

BEACH NOURISHMENT TO REDUCE THE BREACHING RISK OF A SAND SPIT A CASE STUDY FROM CARNARVON, WESTERN AUSTRALIA

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SUMMARY

The Carnarvon Fascine is a tidal lagoon situated in the township of Carnarvon, Western Australia. The lagoon is a significant recreational boating asset for both the local and tourist community as it provides safe waters for vessels and houses several boating facilities. In 2017 the barrier spit that protected the lagoon entrance channel from the open ocean was breached, leading to the disintegration of the spit and infilling of the lagoon entrance channel (see Figure 1). The sedimentation of the channel resulted in substantial navigational issues as the lagoon was effectively closed off from the ocean. In 2023 the entrance channel was dredged to re-establish vessel access and the spoil was used to reconstruct the dune system on the spit with the aim of reducing the risk of future breaches.

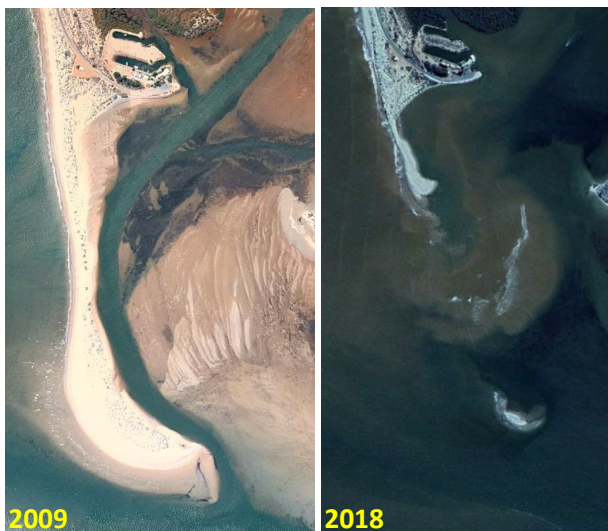


Figure 1 - Carnarvon Tidal Lagoon Entrance

SEDIMENT DYNAMICS

The tidal lagoon is the former southern arm of the Gascoyne River that was closed following the construction of a causeway in 1981, subjecting the area to only marine forcing from that date. Sediment supply to the spit is inconsistent driven by a combination of tropical cyclones, diffracted swell waves and flood dynamics of the Gascoyne River (Seashore, 2020). Historically when in a dynamic equilibrium, the spit has eroded/narrowed during the summer months when the wave climate is dominated by locally generated wind waves from the south and accreted/widened during the winter months when swell waves are diffracted from the north. These seasonal dynamics were also observed during the recent natural reformation of the spit between 2020-23 in which 100m of growth was observed over winter and only 40m observed during summer.

OPTIONS ASSESSMENT

Due to the dynamic nature of the lagoon entrance, a substantial number of studies were undertaken to determine the most suitable way to provide long-term vessel access. Options that were explored include the construction of training walls, groynes, numerous channel alignments and spit stabilization. Ultimately the decision was made to dredge the natural entrance channel to a navigable depth and utilize the dredge spoil to reconstruct the dune system on the spit to help stabilize the spit and reduce the risk of breaching.

SPIT STABILISATION TECHNIQUES

A total of 140,000m³ of dredge spoil was used to reconstruct the dune system on the spit. The dunes were designed to be able to withstand erosion and wave runup from a 1 in 50-year annual recurrence interval (ARI) tropical cyclone event without any overtopping/breaching. The construction of the dunes involved the creation of undulating ridges designed to mimic the adjacent dune environment as seen in Figure 2. Additional stabilization techniques were adopted to manage aeolian transport including sand fencing, brush matting and hydro mulch. Dune revegetation is scheduled for April 2024 which is the start of the next wet season.

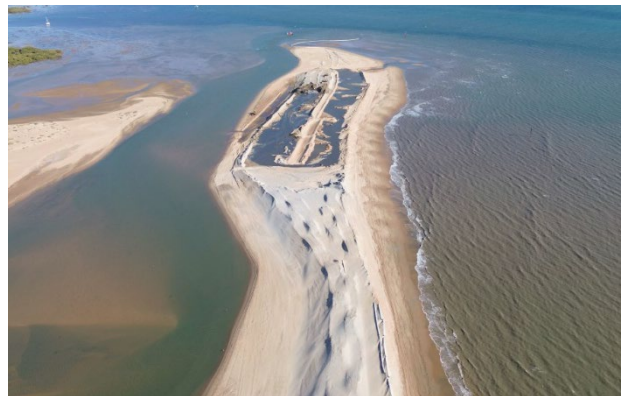


Figure 2 - Dune Reconstruction Works - October 2023.

PROJECT SUCCESS

The dredging campaign within the entrance channel was completed over a 3-month period between September and November 2023. At present, the dredged channel has remained relatively free from sedimentation. The reconstructed dunes are a substantial landscape feature and are expected to provide ample protection from overtopping and subsequent breaching during cyclonic events up to and including a 50-year ARI event.

REFERENCES

Seashore (2020): Fascine Entrance Channel Planning Study.