Management and Protection of Indigenous and Cultural Foreshore Assets in NSW Australia

James T Carley[1], Ian R Coghlan[1], Chris D Drummond[1] and Michael Thomas[2]
[1] Water Research Laboratory, School of Civil and Environmental Engineering, UNSW Sydney, Australia
email: james.carley@unsw.edu.au
[2] NSW National parks and Wildlife Service, Taree, Australia

Abstract
This paper examines the impacts of natural coastal processes on a range of important indigenous and cultural assets on the coast in NSW Australia, through a series of case studies.

At Saltwater Point, near Taree NSW, Biripi country, the boulder lined cliff is receding, likely exacerbated from sea level rise, resulting in the exposure of buried artefacts, especially stone tools. Saltwater Point is also a renowned surfing break. The paper applies contemporary coastal process techniques and presents a range of management options for this site.

In Lake Victoria NSW, Barkindji country, altered water levels and erosion caused indigenous burial sites to be eroded. In 1994, one of the earliest geotube structures in Australia was constructed to protect this site.

Arrawarra, near Coffs Harbour NSW, Gumbaynggirr country is one of the best examples of a coastal fish trap in NSW, and is possibly the oldest functioning open coast coastal structure in the state. There are numerous examples of fish traps on rivers in Australia which may be millennia old, however, sea level rise and wave action have meant that any surviving coastal structures more than 6,000 years old would now be well under the sea. There are also hundreds of surviving examples of fish traps on the Australian coast. The Arrawarra fish traps are believed to be at least 1,000 years old, and were rebuilt in 2006. Arrawarra is also the site of a renowned surf break.

Conventional coastal management in Australia has often involved high dollar value real estate or public infrastructure on sandy beaches. This paper presents alternative stakeholders and paradigms into the complexity of coastal management.

Keywords: erosion, cliff erosion, indigenous artefacts, aboriginal archaeology, surfing, coastal management, coastal structures.

1. Introduction
This paper examines the impacts and engineering management of coastal processes on important indigenous foreshore assets in NSW Australia, through case studies for:

- Saltwater Point Biripi country
- Lake Victoria Barkindji country
- Arrawarra Gumbaynggirr country.

2. Saltwater Point NSW, Biripi Land
Saltwater Point is Birpai (Biripi) land, located near the present village of Wallabi Point NSW (Figure 1). Saltwater Point has a long history of aboriginal occupation and is also a renowned point break for surfing, with protection from southerly winds.

The foreshore is mostly composed of loose rounded hard igneous cobbles, with some embedded in an underlaying conglomerate of soft, erodible siltstone (Figure 2, Figure 3).

The loose cobbles extend up to about 2 m AHD (Australian Height Datum – approximately mean sea level), before transitioning to a steeper cliff face, which is soft in places, and less erodible in others. The prevailing waves transport sand and the cobbles predominantly to the north. Generally, the cobbles disappear from view at the concrete access ramp, but are evident at the northern end of Saltwater Beach – Wallabi Beach at times.

Reference [2] notes that the embankment has been eroding/receding, particularly as a result of large ocean storm events from the north-east to east such as those of June 2016 and February 2020. This erosion has unearthed indigenous artefacts such as stone tools (Figure 4).

The following options were not considered viable, with a brief reason provided with the structure type:

- Sand (required steepness and stability)
- Shotcrete (aesthetics)
- Concrete piles - secant or contiguous (hard substrate, aesthetics)
- Formed concrete (cost and aesthetics)
- Sheet piles (hard substrate, aesthetics)

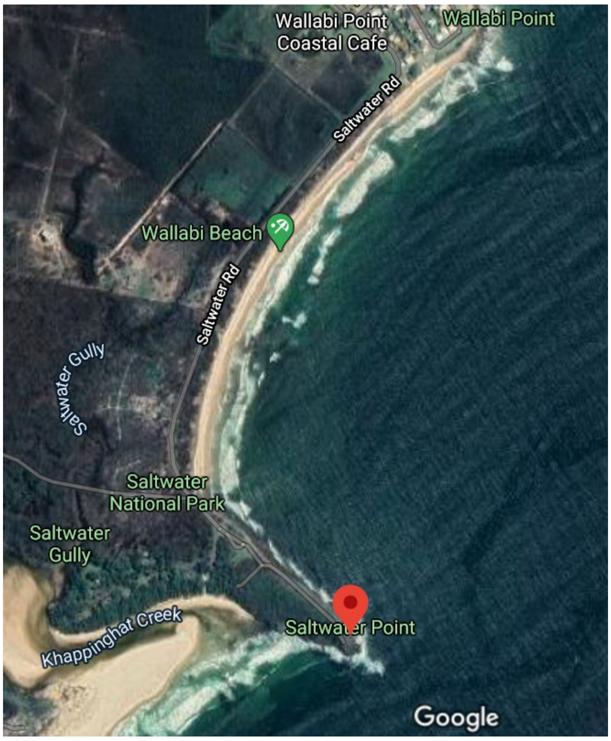

Figure 1 Saltwater Point location (Google maps)

Figure 2 Foreshore and embankment looking east at Saltwater Point, with right hand point break (Chris Drummond)

Figure 3 Foreshore and embankment looking west at Saltwater Point, with right hand point break (Chris Drummond)

Figure 4 Eroding embankment unearthing artefacts

Ten potentially feasible protection options were considered, namely:

- Angular cobbles/pebbles
- Rounded cobbles/pebbles
- Large armour rock
- Dimensioned stone
- Gabions
- Grouted small rock
- Geobags
- Artificial rock
- Timber
- Hybrid of the above

An unmanned aerial vehicle (UAV, "drone") survey was undertaken by WRL Senior Engineer and drone pilot Chris Drummond on 7 July 2020 at low tide. This drone survey captured high resolution aerial images and a detailed digital terrain model

The UAV survey of the site was completed using a DJI Phantom 4 RTK multirotor equipped with a high resolution RGB camera. This platform is a fully autonomous survey-grade mapping UAS which carries an on-board RTK-GNSS receiver. Survey control was provided by strategic placement of six black and white targets which were surveyed using ground based RTK-GNSS. observations connected to nearest CORSnet base station. Aerial images were processed using Pix4Dmapper to produce a geo-rectified orthomosaic image and 3D digital elevation model. Point clouds were cropped to exclude water surfaces by removing survey points below 0.4 m AHD, as well as manual cropping as required. This process ensured that the point cloud was an accurate representation of terrestrial surfaces only.

The 2018 NSW government bathymetric LIDAR dataset (https://elevation.fsdf.org.au/) was integrated with the WRL UAV survey to generate a seamless DEM, from which cross sections were extracted for visualisation and wave calculations (Figure 5).

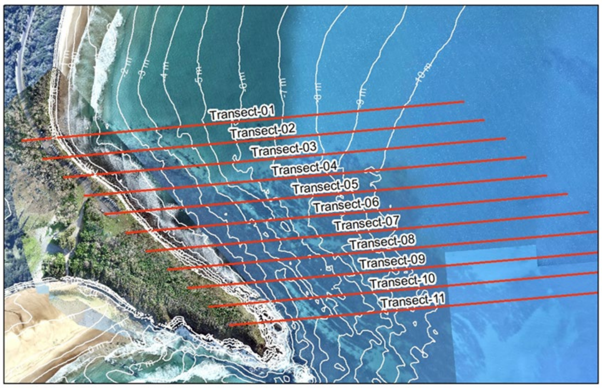

Figure 5   50 m transects developed for visualisation and wave modelling [2]

A range of standard coastal engineering techniques were applied for preliminary sizing of concept options. These included:

- Tides and storm surge from measured data
- Offshore waves from measured data
- Wave transformation from numerical modelling
- Wave runup from empirical models
- Sea level rise from future projections

All these options have advantages and disadvantages, and differing aesthetics, noting that the foreshore at Saltwater Point is naturally lined with rounded boulders. The selection of the preferred option involves criteria beyond engineering. Because the structure will be located on a natural headland with a natural cobble foreshore, "end effect" issues associated with coastal structures on sandy beaches are not applicable. A range of qualitative assessment criteria was developed and conveyed to stakeholders, namely:

- Design life
- Steepest gradient
- Relative capital cost
- Maintenance
- Main advantages
- Main disadvantages

Following consultation between NPWS staff and traditional owners, stakeholders elected to pursue a hybrid large armour rock and cobbles/pebbles, similar to that used at the iconic surf break, Crescent Head (Figure 6, Figure 7).

At the time of writing (August 2021), the project is progressing to design development.

Figure 6   Angular and rounded rock enhancement of existing cobble foreshore at Crescent Head NSW. Note adjacent surf break (James Carley)

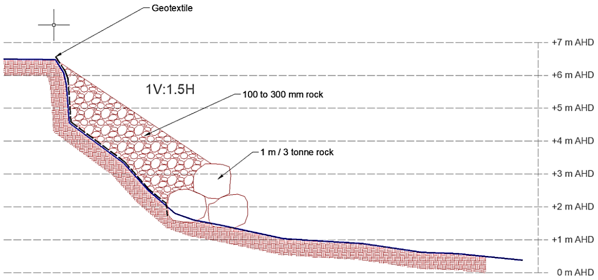

Figure 7   Suggested cross section of large armour rock toe with cobble infil [2]

3. Lake Victoria NSW, Barkindji Land

A general map of the study area is shown in Figure 8 and Figure 9. [9] and [10] reported that Lake Victoria, traditionally known as '*tar-ru*' is located in the south-western comer of NSW and is connected to the Murray River by a series of locks which control the inflows to the Lake.

Prior to the late 1920s the Murray River and Lake system were connected by Frenchmans Creek and the Rufus River. The Murray River filled and drained the Lake depending on the levels in the River. This natural process of Lake filling and draining was modified in the late 1920s with the construction of a network of locks, levee banks and inlet and outlet works.

In 1994 when the lake was lowered for maintenance, human remains and artefacts were discovered [7].

The Murray Darling Basin Authority consequently consulted with Barkindji people, and engaged Australian Water and Coastal Studies (AWACS) to develop options for protection of embankments [9], [10], (Figure 10).

Figure 8 Lake Victoria location in western NSW [7]

Figure 9 Lake Victoria location north of Murray River (Google maps)

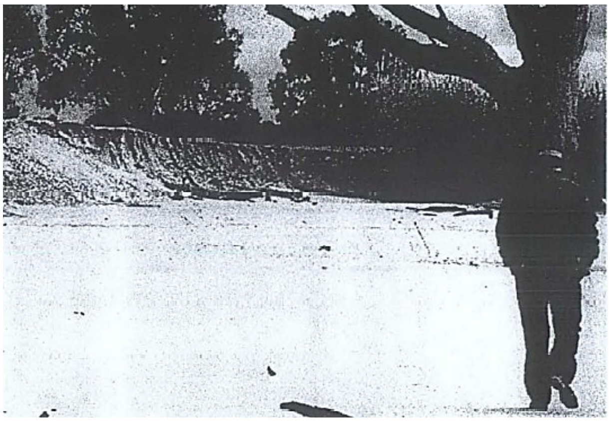

Figure 10 Bank erosion at Snake Island c1994 [10]

This led to one of the first geotextile tube ("geotube") structures in Australia. Comprehensive coastal engineering studies were undertaken, including:

- Site data acquisition and compilation including sediment coring
- Anemometer installation
- Wind wave calculations
- 2D wave flume modelling of geotube stability and wave transmission
- 3D basin modelling of geotube stability and wave transmission
- Construction documentation and monitoring

The geotube barrier (Figure 11, Figure 12, Figure 13) was constructed by extracting sand from 3 m beneath the clay floor of the lake and hydraulically filling a 1.2 m diameter tube and nourishing the area between them and landward of them. The tube was constructed from two layers, namely an outer non-woven geotextile (Bidim A44) and an inner woven polypropylene. It was reported to stand 0.8 m high. The design report acknowledged the risks of vandalism, debris damage and estimated a life of the outer fabric exposed to UV light of 5 to 10 years, but noted that it would be covered with sand approximately half the time.

The geotube wave barrier, more recent structures including geobags, and general change around the Lake are documented annually in MDBA reports [4].

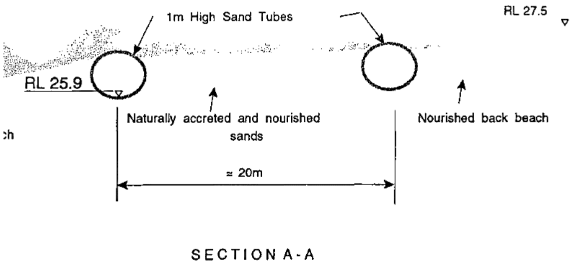

Figure 11 Geotube barrier cross section [10]

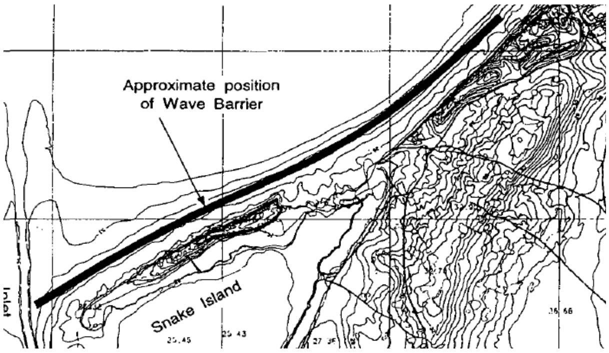

Figure 12 Geotube barrier alignment on Snake Island [10]

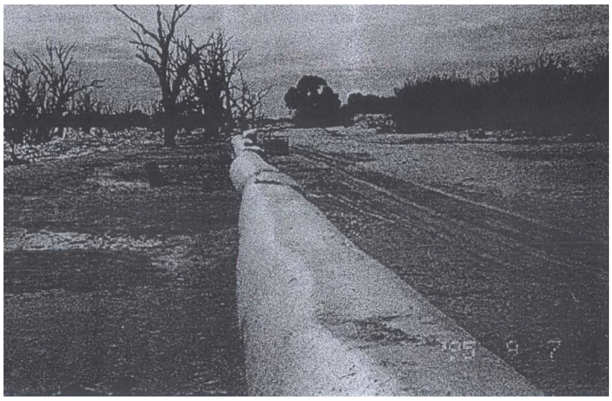

Figure 13 Geotube barrier on Snake Island c1995 [10]

4. Arrawarra NSW, Gumbaynggirr Land

4.1 Fish Traps in Australia

Reference [5] noted the following regarding fish traps: *"Indigenous people throughout Australia have constructed fish traps and weirs over a long period of time and there is considerable variety in types, numbers, size and location of these sites. They were designed to capture aquatic animals, predominantly fish, and the more durable of these structures (i.e. those made of stone) are still visible on Australia's coasts and rivers today…*

Fish traps have assumed an important place in discussions concerning late Holocene Aboriginal culture change, in particular their possible role in increasing marine production … However, attempts to directly date these structures have so far been unsuccessful … with chronology often established through dating of associated cultural [relics]*… Recent discussions … have also developed the idea that some stone features in the intertidal zone are associated with the cosmological landscape rather than serving a purely economic function."*

[5] has documented hundreds of indigenous fish traps in Queensland. They are less documented in NSW, but examples of their documentation include [1] which confirms three fish trap sites on the northern NSW coast, and [3] which discusses tens of fish traps throughout NSW based predominantly on oral history. [8] estimated the distribution of fish traps around the Australian coast as shown in Figure 14, and conceded that there were many more to be discovered.

Fish traps more than approximately 6,000 years old will no longer be visible on the present foreshore due to the rise in global sea level rise. Global sea levels rose approximately 120 metres in the period from 21,000 years ago to 6,000 years ago.

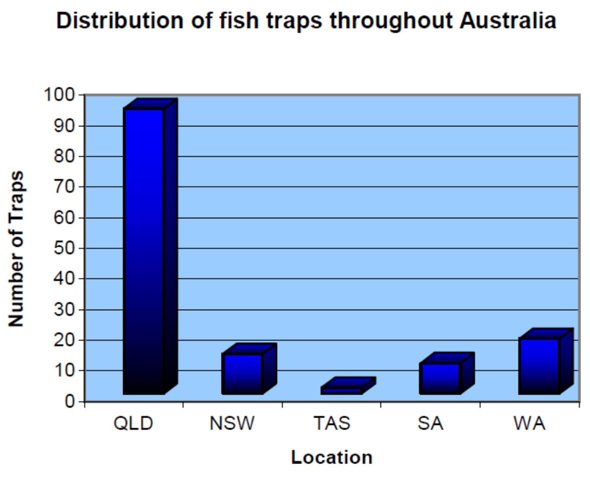

Figure 14 Prevalence of fish traps in Australia by state. Note that the author [8] and other references indicate that this is almost certainly an underestimate, however, the relative prevalence appears plausible

4.2 Arrawarra Headland Fish Trap

Perhaps the most visible fish traps in coastal NSW are at Arrawarra, Gumbaynggirr country, approximately 30 km north of Coffs Harbour Figure 15.

Reference [6] stated that these are thought to be approximately 1000 years old. They were restored under the supervision of Garby elders over 3 years from 2006.

This fish trap coexists with a renowned right hand surfing point break (Figure 16, Figure 17), and is also arguably the oldest evident coastal structure in NSW. They are an important component of cultural tourism in the area.

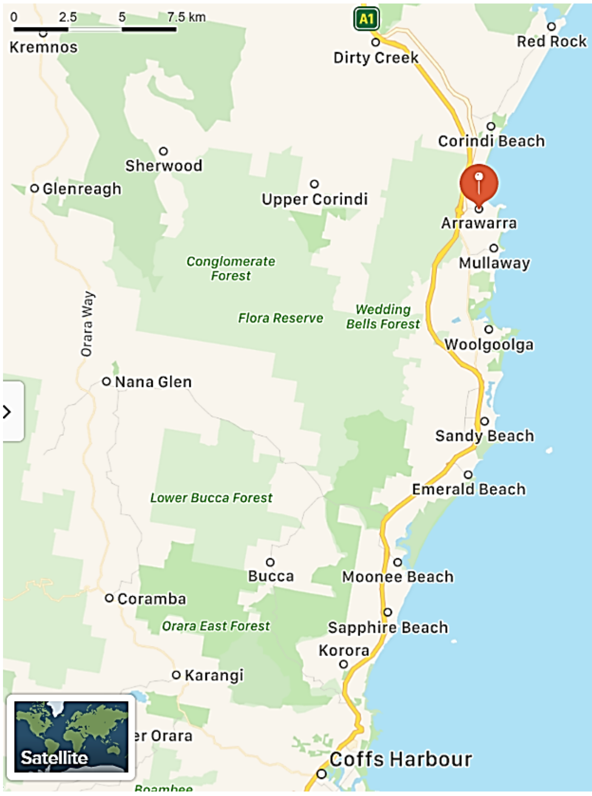

Figure 15 Arrawarra Headland location (Apple Maps)

Figure 16 Foreshore and fish trap at Arrawarra Headland, 2015. Note adjacent right hand point break (James Carley)

Figure 17 Nearmap image of fish trap at Arrawarra Headland, 21/12/2013. Estimated to be approximately 1000 years old. Rebuilt in 2006

5. Conclusions

Coastal management using coastal structures has usually revolved around protection of built assets with high economic value such as houses and infrastructure.

Surfers are also often involved as stakeholders within coastal management. Fish traps at Arrawarra and other sites, together with embankment protection at iconic surf breaks shows that coastal protection works and surfing can coexist.

While less obvious to many, engineering protection of cultural assets using contemporary coastal engineering techniques has already been undertaken in Australia, and is likely to become an increasing consideration within coastal management.

6. References

[1] Campbell, Valerie (1978), Two fish traps located on the mid-north coast of New South Wales, in Records of times past: Ethnohistorical essays on the culture of the New England tribes. Edited by Isabel McBryde, Canberra, AIAS

[2] Carley, J T, C D Drummond and I R Coghlan (2020), Embankment protection options for Saltwater Point NSW, WRL TR 2019/35, September 2020, Water Research Laboratory, UNSW Sydney

[3] Fuller, Robert S. (2020), The astronomy and songline connections of the saltwater Aboriginal peoples of the New South Wales coast A thesis in fulfilment of the requirements for the degree of Doctor of Philosophy

[4] Murray Darling Basin Authority (2020), Lake Victoria Annual Report, Available for 2007 to 2019, https://www.mdba.gov.au/publications/mdba-reports/lake-victoria-annual-report

[5] Rowland, J and Sean Ulm (2011), Indigenous Fish Traps and Weirs of Queensland, q a r | Vol. 14 | 2011

[6] UNE News (2006) Prehistoric fish traps the focus of crosscultural project April 11, 2006, University of New England

[7] Visit Wentworth NSW (2021), https://visitwentworth.com.au/

[8] Welz, Aara I. (2002), Fish Trap Placement! The Environmental and Cultural influences in Fish Trap Placement along the Australian Coastline A 30,000-word thesis submitted for the degree of Bachelor of Archaeology (Honours), in the Department of Archaeology at the Flinders University of South Australia.

[9] Wyllie, S J and D A Allsop (1994), Lake Victoria - Southern Foreshore Erosion Protection Of Aboriginal Burial Sites Report 94/111, Australian Water and Coastal Studies Pty Ltd (AWACS), July 1994

[10] Wyllie, S J and C R Nalty (1995), Lake Victoria Snake Island Wave Barrier Design And Construction, Report 95/37, Australian Water and Coastal Studies Pty Ltd (AWACS) October 1995