GOVERNMENT OF
WESTERN AUSTRALIA

Browse LNG Precinct




Browse Liquefied Natural Gas Precinct
Strategic Assessment Report

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Appendix F-2

Report on macro-fossils in intertidal outcrops of the Broome Sandstone, 1·2-2·7 km south of James Price Point (proposed marine infrastructure shore crossing) and 6·2-7·5 km south of James Price Point (proposed southern pipeline shore crossing)

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Report on Macro-Fossils in Intertidal Outcrops of the Broome Sandstone, 1·2-2·7 Km South of James Price Point (Proposed Marine Infrastructure Shore Crossing) and 6·2-7·5 Km South of James Price Point (Proposed Southern Pipeline Shore Crossing).

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Executive Summary

Intertidal platforms and cliff sections of the Broome Sandstone were examined on 31 March and 1 April, 2010 at extreme low tide along two stretches of coastline, 1.2-2.7 km respectively 6.2-7.5 km south of James Price Point.

A few isolated, putative sauropod underprints were found in the northern survey area within a previously identified corridor of the Broome Sandstone yielding similar circular structures (see Siversson, 2010).

The Broome Sandstone exposed in cliff sections and within the intertidal zone 6.2-7.5 km south of James Price Point did not yield dinosaur footprints or any other macro-fossils.

Potholes, superficially resembling sauropod imprints, are locally common on platforms of the Broome Sandstone in both survey areas. They typically increase in diameter and abundance in a seaward direction and often merge near the outer edge of the intertidal platform.

1.0 Introduction and Background

The Strategic Assessment for the Browse LNG Precinct includes palaeontological surveys of the Lower Cretaceous Broome Sandstone around James Price Point (JPP). In a preliminary study (Siversson, 2010) carried out by staff from the Western Australian Museum (WAM), putative sauropod underprints were identified within a 280 meters long and 30 metres wide corridor, approximately 2 km south of JPP. Suboptimal tides prevented the survey team from examining the lowermost metre of vertical outcrop of the Broome Sandstone within the total intertidal zone. A second survey was therefore carried out by a WAM team from 31 March to 1 April, 2010, taking advantage of extreme spring tides. The scope of the survey was expanded by including the southern of two proposed pipeline crossings, 6.2-7.5 km south of JPP.

As indicated in the previous report on the palaeontology of the James Price Point area (Siversson, 2010), the Broome Sandstone is dominated by intertidal sedimentary structures in this part of the Dampier Peninsula, including e. g., flaser bedding (**Figure 3**), ripple marks (**Figure 2**) and desiccation cracks (Siversson, 2010, figure 8). The intertidal facies type of the Broome Sandstone has produced sauropod underprints/trackways at undisclosed sites along the west coast of the Dampier Peninsula (Thulborn et al. 1994; Long, 1998; Siversson, 2010). The association of intertidal facies of the Broome Sandstone and putative sauropod underprints in the JPP area does thus conform to observations from, presumably, more southern outcrops of the Broome Sandstone (see Thulborn et al., 1994; Long, 1998).

2.0 Methodology

The survey was carried out by a field crew from the Western Australian Museum comprising the officer in charge, Dr Siversson, Curator of Palaeontology, and a technical officer. The team was accompanied on site at all times by a member of the Jabirr Jabirr people, the area's traditional owners.

The field work was designed to maximise discovery of possible macro-fossils, in particular dinosaur footprints, within: (1) a narrow strip of the Broome Sandstone (lowermost metre of the unit within the total intertidal zone), exposed only during maximum spring tides, 1.2-2.7 km south of James Price Point (marine infrastructure shore crossing of a proposed LNG plant); (2) a 1.3 km long stretch of Broome Sandstone intertidal (and coastal cliff) exposure situated 6.2-7.5 km south of James Price Point (proposed southern pipeline shore crossing survey area).

The survey team arrived at the northern of the two survey areas on the afternoon of Wednesday 31 March, 2010. Approximately two hours were spent examining outcrops of the Broome Sandstone as they emerged from the retreating sea. At about 4.30 pm the receding tide had exposed about as much of the Broome Sandstone in this area as was exposed during the previous survey in November 2009 (see Siversson, 2010) and the following 1 ½ hours were spent surveying the lowermost, rarely exposed part of the Broome Sandstone.

Mapping of putative sauropod underprints involved measuring the maximum diameter of the imprints, recording their position with a hand held GPS device and photographing some of the footprints. All specific locality data was stored by Dr Siversson.

The southern pipeline shore crossing survey area, situated 6.2-7.5 km south of JPP, was examined on the morning of Thursday 1 April, 2010. The outcrops of the Broome Sandstone at this locality are largely restricted to a continuous cliff section with abundant dissolution pipes. The intertidal platform itself is poorly exposed and largely confined to a narrow N-S trending platform ridge (seen in the background of **Figure 4**) in the northernmost part of the survey area and a smaller E-W trending platform in the central part of the survey area (foreground area in **Figure 4**).

3.0 Results

A small number of putative sauropod underprints (**Figure 1**) were located in the lowermost part of the total intertidal zone additional to similar more-or-less circular structures identified within the same lithological bed during the November, 2009 survey (Siversson, 2010). At the 1997 CAVEPS (Conference on Australasian Vertebrate Evolution Palaeontology and Systematics) meeting in Perth, similar features discovered at undisclosed localities within the intertidal zone of the Broome Sandstone were cautiously interpreted by a presenter as sandstone casts of tree-stumps (initially thought to represent sauropod underprints).

The proposed southern pipeline shore crossing area (~ 6.2-7.5 km south of James Price Point) did not yield any macro-fossils during this survey. Potholes (a common, natural erosion feature on intertidal hard rock platforms) are abundant on flat platforms exposed at this locality (**Figure 4**). The continuous cliff section of Broome Sandstone in the area is degraded by dissolution, similar to that seen in many coastal outcrops of calcareous rocks. Some of the dissolution pipes are lined with putative chalcedonic silica (**Figure 8**). A general ban on rock sampling during the survey prevented positive identification of the mineralogical composition of the pipe lining.

4.0 Discussion

It is possible that the circular structures in the lower part of the intertidal zone (situated within the proposed marine infrastructure shore crossing) have been formed by several processes. The putative sauropod underprints do not occur as picture-perfect trackways in the James Price Point area which adds to the general difficulty of positively identifying these structures. The circular structures are occasionally present in direct association with ripple marks (Siversson, 2010, figure 11), without any indication that the current was obstructed by a tree (thus excluding tree stump holes as a possible explanation in these cases). A third possibility is that some of the structures represent feeding traces produced by rays feeding on intertidal sand flats (similar circular structures are produced by modern stingrays). A large part of the difficulty in identifying the structures relates to the restrictions imposed on the survey (e.g., no rock sampling permitted).

All intertidal hard rock outcrops were assumed to be Broome Sandstone although encrusting epifauna made it impossible to positively identify isolated outcrops in the lowermost part of the intertidal zone (sampling of the strata was not permitted). Boulders of pale Cenozoic calcarenite, which forms the sea floor bedrock offshore, occur as a boulder bed immediately above the Broome Sandstone, 1.9 km south of JPP. These were presumably deposited during cyclonic storm surges. A modern beach rock is also present in this area above the Broome Sandstone. All fresh outcrops of hard rock within the intertidal zone, devoid of encrusting epifauna, lacked calcareous fragments and are assumed to represent the Broome Sandstone.

5.0 Recommendations

As outlined in the previous report (Siversson, 2010), development of a marine infrastructure shore crossing (and pipeline crossings) will result in the redistribution of sand transported by longshore currents. It is possible that museum-grade dinosaur trackways will become exposed as a result of construction work. Their preservation (if threatened by construction work) would require their removal from the site and subsequent storage at a secure facility. Long-term storage should be negotiated between the Traditional Owners and the Western Australian Museum. It needs to be recognised however that the WAM is not in a financial position where it alone can fund a major excavation operation of dinosaur trackways in the intertidal zone of the Broome Sandstone.

Based on the results of the palaeontological survey of the proposed southern pipeline shore crossing area, construction work is unlikely to have a negative impact on dinosaur trackways if the pipeline trench is excavated in the northernmost part of the survey area. The southern part of the survey area is almost entirely covered by modern sand deposits (**Figure 6**), adding an element of uncertainty regarding the possible presence of imprints under the sand.

The 280 metre long corridor yielding putative sauropod underprints is right in the middle of the proposed marine infrastructure shore crossing. Construction work is therefore likely to result in the complete destruction of these circular structures. The significance of the structures depends to some extent on their true identity. As sauropod underprints, they are clearly not of museum grade quality (given that excellent indisputable sauropod trackways occur elsewhere in the Broome Sandstone). It is recommended however that a few of the best preserved putative underprints be collected and preserved for further study (long-term storage negotiated between the Traditional Owners and the WAM). This also applies if any evidence arises indicating that some of them are tree stump casts or feeding depressions produced by rays.

6.0 References

Long, J. A. 1998. *Dinosaurs of Australia and New Zealand and other animals of the Mesozoic era*. 188 pp. University of New South Wales Press Ltd, Sydney.

Siversson, M. 2010. Preliminary Report on the Dinosaur Footprints in the James Price Point Area, Western Australia. *Aecom*, document No. 60103995, 14 pp.

Thulborn, R. A., Hamley, T. and Foulkes, P. 1994. Preliminary report on sauropod dinosaur tracks in the Broome Sandstone (Lower Cretaceous) of Western Australia. *Gaia* 10:85-94.

Figure 1 **Putative sauropod underprint (70 cm diameter), southwestern corner of a 280x30 metre corridor, yielding similar circular structures (see Siversson, 2010).**

Figure 2 **Linguoid current ripples in the Broome Sandstone, 1.7 km south of James Price Point.**

Figure 3 **Flaser bedding and cross bedding in the Broome Sandstone, 1.5 km south of James Price Point.**

Figure 4 **Platform of the Broome Sandstone with potholes, central portion of the southern pipeline shore crossing survey area, approximately 7 km south of James Price Point.**

Figure 5 **Lowermost metre of the Broome Sandstone within the total intertidal zone, exposed only during extreme low tide. The photograph was taken a few tens of metres west of a platform exposing numerous potholes, about 1.5 km south of James Price Point (see Siversson, 2010, figure 1). The potholes of these platforms increase in size and density in a seaward direction, indicating that they are formed by natural erosion.**

Figure 6 **Southern part of the southern pipeline shore crossing survey area, 7 km south of James Price Point, during extreme low tide. As indicated by the photograph, the area is largely covered by sand.**

Figure 7 **Cliff section of Broome Sandstone, 7 km south of James Price Point. The sandstone is severely degraded by dissolution in this area, often expressed as pipes lined with putative chalcedonic silica (no sampling permitted for this study).**

Figure 8 **Putative chalcedonic silica (no sampling permitted for this study), commonly lining dissolution pipes in cliff sections of the Broome Sandstone, 7 km south of James Price Point.**