



CITY OF ADELAIDE

Laser Scan Survey

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PROJECT SUMMARY SHEET

<i>Client</i>	SCOTTISH MARITIME MUSEUM
<i>National Grid Reference</i>	NS 313388
<i>Address</i>	HARBOUR STREET, IRVINE
<i>Parish</i>	IRVINE
<i>Council</i>	NORTH AYRSHIRE
<i>Planning Application No</i>	N/A
<i>NMRS No</i>	NS33NW 63.04
<i>Oasis No</i>	HEADLAND1-63358
<i>SMR No</i>	WOSASPIN 42214
<i>HB/SAM No</i>	35451
<i>Listing Category</i>	A
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<i>Fieldwork</i>	MAGNAR DALLAND JÜRGEN VAN WESSEL
<i>Specialists</i>	N/A
<i>Schedule</i>	
<i>Fieldwork</i>	JUNE – JULY 2009
<i>Report</i>	AUGUST 2009

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Date:.....

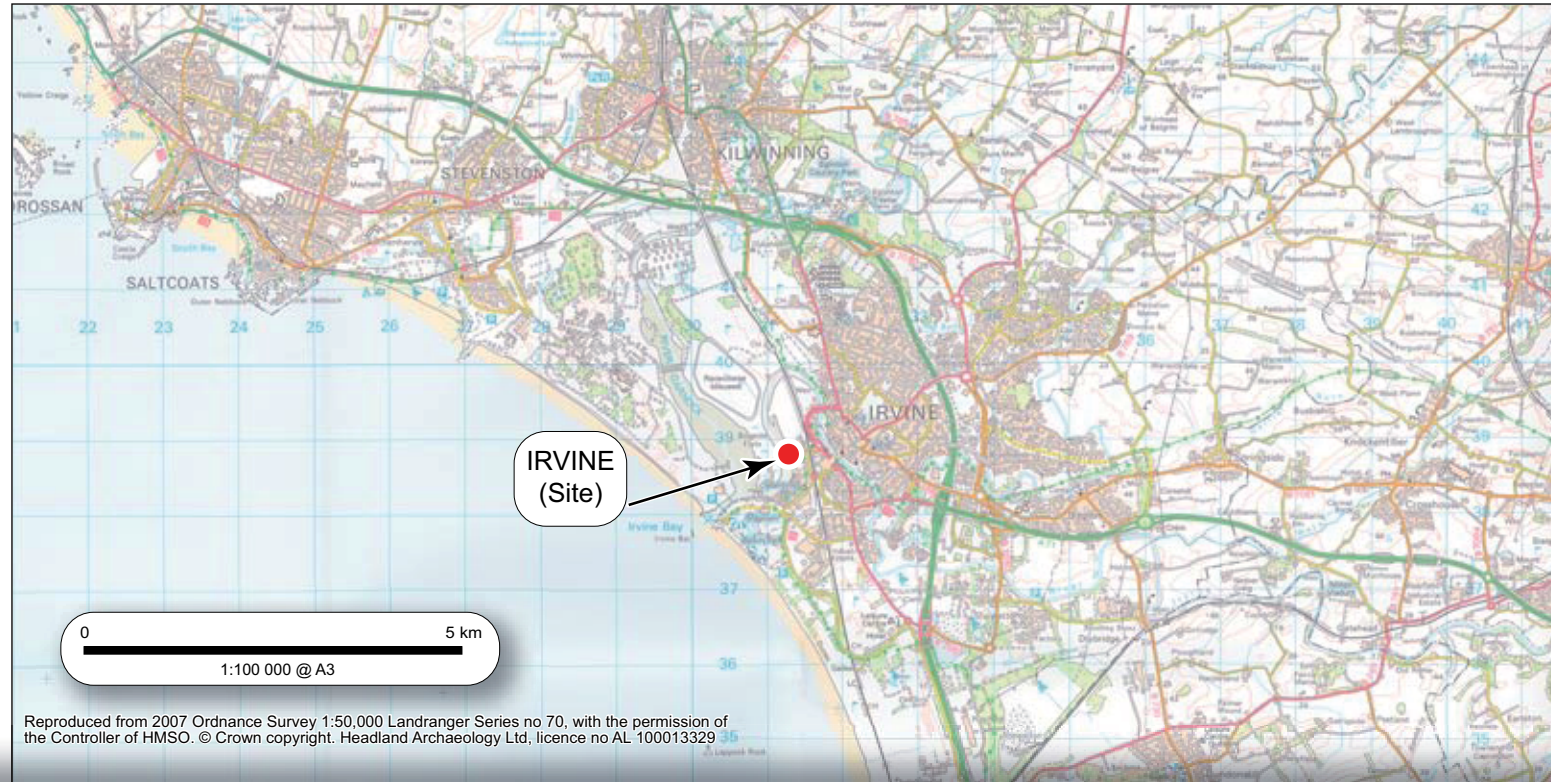


This document presents the results of a laser scan survey of the emigrant clipper ship City of Adelaide (RNVR vessel Carrick), currently located in Irvine and designated as a Category A Listed structure. Due to the Listed status of the vessel and her historical and archaeological significance a Deconstruction Plan was submitted by the Scottish Maritime Museum to North Ayrshire Council and Historic Scotland for approval prior to the implementation of the plan. A Method Statement was prepared to accommodate a full survey of the vessel prior to the implementation of the Plan for controlled deconstruction or removal of the vessel from the current site. The survey succeeded in providing a full and accurate 3D archaeological record of the vessel in addition to the provision of data to help in the development of engineering strategies.





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Illus 1
Site location

CITY OF ADELAIDE

Laser Scan Survey

by Jürgen van Wessel
with contributions by Dan Atkinson and Magnar Dalland

1. INTRODUCTION

This document presents the results of a laser scan survey of the emigrant clipper ship City of Adelaide (RNVR vessel Carrick), currently located in Irvine and designated as a Category A Listed structure (Illus 2). Due to the Listed status of the vessel and her historical and archaeological significance, a Deconstruction Plan was prepared in line with the recommendations presented in the National Historic Ships guidance document *Deconstructing Historic Vessels* (Kentley *et al*, 2007). The Plan was submitted to North Ayrshire Council Planning Department and Historic Scotland for approval, prior to the implementation of the plan. A Method Statement was prepared to accommodate a full survey of the vessel prior to the implementation of plans for controlled deconstruction prepared by the Scottish Maritime Museum (hereafter the 'client'), or plans to remove the vessel from the current site.

2. OBJECTIVES

The objectives of the survey were to:

- provide an accurate 3-dimensional archaeological record prior to the implementation of any works affecting the structure or fabric of the vessel.
- provide an accurate 3-dimensional record to inform any proposed engineering strategy prior to the implementation of any works affecting the structure or fabric of the vessel, proposed deconstruction (sectioning), or removal from the current slip.
- provide accurate data for any proposed archaeological interpretation and hull analysis, the production of models, or the construction of a replica vessel at any point in the future.

3. METHOD

3.1 Photographic survey

A complete photographic survey of both the interior and the exterior of the vessel was made using a digital SLR attached to the scanner unit and equipped with a 'fisheye' lens. The photos permit a complete 360° panoramic view taken from each survey station. During post-processing these images were mapped onto the point clouds produced by the laser scanner to create a 3-D colour image of the vessel and its immediate environment.

3.2 Metric survey

A network of reference points was established using a Leica EDM. These points were all surveyed within the same local grid and were used as base stations for surveying

the location of markers placed on the vessel. The position of these survey markers was used to accurately join the individual parts of the main laser survey.

3.3 Laser scanning

The main data capture was performed using a Leica HDS6100 phase-based laser scanner, which produces a 360° scan of all surfaces within a range of up to 70 m from the scanner. Each measured point returns a 3D coordinate and an intensity value which depends upon distance, and on the nature of the surface it is reflected from (producing the intense circles around scan stations in some cases). This gives the point cloud some 'texture' and allows recognition of features without relying on photo mapping (see above). The scans were processed using Leica Cyclone 6.0 software applications that allowed accurate registering (or stitching) of the scans.

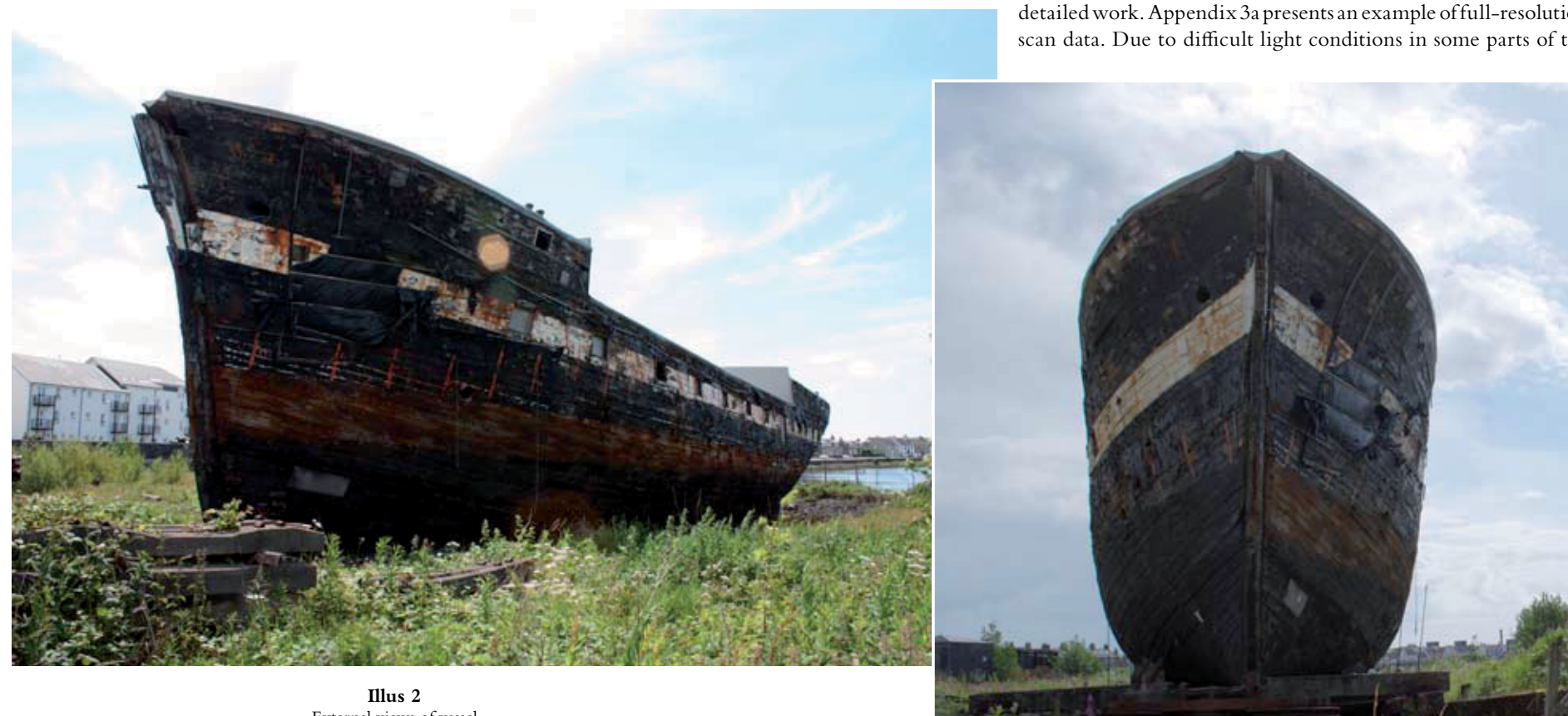
3.3.1 Accuracy and resolution

The scans were carried out with the scanner set on 'High' which equals a point spacing of 6.3 mm at a distance of 10 m from the scanner. Due to the close proximity

of scanning positions the effective point density will be much higher as the same surfaces are scanned several times. A total of 72 scans were carried out during the survey producing some 3.5 billion points and generating over 13Gb of raw data. Each scan produced a point-cloud to an accuracy of between 2 and 5 mm for individual points. However the high number of overlapping points means that this accuracy can be improved significantly. As scanner performance decreases with distance, some areas at the very top of the ship's external elevations may be less detailed than elsewhere, although the accuracy of those points will still be within the above tolerances.

3.3.2 Data processing

The large amount of data meant that the processing power of normal PCs would not be able to deal with the full scans in their entirety. To get around this problem only a sub-sample of the original data was used when stitching individual scans to create an overall 3-D model of the ship. Typically less than 7 % of the original data or approximately 1 in 16 points were used. These reduced data sets were used to produce the models presented with this report – further detail can be provided should the need arise in future. This is standard scanning practice, allowing a quick assessment of the results, and providing a framework on which to base more detailed work. Appendix 3a presents an example of full-resolution scan data. Due to difficult light conditions in some parts of the



Illus 2
External views of vessel

vessel (for example, sunlight shining through portholes into an otherwise dark space) some of the photographs were poorly exposed or focussed. This combined with some inaccuracies in the process of registering the photos onto the point clouds means that views with photographic overlays are best used for visualisation – measurements should rather be taken from the intensity-mapped views.

At this stage, it is common to find aesthetic ‘distractions’ in the results (for example, circles around scan stations where point density is very high and ‘ghosts’ of objects moving in the way of the scan) – these are easily repaired during subsequent, more specific work.

4. RESULTS

4.1 The laser scan survey

The main result of this survey comprises a stitched and coloured 3D point cloud of the entire vessel. This cloud should be seen as a high quality data source – it will provide any information necessary for measuring, illustrating and modelling of the ship as required in future. Such manipulation is possible using specialist software that is designed to handle the substantial volume of data.

The results of this survey are therefore presented as a number of static and interactive views of the processed cloud. It must be emphasised that these are merely illustrative. Although they are metrically accurate, they are intended only to give an overview of the data captured, and as an aid to visualising the ship.

4.1.1 Static views

These include two external elevations and one interior elevation (Appendix 1), a series of deck plans (Appendix 2), and some perspective and detail views (Appendix 3) show the scope of the scan. Although information has been captured about the slipway and immediate surroundings, this has been removed for the purposes of this report. Appendices 4 and 5 detail the areas around the possible cutting zones.

4.1.2 Interactive views

In order to provide a sense of the richness of the gathered data, a series of interactive panoramas have been provided on the DVD included with the report. There are three different views for each scan position; a Quicktime VR interactive panorama (best for visualisation), and two measurable ‘TruViews’, one mapped with photographs, the other with point intensity. Please refer to the note at the end of 3.3.2 regarding measurability. All three views can be panned, zoomed, annotated and printed, allowing the most convenient access to the point-cloud data. Details of the separate views can be found on the index page of the DVD.

4.2 Archaeological comment

Although the purpose of the survey omits an extensive archaeological discussion the results of the survey in relation to the archaeological aspects of potential deconstruction or removal of the vessel provide interesting observations. The laser scan survey has enabled the description of the vessel with great accuracy and extraordinary detail (Illus 3). Perhaps of note is the apparent lack of distortion in the hull structure illustrated by the survey results – testimony indeed to composite construction. Further notable examples of the level of detail include the construction attributes; the presence of singular detail such as the location of mast partners and bracing in the deck structure; the location of the mizzen mast step on the keelson; and the phases of cementation in the bilges throughout the course of the vessel's career. Subsequent removal of the cement has allowed for a priceless insight into the construction of the lower hull. Consequent interrogation of the scan data will allow for the possibility for accurate archaeological interpretation and analysis. Subsequent accurate drawn records could also be obtained.



Illus 3
Internal views of vessel

5. PRODUCT APPLICATIONS

Archaeological Record

The point cloud forms a highly detailed record of the ship in its current state. This is essential in the event of deconstruction, vandalism or other detrimental actions.

Engineering aid

The point cloud can be used to produce line-drawings and ortho-photos of areas of interest, for example to inform engineering proposals and to produce more comprehensive reports of the ship's condition.

Digital 3D products

With a suitable time investment, the point cloud can be transcribed as a digital 3D model. This will allow the production of a number of multimedia products – fly-around videos, visualisations for vessel reconstructions within architects designs, or animations of the possible deconstruction process, for example. Depending on the desired purpose, such models could be created to varying degrees of detail – a simple model for display on a museum website, through to film-quality renderings of the ship battling the open sea.

Physical products

Through the crafts of model-making or 3D printing, it is possible to use the scan data to produce physical representations of the ship at any scale. Again, this can be used in museum displays, merchandising or to promote re-housing bids as part of a larger diorama.

6. REFERENCES

Kentley E., Stephens S., Heighton M. (2007) *Understanding Historic Vessels Volume 2, Deconstructing Historic Vessels*. National Historic Ships

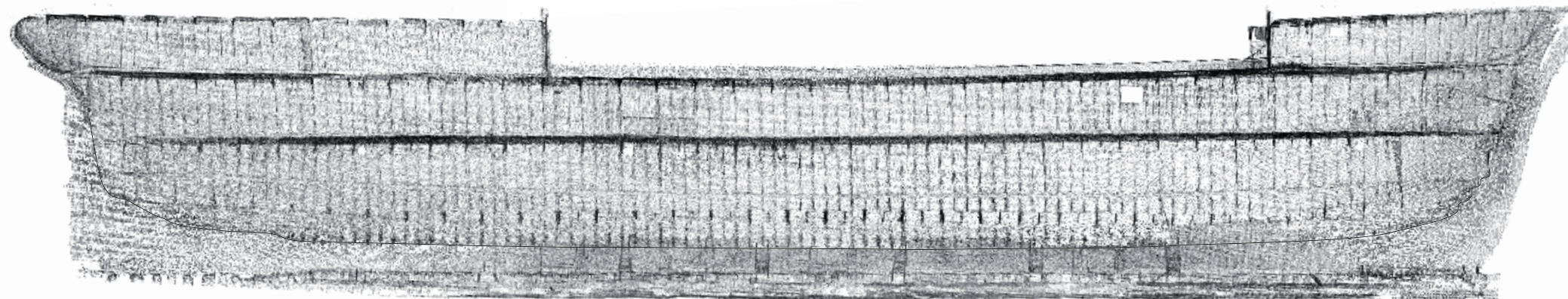
APPENDIX 1; ELEVATIONS



Illus A 1a
Starboard side elevation



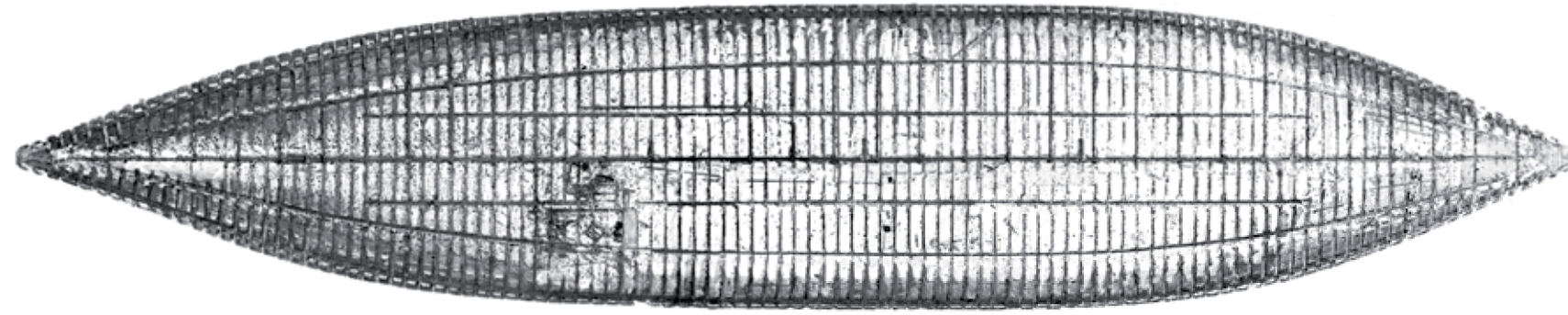
Illus A 1b
Port side elevation



Illus A 1c
Port side internal elevation

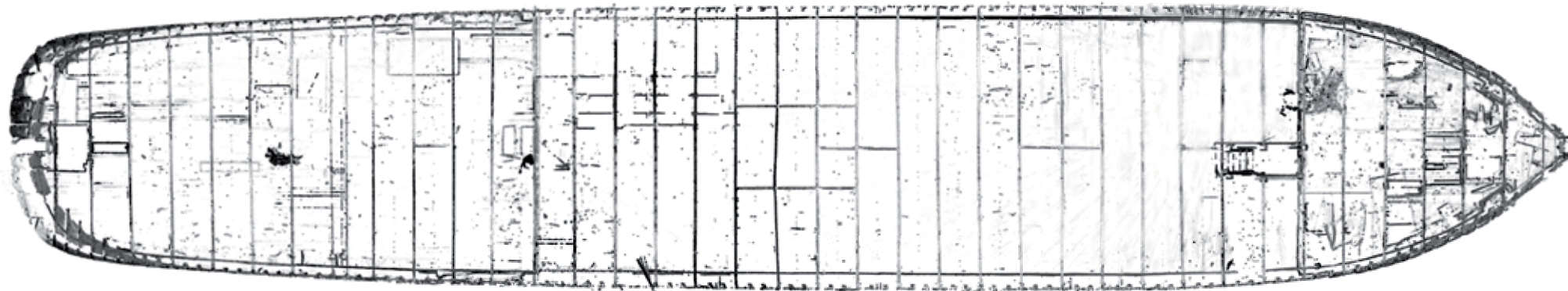
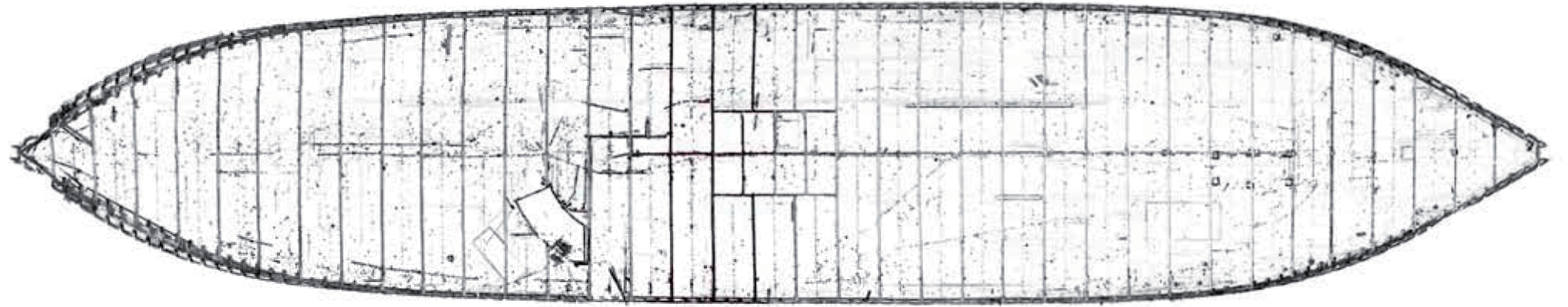
0 10 m
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APPENDIX 2; PLANS OF HOLD AND DECKS



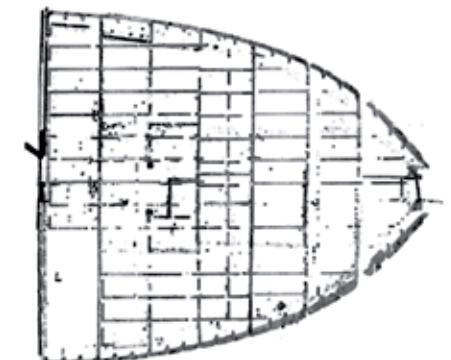
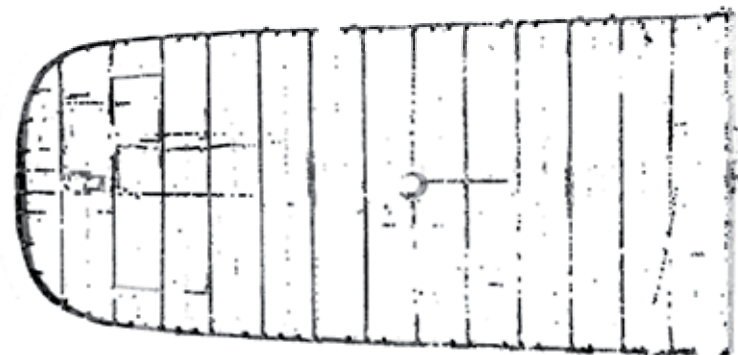
Illus A 2a
Hold, up to second stringer

Illus A 2b
Main Deck



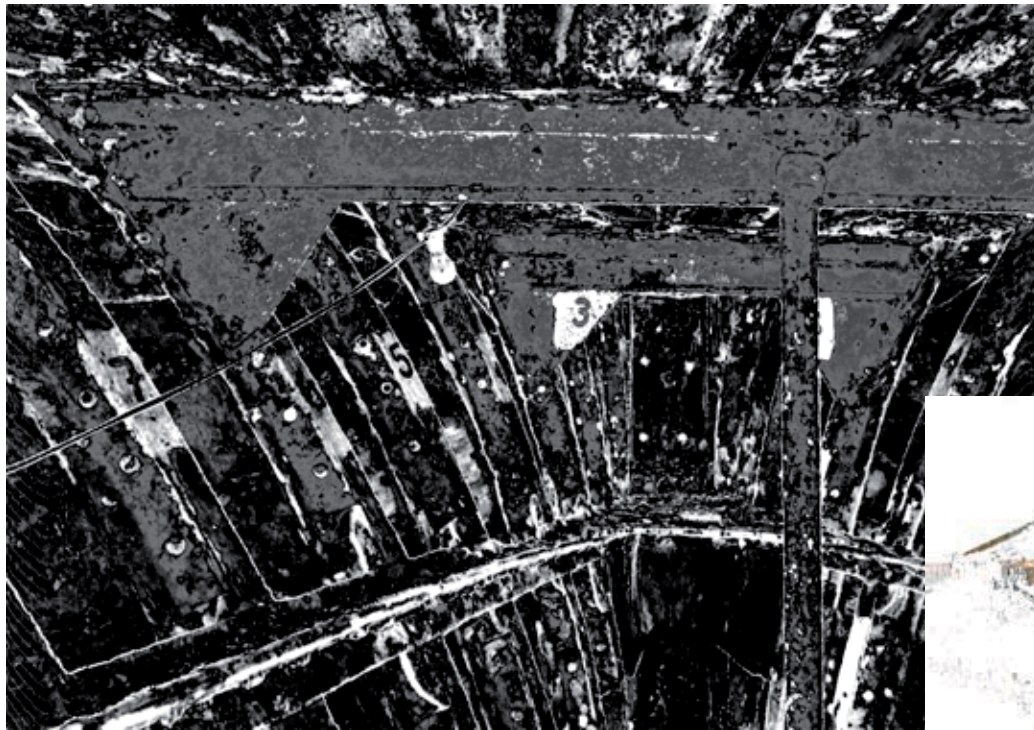
Illus A 2c
Upper Decks

Illus A 2d
Roof



0 10 m
1:200 @ A3

APPENDIX 3; ASSORTED VIEWS



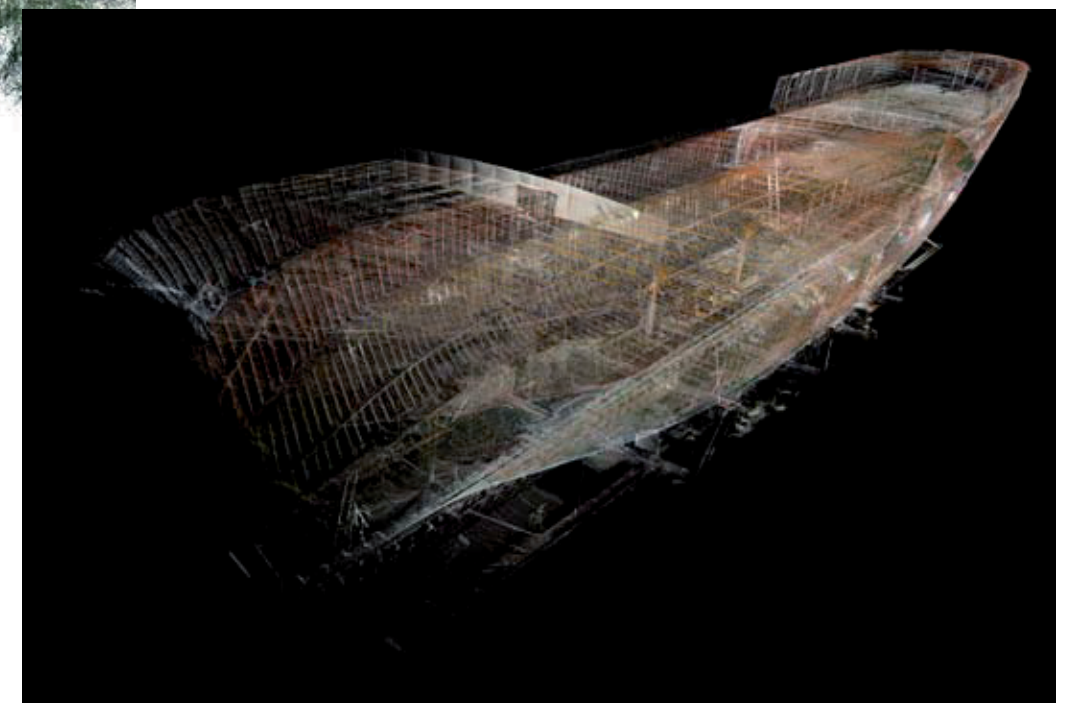
Illus A 3a

Example of detail captured by the laser scan. Looking aft at the stern-post in the hold a



Illus A 3b

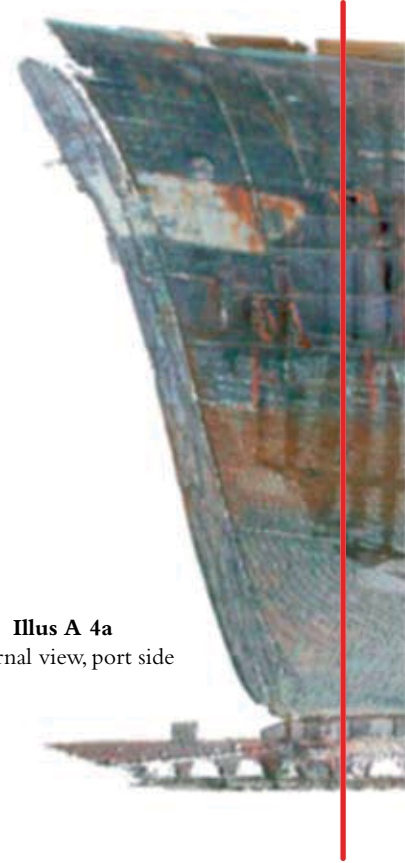
The scan has also captured much of the immediate surroundings of the ship



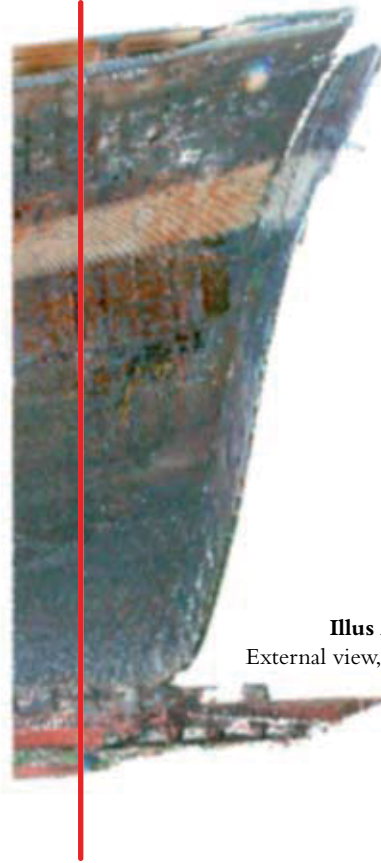
Illus A 3c

A cutaway view showing some of the structure of the ship

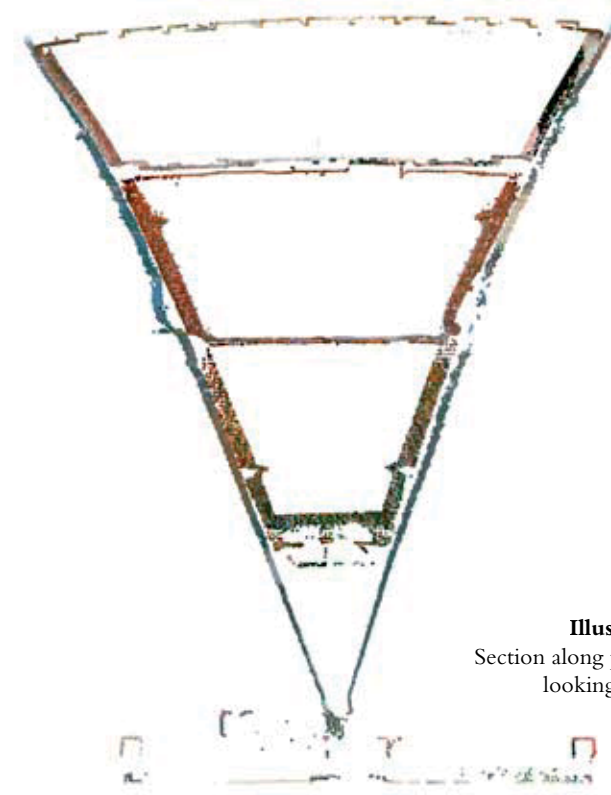
APPENDIX 4; DETAILS OF THE POSSIBLE FORWARD CUT
AREA



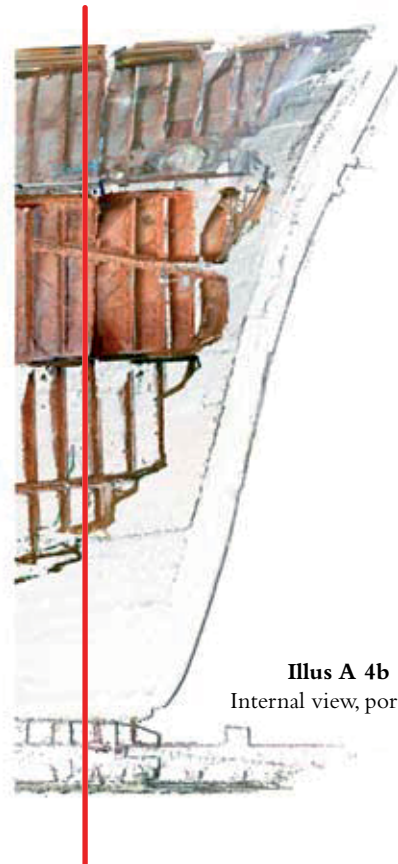
Illus A 4a
External view, port side



Illus A 4c
External view, starboard side



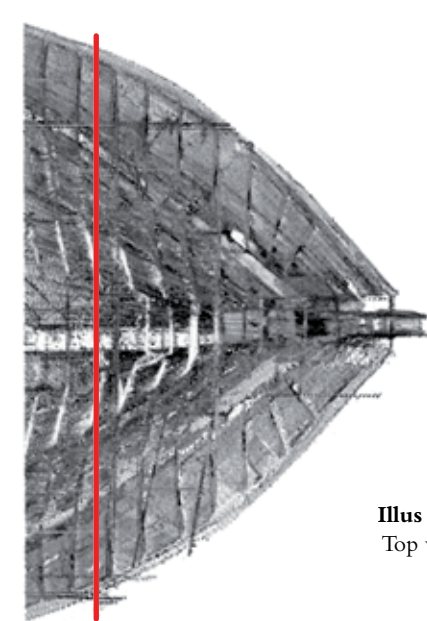
Illus A 4e
Section along possible cut line,
looking forward




Illus A 4b
Internal view, port side



Illus A 4d
Internal view, starboard side

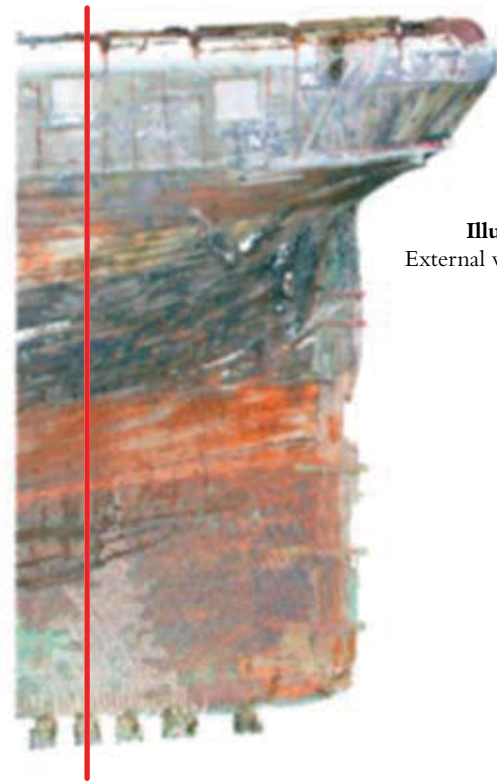


Illus A 4f
Top view

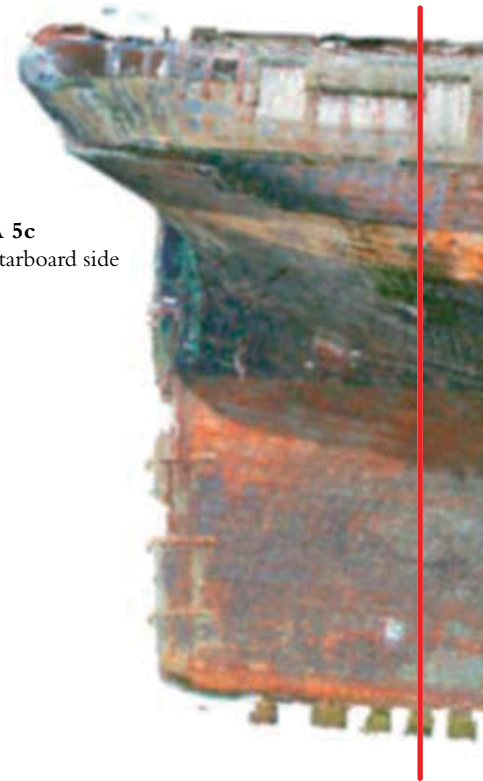
 possible cut line

0 5
1:100 @ A4

APPENDIX 5; DETAILS OF THE POSSIBLE AFT CUT AREA



Illus A 5a
External view, port side



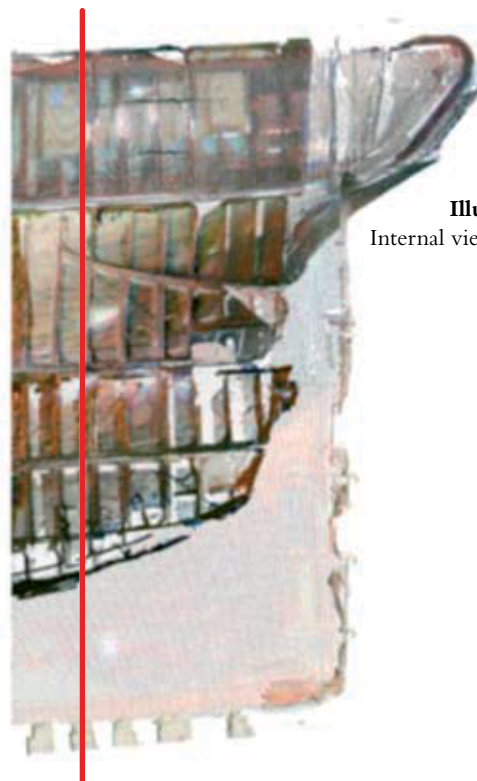
Illus A 5c
External view, starboard side



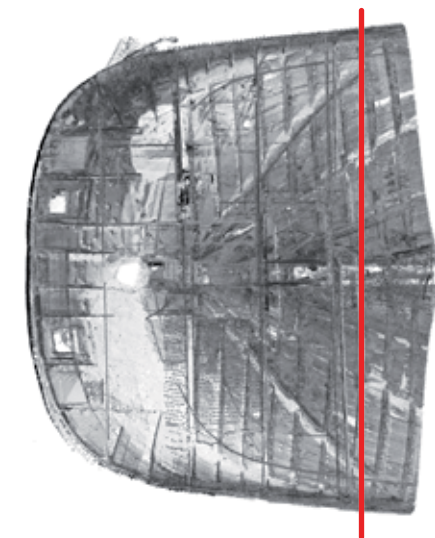
Illus A 5e
Section along possible cut line,
looking forward



Illus A 5b
Internal view, port side



Illus A 5d
Internal view, starboard side



Illus A 5f
Top view

