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The Australian Historic Shipwreck Preservation Project 2012: First report on the background, reburial and *in-situ* preservation at the *Clarence* (1841–50)

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Introduction

The Australian Historic Shipwreck Preservation Project (AHSPP) is a collaborative national project funded by an Australian Research Council Linkage Grant, which began in early 2012. With ten state, territory and federal Partner Organisations working with three universities, this is the largest inter-institutional maritime archaeological project run so far in Australia.

In accordance with the 2001 UNESCO *Convention on the Protection of the Underwater Cultural Heritage*, the project has investigated a threatened and demonstrably deteriorating historic shipwreck *Clarence* (1841–50) located in the Victorian jurisdiction. The maritime archaeology staff at Heritage Victoria was instrumental in hosting the project. The project aims to address national research priorities while also providing a multi-year study of the long-term efficacy of reburial and stabilisation of assemblages and heavily impacted structural elements. For example it is calculated that *c.* 30% of the recorded exposed frames and 30 cm of marine sediment has been lost as a result of anchor damage and scouring since surveys were carried out in the mid-1980s (Harvey 1986; 1989). The three-year project aims to systematically test *in-situ* preservation methodologies and provide a critique of practical protocols for the assessment and conservation of 'at-risk' historic shipwrecks.

The *Clarence* project has provided much needed test excavation, recording and *in situ* reburial and stabilisation as well as training and development opportunities to early career professionals, students and volunteers. The logistics of planning such an exercise (hosting some 65 participants on site in Year 1 alone) are considerable and complex. As in the Queensland jurisdiction, this workplace required ADAS 1 and 2 certification with tethered SCUBA and Surface Supplied Breathing Apparatus (SSBA) for survey, recording, test-excavation, coring, reburial and stabilisation with very large quantities of infill, sand-bags and shade cloth. Scientific (commercial) divers with Supervisor status (James Parkinson and Peter Veth) were also required to oversee safety, air supply, communications and compliance.

This paper outlines the planning, preparation and execution of the first stage of the *Clarence* reburial and stabilisation project primarily conducted in April and May 2012. It explores the test-excavation strategy, history of shipbuilding and preliminary archaeological and conservation results from this primary field season. The project web site at <www.ahspp.org.au> hosts many resources including previous reports, image galleries, current archaeological and conservation outcomes, plans, team profiles and media outputs. It is updated regularly and serves as a research tool.

Project background

Following some two years of discussion amongst the nation's maritime archaeology practitioners and academic staff then at the Australian National University and Monash University, the ARC awarded a significant grant to the AHSPP, with Winthrop Professor Peter Veth (now at the University of Western Australia) as the Lead Chief Investigator.

As part of the administration of the Historic Shipwrecks Program, the Commonwealth Government sought consensus from Historic Shipwrecks Act Delegates and practitioners for a national collaborative project that would meet a range of objectives. The project needed to address a national issue faced by all Delegates, provide a research outcome, be relevant to the future ratification of the UNESCO *Convention on the Protection of the Underwater Cultural Heritage* (CPUCH), and provide training and

professional development opportunities to practitioners and students in Australia and the Asia-Pacific region.

Following the submission of project ideas and voting by practitioners, the decision was made to pursue an *in-situ* preservation project on a submerged site that would address the *in-situ* preservation and reburial of shipwrecks subject to accelerated degradation. It was recognised that this research would be able to contribute to the innovative research on *in-situ* preservation being undertaken in Europe (Nyström-Godfrey *et al.* 2011) and Western Australia (Richards 2012). The next most highly-ranked project was for studies of Australian shipbuilding.

The project groundwork was facilitated by Andrew Viduka of the Heritage Division of the Commonwealth Department of Environment, Water, Heritage and the Arts (later the Department of Sustainability, Environment, Water, Population and Communities [SEWPaC]; and, now the Department of the Environment, October 2013) (Viduka 2012). The *Clarence*, located in Port Phillip Bay, was selected as the case study as it also met a number of other aims of the (now defunct) National Maritime Heritage Strategy and the Historic Shipwrecks National Research Plan (HSNRP) (Edmonds *et al.* 1995). Follow-up *in situ* reburial work will now also be carried out on the *James Matthews* (1841) lying off Woodman Point in Western Australia during October 2013, and ongoing, as an additional component of the AHSPP, thereby providing a comparative study in a different setting.

Clarence was an early Australian-built timber coastal trader, and had been investigated, monitored and managed since it was declared a historic shipwreck protected zone in 1985. Its elevated status as a protected zone site was due to its significance and values and ongoing degradation and damage from anchors due to illegal anglers, as well as scouring caused by the strong currents generated from The Rip at Port Phillip Heads.

Clarence met multiple criteria that ensured its selection for this project, including:

- Exposure to continuing human agency and natural environmental impacts;
- Its accessibility in Port Phillip Bay lying near the local boat ramp at St Leonards;
- Previous historical research, monitoring and excavation (Gesner 1985; Harvey 1986, 1989; Coroneos 1991a);
- It is an example of early colonial shipbuilding in a frontier situation;
- It was one of the first Australian-built vessels to be extensively surveyed; and
- It is located in a jurisdiction with capacity to undertake the fieldwork.

The works programme on the site was supported by the jurisdiction Delegate, then Heritage Victoria (HV) Executive Director Mr Jim Gard'ner. Heritage Victoria had field capacity including the availability of its vessel *Trim*, experienced professional staff, experienced and active volunteers, and allied field equipment.

It was considered essential to assess a proportion of the fabric and assemblages that would be reburied via test-excavation to have quality contextual data for conservation experiments including sediment core data, ferruginous and timber coupons, and samples of structure covered by matrix. The logic of this strategy was sound given the significant discovery that the ballast of *Clarence* was kaolin (pipe clay)—something that had not been documented during previous survey or excavations. To rebury and stabilise a site and *not* know this significant feature was present within the hull would be unsustainable from both an archaeological and conservation perspective. The overall aim was to recover and record a sample of artefacts using photographic, 3D and X-ray imaging, record the exposed structure, and to then return these artefacts on to the site to be conserved *in situ* via several stages of reburial and stabilisation.

The artefact recording and conservation all took place on site. Diving and recording work was conducted from a barge platform placed adjacent to the site for the duration of the fieldwork and post-processing of data occurred at the field camp at Portarlington.

Australian colonial shipbuilding—historic background and shipbuilding on Williams River

A sub-theme of the current project builds on the long-standing interest of maritime archaeologists in the origins and development of colonial-period Australian shipbuilding (Bullers 2006, 2007; Coroneos 1991a, 1991b; Harvey 1989; Jeffery 1989, 1992; Nash 2003, 2004a, 2004b; O'Reilly 2006; Orme 1988; Richards 2006; Tracey 2007, 2009).

During the late 18th century and the first half of the 19th century while many larger vessels over 100 tons regularly arrived in the Australian colonies from overseas, and some were purchased by the colonial merchants, very few smaller vessels arrived. The Australian colonies were simply too remote for most vessels under 100 tons to make the long voyage from Britain, or even India. As a result there was a growing need for small vessels to meet the colonists' needs for transport and trade between the newly established colonies. From the earliest days of European settlement traditional British techniques of wooden boat and shipbuilding were brought to the Australian colonies and have been presumed to be the primary source of shipbuilding knowledge (Bach 1976; Nash 2003; Orme 1988). Boat and shipbuilding was vitally important to the new Australian colonies and has been described as 'the first important manufacturing industry to develop' (Hudspeth & Scripps 1990: 55) and 'a significant industrial activity since the early colonial period' (Alexander 2005: 331).

Initially boat and shipbuilding in the Australian colonies was a restricted activity under the terms of an order imposed on the original settlement at Port Jackson (Sydney) by Governor Hunter in 1797. As a result few vessels were built before 1820 and significant shipbuilding activity in the Australian colonies did not arise until the 1820s. While large numbers of vessels were built during the 1830s and 1840s, according to Bullers (2006: 62) *Clarence*

is one of only 17 vessels that were built in Australia before 1850 that have been located.

Archaeological questions relevant to construction of *Clarence*

Nautical archaeology and the archaeological study of ships and shipbuilding of the northern European tradition of wooden ship and boat building has been the subject of extensive archaeological research in recent decades (Beltrame 2003; Flatman 2003, 2009; Gould 2000; Greenhill 1976; Hocker & Ward, 2004; McKee, 1983; Nowacki & Valleriani 2001). This research suggests that over generations ship and boat builders in northern Europe, specifically in Britain, developed detailed knowledge and understanding about shipbuilding including the most suitable timbers for particular tasks: oak for frames, beech for decks, ash for oars, fir for masts and spars and so forth. Until the nineteenth century most of this shipbuilding knowledge was passed down verbally either from father to son or through the apprenticeship system (MacGregor 1997).

Significant research questions about the colonial settlement of countries like Australia, and earlier the Americas, revolve around the transfer of technological knowledge and technology to a colonial setting as well as the associated issue of adaptation to the local environment (Connah 1988; McAllister *et al.* 2006; Pearson 1996; Pickard 2010).

On the one hand, colonists brought with them significant aspects of their parent culture, which can be seen in terms of cultural continuity, but researchers have debated the speed and extent of adaptation to meet the distinctly different environments that the colonists faced in the new lands (Bolton 2008; O'Reilly 2006). In Australia previous research has clearly demonstrated that the wreck sites of Australian-built vessels hold significant archaeological potential to answer questions about adaptation by the early Australian colonists to the unfamiliar Australian environment (Bullers 2006; Nash 2004a; O'Reilly 2006; Orme 1988). Research on Australian-built vessels to date has often focused on use-life or what Coroneos (1991b) termed the short working lives of early Australian wooden sailing vessels, which he successfully argued was not due to poor construction but the hazards posed by the Victorian coast and ports (Richards 2006: 49). The majority of Australian-built vessels were small coastal traders that were often unregistered and therefore largely unrecorded (Broxham 1996; Gillespie 1994; Graeme-Evans & Wilson 1996; Kerr 1974).

One of the fundamental archaeological research questions that arises is 'How did Australian ship-builders adapt their technical abilities to suit their new environment and the timber that was available to them?' (Bullers 2007: 17). According to Bullers (2006: 62) a total of 2 786 Australian-built vessels are recorded as having been wrecked on the Australian coastline and the available databases indicate that only 271 vessels have been located to date (approximately 10% of the total number wrecked). Only 14 Australian-built vessels (about 0.5%) have been properly surveyed and/or excavated with the results published.

Clarence can be seen as representative of the majority of Australian-built vessels, which were small coastal traders under 100 tons. *Clarence* (Victorian Heritage Register S127) was considered ideal for this study for a number of reasons, as have been noted above. Furthermore, the site can inform us about aspects of cultural continuity in the transplanting of traditional techniques of shipbuilding from overseas into the Australian colonies by addressing questions such as how did the colonists adapt foreign, primarily British, traditional shipbuilding methods to suit new environments and different timber types?

Who built *Clarence*?

In his report on the historical research conducted on *Clarence*, Gesner (1985: 13) was unsure as to who built the vessel and wrote that

> …there is no conclusive evidence which will answer by whom she was built, although it has been suggested by an authoritative source that she was most probably built by, or under the direction of, William Lowe at his Deptford shipyard.

Tracey (2009: 35) has suggested that

> …wooden shipbuilding on the coast of New South Wales was often a short-term industrial activity where the shipwright selected a specific area in which to construct a single vessel.

In some cases this was undoubtedly true but in others a shipwright would become firmly established in a single location and he would build vessels over a long period of time. Both models for shipbuilding are known to have existed in the Williams River area during the 1830s and early 1840s. From the available records we know that at least two, and probably three, shipbuilders built vessels near the head of navigation on the Williams River near Clarence Town around the time *Clarence* was built in 1841—William Lowe, James Marshall and John Cameron. Each of these three individuals had different backgrounds, training and levels of experience in the shipwright trade. From recent research we know that at least 27 vessels were built on the Williams River between 1831 and 1843 (Australian National Shipwreck Database [ANSD] shipwreck ID numbers 340 & 2206; Register of British Ships, Port of Sydney, 1834–1842; *Sydney Monitor,* 7 March 1835: 1; *The Australian* 13 March 1835: 2).

Interestingly Lowe, Marshall and Cameron all had the capacity to build *Clarence* and at this stage any one of them may have done so though Cameron is considered to be the least likely. The question of who did build *Clarence,* of course, may have important consequences in terms of the quality of building. Lowe, for example, would appear to be a highly trained, well-experienced shipwright, capable of building a range of vessel types in different sizes, whose career lasted more than 30 years. Marshall also appears to be a competent shipwright who

built vessels for at least 15 years, but when building on his own he restricted his shipbuilding to small wooden sailing vessels under 100 tons (like *Clarence*). We know so little about John Cameron, who may be an example of Tracey's single-vessel-in-the-bush style of shipwright, that it is hard to judge his shipwright skills although it is possible that Cameron had learnt to build vessels by working for either or both Lowe and Marshall.

Further archaeological analysis of the hull timbers, both from the 1980s and the most recent excavations will assist with a deeper understanding of the quality of the construction of *Clarence* and provide greater evidence to determine who built the vessel.

Project planning and implementation for the *Clarence* project

The preparation for the field component of the project commenced well before the ARC announced that the AHSPP's application was successful. Additionally, just one of the authors (Veth) logged some 1 200 hours, hosted 65 meetings and received over 2 000 emails for action between the ARC being awarded and the budget becoming available. Some investigators began early planning for the project in order to get critical aspects locked in for the proposed April 2012 fieldwork start, such as commercial diving support, accommodation and equipment. Meanwhile administrative requirements continued to be pursued, including the advertising and appointment of the Project Manager (Philippou), who started on the project once the grant was finally 'live' in February 2012. It is normal for Linkage Grant budgets to have a long lead time and especially so with 14 contractual parties. Despite very significant forward planning the time-lag for the novation of the grant from the Australian National University (ANU) to the University of Western Australia (UWA) left less than two months to actualise fieldwork planning, including: order and receipt of excavation, recording, conservation and safety equipment; confirmation of tug, jack-up barge platform, dive supply, conservation and storage container modules; identification and selection of field personnel including inter-state and international participants; determination of final recording protocols; and finalisation of accommodation. This all had to be ready for the 16 April start date, which was mooted by one of the authors (Staniforth) as the ideal diving window.

In mid-March a group of 12 investigators involved with the AHSPP gathered in Melbourne for a data management workshop. The workshop aimed to introduce the spatial recording program for the project and brief the participants on principles for artefact recording, hierarchy and nomination of responsibilities for data management, and to finalise the pre-disturbance, sampling and excavation strategies. The workshop participants also developed the final draft of the field research design and methodology for inclusion in the Heritage Victoria (HV) permit and consent applications. This workshop also focused on different approaches to test-excavation consistent with earlier excavations at the stern and bow sections and how to retrieve the highest quality data on remaining cultural assemblages, and structural and shipbuilding attributes. Concerns about the instability of the marine sediments and differently configured test-pits and trenches and how to stabilize these during excavation—given the tidal regime—were uppermost during these discussions. The final plan was to trench between the previous test-pits on the starboard side from the keelson to outer frames; an approach which proved effective given the combination of very loose unconsolidated marine sediments overlaying an extremely well consolidated strata of kaolin.

Figure 1. Jack-up Platform Barge 1—the AHSPP's diving platform (Photo: A. Viduka).

Preparation and logistics of the jack-up barge diving platform

Discussions regarding logistics, particularly plant mobilisation, were held between Professional Diving Services (PDS) and members of the project team in development of the ARC application and subsequent to the awarding of the grant. The team at PDS including James Parkinson—a maritime archaeologist and commercial diving supervisor—drafted a plan for much of the plant and logistical requirements for the diving component of the project, and their expertise in marine project management contributed significantly towards the required Fieldwork Diving and Safety Plans; Health, Safety and Environmental compliances; and, with Peter Veth developed the framework required for the UWA Boating, Diving and Safety Committee. In essence duplicate records of all diver competencies, diver support systems, safety protocols, diving medical clearances, and dives logged with repeat values were required both by the PDS workplace and the Administering Institution.

The project called for a number of items to be manufactured to meet the 'on-site recording and *in-situ* preservation' aims including an X-ray enclosure and its accommodation—a modified shipping container. Professor Dudley Creagh of the University of Canberra worked closely with the engineering team at the ANU to design and build a lead-lined portable enclosure that would house the X-ray and 3D imaging equipment supplied gratis by the Australian Federal Police (AFP).

Figure 2. X-ray and finds processing container (Photo: A. Viduka).

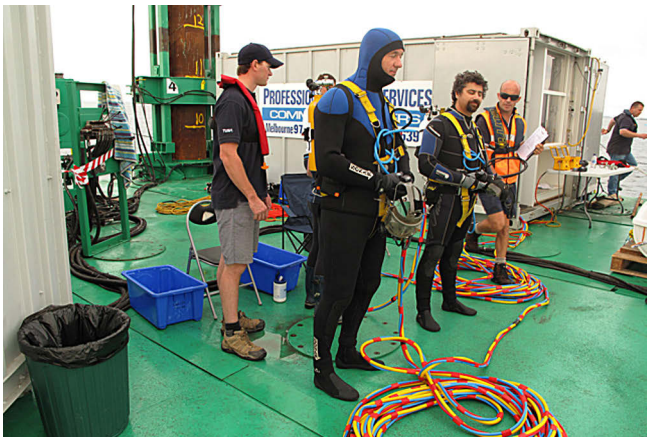

Figure 3. SSBA divers Mike Nash and Amer Khan preparing to dive (Photo: A. Viduka/AHSPP).

The X-ray unit required an insulated 20-ft shipping container with an internal 2-mm steel partition to provide an X-ray system compartment, climate control and emergency exits to ensure compliance with strict regulations relating to use of X-ray equipment. Furthermore, details of the enclosure were needed to enable a specific risk assessment to be developed for the permit to operate the unit. Creagh created the Occupational Health and Safety Manual for the X-ray Unit, to be used under the AFP's Operator license.

The diving platform, an 18 m x 12 m jack-up barge (Fig. 1), was fitted out early in April in preparation for mobilisation in advance of the 16 April start date. The barge was capable of housing three shipping containers (the X-ray and finds processing container (Fig. 2), a storage container and the dive control room), as well as sundry plant and equipment including portable toilets, air compressors, a large water pump and conservation equipment. Over 600 sand-bags on pallets were placed on the barge prior to mobilisation. All plant and equipment needed to be secured prior to the barge being towed out to site.

Equipment was mobilised from the PDS depot in south eastern Melbourne and Heritage Victoria's storage depot at Altona in the week prior to the Easter break. As a component of in-kind support, the Port of Melbourne Corporation allowed free use of its slipway for the preparation and fit out of the barge by the owners, Fitzgerald Constructions, at Victoria Dock in Port Melbourne's Docklands precinct.

Permits and consents

A number of consents and permits were required for work on the site. These included the permit to excavate an historic shipwreck (within a protected zone) under the Victorian *Heritage Act 1995*, a works permit that allowed excavation of the seabed and placement of the barge as required by Parks Victoria (PV), and consent for use and development of coastal Crown land under the *Coastal Management Act 1999* (Vic) (CMA).

Although Heritage Victoria is a Partner Organisation, a full application and permit was required. AHSPP official ARC Research Associates employed with Heritage Victoria abstained from the application process. However, Heritage Victoria played a critical role in commenting on and eventually ratifying the CMA consent application.

As managers of Port Phillip's waterways, PV needed to approve the works and also the placement of the barge on site for a month so it could issue a Notice to Mariners (NTM). The CMA consent and the PV permits both required risk assessments for work taking place on the barge and contingency planning in case of extreme weather events, and PDS was responsible for development of these documents (PDS 2012a, 2012b). Without the consent and NTM in place, the barge would legally be unable to leave dock.

A permit was also required for use of the X-ray equipment, and the AFP worked with Creagh to enable researchers on the project to work under its license with supervision from trained personnel.

Fieldwork and field logistics

Once the Partner Organisations committed to providing expert staff to the project, experienced volunteers were invited to participate in the fieldwork. The project had capacity for around 30 people to stay at the site accommodation, plus day participants. Due to necessary compliance with Australian Standard 2299.1, only ADAS Part 2 qualified divers (AS2815.2) on SSBA (Fig. 3) could operate the dredging or sediment coring equipment. This was extremely restrictive as many professional maritime archaeologists in Australia are only Part I qualified; almost all the volunteers, including students, hold only recreational—albeit often more senior—qualifications. Furthermore, to comply with UWA's Diving Protocol, all divers had to have a current Occupational Diving Medical, which left some long-standing and highly experienced volunteers unable to dive with the project.

For the period of the April/May field season, 65 people participated both on and off-site, and this necessarily involved many complicated personnel movements. The jack-up barge was in survey for 25 people, but only four divers could be in the water simultaneously. Some divers

Figure 4. AHSPP team filling more sand-bags for stabilising the site (Photo: J. Rodrigues).

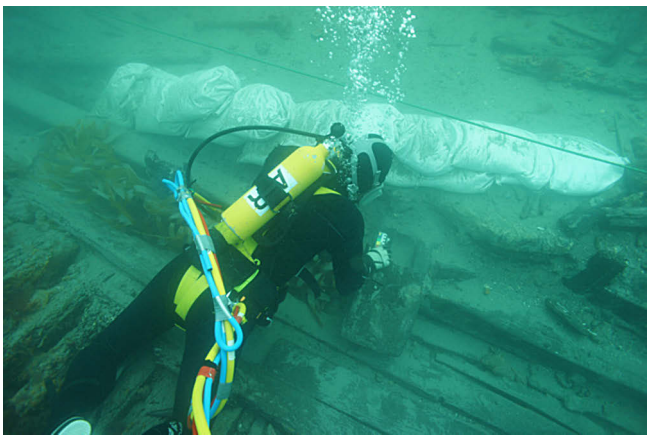

Figure 5. Lead CI Peter Veth on SSBA preparing the mast-step for photography (Photo: T. Massey).

on SSBA were capable of diving for long periods (up to three hours) due to the shallow water and bearable water temperature averaging 16°C. Divers on tethered SCUBA generally spent 30–70 minutes in the water and could complete a 1 m^2 excavation or survey square in that time. Non-divers on the barge were tasked with dive tendering, assisting with surface communications, filling cylinders, artefact cataloging, photography, X-ray imaging, and artefact conservation. The dive teams generally changed over around midday. HV's *Trim* steamed between the barge and St Leonards pier to offload divers and equipment, collect fresh divers, and transfer sand-bags to the site.

The participants staying at the accommodation throughout the month were assigned a variety of tasks when not on barge or diving duty. On both diving and non-diving days personnel were involved with laboratory assistance, filling sand-bags (Fig. 4), transportation of personnel, equipment and site inductions, transfer and naming of data and image archives, updating the website <www.ahspp.org.au>, digitisation of research reports, media and community liaison, collecting field supplies and housekeeping.

Survey and excavation data was scanned and digitised and images were transferred into the image archives and into the GIS platform at the end of each diving day. This ensured that appropriate data was collected and that all artefacts and site data retrieval would be on track for reburial by the first week of May.

During the field period, lasting a total of 26 work days, the team completed 167 individual dives, and accrued 181 diving hours, during a possible 17 days of diving (with inclement weather and transfers being ongoing issues). A further two days of diving (Friday 1st and Saturday 2nd of June) were undertaken by Heritage Victoria, PDS and volunteers under the supervision of Partner Investigator Vicki Richards to complete the backfill of the trenches and the artefact repository located to the stern of *Clarence*.

Excavation strategy and implementation

In 1987 the Victoria Archaeological Survey conducted a season of excavation on *Clarence* (Harvey 1989) following on from a pre-disturbance survey (Harvey 1986) and historical research (Gesner 1985) in the mid-1980s. The 1987 fieldwork team excavated two trenches on the site, one at the bow and the other at the stern. Early plans to excavate a third trench across the hull at midships were abandoned in favour of an extension to the bow trench. The trench in the stern was considerably smaller than the bow trench and the excavated area amounted to approximately 12% of the site, or 19 m^2.

As the midships remained undisturbed by previous fieldwork, the initial plan for the 2012 excavation was to create three 1 m x 3 m trenches in previously unexcavated portions of the site. They were to be located on the N-S datum line points at 4–5 m S; 8–9m S; and 12–13 m S. With deference to the shallow sediment expected on site, previous excavations and the small footprint of the hull, this plan was adjusted to an excavation on the undisturbed starboard portion of the hull. The project team anticipated slumping of the sides of the narrow trenches and loss of destabilised sediment in the strong current. In 1991 Coroneos noted that the natural sediment in the area of the *Clarence* was unstable and that considerable sediment loss had occurred through marine erosion following the 1987 excavations. Therefore the team considered the need to stabilise the centerline of the site to prevent slumping from the port side into the starboard trench to maintain integrity of the trenches. An interim stabilisation strategy was developed, consisting of sturdy PVC sheeting held in place with a bund of sand-bags to shore up the centerline. However, once divers commenced pre-disturbance work on site it was apparent that there was only a shallow layer of (loose marine) sediment overlying a dense kaolinite-rich unit.

Excavation commenced on 26 April after several days of inclement weather that prevented boating and diving operations (Fig. 5). An excavation, survey, photography, conservation and backfill strategy was implemented that ensured efficient diving operations and maximum use of the time available for fieldwork. A cautious and staged approach to excavation was developed that ensured the site would be, at minimum, backfilled with sediment and

Figure 6. X-ray enclosure showing access doors for the IP, the specimen stage and the source. The photographic image on the viewing screen of the camera can be seen (Photo: D. Creagh).

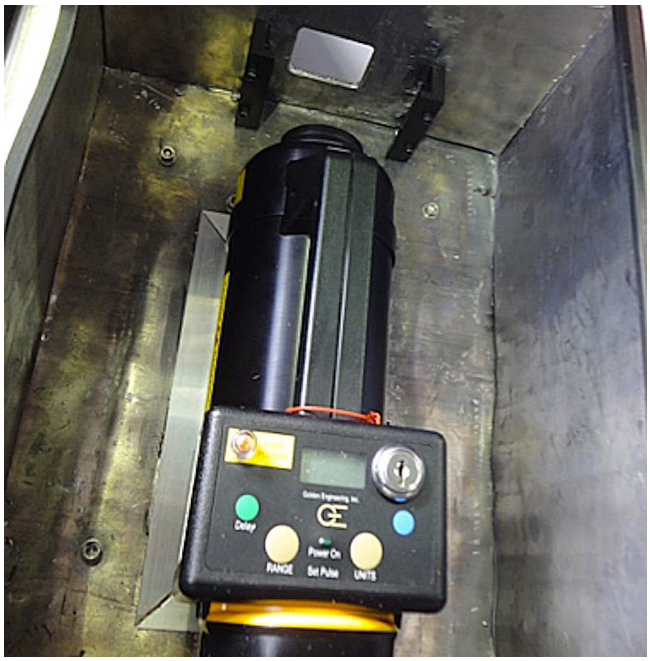

Figure 7. X-ray source in position (Photo: D. Creagh).

the trenches covered with shade cloth and bags at the close of the fieldwork. Consultation with the project team and HV determined that a small group would return to the site at the end of May to ensure that a minimum of 50 cm sediment would cover any excavated areas as well as the inside of the artefact repository at the stern. Sediment cores were taken in pre-disturbance mode and after reburial the site was left covered with shade cloth until the final stage of stabilization. Three large PVC tarpaulins were then deployed, having numerous reinforced eyes for stitching together and toggles for fastening sand-bags on the perimeter and across the entire wreck site. This final work was undertaken in November 2012.

X-ray imaging

The Australian Federal Police provided the X-ray source (GE XR200) and a portable imaging plate (IP) scanner (GE CR25P). In use, the IP is set behind the object, an X-ray exposure is made, and the IP is removed and scanned in an IP scanner. A large exclusion zone was required to remove any radiation hazard. To enable its use on the barge an X-ray shielding enclosure which complied with Australian radiation standards was manufactured and located inside the shipping container.

The outer X-ray box was clad with stainless steel and covered with lead. There were four doors: a source access door, two side access doors to enable the artefact to be mounted on a rotary stage, and a door to allow the loading of the IP. Within the box a thick aluminium plate was mounted on four vibration isolators. This carried the box for the source, the rotary stage, and the IP carrier (Figs 6 & 7).

Figure 8. Leather fragments and timber *in situ* (Photo: J. Parkinson).

Figure 9. X-ray image of the timber base (Photo: D. Creagh).

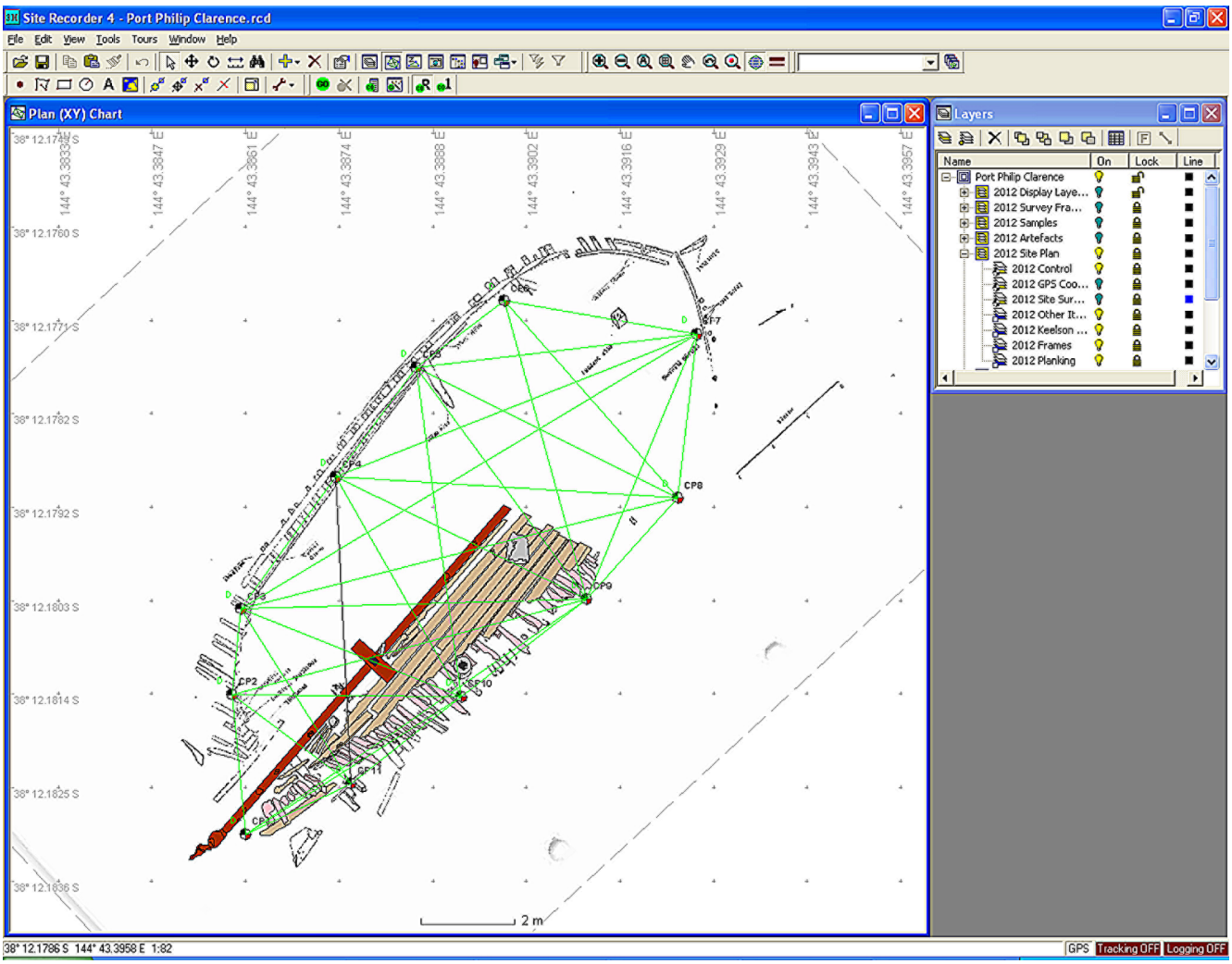

Figure 10. 2012 excavation trench overlaid on the 1987 site plan (A. Khan, AHSPP).

The source box itself was made from stainless steel clad with lead. A beam defining aperture restricted the beam so that it only illuminated the IP. Removal of the top of the source box allowed the camera to be positioned. The camera had to be removed to enable the X-ray source to be placed in position. The X-ray image is a 2D image: to construct a 3D (CT) image the artefact had to be rotated in the beam. Special algorithms enable the data set comprising the 2D images, taken for a full rotation of the artefact, to be converted into a 3D image. This image can then be compared with the 3D photographic image for a chosen orientation of the artefact. As an example: some artefacts (leather items and a wooden lid [Figs 8 & 9]) were photographed *in situ*, and afterwards a 2D X-ray image of the wooden lid was acquired.

Whilst it has been demonstrated that this system enabled the safe operation of an X-ray source on site, it was not possible during the excavation and reburial period in April/May to acquire all of the 2D X-ray data sets necessary for the 2D to 3D transformation. This was due to the long acquisition times imposed by the use of IPs (typically 3 minutes per exposure), and the problem of their reproducible positioning in the X-ray system and the IP reader. Spatial reproducibility is essential for a successful 2D to 3D transformation.

Several immediate lessons were learnt from the field trials of the X-ray device. Firstly, the objects recovered during the excavation of *Clarence* were generally too large to be imaged within the on-site enclosure (generally larger than the 20 cm maximum dimension limit). The excavated material assemblage was predominantly organic; with wooden cask staves making up the majority of the recovered artefacts. While material of this type can be X-rayed, imaging long organic materials is more easily achieved by Computed Tomography (CT). A CT scanner was beyond the scope and budget of this project.

Digital imaging detectors are required to enable an entirely automated procedure and for acquisition time to be reduced to an exposure every 5 seconds. The Australian Customs and Border Protection Service has recently donated an X-ray source to the University of Canberra, but funds for a suitable X-ray detector system need to be obtained.

The trial was successful in showing that objects can be X-rayed on site safely—and in some cases—such as the oak tierce lid fragments—the images will be

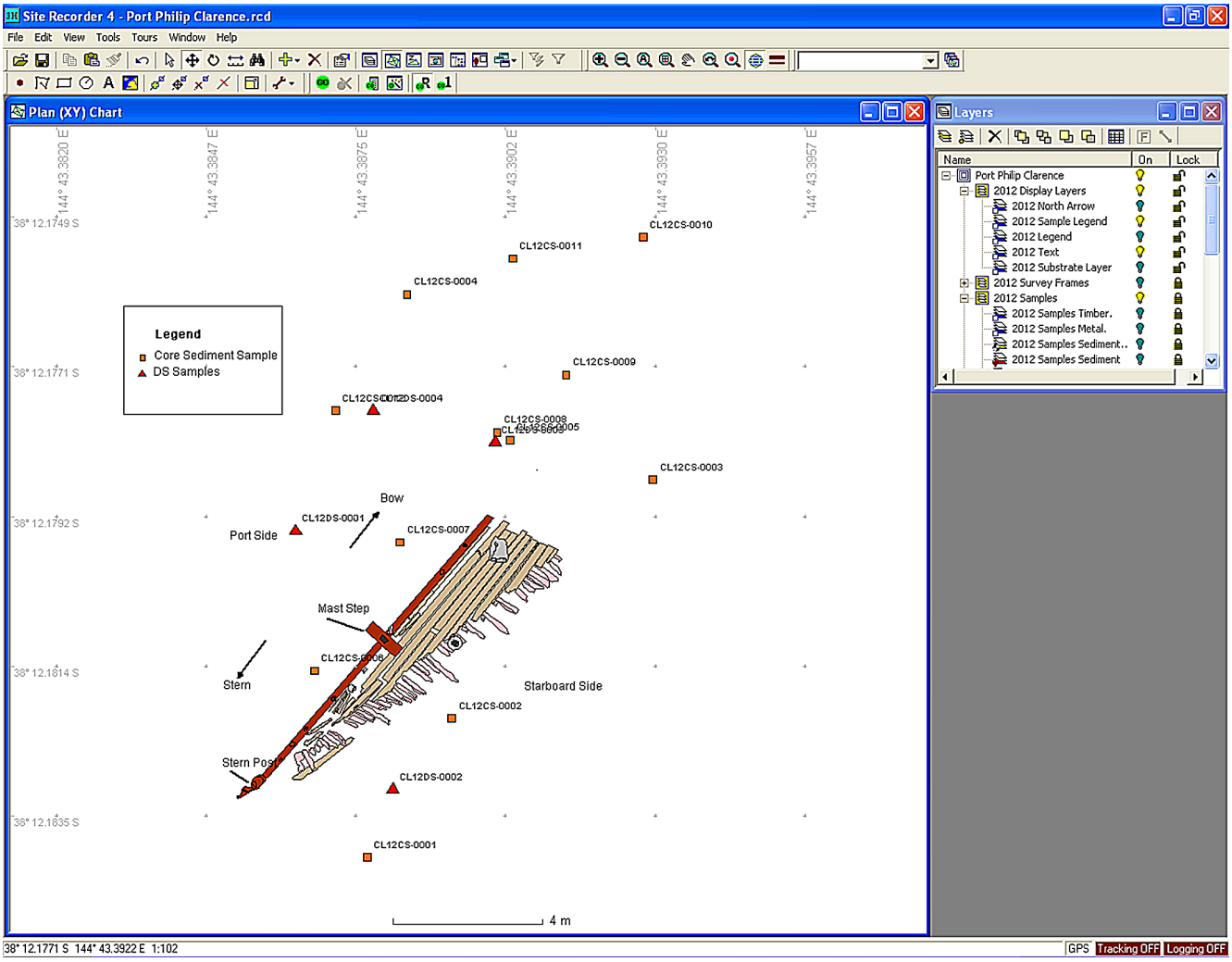

Figure 11. 2012 sample layers overlaid on the plan of the 2012 excavation trench (A. Khan, AHSPP)

very useful in final conservation and site-condition reporting. However CT scanning will inevitably be superior with respect to acquisition time and the size of manageable objects.

Sediment sampling

Sediments were sampled as undisturbed 50 mm diameter short cores from locations within and outside of the wreck as part of the extensive pre-disturbance surveys. Areas proximal and distal to the wood structure were sampled, as were areas of seabed marginal to the wreck. This provides a data set on baseline sediment properties and control for comparison with sediment entrainment, mobilisation and deposition over the wreck as the site stabilises. Detailed sedimentological, geochemical and microbiological analyses are in train and will be reported on in full, elsewhere.

In short, sediments are dominated by well sorted fine and medium sands, consistent with the well-fluxed tidal-current dominated environment of the wreck site. The sands are variably mixed with biogenic carbonate and local shell. The facies at *Clarence* are typical of shallow waters around the periphery of Port Phillip and consistent with seafloor sediments mapped as nearshore and offshore sandbar zones for the wreck area (Holdgate *et al.* 2001, adapted from Buckley & Clark 1987; Holdgate *et al.* 2011). The seafloor sediment train at the site is tidal current supplied, and a north-west extension of sands from the Nepean Bay Bar and West Channel to the south and southwest. The modal sizes, sorting and lack of binding fines make the sands around the wreck highly mobile as a shallow sand sheet, overlying the eroded transgressed surface of harder clayey Tertiary regolith basement at shallow depth.

Within the wreck structure, very firm to hard clayey sediments were unexpectedly encountered during sampling and excavation. The clays are variable in composition, mostly dense and locally admixed with shelly inclusions and organics. Provisionally identified as clay ballast, these samples are being analysed using a variety of techniques (including XRD analysis at the ANU) and appear to be kaolinite-rich. These clays could not deposit from suspension in these well fluxed waters and, consequently, are interpreted as ballast. They will be compared and contrasted with Tertiary-derived clay-

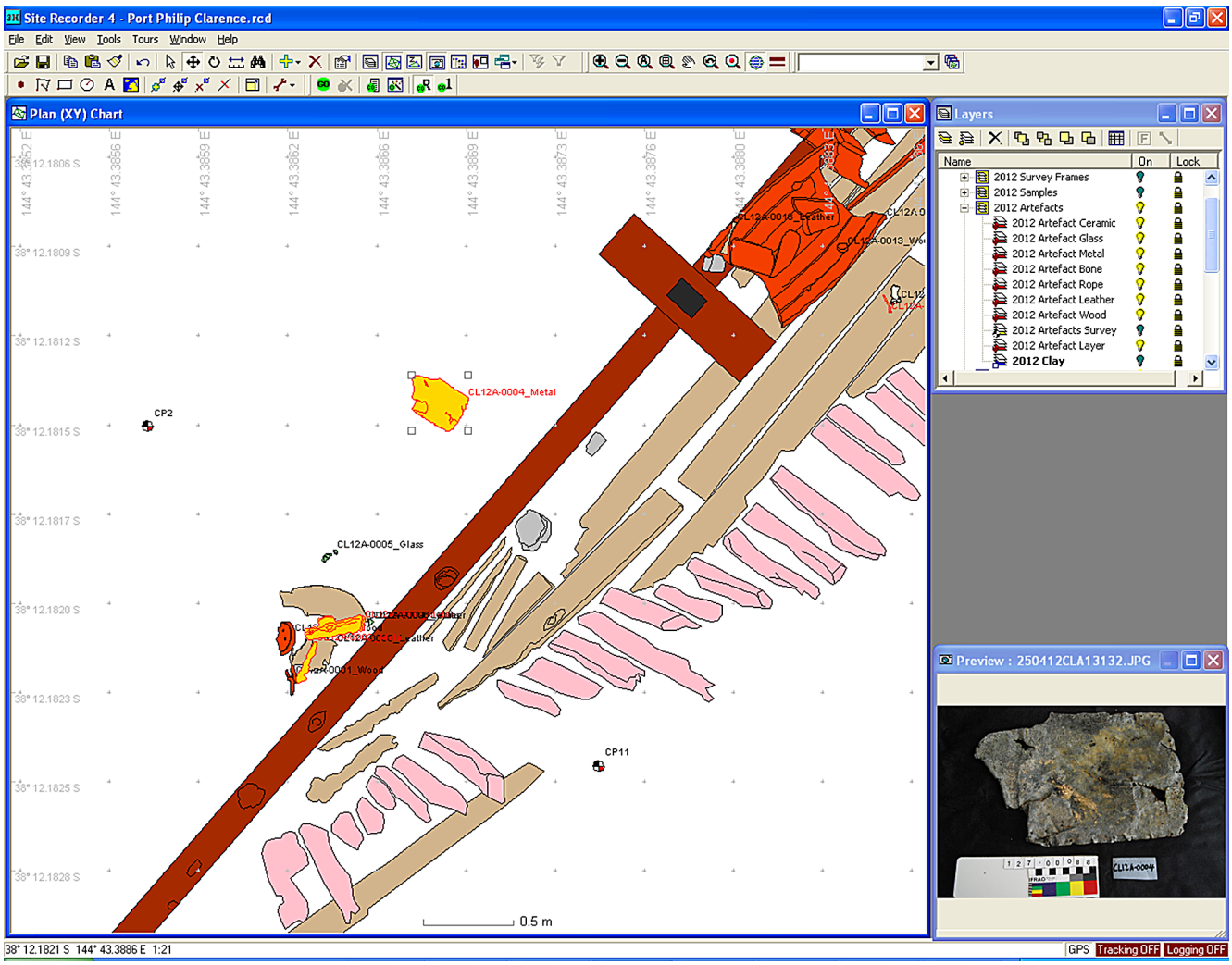

Figure 12. The 2012 excavation trench shown with artefacts and image preview in SR4 (A. Khan, AHSPP).

rich samples from the local clay-rich saprolites and sub-soils from the Portarlington-St Leonards shoreline to exclude a local terrigenous source.

Site survey with Site Recorder 4

Prior to excavation, the diving tasks involved setting up a network of star pickets as site datums around the perimeter of the hull. Once installed, tide adjusted depth measurements were acquired and distances between each datum and at least five other datums were taken. Once the network was set up it was possible to measure in points inside and around the wreck. Each recording required measurements to at least three datums and a tide adjusted depth measurement.

The survey measurements on the site were primarily taken using Direct Survey Method (DSM or 3D tri-lateration). This technique was selected to avoid the limitations of using baseline-offsets and plumb bobs in sites with high vertical relief and strong to very strong current.

Pre-disturbance recording was then undertaken including: detailed photography and videography, core sampling of sediments for chemical analysis, timber sampling and positioning of hundreds of sand-bags for site stabilization. Sediment capture depots were created off the bow and stern, with an experimental shade cloth cover over the stern depot to help trap excavated sediment and prevent its loss in to the water column.

For the archaeological studies from 1985 and 1987 investigators published 2D pre-disturbance and post-excavation site plans (Gesner 1985; Harvey 1986, 1989). In preparation for the 2012 excavation these plans were scanned from the reports and added to the SR4 *Clarence* project file.

The previous site plans were scaled, aligned and geo-referenced within Site Recorder 4 (SR4) (Fig. 10). Initial scaling and alignment was completed using the scale bar and north arrow on the site plans. A point coordinate for the site location was used to locate the site approximately in space. Further refinement of the positioning of the site plans was possible once the 2012 survey was underway and identifiable points in the site plans were surveyed.

The 2D site plan for the excavation trench was assembled using data from a range of survey techniques, including DSM, feature measurements, drawing frames, and scaled and rectified photography.

Core samples acquired in and around the wreck site were mapped in using DSM. Handling of core samples in

Figure 13. Conservation area on the barge (Photo: J. Rodrigues).

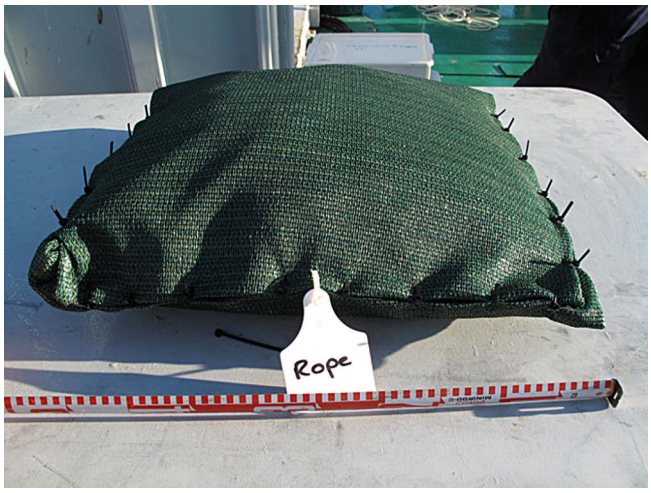

Figure 14. Recovered rope prepared for reburial (Photo: K. Kasi).

SR4 was only to provide a spatial front-end for mapping purposes (Fig. 11)—data analysis was performed offline using an external system dedicated for core sample analysis.

At least one point on an artefact was surveyed in and the artefact photographed *in situ* to establish its orientation. *In-situ* photos were also used to create digitised line drawings of the artefacts and added to artefact data layers. This allowed all artefacts to be scaled, aligned and accurately positioned within the site plan (Fig. 12).

The structural site plan, sample layers, and artefact layers are integrated within SR4 and can be selectively made editable or visible within the system.

Different plans can be generated from the data layers and can be published to a variety of formats. These can be directly printed to hardcopy or generated to PDF. A limited version of the site plan can be published to a Google earth KML format file for ease of viewing. A free version of the SR4 software (Site Reader) allows direct access to the data layers and selective activation of components of the survey. Versions of the site file will be made available through the project website and will be updated as further work progresses on the data processing.

Conservation and *in-situ* preservation

One of the major conservation objectives of the *AHSPP* was to ensure that the post-recovery integrity of artefacts was optimised prior to reburial or conservation. The other major aim was to preserve the site *in situ* through the application of an appropriate reburial strategy supported by an extensive monitoring programme in order to assess the long-term viability of the methodology (Richards *et al.* 2009). This is effectively the longitudinal evaluation of the *in situ* reburial and stabilisation protocol over three years in the first instance (the life of the grant)—and ideally decadally into the future.

A pre-disturbance conservation survey was carried out collecting baseline sediment core samples prior to excavation. In addition, wood samples were recovered from different areas on the site after excavation for species identification, and to take deterioration measurements. Data from this survey provides a baseline against which the results generated from the post-reburial monitoring programme may be compared and the success of the applied mitigation strategy properly assessed.

Large areas are usually required for conservation artefact handling and storage. However the space on the barge was limited so the conservation workspace was located on the deck between two shipping containers, with an approximate area of 35 m^2 (Fig. 13), while the conservation science preparation and materials/equipment storage area was located in the back half of the middle shipping container; an area of 7.5 m^2. Overall, the areas were adequate. However, had more artefacts (>50) been recovered the lack of space may have proved problematic.

Polypropylene containers of various sizes (with their lids connected via cable ties) and padded lifting crates were prepared for the recovery of any artefacts exposed during the excavation phase. After the objects were recovered they were cleaned to remove clay deposits or biological growth that may obscure archaeological information prior to being transferred to the artefact documentation team for registration, recording and photography. Some objects were deemed suitable for X-ray and X-ray imaging. A few artefacts, such as the coil of rope, were extremely fragile and supports were made so the object could be handled with minimal damage during documentation. The artefacts were kept wet at all times with seawater to avoid osmotic shock when reburied.

After the artefacts had been registered and properly recorded they were prepared for reburial. Decisions on whether objects should be fully conserved for further analysis and/or display were based on archaeological significance assessments (articulated in full in the HV permit) and an evaluation of the costs associated with their treatment and ongoing collection management. Based on these criteria, no artefacts were selected for conservation treatment at the Western Australian Museum's Department of Materials Conservation, and all objects were reinterred onto the site or within the reburial depot.

Figure 15. Off-site storage depot at the end of the May 2012 fieldwork period (Photo J. Parkinson).

The artefacts were wrapped in polyester geotextile (Bidim A14), followed by a high density polyethylene shade cloth protective wrapping (Coolaroo Exterior Fabrics—Extra Heavy 84—90% UV Block Heritage Green 3.66 m wide) secured by cable ties. Registration tags were placed in with the artefact and then a polyester based polyurethane cattle tag was attached to the outside of the shade cloth denoting an identification number, which related directly to the artefact on the database and a brief description of the item so they could be easily identified in the future (Fig. 14). The artefacts were then placed in wet storage awaiting the reburial phase of the project.

The smaller artefacts were placed in the crates used for their initial recovery to transport the objects to the seabed for reburial, however the cask stave packages were too large so they were secured to the top of the crates for support.

Previous research has established a 50 cm datum as the *minimum* depth of burial for the protection of recovered artefacts (Nyström-Godfrey *et al.* 2011). Therefore, it was decided that the few recovered metal, glass and ceramic artefacts could be reburied on the wreck site as it would be possible to obtain this depth of sediment coverage when replaced directly adjacent to the keel. However, because they were different material types they had to be separated by at least 20 cm to minimise the chances of unwanted chemical interactions. Owing to the size of the organic materials, especially the cask staves, it was not possible to rebury the organics on-site as it would be impossible to obtain the 50 cm datum required to ensure their long-term protection. Therefore the organic materials were reburied in an off-site storage depot purpose-built to obtain this depth of burial.

A proprietary 2000 L high density polyethylene water tank (1.8 m height; 1.2 m diameter) was purchased, the ends cut off and the tank sawn in half. This cylinder (1 m height) was then dredged into the seabed 10 m south of the site, just off the starboard stern. The sand was dredged from within the confines of the cylinder and the least degraded organic artefacts (i.e. two wooden casks and leather artefacts) placed at the bottom of the depot, covered with 10 cm of surrounding sand then the more fragile organics (i.e. rope, dunnage and the most degraded cask) were placed on top of this layer. The depot was then backfilled with surrounding sediment, covered with shade cloth and anchored with polypropylene sand-bags (Fig. 15).

Since it is scientifically inappropriate to annually re-excavate a site to collect samples and/or recover the reinterred artefacts to ascertain whether the reburial strategy has been successful and not detrimental, replicate sacrificial modern samples were deposited in the same archaeological context as the reburied artefacts. Thus, sacrificial modern ferrous alloy (duplicate cast iron and mild steel coupons) and wood samples (duplicate samples of pine, Sydney blue gum and blackbutt) were reburied with the artefacts on-site and in the reburial depot.

Four ferrous alloy and eight wood sample plates were manufactured. One of the duplicate iron or wood samples was wrapped in Bidim A14 geotextile to ascertain its protective effect on the iron and wood artefacts after reburial. The four iron alloy sample plates were positioned along the keelson, adjacent to where the iron artefacts were reburied on-site. Four wood sample plates were placed 1 m towards the stern to ensure there would be no influence of the metal corrosion products on the degradation of the wood samples (Fig. 16). The remaining four wood sample plates were placed around the internal perimeter of the off-site reburial depot.

Figure 16. Sacrificial iron and wood samples and wrapped metal artefacts on-site prior to reburial (Photo: K. Kasi after J. Parkinson).

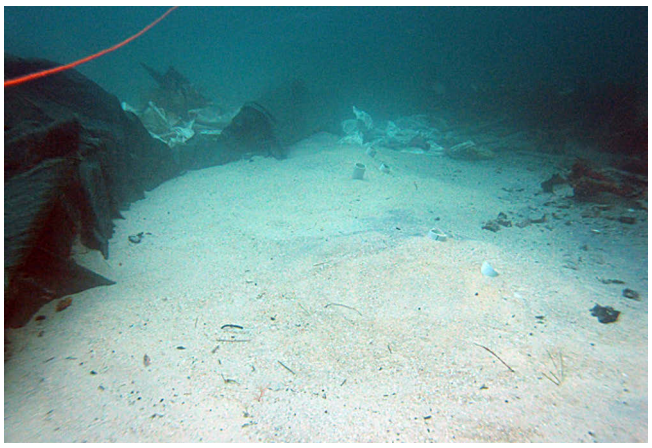

Figure 17. The excavated area after reburial to a depth of approximately 1 m. The tops of the sacrificial sample rods are just visible on the sediment surface (Photo: J. Parkinson).

These samples will be recovered at regular intervals (every 12 months for three years) and analysed by a number of instrumental techniques in order to quantify the extents of deterioration and estimate their current degradation rates. By using the deterioration rates of the modern materials and extrapolating from the initial extents of deterioration of the wreck materials measured during the pre-disturbance survey, the effect of the reburial strategy on the wreck and the reburied artefacts may be determined (Richards *et al.* 2009).

Towards the end of the four-week fieldwork period, the excavated area was backfilled with dredged sediment from the site, which had been collected in two sediment traps positioned near the bow and the stern of the site. While the stern trap was extremely efficient the bow sediment trap only retained a fraction of the spoil. Therefore the forward section of the excavation trench was backfilled with proprietary sand emptied from the polypropylene sand-bags previously placed around the periphery of the site to stabilise the exposed higher profile frames. During this latter reburial phase the weather rapidly

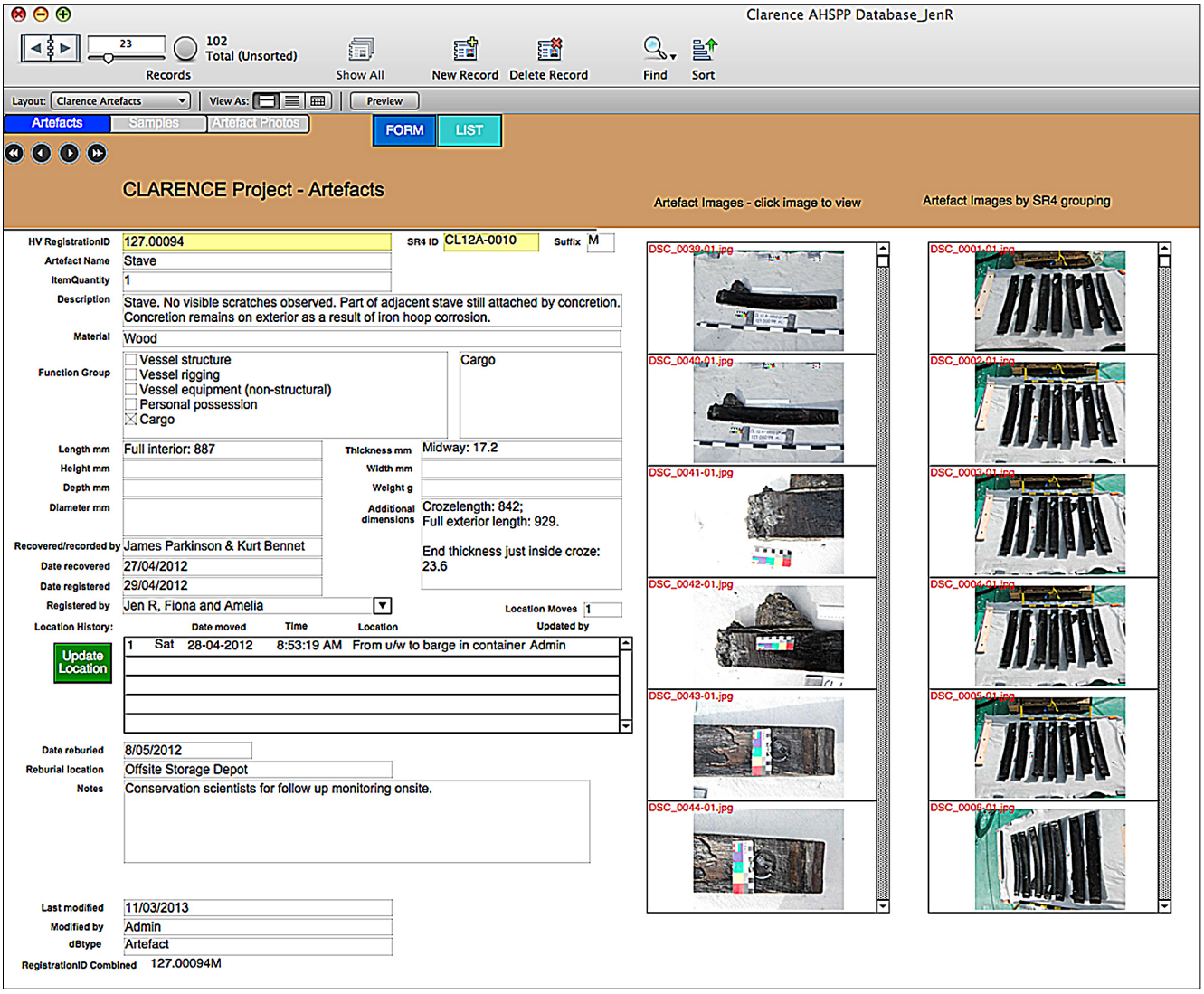

Figure 18. Screen shot of artefact tab in *Clarence* database (Photo: J. Rodrigues).

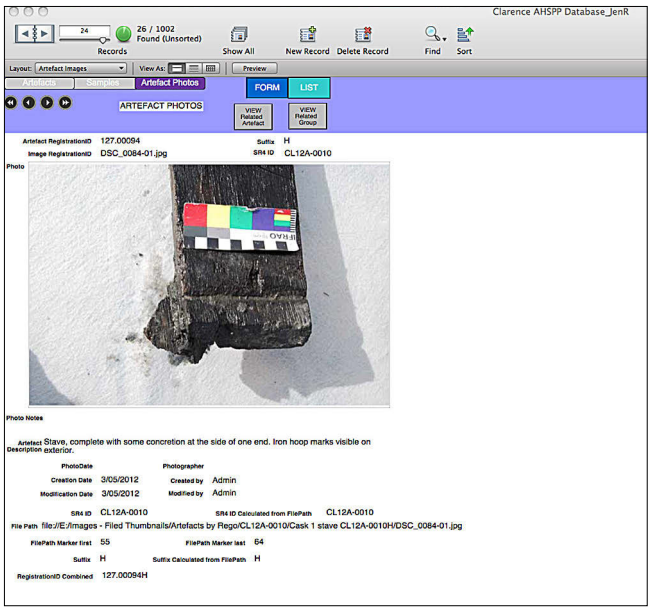

Figure 19. Screen shot of artefact photo tab in *Clarence* database (Photo: J. Rodrigues).

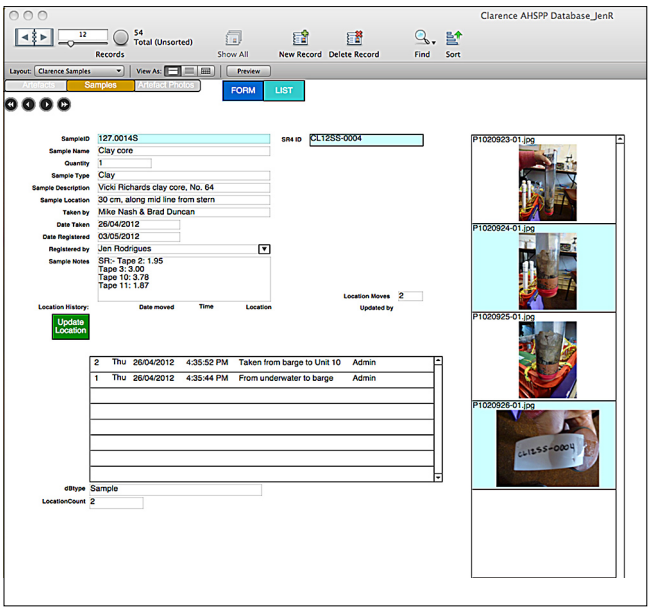

Figure 20. Screen shot of samples tab in *Clarence* database (Photo J. Rodrigues).

deteriorated and it was not possible to completely rebury the excavation trench and off-site reburial depot to the 50 cm datum. As a short-term remediation measure the areas were stabilised with a layer of shade cloth anchored with sand-bags.

Three weeks later, in June 2012 a field trip was organised to further rebury the excavation and the reburial depot again, using proprietary sand emptied from the sand-bags on-site. An average reburial depth of 1 m was achieved, which was significantly deeper than the original sediment depths; especially at the stern of the wreck (Fig. 17). Sediment core samples were then collected from the excavated area and the reburial depot as a baseline for future comparative analysis. The backfilled areas were then stabilised with a layer of shade cloth, anchored with more sand-bags until the final phase of the remediation strategy could be completed in November 2012, which involved covering the entire site with a 250 m^2 shade cloth mat, followed by three (14 m x 7 m) polyvinyl chloride (PVC) tarpaulins. This exercise will be reported on separately.

Finds and sampling recording

Fundamental to the finds recording strategy was the recognition that this would be a one-off opportunity to record the site material in its original and most complete form, and secondly, that it needed to be done in a limited time-frame before reburial. There would be no opportunity to go back to record something missed as, once reburied, the material would be subject to secondary transformation processes. Even if subsequently recovered, the material might not be in the same condition as first recovered. Therefore, the recording needed to be comprehensive and efficient in order to provide the necessary wealth of reliable baseline data to inform future research, and particularly allow future assessment of the effect of the reburial strategy on the artefacts.

The finds recording methodology and ensuing database had to be able to meet the needs of the project by capturing all relevant and important information during excavation within the time constraints and despite potential unforeseen delays before the objects were reburied. As well, it had to meet the needs of the finds recording system of Heritage Victoria, managers of the *Clarence*, which would ultimately archive and manage these baseline data.

A number of options were investigated and assessed prior to the fieldwork commencement. The critical requirements were a system that could efficiently meet the management needs of the archaeological site team; recording site location data, subsequent movements, condition reporting, photographs, samples and general process tracking and verification to ensure nothing was missed.

The primary option was the HV database, which is where the data will eventually be managed and made available to the public. However the HV database is essentially a collection management rather than a site-specific archaeological tool, and is designed to cater to recording finds already collected across a wide variety of sites in Victoria. As a collection management tool it is quite appropriately "locked down" with very specific data entry rules to ensure consistency of the data it manages. It also contained a large number of options that were irrelevant for this project, but, fundamentally, did not provide the on-site tracking tools necessary to the archaeological recording and management of *Clarence*. Therefore, it was decided that a new database with all relevant fields would be needed to manage both the site data and track the movement and recording of artefact data in real time (Fig. 18), which could then export all of the final data into the HV database for archiving and public access without compromising information for either party.

Figure 21. Amelia Lacey photographing artefacts (Photo: J. Rodrigues).

Figure 22. Ian MacLeod, John Osmond and Joe Brothers cleaning tierce staves (Photo: J. Rodrigues).

After assessment of the available options, it was decided that the most productive solution was to build a site management database for the AHSPP using the Filemaker Pro database platform. This option was chosen as it enabled the quick construction and implementation of a complex relational database which could bring together and manage the suite of SR4 location data, finds recording dimensions and observations, photographs (Fig. 19), artefact and (significantly) site and artefact samples (Fig. 20), and X-ray images. The Filemaker platform offered considerable user configurability for artefact and sample recording and analysis, with the ability to export the data in a variety of formats, including directly into the formats required by the HV database. The *Clarence* finds database itself was simple to develop but the process of retranslating the data to the available fields in the HV database was time consuming. This ensured that the maximum amount of information was captured during excavation using the most efficient and reliable means possible, and could subsequently be analysed and verified before uploading for eventual public access through the HV website.

Consideration was also given as to whether the team could continue the registration numbers from HV's pre-existing *Clarence* artefact registration system or whether to use a system more compatible with SR4. It was finally decided that a new system for the field project was necessary, and that these registration numbers could then be used as a "field number" reference when data was imported into HV's registration system. At the early stage, it was not certain whether HV would in fact include this data as the *Clarence* finds were to be returned to the seabed, but this was a decision beyond the scope of the AHSPP finds management team.

Process during fieldwork

Artefact photography also fell in the domain of the finds recording team (Fig. 21). During the fieldwork, the process was straightforward but at times was hampered by unforeseen factors such as inclement weather; need to acquire more adequate lighting on site; and somewhat confined space inside the sea-container, speaking to one of the constraints of modularised recording nodes on a constrained barge platform. A significantly larger artefact assemblage would have posed real challenges to effective recording in this system.

Recording methodology

Both finds and samples were registered so as to track everything that was raised by divers and conservation scientists from the site. However two slightly different systems were used to clearly differentiate between artefacts and samples. Artefacts were registered with a 'CL' prefix referring to *Clarence* while the prefixes of samples varied, such as 'SS' for soil sample or 'CS' for clay sample.

All finds and samples were photographed with registration tags and scales and these images were imported as thumbnails into the database for ease of access. Raw images were saved separately and a backup was also kept on the project computers. Data was backed up on external hard drives at the end of each day where any recording took place.

Part of this overall process also involved the training of students and volunteers. They would thus take turns to be trained in the cleaning (Fig. 22), recording, photographing and packing of objects using appropriate material as well as awareness of artefact conservation issues such as handling of fragile material and keeping organic material wet during recording and photography.

The finds were always stored wet in tubs on the barge (Fig. 23) and, due to the conditions experienced with transshipment from the barge to the tender vessels, could not be brought back to the accommodation site where the finds team could otherwise have continued the processing even during non-diving days when the team could not get access to the barge. Inevitably, the finds processing would stall until the team could return to the site. Although frustrating, there was no alternative until it became a priority for the finds and conservation teams to be transported to the barge at the earliest opportunity during the last days of the

Figure 23. Artefact CL12A-0019 rope in holding tank (Photo: J. Rodrigues).

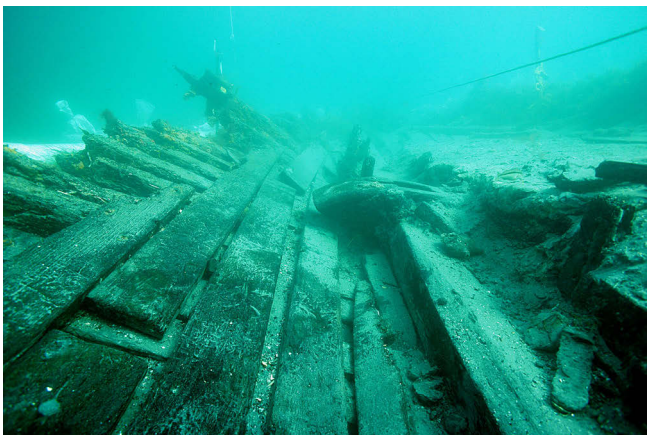

Figure 24. View of the excavation trench looking to starboard with the mast-step in the mid-ground (Photo: T. Massey).

fieldwork to complete processing and at the same time prepare all of the finds for packing, tagging and reburying.

Artefact recording summary

It was found that the close collaboration between the finds recording and conservation teams and the close proximity of these two work stations resulted in the vast majority of processes for conservation and finds management running extremely smoothly. The close working relationship and good communication between the two teams from the preliminary design stages through to the field, and the flexibility inherent in the database methodology adopted, was critical to the success of the site recording and analysis in the available time frame.

Artefacts and conservation summary

Nineteen artefacts, and an additional 16 pieces of dunnage were recorded in the artefact database. There are 102 artefact assemblage entries in the artefact database, made up of 109 individual pieces. All artefacts were returned to the site but organics were buried in the off-site storage depot next to the shipwreck. Small samples were taken from the cordage (0019) and leather (0008) by the conservation team who also took soil, clay and water samples.

Further research and analysis of the artefact assemblage, particularly the casks, leather and timber, and kaolinite ballast is presently underway and will be published in due course.

Concluding discussion

In November 2012 subsequent fieldwork was undertaken to fully stabilize the site with a shade cloth layer followed by the installation of three PVC tarpaulins; the taking of further sediment cores for physic-chemical assays; and, post-disturbance marine biology surveys which will be reported on elsewhere. An inspection of the site in March 2013 showed that at the structural level the stabilization and conservation protocol appears to have been successful; all sand- and rock-bags had remained in place, and the stitched PVC covers were intact. The shade cloth and lower unit bags and sediments were in place with an encouraging growth of benthic fauna and dark anoxic sediments entrapped over the site.

With respect to the over-riding research regarding *in situ* reburial and stabilisation, it is axiomatic that of the 2,786 colonial built vessels in Australian waters—of which only 0.5% have been adequately surveyed—many will be at risk and justify some kind of intervention. The current *in situ* reburial and stabilisation *experimental design* should assist in scoping this task with sorely needed data on the efficacy of the approach adopted here; especially when conducted at this scale. The project had the expertise, infrastructure and funds to conduct this task to a high level on *Clarence*. Despite the high-end logistics of SSBA and commercial/scientific codes for this workplace, the safe execution of complex tasks, such as deploying the largest shade cloth cover (250 m^2) and the first ever stitched PVC tarpaulin on a wreck site , as well as the movement of 3 500 sand-bags over a considerable distance, means it was appropriate.

Coring on and off the site, and along the adjacent shores of Port Phillip Bay show that the vessel settled down towards hard pan; having a significant layer of kaolin ballast overlain by a poorly consolidated layer of marine sediments which is likely to have been reworked over time. The low density of artefacts from previous and current excavation suggests that this material has been lost from the site through past human and natural agency.

The most diagnostic artefacts such as the cask staves and lids; coir cordage; leather patches and ferruginous objects were recovered from within the kaolin unit and the marine sediment disconformity above it. The paucity of artefacts recovered from the marine sediments illustrates the instability of this upper unit.

We conclude that targeted test-pitting/excavation of such a site, which was being scoured and losing much of

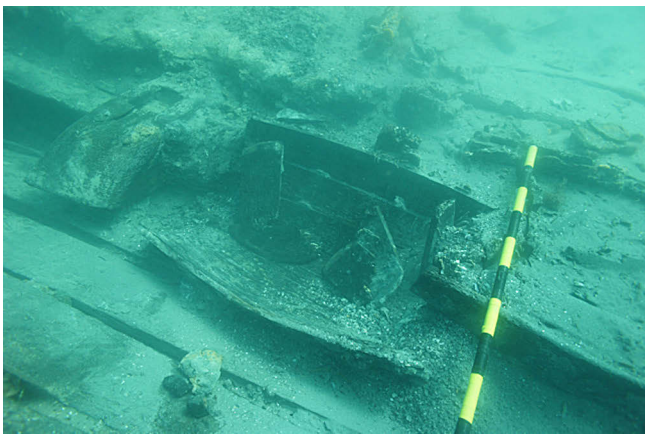

Figure 25. Detail of cask *in situ* near mast step (Photo: J. Parkinson).

Figure 26. View of trench showing distinctive paired frames beneath well preserved ceiling planking, cask staves in situ and kaolinite-rich clay deposit presumed to be ballast at right (Photo: AHSPP).

its structure from anchor damage, was warranted. This was born out by the previously undocumented presence of the site's largest artefact—a kaolin ballast layer which still sported marks in profile from the original bucketing of the pipe clay into the hold by labourers. To (re)inter a site without this baseline data being known is as perilous as conducting unwarranted excavation where a site matrix has integrity (not the case here and the reason for starboard sampling). The ethics and planning of (test) excavation must nest under the site's research questions and the specifics of the site (and its unique site formation processes).

The X-ray design and implementation was successful. However we believe that Computed Tomography would be more flexible and deliver improved 3D images of larger objects. The time-consuming nature of IP captures, size limits on artefacts and inability to penetrate larger concretions renders such a system only relevant for interrogating the internal structure of specific organics (such as the tierce barrel lids). Here clinal variation in *Teredo* worm damage, porosity and internal structure can be gleaned from the X-rays and will be published.

The jack-up barge was positioned directly adjacent to the site hosting three modified container laboratories for the diver air supply and communications systems; conservation and storage laboratory; and finds processing/X-Ray chamber/photography area. The ability to have 25 archaeologists, conservators, photographers, finds managers and assistants on site at any one time (and to rotate some mid-day) created many efficiencies in processing finds, data and sequential actions on the wreck site. The logistics of vessel to fixed platform transfer of people and equipment was complex, and unquestionably vulnerable to foul weather. On balance a barge on-site platform is relatively affordable, offers many benefits and did work in these partially protected waters. However, a moored platform with a protected diver egress bay would have allowed for easier transfers and been less subject to swell and fetch. The equivalent work platform on a charter vessel would cost approximately ten times the daily amount and is generally considered prohibitive by todays' research grant quantum. The team is still appraising the efficacy of a jack-up barge as the ideal working platform.

The excavation of the starboard section of *Clarence* was conducted from the stern post, tracking the keelson (with stabilised deposits) to the outer frames from Datum 0.0 to 8.4 m N. Artefacts were encountered near the mast-step (Fig. 24) including staves and lid fragments from tierce casks (Fig. 25) partially embedded in the kaolin ballast, welded leather patches and coir cordage. Dunnage was common and appeared to be mobile over the site especially within the unconsolidated marine sediment unit. The lower kaolin unit and upper marine sediment unit ranged from 15 cm bsl from the stern to a maximum depth of 48 cm bsl along the keelson at the mast-step.

The secondary research question as to how colonial-era Australian ship-builders adapt their technical abilities to suit their new environment and the timbers that were available to them will be addressed as wood sample analyses and 3D visualisations (in preparation from photo-mosaics by iVEC@UWA) are completed. Many of the earlier archaeological observations by Harvey (1986, 1989) regarding the presence of paired-framing (Fig. 26) and lack of iron fittings such as knees were supported by further testing on *Clarence*. The major find was the presence of the ballast of kaolinite-rich clays which is the first time this feature has been located and sampled in Australia. It is anticipated that this practice, known from the United Kingdom from at least the 1820s, may have occurred in other cases where vessels under 100 tons were transporting livestock and there was access to kaolinite clays.

What is clear from a critical analysis of the system tested so far is that a) such wooden colonial built vessels 'at risk' deserve and will no doubt benefit to varying degrees from such interventions; b) that the process of recovery, documentation and reinterral can only be expedited up to a point (rapidity is a redundant descriptor); and, finally, c) that an ambitious programme of documenting the various archaeological, conservation, site formation and biological

values of a wreck before total and comprehensive reburial with exhaustive monitoring can, and indeed has been, done in the case of the AHSPP.

As a postscript it is worth noting that during the March site inspection visit an illegally moored fishing party was apprehended by Heritage Victoria within the designated protected zone. Over the last month a commercial fishing vessel was drifting through the zone and the skipper interviewed in preparation for formal enforcement action. Further compliance visits to the site by Heritage Victoria has found that anglers are aware of the protected zone and the potential for infringement notices to be issued and are, therefore, keeping outside its boundaries.

Acknowledgements

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