Ninety Mile - Gippsland Lakes VIC02.02.02

Regional Setting

This compartment extends from Red Bluff (soft sandstone promontory between Lakes Entrance and Lake Tyers Beach) to McLaughlins Beach outlet.

Ninety Mile Beach is directly exposed to south-easterly Tasman Sea swells and also receives refracted south-westerly swells moving through Bass Strait (dominantly towards its south-west end).

The Gippsland Lakes were naturally only intermittently connected to the sea (ICOLLs) but are now permanently connected via an artificial channel at Lakes Entrance, which has affected tides and salinity in the lakes.

The dominant regional processes influencing coastal geomorphology in this region are the humid warm to cool temperate climate, micro-tides (2m), south-easterly Tasman Sea swells, easterly seas, dominantly quartz (terrigenous) sediments with northerly longshore transport in the northern part, and the El Nino Southern Oscillation (driving beach erosion/accretion cycles, cyclone frequency).

Regional hazards or processes driving large scale rapid coastal changes include: East Coast Lows (extra-tropical cyclones), mid-latitude cyclones (depressions), and storm surges (<1m).

Justification of sensitivity

The sensitivity rating is 4 or 5 for much of Ninety Mile Beach; the shoreline is losing sand, and is probably an early responder to sea-level rise. However, the NE part of the beach is gaining sand and rated 1 or 2. Inundation will cause more shoreline change around the Gippsland Lakes than erosion.

The source of sand for Ninety Mile Beach and the backing dune barriers is a combination of shelf sands worked landwards by waves during post-glacial marine transgressions and interglacial high sea stands, and shoreline re-working of local Quaternary and Tertiary-age sandy sediments underlying the beach and lakes complex.

Sediment transport modelling (Harris & Heap 2014) suggests shorewards transport of sand from Bass Strait is likely continuing today between Corner Inlet and Seaspray. Evidently, this is occurring at a rate insufficient to prevent a degree of shoreline recession and alongshore sand loss, as observed in recent decades along much of Ninety Mile Beach (see below). The northwards spread of Holocene barriers, from a single barrier in the southwest to a double barrier in the northeast towards Lakes Entrance, reflects long-term accumulation of sand from the southwest towards the northeast through north-eastwards littoral drift; this remains the dominant drift direction today (see Fig. 1.10 in Short and Woodroffe, 2009).

In recent decades, there has been evidence of beach recession southwest of Lakes Entrance, with erosion events exposing former back-barrier lagoon peats on the beach face (e.g., see Womersley, Rosengren and Mawer (2013), Fig 2-14) and nearly undermining the Surf Life Saving Clubhouse at Seaspray. Ortho-rectified air-photos from five dates show a generally stable, oscillating shoreline position at Seaspray from 1965 to 1992, followed by a dominantly recessional trend from 1992 to 2006 (C. Sharples *unpublished*). Beach profile monitoring at Seaspray shows continued net recession between 2007 and 2012 (Bishop & Womersley 2013). In contrast, at the far northeast end of this compartment (just southwest of Red Bluff), four ortho-rectified air photo dates show a generally stable, oscillating shoreline position between 1959 and 1984, followed by major shoreline accretion between 1984 – 2006 (C. Sharples *unpublished*). Similarly, beach monitoring at Eastern Beach near Lakes Entrance shows little shoreline change between 2007 and 2012 (Bishop & Womersley 2013). It is likely that sand transport continues north-eastwards around the small bedrock promontory of Red Bluff at the north-east end of this compartment, but not at a sufficient rate to prevent sand accumulating on the up-drift (SW) side.

A slightly declining sand budget for most of Ninety Mile Beach is indicated, except for the north-eastern portion near Lakes Entrance / Red Bluff which is gaining sand. Indications of a recession trend southwest of Lake Entrance in recent decades imply that much of the compartment will be an early responder to sea-level rise, although there is insufficient evidence as yet to attribute recent observed recession to sea-level rise. The north-eastern portion of the beach is likely to be a late responder to sea-level rise, owing to its gaining sand budget. The initial impacts of sea-level rise are expected to be recession of the outer barrier front, with loss of sand offshore and alongshore, accompanied by beach accretion at the northeast end. However, with continuing sea-level rise, there is expected to be increased breaching and over-wash of the outer barrier, leading to a landwards translation of the barrier (Womersley, Rosengren & Mawer 2013). This may result in the north-east end of the beach then receiving less sand and beginning to recede.

Shoreline erosion is occurring at many locations within the Gippsland Lakes, and can be related to a number of causes independent of sea-level rise, such as widespread dieback of protective reeds due to increasing salinity caused by the permanent opening of Lakes Entrance. Given the very low profile of many areas surrounding the lakes, shoreline change in the lakes is likely to be more the result of increasing inundation with sea-level rise than because of actual shoreline erosion and recession (Arrowsmith, Race & Rosengren 2013).

Other comments

Considerable infrastructure, including roads and residences, are potentially at risk from shoreline recession and inundation at a number of locations along Ninety Mile Beach (e.g., Seaspray, Golden Beach) and around the lakes (e.g., Lakes Entrance Township, Paynesville, Loch Sport).

Whilst shoreline recession and inundation are both likely to be significant effects of sea-level rise along Ninety Mile Beach, increasing inundation levels are the primary vulnerability around the lakes, especially when storm surge events coincide with river catchment floods in Lake King.

Confidence in sources

High confidence: This is one of the most intensely studied coastal sections in Australia.

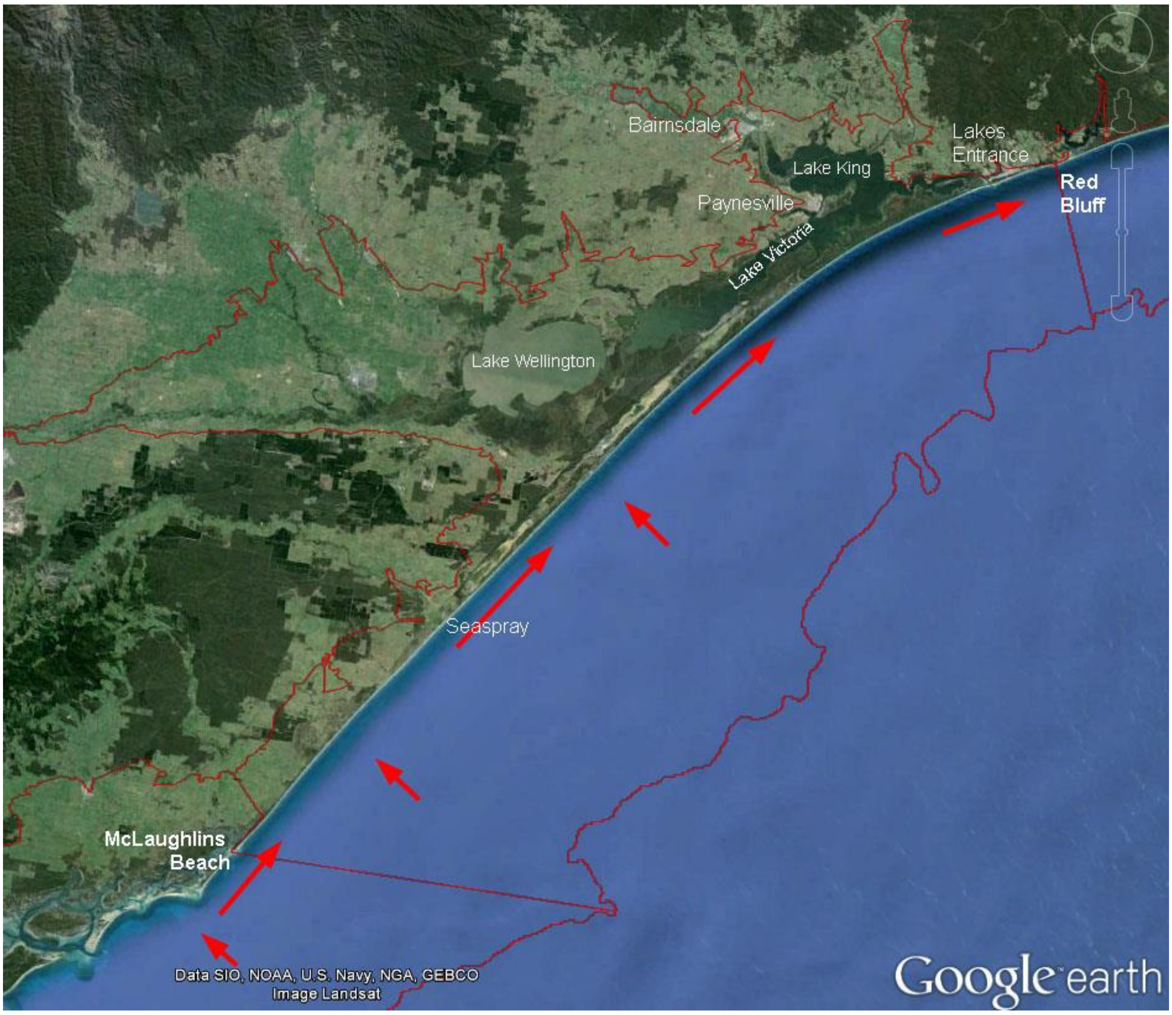

Figure 1: *Compartment VIC02.02.02 Ninety Mile Beach - Gippsland Lakes. Red arrows represent inferred dominant sediment transport patterns. In future with rising seas reaching a point where storm wave wash-over becomes more frequent, barrier translation or 'roll-over' may result in significant amounts of sand also being transported landwards, partly by wave over-wash and partly by wind action.*

Figure 2: *View north-eastwards along Ninety Mile Beach and the outer dune barrier at the Honeysuckles (near Seaspray). This is one of the narrowest points in the outer barrier. Photo by C. Sharples (2010).*

Additional information (links and references)

Useful previous studies of Ninety Mile Beach and the Gippsland Lakes are available, beginning with Bird, E.C.F (1965). Subsequently, Thom (1984) and Bird, E.C.F. (1993) provide useful geomorphic information. Arrowsmith, Race & Rosengren (2013) and Womersley, Rosengren & Mawer (2013) provide recent summaries (by Rosengren) of geomorphic information on Ninety Mile Beach and Gippsland Lakes, as well as recent coastal erosion and recession hazard assessments (reports produced as part of a series of Local Coastal Hazard Assessments (LCHAs) funded by Victorian State Government agencies).

Arrowsmith, CL, Race, G & Rosengren, N 2013, *Report 4: Lakes Shoreline Erosion Hazard; Gippsland Lakes/90 Mile Beach Local Coastal Hazard Assessment Project*

Report by Water Technology Pty. Ltd. for Department of Environment and Primary Industries, Victoria., Melbourne, Victoria.

Bird, ECF 1965, *A Geomorphological Study of the Gippsland Lakes*, vol. G/1 (1965), Department of Geography Publication, Research School of Pacific Studies, The Australian National University, Canberra.

Bird, ECF 1993, *The Coast of Victoria: the Shaping of Scenery*, Melbourne University Press, Melbourne.

Bishop, W & Womersley, T 2013, *Report 5: Coastal Monitoring; Gippsland Lakes/90 Mile Beach Local Coastal Hazard Assessment Project*, Report by Water Technology Pty. Ltd. for Department of Environment and Primary Industries, Victoria.

Harris, PT & Heap, A 2014, 'Geomorphology and Holocene Sedimentology of the Tasmanian Continental Margin', in KD Corbett, PG Quilty & CR Calver (eds), *Geological Evolution of Tasmania*, Geological Society of Australia (Tasmania Division), pp. 530-539.

Short, AD & Woodroffe, CD 2009, *The Coast of Australia*, Cambridge University Press.

Thom, BG 1984, 'Sand Barriers of Eastern Australia: Gippsland - a Case Study', in BG Thom (ed.), *Coastal Geomorphology in Australia*, Academic Press, Sydney, pp. 233-261.

Womersley, T, Rosengren, N & Mawer, J 2013, *Report 3: Outer Barrier Coastal Erosion Hazard; Gippsland Lakes / 90 Mile Beach Local CoastalHazard Assessment Project*, Report by Water Technology Pty. Ltd. for Department of Environment and Primary Industries, Victoria.