TECHNICAL REPORT

The coast of the Shires of Gingin and Dandaragan, Western Australia:
Geology, Geomorphology and Vulnerability

March 2012

GOVERNMENT OF WESTERN AUSTRALIA
Department of **Planning**
Department of **Transport**
Western Australian Planning Commission

The Department of Planning engaged Damara WA Pty Ltd to prepare this report as a background technical guidance document only. Damara conducted this project in conjunction with the Geological Survey of Western Australia.

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Cover Photograph
The Hill River in flood discharge during June 2003 (Photographer: Ian Eliot).

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WEB SUMMARY

Some landforms and coastal features are more vulnerable to climate and sea level variation than others. Hence the immediate aim of this project was to determine the vulnerability of landforms on the Gingin-Dandaragan coast to changing weather and oceanographic (metocean) conditions, including projected changes in climate. Information was gathered on coastal landforms and coastal processes to identify vulnerable locations and assist decision-making regarding proposed coastal development and for coastal management purposes.

The natural structure and formation of landforms and coastal features between Wreck Point and Fisherman Islands is tied to outcrops of coastal limestone along the shore as well as the presence and shape of the nearshore reef system. This geological control was used to identify discrete sediment cells where changes to landforms in one part of a cell were highly likely to affect the remainder of the cell but with potentially limited affect on adjoining cells. Thirty six cells were identified along approximately 160 km of coast. Potential relationships between the sand dune ridges (barriers) and the underlying coastal limestone topography were determined; landform patterns comprising the dune systems identified; and individual landforms described for each cell. The scales of description respectively correspond to scales used in the compilation of coastal management strategies and plans.

Landform vulnerability was estimated as a combination of the susceptibility of the geological structure supporting the landforms to environmental change and the current condition of the landforms as indicated by existing evidence of erosion. Together, a geological structure and the landforms it supports define a land system. The assessment involved consideration of the integrity of the geological or geomorphologic structures of land systems and the condition or stability of the landforms supported in a matrix to estimate five grades of vulnerability (Figure A). Susceptibility rankings were determined from values assigned to marine topography near the shore; the shape of the shoreline; coastal orientation; and the prevailing type of landforms present in the cell. Similarly, instability rankings were based on the proportion of rocky versus sandy seabed; beach type and/or beachface shape; whether the frontal dune complex was eroded; and an overall estimate of vegetation cover on the sand barrier. The analysis was intended to be indicative rather than prescriptive, with applications for strategic planning purposes as a first step to more detailed risk assessment procedures.

Results included the definition of the 36 cells, which were named after their southern boundaries, and the estimated vulnerability of each cell (Table A & Figure B). Vulnerability rankings determined on a five-point scale for each sediment cell indicated four (11%) of the 36 cells examined had a low level of vulnerability; 10 (28%) were of low-to-moderate vulnerability; 16 (44%) were moderately vulnerable; six cells (17%) had a moderate-to-high vulnerability ranking; and none had a high vulnerability ranking. More detail is available from the full technical report *The Coast of the Shires of Gingin and Dandaragan, Western Australia: Geology, Geomorphology & Vulnerability*.

			INSTABILITY (CONDITION) (Existing morphologic change to land surface)		
			Low (Stable)	Moderate	High (Unstable)
			Example		
SUSCEPTIBILITY (STRUCTURE) (Potential change to geological structure	Low	Barrier perched on extensive tracts of coastal limestone	(1) Vegetated swales in parabolic dunes landwards of a vegetated frontal dune ridge overlying coastal limestone above HWL	(2) Vegetated dunes landwards of a vegetated frontal dune ridge and perched on coastal limestone at HWL	(3) High foredune ridge and/or vegetated foredune plain overlying coastal limestone below HWL
	Moderate	Weakly lithified barrier with intermittent limestone outcrops	(2) Mainly vegetated swales in parabolic dunes landwards of a mainly vegetated frontal dune ridge	(3) Vegetated dunes landwards of a mainly vegetated frontal dune ridge (50 to 75% cover) and overlying coastal limestone	(4) Cliffed or discontinuous foredune fronting moderate numbers of mobile blowouts and sand sheets (<50% of the alongshore reach)
	High	Barrier comprised wholly of sand. No bedrock apparent along shore or in dunes	(3) Swales in parabolic dunes landwards of a partly vegetated frontal dune ridge	(4) Mainly vegetated dunes landwards of a partly vegetated frontal dune ridge with 25 to 50% cover	(5) No foredune. Eroded frontal dune with numerous mobile blowouts and sand sheets (>50% of the alongshore reach)

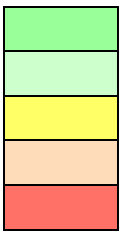

Figure A: Indicative Vulnerability Matrix for a Mixed Sandy and Rocky Coast

Note: Susceptibility of a geologic structure to environmental change and the current instability of coastal landforms were estimated for each coastal cell on a three point scale as being low, moderate or high. In the matrix these were combined to provide a five point estimation of the vulnerability.

Table A: Susceptibility, Instability and Vulnerability Rankings for Each Cell

Cell	Southern Boundary of Cell	Susceptibility Rank	Instability Rank	Vulnerability Rank
36	South Fisherman	L	L	L
35	Sandy Point	M	L	L-M
34	Sandland	M	M	M
33	North Head	M	M	M
32	Pumpkin Hollow	L	L	L
31	Middle Head	L	M	L-M
30	Island Point	M	M	M
29	South Booka Valley	H	M	M-H
28	South Hill River	M	H	M-H
27	Black Head	L	M	L-M
26	Thirsty Point	M	M	M
25	Hansen Head	M	M	M
24	Kangaroo Point	M	M	M
23	Boggy Bay	M	M	M
22	Grey	M	M	M
21	South Grey	L	M	L-M
20	North Wedge	L	M	L-M
19	Wedge Island	M	H	M-H
18	Magic Reef	H	M	M-H
17	Narrow Neck	M	M	M
16	Dide Point	L	M	L-M
15	Lancelin Island	H	M	M-H
14	Edward Island	M	M	M
13	South Pacific Reef	M	M	M
12	Ledge Point	M	M	M
11	Green Reef	M	M	M
10	Manakoora Sand Patch	M	H	M-H
9	South First Bluff	M	M	M
8	Second Bluff	L	M	L-M
7	Eagles Nest Bluff	L	L	L
6	Seabird	M	M	M
5	Moore River	M	M	M
4	South Moore River	L	M	L-M
3	North Two Rocks	L	M	L-M
2	Two Rocks	L	M	L-M
1	Wreck Point	L	L	L

Key	Vulnerability of environmental change	Implications for development
	Low	Coastal risk is unlikely to be a constraint to development
	Low-to-moderate	Coastal risk may present a low constraint to development
	Moderate	Coastal risk may present a moderate constraint to development
	Moderate-to-high	Coastal risk is likely to be a significant constraint to development
	High	Coastal risk is a highly significant constraint to development

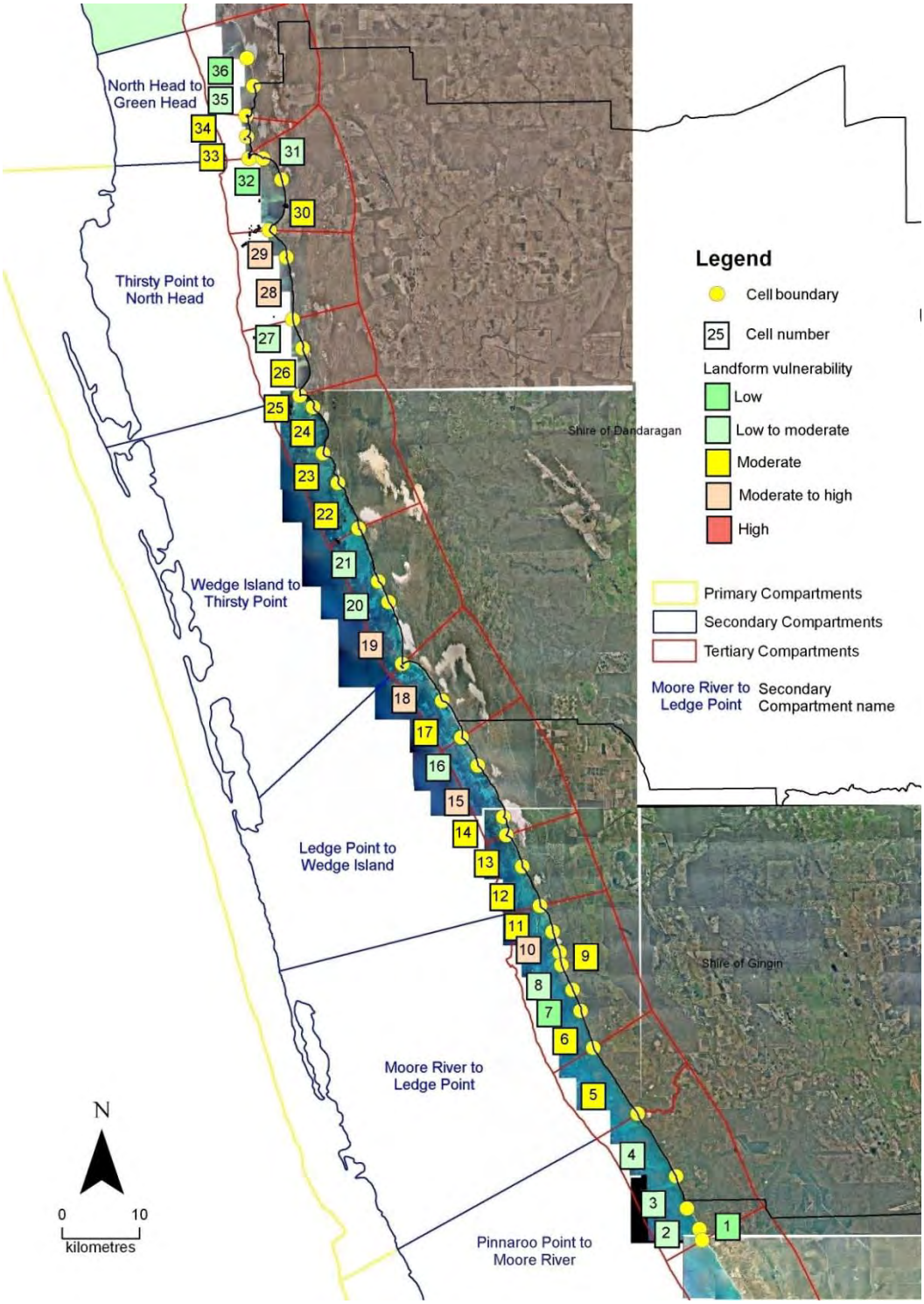

Figure B: Estimated Vulnerability Rankings for the Gingin-Dandaragan Coast

Note: Compartments were defined as large sections of coast with a common land system. Three levels were identified from primary to tertiary compartments, with the offshore boundaries at the 130m, 50m and 20m depth contours. Each compartment contained a number of sediment cells to which the vulnerability rankings were ascribed. The vulnerability rankings referred to the cell as a whole but not to individual landforms. Different landforms within each cell were likely to have higher or lower levels of vulnerability than the cell as a whole.