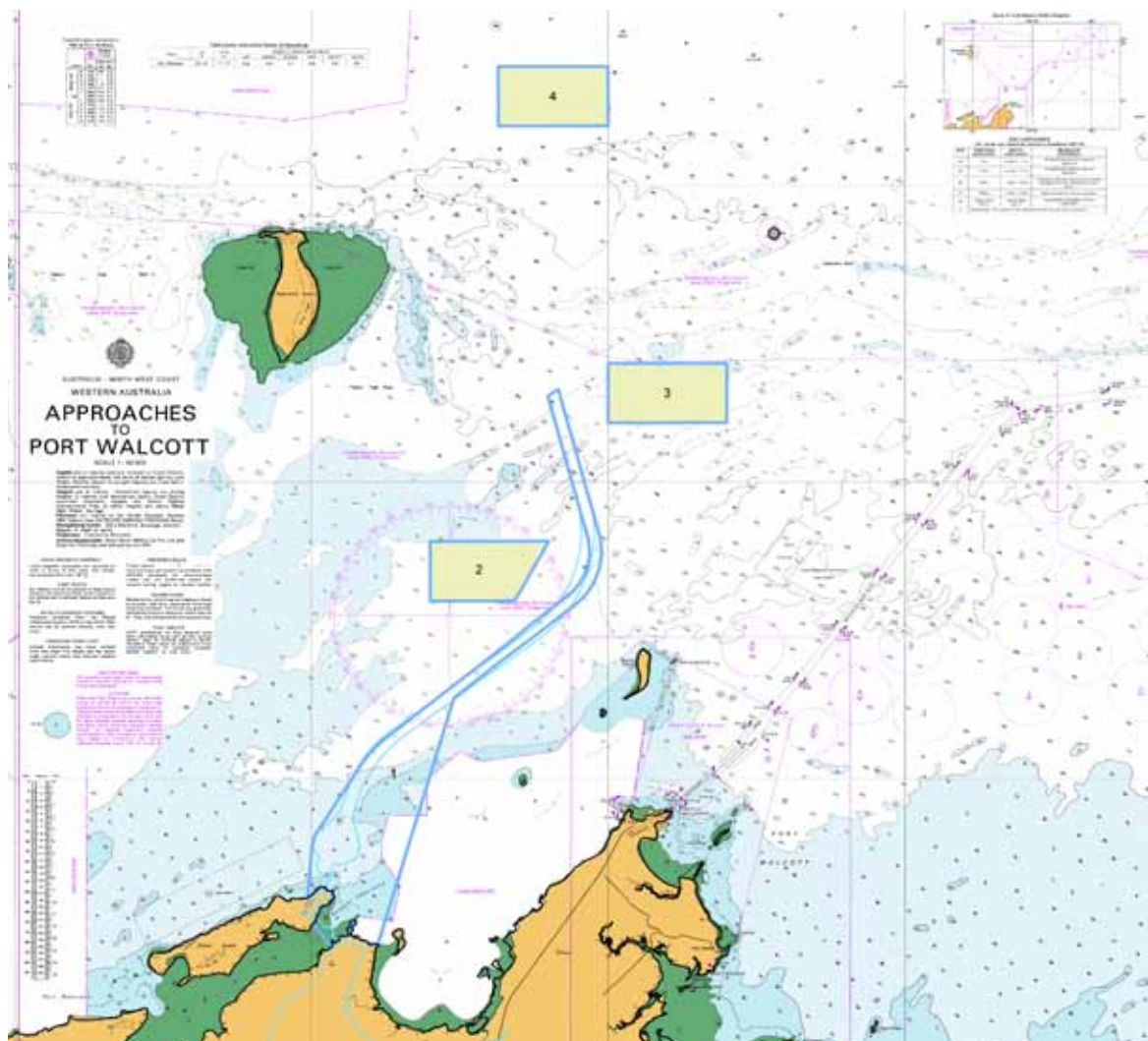


# Anketell Port Development

## Maritime and Underwater Cultural Heritage (MUCH) desktop analysis

Ross Anderson and Jeremy Green



# Anketell Port Development – Maritime and Underwater Cultural Heritage (MUCH) desktop analysis

## Background

The Department of Maritime Archaeology, Western Australian Museum was requested to undertake an historical desktop gap analysis for a Maritime and Underwater Cultural Heritage (MUCH) survey of the proposed Anketell Port development at Dixon Island west of Cape Lambert by API Management Pty Ltd (API).

## Study area

The study area is defined as including the coastline, inter-tidal and coastal littoral zone and coastal waters and adjacent land from Cape Lambert in the east to the north-eastern coast of Nickol Bay, just south of the southern entrance to Port Robinson (Figure 1). The Anketell Port development envelope includes Anketell Point, the northern end of Dixon Island and port infrastructure areas inland. The coastal littoral and seabed area between Anketell Point and Dixon Island is bridged blocking the northern entrance to Port Robinson (Bouguer Entrance), while an ore jetty, turning basin, dredged shipping channel, and Dredge Material Dumping Areas (DMDAs) are situated offshore (Figure 3).

## Legislation

The Chief Executive Officer ('The Director') of the Western Museum is responsible for the state *Maritime Archaeology Act 1973*, and is the delegate for the Minister responsible for the Commonwealth *Historic Shipwrecks Act 1976*.

### *Historic Shipwrecks Act 1976*

This Act applies to '...all remains of ships (whether or not the existence and location of the remains are known) that are:

Situated in Australian waters, or waters above the continental shelf of Australia, adjacent to the coast of the State; and

At least 75 years old;

to be historic shipwrecks...' (Part II, 4A. (1)).

The Act applies from the Continental Shelf, including the Exclusive Economic Zone (see Figure 2) to the Low Water Mark, except in the cases of enclosed bays, rivers and other State Waters. It protects all shipwrecks and artefacts associated with such shipwrecks that are over 75 years of age, or subject to declaration by the Minister. Section 17(1) relating to the discovery of shipwrecks and relics to be notified states:

A person who finds, in a fixed position in Australian waters or waters above the continental shelf of Australia, the remains of a ship or of a part of a ship, or an article associated with a ship, shall, as soon as practicable, give to the Minister a notice setting out a description of the remains or of the article and a description of the place where the remains are, or the article is, situated, being a description of that place that is sufficient to enable the remains or article to be located.

Hence it is a requirement under the Act to report potential wreck sites and it is an offence to fail to do so (see <<http://www.comlaw.gov.au/Details/C2006C00172>>).

### *Maritime Archaeology Act 1973*

This Act makes provision for the preservation on behalf of the community of the remains of ships lost before the year nineteen hundred, and of relics associated therewith, and for other purposes incidental thereto. The Act defines maritime archaeological sites,

4. (1) For the purpose of this Act apply to:

- a. any area in which the remains of a ship, which in the opinion of the Director may have been a historic ship, are known to be located;
- b. any area in which any relic is known to be located, or where in the opinion of the Director unrecovered relics associated with a ship which may have been a historic ship are likely to be located; and
- c. any structure, campsite, fortification or other location of historic interest that, in the opinion of the Director, is associated with, and was occupied or used by, persons presumed to have been in a historic ship,

shall be a maritime archaeological site.

(2) A maritime archaeological site may be situated below low water mark, on or between the tidemarks, or on land, or partly in one place and partly in another.

In addition the Act specifies:

#### New finds

17.(1) A person who finds a ship that was, or appears likely to have been, lost before the year nineteen hundred and fails to give notice of the finding to the Director in writing as soon as practicable after the finding commits an offence.

Since the Commonwealth Act takes precedence over the State Act, the State Act only applies above the Low Water mark for all maritime archaeological sites including shipwrecks and below the Low Water Mark to the 3 nautical mile limit for all underwater cultural heritage, including maritime archaeological sites, but excluding shipwrecks (see Figure 2).

### **Environment**

The proposed Anketell Port development is situated at the eastern end of the Dampier Archipelago and at the northeast point of Nickol Bay, with the planned alignment of the dredged shipping channel exiting to the east of Delambre, Haüy and Legendre islands. These islands made up primarily of Pleistocene coastal limestone, are the easternmost islands of the Dampier Archipelago (McIlroy, 1979: 8). The port of Dampier lies to the west, and to the east lie Cape Lambert, Point Samson, Jarman Island, Port Walcott, Butchers Inlet and the historic port town of Cossack (Tien Tsin), the first port in the north-west of Western Australia. The historic town of Roebourne is situated further inland on the banks of the Harding River (Figure1).

The coastline is a combination of rocky reefs, islands, beaches and muddy mangrove-lined inlets and marshes. Tidal variation is in the range of 4.4m (Ridgway, 1988: 17).

The Pilbara region is frequented by cyclones between the months of December and April that have caused a number of shipwrecks. Cyclones in the northwest of Western Australia are reported to be generally more frequent and more violent than elsewhere on the Australian coast (Australia Pilot, 1959: 34). On Christmas Day in 1870 a cyclone wrecked four luggers at Cossack (the *Mystery*, *Coquette*, *Pilot* and *Crest of the Wave*), in 1872 a cyclone destroyed the towns of Cossack and Roebourne, while in 1878 another cyclone 'destroyed' the entire pearling fleet, at that time made up of some 1500 divers, of which 800 were Malays and

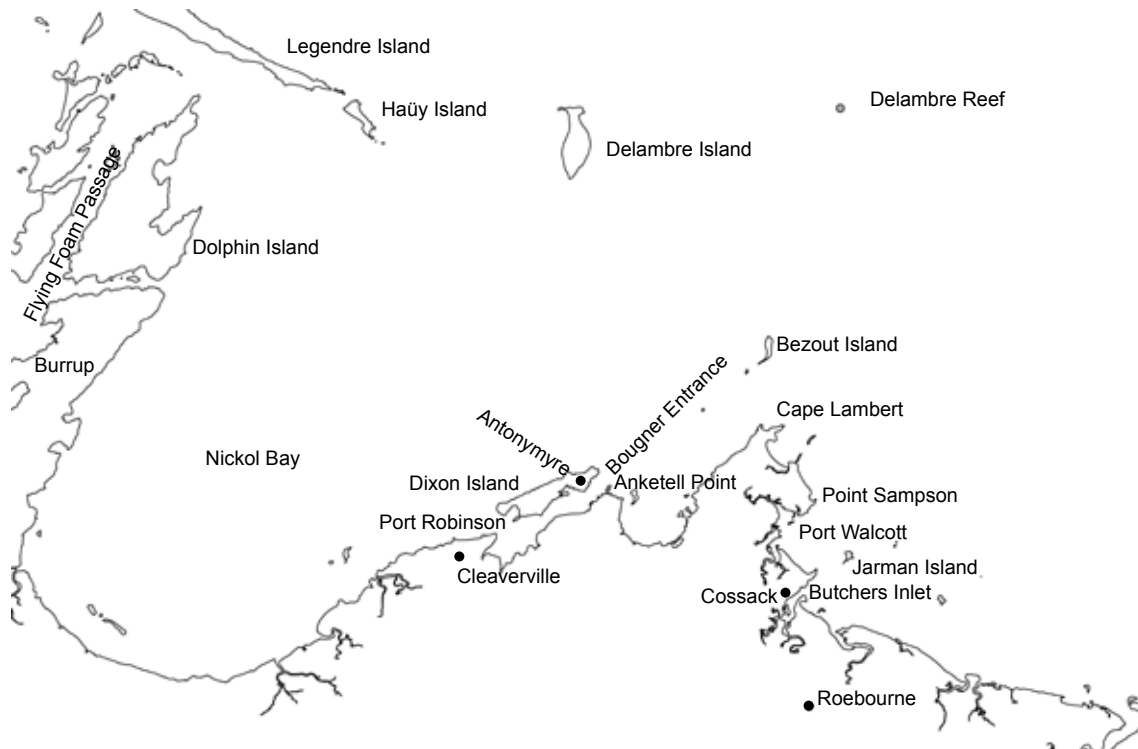


Figure 1: Map of study area.

the rest Aboriginal people. Shallow draft vessels would often take shelter from cyclones in mangrove-lined creeks and inlets, and were sometimes wrecked despite taking shelter. Severe damage and loss of life also occurred at Cossack as a direct result of the eruption of Krakatoa in 1883 (Ridgway, 1988: 21). Local magnetic anomalies are reported northward of Cape Lambert, in the approaches to Port Walcott (Australia Pilot, 1959: 31).

Butchers Inlet is recorded to have silted up at the beginning of the 20th century making it inaccessible to shipping (Ridgway, 1988: 21), which as well as being a factor in the decline of Cossack as a port, may explain why few remains of the many shipwrecks recorded in Butchers Inlet and immediate area are visible (Sledge, 1978: 18)

### European and maritime historical background

The early European exploration of northwest Western Australia commenced around the Nickol Bay and Port Walcott areas, as colonial settlers established pastoral and pearling industries. Shipping links to the outside world centred on the port of Cossack.

In 1818, explorer and surveyor Captain Phillip Parker King, in the *Mermaid*, charted Nickol Bay. Visits to the region by American whalers are recorded to have occurred from around the 1840–50s. In April 1861, a government-funded expedition sailed to Nickol Bay in the *Dolphin*, while in 1862, Bateman sent his vessel *Flying Foam* to harvest pearl shell in the area. In April 1863 Captain Peter Hedlund (Hedland) in the *Mystery* discovered Mangrove Harbour (later named Port Hedland) and Tien Tsin Harbour (later named Port Walcott, and the township of Tien Tsin was renamed Cossack in 1873). The *Mystery* and the *Tien Tsin* brought settlers and stock, and established the first European settlement in the northwest on the banks of the Harding River, inland from Tien Tsin Harbour (McCarthy1990: 30-49).

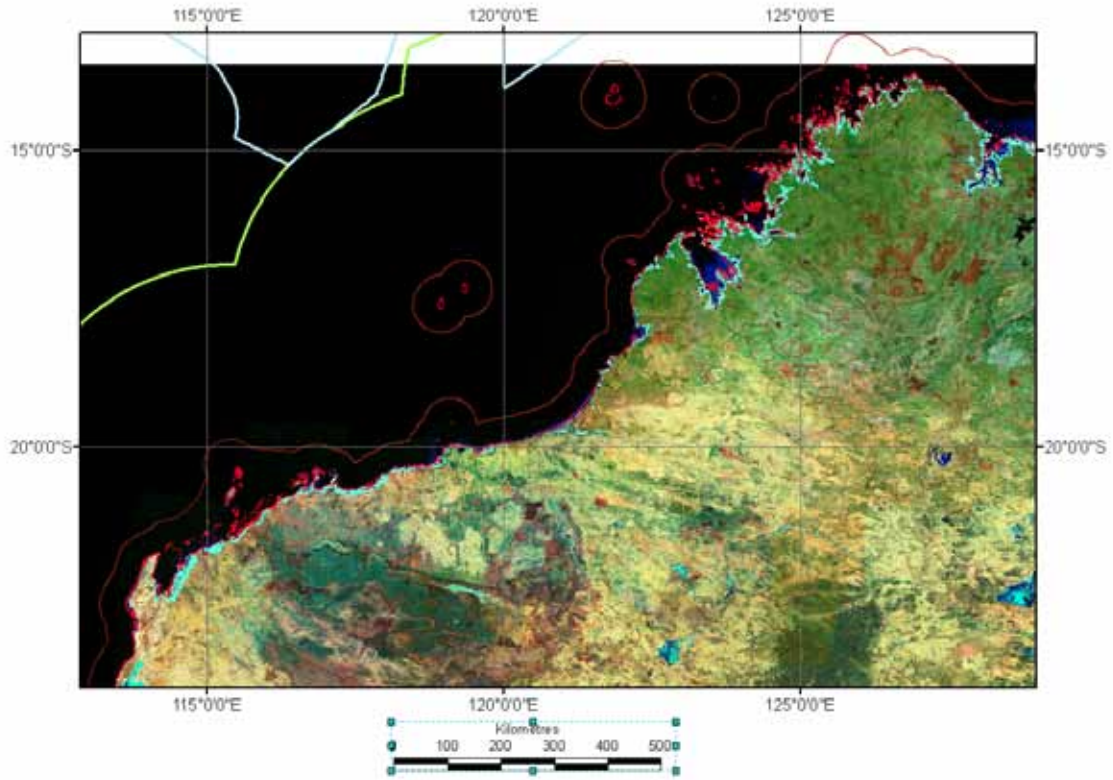


Figure 2. Map of the North West of Western Australia showing the Territorial Baselines. Red is the three nautical mile limit of State Waters, Green is the Continental Shelf, Blue Exclusive Economic Zone.

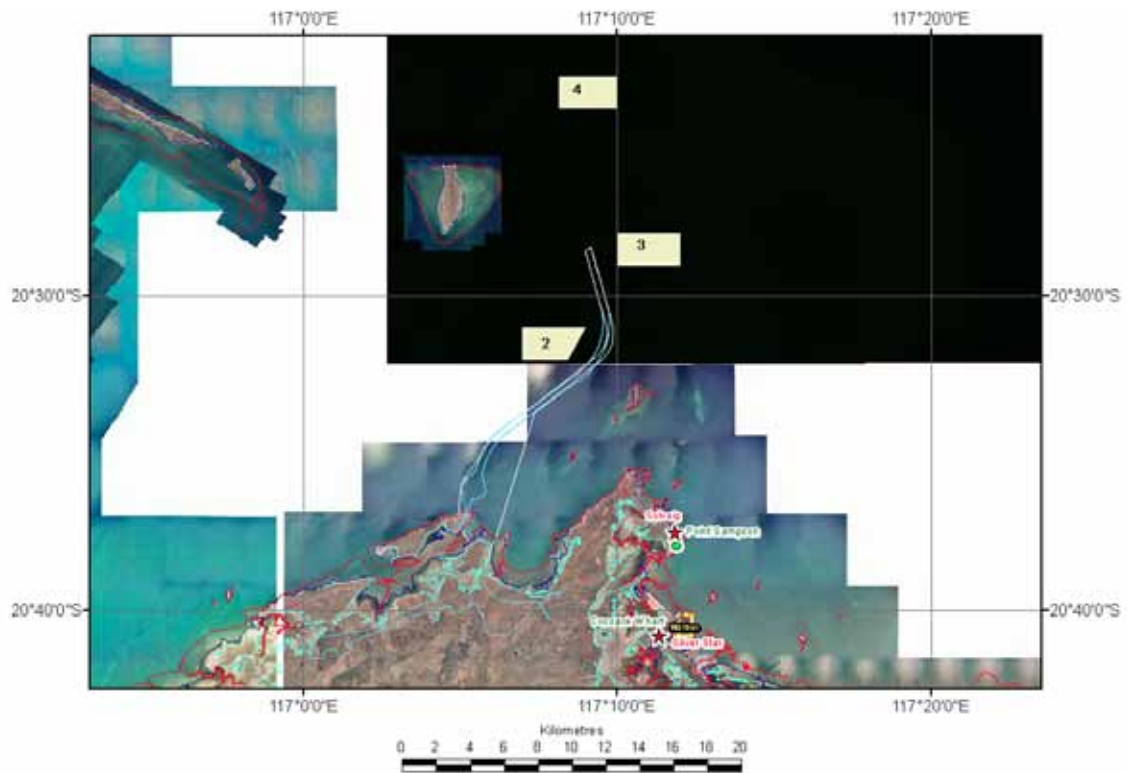


Figure 3. Map showing the Anketell Port Development. Blue line indicates the limit of the PER envelope, the white line indicates the limit of potential marine construction and the three yellow boxes are the proposed DMDAs. Red stars are known and protected shipwrecks; green circles are heritage sites and yellow square is approximate position of a known wreck.



Figure 4 General overview of the area showing the prominent features in the Cape Lambert area.

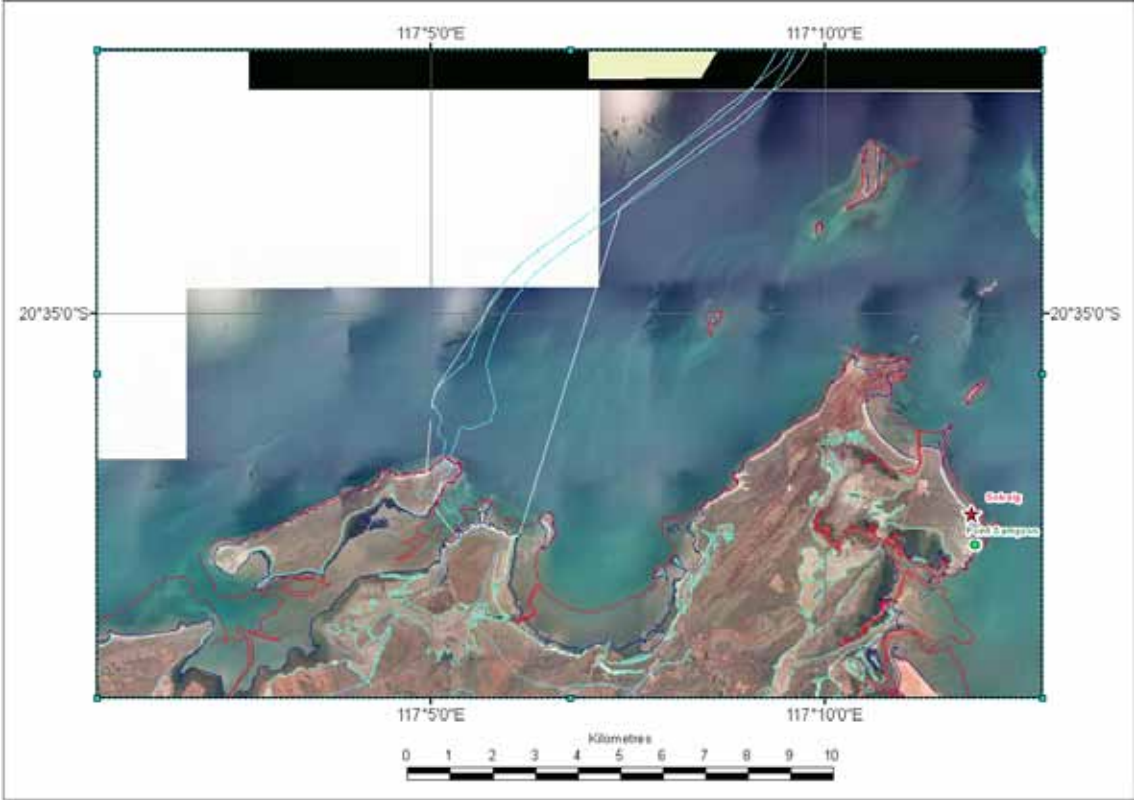


Figure 5. Detail of the coastline showing the arrival point of the dredged channel on Dixon Island.

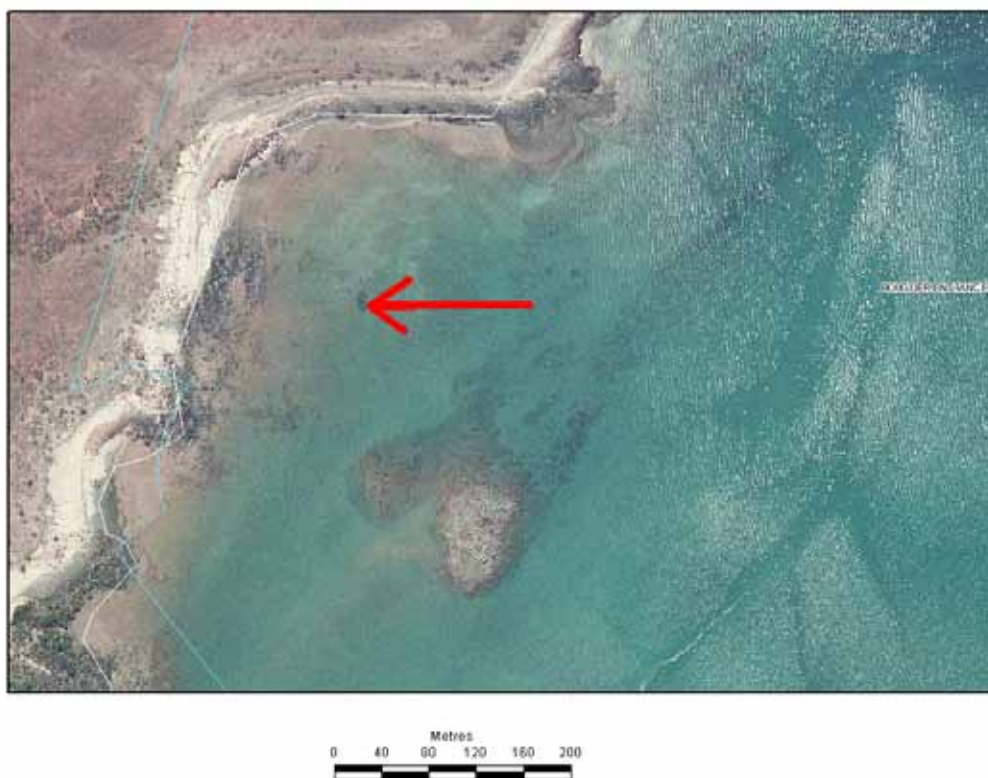


Figure 6. Site of possible interest, note the size of the object is about 20 m, located Lat  $-20.62031^{\circ}\text{S}$ , Long  $117.08661^{\circ}\text{E}$  on the western end of Dixon Island, near Bougiuer Entrance.

In October 1865 some of the remaining settlers from the failed settlement at Camden Harbour (established in November 1864), regrouped at the Harding River settlement, which on 19 August 1866 was proclaimed as the township of Roebourne. The overland stock route between Perth, Champion Bay and Roebourne was opened in August 1866.

Nickol Bay was the birthplace of the north-west pearl shell harvesting industry, that started in the 1860s with coerced Aboriginal labour collecting shell from the shoreline and exposed coastline at low tide, and later developed into naked diving and then helmet diving. The pearling industry involved brutal conditions for the enslaved and unpaid Aboriginal divers, who were tricked or illegally captured from various regions in Western Australia to meet the demands of the pastoralists and master pearlmen. By January 1868 the pearling industry had begun using Aboriginal divers and there were between 8–10 pearling vessels at Tien Tsin Harbour. In 1871 the brutality being inflicted on Aboriginal men, women and children by pearlmen and pastoralists forced the government to act and introduce the first Pearling Acts. This forced the European colonists to look elsewhere and 'Malay' labourers were brought in to satisfy the rapacious demand for labour in the pearling industry. The term 'Malays' is broadly used to describe a diverse range of Solorese, Alorese, Macassan and Kupang people (McCarthy, 2008: 243–63).

By the 1880s, the northwest pearling grounds had become over-exploited and naked Aboriginal divers had reached the physical limit of naked diving. As a result, the centre

of the pearl shell harvesting industry shifted to Roebuck Bay and Broome, where helmet divers operated from pearling luggers (McCarthy, 2008: 256).

Mineral discoveries such as copper at Balla Balla and gold at Ashburton River, and the development of other industries, such as sandalwood trading, led to a growth in coastal shipping resulting in an increase in the population, and shipwrecks, in the region.

### **Ports, anchorages and historic maritime infrastructure**

As most early vessels were of shallow draught, the tidal range of up to 4.4 m in the northwest allowed vessels, such as cutters and schooners, to access and shelter in mangrove-lined inlets and creeks. Produce such as wool, pearl shell and bagged mineral ore was stacked along the banks of creeks and tidal inlets waiting to be picked up by vessels.

Port Robinson is described as 'a snug little harbour available for small vessels with local knowledge, of 8 or 9 feet [2.4 m or 2.7 m draught]' and is marked on nautical charts as an anchorage (*Australia Pilot*, Vol. 5, 1959: 304; Admiralty Chart AUS 327, 1967). The historic town site of Cleaverville was located adjacent to Port Robinson, and fresh water wells were recorded to have been sunk in this area, although without success (*The Inquirer and Commercial News*, 11/7/1877: 3).

Nickol Bay is situated about 12 miles west-south-west of Cape Lambert and is famous as the birthplace of the Western Australia's north-west pearl shell industry. It is described as not having been surveyed, 'but there is anchorage for vessels with local knowledge in depths of from 6 to 7 fathoms (11 m to 12.8 m)' (*Australia Pilot*, Vol. 5, 1959: 304).

Port Walcott is an open roadstead to the east of Cape Lambert and Point Samson and is approached from the north.

The Point Samson jetty was built in 1903 to solve the problems of shipping access to Cossack, and is now in a ruinous condition. The Norwegian-owned iron barque *Solveig* carrying jarrah piles for the Point Samson jetty was anchored in Port Walcott when it was wrecked during a cyclone in 1907. Fishing boats use the tidal inlet of Sam's Creek (Sledge, 1978: 17).

The historic port town of Cossack is situated on the west bank of the tidal, mangrove-lined Butchers Inlet, and was used by shipping for trade, repairs, to shelter from cyclones and also has been used to abandon wrecks and unseaworthy vessels. A timber jetty was built north of Cossack in 1871 (Cumming, *et al.*, 1995: 46), and a beacon brought up by Charles Broadhurst in the SS *Xantho* was installed at Cossack in 1872. The 24 feet (7.3 m) high timber pile structure of Reader Head Lighthouse was built in 1881, but destroyed by fire in 1884. A jetty was built at Cossack in 1875, and quarantine officer stationed there. The Cossack wharf built in 1891–92 was damaged by a cyclone in 1894 and rebuilt. Other port facilities included an associated tramway (built 1888), goods shed (built 1891–92) and explosives magazine (built 1896–97) (Ridgway, 1988: 20; Cumming, *et al.*, 1995: 46).

The surrounding mangroves and marshes caused problems for access to the port, and the tidal range of 4.42 m required all vessels over 200 tons to anchor off Jarman Island. Cargo was lightered to either the Lower Landing on the western bank of Butchers Inlet or to the Upper Landing 3 km upstream. Smaller vessels could enter the inlet at high tide



and anchor at the 'Deep Hole' jetty on the eastern bank (Ridgway, 1988: 17). By 1882 the population of Cossack numbered 1000 people and 171 steamers, luggers, cutter, schooners and other small craft were recorded as using Cossack port facilities that year (Ridgway, 1988: 20).

The Jarman Island lighthouse was built in 1888 to service Cossack and Port Samson, and decommissioned when the Cape Lambert lighthouse was built in 1985 (Cumming, *et al.*, 1995: 37). The Legendre Island lighthouse was originally established in 1927, and was replaced by another light at a different location in 1963, and after being damaged was again replaced in 1989 (Cumming, *et al.*, 1995: 37).

### **Archaeological sites on islands in the Dampier Archipelago**

Islands in the Dampier Archipelago are rich in archaeological remains relating to prehistoric Aboriginal occupation e.g. middens, surface scatters of artefacts, rock engravings and rock art. Historic activities in the Dampier Archipelago include the islands being used as exploration sites, for barracoons (prisons) for Aboriginal workers and divers, trochus shelling camps, whaling stations, wells/ watering sources, pearling camps, graves/ burial sites, pastoral stations, navigation infrastructure (lighthouses and beacons), defence, lazarets and quarantine stations. Archaeological evidence for such activities consists of artefact scatters, ruinous structures, earthworks, rock art and *graffito*, aircraft crash sites, graves and maritime artefacts (Paterson & Souter, 1994: 7; McIlroy 1979).

The Heritage Council of Western Australia (HCWA) records that: 'A lazaret (a hospital for the treatment of contagious diseases) was established at Bezout Island, off Point Samson (P8661) in the Shire of Roebourne for the quarantine and treatment of leprosy patients. There are no remains of this establishment used between 1909 and 1913. The Bezout Island lazaret was replaced by a facility off the coast of Cossack, which was an island only at high tide. The Cossack lazaret (P8665) had been originally established in 1909 but concerns of security had led to preference by the authorities for the Bezout Island lazaret. The Cossack lazaret was re-established in 1913 and operated until 1931. No buildings remain on the site.' (HCWA, 2006: 13).

Although the HCWA assessment is that no extant built remains may be visible, it is highly likely that there are archaeological remains related to the construction and operation of the quarantine lazarets at the unnamed island of Cossack, and Bezout Island.

Overall any activities related to the Anketell Port outside the Port PER envelope that involve development of the offshore islands and reefs (e.g. constructing navigational infrastructure and facilities) may impact potential archaeological remains.

### **Inter-tidal and coastal zones**

Material relating to anchorages, shipping activities, shipwrecks, repairs, cyclones (e.g. flotsam) and navigation infrastructure may be found in protected harbours and inlets and on the coastal littoral zone. Mooring posts and chains for luggers, riveted iron water tanks, ballast, pump wheels, windlasses and other ship-related material have been documented in historic ports and adjacent to camps and missions throughout the Dampier Archipelago, Pilbara and Kimberley regions (Sledge, 1978: 26-28). It is predicted that similar remains will be in evidence in the Cossack, Point Samson, Port Robinson and Cleaverville historic port areas. It should be noted that there are some indication of potential sites available from Landgate aerial photography (see Figure 6).

### Shipwrecks and maritime archaeological sites

There have been no maritime archaeological surveys carried out to date within the Anketell Port study area. Table 1 lists the sites that have been reported and/or located and inspected by the Department of Maritime Archaeology of the WA Museum in the near vicinity.

A wreck consisting of a small boiler, rusted chain and machinery lies in the inter-tidal zone about 400m north of the historic Point Samson jetty ruins, in an area where the rocky shoreline meets a small sandy area. This wreck has been described as a wooden lighter that was blown ashore in a northeast storm (Sledge 1978: 17). It is possibly the remains of the *Bat* (see Table 2).

Two separate reports of anchors on the western side of Cape Lambert and on Delambre Island have been recorded. It is uncertain whether these are submerged or in the inter-tidal zone.

Royal Australian Navy Hydrographic surveys and environmental sea dumping permits record the existence of two wrecks scuttled off Delambre Reef to create artificial reefs. These vessels marked on Admiralty charts are the steel crane barge *Samson II* (scuttled 9/10 1998) and steel barge *Kunmunya* (scuttled 14/12/1996) (A. Hoogvliet, RAN Hydrographic Office, pers. comm., 17/8/2011; Plunkett, 2003: 54).

Table 1. Located shipwrecks and maritime archaeological sites in the Port Walcott/ Point Samson/ Cossack/ Anketell area

Name	Date lost	Where lost	Latitude	Longitude
<i>Solveig</i>	19/2/1903	Port Sampson	-20.625525	117.197857
<i>Silver Star</i>	1942	Cossack Creek	-20.680564	117.187134
Point Sampson jetty		Point Sampson	-20.6321	117.198451
Point Samson lighter wreck		400m north of Point Samson jetty (1903) ruins		
Cossack wharf		Butchers Inlet, Cossack	-20.679707	117.188955
Anchors (reported-not inspected)		Northwest side of Cape Lambert		
Anchor (reported-not inspected)		Delambre Island		
<i>Kunmunya</i> barge	14/12/1996	ENE Delambre Island	-20.430170	117.213296
<i>Samson II crane barge</i>	9/10 1998	ENE Delambre Island	-20.493707	117.4161338

Table 2 lists fourteen shipwreck sites that are recorded in the Department of Maritime

Archaeology's shipwreck database, that are recorded to be lost in or near the Anketell Port PER study area. Of these thirteen are historic shipwrecks, and most are wooden pearling luggers. Numerous shipwrecks recorded as having occurred in the Cossack and Butchers Inlet area have been excluded from this study as they are outside the study area.

Table 2: Unlocated shipwrecks possibly lost in or near the Anketell Port study area

<b>Name</b>	<b>Date lost</b>	<b>Where lost</b>	<b>Source</b>
<i>Lone Star</i>	4/1/1868	Driven by cyclone into mangroves at Nickol Bay – refloated?	Forrest 1996: 55.
<i>Flying Scud</i>	19/8/1870	Struck reef and sank between Point Samson and Cape Lambert	R.J. Sholl, Occurrence Book, Acc. 194, Battye Library; <i>Inquirer</i> , 21 September 1870
<i>Coquette</i>	25/12/1870	Sank in Ricoe Bay, Nickol Bay – refloated?	<i>Perth Gazette</i> , 4 September 1868; Register of British Ships, Sydney; <i>Inquirer</i> , 15 February 1871
<i>Speculator</i>	12/5/1876	Capsized and sank between Legendre and Gidley Islands	Henry McCaffray, evidence given to Frederick Pearse, Justice of the Peace, 17 May 1876, C.S.R. 844, fol. 101; <i>Inquirer</i> , 18 October 1854 and 9 May 1883
<i>Tribune</i>	3/1882	Wrecked in cyclone in Point Samson, Cossack Area	<i>West Australian</i> , 12 May 1882, p. 3b; <i>West Australian</i> , 31 March 1882, p. 3g; Register of British Ships, Fremantle
<i>Ruby</i>	6/3/1882	Lost at sea, (probably east of Cossack but wreckage washed ashore)	<i>Inquirer</i> , 29 May 1882, p. 3c and 5 April 1882, pp. 2f, 7e; <i>West Australian</i> , 4 April 1882, p. 3e; <i>West Australian</i> , 12 May 1882, p. 3c; <i>Herald</i> , 13 May 1882 and 3 June 1882
<i>Bessie</i>	8/3/1882	Foundered in cyclone off Cossack	<i>West Australian</i> 12 May 1882, p. 3b and 31 March 1882, p. 3g
<i>Nautilus</i>	16/1/1884	Driven by cyclone into mangroves at Nickol Bay – refloated?	<i>Herald</i> , 1 March 1884, p. 3a; <i>West Australian</i> , 11 March 1884, p. 3f; <i>Inquirer</i> , 26 March 1884, p. 4c. Forrest 1996: 55.
<i>May</i>	1888	Wrecked and sank off Point Samson	Collector of Customs to Col. Sec., 18 June 1889, CSO 1586/1889

<i>Emma</i>	18/3/1889	Pearling grounds near Cossack	Register of British Ships, Fremantle
<i>Emerald</i>	9/1/1894	Foundered in cyclone off Cossack	<i>West Australian</i> , 27 January 1894
<i>Maggie Gollen</i>	2/4/1898	Sank in severe storm off Cossack	<i>West Australian</i> , 2 April 1898, p. 5a; <i>Inquirer</i> , 8 April 1898, p. 9h; <i>West Australian</i> , 23 to 29 April 1898; <i>West Australian</i> , 8 April 1898, p. 5f, and 13 April 1898, p. 4i; <i>Inquirer</i> , 15 April 1898, p. 13 h McKenna Collection 680, WA Maritime Museum
<i>Glenbank</i>	7/2/1911	Capsized 20 miles off Cossack, 8 or 9 miles off Legendre Reef	SRO 1066 Item 1911/172 and 1911/229 SRO 430 ITEM 1911/0837 Telegram 10/02/1911 Roebourne
<i>Bat</i>	12/4/1919	Driven on shore near Point Samson jetty	
<i>Trude</i>	7/11/1970	Burnt near Cape Lambert	Not historic shipwreck

### Potential impacts

Fragile wooden shipwreck sites are easily destroyed by channel dredging activities. Heavy chain and anchors used by dredges can also severely impact fragile sites. The dumping of dredged material on top of underwater cultural heritage sites has a less destructive impact as it does decrease the possibility of immediate archaeological investigation, but in the long run provides for its protection via burial in sediment. However, it is important to know of sites' existence before they are totally buried. In the case of dredging, it is a different situation as any impact will be destructive. It is important to know what is likely to be encountered before the dredging starts.

The construction of port facilities may negatively impact both terrestrial and underwater sites, through land and underwater disturbance during construction activities such as roadbuilding, excavating trenches for foundations, pipelines and services and installing piling for jetties, harbour works and navigational infrastructure.

The likelihood of wrecks or artefacts being present within the development areas will vary in relation to the distance from shore. Most of the wreck sites in this area are likely to have been the result of cyclones, where typically vessels are either driven ashore or more rarely sink at sea in the cyclone. The further from shore the less likely to find sites. In addition, vessels might also be abandoned in this area, but again this is likely to be a shallow water event in less than a few metres at low tide.

## Survey requirements

The WA Museum has developed general guidelines for the survey of areas that are likely to be impacted by development such as the proposed Anketell dredging. It is considered that any survey work conducted in the PER area needs to be both acoustic and magnetic, noting that there is a large magnetic anomaly east of Bezout Island. It is recommended that magnetic surveys be conducted in conjunction with sonar (side scan or multi-beam). Survey results should be plotted as a contour or an XY plot, not simply recording strikes. This requires a data output that can be geo-referenced.

Small-scale survey lane widths should be calculated to result in optimum coverage of the area and should always be conducted in conjunction with sonar (side scan or multibeam).

## Channel and turning basin

The area proposed for offshore construction and dredging is shown in blue in Figure 3 extends from the low water mark for a linear distance of approximately 18 km enclosing an area of approximately of 7 sq km. The area shown Figure 3 in white encloses an additional area totalling 19.7 sq km. As noted above, dredging is likely to have a much higher impact on any underwater cultural heritage than the dumping of spoil in DMDAs.

Normal conventions for the establishment of heritage buffer zones is considered to be 500 m. Given that the dredging will require the placement of dredge anchors some distance off the main dredging area, 500 m is calculated as a reasonable buffer zone beyond the existing Port PER area for the purposes of mitigating any impact to underwater cultural heritage sites.

Survey lanes are calculated on the basis of the Anketell dredged channel being approximately 300 m wide with an additional 500 m on either side of channel allowing for a total heritage buffer zone of 1300 m. As the maximum depth over the proposed area is not greater than 20 m, a high resolution magnetometer survey would necessitate 50 m lanes on the basis that a 1 nT signal would record at best a 100 kg iron object if the detector head was at the surface (see Figure 7). This would involve 14 runs of 18 km (250 linear km) with an additional 50 km calculated to survey the increased extent of the turning basin. In conjunction with the magnetic survey, an acoustic survey (sidescan and multibeam) could be carried out and although the acoustic survey would not require such close lane widths, there would be no disadvantage in gathering overlapping information.

## Dredged Material Dumping Areas (DMDAs)

For the three DMDAs a lower resolution acoustic and magnetic survey is adequate. The depth in Areas 2 and 3 is not greater than 20 m and in Area 4 it is 25 m. The survey requirements for DMDAs is calculated on the basis of 100 m survey lane based on the above consideration and gives the following coverage:

Area ID	Area covered in sq km	Linear survey distance in km
2	5.489	54
3	6.415	63
4	6.415	64

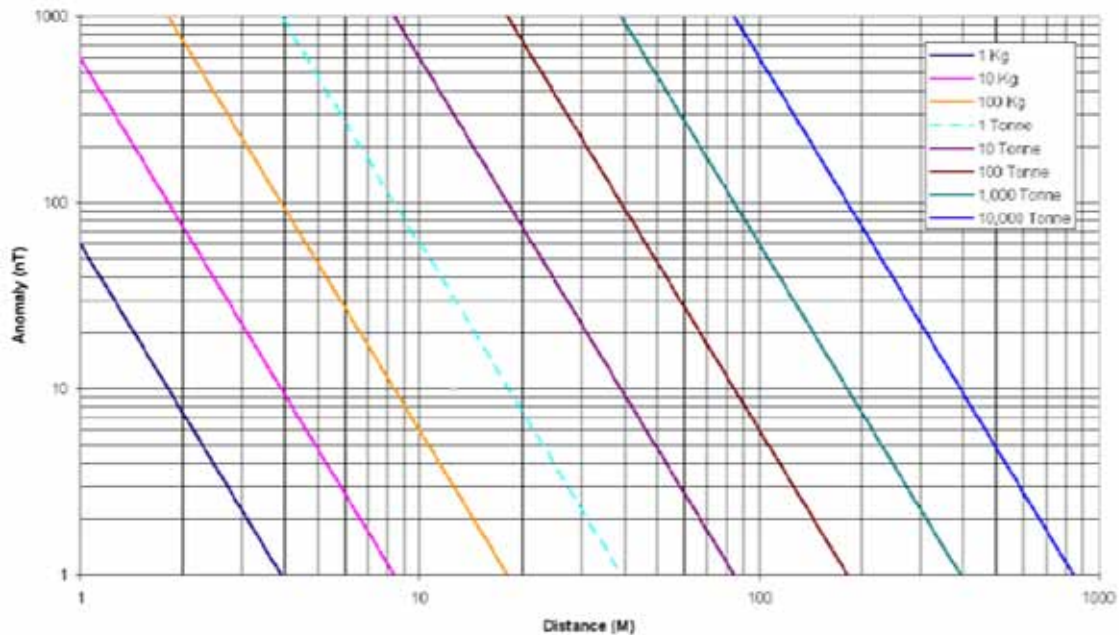


Figure 7. Plot of anomaly size in nT by distance in metres for a variety of sizes of targets.

### Recommendations

1. That maritime and terrestrial archaeological surveys be carried out by appropriately qualified and experienced archaeologists in any areas of Anketell Point, Cape Lambert, Port Robinson, coastal littoral zone and historic townsite of Cleaverville that will be, or may be, affected by Anketell Port construction and operation activities.
2. That maritime and terrestrial archaeological surveys be carried out by appropriately qualified and experienced archaeologists on Dixon Island, Bezout Island, Haüy Island and Delambre Island, if they will be, or may be, affected by Anketell Port construction and operation activities.
3. That maritime archaeological remote sensing surveys using magnetometer and sidescan sonar and/ or multi-beam sonar be carried out by, or under the supervision of, an appropriately qualified and experienced maritime archaeologist in any areas within the Port PER that have not been subject to remote sensing surveys at sufficient resolution to confirm either the presence or absence of underwater cultural heritage sites.

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