THE HISTORY AND ARCHAEOLOGY OF THE GARDEN ISLAND SHIPS’ GRAVEYARD, NORTH ARM OF THE PORT ADELAIDE RIVER, PORT ADELAIDE, SOUTH AUSTRALIA

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The work presented in this Thesis is to the best of my knowledge and belief original accept as acknowledged in the text. The material has not been submitted in whole or part for a degree at this or any other University.

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CONTENTS

List of Figures 4
List of Tables 8
Preface 9
Abstract 10
Chapter 1: An introduction to Ships’ Graveyards 11
Chapter 2: Theoretical appraisals 21
Chapter 3: History of Garden Island 25
Chapter 4: History of North Arm surveys 31
Chapter 5: Vessels abandoned in the graveyard: reasoning and identification 36
Chapter 6: Site formation processes: a temporal and spatial definition of the graveyard 79
Chapter 7: Characteristics of vessels and vessel abandonment in the North Arm 100
Chapter 8: Reasons for abandonment in the North Arm 113
Conclusion 127
Acknowledgements 129
Glossary 130
Appendices
  Appendix 1: Plans of other Ships’ Graveyards 133
  Appendix 2: Database of vessels in, or once in graveyard 143
  Appendix 3: Plans of vessels in graveyard from 1996-1997 seasons 165
  Appendix 4: Marine biology of Garden Island 179
Reference List
  Primary Sources 181
  Secondary Sources 184
LIST OF FIGURES

1. North end of the New Guy’s House Boat 12
2. County Hall Ship as excavated 1910 13
3. The ceiling planks of Roskilde Wreck 2 14
4. Thirty-one wooden steamers in Mallows Bay go up in Smoke on November 7, 1925, the greatest destruction of shipping at one time in the history of the Potomac River 16
5. Portion of an aerial photograph of wrecks in the Inner Harbour, Kingston 17
6. J 4 submarine scuttled at the Port Phillip Bay graveyard in 1926 19
7. A model of structure use-life that can be used for vessel use-life 22
8. Northern Port Adelaide area with Garden Island highlighted 25
9. Garden Island aerial photograph with approximate area of Ships’ Graveyard highlighted 26
10. North Arm road near powder magazine 26
12. Plan of proposed townships of ‘Milunga’ (section C), ‘Northarm’ (G) and ‘Newhaven’ (H) 28
13. Ship’s graveyard remains 1997 30
14. Portion of Marine Board soundings chart March 1931 32
15. Portion of ‘Garden Island: position and details of hulks’ 33
16. Graveyard remains 1983 33
17. Graveyard remains 1993 34
18. Survey of graveyard 1989 34
19. Early photo of the majority of the hulks in the North Arm 37
20. Seminole in 1865 38
21. Seminole view of starboard side 40
22. Seminole view towards stern 40
23. Sunbeam view of starboard side 41
24. Sunbeam view towards bow 41
25. Barge at Poplar Docks 1932 possibly similar to barge in North Arm Ships’ Graveyard
26. Hopper barge plans 14/01/1884
27. Side ladder bucket dredger similar to westerly hopper dredger
28. Killarney marine boiler
29. 50 ton crane and pontoon similar to iron pontoon
30. Enterprise view of portside stern
31. Sarnia view from bow
32. Sarnia view to bow
33. Sarnia plan 1878
34. Sarnia plan 06/04/1899
35. Sarnia plan 10/05/1905
36. Sarnia plan 07/03/1912
37. Gem as Williamstown Ferry 1906
38. View of side of Gem remains
39. Central axis of Gem remains
40. Ullock or Moe view to stern
41. Iron pontoon on top of Ullock or Moe
42. Iron pontoon on top of Ullock or Moe
43. Reinforced concrete pontoon plan
44. Stanley towing Casablanca (n.d.)
45. Stanley portside view towards stern
46. Grace Darling in Port Adelaide (n.d.)
47. Grace Darling view towards stern
48. View of Mangana, Juno, Flinders and Grace Darling in the 1930’s
49. Pontoon alongside Flinders
50. Thomas and Annie (n.d)
51. *Thomas and Annie* view towards stern  
52. *Thomas and Annie* view of rudder  
53. *Juno* in Port Adelaide (n.d.)  
54. W.J. Corey (left) and friend on the *Mangana* with view of *Garthneill* around 1936  
55. *Garthneill* in Port Adelaide 1928  
56. *Garthneill* view towards stern  
57. *Glaucus* view of stern  
58. Easterly dredger looking towards stern  
59. Easterly dredger portside at stern  
60. *Dorothy H. Sterling* in Port Adelaide 1910  
61. *Santiago* view of starboard side  
62. Range of dates for deposition of individual vessels in the North Arm graveyard as extracted from historical sources and inferences from spatial positioning (** where either *Moe* or *Ullock* are in the graveyard)  
63. Markings for North Arm water main 1933  
64. Land use comparison, 1963 map portion (top) showing division of Garden Island and past land use by the Harbours Board where line of delineation marks approximate conclusion of beached vessels on the island, current map portion (bottom) shows ownership of entire island by the MFP Corporation  
65. ‘Phases’ of vessel deposition in the North Arm from current remains  
66. Number of vessels in graveyard 1879 - 1997  
67. *Garthneill* bow explosion holes  
68. Boiler plan of *Santiago*  
69. *Grace Darling* as hulk at North Arm awaiting further dismantling  
70. Views of dismantling of *Dorothy H. Sterling*  
71. Views of dismantling of *Dorothy H. Sterling*  
72. Views of dismantling of *Dorothy H. Sterling*
73. Percentage of vessels in graveyard by nation of build

74. Percentage of British built vessels in graveyard by Port of build

75. Percentage of U.S. built vessels in graveyard by Port of build

76. Percentage of Australian built vessels by state of build

77. Vessels interned in graveyard as primary use vessels or after secondary use

78. Santiago as coal hulk 1930

79. Gem as bridge

80. Gem as footbridge

81. Garthneill as grain silo 1930

82. Years of service for graveyard vessels

83. Comparison of average ages of vessel use life after primary and secondary use

84. Enterprise, prop with weld

85. After end of a screw-steamer showing placement of sole-piece (Numbered No.16)

86. Change in ship propulsion between 1910 and 1940

87. Advanced single cylinder steam engine

88. Coal consumption per indicated horsepower per hour: 1855 - 1891

89. Comparison of energy efficiency in different propulsion engines (Energy consumption in megajoules per tonne-mile)

90. Motorship launches compared with steamship launches

91. M.V. ‘Minnipa

92. Date of manufacture of graveyard vessels and S.A. wrecks against years of service of vessels built in that year

93. Scrap iron from the North Arm Ships’ Graveyard ready for export to Japan 10th September 1938

94. Scrap iron from the North Arm Ships’ Graveyard ready for export to Japan 27th April 1939

95. Scrap iron from the North Arm Ships’ Graveyard ready for export to Japan 25th May 1939
LIST OF TABLES

1. Comparison of past vessel identifications to 1997 survey 35
2. Surveyed v. historical dimensions of vessels in graveyard 76
3. Reasoning behind date of deposition of vessels in North Arm graveyard 80
The fieldwork on which this thesis is based commenced in 1996 when I was engaged in the Maritime Archaeology (ARCH 3005) course as part of my undergraduate Bachelor of Arts program. Work has continued through 1997 with the second year of this topic and the Thesis work carried out as part of an Honours degree in Archaeology with Flinders University. Even though a separate section has been allocated for acknowledgments, I would like to emphasise the great and extremely helpful work of various Flinders University students and staff that have helped me in the past year. Without their help the results of this thesis would have been based on very sparse information indeed.

It is the author’s expectation that while all of the information appears to be correct, continued work by future Maritime Archaeology students will not only expand on but may find errors in the current findings, especially where positive identification of vessels is concerned. Examination of Lloyd’s Survey documents, a definite requirement for further extraction of detail from the archaeological record, will undoubtedly shed new light on vessel characteristics. Examination into oral histories, especially those of past scrap salvagers or Harbours Board workers, is another important avenue that would yield great details about site formation and abandonment methods are concerned.

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ABSTRACT

Investigations into a ship graveyard in Port Adelaide have been carried out since the late 1970’s, but only relatively recently from a perspective both archaeological and historical. One of the problems in the past in gaining a more accurate portrayal of the significance of the abandonment ground has been an inability to combine relevant and historiographic principles with archaeological approaches. Apparently used between 1909 and 1945, the site a mangrove and samphire dominated section of island, has provided a rare insight into the practices which dictated the disposal of a considerable number of ships, while shedding light on the circumstances which lead to the decision that a ship is of no further value.

While the progressive adoption of Diesel powered vessels appears to have been a major reason for abandonment, other factors such as the winding down of government-run dredging and deepening operations in the Port have also played a role. Changes in state government legislation, attitudes towards the use of particular sea routes and perceived threats to navigation have also been factors that determined shifts in the bureaucratic method of deposition and the actual number of ships deposited throughout the early twentieth century.

This thesis discusses the results of ongoing archaeological fieldwork and historical research into local newspapers, registry documents and government records. Of particular interest has been how the histories of individual ships contributed to the creation of the graveyard. This research has shown that while such graveyards are not rare occurrences around the globe, their definitions on temporal and spatial levels are born from actions that arise from issues which although being inextricably linked with changes in technology and world economy, were guided by practices dictated by a set of locally conceived and particularly unique culturally defined practices. This thesis suggests that the investigations of such sites are useful from many different perspectives especially as the study of the practices of peoples linked on a global scale can tell us about occurrences in world economy, technological evolution and technological diffusion. It can also begin to tell us to what extent locally conceived and apparently behaviourally insular and unique practices (due to perceptions of law, economy, technology and environment) persist in light of other cultural exchanges.
CHAPTER 1:
AN INTRODUCTION TO SHIPS’ GRAVEYARDS

The Need For A Ships’ Graveyard

The need for Ships’ Graveyards, or at the very least the purposeful abandonment or wrecking of vessels is a direct consequence of marine insurance. Marine insurance for sea-going vessels has existed for centuries, being the oldest form of insurance in history. Ever since humans began to travel upon the seas there have been forms of marine insurance, from the time of the Phoenicians to the Hanseatic Merchants and beyond (Blake 1960:4). The first known written source concerning marine insurance appears approx. AD 533 with special provisions for marine insurance espoused within the Justinian laws of Rome due to the perception of sea travel and transport as dangerous (Blake 1960:4).

The importance of marine insurance for the protection of marine investment is best illustrated by the creation of ‘Lloyds Register of Shipping’ in 1760 (to be distinguished from Lloyd’s Insurance) which was effectively a system by which ships were surveyed determine their sea worthiness. Although Lloyd’s Register has remained the primary and most popular register for shipping since its creation, many other countries followed suit with their own registers such as, ‘Register of Australian and New Zealand Shipping’, ‘Bureau Veritas’ (French), ‘List of Merchant Vessels/Merchant Vessels of the United States’, ‘Registro Libro’ (Italian), and Det Norske Veritas’ (Scandinavian) (Foster 1987:47). Implicit in the idea of ship registration is the fact that at some time a vessel was deemed to be unseaworthy (usually due to advanced age or poor condition) and was de-registered. The consequence of this was that it ceased to be eligible for insurance and would probably not be commissioned for use. Such a process of registration did not by any means protect vessels from mishaps at sea as many an ‘A1’ classed vessel still succumbed to the ravages of the sea. Examples of this can be seen in South Australian owned vessels such as the Yongala which was lost on the 23rd March 1911 (Fitchett 1976:14-15).
Due to the fact that in many cases the cost of making a unseaworthy ship seaworthy was nearly as expensive as buying a new vessel, most vessels ceased to serve their primary function and fulfilled secondary roles in the form of hulks, lighters (vessels which were moored, beached or towed and used for storage) or for a range of other functions such as bridges, grain silos or floating museums. The intention of the registration process was to reduce the number of vessels that were wrecked due to their poor condition and to attempt to ensure that if put in a hazardous position, the likelihood of survival was at a maximum. Yet, where secondary use of de-registered, ‘useless’, or ‘uneconomic’ vessels was not considered necessary or where the vessel became unsuitable for secondary uses there became a need to dispose of the vessels in some way. The reasons for disposal are also none-the-less linked with factors unique to individual nations and which arise out of consequences of combined factors born from historical events and the effects of technology on the shipbuilding industry (to name just a few).

Ship’s Graveyard Case Studies

Ship abandonment grounds are a widespread occurrence, being located in many countries worldwide. They have not, however, been well documented, as maritime archaeology has in the past tended to concentrate on shipbuilding techniques and on wrecked vessels usually underwater (for example Bass 1974, Muckelroy 1978, Gould 1983, Green 1990, Steffy 1994). As a consequence, the Ships’ Graveyards mentioned in the following section provides by no means an exhaustive list. Many graveyards have been destroyed through encroaching development and ‘clean up the coastline’ strategies, while the vast majority may still exist but have not been documented or recorded. For plans and maps of the majority of Ships’ Graveyards cited in this section refer to Appendix 1.

Figure 1: North end of the New Guy’s House Boat (Scale in Inches) (Marsden 1994:99)
The most well known Ships’ Graveyard in existence is *Scarpa Flow* which is surrounded by the Orkney Islands, on the northern rim of the North Sea, where on the 21st June 1919 a diverse array of 148 World War One German Navy Ships were scuttled to prevent British capture [Http://giraffe.rmplc.co.uk/eduweb/sites/jralston/rk/scarpa/backgrnd.html, Kemp 1988:755].

Vessels have been disposed of in forms that resemble the Ships’ Graveyard as we know them today for many different reasons, and by many different methods since at least medieval times. There has also been speculation in recent times of ships supposedly abandoned in the Second Century AD around the Port of London where old or unwanted ships were disposed of in close proximity to refuse sites (Marsden 1994:104, 128). The two ships found dubbed the *New Guy’s House Boat* found in 1958 (fig. 1) and the *County Hall Ship* found in 1910 (fig. 2) date from AD 190 to 225 and AD 293 to 300 respectively and were supposedly deliberately abandoned during the Roman occupation of the area.

Extensive work done in Sweden has illustrated the prevalence of abandonment regions and graveyards in countries with a long history of seafaring. The sites uncovered in Sweden have proved to cover extensive periods of time ranging from the use of scuttled *Skuldelev* Viking ships to block passages into Stockholm, to the deposition of vessels in Kalmar between the 13th and 17th century (Akerlund 1951)
and in the region around a 17th century naval base at Karlskrona in the south east of the country (Lars Bruzelius, Jon Adams, pers. comm.).

Indeed, northern European studies into Ships’ Graveyards, although much removed in many ways from later ship abandonment grounds in the new world, have been to date the most copiously documented in recent times. Danish studies into the abandonment of old ships to be used as the foundation of early Seventeenth Century shipyards have been well documented and publicised, with one in particular the ‘B & W site’ at Roskilde near Copenhagen (fig. 3) being of particular note (Lemee & others 1996, http://www.natmus.min.dk/nmf/nb/8/english/art4.htm). The two documented vessels, (there are at least three others) one a Dutch merchant ship and the other possibly an early Danish far east trader, were used as ‘caissons’ and were filled with building debris before being deliberately sunk as part of a land reclamation project that would see them as the future foundation of a ship ‘careening bay’.

Another early Ships’ Graveyard has been found in French Canada comprising of a collection of boats found under a corner of the Maison Estebe (building of the Musee de la Civilisation), Quebec City in 1974. (Musee de la Civilisation 1985). This site has illustrated how a Ships’ Graveyards can be considered as a ‘time capsule’, illustrating continuity and change of ship and boat building technology, as the vessels can be seen to differ markedly as time progresses. It has been suggested that the boats in the graveyard were used

Figure 3: The Ceiling planks of Roskilde Wreck 2. Photo Christian Lemee (http://www.natmus.min.dk/nmf/nb/8/english/art4.htm)
as landfill due to a recorded change in the shoreline of the river bank on which they were deposited sometime in the late 18th to early 19th century.

Canadian and United States sources for historically researched and archaeologically recorded Ships’ Graveyards have proved to be the richest of all overseas occurrences of vessel abandonment within concentrated groups over short periods of time.

The only well documented Ships’ Graveyard in the U.S.A is a site in Maryland along the Potomac River, which has been extensively researched by Fred Hopkins (Hopkins 1995) and recorded by Donald Shomette (Shomette 1995, 1996:201-338). This graveyard is unique in its specific historical context because the vast majority of the vessels within the graveyard are related to the same historical event within American history. The largest concentration of vessels are all of the same type (wooden screw steamers) with the only differences beside name of ship being the slight differences in manufacture due to the different shipyards producing them.

The 218 vessels in the main concentration of wrecks were deposited in the Potomac river at the end of the First World War having been deemed obsolete and therefore only good for scrap metal and firewood. These vessels have been dubbed the ‘Emergency Fleets of Mallow’s Bay’ (Hopkins 1995:72) because in a similar manner to the way they were deposited together in an extremely short period of time due to emergency circumstances as part of a controlled abandonment process, they were also created due to an unforeseen emergency. An urgent need for ships arose through U.S. loss of cargo ships across the Atlantic due to German submarine activity (with one quarter of all ships leaving England at this time being destroyed) Steam technology was intended to compensate for such losses by ‘out-running’ the Germans (Shomette 1996:213). Five hundred ships (all of similar dimension and design) were ordered to be constructed as a result of the U.S. Shipping Bill in 1916. Only approximately three hundred were built. By the end of the war, however, most contracts for ships were cancelled and with a sharp dip in the world economy the accumulative value of the built ships declined from US$676,703 to US$100,000 each, forcing the sale of the majority of the ships, most of which had begun to rot (Hopkins 1995:73). Due to inadequate sales and a bill of US$30,000 per month to keep the useless fleet afloat, the vessels were sold to the Western Marine
Salvage Company who intended to strip the vessels of all machinery, boilers, etc. and dispose of the wooden hulls by burning and covering them up along waterways in Virginia (see fig. 4).

![Figure 4: Thirty-one wooden steamers in Mallows Bay go up in smoke on November 7, 1925, the greatest destruction of shipping at one time in the history of the Potomac River (Shomette 1996:252)](image)

Problems for the company ensued due to the magnitude of the project, as it was deemed that the process of burning and covering would pose a threat to the environment and navigation. This section of the Potomac appears to be the largest known graveyard anywhere in the world with a known 350 documented ships being placed in the area including U.S. revolutionary war longboats and other World War One wrecks. It is estimated that 300 more may have once been in the area (Hopkins 1995:75, Shomette 1995:66).

In Canada a number of abandonment sites have been recorded by Marine Archaeologist Jonathon Moore (Moore 1995). One such site, located in the inner harbour of the city of Kingston in Ontario, is located in relation to other sites along Lake Ontario (fig. 5). The Kingston inner harbour graveyard contains a large collection of vastly different vessels which date from 1885 with the disposal of the schooner Belle until 1965 with the screw steamer C.D. 110. The vessels in the inner harbour also serve the purpose of
actively altering the characteristics of the coastline in such things as breakwaters and pier extensions (Moore 1995:22).

As with most of the other graveyards the site was once in a much better state of preservation, but over time, development, vandalism and in this case, relocation of vessels to deep-water sites, have greatly diminished the extent and integrity of vessels in the graveyard (there were once almost forty vessels in the graveyard). There are great similarities between this Canadian ‘Marine Boneyard’ and the North Arm graveyard in South Australia including some of the reasons for abandonment, final fate of vessels, bureaucratic processes and concerns about the disposal of vessels.

There are currently four examples of abandonment graveyards in Australia. These graveyards are the Homebush Bay site in New South Wales, the Barwon Heads scuttling yard/graveyard in Victoria, the Bishop Island site in the Brisbane River in Queensland and the South Australian site that is the focus of this thesis. It is expected that there are many more Australian Ships’ Graveyards, as each state is relatively isolated from one another and would have required a means for
disposing of useless vessels. This may have been in the form of sites above water (as in the South Australian, New South Wales and Queensland examples) or underwater (as in the Victorian example). It can therefore be reasonably expected that there are places in Western Australia, Tasmania (there is possibly one at Strachan) and the Northern Territory for ship abandonment. There are also likely to be other sites around each state or along Australia’s major rivers and estuaries that can be classified as Ships’ Graveyards which are not known to the author.

The abandoned vessels at the Homebush Bay site were recorded in 1993 in anticipation of development in the Bicentennial Park area near Sydney (Bower 1993). The three vessels mentioned in the report were the *Heroic*, the *Karangi* and an unidentified wooden barge, all common, particularly slow and ugly ‘workhorses’ that were abandoned in the mid to late twentieth century. The vessel types dis-assembled in the breaking yard however have ranged from Navy vessels of World War Two origin to tug vessels and simple barges or lighters. The site itself only dates from 1966 when it was deemed to be a region for hulk demolition by the Maritime Services Board of New South Wales with many ships besides the ones mentioned broken up on the site (Bower 1993:7). This site has proved to be interesting, as it is comparable to the North Arm graveyard in that there is clear evidence of bureaucratic processes at work which dictated the place, method and means of breaking up vessels that had been deemed useless.

The Ships’ Graveyard in Victoria is extensive and lies seven nautical miles west of Barwon Heads in Port Phillip Bay (Duncan 1994). This Ships’ Graveyard is substantially different to the other Australian examples of graveyards that will be cited as it can be considered more of a ‘scuttling yard’; that is all the vessels sunk within it are in very deep water. This illustrates the way that the shipping establishment could make the most out of the geography of the area, or more particularly the depth of the water in the open ocean, so that the vessels could be disposed of in a way that did not lead to the accumulation of vessels at a site that would cause serious threats to navigation or be an eyesore. The graveyard appears to be dedicated to the disposal of obsolete vessels, including a whole series of outdated Commonwealth owned submarines (called J-class submarines) that were of no use after the First World War and were disposed of between 1924 and 1930 (Smith 1990:12). This graveyard undoubtedly is the largest of any of the graveyards in Australia as it holds approximately forty one vessels. It is also the least accessible of the Australian sites as it is not
approachable to most divers, the depths of many of the scuttled vessels exceed recommended depths that can be reached recreationally. The vessels off Barwon Heads range in date from 1913 with the internment of the iron sailing barque *Brunette*, until the disposal of the steel hopper barge *VH B 53* in 1971. Such a site has proved a good source of comparison in abandonment strategies, especially with regards to perceived threats to navigation, divergent methods of disposal (ie. explosives use) and in the relationship between human industrial processes and the coastline/regional geography.

Figure 6: J 4 Submarine scuttled at the Port Phillip Bay Graveyard in 1926 (Duncan 1994 see also Smith 1990:10-11)

Bishop Island in the Brisbane River, Queensland is actually an artificial island made from hulked and abandoned vessels that were placed together and over some time had dredging spoil dumped over them (Peter Bell pers. comms.). The area surrounding the site has been a hulking ground since the 1930’s but is currently non existent due to the expansion of port facilities and encroaching commercial development in the early 1990’s. The only apparently significant remnant of the hulking ground is a Burmese barque built in 1855 called the *Maida* which was used in the land reclamation process (Peter Gesner pers. comms.).

Nowadays the situation for ship disposal has changed drastically as most ship-breaking is done overseas, mainly in Asian countries (especially India and Thailand). This practice has occurred in Australia since at least the late 1930’s with the breaking up of the McIlwraith McEachern Limited steamer *Karoola* in Japan in October 1937 (Fitchett 1976:75). The practice does not appear to have become the norm until the early 1960’s with the towing of such vessels as the *Woolambi* to Japan for breaking up on 19th December 1961 and the *Minnipa* to Hong Kong in late 1963 (Fitchett 1976:70, Parsons 1986c:130) where they probably became razor blades. Vessels were however still being broken up in Port Adelaide in the 1960’s
The *Active* alongside the old Jervois Bridge around 1965 (Ritter 1996:45). This process was probably limited to smaller, wooden vessels.

Changes in dominant modes of transport have shown that industrial processes of ‘vehicle abandonment’ and reuse have not disappeared but have only changed in type. We could easily see that motor vehicle scrapyards and, in some cases, aircraft junkyards are the ‘industrial graveyards’ of the present era, being descended from a long history of ship abandonment before shipping’s eventual demise as transport ‘super-power’.
CHAPTER 2:
THEORETICAL APPRAISALS OF SHIPS’ GRAVEYARDS,
VESSEL ABANDONMENT AND VESSEL REUSE

To date the only known studies of ‘abandonment’ have centred solely on the abandonment of domestic and prehistoric sites (Cameron 1991, Cameron and Tomka 1993). Subsequently there has been no specific theoretical appraisal of vessel abandonment or Ships’ Graveyards. This has been due to general neglect by archaeologists as well as the fact that theory on reuse and abandonment has centred upon domestic sites and consumer goods rather than on sites created via processes of ‘industrial consumption’.

It is also important to note that the attitudes towards anything of a ‘maritime’ nature not related specifically to shipwrecks has tended to be treated as being of no considerable public or academic value to the majority of South Australians as noted by Young (1980 31-32, 34). This has undoubtedly been a factor in the low numbers of people who have knowledge concerning things ‘maritime’ and also the amount of archaeologists willing to study such sites from a theoretical angle.

The first observation that may be explained according to theoretical models is the actual positioning of Ships’ Graveyards. The implicit idea is that the location of archaeological sites can be mapped according to inherent features of human behaviour. Likewise we can read the behaviour of groups from the distances between centres of occupation and archaeological sites. Rathje (1981:52) has mentioned such models in his studies of modern material culture, particularly when concerning the disposal of drinking and sex-related objects in direct relation to street patterns and dead ends (that is, land use). Shomette (1996:236) has implied that the rationale for the consideration of ship abandonment sites in Maryland, U.S.A. were guided by the following factors; rural location, threat to navigation, objections from residents, and sparse population. In other words the ships were treated in ways akin to the objects outlined by Rathje albeit on a much larger scale.
In the case of Ships’ Graveyards, the permanence and extent of the material disposed coupled with encroaching settlement and development (and technological advances) meant that at later stages abandonment sites were considered examples of bad planning (Shomette 1996:246). This effectively meant that at some point in time it was an inevitable fact that such ‘abandonment sites’ were themselves abandoned. The only theoretical studies in relation to this behaviour concern the abandonment of African domestic sites outlined by Cameron (1991). Many of the reasons given by Cameron for abandonment of village structures along with the way that such structures are repaired and modified, can be used to explain why vessels are abandoned (Cameron 1991:156-157). Hulks or lighters, vessels that have had their primary function ‘abandoned’ but have had a secondary use applied due to such things as ‘structural deterioration’, may be likened to structures within occupied villages that have ceased to be used as habitation sites but are used for other purposes (Cameron 1991:157-158). The model below (fig. 7) can therefore be used not only in charting the use-life of domestic structures in villages but also in sea-going vessels:

![Figure 7: A Model of structure use-life that can be used for vessel use-life (Cameron 1991:158)](image)

The upper section of the model diagram is seen in most cases of vessel abandonment with vessels being either abandoned after primary use, secondary use (reuse) and subsequently ‘scavenged’. The lower
section illustrates processes in abandoned vessels which are much rarer but are nonetheless documented. For instance the rebuilding of abandoned vessels is not much attested to but in localised cases does occur. Change in structure function in villages, although inextricably linked with catastrophic events, rates of decay etc., is believed to be “...affected by social needs and desires” (Cameron 1991:159, 161, 162). This is similar in regards to vessels, but is more specifically geared towards industrial and economic forces such as need for raw material, shipping services, economic stability and the health of such industries as ship building, ship breaking and salvage. As to the abandonment of sites themselves, the model in most sections fit, if we can forget about repair and maintenance which was not a requirement for the use of a Ships’ Graveyard site as industrial dumping ground.

As can be seen from the discussion above, the most important contribution to the study of industrial maritime dumping sites is the study of reuse and recycling which is an inherent feature of Cameron’s work. Studies into reuse, recycling and lateral cycling is a fundamentally important aspect of the study of the mechanisms involved in artefact uselife and has been greatly expanded over the years to increase understanding of refuse disposal patterns and other spatial implications in site formation (Schiffer 1972; Schiffer, Dowling and McCarthy 1981).

For the sake of theoretical discussion it is important to point out that the sites aforementioned and the topic of this thesis are all Ships’ Graveyards. This is an important point to make as there is a fundamental distinction to be made between boats and ships in definition which effects the models we can use in our theoretical sojourns.

McKee (1976:4) prefers to define a boat as a vessel owned by her user while a ship may be owned by an absent individual or organisation that has no role in its operation (he also specifies a length limit of a boat to 25 feet). For the sake of any theoretical discussion it may be easier to categorise a boat as a vessel involved in recreational purposes and a ship as a vessel involved purely in commercial purposes (although this is not the traditional distinction outlined in such sources as Kemp 1988:92, 780-788). This is important as the buying behaviour of individuals using ships for commercial purposes may be guided by such commercial or industrial needs and purposes, whereas an individual who uses boats for recreational purposes may be dictated to by things such as status and aesthetics.
Studies into consumer choice and behaviour, although highly developed and represented within the archaeological literature (such as Miller 1987) as yet do not tend to encompass sites with such an industrial emphasis. So called ‘general models’ of consumer behaviour (for example Henry 1991) although possibly adaptable to industrial settings appear have the same household/domestic emphasis and as such remain too broad and without ‘direction’ for practical application. Currently there are no models in archaeological literature that can adequately explain or account for consumer choices within a commercial or industrial setting. Attempts into the explanation of consumer choice has in the past been limited to the study of household or domestic decision making (Rathje 1984, Spencer-Wood 1987, Purser 1993, Gibb 1996). The formulation of models purely concerning industrial consumption remains a job for the future.
CHAPTER 3:

THE HISTORY OF GARDEN ISLAND &

THE NORTH ARM OF THE PORT RIVER, PORT ADELAIDE

Brief History of the North Arm and Port Adelaide

The North Arm, so-called because it is a major northern section of the Port River is situated approximately in the north-western region of Port Adelaide (see fig. 8). Port Adelaide itself, South Australia’s major port is situated north of the capital of Adelaide and has a wide and varied history, playing a prominent role in the development and prosperity of the early colony.

Figure 8: Northern Port Adelaide Area with Garden Island Highlighted (PANAIRAMA CD-ROM Map 50000493)
The North Arm itself (see section highlighted in fig. 9) has also had an interesting history, having been the home to a variety of maritime industries. It is also a place where the remains of these past industries are the best preserved within the Adelaide metropolitan area.

One of the earliest known uses, and indeed the earliest obtainable photographic image (fig. 10) of the relevant section of the North Arm were the explosives stores (magazines) which were spread along the shorelines of the North Arm. These date from at least the late 1880’s when explosives were not allowed to be taken or stored within the central township and port.
Other prominent uses for the channel were a reputed (maybe legendary?) Torpedo station situated along the river adjacent to Garden Island and the anchorage of mail steamers which serviced the Port from the early 1850’s (Parsons 1986b:108). A more recent occurrence in the North Arm, quite close to the area studied in this thesis, are the slipways which sprang up along the western section of the southern shore of the estuary (see fig. 11).

![Figure 11: North Arm Slipways 1983 (Courtesy of S.A.M.M. #7407)](image)

The North Arm was originally intended to be the central location of the planned harbour facilities of the new Port of Adelaide by the first surveyor-general Colonel William Light. Reasons against such action were connected with its unsuitability as a usable harbour and the poor availability of fresh water, a concern that was later laid to rest with the construction of the Thorndon Reservoir in the late 1850’s (Parsons 1977:1). There were several other attempts to relocate the Port of Adelaide to the land to the south of Garden Island. These attempts commenced in 1838, with serious attempts being made between 1841 and 1847 with the proposed establishment of the cities of ‘Newhaven’ and ‘Northarm’ (see fig. 12) (Ritter 1996:4-7). Indeed the name ‘Port Misery’ by which the original Port Creek settlement was known, is significant, for at the time of Governor Gawler (circa 1838) it was popular opinion that the settlement should be moved to the North Arm, a move stopped due to lack of funds (Parsons 1977:30-31). All of these
attempts failed for a variety of other reasons, most being linked to the general prosperity of the colony and its various early industries such as copper mining.

Figure 12: Plan of proposed townships of 'Milunga' (section C), 'Northarm' (G), and 'Newhaven' (H) (Ritter 1996:6)

Land ownership of Garden Island was unchanged during much of South Australia’s history; has mainly been Crown Land. One section of the island (the western most third) was dedicated to the Harbours Board and in 1962 the entirety of the island became a Harbour Board dedicated reserve. The first public road was opened on the land early in 1968 and its use for a variety of recreational boat moorings and public waste disposal grounds soon followed in the early 1970’s (Hosking, Farger and Oborn 1979a:6). The last transferral of land ownership occurred in 1990 with the purchase of the land by the MFP corporation.

The environment of the island has been mostly affected by its usage as a landfill site since 1972. This has greatly reduced the amount of native mangrove environment and original vegetation (MFP Australia & Rust PPK 1996:9). Although this has undoubtedly had an adverse effect on the vegetation and
surrounding marine life of the area, it does not appear to have greatly impacted the graveyard wrecks (although much ‘stray’ waste has ended up within close proximity of the vessels). In fact, the use of the land as a waste disposal site has protected it, making it unattractive to developers.

Commercial development of Garden Island and the surrounding area has been suggested many times (see Welsh 1978, Hosking, Fargher and Oborn 1979a, 1979b) but has only proceeded, in any real sense, since 1991 by MFP Australia. It can be said that over the years the vast majority of the ‘grand plans’ for the North Arm have not become reality.

The urban development proposal was initially encapsulated in a draft Environmental Impact Statement (EIS) in 1992 (MFP Australia 1992), which outlined boundary of site for development, and issues and effects to existing characteristics of the area within its boundary. The vast majority of the statement concerns the natural features of the area but some mention of archaeological issues are also made. The main thrust of these references centre on the protection (and where possible) the integration of the archaeological sites into the development concept whether Aboriginal or European in origin. In regards to the graveyard it is simply mentioned that monitoring of the site is required and that the maintenance of water levels in the North Arm is the most important aspect of their protection (MFP Australia 1992:15). Tidal variation on site at times exceeds two and a half metres (Ports Corp South Australia 1996:8-13). This means that at times much of the site is hidden, a factor that contributed to the late discovery of vessels or true vessel extent, as well as effecting time allowable for documenting site features. It is surprising though, that such a report would cite tidal variance as the major threat to site, as many other human instigated factors appear to impact site integrity to a greater extent.

The subsequent submission on behalf of the MFP (MFP Australia & Rust PPK 1996) makes no mention of the graveyard (besides an ‘anchor’ on one map and a label ‘The wrecks’ on another two maps) in reference to the planned rehabilitation of the island. The North Arm can be considered to be an archaeological site of high integrity and great importance and may be an important cultural tourism opportunity. The main concentration of the vessels is illustrated by the map on the following page (fig. 13).
NORTH ARM SHIP'S GRAVEYARD

GARDEN ISLAND, PORT ADELAIDE

20/8/1997
N. Richards

Figure 13: Ships Graveyard remains 1997 by N. Richards

LEGEND

1. - 'Semintel' related wreckage
2. - 'Semintel'
3. - 'Sunbeam'
4. - Wooden Barge
5. - Iron Hopper Barge
6. - 'Killarney'
7. - 'Probable Iron Crane Pontoon'
8. - 'Lady Daly'
9. - 'Enterprise'
10. - 'Sarnia'
11. - 'Gem'
12. - 'Moe' or 'Ullock'
13. - 'Probable Reinforced Concrete Pontoon'
14. - 'Stanley'
15. - 'Grace Darling'
16. - 'Iron Pontoon'
17. - 'Flinders'
18. - 'Thomas and Annie'
19. - 'Julie'
20. - 'Mangana'
21. - 'Gardyneil'
22. - 'Gautus'
23. - 'Iron Hopper Dredger/Barge'
24. - 'Dorothy H. Sterling'
25. - 'Santiago'

Scale in Metres

extensive explosions
bay

14. & 25. to East
CHAPTER 4:

HISTORY OF NORTH ARM SHIPS’ GRAVEYARD SURVEYS

& COMPARISONS OF SHIPS IDENTITY

Although the aim of this thesis is not to concentrate on the individual ship’s histories it was still a primary aim of the research to identify the remains in the North Arm graveyard. The reasons that identification is required is simple; as identification is a prerequisite for the interpretation of the graveyard remains, for establishing a ‘chronology’ of use of the graveyard (charting the site formation of the graveyard as an archaeological site) as well as being able to determine the reasoning of South Australian bureaucratic processes which lead to the abandonment of the vessels at the North Arm.

The identifications on the vessels originally originated from work done by students in the Maritime Archaeology topic (ARCH 3005) run at Flinders University commencing in 1996 and which is, at the time of the writing of this thesis, an ongoing project.

Upon commencement of the research into ship identity at the North Arm in 1996, the only sources of information came from work that had been previously done for the ship’s database at the State Department of Heritage, Maritime Heritage Unit headed by Bill Jeffrey and Terry Arnott, work done by the now defunct Society for Underwater Historical Research (SUHR) in their publication ‘Soundings’ (Brown 1989a, 1989b, 1989c, Samuels 1989) and references in books such as ‘Scuttled and Abandoned vessels in Australian Waters’ (Parsons & Plunkett 1995) and ‘Wrecks on the South Australian Coast’ (Loney 1993) which contained some helpful information but was at the best of times incomplete and often wrong. Nevertheless from these sources provisional lists of possible candidates for disposal in the North Arm were made which could then serve as a platform for the verification of identity.

There were a wide range of maps on the graveyard which had been made previously whereby individuals had endeavoured to match historical sources to archaeological material each with a differing level
of accuracy. The earliest survey of the North Arm graveyard at Garden Island came in the form of a Marine Board Soundings chart dated March 1931 (Fig 14).

The expectation was that as this map was produced around the time of the initial abandonment of the vessels in the graveyard, its accuracy would be unparalleled in relation to later maps. Yet, its accuracy as a document outlining the whereabouts of vessels and the name of particular vessels was either questionable or wrong. The first indication of the questionable accuracy of the survey was that the vessel marked Sarnia is identified incorrectly with the actual Sarnia elsewhere in the graveyard (in the eastern section). Also the shape to the extreme left on the survey is outlined an individual vessel when archaeology tends to indicate that it may instead be wreckage associated with another vessel, the vessel directly to its right. The next map (fig. 15) was a survey of the area made by Neil Cormack in 1978 apparently for the Department of Marine and Harbours which culminated in the first known representation of the extent of the North Arm graveyard historical or archaeological objects for study. It was subsequently reproduced in many separate publications.
While the accuracy of this representation was much better, and the graveyard’s true extent was surveyed, many of the other vessels in the area which, from historical sources and state of insitu decomposition would have undoubtedly been perceivable at the time of this survey were not included. Fourteen vessels are represented in the Cormack survey, while the 1996-1997 surveys revealed that more like twenty five vessels were easily seen on the bank (although later work settled on the existence of twenty four definite vessels). The other problematic aspects of this survey were that while many vessels were defined as being 'unidentified' a few of the vessels were mistakenly identified. In particular...
the vessel dubbed *Grace Darling* in figs. 15, 16 and 17 is elsewhere and the vessel at the graveyard is in fact the *Glaucus*, a fact arising from inconsistencies in measurements. Other representations followed the same suit as Neil Cormack’s representations by not including all wrecks in the area properly and not accurately correlating the historical information with the archaeological material (figs. 16 and 17).

Even though Loney’s representation from 1993 (fig. 17) is the most recent, Sexton’s survey of the wrecks done in October and November 1989 (fig. 18) proved to be the most accurate of all the representations, probably due to the fact that in this case the surveyor actually went out into the field on more than one occasion!
In this instance Bob Sexton has surveyed all vessels (with the exception of one north of vessel titled ‘Hopper Barge’) but has also surveyed in areas which appear to be wreckage only. Another important feature of this representation is that in all cases where a label for identification has been attached, the identity was confirmed by the current work. Below (Table 1) is a summary of the divergence and comparisons of vessel identification.

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<th>No.</th>
<th>1997 survey</th>
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<th>Loney</th>
<th>Loney &amp; Stone</th>
<th>Sexton</th>
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</tr>
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<td>Ketch</td>
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<td>Grace Darling</td>
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<tr>
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</table>

Table 1: Comparison of past vessel identifications to 1997 survey
CURRENT VESSEL IDENTIFICATION

The following section contains the reasoning behind the identification of each vessel from west to
east from the surveyed ship remains in the graveyard in 1997. For all comparisons of surveyed and historical
dimensions see Table 2. All the numbers referred to in the text refer to the North Arm map (fig. 13). For
further vessel details refer Appendix 2 and for plans of selected surveyed vessels refer Appendix 3.

The most complete found concerning vessel identification was photographic spread in the
newspaper the, Adelaide Chronicle July 20th 1933, which shows the majority of the hulks (fig. 19). Other
relevant details into the identification will be delved into but the vessels listed in fig. 19 are panel 1; the
barque ‘Mosquito’ (actually the barque Sunbeam), panel 2; the steamer Gem (vessel with twin funnels),
panel 3; the Stanley (can just see the bow), the Moe (maybe the Ullock) in the foreground and the Grace
Darling (in the background), panel 4; from left to right the Mangana, Flinders and the Grace Darling,
panel 5; Sarnia (in background) and the Gem, panel 6; the Moe (maybe Ullock) in foreground and the
Grace Darling, panel 7; the Dorothy H. Sterling.

All of these identifications were not taken to be true at face value and other evidence was sought to
provide positive identification.
Figure 19: Early photo of the majority of the Hulks in the North Arm (The Adelaide Chronicle July 20 1933 p.37)
I. Vessel Associated Wreckage

The fact that this wreckage is not included in figs. 15, 16 and 17 can most likely be attributed to the fact that at medium to high tide the remains are inundated with water, if not totally covered and obscured. Nonetheless the original soundings chart from March of 1931 (fig. 14) suggests that there was in fact an entire vessel once situated there. Although this is considered a possibility it is more probable that the remains, while being vessel associated are not in fact a separate vessel as indicated.

It was originally reasoned by the author that historical mention of a vessel Dorothy S. being abandoned in and then taken from the graveyard may have resulted in the ripping out of sections of keel or keelson of the vessel which had sunk into the mud, and that this may have been why a separate vessel was indicated on the soundings chart. On closer examination it was found that it was not a case of a ripped off keel having remained insitu but rather that there was an area where there were numerous spans of wood associated with large amounts of ferrous cabling. Furthermore the existence of straight (relatively unbent) iron bolts in the aforementioned ‘keel’ is (relatively thin in all aspects for keel or keelson material), indicated that such a theory was mistaken. Instead, although it may be possible that the wreckage was associated with a separate and now missing vessel, the remains closely correspond where dimensions are concerned (the most prominent length being over thirty metres) with the wreckage next to it (Seminole). The other likelihood that the wreckage is simply rubbish and not vessel related is dubious due to its position and proximity to other vessels as well as the dimension of the remains.

2. Seminole

In every past survey carried out the existence of vessel No.2 is not shown although Sexton refers to it as ‘Wreckage’. It is indicated as being a ‘hulk’ in fig. 14 and upon survey is too extensive and ‘ship-shaped’ to be considered to be anything other than a separate ship. The evidence
of a definite stern-post upon underwater survey further verified its identification as a vessel in its own right. The vessel is constructed with wooden frames and planking. It is the only sailing vessel that has evidence of copper alloy sheathing and is of considerable size (in excess of sixty metres) considerably reducing the candidates for North Arm disposal. It should be noted that all aforementioned secondary sources on the Ships’ Graveyard have no mention of a wooden hulled vessel of this size being in the North Arm. The breakthrough came with the obtaining of two documents obtained from the South Australian Maritime Museum Archives, both written by Vernon Smith (Smith 1953), ex curator of the Port Adelaide Nautical Museum dated 19th October 1953 and titled ‘Sailing-Ships hulked at Port Adelaide’ and ‘Vessels Broken up at Ships’ Graveyard, North Arm’ (these lists are by no means proved accurate, exhaustive or complete). These documents first mention the ship Seminole (as seen in fig. 20) which upon investigation in Port Adelaide Customs House Register 3/1903 and Bureau Veritas 1868 confirmed that its dimensions fit the surveyed remains. Also other historical sources mentioned that the vessel, sometime after 1898 had become a store-ship at Adelaide (Matthews 1987:288), with the Customs House Register confirming this and adding that the vessel was broken up and register closed 22nd April 1910. The existence of the figurehead of the Seminole in the S.A. Maritime Museum also adds credence to the past existence and breaking up of the vessel in Port Adelaide. As can be seen from figs 21 and 22 the site is greatly decayed and at a medium to high tide is totally consumed by water.
Figure 21: Seminole view of starboard side (remains as of 22-03-97 Photo: M.Staniforth)

Figure 22: Seminole view towards stern (remains as of 22-03-97 Photo: M.Staniforth)
3. *Sunbeam*

The identification of vessel remains as being those of the *Sunbeam* was without doubt before the commencement of the current work. Its location is seen on the earliest of surveys and is evident on all later surveys. Its surveyed remains correspond extremely closely with the historical remains as most of the extremities of the vessel are still present (i.e. the height of port and starboard side and bow and stern are still present, as seen in figs. 23 and 24). Slight inconsistencies in measurements can therefore be attributed to two things: inaccuracy in recording (which can be expected due to size of the vessel) or the ‘spreading’, ‘warping’ or ‘contracting’ of the remains due to its progressive decay.

Initially there appeared in the secondary sources a divergence of opinion on when the *Sunbeam* first appeared in the graveyard. One suggestion was 1886, as it disappears from *Lloyd’s Register of Shipping* in 1886. This is erroneous for the simple reason that the vessel continues to persist in the *Mercantile Navy Register* until 1910 indicating that in accordance with other sources of history it was simply hulked in 1886 (Parsons 1995:46) before being “Stranded at Garden Island near Adelaide, S.A” around 13th October 1910 when its certificate was delivered up (Customs House Register, Melbourne 6/1886).

![Figure 23: Sunbeam view of starboard side (remains as of 22-03-97 Photo: M.Staniforth)](image-url)
4. **Unidentified Wooden Barge**

There is no current identification available for this vessel. It is definitely of a wooden superstructure and has apparently been substantially salvaged. Its dimensions indicate that it is rectangular in plan indicating that it was probably a barge. It shows no signs of propulsion and from its dimensions in fact appears to be ‘un-sailable’. Thus, if its identity as a wooden barge is correct it is probable anyway that it never had an official number or ‘official’ name and is therefore impossible to identify by normal means (oral histories being only other feasible alternative). If it had been converted from a ketch to a barge, which was a possibility it should have shown some sign of a change in shape and would not have been so uniformly rectangular. The depiction of a Thames Barge (fig. 25) is quite possibly similar to the vessel in the North Arm. Its box like configuration and square, steep and sharp ends could quite plausibly match the remains that are present in the graveyard and most probably fulfilled the same function of carting goods such as
timber. It could not however be one of the numerous wool barges that were present in Australia at the start of the century as they were on a much larger scale due to the quantity of goods carted.

Figure 25: Barge at Poplar Docks 1932 possibly similar to barge in North Arm Ships’ Graveyard (Falconer 1993 p.46)

5. **Iron Hopper Barge No.1**

This vessel is evident on the 1931 survey is definitely not the *Sarnia* as ascribed. The *Sarnia* was a dredger deposited in the graveyard in the mid 1920s yet not in the western extremity of the graveyard. Furthermore the historically described *Sarnia* (No.4 dredger) was definitely wooden hulled, iron framed (with these remains being iron hulled, iron framed) according to details from Harbours Board correspondence files and newspaper reports and was of considerably smaller dimensions (width is over three metres larger on the remains). Nevertheless there are few candidates for dredgers of this type in Port
Adelaide. According to Mathews (Mathews 1984) there were only eight dredgers built for use in South Australia before 1908. The government control and monopoly on deepening operations in the early colony may indicate that only these eight and possibly the ninth dredger are candidates for disposal on Garden Island. The No.1 dredger Adelaide fits the dimensions and specifications of the remains yet its withdrawal from service in 1879 disallows it as a candidate because the vessel north of the dredger (to be discussed) could not get to its current location if the dredger Adelaide was placed where the remains lay. The No.2; South Australia, No.3; London, No.5; Wallaroo, No.7; Grappler, and No.8; Kooringa dredgers are all of considerably different dimensions or were disposed in places that can be confirmed while the dimensions of the No.6 dredger; H.C. Meyer and No.9; Tridacna are unknown to the author. The vessel may be similar to the last (most easterly beached) vessel even although both are greatly decomposed. Plans of a hopper barge with short propeller shaft and close to stern engine housing plate match the archaeological record (fig. 26).
Figure 26: Hopper barge plans 14/01/1884 (Plan # 1954/34)
The identification of the vessel as either a barge or dredger is impossible to guarantee at the present time. The depiction of a dredger below (fig. 27) indicates that the vessel may have had a side bucket ladder dredger configuration meaning that no internal well for dredging apparatus was required. This would mean that as in hopper barges (which did not dredge) no evidence of the more common internal bucket ladder configuration would appear on the archaeological record. The existence of a collection of other boiler sections and probably pieces of assorted dredging apparatus (for details of dredging apparatus see Sargeant 1918 and Encyclopaedia Britannica 1910-1911) at the stern of the vessel may help in this identification as it is highly likely that it is associated. More work must be done on this vessel to gain a definite identification or at least a definite function and configuration.

It does not help that the South Australian government appears to have initially self-registered vessels that they owned and used, meaning that no information is available short of delving into now destroyed or ill-maintained government or Harbours Board records the whereabouts of which may not be publicly accessed.

Figure 27: Side ladder bucket dredger similar to westerly hopper dredger (Courtesy of S.A.M.M. #691)
6. **Killarney**

The remains of this vessel which can be seen in fig. 28 were the hardest to identify. This was due to its advanced state of disintegration and the fact that it was impossible to obtain any definitive width of the vessel. This was because it consisted of a wooden keelson/keel with iron boiler on top and evidence of wooden stern post and propeller aperture with little sections of the hull intact besides one section of framing with apparent copper alloy sheathing. Furthermore the only length measurement obtainable went from the intact stern post to the evidence of a stem post at the forward end of the keel (no bow was intact). In the end this length did not pose to be a problem as the existence of a file at the State Archives titled ‘Declarations for Vessels now Broken up or for other reasons now out of Commission 1916 - 1926’ (GRG 51/97) served as a means to narrow down candidates for the vessel. It should be pointed out that from the scant physical remains found, it was possible to identify the vessel as a wooden screw steamer (because of propeller shaft aperture). Harbours Board correspondence files mention a vessel named *Killarney* being at the North Arm but neglected to refer to its vessel type or dimensions. A wooden steamer of this name was not found in the *Lloyd’s Register of Shipping* although as later discovered it was listed in the *Mercantile Navy Register*.

The declarations list of vessels comprised of the last survey documents for certain vessels and listed eighty-one, eleven of which were classified as ‘wooden-steamers’. Due to the existence of a stem post on the remains of the vessel it was reasonable that one could not infer more than one metre onto the vessels remains, and investigations into the dimensions of the eleven ‘wooden steamer’ candidates revealed that only one, the *Killarney* was likely to be the vessel (the rest of the vessels ranged in size from about seventeen to twenty-eight metres long). This, enforced by the other historical information is sufficient to positively identify the vessel. Customs House Registers (Sydney 1/1876) mention that the vessel had been broken up and its “registry thus closed 3rd November c.1931” although there are references to the vessel sinking in Hawker’s Creek, Port Adelaide in 1925, being raised and abandoned sometime in 1928 and subsequently being sold for breaking up at the North Arm (GRG 51/32/2 HB 1066/25:25, GRG 51/170/749/1928). Other descriptions of sections of the vessel (number of masts, decks, type of bow and stern etc.) obtained from registration documents (Customs House Register, Sydney 1/1876) proved no help due to the vessel’s incomplete state.
7. **Iron/Steel Pontoon**

As with vessel No.4 these remains were unidentifiable. This vessel is a pontoon with many internal compartments and arguable evidence of second hull within. This vessel was placed on the top of the bow of vessel No.8 (to be mentioned) and appears to have had no means of propulsion. It is therefore likely that no identity can be attached to these remains as it was probably towed behind another vessel. The only clue to its function is that it corresponds with construction plans of a crane pontoon (not included, but resembling fig. 29) where the central square section was a crane mounting feature.

8. **Lady Daly**
Unmistakably a wooden sailing vessel. This greatly deteriorated ship had measurable length and width only as a minimum expected to be accurate. One complicating factor was that one to two metres of length was underneath vessel No.7 which had been placed over the bow section. Such an estimate was reached through inferring hull shape and the lack of wooden wreckage evident on the other side of the Iron pontoon. The most likely candidate is a vessel, *Lady Daly*, a wooden fore and aft schooner included in the 1953 Papers of Vernon Smith (Smith 1953) and described as being “… dismantled and the hulk sunk in the Port River on the 6th September 1929” (Parsons 1983:59, Parsons & Plunkett 1995:44, Customs House Register, Adelaide 22/1877). Due to the advanced deterioration of the remains, other features such as build of stern and construction methods cannot be investigated. *Lady Daly* is the likeliest and only known fitting candidate yet may be the closest to a provisional identification of a vessel in the graveyard. The date of abandonment however corresponds if one considers that the proposed abandonment date is in 1929 and the Marine Board soundings chart of 1931 (fig. 14) shows a vessel in the position of the wooden ship wreckage mentioned. Other descriptions of sections of the vessel (number of masts, decks, type of bow and stern etc.) obtained from registration documents (Customs House Registers, Melbourne 15/1876 Adelaide 22/1877) proved no help due to the limited amount of the vessel remaining.

9. *Enterprise*

This iron vessel (see fig. 30) is in quite good condition and is one of the only vessels to have had limited salvaging of metal carried out on it over time. As a consequence dimensions obtained from this vessel can be considered extremely accurate and the vessel’s hull highly intact. Tracking down a candidate for this vessel proved difficult as it was an iron steamer of relatively small size and could not be considered a cargo ship. Its identification as *Enterprise* arose through a detailed perusal of the book ‘Steam Tugs in South Australia’ where the only vessel to correspond with the remains (to within centimetres in all surveyed lengths and widths) was the *Enterprise* (Parsons 1983:74). Customs House Registry documents describe how the vessel’s engines were removed and its registry documents cancelled on the 18th August 1913 (Customs House Register, Adelaide 6/1880). Historical sources (Parsons 1983:25) describe how previous
to cancellations of its registration the vessel was made into a water tender for vessels at anchorage for its last few years before being abandoned (whereabouts unspecified).

The fact that the vessel is not featured in the file ‘Declarations for vessels now broken up…1916-1926’ (GRG 51/97) adds credence to its disposal somewhere in Port Adelaide previous to 1916. Features of the vessel described in its registry documents (Customs House Registers, Sydney 31/1872, Adelaide 17/1873, 6/1880) such as its single deck, elliptic stern configuration, carvel build, lack of gallery, and iron framing correspond with the remains while all other features were impossible to determine due to the fact that certain sections of the vessel were either covered by mud or had been removed.

Figure 30: Enterprise view of portside stern (remains as of 22-03-97 Photo: M.Staniforth)
10. Sarnia

The Sarnia although misidentified in fig. 14 as being in the western section of the graveyard appears to have been the one of the first vessels deposited in the eastern section of the graveyard. Its history within Harbours Board correspondence files is extensive and detailed and therefore leaves no doubt that the vessel marked Sarnia in fig. 14 is not. One document gives an exact time of 5 p.m. 7th April 1927 for the disposal of the Sarnia at the North Arm (GRG 51/170/1723/1926). The physical remains of this vessel are of odd manufacture probably arising through it being built in South Australia when local shipbuilding was in its infancy. On initially finding the wreckage it was thought that the remains were either of the hull of the paddle steamer Gem (as it appeared that the iron framework allowed for paddle wheels and associated machinery) or was deck framework from the Gem arising from its usage as a bridge/pontoon across a Quay in Port Adelaide around 1926 (see figs. 31 and 32) (Ritter 1996:70-73). The evidence of boiler housing plates on the Sarnia framework, the smaller width of the Gem when compared to the surviving width of the framework, the fact that the Gem would not have had such heavy iron framework so close to its hull base (as it is described as composite, any iron would be above the wooden knees of the vessel) and the fact that the Gem was not even removed from the Quay where it served as a bridge until three months after the Sarnia had been deposited in the graveyard (therefore it must be further into the bank, or further north) confirms vessel No.10 as the Sarnia. Any salvaging of the Sarnia would have taken the wood from its hull and left the intricate iron framework which is evident. The evidence of some ferrous material on remaining framing may be attributed to the changes that occurred in its dredging configuration over the years (compare figs. 33, 34, 35, 36) or from repair done on it as a hulk. The framing that is evident is probably associated with the ‘dredger well’ central to its hull which was modified but remained after it was converted from a bucket ladder dredger (figs. 33, 34, 35) to a grab dredger (fig. 36).
Figure 31: Sarnia view from bow (remains as of 22-03-97 Photo: M.Staniforth)

Figure 32: Sarnia view to bow (remains as of 22-03-97 Photo: M.Staniforth)
Figure 33: Sarnia plans 1878 (Plan #1526/29)
Figure 34: Sarnia Plan 06-04-1899 (Plan #1532/29)
Figure 35: Sarnia plan 10-05-1905 (Plan # 1534/29)
Figure 36: Sarnia plan 07-03-1912 (Plan #1537/29)
11. *Gem*

The existence of the Paddle steamer *Gem* is included in fig. 14. Its only known mention as being located in the North Arm came from secondary written information in the book ‘Spanning Time and Tide’ a book concentrating on the bridges of Port Adelaide (Ritter 1996). This is because the *Gem*, after being semi-dismantled as a ferry in Williamstown (due to the liquidation of Victorian Steam Ferries in 1908) (Evans 1969:35) became a silt pumping barge before becoming a pontoon bridge across the No.2 Quay. Finally it was removed on the 19th July 1927 with its first mention of being in the North Arm arising from a request to break up the vessel where it lays in the graveyard on the 26th October 1927 (GRG 51/170/1470/1927).

In registry documents from its Customs House Register (Melbourne 33/1868) the vessel is described as having composite framework meaning that it had a wooden hull with metal (iron) framework above the bilges of the vessel (such is standard with river going vessels). This is reflected in the physical remains as there is definite evidence of a wooden hull. In addition to this there is evidence of ‘RHV’ metal spans evident in figs. 38 and 39 (I-shaped in cross-section) along parts of the inner hull. This may have been used for many reasons, functioning as a boiler/engine bed associated with silt pumping machinery installed after its initial use-life had commenced or may in fact be associated with measures to strengthen the vessel during its time as a bridge. The remains at the graveyard are definitely not that of a screw steamer as there are intact indications of bow and stern, without evidence of propeller shaft apertures, further adding to evidence that the remains are that of a paddle steamer which propels itself via wheels placed on the port and starboard sides of the vessel (as the *Gem* did).
Figure 38: View of side of Gem (remains as of 03-07-97 Photo: N.Richards)
12. Ullock or Moe

The Ullocks’ final Customs House Register (Melbourne 21/1912) cites that the vessel was broken up at Port Adelaide. This information is substantiated by a newspaper reference to its breaking up on the Birkenhead bank (Advertiser 07/05/1937). Contained in Harbours board files (GRG 51/170/274/1937, GRG 51/170/901/1937) are discussions on the disposal of the Ullock in the North Arm and a series of legal problems which arose because of its deposition there sometime after the 2nd April 1937 (it was dumped without permission, and was hence was an illegal dumping). The Advertiser reports that the Ullock was beginning to be broken up for scrap on the 7th May 1937 (Advertiser 7/05/1937 p.24) while its final Customs House Register cites ‘closed 27th October 1937’ (Adelaide 11/1912).

The Moe was an iron sailing vessel closely matching the historical dimensions and vessel type of the Ullock. The Moe appears to have been initially abandoned in the North Arm sometime after the initial request for abandonment by its owners McIlwraith and McEachern on the 21st August 1926 (GRG 51/170/1061/1928). The next references to the vessel tell of two incidents where the ship floated away from the graveyard with a high tide (due to its improperly executed abandonment) on the 24th July 1929 and a
further refloating where it travelled some kilometres away and damaged a wharf on the 1st February 1930. This is not, however, the end of the story, as these floatings do not explain the absence of the vessel from the graveyard. The vessel is further documented as being re-interned on the shore of the graveyard on the 25th September 1931 between 3:35pm and 5:40pm (GRG 51/32/5 HB 887/37 p.233).

The fact that the Moe is documented as floating away aids in identifying the remains as seen in fig. 40 as those of the Ullock but other problems are evident. A vessel dubbed Moe which corresponds with the present day remains is present in fig. 19. The fact that the photo is taken in 1933 would indicate two things. It is either the Moe, or, if the identification is wrong, then the Ullock may have been placed in the area earlier than documented. One problem which arose during the process of identifying this vessel was that both the Moe and the Ullock are historically documented as having been placed in the graveyard. The dimensions of the two vessels are extremely similar; they are both single decked, round sterned, three masted iron barques, the only distinction between the two being the way in which the plating was arranged with the Ullock an ‘in and out clincher’ built vessel matching the vessel in the North Arm (the Moe was ‘carvel’ built) (see Customs House Registers 21/1912 Melbourne for Ullock and 3/1921 Adelaide for Moe). It is difficult to discern the plate construction of the remains because almost nothing of the hull survives. Only one to two plates along the side. The crucial factor will lie in obtaining Lloyd’s Survey documentation for both vessels which will include all construction details and specifications, something which at the conclusion of this thesis was unobtainable due to time and financial constraints.

13. Iron Pontoon

As with vessels No.4 and No.7 this vessel as seen in figures 41 and 42 proved unidentifiable. This vessel lies on the aft section of the Ullock or Moe covering about nine metres of the barque’s length. It is of similar length and breadth as the first iron pontoon mentioned but has smaller draught and is not strictly square in profile, having rounded ends. There is no observed means of propulsion at all, but there does appear to be some evidence of attached chain and rope, probable indications of its usage as a towed vessel. There may however be a clue to its identity as a concrete reinforced barge/pontoon as it is of similar dimensions and appears to have the same pattern of upper compartmentalisation (see fig. 43).
Figure 41: Iron Pontoon on top of Ullock or Moe (remains as of 22-03-97 Photo: M.Staniforth)

Figure 42: Iron Pontoon on top of Ullock or Moe (remains as of 03-07-97 Photo: N.Richards)
Figure 43: Reinforced concrete pontoon similar to pontoon on top of Ullock or Moe (Plan # 1986/40)
14. *Stanley*

This vessel is mentioned in the 1931 soundings chart but not elsewhere. Its presence in this survey fits with its historically mentioned time of deposition in the graveyard on the 7th October 1930 (GRG 51/170/394/1930). These correspondence files outline the vessel’s usage after its primary phase as a working boat (as seen in fig. 44) and the whereabouts of its dismantling and its final deposition. Physically the remains of the vessel (fig. 45) shows no evidence of its being a screw steamer or a paddle steamer (which it was converted from) as the port and starboard sides are not present above the bilges and major portions of the stern of the vessel is missing. Its final registry document (Customs House Register, Adelaide 14/1879) confirms that it was indeed broken up for scrap iron in the Port in 1930 as its registry closes 3rd October 1930.
15. *Grace Darling*

The steamer *Grace Darling* (in fig. 46) has only been correctly identified by Bob Sexton in his 1989 survey. Every other representation of the graveyard indicates that the position of the vessel is further east on a site that can proved to be the screw steamer *Glaucus*. The error is evident because the surveyed extent of the vessel remains, although matching the historical dimension of the *Grace Darling* is actually missing quite a significant portion of its bow. This means that it cannot actually be the *Grace Darling*, but must be a vessel of substantially larger length. The *Glaucus* exceeds the fifty-three metres of the remains by a substantial amount and is historically mentioned as being deposited in the Ships’ Graveyard.

The remains of a vessel further west (those shown in fig. 47) fits the actual dimensions of the *Grace Darling* and is a complete hull from which quite accurate dimensions can be extrapolated. Historical details on the deposition of the vessel in the
graveyard states that on the 19th June 1931 the *Grace Darling* was deposited east of the water pipes (though the centre of the graveyard) and north of the *Juno* and *Mangana* (vessel to be discussed which are further east, yet more northerly than where the vessel had been thought of as being) (GRG 51/32/2 HB 540/31 p.155). This date and location is further backed up by a statement from its last owner, J. Darling & Son on 28th July 1931 which follows that the hulk was deposited on the aforementioned day (GRG 51/170/540/1931). The best signifier of the existence and position of the *Grace Darling* in the graveyard was a picture of four of the hulks taken from the bank on which they were placed in the 1930's. The name *Grace Darling* is seen on the starboard bow side of the vessel where the wreckage now lies (fig. 48).

![Figure 48: View of Mangana, Juno, Flinders & Grace Darling in the 1930's (Left to right) (Courtesy of J. Perkins & S.A.M.M #5918)](image)

16. Iron Pontoon

The pontoon depicted in fig. 49 lies alongside and touches the port side stern section of the vessel *Flinders* (No.17, to be discussed). It appears in cross section to be of a kind between the two aforementioned iron pontoons as it has the same approximate length of the two other iron pontoons but has a
breadth in between the two. Once again identification of the vessel is impossible for reasons already mentioned.

![Figure 49: Pontoon alongside Flinders (remains as of 03-07-97 Photo: N.Richards)](image)

17. Flinders

Historical information from Harbours Board correspondence files indicate that permission for the abandonment of Flinders occurred on the 26th August 1931. It was then deposited in the North Arm on the 4th September of that year being scuttled with explosives at various times (GRG 51/32/5 HB 887/31 p.199, 235, GRG 51/170/887/1931). Descriptions from its registry documents (Customs House Register, Hobart 4/1879 Melbourne 1/1894) it as a clinker built, double masted, double decked, round sterned iron vessel all correspond with the physical remains. Also fig. 48 shows that a vessel with apparent fire damage was in the place of the Flinders’ current remains, something which is in accordance with the vessel’s fire damage, inflicted on it in 1911 (Parsons 1981a:80, 1981c:56, 1986c:127,1989a:66, Parsons & Plunkett 1996:42, Loney & Stone 1983:22, Loney 1993:160). Historical sources (GRG 51/32/5 HB 887/31 p.235) also
explain the location where explosives were set off (at the ends and at the forward bulkhead) and this is evident from the archaeological evidence.

18. Thomas & Annie

The Thomas and Annie is without doubt the smallest vessel in the graveyard as can be seen in fig. 50. While its final registry document (Customs House Register, Adelaide 2/1936) cites that its certificate was closed on the 5th December 1945 it also specifically states that “Vessel abandoned for years in the North Arm Port River Port Adelaide and no longer considered a vessel”. This final registry document is dated 19th November 1936 and its final owner is cited as being F.B. and T.E. Albino in 1941. This means that the time of deposition in the graveyard lies sometime between its final purchase in 1941 and its closing of registration at the end of 1945 (although it appears more likely that the vessel would have been abandoned closer to 1941). The only other mention of the Thomas and Annie is in a document which mentions a mishap in August 1939 where the ketch sank, was raised and was subsequently condemned (GRG 51/170/901/1937). Seeing that the life span of a
hulk, especially a wooden hulk, is quite insubstantial, it would therefore not be unreasonable to see that by
the early 1940’s the wooden hulk would have been ready for abandonment. The two most obvious features
of the site are the insitu rudder (fig. 51) and windlass (in fig. 52), both quite well preserved.

![Figure 52: ‘Thomas & Annie’ view of bow (remains as of 03-07-97 Photo: N.Richards)](image)

19. Juno

The Juno (depicted in fig. 53) is also evident in fig. 48 as the vessel cut down in the middle. Although the copy of the photo from the South Australian Maritime Museum lists it as ‘Karatta’, that vessel’s dimensions vastly exceed the surveyed dimensions while those of the Juno closely correspond. Although this may be sufficient to qualify its abandonment in the graveyard, another document which specifically describes its abandonment as occurring at 4pm on the 21st April 1931 and a description of it being “… at the North Arm alongside and inshore of the Mangana” (to be mentioned) (GRG 51/170/443/1931) makes it definite. As it was deposited after March 1931 it is notably absent from the earliest surveys of the area.

![Figure 53: Juno in Port Adelaide (n.d.) (Courtesy of S.A.M.M. #34)](image)
20. Mangana

The Mangana also occurs in fig. 48 with its name written on port and starboard sides of the bow. This vessel was abandoned just over a month prior to Juno on the 23rd March 1931 (hence its reference in the beaching of Juno) (GRG 51/170/140/1931 & Customs House Register, Sydney 42/1897) in time to be included in the March 1931 soundings survey (fig. 14). Reference to one of its masts listing to one side is also evident in fig. 48 and information concerning a cracked plate twenty by twenty four inches in shape is echoed in the archaeological remains with a cutting made in the port aft section of the remains (GRG 51/32/5 p.95). Another piece of historical information that corresponds is the pair of mountings which fit with the vessel’s twin cylinder steam engine.

A photo obtained from the personal collection of Mr. W.J Corey shows himself (left) and a friend on the Mangana around 1936 (fig. 54). The vessel in the background is the Garthneill which was abandoned some years after the Mangana and is therefore not present in fig. 48 or in the March 1931 survey (fig. 14).

![Figure 54: W.J. Corey (left) and friend on the Mangana with view of Garthneill around 1936 (Courtesy of Mr. W.J. Corey)](image)

21. Garthneill
The Garthneill (as seen in fig. 55 and 56) is reported as being abandoned on the 29th November 1935 (News 29/11/1935). This is consistent with the approximate date of 1936 given for the above photographic image (fig. 54). This explains why the vessel appears to be in such good condition. The characteristics of the hull, or specifically the unusual construction method of the hull, with it appearing to be of both normal and ‘in and out’ clinker construction can be readily seen in fig. 54 with one section apparently sticking out more prominently than the others. This is mirrored on the remains of the vessel. Mention of the vessel being holed fore and aft, bow plates cut away and explosives used on the vessel are also evident.

The significance of the Garthneill comes from it being one of the last British square-rigged sailing ships used for commercial purposes to be put out of commission (Advertiser 19/8/1932 p.17, 29/11/35 p20).

22. Glaucus
Much of the history of the screw steamer *Glaucus* (fig. 57) remains a mystery as references to the vessel in newspapers and Harbours Board correspondence files are a rarity. Nevertheless according to its only known correspondence reference (GRG 51/170/622/1934) it is described as being abandoned in the graveyard at 5:45pm 4th July 1935. The lack of information arises because it appears to have been an ‘emergency’ abandonment due to negligence in its dismantling.

The width of the historical and surveyed vessel correspond, but due to the removal of the majority of the bow end, length could not be used as a diagnostic tool for positive identification. It is considered reasonable that the surveyed remains could have been almost twenty metres longer by inferring a bow point from the shape current of the vessel.

23. Iron Hopper Dredger
This vessel is similar to the other iron hopper barge/dredger. Like the other vessel it has evidence of hopper doors in what is thought to be aft of centre of the vessel but in this case the vessel actually has more evidence of means of propulsion. This barge has unfortunately been cut in half as seen in figs. 58 and 59, so it is impossible to affix a definite identification. It does however contain evidence of engine/boiler housing which indicates the relatively short length of the propeller shaft that propelled the vessel. This may be in accordance with plans obtained of the No. 8 and No.9 steam hopper barges (fig. 26) that were used by various ports authorities in the early twentieth century. Such a vessel’s abandonment would have been of little importance and may not therefore have featured very prominently or copiously in any historical mentions in newspapers or harbours board correspondence files especially as it appears that many vessels were built to the same specifications with exactly the same configurations.

Figure 58: Easterly dredger looking towards stern (remains as of 03-07-97 Photo: N.Richards)
24. Dorothy H. Sterling

The Dorothy H. Sterling, as seen in 1910 in fig. 60, is probably the most documented of all of the abandoned vessels at the graveyard as it features in the major South Australian newspapers (predominantly the ‘Register’, ‘News’ and the ‘Advertiser’) continually from about February of 1929 until July 1932. As this vessel was foreign (U.S.A) owned and never hulked at the time of its demise there are no Australian registration documents of the vessel to provide information. As a consequence, beside rare references in the correspondence letters of the Harbour Master of the time as to the progress of the breaking up of the vessel, most of the information on its final deposition has come mainly from the aforementioned, often error fraught newspapers. The ‘News’ provides the only indication of a position and date on the final abandonment being at the ‘extreme east end of the North Arm where it was beached and scuttled’ on the 6th June 1932. This has proved to be extremely accurate as at that time the Dorothy H. Sterling (which is situated a few hundred metres from the large concentration of beached vessels) was at the extreme east end of the graveyard, only to be later exceeded in
A 1996 survey (Richards, Roe and Welsh 1996) shows that the dimensions of a disintegrating wooden vessel that had been reclaimed by a process of continual silt deposition and subsequent mangrove progress were extremely compatible with known dimensions of the wooden schooner.

The significance of this vessel not only lies with it being intrinsically linked with the Great Depression but with its comparable dimensions to some of the largest sea-going vessels of the world. For example, it is only about six and a half metres shorter in length than Australia’s largest wooden sailing ship the *Schomberg*, wrecked in Curdies Inlet, Peterborough, Victoria (Foster 1996:125) and is comparable in length to Australia’s and the world’s largest steel sailing vessel the *Speke* (94.55 metres long) wrecked off Kitty Millers Bay, Phillip Island, Victoria (Jordan 1995:258-259, Testa n.d.:77). This is an impressive statistic, as wooden vessels could only be a maximum of three hundred feet (ninety one and a half metres) without ‘hogging’, ‘sagging’ or breaking their backs (where the extremities of the vessel drop and the hull bends) leading to certain disaster due to breakage and leakage while at sea (Stokoe 1968:12-16, Pollard and Robertson 1979:14, Coates 1985:417-437, Kemp 1988:391, 737). The failure of the Mallow’s Bay wooden steamers may have been the reason that the *Dorothy H. Sterling* was built as a schooner rather than as a steamer as was the documented initial intention.

25. *Santiago*

Verification of the identity of the vessel *Santiago*, the wreck located furthest away from the main concentration of the graveyard proper (some may argue that the North Arm graveyard extends much further) was primarily the product of work done by the State Heritage Branch’s Maritime Heritage Unit through attempts to preserve it as the world’s oldest unrestored iron vessel. The dimensions of the hulk which was largely untouched by salvagers matches exactly the historical dimensions. Very few official Harbours Board documents exist, mainly due to the supposed destruction of many historical documents from the early 1940’s. Of the few documents that survive, mostly as notations on earlier documents, is a mention of the whereabouts and time of deposition of the vessel as being on the beach of Garden Island, west of the water pipes on the
19th April 1945 and from there moved to its current position in the gutter of the North Arm east of the water pipes (GRG 51/263/901/1937).

The significance of the Santiago has been attested to with its protection under appropriate Historic Shipwrecks legislation (S.A. Historic Shipwrecks Act 1981). Protection has been given to the vessel as currently believed to be the oldest surviving iron vessel in the world and attempts to stabilise the gradual corrosion of the vessel using sacrificial anodes and rust conversion products have been ongoing for some years (Portside Messenger 17/2/93, Advertiser 17/5/95, 15/6/95, Kentish 1995:i-1, Jeffrey 1995:4-5).

Figure 61: Santiago view of starboard side (remains as of 03-07-97 Photo: N.Richards)
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<td>Iron Pontoon</td>
<td>12.30</td>
<td>N/A</td>
<td>6.20</td>
<td>N/A</td>
</tr>
<tr>
<td>14</td>
<td>Stanley</td>
<td>21.50</td>
<td>24.40</td>
<td>5.10</td>
<td>5.25</td>
</tr>
<tr>
<td>15</td>
<td>Grace Darling</td>
<td>53.60</td>
<td>53.38</td>
<td>7.50</td>
<td>8.25</td>
</tr>
<tr>
<td>16</td>
<td>Iron Pontoon</td>
<td>12.48</td>
<td>N/A</td>
<td>4.50</td>
<td>N/A</td>
</tr>
<tr>
<td>17</td>
<td>Flinders</td>
<td>68.50</td>
<td>69.27</td>
<td>8.70</td>
<td>8.63</td>
</tr>
<tr>
<td>18</td>
<td>Thomas &amp; Annie</td>
<td>14.40</td>
<td>14.82</td>
<td>4.80</td>
<td>4.91</td>
</tr>
<tr>
<td>19</td>
<td>Juno</td>
<td>40.10</td>
<td>39.62</td>
<td>7.00</td>
<td>7.01</td>
</tr>
<tr>
<td>20</td>
<td>Mangana</td>
<td>58.15</td>
<td>63.53</td>
<td>8.20</td>
<td>8.27</td>
</tr>
<tr>
<td>21</td>
<td>Garthnneil</td>
<td>67.50</td>
<td>72.59</td>
<td>11.10</td>
<td>10.98</td>
</tr>
<tr>
<td>22</td>
<td>Glaucus</td>
<td>&gt; 53.30</td>
<td>72.74</td>
<td>10.20</td>
<td>10.43</td>
</tr>
<tr>
<td>23</td>
<td>Iron Hopper Dredge</td>
<td>18.52</td>
<td>N/A</td>
<td>9.05</td>
<td>N/A</td>
</tr>
<tr>
<td>24</td>
<td>Dorothy H. Sterling</td>
<td>82.50</td>
<td>81.43</td>
<td>14.85</td>
<td>15.25</td>
</tr>
<tr>
<td>25</td>
<td>Santiago</td>
<td>50.90</td>
<td>50.90</td>
<td>8.08</td>
<td>8.08</td>
</tr>
</tbody>
</table>

Table 2: Surveyed v. Historical Dimensions of Vessels in Graveyard

**VESSELS KNOWN TO HAVE BEEN IN GRAVEYARD BUT ARE NOW ABSENT**

Within current research various names of vessels are documented as having been placed within the ‘North Arm’ but are absent in light of the aforementioned identifications (which are considered accurate by the author). There are a wide range of reasons why vessels mentioned as being in the graveyard but are not reflected in the contemporary archaeological record. Among them are issues such as whether a vessel listed as being in the ‘North Arm’ is actually in the graveyard or whether the currently studied concentration of wrecks is simply the surviving remnant of a wider spread phenomena. The simple fact that the ‘North Arm’ is of larger extent than the currently defined boundaries of the graveyard leaves open the possibility that vessels beached elsewhere within the North Arm, yet not at the current site of the graveyard, have simply been removed by the encroaching development of the Port Adelaide area. The problem of inconsistencies in
the definition of the ‘North Arm’ is one to be considered as it is possible that smaller vessels may have been scuttled further east where the North Arm joins the Barker Inlet.

The clearest evidence of an extension of the abandonment ground comes from certain aerial photographic maps from the 1970’s (DENR Maps 6628-31b, g and h) which clearly indicate ‘wreck’ in certain places west of the Torrens Island Bridge (and past the western boundary of the Ships’ Graveyard), on the southern bank of the North Arm in the general vicinity of the current slipyards. Attempts to discover the existence of such vessels in photographic and historical records have proved fruitless and undoubtedly more research is required.

Nevertheless there are certain vessels which have been encountered in the current research into vessel abandonment, which in the author’s opinion were at some time within the boundaries of the study area.

1. Kadina

The Kadina was a wooden ship listed as ‘stranded’ at Wallaroo in May 1875, recovered and hulked before finally being damaged by fire while moored in the North Arm on 4th April 1879 and subsequently destroyed by explosives on 6th June 1879 (Parsons 1985a:14, 1986a:75, 1994:57, Parsons & Plunkett 1995:43-44, S.A.P.P. 1880 No.40, p.6.). The reason the vessel is believed to have been finally destroyed in the actual area of the graveyard is the fact that the southern shores of the North Arm were littered with explosives stores, a fact that is still currently evident from place names along the shoreline such as ‘Magazine Creek’ (as in gunpowder magazine) to the south of Garden Island and ‘Magazine Road’ which is currently owned by Penrice Pty. Ltd at Gillman and leads to an explosives hulk with associated jetty and railway. It is not conceivable that there would have been an allowance made by any Port Authority of the time to allow the detonation of explosives on a ship close to any explosives stores when the safety of such stores were the reasoning behind its isolation from Port Adelaide’s centre, along with other public safety issues. Therefore it can be reasoned that the northern shore of the North Arm (the shoreline of the graveyard) was the location of the destruction of the Kadina with it being the earliest known purposefully destroyed vessel in the North Arm graveyard. The destruction method and the age of the incident is the most probable reason why there
are no contemporary remains of the vessel as the destruction of the vessel is said to have broken “…the ship into pieces, scattering parts in every direction.” (Parsons 1985a:14).

2. *Dorothy S.*

The case of the *Dorothy S.* began as a mystery until further delving into archival sources determined its final fate. This wooden ketch was reported to have been disposed in the graveyard on the 28th June 1928 (Parsons 1995:42). This date is in fact wrong with regard to disposal of the vessel at the North Arm, as a Mr. Robert Rake is documented as seeing the vessel at the Ships’ Graveyard on the 28th of October 1926 and requests to refloat the vessel to house two ‘Hydroplanes’ in ‘Bream Creek’ (GRG 51/170/1573/1926).

It was still in the North Arm on the 2nd June 1928 with a documented request of a Mr. George Lewin to buy the vessel for breaking up (a request that was declined, supposedly due to its sale to Mr. Robert Rake) before being documented as being in Bream Creek on the 12th June 1928 (GRG 51/170/749/1928, GRG 51/32/2 HB 1573-26 p.64). The word ‘Hydroplane’ is unknown to the author as the vessel was just over twenty two metres long and would not supposedly be able to hold two ‘Planes’ of the flying kind, likewise it does not seem to be a marine term (it is not present in Kemp 1988). The mention of ‘Bream Creek’ is also a mystery as it is not present on any past or modern day chart of the area (it is possibly a colloquial name of an already named inlet or creek), and therefore cannot be located as yet. Wooden ships of this kind when removed from muddy areas are known to have often left sections of keel or keelson behind and it is this reasoning that lead the author to initially believe that the area of wreckage in the western extent of the graveyard was evidence of the removal of the *Dorothy S.*, a theory which has been revised due to similarities in dimension between sections of the wreckage and the material from the *Seminole* (also the wreckage is not of desirable thickness to be keel or keelson material).
CHAPTER 6:

SITE FORMATION PROCESSES:

A TEMPORAL AND SPATIAL DEFINITION OF THE GRAVEYARD

Positive identification is the most accurate way to assign dates of deposition of vessels in the North Arm Graveyard. Even so, without such identifications, it is still possible to date the vessels to certain times according to their spatial position to other vessels.

Identifying and assigning probable dates to remains of vessels in the graveyard can help in two major areas. Firstly, it can be used to show that such identifications are correct and secondly, it can show the details of the site formation processes which occurred. Of the twenty four vessels in the graveyard (twenty five if the wreckage is included) ten of the vessels can be isolated to the day of deposition while the range of time for the remainder of the remains range from two months to over sixteen years. Definite dates arise from specific historical references in Harbours Board correspondence files. Small ranges of dates come from a range of primary documents such as the Customs House Register (date of last document, date of final transferral of ownership and date of registry closure which although not definite to the day at least give a range), and historical references to ships in secondary sources. Large date ranges occur when there is no definite identification of the remains and dates must then be inferred from the positioning of vessels in relation to identified vessels.

The following table (table 3) summarises the sources for historical references of vessel deposition in the North Arm and illustrates the range of dates which particular vessels of no definite abandonment date may have been placed in the graveyard both from the pure historical record and, where required, through inferences from the juxtapositioning of vessels.
<table>
<thead>
<tr>
<th>Wreckage</th>
<th>Earliest Date</th>
<th>Reference/Reasoning</th>
<th>Latest Date</th>
<th>Reference/Reasoning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seminole</td>
<td>19 Dec 1908</td>
<td>Final date of registry (Adelaide 3/1903)</td>
<td>22 Apr 1910</td>
<td>Registry closes (Adelaide 3/1903)</td>
</tr>
<tr>
<td>Sunbeam</td>
<td>28 Jul 1909</td>
<td>Historical Mention of conversion to hulk (Melbourne 6/1898)</td>
<td>13 Oct 1910</td>
<td>Register closes (Melbourne 6/1886)</td>
</tr>
<tr>
<td>Wooden Barge</td>
<td>27 Jun 1913 - 18 Aug 1913 (period)</td>
<td>After abandonment of 'Enterprise' (is more inland)</td>
<td>c. 11 Aug 1925 - 12 Jun 1928 (period)</td>
<td>Before Abandonment of 'Killarney'</td>
</tr>
<tr>
<td>Hopper Barge 1</td>
<td>27 Jun 1913 - 18 Aug 1913 (period)</td>
<td>After abandonment of 'Enterprise' (is more inland)</td>
<td>c. 11 Aug 1925 - 12 Jun 1928 (period)</td>
<td>Before Abandonment of 'Killarney'</td>
</tr>
<tr>
<td>Killarney</td>
<td>11 Aug 1925</td>
<td>Historical Mention of sinking and raising (GHG 51/32/2 Hb 1066/25:25)</td>
<td>12 Jun 1928</td>
<td>Historical mention of being broken up (GHG 51/170/749/1928)</td>
</tr>
<tr>
<td>Sunbeam</td>
<td>28 Jul 1909</td>
<td>Seen in Marine Board Soundings Chart March 1931</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Wooden Barge</td>
<td>27 Jun 1913 - 18 Aug 1913 (period)</td>
<td>After abandonment of 'Enterprise' (is more inland)</td>
<td>c. 11 Aug 1925 - 12 Jun 1928 (period)</td>
<td>Before Abandonment of 'Killarney'</td>
</tr>
<tr>
<td>Hopper Barge 1</td>
<td>27 Jun 1913 - 18 Aug 1913 (period)</td>
<td>After abandonment of 'Enterprise' (is more inland)</td>
<td>c. 11 Aug 1925 - 12 Jun 1928 (period)</td>
<td>Before Abandonment of 'Killarney'</td>
</tr>
<tr>
<td>Killarney</td>
<td>11 Aug 1925</td>
<td>Historical Mention of sinking and raising (GHG 51/32/2 Hb 1066/25:25)</td>
<td>12 Jun 1928</td>
<td>Historical mention of being broken up (GHG 51/170/749/1928)</td>
</tr>
<tr>
<td>Sarnia</td>
<td>7 Apr 1927 (5:00 pm)</td>
<td>Historical Mention of abandonment (GHG 51/170/1722/1925)</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Gem</td>
<td>19 Jul 1927</td>
<td>Mentioned as being removed from quay (Ritter 1996:72)</td>
<td>26 Oct 1927</td>
<td>Historical mention of being broken up (GHG 51/170/1470/1927)</td>
</tr>
<tr>
<td>Lady Daly</td>
<td>11 Aug 1925 - 12 Jun 1928 (period)</td>
<td>After deposition of 'Killarney' (is more inland)</td>
<td>6 Sept 1929</td>
<td>Register closes (Adelaide 22/1877)</td>
</tr>
<tr>
<td>Iron Pontoon 1</td>
<td>11 Aug 1925 - 6 Sept 1929 (period)</td>
<td>After deposition of 'Lady Daly' which is underneath pontoon</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Stanley</td>
<td>7 Oct 1930</td>
<td>Historical Mention of abandonment (GHG 51/170/394/1930)</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Mangana</td>
<td>23 Mar 1931</td>
<td>Historical Mention of abandonment (GHG 51/170/403/1931, 42/1897 Sydney)</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Juno</td>
<td>21 Apr 1931 (4:00 pm)</td>
<td>Historical Mention of abandonment (GHG 51/170/443/1931)</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Hinders</td>
<td>26 Aug 1931</td>
<td>Historical Mention of abandonment (GHG 51/32/5 HB 887/31 p.199, 235, GHG 51/170/887/1931)</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Iron Pontoon 3</td>
<td>26 Aug 1931</td>
<td>After deposition of 'Hinders' (pontoon alongside 'Hinders')</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>** Moe</td>
<td>25 Sep 1931 (2nd Abandonment)</td>
<td>Historical Mention of abandonment (GHG 51/32/5 HB 887/37 p.233</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Dorothy H. Sterling</td>
<td>6 Jun 1932</td>
<td>Historical Mention of abandonment (The News 6/06/1932)</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Glaucus</td>
<td>4 Jul 1935 (5:45 pm)</td>
<td>Historical Mention of abandonment (GHG 51/170/622/1935)</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Hopper Barge 2</td>
<td>4 Jul 1935</td>
<td>After 'Glaucus' as it is alongside vessel at extremity of graveyard</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Gartneill</td>
<td>29 Nov 1935</td>
<td>Historical Mention of abandonment (The News 29/11/1935)</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>** Ullock</td>
<td>7 May 1937</td>
<td>Historical Mention of being broken up (Advertiser 7/05/1937 p.24)</td>
<td>27 Oct 1937</td>
<td>Register closes (Adelaide 11/1912)</td>
</tr>
<tr>
<td>Iron Pontoon 2</td>
<td>7 May 1937 - 27 Jul 1937 (period)</td>
<td>After deposition of 'Ulllock' ('Ulllock' under pontoon)</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Thomas &amp; Anne</td>
<td>1 Jan 1941</td>
<td>Last transfer of ownership in 1941</td>
<td>5 Dec 1945</td>
<td>Register closes (Adelaide 2/1936)</td>
</tr>
<tr>
<td>Santiago</td>
<td>19 Apr 1945</td>
<td>Historical Mention of abandonment (GHG 51/263/901/1937)</td>
<td>--</td>
<td>--</td>
</tr>
</tbody>
</table>

** in case of 'Moe' and 'Ullock' only one is actual candidate for remains

Table 3: Reasoning behind date of deposition of vessels in North Arm Graveyard
If these data are put into graphic form (fig. 62) we can see the order of vessel deposition in the graveyard. As not all of the vessels can be pinned down to single years, it is currently impossible to create a truly accurate chronology in the site formation process, because some vessels do not have any date of deposition. These include the barges and pontoons, which can only be dated to a particular range due to their abandonment on top of or alongside other historically named and identified vessels. As a consequence, there are a number of possible orders to determine the true order of deposition, although all of the major sea-going vessels were deposited in succession.

Range of Dates for North Arm Deposition

![Graph showing range of dates for deposition of individual vessels in the North Arm graveyard.]

Figure 62: Range of dates for deposition of individual vessels in the North Arm graveyard as extracted from Historical sources and inferences from spatial positioning (** where either Moe or Ullock are in the graveyard)
As already indicated the vessels without identification all have large ranges of possible time of internment. Nevertheless there is a pattern for the deposition of vessels in apparent abandonment ‘phases’.

Phase 1 (1908 - 1913)

The first phase begins between 1908 - 1910 with the deposition of the Sunbeam and the Seminole. There is a three year gap with the next vessel Enterprise being placed inland and east of the Sunbeam.

Two vessels of Indeterminate phasing (1913 - 1925)

The next two vessels the iron hopper dredger and the wooden barge are unidentified and date from the deposition of the Enterprise until the abandonment of Killarney. As they are unidentified it is not possible to establish whether they were disposed of at the end of the first phase around 1913 or at the beginning of the second phase around 1925 (or indeed whether each belongs to a separate phase).

Phase 2 (1925 - 1927)

The second phase begins with the abandonment of the Killarney between 1925 and 1928 followed by the Lady Daly as the Killarney is boxed in by the iron dredger and wooden barge to the north and the Lady Daly to the south. Even though the Lady Daly was deposited in the graveyard between 1925 and 1929, it is logical to imply that it was run ashore before the deposition of the next vessel, the Sarnia in 1927, as the authorities would have preferred to keep the wrecks together rather than spreading them along the coastline. The water pipe between the two concentrations of the graveyard extended the phase, as after the Lady Daly the only place left is east of the water pipe where the Sarnia in early 1927 and the Gem in late 1927 were placed.

The placement of the aforementioned water pipe was used to supply facilities on nearby Torrens Island and must have occurred some time before the placement of the Sarnia in the eastern portion of the graveyard. This is because the large gap between the two concentrations of graveyard is directly due to the existence of the pipe and the warnings posted, not to moor vessels opposite it (see fig. 63)
Phase 3 (1930 - 1932)

The third phase begins with the abandonment of the *Stanley* in late 1930; the first of the largest number of vessels to be disposed of in a short period of time. The *Mangana* is next in March 1931, followed by the vessels *Juno* in April, *Grace Darling* in June, *Flinders* in August and ending with the outer graveyard disposal of the *Dorothy H. Sterling* in 1932. It appears as if after the *Mangana* the strategy was to fill the section between it and the *Stanley*, while the size of the *Dorothy H. Sterling* is the factor which appears to have caused its deposition in the river rather than on the northern shore. The *Dorothy H. Sterling* is quite long and would have stuck out of the bank, obscuring the substantial portions of the channel, while if it was placed parallel with the shore to the east of *Mangana* would have gone over the Harbours Board boundary (to be discussed).
Special Case: that of the Moe or Ullock

Due to complications in the identification of one vessel, that which is either the Moe or the Ullock, it is currently impossible to assign one vessel to any definite ‘phase’. If the remains are that of the Moe the vessel would fit neatly into the progressive abandonment stretching west to east in phase 3. If the vessel is the Ullock it may fit into phase 4, and although this would mean it does not fit neatly into a progressive abandonment strategy to maximise site space, it is feasible due to unique historical circumstances that may have arisen through an illegal abandonment of this vessel.

Phase 4 (1935 - 1937)

This phase coincides with the deposition of the Glaucus in 1935 to the east of the phase three vessels. For some reason a gap was left between the Glaucus and the bow of the Mangana. This is due to the reason why the Glaucus was abandoned in the graveyard. Historical evidence of the events leading to the disposal of the vessel are scanty due to the fact that it appears to have been an ‘emergency abandonment’. In this case the usual process of applying to abandon were bypassed, as during initial shipbreaking the vessel was accidentally holed and began to sink (GRG 51/170/622/1934). Temporary measures were taken, but the vessel, of quite a substantial size, had to be disposed of that day and was probably done so in a hurry in comparison with the other vessels. When the time for the Garthneill came to be disposed of, it was decided to fill the aforementioned hole by driving it into the aperture in late 1935.

The barge to the extreme east of the main concentration was definitely abandoned after the Glaucus as it is alongside it and is at the extremity of the graveyard, but dates after the Garthneill otherwise it would have taken the place of the barque.

Phase 5 (1941 - 1945)

The last phase involves only two ships the Thomas and Annie and the Santiago. The Thomas and Annie was placed quite a distance north of the vessels to the east. The late abandonment of this vessel does not pose a problem to the chronology of deposition in the site. As the vessel was quite small (nearly five metres in breadth) it was easy for them to float the vessel through a 4.8 metre gap between the Grace
Darling and the Ullock which at high tide would have been significantly larger. The floating of the vessel inland was desired as the small wooden vessel, if not placed quite a distance inland would have floated away easily.

The Santiago was placed amongst the other wrecks in 1945 and moved sometime soon after this to its current location in the extreme east extremity of the graveyard in the centre of the channel. This movement can be explained due to the Harbours Board land ownership of the area, as it (the Harbours board) only owned approximately one third of the island until the 6th December 1962 when the other portion of the island was converted from Crown land to Harbours Board land (see fig. 64). The last wreck (the dredger) roughly coincides with the end of the pre-1962 Harbours Board land, meaning that effectively, the Harbours Board did not have any shoreline left to dispose of vessels. The fact that they effectively ‘owned’ the waterways though meant that they could dispose of vessels such as the Dorothy H. Sterling and the Santiago where they did.
Figure 64: Land use comparison, 1963 Map portion (top) showing division of Garden Island and past land used by the Harbours Board where line of delineation marks approximate conclusion of beached vessels on the island, current Map portion (bottom) shows ownership of entire Island by the MFP Corporation (DENR Maps 27 01 1963 146 024 0008 009, & 662831)
**Vessels of possible multiple phases**

The three pontoons can be dated from the vessels that they are on top of or alongside. Although each of the pontoons may belong to a separate phase of abandonment, it is likely that they were deposited at the same time as part of a ‘back-filling’ process. This meant that the authorities made use of the pontoon’s small size, but relatively heavy weight, to secure other vessels, while also making the most of the limited space for the disposal of other ships. This theory is supported by the fact that each pontoon is in a similar state of decay. The phases of abandonment have been graphically depicted below (fig. 65).

![NORTH ARM SHIP'S GRAVEYARD](image)

**Figure 65: ‘Phases’ of vessel deposition in the North Arm from current remains**

From the graph below (fig. 66) it can be seen that there have been significant changes to the usage of the graveyard over time. The increased use of the North Arm from the supposed destruction of the *Kadina* in 1879 was more incremental, but due to a general lack of specific references to the disposal of early wooden ships in the North Arm area it is not properly reflected in the historical or archaeological record. The increased use of the graveyard in the early 1930’s can be seen as being due to the proper ‘establishment’ of the graveyard as an ‘official’ disposal ground after the disposal of large vessels as the *Seminole* and the earliest iron ships such as the *Sunbeam* and the *Enterprise* in the early 1910’s. The internment of these vessels meant that destruction strategies were altered due to the size and hardiness of materials now used
(destruction of vessels became more expensive and time consuming). The peak of use occurring in the early 1930’s can be seen as part of a mass disposal period akin to the Mallows Bay case study where classes of vessels were deemed useless (to be discussed). This process can also be linked to the Great Depression and the general decrease in trade. The abrupt fall in use after this time however can be attributed to many other occurrences, among them the need for scrap material for World War Two, the illegal disposal of the Ullock (depending on future positive identification of the remains) which triggered a reappraisal of abandonment strategy, and the general lack of legally useable land that could be used by the Harbours Board for disposal which limited future operations. By the latter half of the Twentieth Century, disposal methods had become more efficient and the source for abandonment grounds was now off-shore, meaning that the abandonment ground in the North Arm had effectively ‘abandoned’ itself.

**Number of vessels in graveyard 1879-1997**

![Graph showing number of vessels in graveyard 1879-1997](image)

*Figure 66: Number of Vessels in Graveyard 1879 - 1997*
Placing vessels in the Graveyard

The process by which the vessels in the graveyard were placed is an important feature of the graveyard’s creation. The way that the vessels were placed on the shore of the graveyard may have been due to the individual characteristics of particular vessels.

Ten of the vessels were placed bow into the mud of the island. All of these vessels were of considerable size and were of iron hull construction. This meant that it was a requirement to beach the vessels at relatively high speed where they were pushed into the beach by other ships. Parsons mentions that it was intended to tow the *Dorothy H. Sterling* to Ethelton and run her into the mud (Parsons 1986b:302). While this did not happen to the schooner it is highly probable that such a practice is what interned many of the other ships in the graveyard. Indeed the archival sources which specifically refer to the beaching of the vessels usually make mention of the use of at least two vessels in the process of abandonment. This may be due to the fact that two vessels were attached to the vessel and used for the beaching, or that one was used for the towing to the location and the other was used for the pushing of the vessel onto the beach.

Of the other vessels abandoned five were beached parallel with the shore. These vessels were smaller in size and were of relatively flat bottom meaning that it was easy for them to be pushed side onto the beach. By doing this most of the hull would have come into contact with the highest parts of the beach rather than being deposited on the comparatively uneven beach gradient that may have complicated how well the vessel remained where it was placed with the varying tide.

Of the three vessels stern into the mud the two in the western portion of the graveyard may have been placed there at a time when the current access track was actually a seasonal water source and was used to get the vessels closer into the island. The water source has since then silted up due to the presence of the wreckage and ensured a safe beaching. The other vessel *Thomas and Annie* to be positioned stern in was probably due to it being floated in at high tide and moving while the tide retreated. All of the pontoons and the wooden barge have been abandoned within close proximity to other vessels either on top of or alongside of them, supposedly to ensure that they did not float away. The *Santiago* and *Dorothy H Sterling* were placed in sections of the North Arm used as dumping ground for dredger spoiling (GRG 51/170/901/1937) and were pushed into position by the same process as the vessels beached stern out. Also, the existence of
piles around the beached vessels of the graveyard not only served as warnings of the extent and existence of the vessels but may have been used in relation to the abandonment process by setting up a system of leverage that would have helped in their beaching.

‘Safe’ abandonment practices

Strategies to ensure ‘safe abandonment’, besides the deposition of pontoons on top of other vessels can also be attested to archaeologically. Archaeological evidence of the use of explosives to ensure that water would fill the hull of the vessels and would not float away can be found in all documented cases (GRG 51/170/901/1937, GRG 51/32/5 HB 887/31 p235, News 29/11/35 p.3). In particular the evidence of explosive’s use on the Garthneill shows that they were used to ensure that the vessel would not move, as threats to navigation appear to be a primary worry of the Harbour Master (see fig. 67) (GRG 51/170/887/1931)

Figure 67: Garthneill bow explosion holes (22-03-97 Photo: M.Staniforth)
Other strategies in the archaeology are such things as the cutting away of significant sections of hull (eg. Garthneill, Mangana) (GRG 51/32/5 HB 140/1931 p.51). This was sometimes done in relation to salvage, as although the fact that the easterly dredger was cut in half undoubtedly helped to keep it there, it was probably also done to obtain machinery or desired sections from the ship. The best way, however, to ensure that most vessels had been secured to their ‘spot’ was to break them down as much as was economically and practically allowable. In wooden vessels the case is different as the more metal that is taken or salvaged (in the form of bolts etc.) the more likely it is to move or float away due to its lighter weight (Shomette 1996:267). A final strategy that is present in the archaeology is the apparent filling of the hulls with debris, particularly the use of concrete or cement in hulls to weigh them down. Shomette (1996:242, 278, 312) has noted the filling of hulks with debris as part of the abandonment process and has noted one case where concrete was used extensively within the hull of an abandoned vessel. His observation on the use of concrete as a part of the shipbuilding process does not appear in the North Arm graveyard but is apparently used only in relation to securing ships to their positions.

**Legal processes in ‘safe’ abandonment**

The South Australian Harbours Act 1913, specifically Division 6 ‘Wrecks, Obstructions and Damage’ Article 80, paragraphs A-D outlines the rights of Harbours authorities in regards to the proper disposal of vessels. Paragraph A refers specifically to the time allotted to dispose of and break up a wreck:

“The Board shall give notice in writing to the owner of such vessel, or to an agent of such owner, that he is required, within a time specified in such notice, either to remove the wreck in a manner satisfactory to the Board, or to undertake, under security satisfactory to the Board, to remove the wreck in a manner satisfactory to and within a time to be fixed by the Board.” (South Australian Harbours Act 1913, Division 6, Article 80, paragraph A).

Paragraph B refers to the expenses incurred by someone not abiding by paragraph A

“In case the owner or an agent cannot be found within the State, or if he fails within the time specified in the notice to remove the whole of the wreck in a way satisfactory to the Board, or enter into such undertaking as aforesaid to remove the same, or if, having undertaken to
remove the wreck, he fails to remove the wreck; and the Board may remove the wreck; and the Board may recover from the owner, in any Court of competent jurisdiction, the expenses incurred in removing it (in this section referred to as “the expenses of removal”). (South Australian Harbours Act 1913, Division 6, Article 80, paragraph B).

Legislation (or amendments to legislation) with regard to the abandonment of vessels appears to have been reactionary, occurring because of the growth in use of iron vessels and the growing need for their disposal, a fact that is seen not only in South Australia but also in other places with Ships’ Graveyards such as in the U.S. State of Maryland with the enactment of the Rivers and Harbours Act in 1915 (Shomette 1996:239).

Before the initiation of the South Australian piece of legislation there was no legal process in relation to the abandonment of ships in the North Arm and subsequently no official correspondence on the disposal of vessels such as *Seminole, Sunbeam* and *Enterprise*. This fact is evident when at later times the authorities endeavoured to establish which vessels were in the graveyard and their documentation could only tell them of a limited few that had been ‘officially’ abandoned (ie. documented) (GRG 51/170/901/1937). Yet after the legislation was instituted there was an increase in documentation on the decommissioning and abandonment of vessels with archival documents such as the “Engineer-Surveyor’s declaration for vessels broken up or out of commission” (GRG 51/97) and correspondence concerning the final fate of vessels coming into existence. Yet this appears to be because of the need to dispose ships that were either quite large, were of metal construction, or were of steam propulsion only, as small wooden vessels such as *Lady Daly* and *Thomas and Annie* are absent from the official documentary record of the Harbours Board. The reason for this is due to two reasons: firstly, that large and iron vessels were a considerable problem to dispose of and break down, and secondly, that screw-steamers had upon them boilers and engines that were of considerable value and were often registered individually to the ship they were on (an example of importance of these registered boilers can be seen on the plan on the next page, fig. 68).
The approval for abandoning a ship in the North Arm was a long process. In most cases owners had to sign contracts which specified the place of breaking up and duration of time allowed for such breaking up.

The contracts specify that the owners should keep the hull in floating condition, that they remain responsible for damage incurred by the vessel during breaking up and after abandonment, that the area used for breaking up should be cleared of all debris and that such breaking up should be done within six months of commencement. In addition, a fifty pound deposit was lodged, which was refundable only on the successful completion of the task, as well as a one pound per week rental fee for sites used and a three shilling per ton of scrap metal wharfage fee (GRG 51/170/444/1935, GRG 51/263/901/1937, GRG 51/170/274/1937).

The 1913 Act however appears to have failed in one major feature. If the remains of one vessel is indeed the Ullock it was dumped in the wrong place, and was therefore an illegal abandonment. This meant that the Harbours Board could legally remove and re-

Figure 68: Boiler Plan from Santiago (GRG 51-237-1)
inter the vessel at the owners expense. The problem was that this action was useless if the owner did not have the means to pay for such action. This was often the case with many of the owners or salvagers during and after the Great Depression (who had just paid substantial amounts in rent and wharfage dues to abandon their vessels). This effectively meant that the main sections of the act concerning the legal process of abandonment (Section 80, paragraph A and B) were useless in certain situations (GRG 51/170/901/1937, GRG 51/170/274/1937). This is also the reason why the damage done to a wharf via a collision with the Moe was carried by the Harbours Board (GRG 51/170/1061/1928).

The occurrence of an illegal abandonment in the Ullock coupled with the inability of the Harbours Board to enforce the Harbours Act triggered an opinion in 1941 that “for the future, the abandonment of hulks in the North Arm be definitely disallowed” (GRG 51/170/901/1937). This may have also contributed to the abandonment of the Santiago in the North Arm rather than on the island foreshore in 1945.

‘Breaking up’ and Subsequent Salvage

Whether the vessels were broken up off site or on site appears to be both as documentation on this site in particular and other sites (see Shomette 1996:204) has specified that although they may have been partly salvaged and broken down before their abandonment in places such as the ‘Portland Canal’, they were also broken up immediately after beaching and at numerous times, many years after their abandonment. The significant aspect of this is that the breaking up to the greatest extent occurred on site, apparently to control breaking up to a greater degree while minimising threats to navigation if sections broke off in transporting diminished hulls to site. Evidence for insitu breaking up on the Garden Island shore can be seen in the photographic record such as in figs. 19, 48 and 69.
The salvaging of vessels in the graveyard continued for some time. There is an appearance of some kind of hierarchy in regards to salvage of materials, with the largest amounts of choice metals going early on for substantial sums of money followed by secondary salvage for less cost, and finally tenders for the cleaning up and removal of the rest of the vessels.

Initial breaking up of the vessels in the North Arm often became major events to the local press as with the case of the *Dorothy H. Sterling*. These articles ranged from accidents due to exploding oxy-acetylene equipment (News 5/2/31, 17/2/31) to ongoing mentions and pictures on the progression of the breaking up process (Advertiser 2/8/30, 6/3/31, 30/4/31, 3/2/32, Register 15/1/30, 24/2/30, 3/7/30, Mail 14/9/1930, News 4/3/32) (see figs. 70, 71 and 72).
Figure 70: Views of dismantling of Dorothy H. Sterling (Top to Bottom: Register 15/1/30, 24/2/30, 24/2/30)
Figure 71: Views of dismantling of Dorothy H. Sterling (Top to Bottom: Register 3/7/30, Advertiser 2/8/30, 30/4/31)
Figure 72: Views of dismantling of Dorothy H. Sterling (Top to Bottom: Advertiser 5/2/31, News 4/3/32)
The late twenties was when the largest number of requests for the purchase of hulks for secondary salvage occurred. The first reference to the secondary salvaging of vessels in the graveyard concerns a Mr. W. Mitchell who purchased the Gem and Sarnia for ten pounds in 1927 (GRG 51/170/1470/1927). Subsequently, Mr. George Lewin made many requests for vessels, with unsuccessful attempts in the salvage of the Dorothy S. in 1928 and successful attempts for the Killarney in 1928 (the first known vessel to be sold under provisions of the 1913 Harbours Act) and Gem and Sarnia in 1928-1929 (GRG 51/170/749/1928, GRG 51/170/1470/1927). Often the prices for the hulks after initial salvage started at approximately ten pounds but with successive stripping went down to one or two pounds per hulk (GRG 51/170/749/1928, GRG 51/170/1470/1927) due to the fact that the best, and least worn, sections of metal had already been taken. It appears as if a contract for the right to take scrap from vessels of the graveyard as a collective was considered in early 1937 before being granted to William Charlick Limited in late 1937 at a ten pounds per week rental fee and a three shilling per ton of scrap wharfage fee (GRG 51/170/274/1937, GRG 51/170/274/1937). There were many such requests for the breaking up of the vessels over time and most requests were granted. Yet in 1967 one such salvager offered to dispose of and completely break down the vessels free if the board could install an access track at a cost of eighteen hundred dollars (GRG 51/170/901/1937). This offer was declined (as the vessels are still there) even though the Marine and Harbours Department knew that to undertake this task themselves it would cost much more than the specified amount. The reasons for this are unknown but may stem from a continued fear of a potential threat to navigation caused from the salvage attempts of such an individual.
CHAPTER 7:  

CHARACTERISTICS OF VESSELS & VESSEL ABANDONMENT IN THE NORTH ARM

Information derived from characteristics of individual vessels that were or are in the graveyard can provide aspects of shipping in the early twentieth century.

Nationality of Vessels in Graveyard

The nationalities of the vessels in the North Arm reflect international shipping output and attest to aspects of Australian Shipbuilding.

From the data it is clearly evident that British ships were the most popular. (see fig. 73), not probably due to perceptions of the inferiority of Australian shipbuilding.

Although it has been much suggested that Australia has to many extents failed miserably in creating any long-lasting resemblance to prosperity in any maritime industry (see Chapman 1969: Appendix 1, Cassidy 1982:192-200). Rather it may be because the British shipbuilders have been proved historically to have been the most inexpensive and most skilful of iron shipwrights for this period. Although Australians have built vessels since the inception of the first Australian colony, the industry remained very small due to the British ban on shipbuilding and because of the East India company’s monopoly on trade in Asia that Britain wanted to maintain. The boom time in our shipbuilding industry began at the end of the First World War.
with favourable prices and large orders for the manufacture of Merchant ships from the Australian Government. Interestingly that there was a decline in the industry and an almost complete cessation of shipbuilding in Australia between 1924 and 1939 (Chapman 1969: Appendix 1), just when the most vessels were deposited in the graveyard. It has been well documented that the Australian Shipbuilding Industry did very little to make itself competitive on the international scale. Before 1940 the only aid to the assistance of Australian shipbuilding was in the form of import duties on foreign built ships. This was not sufficiently significant to make Australian ships attractive in price so as to warrant substantial growth in the Australian industry. Thus, when a bounty system was introduced after World War Two it was geared towards matching British costs in shipbuilding rather than true competition (Chapman 1969:1.1, House of Representatives 1992:15).

The bounty system comprised of: a subsidy towards construction costs of vessels larger than two hundred tons gross, (not exceeding one third of that cost), and a ban on the importation of foreign built vessels over two hundred tons (Chapman 1.1, 1.5.6). The subsidy was designed to make the price of an Australian built vessel the same as that of a British built vessel, but due to: the small volume of production in Australia, limited scope of the market, dispersed nature of the industry and high labor and material costs, such a subsidy remained inadequate (Chapman 1969:1.1, 1.5.1-1.5.5).

The large numbers of British built vessels can in South Australia can be understood when examining occurrences in the coastal shipping trade in South Australia in the early twentieth century. The Adelaide Steamship Company, a giant in the early Australian shipping industry, went through phases of mass buying. From 1901 until 1911 the company purchased ten vessels from Britain (one of which, the Flinders is in the graveyard) due to the prosperity of their business (Page 1975:181). This prosperity was due to a combination of factors in the general economic climate of the time. For instance, the result of government assistance to wheat farmers of Eyre Peninsula increased yields in cereal production due to the introduction of superphosphates, and prosperous mining in Wallaroo and Moonta in the early twentieth century all contributed to an increased need for freight shipping in the ports of South Australia. This meant more ships and more reliable services were required (Fitchett 1976:17). One of the first steamers to make regular visits
to the western portion of South Australia was a steamer in the graveyard, the *Grace Darling* (Pemberton 1979:38).

Further breakdown of statistics on the British built ships show that the vast majority of vessels were built in the Scottish shipyards while the remainder (built in the ports of Liverpool and Sunderland) are also northern shipbuilding centres (see fig. 74).

The prevalence of British shipbuilding may also be seen from other perspectives. The British had a virtual monopoly on shipbuilding from the time of Waterloo until the mid twentieth century. This was because (Jones 1990:151): its level of technical education was the best in the world, even though it has been documented as being ‘hostile’ and apathetic to technical education (Haas 1990:326-327). Its island position, sheltered ports, abundance of wealth, abundance of raw materials and the fact that there was no real challenger to their monopoly until the rise of Germany and to some extent the Netherlands and Japan as shipbuilding powers in the period 1885 - 1914 helped to maintain its hegemonic power (Court 1954:322, Pollard and Robertson 1979:9, Jones 1990:151, 152). American threats to British trade in the early to mid 1800’s in the era of the wooden deep sea sailing vessel and clipper trade were ended by the American civil war which saw an increase in British tonnage (from 946,000 in 1860 to 1,853,000 tons in 1866) and the decrease in American tonnage (from 2,245,000 to 484,000 tons for the same period) (Hutchins 1948:30, Parkinson 1960:3, Pollard and Robertson 1979:11). This was further exaggerated with the technological innovation of the iron hulled and steam driven ship occurring in Britain (Harley 1973:372).

The extent of the British monopoly can be illustrated with comparative data on the shipping output of individual nations. In the 1870’s the British output was larger than the next six nations combined and by
1912 they were still producing over half of world output (Pollard and Robertson 1979:25, Jones 1990:152, Shomette 1996:213). Britain’s high industrial output also meant that when compared to the fleets of other nations, it used more ships and therefore had a comparatively younger fleet which was more technologically advanced. This contributed to Britain’s maintenance of its position as a superpower through the operations of its Merchant Marine (Kennedy 1994:71, 72). The British dominance of shipping, however, was quite short lived, as by 1958 its production had fallen to less than twenty percent of the world’s total, due to shipbuilding activities in eastern European, mainly Communist countries (Parkinson 1960:3).

The number of vessels in the graveyard of U.S. build is not as much as either those vessels built in Britain or in Australia, but nonetheless it is important. All of the vessels of American build (two currently in the graveyard, one removed) although built on both the east and west coasts were close to the Canadian border (see fig. 75). This is significant as all of the ships were of wooden construction and were sailing ships, factors no doubt dictated by the fact that the states of origin of the vessels had close and ample supplies of Canadian Pine and other such ideally suited softwoods. All of these vessels of U.S. build have at one time been deep sea going vessels. This is a fact that may have contributed to their subsequent demise and conversion into hulls for secondary purposes.

The forces which act upon deep sea going, wooden sailing vessels has been documented by Gerr (Gerr 1975) as being a major contributor to both the loss of wooden vessels at sea and in the considerable wear and tear that wooden vessels (especially schooners) are subjected to. Although the Dorothy H. Sterling was abandoned due to economic difficulty it could be said that the careers of the other vessels and their conversion for secondary purposes was due to their condition after being subjected to the destructive forces.
of wave and wind action at sea. Another complicating factor was that by 1890 the need for wooden vessels was at an all time low point (Cage 1995:3). This can be seen in the abandonment of the Seminole and one of the reasons why the Dorothy H. Sterling received poor bids on its sale, which led to its breaking up.

The graph in fig. 76 shows that the vast majority of Australian built vessels came from the eastern states, with only small numbers of vessels coming from South Australia and Tasmania. This is surprising, as most of the Australian built ships should have come from shipyards that were later to be considered as the primary shipyards in Australia. When the bounty scheme of assistance to Australian shipping was introduced after the Second World War only six yards were made eligible for the subsidy. This must have been due to their comparative larger size before the introduction of the bounty system. Of these shipyards two were South Australian (Whyalla Shipbuilding and Engineering Works, Whyalla and Adelaide Ship Construction Pty Ltd, Port Adelaide), two were in New South Wales (NSW State Dockyard, Newcastle and Cockatoo Docks and Engineering Co Pty Ltd, Sydney) and the remaining two were in Queensland (Evans Deakin and Co. Pty Ltd, Brisbane and Walker Ltd, Maryborough) (Chapman 1969:1.1, 1.2.1, Appendix 1). This is not reflected in the state of origin of vessels in the graveyard, because all of the Australian built vessels in the graveyard were significantly under two hundred tons, Meaning that they were therefore products of small shipbuilding yards.

![Vessels of Australian build by State](image_url)
**Primary & Secondary Use lives**

The vessels in the North Arm were placed in the graveyard for (to be discussed). What is interesting is that the majority of the vessels, after fulfilling their primary roles as tugs, general cargo carriers, passenger ships etc., were converted into objects of secondary use upon the decision that they were unseaworthy or uneconomical in their primary use (see fig. 77). Many of the vessels such as the *Seminole, Sunbeam, Flinders* and *Santiago* fulfilled common secondary roles such as storeships (hulks or lighters) or carried such things as timber, or were used to carry coal for the ‘bunkering’ (loading for refuelling) of steamships with coal (see fig. 78). Such vessels would be loaded with a cargo and would remain stationary or carry their cargo to places where it was required. Individual shipping lines and companies had substantial ‘fleets’ of hulks and storeships. For example, the Adelaide Steamship Company has at least fifty three such vessels stationed from Port Adelaide to Townsville (Page 1975:161, 178, 325, 326, 328, 330, Parsons 1986c:116-122).

**Figure 77: Vessels interned in graveyard as primary use vessels or after secondary use**
This was the same for wooden and iron/steel vessels although it appears that the latter could fulfill a varied number of roles that their wooden counterparts could not. (Many of the vessels in the graveyard have been documented as fulfilling a wide, varied and in some cases odd range of functions.) Two vessels in the graveyard, the Stanley and the Enterprise, are documented as being used as water tenders where their iron hulls were used to hold water and would be towed to vessels that required fresh water supplies to allow water to be transferred to ship. The Gem is documented as having fulfilled two functions in a secondary role, firstly as a silt pumping barge and then as a bridge across the No.2 quay which had been dubbed ‘Tragedy dock’ (see figures 79 and 80).
Figure 79: Gem as bridge (Courtesy of S.A.M.M. No.5475)

Figure 80: Gem as footbridge (Ritter 1996:71)
The Garthneill almost fulfilled an interesting use as South Australia’s first Nautical Museum before the idea was dismissed (Advertiser 1/2/35 p22 col. C). Its actual secondary use, though, was just as unique and innovative as it served as a floating wheat and flour silo and processing mill (shown in fig. 81). This allowed for quick loading from ketch to ship for delivery and to screw-steamer for transportation after milling (Advertiser 7/1/32 p9, 19/8/32 p17, 7/2/1935 p16).

Figure 81: Garthneill as Grain Silo 1930 (Courtesy of Ron Blum #2119)

The one exception to the rule of vessels being abandoned after hulking is the Dorothy S., which was bought and used as a stationary hulk (GRG 51/170/1573/1926). The conversion of vessels for secondary use is not unique to the vessels of the North Arm graveyard; a Shomette (1996:250) refers to vessels in the Mallows Bay graveyard, the Obak and Botsford, that were used as floating dormitories for the shipbreakers trying to dismantle the other vessels.

The rationale behind the hulking or conversion of a ship to a secondary use can be attributed to a range of factors. The rate of advancing technology with regard to the decline of the sailing ship as an
economic tool of trade combined with general disrepair in vessels would have led to the conversion of vessels such as *Seminole*, *Sunbeam*, *Santiago* and *Garthneill*. Disrepair or a perceived uselessness of other vessels such as *Stanley*, *Gem*, *Sarnia*, and *Enterprise* would have led to their conversion, while the gutting of the *Flinders* by fire three years after its building and soon after its South Australian purchase in 1911 is what led to its hulking (Page 1975:178, Parsons 1986c:127).

**Primary & Secondary use life and its consequences on years in service**

The hulking of vessels was an economic issue for owners as it was a tool for prolonging the use life of a vessel. The years of service for all of the vessels in the graveyard (with the exception of the *Dorothy H. Sterling* because of its unique circumstances) served in excess of twenty six years, a quite respectable duration. The average use life of the vessels in the graveyard shows that there was a great variance in time before the vessels were abandoned (see fig. 82).

![Figure 82: Years of service for graveyard vessels](image-url)
This variance may be the product of a distinction between vessels that were converted to secondary use. The documented average on the above graph is derived from the South Australian State Heritage Shipwreck database for all vessels of known manufacture and wrecking date and closely corresponds with the values cited by Jeffery (1992:218) and Murphy (1993:155) for late nineteenth century vessels.

A comparison of the average use life of vessels known to have been converted before abandonment and the use life of vessels abandoned at the end of their primary use life illustrates that the difference between the two is significant; hulked vessels having a much longer life than those which were not hulked (see fig. 83). Although this fact may arise from the small sample size of the vessels in the North Arm graveyard the difference, which is close to fifteen years, would have made conversion of vessels for secondary use an extremely attractive option for vessel owners. The difference between averages derived from graveyard data and wreck data illustrates the importance of the conversion option from the economic perspective of shipowners.

Average age of vessels

Figure 83: Comparison of average ages of vessel use life after primary and secondary use
What must be considered however is that hulked vessels represent vessels which were ‘failures’ in their early primary function due to a range of controllable or uncontrollable factors, and that hulking became a means by which owners could still regain capital from vessels. Non-hulked vessels may have been more effective and were used until other factors linked with technological innovation and general economic hardship forced their disposal.

Evidence of Secondary use in the Archaeological record

Evidence of secondary use of vessels in the graveyard is not limited to archival and historical evidence. There is a definite distinction archaeologically between vessels that were used for secondary use and those that were not (although not in all cases). This is especially evident where the use of iron steamships as hulks is concerned. The most distinctive indication of the conversion process is in the form of modification to steam vessels in the stern area. In particular it has been noticed that the sole-piece of the stern frame (see fig. 84 and detail no. 16 in fig. 85 for comparison) has had more metal welded into place. This indicates two things. Firstly, that there was use for the vessel after the
removal of the propeller and propeller shaft (as a propeller can not turn after such modification), and, secondly, that it was done to strengthen the vessel to enable proper towage after sections of the stern were weakened with the removal of the propeller etc. Sailing vessels documented as being used as hulks (such as *Sunbeam*, *Santiago*) however do not appear to have been modified in this way as most of them still currently appear to have free moving rudders whereas the steamships appear to have had their rudders removed. This may have been due to the comparatively higher strength of the sterns of the sailing vessels which enabled the continued use of their rudder for use while a hulk (it could be used to aid the manoeuvring of the hulk). On steamships the gap left by the absence of propeller may have meant that manoeuvring with an intact rudder could have caused substantial bending or warping of the rear section. The vessel *Enterprise* and *Flinders* have shown such modifications (as in fig. 84) whereas other hulked vessels such as *Stanley* does not show this conversion due to the absence of significant portions of stern from the record.

Figure 85: After end of a screw-steamer showing placement of sole-piece (Numbered No. 16) (Pausch 1890, Plate 25)
As has already been discussed, it is only recently that the specific need for a place to have a Ships’ Graveyard or scuttling region has ceased to be an issue. It is clearly evident that although the need for abandoning ships may appear to be the same worldwide the specific reasons for abandoning ships are related to a range of issues that may have been common to all Ships’ Graveyards of comparable use period. It is also possible that the reasons for abandonment in each case is individually specific due to many other issues confined to the community closest to that graveyard.

There are a number of reasons for the abandonment of vessels in the North Arm Ships’ Graveyard at Port Adelaide, many of which were related to that region, while others can be tied in with wider global phenomena.

Technological Innovation: Wood and Sail to Iron and Steam

There have been two monumental occurrences in the history of shipbuilding. These are: firstly the adoption of iron hulled and steam driven ships (Blake 1960:33) and, secondly the adoption of the motorship originally driven on the Diesel engine. Fig. 86 illustrates the transition in propulsion technology particularly in the case of the change from sail to coal fired steam propulsion.
The adoption of iron and steam in shipbuilding technology can be attributed to the rapid growth of the British shipbuilding industry and the decline of the other industries in countries such as the USA. The growth and well-being of the U.S industry had in the past been due to the abundance of timber supplies and its advantageous position to trading routes (Pollard and Robertson 1979:11-12). The process of conversion to the use of iron ships in Britain, however, was not a smooth one. Although Blake (1960:33) cites that the British aversion to the adoption of new technology was due to ancient, noble, sturdy traditions, and a beautiful, efficient product, we actually notice that it was due to economic and resource related issues. The transition was due to dwindling timber supplies and the significant abundance of both iron and coal in Britain. Timber supplies in the U.K. were dwindling by 1810 and the emergency supplies planted had not matured rapidly enough so that by 1860 there was insufficient timber to supply Navy or Merchant Marine in Britain (Pollard and Robertson 1979:13). In this way Britain was forced to use iron and steam technology (see fig. 87 for example of steam engine) and did not realise until later that its use enabled larger sized, stronger, lighter, more water tight, faster and more powerful vessels that did not ‘hog’, or were prone to attack from ‘shipworm’ (teredo) as well as being more cost efficient due to reduced capital, labour and building costs (25 - 50% of total weight of timber is lost in wooden shipbuilding as compared with a minute fraction in iron shipbuilding) (Lewis & O’Brien 1966:77-78, Harley 1971:217, Sexton 1976:2, Pollard and Robertson 1979:13-14). It also allows for a significant decrease in thickness of hull, a 35% increase in cargo capacity and a 25-50% increase in hold. Figure 87: Advanced single cylinder steam engine (Embelton 1966:196)
capacity, facts that were further increased with the introduction of steel hulls in the 1870’s (Pollard and Robertson 1979:14).

The power of vessels made from ferrous material relied on innovation in the steam engine to be able to compete with the wooden sailing vessels. Although sailing ships were more expensive and of less capacity they remained faster and of less running costs for many decades. This was due to the fact that the running costs of sailing ships do not increase with the length of journey as it does with steam propelled vessels.

The opening of the Suez canal in 1869 (which cut trade routes drastically), the use of stronger steel for boiler manufacture, changes in shape of marine boilers (which increased temperatures and pressures allowable), advances in propeller design and the increasing efficiency of steam engines (as illustrated in coal consumption statistics in fig. 88) to innovations in the kind of engines available between the 1840’s and the 1910’s effectively destroyed the wooden sailing vessel as preferred vessel of use in maritime industries for long distance journeys (Court 1954:321-322, Jones 1957:12, Parkinson 1960:6, Canby 1965:83, 89, Harley 1971:216, 223-224, Pollard and Robertson 1979:15, Buxton 1993:71). The innovations in the hull type and propulsion means undoubtedly had effects on the larger sailing ships of both hull type, as the Seminole and the Santiago as well as having effects on the smaller, wooden sailing vessels Thomas and Annie and Lady Daly. It is interesting to note that the U.S.A. were still making wooden hulled sailing ships of large size such as the Dorothy H. Sterling in the 1920’s.

![Figure 88: Coal consumption per indicated horsepower per hour: 1855-1891 (Harley 1971:220)](image)

**Technological Innovation: Steam to Diesel**

115
A more important innovation from the point of view of the graveyard was the creation of the Diesel Marine engine, patented in 1892 by Rudolf Diesel (Lewis & O’Brien 1966:129, Griffiths 1995:313). Development of the Diesel engine progressed from 1897 until 1910 by which time it offered vessels of less weight, lighter, smaller engines, less need for refuelling, even larger hold capacities, an increase in running efficiency of 15 - 20% (indicated in fig. 89), and vessels which did not require hulks for the bunkering of fuel, reducing crew numbers and running costs (Parkinson 1960:6, 105-106, Bach 1976:319, Buxton 1993:77, Griffiths 1995:320-321, 325). Even though this was greatly in excess of the accomplishments achieved from the development of steam engines, the British did not adopt the Diesel engine very quickly, a fact which would greatly impair its future power as a leader in technology and the maritime industries (Parkinson 1960:105).

Figure 89: Comparison of energy efficiency in different propulsion engines (Energy consumption in mega joules per tonne-mile) (Buxton 1993:78)

The aversion to the adoption of the Diesel engine was undoubtedly linked with the fact that throughout the nineteenth century, Britain was the world’s principal source of coal, and coal was its most plentiful fuel source (Harley 1971:217, Griffiths 1993:316, 318, 319, 329-330). The perception of the time was that the adoption of Diesel by the British would cause a downturn in their coal industry and may have meant an increase in running costs for motorships due to the importation of fuel. They were thus ‘blinded’ to
the advantages of an alternative fuel source due to the existence of other profitable industries, and coerced shipbuilders to persist with steam driven ships. The consequence of this was that both industries would suffer in the end.

Northern European, particularly Scandinavian countries were much faster to take on Diesel as a fuel source due to the fact that they had little in the way of an indigenous fuel source and did not care whether they had to import coal or the more efficient Diesel (Jones 1957:83-84, Griffiths 1995:317, 328-329). Fig. 90 illustrates this, with the rest of the world having a larger output of motorships in relation to steamships earlier than Britain.

![Figure 90: Motorship launches compared with steamship (Griffiths 1995:318)](image)

The future of the Diesel engine was secured by 1950 with the technological discoveries of the Second World War being implemented into ship engine design, creating a more efficient and reliable marine engine and further distancing the steam engine as preferred choice of shipowners (Buxton 1993:73, Griffiths 1995:322).
The Diesel motorship is credited with an important role in Australian history, as it is largely responsible for the recovery of the Australian steel manufacturing industry at Newcastle and Port Kembla in the 1930’s, (Australian National Maritime Association 1989:102) but was nonetheless the deciding factor in the continued life of most of the graveyard wrecks.

One correspondence in particular concerns Mangana, the growth of the motorship and the decline in use of the steamship. It states “I consider the best method of getting rid of this class of vessel is to scuttle them in deep water” (GRG 51/32/4 HB 140/31 p.279). The implication of using ‘class of vessel’ in this context indicates that it was becoming a need to dispose of the single screw steamship.

The change in technology is perhaps best illustrated in the Australian context with information pertaining to the consumer behaviour of the largest fleet owners of vessels in Australia. For example Huddart Parker, set up in Geelong in 1853 began to dispose of its steam vessels in the late 1920s with the stripping and scuttling of the vessel Coogee in the Port Phillip Bay graveyard on 27th February 1928 (Fitchett 1976:56-57). The reason for this is that with the first purchase of motor ships such as the Mulcra, Momba and Mundalla in the early 1920’s and Minnpa (fig. 91), Manunda and the Moonta by the Adelaide Steamship company in the late 1920’s/early 1930’s, and the Westralia by Huddart Parker (Page 1975:220, Fitchett 1976:19, 67, Parsons 1986c:130) the need for steamships and hulks for coal bunkering soon declined. The absence of Diesel motor-ships in the graveyard further illustrates the motor-ship’s continued value and use in contemporary maritime trades and industries.

Figure 91: M.V. Minnpa (Pemberton1979:42, see also Pemberton 1975:205-206)
Upon perusal of a graph with cross matches date of vessel manufacture with years in service (fig. 92) it appears as if the older the vessels the longer they lasted. This is contrary to the belief that refinements and developments in technology increase service through the creation of better products and industrial processes.

As time progressed, the need for steam vessels declined due to the adoption of the motorship. Even though the adoption of the motorship would have meant a decrease in steamships (and an increase in their abandonment) it also directly effected the need for hulks, as coal bunkering was no longer required for refuelling. The consequence of this was that conversion of vessels to secondary usage ceased to be an option. The majority of the North Arm vessels were manufactured in the late nineteenth century and were operating at a time when Diesel operation was becoming more popular and the need for hulk conversion was declining.

**Date of Manufacture v. Service life for graveyard vessels and S.A. Wrecks**

![Graph showing Date of Manufacture v. Service life for graveyard vessels and S.A. Wrecks.](image)

*Figure 92: Date of manufacture of graveyard vessels and S.A. wrecks against years service of vessels built in that year.*
It should be stated that the ‘instability’ in the left section of the graph can be attributed to a time
when wooden and sailing ships were still the most popular. They were therefore not reflected properly in the
archaeological record as they could be dismantled more easily and could be used for such purposes as land
reclamation projects without posing a long term threat to development or the environment, as iron and steam
driven ships did later on. It is evident when cross matching the use life of vessels abandoned in the
graveyard with the average use life of vessels wrecked in South Australian waters (data from South
Australian Heritage Branch Shipwreck Database for vessels of known date of manufacture and date of loss)
during the time when the graveyard was in use, that difference in the loss of wrecked vessels and abandoned
vessels were due to distinct reasons. Wrecked vessels were usually lost due to uncontrollable factors such as
human error and natural forces at sea (hence its erratic representation) while the loss of abandoned vessels
proceeded due to preconceived assumptions on the worth and value of the vessel.

The Great Depression

The Great Depression destroyed many companies in the 1920’s, the *Dorothy H. Sterling* being a
prime example of its effects on shipping (Parsons 1986b:301-302). The value of the ship was fifty thousand
pounds upon its construction in 1920 and within nine years its auction value was a mere five hundred
pounds (Mail 14/09/29). The wooden vessel, along with the other wooden vessels of the graveyard, were
then used as a source for firewood by the homeless and unemployed. Shomette (1996:263) has also noted
that this occurred at the Mallow’s Bay site. The iron ships were further broken down by unemployed
returned servicemen even though the metal received provided them only a pittance in comparison with to the
amount of work done in the shipbreaking process. Cameron (1991:165) has suggested that economic
burden is a major factor in the abandonment of structures within village complexes, especially among those
people already suffering prolonged hardships. This is reflected in ship abandonment processes of companies
during the Great Depression who were forced to abandon their ‘sea-going structures’ due to economic forces
beyond their control.
The Commonwealth government’s requisitioning of vessels for use in World War One for a variety of purposes led to many of these vessels being attacked and destroyed. This was a fate for many Australian built vessels such as the steamship ‘Warilda’ originally owned by the Adelaide Steamship Company which went down while fulfilling its role as a hospital ship in the English Channel on the 2nd August 1918 (Fitchett 1976:24).

During the First World War shipbuilding output had increased significantly to cope with the loss of ships in wartime casualty. Although British shipping output had only increased 176,000 deadweight tons for the period 1914 to 1922 American shipbuilding had increased 10,669,000 deadweight tons (Kennedy 1994:67 see also Hutchins 1948:52-53 for tonnage comparisons). After the war the general down turn in world trade left an excess of ships that were of no use, with some twenty percent simply sitting in port (Kennedy 1994:67, 68). Although Britain responded to their oversized fleets by selling ships off to private ownership, the oversized fleets of countries such as Canada, France and Australia, all of which maintained fleets through state ownership and funding (Kennedy 1994:67) tended to dispose of unwanted vessels through means such as graveyard abandonment.

Jones (Jones 1957:45) has shown that for the period of 1920 until 1938 the effect of the First World War on shipping was derived not from losses of ships in the war (0.46% of the British fleet and 0.63% of the world fleet). Rather, the need for the breaking up of vessels due to technological improvement and more importantly the downturn in the world economy, was the primary cause of vessel loss. This claim is substantiated by Shomette (1996:232) in relation to the deposition of vessels in Mallows Bay. For this period the United Kingdom broke up 1.42% of their fleet and the world 1.38%. Although this may appear to be insignificant, this percentage is quite large when considering that at this time gross world tonnage was at an unsurpassed high and many of those vessels broken up would have become features in Ships’ Graveyards such as Garden Island.

Australia lost an unprecedented number of vessels in the Second World War, many of which had to be brought back by salvage boats stationed in each state, and in most cases those that could not be made functional again were subsequently scrapped (McDonell 1980a, 1980b). Cameron (1991:166) has cited that
‘external social forces’ are major contributors to structural abandonment. In regards to ship abandonment the two World Wars and the trade embargo with Japan (which was to effect the scrap metal industry) undoubtedly had the same effect on shipping and the need for ships.

The Scrap Metal Industry

The prosperity of the scrap metal industry in Australia was an important factor in the abandonment of vessels. At a time when scrap metal was receiving high prices per ton, vessels were broken down to such an extent that they but were totally dismantled. The vessels in the graveyard which are of high integrity and do not appear to have been substantially impacted by salvaging of metal were disposed of when raw materials were cheap and/or when prices for scrap metal were low. Early vessels Sunbeam and Enterprise for example were not salvaged for their metal to a great extent and by the time salvaging of metal became prosperous again their hull material was too degraded to warrant removal. The iron and steel vessels in the eastern portion of the graveyard were continually salvaged as can be shown by the diminished height of their sides. The metal taken off vessels appears to indicate when and by whom the metal was taken.

Large sections of metal removed are seen by distinctive cuts in the hulls and are probably associated with salvaging before or just after abandonment. The salvagers in this case preferred to get the largest sections of undamaged metal in the smallest time possible and therefore took cuts from the either side, above the Plimsoll line and down the extent of the ship. This metal may have been used in the state it was removed, and was probably used in the construction and repair of other vessels and in munitions. Salvage attempts in later years by individuals of little means took metal from smaller, more localised areas preferring to take cuttings from the damaged areas such as around hull explosive holes. The metal was melted down if from smaller sections or was also re-used if from the larger sections. It has been stated that at most times scrap was a means of subsistence income only, with the fragility of the early twentieth century world economy meaning that it was never a profitable industry (Shomette 1996:259). The down turn in the scrap metal industry, particularly in the late 1930’s via the imminence of war with Australia’s main scrap metal trading partner, Japan, is intimated as being a significant factor in the disposal and condition of vessels such as the Ullock and probably the Santiago (the demand for scrap was low in 1938 and had disappeared by 1940)
123

(GRG 51/170/901/1937). This is in direct contrast to the industry around 1934 when scrap sales in the USA and Australia greatly increased due to Japanese prices, which were two pound more per ton than anywhere else (Shomette 1996:259). Supposedly this was due to the use of scrap metal in ‘earthquake proof’ buildings in Japan (pers. comms. Ray Gilbert 4/8/97). Images from Adelaide newspapers of the scrap from the North Arm ready for export to Japan are shown in figs. 93, 94 and 95.

Figure 93: Scrap Iron from North Arm Ships’ Graveyard ready for export to Japan 1st September 1938 (The Adelaide Chronicle 1/09/1938 p36)
Figure 94: Scrap Iron from North Arm Ships’ Graveyard ready for export to Japan 27th April 1939 (The Adelaide Chronicle 27/04/1939 p36)

Figure 95: Scrap Iron from North Arm Ships’ Graveyard ready for export to Japan 25th May 1939 (The Adelaide Chronicle 25/05/1939 p38)
Changes In Transportation Methods

In the 1890’s the Australian Coastal Shipping trade was well developed. Other means of transport such as the newly completed railways simply could not compete as ocean transport was considerably cheaper than other forms such as rail transport (Australian National Maritime Association 1989:100). Yet the maritime industry was extremely susceptible to disaster due to its competitive nature and low profit margin dependence, which was successively compromised due to such things as the general maritime strike and Great Depression of the 1890’s (Australian National Maritime Association 1989:101). To illustrate the fragility of the industry it is important to note that between the years 1917 and 1919 there were ninety nine industrial disputes concerning maritime workers -

“As labour-intensive industry dependant upon men both ashore and afloat, shipping was in an awkward position. The men of one section of its operations might have to be paid while another section was on strike. When coal miners, waterside workers and railwaymen went on strike, as they did in such years as 1908, 1912 and 1917, then the crews of ships waiting for cargoes had to be paid and the ships themselves maintained. By 1908 it cost £60 a day for an idle ship to lie in a strike-bound port” (Page 1975:141).

After the Second World War the construction of railways such as in coastal Queensland took much of the passenger trade away from coastal shipping and was the cause of the disposal of many ships just back from war torn Europe that had returned to find that no role for them existed anymore (Fitchett 1976:26). Indeed it is documented that it was after World War Two that the first passenger ships which were forced to retire were the South Australian Gulf ships (Pemberton 1975:178).

Motor transport also became a threat to maritime industry as the following extract from a South Australian Parliamentary Paper illustrates:-

“The commissioners recognise that whilst the public naturally seeks what it deems to be the cheapest means of transport, nevertheless where such an operation displaces forms of transport that efficiently and economically serve the public, and have been established at great cost, it inflicts a loss on the community as a whole. Should the territory hitherto using water carriage be served by other means of transport, it must be recognised that many ports
will not pay, and will be difficult to justify the maintenance of the shipping facilities now
provided” (South Australian Parliamentary Papers 1932 no.24 p.8).

Indeed, as the bitumen of motor transport and the tracks of rail transport expanded and progressed, sea transport rapidly declined. This is nowhere better illustrated than in comparisons between New South Wales where roads were set up quickly while shipping speedily declined and in Western Australia where roads spread at a slower rate and large-scale shipping persisted for much longer (Bach 1976:237-239).
As has been shown detailed historical research into extensive sites such as the North Arm Ships’ Graveyard can lead to greater understandings of behaviour in relation to the consequences of new technology (in this case new ship’s hull materials and means of propulsion), and the intimate relationship between such behaviour and site formation processes. Explanations for these behaviours cannot be seen to be entirely insular but are greatly effected by international circumstances and events on both economic and social levels. The insular aspects of these behaviours appear to arise through various interactions between people and environment, in this case the physical geography of the South Australian coastline. Other factors such as choice of settlement location can be seen as the reason why such interpretations of the environment tended to dominate. The combination of all of the listed influences can also eventually come to be seen to be mirrored in the creation of the reactionary legislation concerning maritime refuse accumulation. The role of historical events such as the privatisation or conclusion of intensive dredging operations, the decline of the steamship and the need for coal bunkering (a run off effect from the combination of refinements in new fuel sources and the technological innovation of the Diesel powered engine) are also important contributors to the creation of this site in particular.

It was a major aim of the author that the documentation of such a site will be important in the future study of similar sites, not only in Australia, but overseas, and that archaeology in general can benefit from the integration of terrestrial and underwater techniques and methodologies, which the site at Garden Island represents. From a theoretical perspective such sites are surely invaluable from a site formation perspective, as the vast amount of historical records leave little avenue for speculation concerning the inherent behavioural aspects in the creation of the archaeological record.

The study of sites like the North Arm can not only illuminate that there are quite complex behaviors behind site formation processes, but also that in times of economic depression, widespread upheaval, or of accelerated technological change within industry (in this case maritime industry) individuals were forced to make certain decisions. These decisions concerning maritime assets could be seen not only as unique and innovative but also as being of sound economic sense in relation to the use and reuse of large material objects.
such as ships. It would not be wrong to say that in the 1990’s where efficiency of raw materials and energy has become greatly important there is much to learn from the individuals of early twentieth century Port Adelaide. Although we may nowadays marvel at our ability to transform old ships into razor blades, it might be wiser to marvel at our forebears who, in absence of any comparable destructive salvaging technology, were arguably able to make greater use of their old means of transport and commerce than we are able to towards the end of the millennia. Although they lacked our technological means, they show not only how to struggle to keep our heads above the economic waters but how to effectively use resources to an almost exhaustive extent. Thankfully though they weren’t too efficient at reusing all they created - after all, there are still remains to be studied.
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GLOSSARY


**Careening Bay**: A bay or dock where careening can take place. To careen is to lay a ship on one side so as to allow for the exposure of the hull for cleaning of weeds and barnacles.

**Carvel**: Type of hull construction whereby the planks or plates of the hull are placed close to each other flush along each edge and caulked or sealed to as to make a smooth hull finish (see diagram adjacent)

**Clinker**: Type of hull construction in which the lower edge of each side plank or plate overlaps the upper edge of plank or plate directly below it. Used mainly for smaller boats because of the added water friction that it causes (see diagram adjacent)

**Dredger**: Vessel, usually self-propelled fitted with apparatus and machinery designed to deepen channels, harbours or entrances to rivers. Usual means by which this was done was via a chain of buckets through a central well.

**Hogging**: A condition of a ship where the extremities (bow and stern) have drooped. It is the opposite of ‘sagging’ whereby the middle of the ship droops in relation to the extremities (see diagram below)
**Hulk**: the name applied to an old ship converted to a secondary use which entails that it will no longer be required to move to serve its function. Usual uses were things such as floating storehouses.

**Lighter**: the name which applies to a so-called ‘dumb-vessel’ similar to a barge. Often lighters were made out of old vessels which were then towed around ports as travelling storehouses.

**Plimsoll Line**: the mark on the side of British merchant ships which indicates the draught level or level of allowable (safe) loading. The marking was a prerequisite after 1876 with the passing of the British Merchant Shipping Act.

**Pontoon**: A multi-purpose vessel. Similar to a lighter but specifically made for a variety of purposes. Such uses were in the raising of vessels (in relation to salvage), as a floating platforms for piers or quays or as vessels fitted with capstans or cranes and used in repair, salvage or careening procedures.

**Rigging**: A general term applying to the characteristics of sail vessels according to the configuration of their masts and sails. Examples of the most common rigs and illustrations of each are below.
**Cutter/Sloop**
Small decked vessel, one masted with bowsprit, fore-and-aft rigged.

**Snow Brig**
Same as brig, but with fore-and-aft trysail rigged on a small trysail mast

**Brig**
Two masted vessel, with square rigging on both

**Ketch**
Two masted vessel with fore and aft rigging on both. Fore mast is larger than aft mast.

**Barque**
Vessel of more than three masts, with square rigging on fore and main mast, and a fore-and-aft rig on the aft (mizzen) mast

**Schooner**
Vessel of two or more masts, fore and aft rigged with every mast same length

**Brigantine**
Two masted vessel with square rigging on fore mast and fore and aft rigging on rear mast.

**Ship**
Vessel of three or more masts, with square rigging on every mast

*Scuttling yard*: A place where vessels are scuttled. Scuttling entails the deliberate sinking or underwater abandonment of a vessel for many different reasons ranging from strategic abandonment due to wartime events or due to old age and uselessness of a particular vessel

132
APPENDIX 1:

PLANS AND DIAGRAMS OF OTHER SHIPS’ GRAVEYARDS
English Ships’ Graveyards:
The New Guys House Boat and the County Hall Ship

Position of the New Guy's House boat (Marsden 1994,97)
Approximate site of the *County Hall* ship (Marsden 1994:117)
The Danish Ships’ Graveyard
Roskilde, Copenhagen

Map showing location of the Roskilde Ships’ Graveyard (Maritime Archaeology Newsletter from Roskilde No.7 Dec 1996)

Cross-section of Wrecks 1 (left) and 2 (right). Drawn by Christian Lemee (Http://www.natmus.min.dk/nmf/nb/8/english/art4.htm)
Shipwreck distribution in Mallows Bay, Maryland (Shomette 1995:67 see also 1996:298)
Wrecks around entrance to Mallows Bay feeding creek (Shomette 1996:336, see also 1995:70)
Canadian Ships’ Graveyards:
Kingston Harbour, Lake Ontario

Map showing the location of Marine Graveyards in Eastern Lake Ontario (Moore 1995:4)
Map showing the location of wrecks along the western shore of the graveyard in the Inner Harbour of Kingston, Ontario (Moore 1995:22)
Australian Ships’ Graveyard 1:  
*Homebush Bay, New South Wales*

Map of Homebush Bay 1973 (Bower 1993: Map 2.1)
Australian Ships’ Graveyard 2:
Port Phillip Heads, Victoria

Port Phillip district Ships’ Graveyard (Duncan 1994)
APPENDIX 2:

SHIP’S DATABASE OF VESSELS IN NORTH ARM GRAVEYARD

APPENDIX 3:

SELECTED PLANS OF VESSELS IN GRAVEYARD FROM 1996-1997

SEASONS
Unidentified Wooden Barge

By N. Richards

Key:
- Structural wooden uprights
- Iron bolts
- Stern uprights [After Siegloff & Griffin 1996]
- Iron concretion
Unidentified Iron Hopper Dredger

By N. Richards

Scale

0 2 4 6 8
Metres

hopper doors

assorted dredging associated machinery

[After Matthews 1997]
Remains of 'Killarney'
By N. Richards

[After Roberts 1996 & Hales 1996]
Unidentified Pontoon
(Vessel No. 7)
By N. Richards
[After Habner 1997 & Hancock 1997]

Scale:

0 1
Metres

N

Part of dredging apparatus
Remains of 'Enterprise'

By N. Richards
[After Adamson 1996]

Stern

Unidentified Structure

Bow

Scale:

0 1 2 3 4 5

Metres
Remains of 'Sarnia'

By N. Richards

[After Rapita and Rice 1997]
Remains of 'Gem'
By N. Richards
[After Rapita and Rice 1997]
Remains of 'Thomas & Annie'

By N. Richards

0 1 2 3 4
Metres

N

Rudder

Centreboard casing

Windlass

Sternpost

[AFTER FOSTER 1996 & GREGORY 1996]
Remains of 'Mangana'

By N. Richards

0 2 4 6 8
Metres

[After Pilgrim 1996]
Remains of 'Garthneill'

By N. Richards

[AFTER DULGERNAS & PETERSON 1997]
Unidentified Iron Hopper Barge

By N. Richards

[After Barker 1997 & Hubbard 1997]
Remains of 'Dorothy H. Sterling'

By N. Richards

Scale:
0 3 6
Metres

[AFTER RICHARDS, WELSH AND ROSE 1996]

Extent of remains
Probable Hull Extent
APPENDIX 4:

THE MARINE BIOLOGY OF GARDEN ISLAND
Studies into the Marine biology of the Port Adelaide area has, in the past had a particular focus upon the Ships’ Graveyard, mainly due to the work of Brian James Brock (Brock 1974, 1978, 1982, 1994). Such studies have illustrated the intrinsic worth of the graveyard as a site worthy of study from a marine biology perspective which may prove important from archaeological points of view. The interaction between marine life, both microscopic and macroscopic, may have residual effects on how we can continue our endeavours to preserve and manage such sites from continual predation by natural forces. This is especially evident from the existence of teredo worm in the wooden wreckage which so often is the cause of conservation problems for underwater cultural resource management agencies.

The Ships’ Graveyard hulks are also study sites for the marine biologists who find that marine life builds up to higher levels within the silt laden hulls of the ships and allows for easily accessible and intensive study. This fact is of further importance as Garden Island remains the last place where there is accessible samphire vegetation in the Adelaide metropolitan area, and is an important home of larvae stage crustaceans (Brock 1974). Certain species of red algae also build up on the lower sections of the iron vessels which serve as intertidal zones that provide habitation sites for species of anemones and oysters, providing further opportunities for study (Brock 1985:44). Such studies themselves may cause improvements in the understanding of the importance of mangrove systems within the environment and may shed light upon effective ways to manage fish stocks and contribute to the sustainable development of the Port Adelaide district.

These combined factors will hopefully lead to an integrated, multi-faceted approach to the Ships’ Graveyard not only can be of significant importance to us historically as well as scientifically but also has an impact in the interpretation of the site with ecological and historical/archaeological tourism potential quite evidently present with all its subsequent economic benefits.
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Maps and Images

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DENR 6628-31 12/02/1990
DENR 6628-31 30/01/1997
Colour Print Photographic collection of Nathan Richards

Roll 1- 1  n.d  Starboard side: Santiago
Roll 1- 2  n.d  Starboard side: Dorothy H. Sterling
Roll 1- 3  n.d  Sternpost: Dorothy H. Sterling
Roll 1- 4  n.d  Starboard side and sternpost: Mangana view of Juno
Roll 1- 5  n.d  Starboard side: Dorothy H. Sterling
Roll 1- 6  n.d  North Arm Graveyard looking West
Roll 1- 7  n.d  Stern of Santiago looking east
Roll 1- 8  n.d  Sternpost: Flinders
Roll 1- 9  n.d  Port side: Dorothy H. Sterling
Roll 1-10  n.d  Starboard side: Sunbeam and other wreckage
Roll 1-11  n.d  Starboard side: Ullock or Moe remains and pontoon
Roll 1-12  n.d  Boiler of Killarney and Iron Barge at High Tide
Roll 1-13  n.d  Stern section: Mangana
Roll 2- 1  03/07/97  Ullock or Moe remains @260
Roll 2- 2  03/07/97  Stanley remains @east
Roll 2- 3  03/07/97  Iron pontoon on Ullock or Moe remains
Roll 2- 4  03/07/97  Juno remains @110
Roll 2- 5  03/07/97  Bow section: Juno @310
Roll 2- 6  03/07/97  Stern section: Glaucus @230
Roll 2- 7  03/07/97  Bow section: Grace Darling @280
Roll 2- 8  03/07/97  Ullock or Moe remains @south
Roll 2- 9  03/07/97  Iron pontoon - near Flinders @220
Roll 2-10  03/07/97  Gem remains @280
Roll 2-11  03/07/97  Easterly (Unidentified) dredger @230
Roll 2-12  03/07/97  Easterly (Unidentified) dredger @110
Roll 2-13  03/07/97  Gem remains @30
Roll 2-14  03/07/97  Bow section: Thomas and Annie @60
Roll 2-15  03/07/97  View of rudder: Thomas and Annie @east
Roll 2-16  03/07/97  Stern section: Garthneill @220
Roll 2-17  03/07/97  Mangana remains @280
Roll 2-18  03/07/97  Water pipe marker @330
Roll 2-19  03/07/97  Water pipe marker base @230
Roll 2-20  03/07/97  Sarnia remains @east
Roll 2-21  03/07/97  Mangana remains @320
Roll 2-22  03/07/97  Stern section: Garthneill @150
Roll 2-23  03/07/97  Detail of dynamite holes: Garthneill @160
Roll 2-24  03/07/97  Stern section: Mangana @west
Roll 2-25  03/07/97  Detail of Seminole associated wreckage @280
Roll 2-26  03/07/97  Detail of dynamite holes: Glaucus @220
Roll 2-27  03/07/97  Stern section: Grace Darling @260
Roll 2- 28 03/07/97 Starboard side: *Lady Daly* @270
Roll 2- 29 03/07/97 Stern section: *Flinders* @230
Roll 3- 1 03/07/97 Marine boiler of *Killarney*
Roll 3- 2 03/07/97 Pontoon on *Lady Daly*
Roll 3- 3 03/07/97 Pontoon on *Lady Daly*
Roll 3- 4 03/07/97 *Enterprise* remains
Roll 3- 5 03/07/97 Unidentified iron hopper dredger remains
Roll 3- 6 03/07/97 Bow section: *Sunbeam*
Roll 3- 7 03/07/97 Bow section: unidentified iron hopper dredger
Roll 3- 8 03/07/97 Starboard side: *Dorothy H. Sterling*
Roll 3- 9 03/07/97 Stern section: *Santiago*
Roll 3- 10 03/07/97 Stern section: *Santiago*
Roll 3- 11 03/07/97 Stern section: *Santiago*
Roll 3- 12 03/07/97 Starboard side: *Santiago*
Roll 3- 13 03/07/97 Port side: *Sunbeam* with view of *Killarney* remains

**Colour Print photographic collection of Archaeology faculty, Flinders University**

Roll 1- 1 22 & 23/03/97 Detail of dynamite holes in portside bow section of *Garthneill*
Roll 1- 2 22 & 23/03/97 Detail of stern section modifications to *Enterprise*
Roll 1- 3 22 & 23/03/97 Stern section: *Garthneill*
Roll 1- 4 22 & 23/03/97 Port side: unidentified iron dredger
Roll 1- 5 22 & 23/03/97 Stern section: *Enterprise*
Roll 1- 6 22 & 23/03/97 Starboard side: *Enterprise*
Roll 1- 7 22 & 23/03/97 Starboard side: *Enterprise* (from inside)
Roll 1- 8 22 & 23/03/97 Bow section: *Enterprise*
Roll 1- 9 22 & 23/03/97 *Enterprise* remains
Roll 1- 10 22 & 23/03/97 Port side: *Enterprise*
Roll 1- 11 22 & 23/03/97 Stern section: *Enterprise*
Roll 1- 12 22 & 23/03/97 Detail of inside hull framework: *Enterprise*
Roll 1- 13 22 & 23/03/97 Detail of outer hull plating: *Enterprise*
Roll 1- 14 22 & 23/03/97 Detail of outer hull plating: *Enterprise*
Roll 1- 15 22 & 23/03/97 Detail of bow section: *Enterprise*
Roll 1- 16 22 & 23/03/97 Detail of inner stern section: *Enterprise*
Roll 1- 17 22 & 23/03/97 Unidentified iron dredger remains
Roll 1- 18 22 & 23/03/97 Stern section: unidentified iron dredger
Roll 1- 19 22 & 23/03/97 Stern section: unidentified iron dredger
Roll 1- 20 22 & 23/03/97 Port side: unidentified iron dredger
Roll 1- 21 22 & 23/03/97 Detail of rudder remains: *Garthneill*
Roll 1- 22 22 & 23/03/97 Starboard side (aft): *Garthneill* with detail of cabling
Roll 1- 23 22 & 23/03/97 Stern section: *Garthneill*
Roll 1- 24 22 & 23/03/97 Detail of mast step: *Garthneill*
Roll 1- 25 22 & 23/03/97 Detail of mast step: *Garthneill*
Roll 1- 26 22 & 23/03/97 Starboard side (inside): *Garthneill*
Roll 1- 27 22 & 23/03/97 Detail of double deck: *Garthneill*
Roll 1- 28 22 & 23/03/97 Detail of hopper remains: unidentified iron dredger
Roll 1- 29 22 & 23/03/97 Detail of hopper remains: unidentified iron dredger
Roll 1- 30 22 & 23/03/97 Detail of inner wooden planking: unidentified iron dredger
Roll 1- 31 22 & 23/03/97 Detail of propeller shaft aperture: unidentified iron dredger
Roll 1- 32 22 & 23/03/97 Detail of probable engine/boiler housing plate: *Sarnia*
| Roll 1- | 33 | 22 & 23/03/97 | Bow section: *Sarnia* |
| Roll 2- | 1 | 22 & 23/03/97 | Detail of maststep: *Ullock or Moe* |
| Roll 2- | 2 | 22 & 23/03/97 | Detail of maststep: *Ullock or Moe* |
| Roll 2- | 3 | 22 & 23/03/97 | Detail of maststep: *Ullock or Moe* |
| Roll 2- | 4 | 22 & 23/03/97 | Detail of maststep: *Ullock or Moe* |
| Roll 2- | 5 | 22 & 23/03/97 | Detail of maststep: *Ullock or Moe* |
| Roll 2- | 6 | 22 & 23/03/97 | Bow section: *Gem* |
| Roll 2- | 7 | 22 & 23/03/97 | Bow section: *Gem* |
| Roll 2- | 8 | 22 & 23/03/97 | Detail of dredger well aperture: *Sarnia* |
| Roll 2- | 9 | 22 & 23/03/97 | Detail of engine/boiler plate: *Sarnia* |
| Roll 2- | 10 | 22 & 23/03/97 | Bow section: *Moe or Ullock* |
| Roll 2- | 11 | 22 & 23/03/97 | Bow section: *Moe or Ullock* |
| Roll 2- | 12 | 22 & 23/03/97 | Bow section, port side: *Sunbeam* |
| Roll 2- | 13 | 22 & 23/03/97 | Detail of Donkey boiler: bow end of *Sunbeam* |
| Roll 2- | 14 | 22 & 23/03/97 | Post side (inside): *Seminole* |
| Roll 2- | 15 | 22 & 23/03/97 | Stern section: *Seminole* |
| Roll 2- | 16 | 22 & 23/03/97 | Starboard side (inside): *Sunbeam* |
| Roll 2- | 17 | 22 & 23/03/97 | Starboard side (inside): *Seminole* |
| Roll 2- | 18 | 22 & 23/03/97 | Bow section (in water): *Seminole* |
| Roll 2- | 19 | 22 & 23/03/97 | Bow section, starboard side: *Sunbeam* |
| Roll 2- | 20 | 22 & 23/03/97 | Stern section: *Sunbeam* |
| Roll 2- | 21 | 22 & 23/03/97 | Bow section: *Sunbeam* |
| Roll 2- | 22 | 22 & 23/03/97 | Port side (inside): *Sunbeam* |
| Roll 2- | 23 | 22 & 23/03/97 | Starboard side: *Sunbeam* and view of *Seminole* remains |
| Roll 2- | 24 | 22 & 23/03/97 | Garden island bridge |
| Roll 2- | 25 | 22 & 23/03/97 | Stern section: *Seminole* |
| Roll 2- | 26 | 22 & 23/03/97 | Stern section: *Seminole* |
| Roll 2- | 27 | 22 & 23/03/97 | Bow section: *Seminole* |
| Roll 2- | 28 | 22 & 23/03/97 | Detail of engine/boiler plate: *Sarnia* |
| Roll 2- | 29 | 22 & 23/03/97 | Stern section: *Sarnia* |
| Roll 2- | 30 | 22 & 23/03/97 | Stern section: *Sarnia* |
| Roll 2- | 31 | 22 & 23/03/97 | Detail of construction of stern section, starboard side: *Seminole* |
| Roll 2- | 32 | 22 & 23/03/97 | Stern section: *Seminole* |
| Roll 2- | 33 | 22 & 23/03/97 | Bow section: *Seminole* |
| Roll 2- | 34 | 22 & 23/03/97 | Extent of site; *Seminole* |
| Roll 2- | 35 | 22 & 23/03/97 | Stern section (in water): *Seminole* |
| Roll 2- | 36 | 22 & 23/03/97 | Detail of rudder and stern section: *Sunbeam* |
| Roll 3- | 1 | 22, 23 & 31/03/97 | Total station usage, speed boat club, North Arm |
| Roll 3- | 2 | 22, 23 & 31/03/97 | Detail of stern section: *Ullock or Moe* |
| Roll 3- | 3 | 22, 23 & 31/03/97 | Detail of stern section: *Ullock or Moe* |
| Roll 3- | 4 | 22, 23 & 31/03/97 | Detail of maststep: *Ullock or Moe* |
| Roll 3- | 5 | 22, 23 & 31/03/97 | Detail of pontoon on top of *Moe or Ullock* remains |
| Roll 3- | 6 | 22, 23 & 31/03/97 | Total station usage, speed boat club, North Arm |
| Roll 3- | 7 | 22, 23 & 31/03/97 | Total station usage, speed boat club, North Arm |
| Roll 3- | 8 | 22, 23 & 31/03/97 | Detail of stern section: *Ullock or Moe* |
| Roll 3- | 9 | 22, 23 & 31/03/97 | Total station usage, speed boat club, North Arm |
| Roll 3- | 10 | 22, 23 & 31/03/97 | Total station usage, speed boat club, North Arm |
| Roll 3- | 11 | 22, 23 & 31/03/97 | Total station usage, speed boat club, North Arm |

*Colour Slide photographic collection of Archaeology faculty, Flinders University*
<table>
<thead>
<tr>
<th>Roll A-</th>
<th>Date</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>22/08/95</td>
<td>Ship’s graveyard</td>
</tr>
<tr>
<td>2</td>
<td>22/08/95</td>
<td>Dorothy H. Sterling remains</td>
</tr>
<tr>
<td>3</td>
<td>22/08/95</td>
<td>Dorothy H. Sterling remains</td>
</tr>
<tr>
<td>4</td>
<td>22/08/95</td>
<td>Santiago remains</td>
</tr>
<tr>
<td>5</td>
<td>22/08/95</td>
<td>Santiago remains</td>
</tr>
<tr>
<td>6</td>
<td>22/08/95</td>
<td>Santiago remains</td>
</tr>
<tr>
<td>7</td>
<td>22/08/95</td>
<td>Santiago remains</td>
</tr>
<tr>
<td>1</td>
<td>12/10/96</td>
<td>Grace Darling remains: NE view of rudder</td>
</tr>
<tr>
<td>2</td>
<td>12/10/96</td>
<td>Bow section: Garthneill</td>
</tr>
<tr>
<td>3</td>
<td>12/10/96</td>
<td>Detail of length and stern of: Garthneill</td>
</tr>
<tr>
<td>4</td>
<td>12/10/96</td>
<td>Detail of dynamite holes: Garthneill</td>
</tr>
<tr>
<td>5</td>
<td>12/10/96</td>
<td>Detail of outer hull plates (bow): Garthneill</td>
</tr>
<tr>
<td>6</td>
<td>12/10/96</td>
<td>Bow section: Garthneill</td>
</tr>
<tr>
<td>7</td>
<td>12/10/96</td>
<td>Detail of inner bow plating: Garthneill</td>
</tr>
<tr>
<td>8</td>
<td>12/10/96</td>
<td>Detail of rudder: Garthneill</td>
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<tr>
<td>9</td>
<td>12/10/96</td>
<td>Detail of rudder: Grace Darling (@ NE)</td>
</tr>
<tr>
<td>10</td>
<td>12/10/96</td>
<td>Detail of rudder: Grace Darling (@ SSW)</td>
</tr>
<tr>
<td>11</td>
<td>12/10/96</td>
<td>Detail of propeller shaft: Grace Darling (@ ESE)</td>
</tr>
<tr>
<td>12</td>
<td>12/10/96</td>
<td>Detail of runners and propeller shaft: Grace Darling (@ SSW)</td>
</tr>
<tr>
<td>13</td>
<td>12/10/96</td>
<td>Detail of double decking at bow: Grace Darling (@ WNW)</td>
</tr>
<tr>
<td>14</td>
<td>12/10/96</td>
<td>Grace Darling remains @ NNE</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sunbeam remains</td>
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<tr>
<td></td>
<td></td>
<td>Unidentified steamer (Killarney) @ north</td>
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<tr>
<td></td>
<td></td>
<td>Unidentified steamer (Killarney) @ south</td>
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<tr>
<td></td>
<td></td>
<td>Unidentified steamer (Killarney) @ west</td>
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<tr>
<td></td>
<td></td>
<td>Unidentified steamer (Killarney) @ south</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Unidentified steamer (Killarney), barge and hopper dredge</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Unidentified steamer (Killarney) and Sunbeam @ east</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Unidentified steamer (Killarney) @ north</td>
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<tr>
<td></td>
<td></td>
<td>Iron barge @ south</td>
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<tr>
<td></td>
<td></td>
<td>Iron barge @ south side and eastern end</td>
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<tr>
<td></td>
<td></td>
<td>Iron barge @ north</td>
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<tr>
<td></td>
<td></td>
<td>Iron barge @ north and western end</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Iron barge remains: %aspect @ western end</td>
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<tr>
<td></td>
<td></td>
<td>Iron barge remains: upperdeck @ western end</td>
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<tr>
<td></td>
<td></td>
<td>Detail of bow section and windlass: Thomas and Annie</td>
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<tr>
<td></td>
<td></td>
<td>Bow section: Thomas and Annie (oblique view)</td>
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<tr>
<td></td>
<td></td>
<td>Bow section: Thomas and Annie</td>
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<tr>
<td></td>
<td></td>
<td>Detail of midships: Thomas and Annie</td>
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<tr>
<td></td>
<td></td>
<td>Detail of centreboard casing: Thomas and Annie</td>
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<tr>
<td></td>
<td></td>
<td>Detail of rudder: Thomas and Annie</td>
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<td></td>
<td></td>
<td>Detail of rudder: Thomas and Annie</td>
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<tr>
<td></td>
<td></td>
<td>Maritime Archaeology students on boat</td>
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<td>Maritime Archaeology students on boat</td>
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<td>Santiago remains</td>
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<td>Santiago remains</td>
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<td></td>
<td></td>
<td>Santiago remains</td>
</tr>
</tbody>
</table>
Roll 2- 36 13/10/96  Santiago remains
Roll 2- 37 13/10/96  Santiago remains
Roll 3- 18 12/10/96  Detail of portside framework: Dorothy H. Sterling
Roll 3- 19 12/10/96  Detail of sternpost: Dorothy H. Sterling @ north
Roll 3- 20 12/10/96  Detail of starboard section keelson: Dorothy H. Sterling
Roll 3- 21 12/10/96  Stern section: Dorothy H. Sterling @ north
Roll 3- 22 12/10/96  Bow section: Dorothy H. Sterling
Roll 3- 23 12/10/96  Detail of starboard framework: Dorothy H. Sterling
Roll 3- 24 12/10/96  Detail of starboard framework: Dorothy H. Sterling
Roll 3- 25 12/10/96  Dorothy H. Sterling remains @ south
Roll 3- 26 12/10/96  Dorothy H. Sterling remains @ west
Roll 3- 27 12/10/96  Dorothy H. Sterling remains @ south
Roll 3- 28 12/10/96  Dorothy H. Sterling remains @ SE
Roll 3- 29 12/10/96  Dorothy H. Sterling remains @ east
Roll 3- 30 12/10/96  Dorothy H. Sterling remains @ NE
Roll 3- 31 12/10/96  Dorothy H. Sterling remains @ north
Roll 3- 32 12/10/96  Dorothy H. Sterling remains @ NW
Roll 3- 33 12/10/96  Santiago remains @ north
Roll 3- 34 12/10/96  Santiago remains @ starboard
Roll 3- 35 12/10/96  Santiago remains @ NW
Roll 3- 36 12/10/96  Santiago remains
Roll 3- 37 12/10/96  Bow section: Santiago
Roll 3- 38 12/10/96  Port side: Santiago
Roll 3- 39 12/10/96  Port side: Santiago
Roll 4- 17 23/03/97  Detail of dynamite damage: Glaucus
Roll 4- 24 13/03/97  Total station
Roll 4- 26 31/03/97  Total station
Roll 4- 29 22/03/97  Rhys Roberts recording site Sunbeam
Roll 4- 32 22/03/97  Julie Ford on unidentified site (Enterprise)
Roll 4- 33 22/03/97  Bow section: Sunbeam
Roll 4- 34 22/03/97  Seminole remains
Roll 4- 35 22/03/97  View bow to stern: Sunbeam
Roll 4- 36 22/03/97  Margaret Baker on unidentified hopper dredger/barge
Roll 4- 37 22/03/97  Shirley Matthews and Margaret Baker on unidentified hopper dredger
Roll 4- 38 22/03/97  Julie Ford and Justin Quist on unidentified site (Enterprise)
Roll 4- 39 22/03/97  Seminole remains
Roll 5-  2 23/03/97  Post marking old water pipes in North Arm
Roll 5-  3 23/03/97  Post marking old water pipes in North Arm
Roll 5-  4 23/03/97  Sarnia remains: (wrongly marked as Gem)
Roll 5-  5 23/03/97  Sarnia remains: (wrongly marked as Gem)
Roll 5-  6 23/03/97  Sarnia remains: (wrongly marked as Gem)
Roll 5-  7 23/03/97  Garrath Darkin on Gem remains
Roll 5-  8 23/03/97  Detail of mast step at stern: Ullock or Moe
Roll 5-  9 23/03/97  Ullock or Moe remains
Roll 5- 10 23/03/97  North Arm project
Roll 5- 11 23/03/97  Bow section: Grace Darling
Roll 5- 12 23/03/97  Justin Quist on unidentified site (Enterprise)
Roll 5- 13 23/03/97  Bow section: Grace Darling
Roll 5- 14 23/03/97  Sunbeam remains @ south
Roll 5- 15 23/03/97  Bow section: Garthneill @ south
Roll 5- 16 23/03/97  Bow section: Garthneill @ south
Roll 5- 17 23/03/97  Bow section: Garthneill
Roll 5- 18 23/03/97  Detail of mast step: Garthneill
Roll 5- 19 23/03/97  Detail of broken keelson section: Garthneill
Roll 5- 21 23/03/97  View bow to stern: Mangana
Roll 5- 22 23/03/97  Garthneill remains
Roll 5- 23 23/03/97  View to stern: Garthneill
Roll 5- 25 23/03/97  Total station

Web Sites:

Http://www.natmus.min.dk/nmf/nb/8/english/art4.htm

Http://giraffe.rmplc.co.uk/eduweb/sites/jralston/rk/scarpa/backgrnd.html

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Gilbert, Ray, Maritime Historian, Port Adelaide