA1565	38	02/04/2014	
WA3108	L shaped frames	WA1562, WA1563	38	02/04/2014	
WA3109	Curved rod	WA1560	38	02/04/2014	
WA3110	Bricks		38	02/04/2014	
WA3111	Crosshead connection and connecting rod	WA1566, WA1569	38	02/04/2014	
WA3112	Transmission cable with ring		38	02/04/2014	
WA3113	Shoe	WA1562, WA1563	38	02/04/2014	
WA3114	Long plate	WA1568	39	02/04/2014	
WA3115	Curved floor with hull plating (very bent)	WA1573, WA1574, WA1575, WA 1576	40	02/04/2014	
WA3116	Plating and floors	WA1580	41	02/04/2014	

Object No.	Description	Photo No.	Bucket No.	Date Recovered	Vessel's component part where known
WA3117	Cylinder valve plug	WA1579	41	02/04/2014	
WA3118	Coals	WA1581	41	02/04/2014	
WA3119 - WA3119b	Large section of iron riveted -pan head - hull , clinker built , possibly side of the ship, covered by bituminous substance, possible hatchway visible, rounded end - gunwale, floors and frames - z bar	WA1582, WA1583, WA1574, WA1587, WA1588, WA1589, WA1590, WA1596, WA1601, WA1609, WA1603, WA1604, WA 1612, WA1613, WA1623, WA1631, WA1641	42	02/04/2014	Hull
WA3120	Copper piping	WA1644	42	02/04/2014	
WA3121	Spanner , concreted in the bituminous substance	WA1594, WA1595, WA1616	42	02/04/2014	Hull
WA3122	Coals		42	02/04/2014	
WA3123	Timber fragments	WA1599, WA1631, WA 1656, WA1657	42	02/04/2014	
WA3124	Frames	WA1593,WA1599, WA1644, WA1658, WA1659, WA1661	42	02/04/2014	
WA3125	Grated iron plate for ceiling or decking	WA1597, WA1614, WA1624	42	02/04/2014	
WA3126	Brass support with two rivets and hole (not identified)	WA1608, WA1611	42	02/04/2014	
WA3127	Machinery with copper pipes and gauges (not identified - injection valve and centrifugal governor?)	WA1646 to WA1649, WA1710 to 1713	42	02/04/2014	
WA3128	Rod, squared section (curved metal bar?)	WA1660	42	02/04/2014	
WA3129	Iron plating, same curved end as in bucket #42	WA1678, WA1679, WA1687 to WA1690	43	02/04/2014	
WA3130	Crab winch	WA1680, WA1685	43	02/04/2014	Anchors and machinery
WA3131	Manhole door with handle	WA1714	43	02/04/2014	
WA3132	Frames	WA1683	43	02/04/2014	
WA3133	Margin plate (of double bottom ?)	WA1669	44	02/04/2014	
WA3134	Possible diagonal tie plate (bent)	WA1798	44	02/04/2014	
WA3135	Frames	WA1700	44	02/04/2014	
WA3136	Wooden planks	WA1703	44	02/04/2014	
WA3137	Coals	WA1703	44	02/04/2014	

Object No.	Description	Photo No.	Bucket No.	Date Recovered	Vessel's component part where known
WA3138	Iron double knee, decorated with trigliph, rod and small thick plate attached	WA1715 to WA1718, WA1723 to WA1726	45	02/04/2014	
WA3139	Iron splice	WA1719	46	02/04/2014	
WA3140	Hull plates and butt plate	WA1722	47	02/04/2014	
Appendix 2	Door lock	WA1730	48	02/04/2014	
WA3142	Door hook and catch	WA1731	48	02/04/2014	
WA3143	Leather hat peak	WA1733	48	02/04/2014	
WA3144	Bow - riveted	WA1735 to 1737,WA1765 to 1767	48	02/04/2014	Hull
WA3145	Windlass and chain	WA1741, WA1745,WA1747, WA1753, WA1756, WA1758 to WA1764	48	02/04/2014	Anchors and machinery
Appendix 2	Ceramic fragments, cup, and dish (complete) with markings	WA1748, WA1749,WA1757	48	02/04/2014	
WA3147	L shape frames	WA1769	49	02/04/2014	
WA3148	Hull plates	WA1769	49	02/04/2014	
WA3149	Wood plank	WA1769	49	02/04/2014	
WA3150	Grated iron plate for ceiling or decking	WA1770	49	02/04/2014	
WA3151	Floor	WA1771	49	02/04/2014	
WA3152	Long section of hull with riveted - pan head - plating, nine frames and three stringers and grated iron plate for ceiling, bitumen, stays connection on stringer , plates curved, bracket frames	WA1772, WA1773, WA1774, WA1777, WA1778, WA17781	50	02/04/2014	Hull
WA3153	Wooden beam reinforced with metal string attached to iron riveted plate (gunwale)	WA1785, WA1790,WA1791, WA1793, WA1795, WA1796,WA1797, WA1798	51	02/04/2014	Hull
WA3154	Hub of paddle wheel	WA1786, WA1787	51	02/04/2014	
WA3155	Possible keeper for shaft (not identified)	WA1786 , WA1974	51	02/04/2014	
WA3156	Possible stem bulkhead , four frames and stringer / keel, plating and three brackets	WA1801 TO WA1825, WA1828	52	02/04/2014	Hull
WA3157	Copper piping with flange	WA1825	52	02/04/2014	
WA3158	Thick riveted plate with possible manhole	WA1859	53	03/04/2014	
WA3159	Plate with curved end	WA1866 to WA1868	54	03/04/2014	
WA3160	Plate	WA1866 to WA1868	54	03/04/2014	

Object No.	Description	Photo No.	Bucket No.	Date Recovered	Vessel's component part where known
WA3161	Frame and floor l shape	WA1870, WA1871	55	03/04/2014	
WA3162	Long riveted plates x2	WA1878,WA1879	56	03/04/2014	
WA3163	Small wooden planks		56	03/04/2014	
WA3164	Leather, possibly cover	WA1882	56	03/04/2014	
WA3165	Long wooden beam and planks	WA1888	57	03/04/2014	
WA3166	Gear with pin	WA1889	57	03/04/2014	
Appendix 2	Boot	WA1895, WA1909	58	03/04/2014	
Appendix 2	Bottle with cork and content	WA1896, WA1897, WA1911	58	03/04/2014	
WA3169	Large wooden beam and small planks	WA 1898, WA1899, WA1903	58	03/04/2014	
Appendix 2	Vaginal douche rubber container	WA1900, WA1901, WA1909, WA1979	58	03/04/2014	
Appendix 2	Five fragment of shoes	WA1909, WA1977	58	03/04/2014	
WA3172	Rectangular frame	WA1902, WA1909	58	03/04/2014	
Appendix 2	Shoe fragment	WA1904, WA1908, WA1909	58	03/04/2014	
WA3174	Concretion made of reeds , clothing and metal rods	WA1905,WA1906, WA1923, WA1924	58	03/04/2014	
WA3175	Rope	WA1907	58	03/04/2014	
Appendix 2	Brass button	WA1910	58	03/04/2014	
WA3177	Iron plate	WA1914	59	03/04/2014	
WA3178	Small plank with bevelled angle	WA1914	59	03/04/2014	
WA3179	L-shapes and riveted plates	WA1915, WA1916, WA1917, WA1925	59	03/04/2014	
WA3180	Buoy concrete mooring and chain	WA1928, WA1929, WA1931, WA1932, WA1934, WA1939	60	03/04/2014	
WA3181	Possible floating of paddle wheel (?)	WA1943, WA1946	61	03/04/2014	
WA3182	Possible knee, hinge for floating of paddle wheel	WA1944, WA1945	61	03/04/2014	
WA3183	l-shapes x2	WA1948	61	03/04/2014	
WA3184	Long tie plate	WA1969, WA1970, WA1972	62	04/04/2014	
WA3185	Butt plate	WA1971	62	04/04/2014	
WA3186	Iron riveted plate	WA1975	62	04/04/2014	

Object No.	Description	Photo No.	Bucket No.	Date Recovered	Vessel's component part where known
WA3187	Possible crab winch fragment	WA2000 to WA2004	63	04/04/2014	Anchors and machinery
WA3188	Gunwale possibly stern with bollard or support for stanchions	WA2005 to WA2008	64	04/04/2014	Hull
WA3189	Large wooden beam reinforced with metal string and iron sheeting	WA2009, WA 2010, WA 2011, WA2012, WA2018	64	04/04/2014	
WA3190	Small plank with circular hole	WA2013, WA2015	64	04/04/2014	
WA3191	Iron riveted plate	WA2017	64	04/04/2014	
WA3192	Chain	WA2020	65	04/04/2014	
WA3193	Bottle of beer (modern) and ceramic fragment	WA2029	65	04/04/2014	
WA3194	Animal bone	WA2030	65	04/04/2014	
WA3195	Copper piping and valves	WA2033, WA2037, WA2038	65	04/04/2014	
WA3196	Possible fragment of engine base plate	WA2029	65	04/04/2014	Engine
WA3197	Wooden post , mast fragment	WA2030	65	04/04/2014	
WA3198	Ball of resin	WA2035, WA2036	65	04/04/2014	
WA3199	Gunwale and iron plating with bollard (wa2055)	WA2039, WA2040, WA2055 to 2059	66	04/04/2014	
WA3200	Bollard	WA2039, WA2040, WA2041	66	04/04/2014	
WA3201	Clothing , possibly hemp	WA2042	66	04/04/2014	
WA3202	Shoe complete	WA2044	67	04/04/2014	
WA3203	Iron riveted plates	WA2046	68	04/04/2014	
WA3204	Small brass piping wit hinge	WA2047	68	04/04/2014	
Appendix 2	Leather strap	WA2049	68	04/04/2014	
WA3206	Iron riveted plates, clinker built	WA2050	69	04/04/2014	
WA3207	Copper piping with brass soldering	WA2053, WA2052	69	04/04/2014	
WA3208	Beer bottle x2	WA2054	69	04/04/2014	
WA3209	Butt plate	WA2062, WA2063	69	04/04/2014	
WA3210	Possible base plate of engine	WA2069 to 2071, WA2084, WA2085	70	04/04/2014	Engine
WA3211	Butt plate	WA2073	71	04/04/2014	
WA3212	Shackle with strap	WA2074	71	04/04/2014	
WA3213	Copper piping with bolted end	WA2076	71	04/04/2014	
Appendix 2	Animal bone	WA2077	71	04/04/2014	
WA3215	Copper pipe	WA2083	72	04/04/2014	

Object No.	Description	Photo No.	Bucket No.	Date Recovered	Vessel's component part where known
WA3216	Keel section	WA2091	unknown		Hull

12.2 Appendix 2: Finds retained by WA

Object No.	Material	Description	Vessel's component part where known
WA9001	Leather	Calf length boot	
WA9002	Leather	Tread sole of shoe	
WA9003	Leather	Insole of shoe	
WA9004	Leather	Wooden soled shoe (clog)	
WA9005	Leather	Front lacing Oxford shoe	
WA9006	Leather	Back part of sole of shoe	
WA9007	Leather	Right quarter of shoe	
WA9008	Leather	Oval-towed vamp part of shoe	
WA9009	Leather	Heel stiffner for shoe	
WA9010	Leather	Left quarter of shoe	
WA9011	Leather	Heel stiffner for shoe	
WA9012	Leather	Complete insole of shoe	
WA9013	Leather	Joined galosh part of shoe	
WA9014	Leather	Bottom unit of shoe	
WA9015	Leather	Bottom unit of shoe	
WA9016	Leather	Vamp part of shoe	
WA9017	Leather	Vamp part of shoe	
WA9018	Leather	Complete bottom unit of shoe	
WA9019	Leather	Complete bottom unit of shoe	
WA9020	Leather	'Wellington' boot	
WA9021	Leather	Elastic-sided boot	
WA9022	Leather	Lining for boot	
WA9023	Leather	Boot with brogue detailing	
WA9024	Leather	Near complete bottom unit of shoe	
WA9025	Leather	Tread area of bottom unit of shoe	
WA9026	Rubber	Vaginal Douche	
WA9027	Leather	Peak of cap	
WA9028	Leather	Bottom unit of shoe	
WA9029	Animal bone	Animal bone	Animal bone

Object No.	Material	Description	Vessel's component part where known
WA9030	Animal bone	Animal bone	Animal bone
WA9031	Wood and brass	Hand pump	Anchors and machinery
WA9032	Wood and brass	Door lock	Fixtures and fittings
WA9033	Steel	Spanner	
WA9034	Brass	Valve	Fixtures and fittings
WA9035	Brass	Valve	Fixtures and fittings
WA9036	Brass	Valve	Fixtures and fittings
WA9037	Brass	Valve	Fixtures and fittings
WA9038	Brass	Small pipe	Fixtures and fittings
WA9039	Leather	Strap / Belt	
WA9040	Copper	Pipe	Fixtures and fittings
WA9041	Copper	Pipe	Fixtures and fittings
WA9042	Copper	Pipe	Fixtures and fittings
WA9043	Iron	Rivet	Fixtures and fittings
WA9044	Copper	Rivet	Fixtures and fittings
WA9045	Copper	Rivet	Fixtures and fittings
WA9046	Iron	Rivet	Fixtures and fittings
WA9047	Iron	Rivet	Fixtures and fittings
WA9048	Iron	Rivet	Fixtures and fittings
WA9049	Iron	Rivet	Fixtures and fittings
WA9050	Iron	Shackle and iron bar	Fixtures and fittings
WA9051	Brass	Metal box for engine oil (?)	Fixtures and fittings
WA9052	Iron	Rectangular frame, hawsehole	Fixtures and fittings
WA9053	Iron	Iron L-shaped floor with manufacturer mark	Hull
WA9054	Wood	Timber	
WA9055	Pottery	Ceramic fragment - stoneware	
WA9056	Pottery	Ceramic fragment - stoneware	
WA9057	Pottery	Ceramic fragment - stoneware	
WA9058	Pottery	Ceramic fragment - stoneware	
WA9059	Pottery	Ceramic fragment - stoneware	
WA9060	Pottery	Ceramic fragment - stoneware	
WA9061	Pottery	Ceramic fragment - stoneware	
WA9062	Pottery	Ceramic fragment - stoneware	
WA9063	Pottery	Ceramic fragment - stoneware	
WA9064	Pottery	Ceramic fragment - refined whiteware	
WA9065	Pottery	Ceramic fragment - refined whiteware	
WA9066	Pottery	Ceramic fragment - refined whiteware	
WA9067	Pottery	Ceramic fragment - refined whiteware	

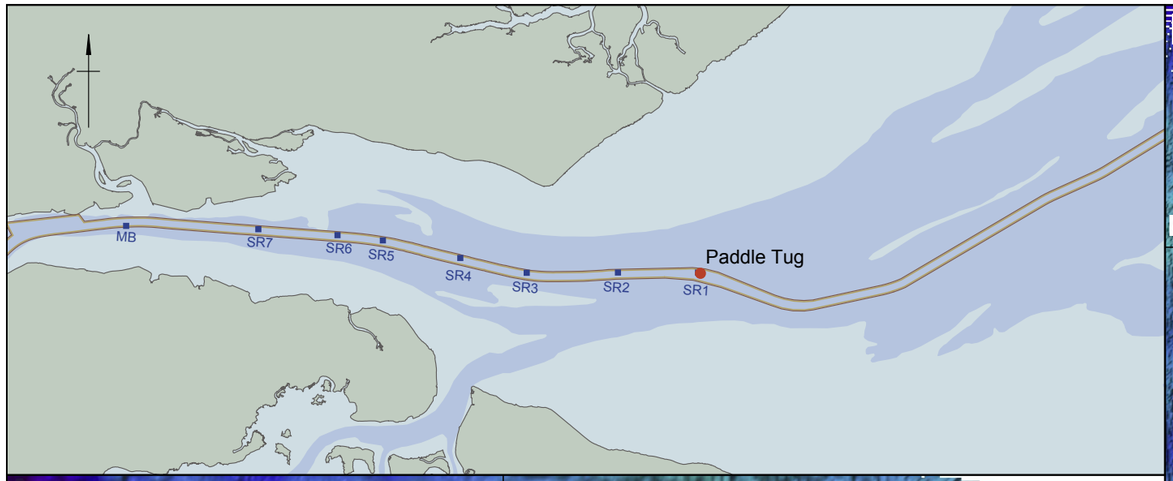
Object No.	Material	Description	Vessel's component part where known
WA9068	Pottery	Ceramic fragment - refined whiteware	
WA9069	Pottery	Ceramic fragment - refined whiteware	
WA9070	Pottery	Ceramic fragment - refined whiteware	
WA9071	Pottery	Ceramic fragment - refined whiteware	
WA9072	Pottery	Ceramic fragment - refined whiteware	
WA9073	Pottery	Ceramic fragment - refined whiteware	
WA9074	Pottery	Ceramic fragment - refined whiteware	
WA9075	Pottery	Ceramic fragment - refined whiteware	
WA9076	Pottery	Ceramic fragment - refined whiteware	
WA9077	Pottery	Ceramic fragment - refined whiteware	
WA9078	Pottery	Ceramic fragment - refined whiteware	
WA9079	Pottery	Ceramic fragment - refined whiteware	
WA9080	Pottery	Ceramic fragment - refined whiteware	
WA9081	Pottery	Ceramic fragment - refined whiteware	
WA9082	Pottery	Ceramic fragment - refined whiteware	
WA9083	Pottery	Ceramic fragment - refined whiteware	
WA9084	Pottery	Ceramic fragment - refined whiteware	
WA9085	Pottery	Ceramic fragment - refined whiteware	
WA9086	Pottery	Ceramic fragment - refined whiteware	
WA9087	Pottery	Ceramic fragment - refined whiteware	
WA9088	Pottery	Ceramic fragment - refined whiteware	
WA9089	Pottery	Ceramic fragment - refined whiteware	
WA9090	Pottery	Ceramic fragment - refined whiteware	
WA9091	Glass	Base of bottle	
WA9092	Glass	Glass fragment - unidentified	
WA9093	Pottery	Ceramic fragment - refined whiteware	
WA9094	Pottery	Ceramic fragment - refined whiteware	
WA9095	Pottery	Ceramic fragment - refined whiteware	
WA9096	Pottery	Ceramic fragment - refined whiteware	
WA9097	Pottery	Ceramic fragment - refined whiteware	
WA9098	Pottery	Ceramic fragment - refined whiteware	
WA9099	Pottery	Ceramic fragment - refined whiteware	
WA9100	Pottery	Ceramic fragment - refined whiteware	
WA9101	Pottery	Ceramic fragment - refined whiteware	
WA9102	Pottery	Ceramic fragment - refined whiteware	
WA9103	Pottery	Ceramic fragment - refined whiteware	
WA9104	Pottery	Ceramic fragment - refined whiteware	
WA9105	Pottery	Ceramic fragment - refined whiteware	

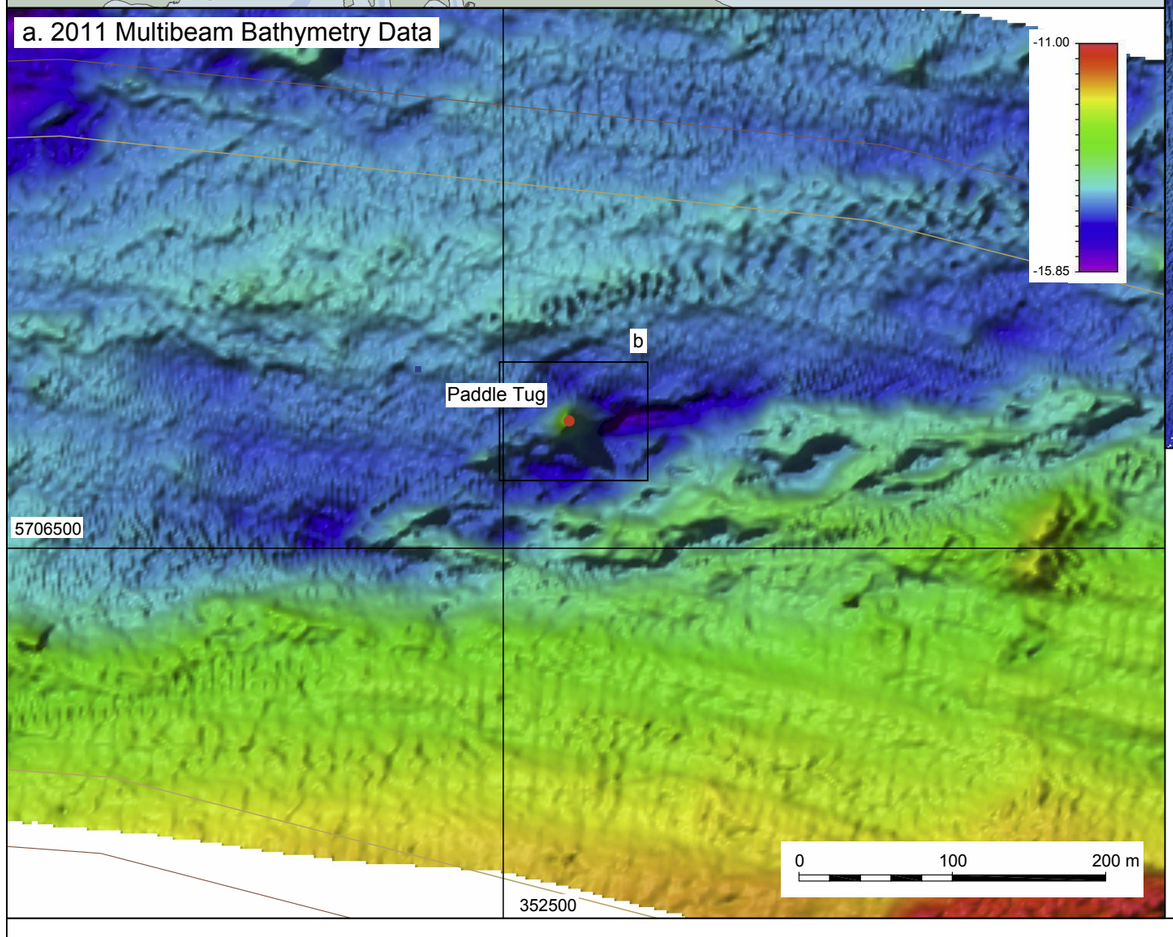
Object No.	Material	Description	Vessel's component part where known
WA9106	Pottery	Ceramic fragment - refined whiteware	
WA9107	Pottery	Ceramic fragment - refined whiteware	
WA9108	Pottery	Tea cup complete - teaware	
WA9109	Pottery	Ceramic fragment - refined whiteware	
WA9110	Pottery	Ceramic fragment - refined whiteware	
WA9111	Pottery	Ceramic fragment - refined whiteware	
WA9112	Pottery	Ceramic fragment - refined whiteware	
WA9113	Pottery	Ceramic fragment - refined whiteware	
WA9114	Pottery	Ceramic fragment - refined whiteware	
WA9115	Pottery	Ceramic fragment - refined whiteware	
WA9116	Pottery	Ceramic fragment - refined whiteware	
WA9117	Glass	Glass – complete tumbler	
WA9118	Glass	Glass – part of wine glass	
WA9119	Glass	Glass – part of wine glass	
WA9120	Animal bone	Animal bone vertebra	
WA9121	Pottery	Complete plate - flatware	
WA9122	Pottery	Complete jug – whiteware	
WA9123	Pottery	Pottery fragment – pearlware	
WA9124	Pottery	Pottery fragment – pearlware	
WA9125	Pottery	Pottery fragment – refined whiteware	
WA9126	Pottery	Pottery fragment – stoneware	
WA9127	Pottery	Pottery fragment – stoneware	
WA9128	Pottery	Pottery fragment – stoneware	
WA9129	Pottery	Pottery fragment – stoneware	
WA9130	Pottery	Pottery fragment – glazed red earthenware	
WA9131	Pottery	Pottery fragment – refined whiteware	
WA9132	Pottery	Pottery fragment – refined whiteware (sanitary ware)	
WA9133	Glass	Glass fragment – soda bottle	
WA9134	Glass	Soda bottle	
WA9135	Glass	Wine bottle	
WA9136	Brass	Button	
WA9137	Brass	Bottle rim	
WA9138	Brass	Chain	Fixtures and fittings
WA9139	Brass	Chain	Fixtures and fittings
WA9140	Brass	Chain	Fixtures and fittings
WA9141	Glass	Oil lamp	Fixtures and fittings
WA9142	Brass	Oil lamp starter	Fixtures and fittings
WA9143	Brass	Oil lamp support - chandelier	Fixtures and fittings

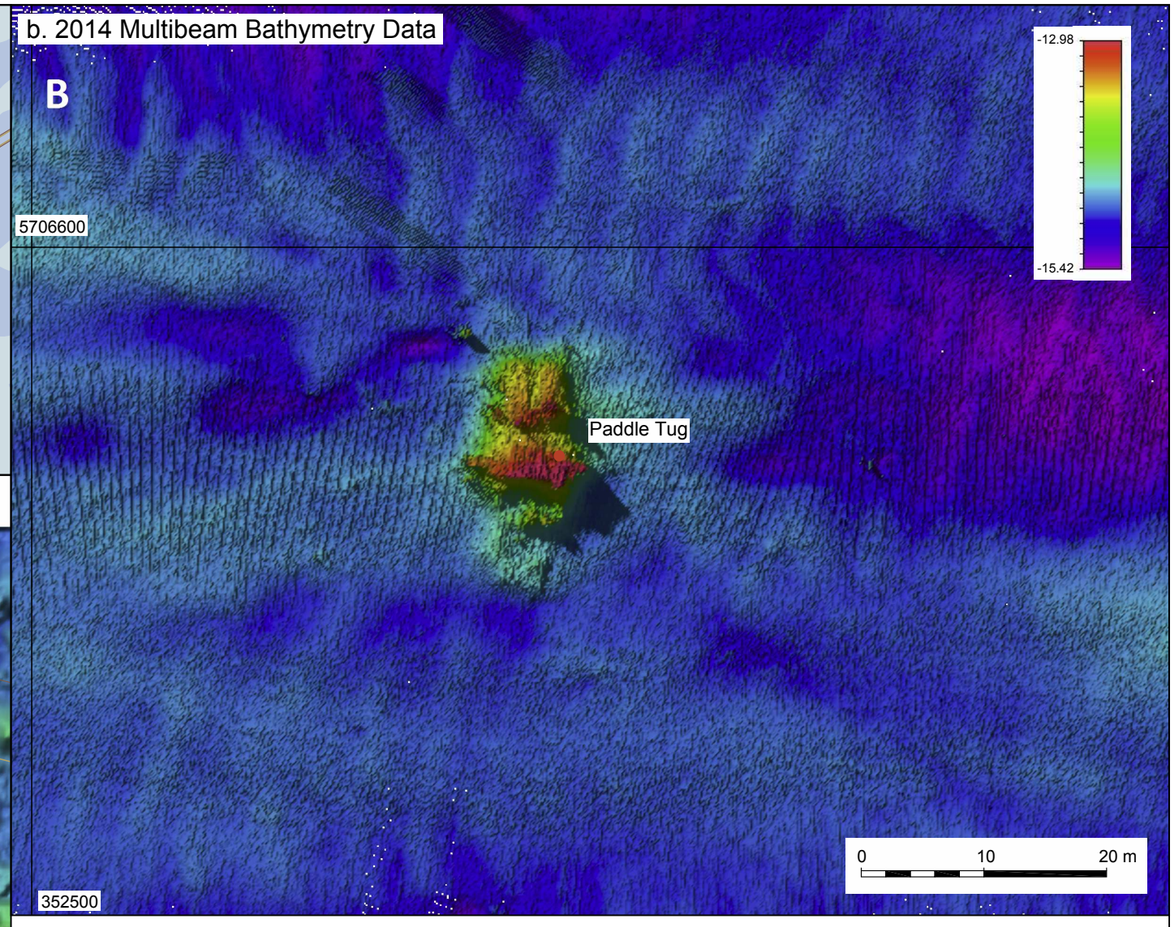
Object No.	Material	Description	Vessel's component part where known
WA9144	Glass	Bottle intact with cork - possibly port	
WA9145	Glass	Bottle intact with cork - soda	
WA9146	Glass	Bottle intact with cork - soda	

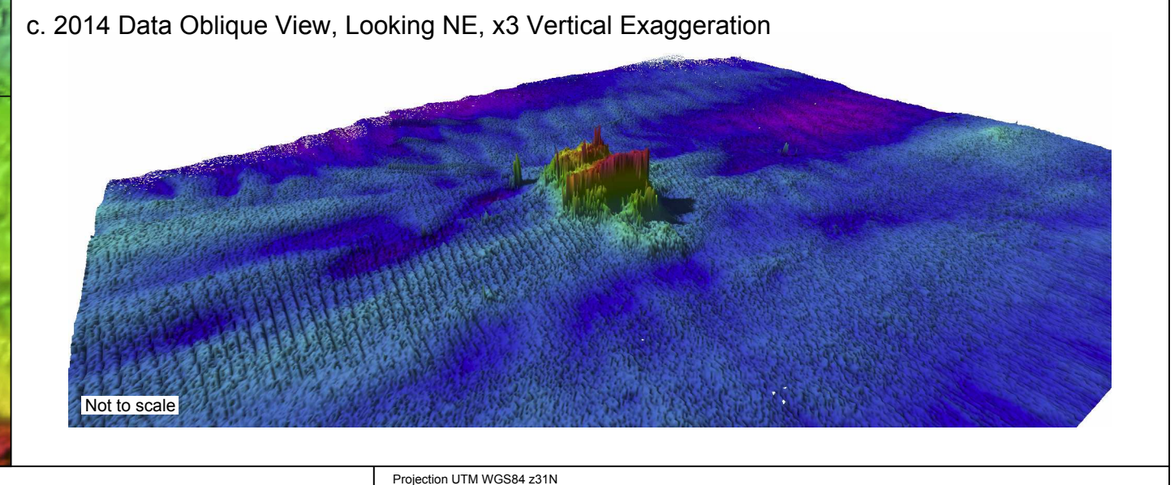
12.3 Appendix 3: Samples retained by WA

Object No.	Material	Description
WA8001	Bitumen	Sample
WA8002	Rubber	Sample gasket
WA8003	Concretions	Concretions - 2 scuppers?









- Site location
- Channel marker buoy
- Dredging limits
- 50m buffer on dredging limits

Projection UTM WGS84 z31N

Multibeam Bathymetry Data Acquired by the Port of London Authority.

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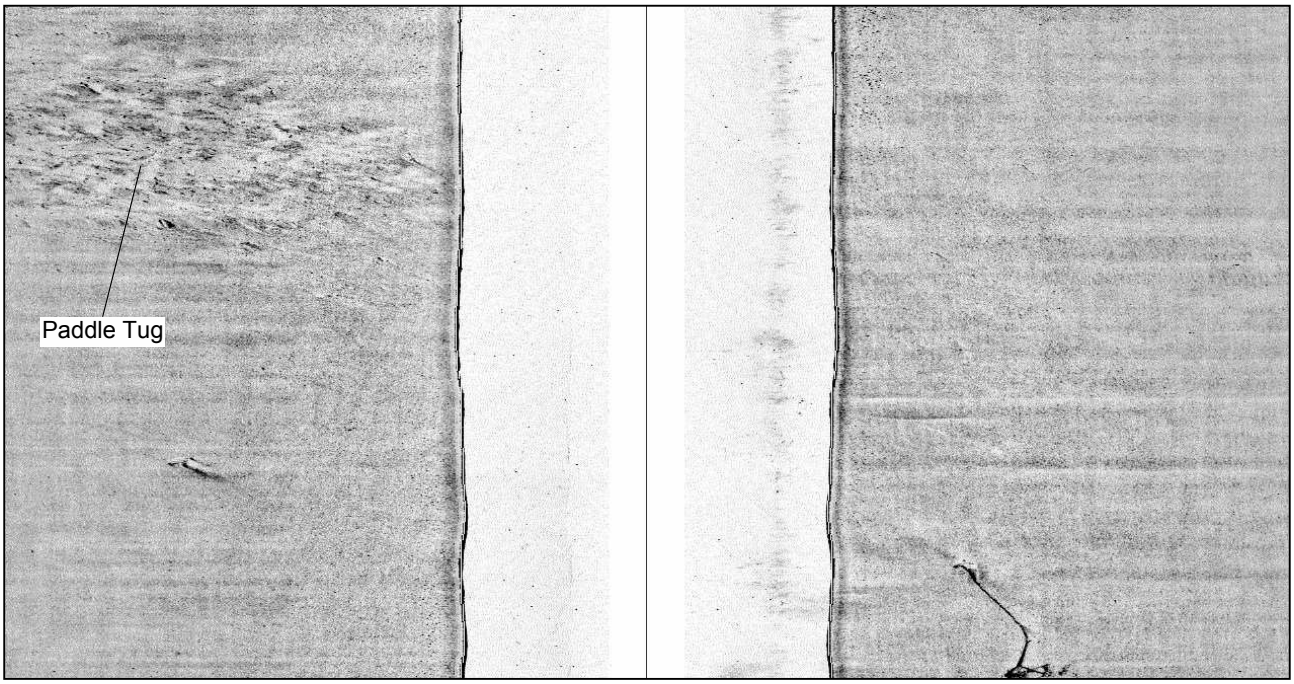
Path:	W:\Projects\London Gateway\LG2015\88631\GO\Rep figs\P-c Assess\2015_03_13		

Site location and 2014 multibeam bathymetry data

Figure 1

A. 2002 Sidescan Sonar Data



B. 2014 Post-clearance Sidescan Sonar Data

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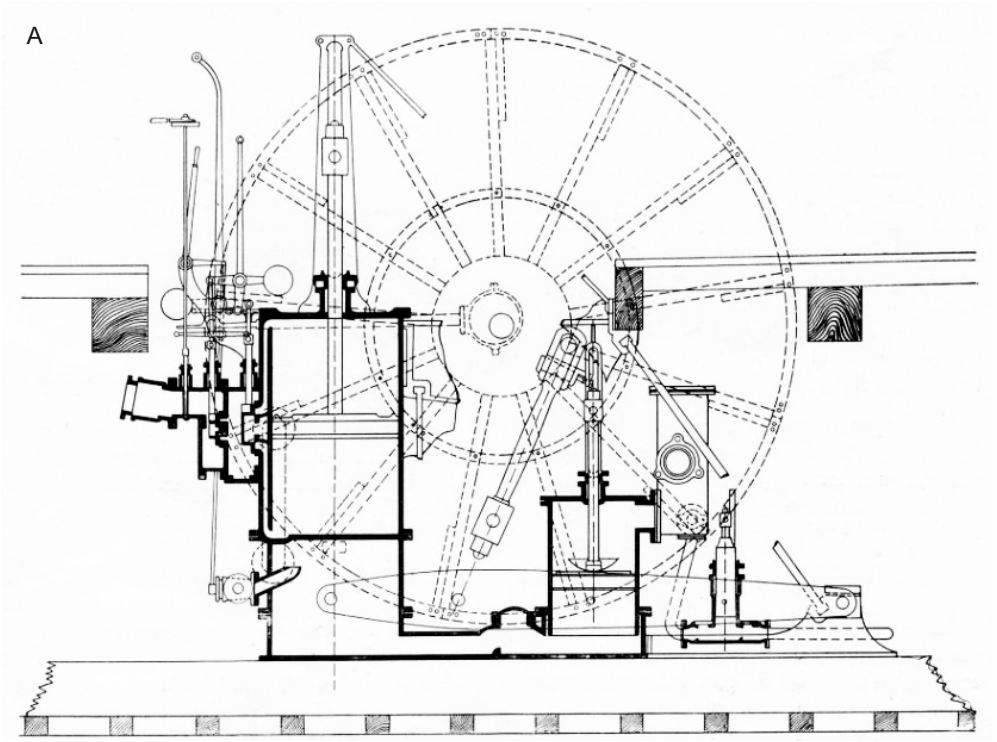
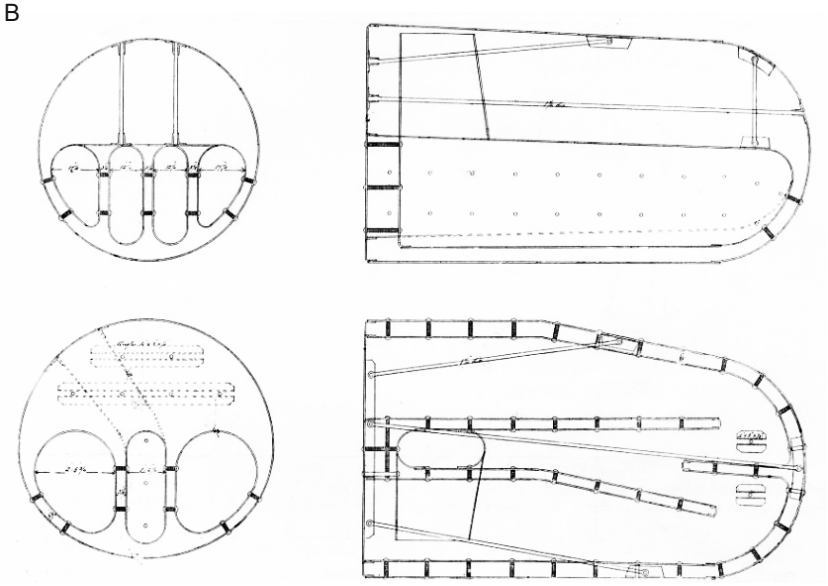
Sidescan sonar images of the Paddle Steamer site

Figure 2

A



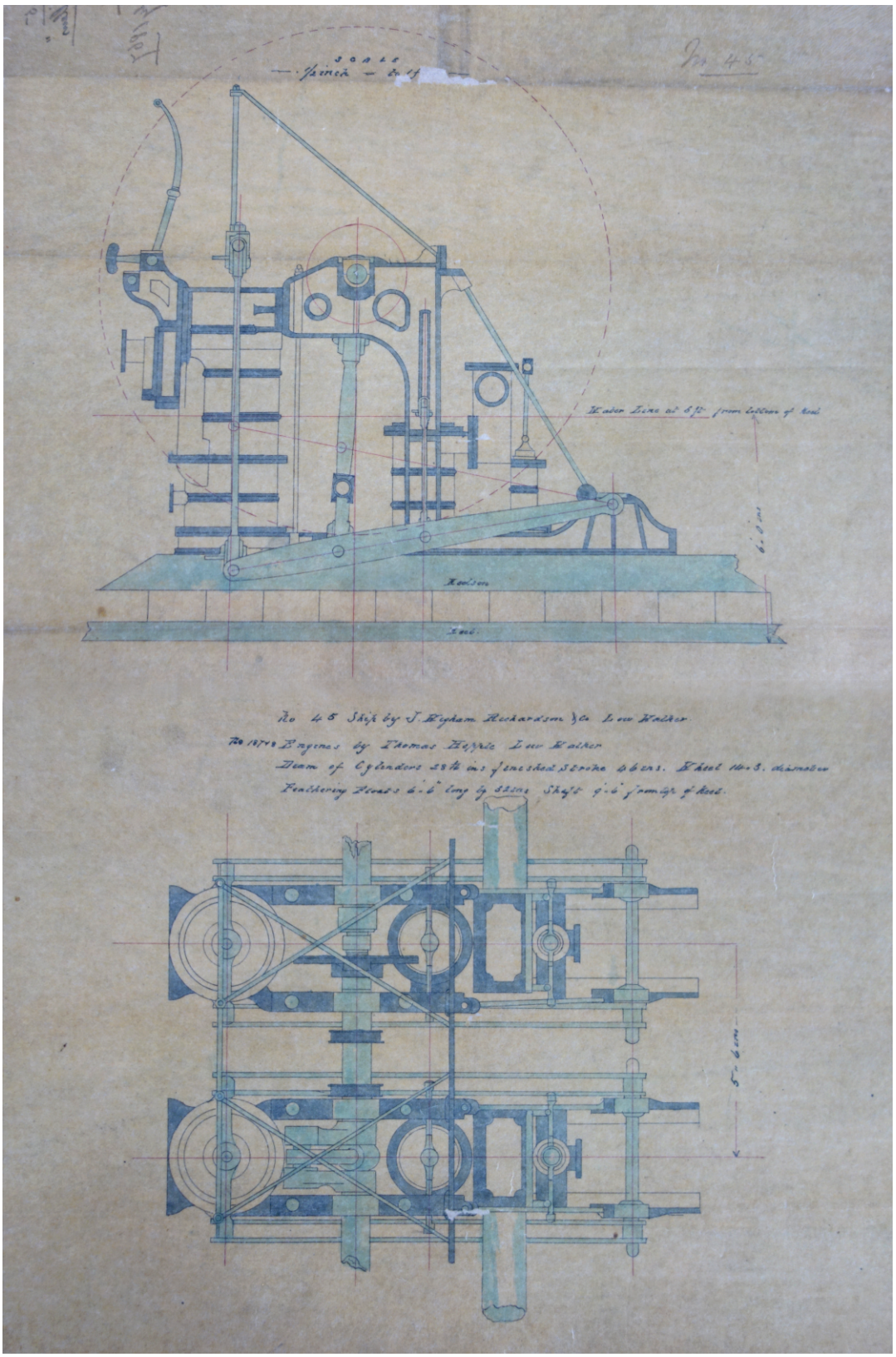
B



Robinson, J. (Captain) (ed.), 1933. The Story of Tyne Tugs, in *Smith's Dock Journal*, Volume 14 (64-73), May 1933.

Date:	13/05/2015	Revision Number:	0
Scale:	NTS at A4	Illustrator:	KJF
Path:	W:\Projects\London Gateway\LG 2015\88631\Graphics_Office\Rep figs\P-c Assess\2015_03_13		

Example of an early 20th century single cylinder side-lever engine (A) and double return flue boiler (B) Figure 3



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Plans of *Achilleus*' engines, built by Hepple in 1867 Figure 4

Plate 1: Boiler, WA3007, held within the grab's teeth having been recovered from the site

Plate 2: Firebricks with Tyne and Wear manufacturer's marks; 'Heddon' and 'Ramsay', **WA3010**

Date:	13/05/2015	Revision Number:	0
Scale:	NTS	Illustrator:	KJF
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Plate 3: Section of hull with iron riveted plating, frames and stringers, **WA3152**

Plate 4: Manufacturer's marks on two iron floor frames

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Scale:	NTS	Illustrator:	KJF
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Plate 5: Admiralty anchors

Plate 6: Bilge pump, **WA9031**

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Scale:	NTS	Illustrator:	KJF
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Plate 7: Pottery

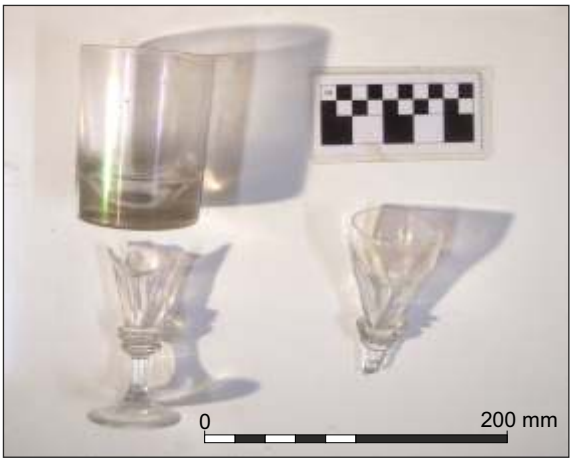

Plate 8: Three glass drinking vessels, **WA9117** - **WA9119**

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Plate 9: Oil lamp, **WA9141**

A. **WA9001** 'Wellington' boot

B. **WA9020** top boot of calf height

Plate 10: Leather items

Date:	13/05/2015	Revision Number:	0
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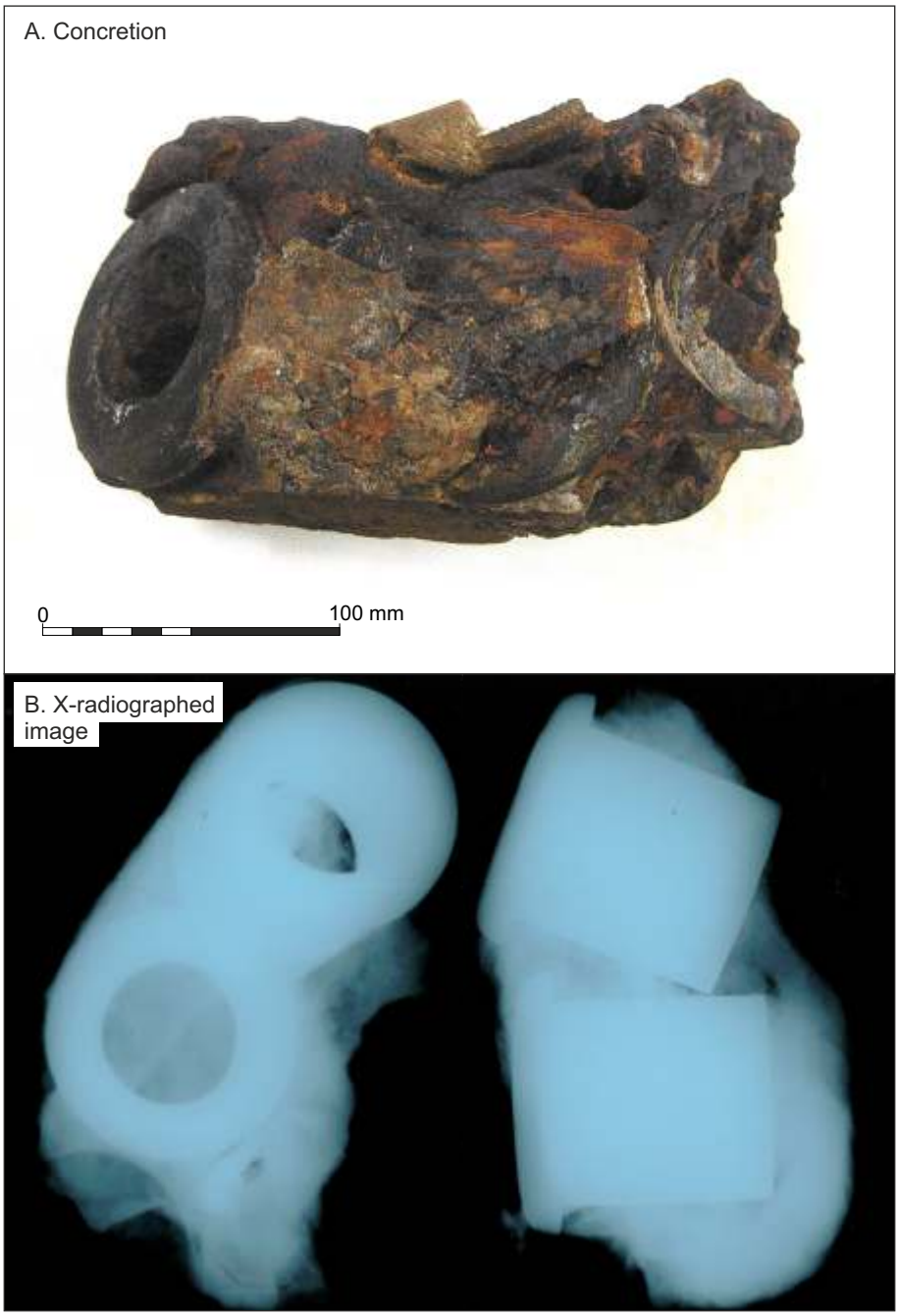

Plate 11: Concretion sample, **WA8003**

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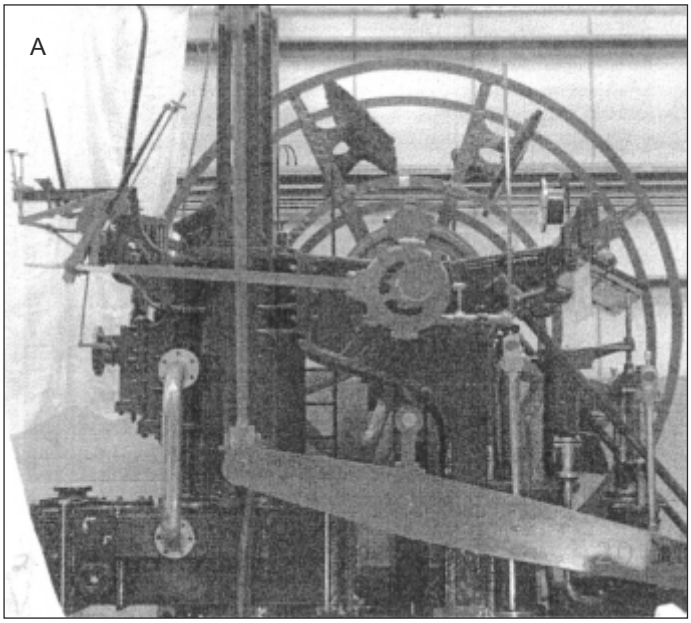
Scale:	See scale bar	Illustrator:	KJF
Path:	W:\Projects\London Gateway\LG 2015\88631\Graphics_Office\Rep figs\P-c Assess\2015_03_13		

Plate 12: Wooden model of *Admiral*, c. 1869. Courtesy of National Maritime Museum, Greenwich



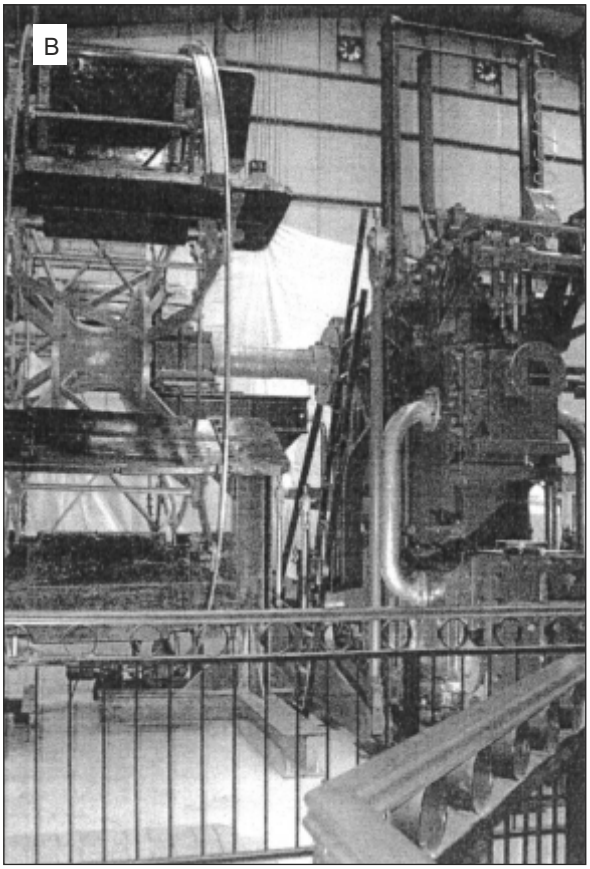


Plate 13: Port engine of *Old Trafford* paddle steamer, from starboard side (A) and aft (B).
Courtesy of George Dickinson

Date:	13/05/2015	Revision Number:	0
Scale:	NTS	Illustrator:	KJF
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