Submission to the Murray-Darling Basin Royal Commission by Professor Nick Harvey

This submission focuses on coastal issues related to the *Water Act 2007* and the management of the Murray Mouth. It draws on my own 40 yrs of experience as a coastal geomorphologist and my former role as a member of the SA Government *Murray Mouth Advisory Committee* in the 1980s. The submission is supported by peer-reviewed publications and government reports.

1. According to the *Water Act 2007, "Part 2AA - Water for the Environment Special Account, 86AA"*, one of the objects is "2*(c) ensuring the mouth of the River Murray is open without the need for dredging in at least 95% of years, with flows every year through the Murray Mouth Barrages*"

2. There is a current failure in the management of the Murray Darling Basin to achieve the above object of the *Water Act 2007*. Over the last 15.75 years dredging has occurred for more than 70% of the time. Between October 2002 and December 2010 (8.1 years) over 6 million m^3 of sand was dredged and pumped onto the nearby coast at a cost exceeding $30 million. A second dredging program began on 9 January 2015 and is still ongoing (3.4 years later) dredging another ~3 million m^3 of sand so far. <https://www.waterconnect.sa.gov.au/Content/FlowReports/DEW/RM-Flow-Report-20180511.pdf>

3. The Wentworth Group of Concerned Scientists estimates that the mouth may require dredging in at least 95% of years. <http://wentworthgroup.org/2017/11/review-of-water-reform-in-the-murray-darling-basin/2017/ >. This figure is in complete contrast to the dredging target of around 5% of years as anticipated by the *Water Act*.

4. It appears that the *Murray Darling Basin Plan* (MDBP) has focused on the use of dredging as a back up for inadequate freshwater flows in order to keep the Murray Mouth (MM) open. The MDBP appears to have ignored the important role of coastal processes in the management of the MM.

5. The former SA Government *Murray Mouth Advisory Committee* explored a number of options to keep the MM open (see Harvey, 1988) including the use of freshwater flows, dredging and the use of groynes at the MM to reduce the input of sand through the MM. It subsequently commissioned a study into littoral drift to determine rates of sediment movement at the MM.

6. Two points are relevant here. First, the littoral drift of sediment towards the MM is currently counteracting the MDBA attempts to moved sediment away from the MM through its dredging and pumping operations. Second, as relative sea-level rises the sandy coast on either side of the MM is eroding, in part, because there is a lack of replenishment sand from offshore sources. This erosion will increase the amount of sediment moving toward the MM. These two points are elaborated on below.

7. Sediment movement at the MM can be very rapid. It was estimated by Harvey (1996) that between 1981 and 1995 the MM moved to the west at an average rate of 80 m yr^{-1} with an estimated loss of 45 hectares of vegetated dunes and about 3 million m^3 of sediment. The entire section of Sir Richard Peninsula as shown in Figure 1 was completely eroded following the artificial opening of the MM in 1981. Detailed analysis of the rapid sediment accumulation on the flood tidal delta inside the MM likens its evolution to a 'canary in the cage of river management' (James *et. al.* 2015).

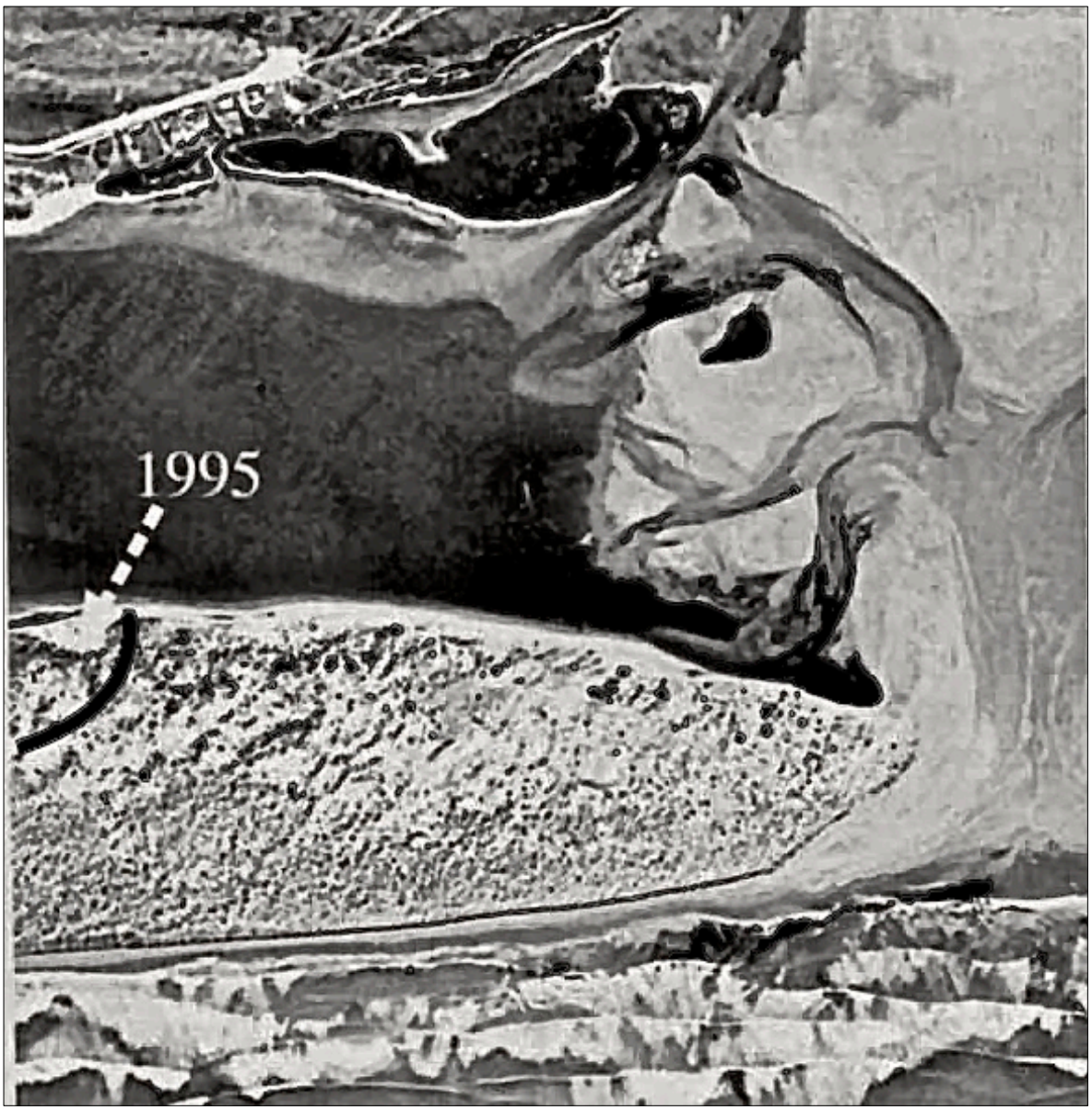

Figure 1: Aerial photograph of Sir Richard Peninsula at the time of the blockage of the MM (right hand side of photo) in April 1981 showing the extent of erosion between April 1981 and September 1995. The 1995 position of the tip of the peninsula is superimposed on photograph. (Source Harvey, 1996 p.55 – photo from the Department of Environment and Natural Resources, South Australia,)

8. A littoral drift study commissioned by the *SA Murray Mouth Committee* used meteorological data and wave-energy hind-casting methods to demonstrate an average net potential littoral drift of sediment at the MM of 260,000 m^3 yr^{-1} between 1940 and 1990. As shown in Figure 2 major directional shifts in potential sand movement are evident. For example, between 1940 and 1950 the movement was predominantly to the west (below the zero line), between 1951 and 1968 predominantly to the east (above the zero line), and between 1969 and 1989, predominantly to the west (Harvey, 1996).

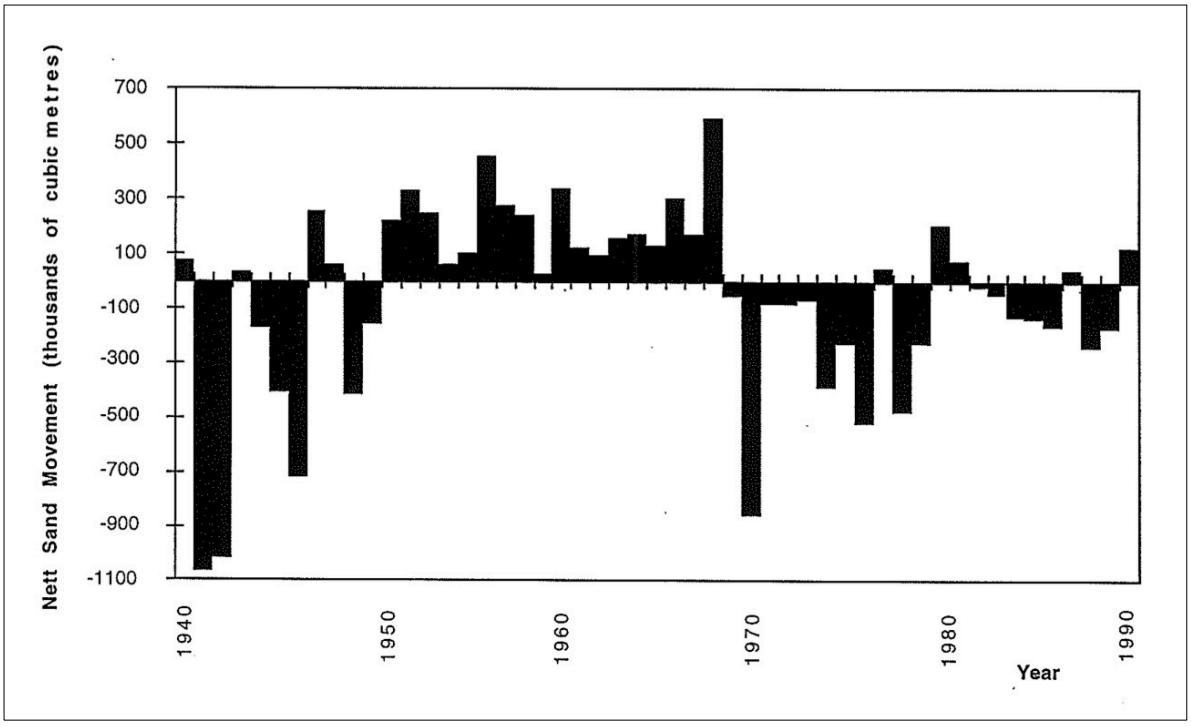

Figure 2: Nett potential sand movement (in thousands of m^3) in an easterly (upper) or westerly (lower) direction in the vicinity of the MM between 1940 and 1990. (Source: Harvey, 1996, p.51 after Chappell, 1991)

9. The above directional shifts in littoral drift have been correlated with the relative movement of the MM as plotted from historic aerial photographs (Harvey, 1996). This westerly migration of the MM following the artificial opening in 1981 was the continuation of a trend starting in 1972. For the previous 27 years the position of the Mouth was east of its relative 1945 position (Harvey, 1996).

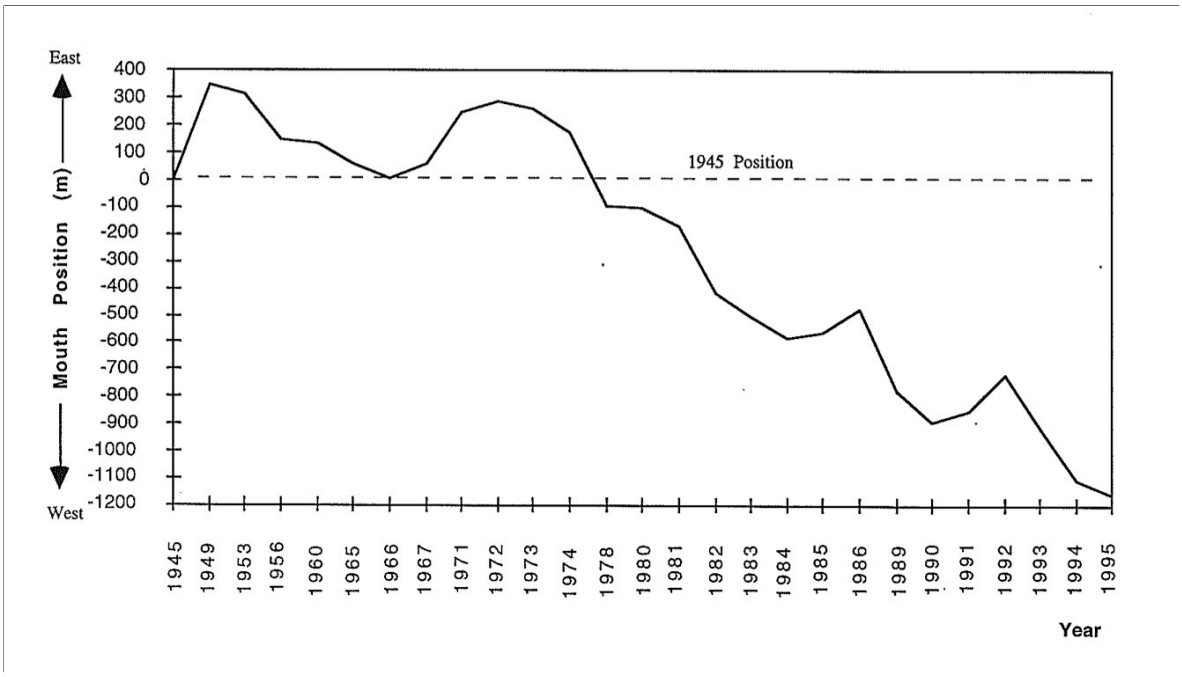

Figure 3: Cumulative movement of the MM (in metres) in an easterly (upper) or westerly (lower) direction between 1945 and 1995, relative to its 1945 position. (Source: Harvey 1996, p 51)

10. The amount of sediment moving towards the MM is likely to increase as sea-level rises. A *CSIRO* modeling study (Webster, 2009) prepared for the *Murray-Darling NRM Board* esitimated sediment movement based on the impact of a 0.2 and 0.5 m sea-level rise on the MM. This report concluded that a 0.5 m rise could be expected to result in 8 million m^3 of sand moving into the MM, while a 1 m rise could result in up to 16 million m^3 of sand. All such sand would be sourced from the adjacent beaches where net beach erosion would be expected.

11. Similarly, Short and Cowell (2009) conducted a sea-level rise vulnerability study for the SA *Department of Environment and Heritage*. They concluded that the Murray Mouth is likely to remain a dynamic inlet with expansion of the flood tidal delta under a rising sea-level acting as a sink for sediment from the adjacent beach systems.

12. In conclusion there is a major problem in achieving one of the objects *(Part 2AA, 86AA, 2(c))* of the *Water Act* because the important role of coastal processes has not been properly factored into management strategies. This is true for both:
    a) the current situation where high rates of natural littoral drift of sand toward the MM are counteracting the existing dredging and pumping program, and
    b) the future situation where modeling shows that even moderate increases in sea level will result in erosion of the adjacent beaches and produce significant increases in the volumes of sediment moving toward the MM

    The consequence of this is that the amount of sediment being brought into the MM from coastal processes will continue and is likely to increase, thus requiring dredging most of the time. Therefore the program of dredging the MM and dumping sediment onto the adjacent sand barriers is not sustainable into the future. Strategies are needed to increase flushing of the MM and also to consider measures to reduce the amount of littoral drift of sand moving into the MM.

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