Australian Government
Bureau of Meteorology

Tropical Cyclone *Chris*

2 - 7 February 2002

Perth Tropical Cyclone Warning Centre
Bureau of Meteorology

A. Summary

A tropical low developed into Tropical Cyclone *Chris* at about 0600 WST on Sunday 3 February 2002 when it was located about 340 km northwest of Broome. The cyclone rapidly intensified as it tracked on a generally southerly course towards the coast. *Chris* reached Category 3 intensity at 2100 WST 3 March and then to category 5 at noon WST 5 March. *Chris* was close to maximum intensity as it crossed the coast at 0400 WST 6 March about 160 km east northeast of Port Hedland between Pardoo and Wallal stations.

Chris continued its south to southwest movement but rapidly weakened overland. It passed just to the west of Marble Bar at about 1500 WST 6 March and was subsequently downgraded below tropical cyclone intensity in the early hours of 7 March.

Pardoo roadhouse suffered significant damage although residents were unharmed. There were significant cattle losses in the region and extensive windmill and fencing damage. Fortunately the significant storm surge occurred at unpopulated areas along Eighty Mile Beach.

B. Meteorological Description

Intensity Analysis
The tropical low was generated by the combination of a strong surge in the northwest monsoon and fresh southeasterlies to the south produced by a high to the south of WA. The low was situated under the upper-level ridge resulting in upper divergence and low vertical wind shear, thus producing an environment conducive to cyclogenesis.

The system intensified in the favourable low wind shear environment that remained throughout its lifetime over water. *Chris* developed rapidly from Category 1 to Category 5 in about 60 hours, twice the standard rate of development according to the Dvorak model.

Chris peaked prior to crossing the coast then subsequently weakened rapidly over land and under increasing northwesterly shear.

Motion
The tropical low initially moved to the southeast in the strong monsoonal flow. As it developed it became influenced more by the mid-level flow.

TC *Chris* moved along a general southerly course under the influence of a mid-level ridge to the east with a weaker ridge to the south corresponding to a "standard poleward flow"(SPF) model of TC motion. However the track shows several short-term deviations to the southwest and south southeast in response to subtle changes in the surrounding ridge

Structure
Although it was an intense system *Chris* was relatively small, as shown by microwave imagery at 0923 WST 5 March and 0538 WST 6 March Throughout its lifetime the radius of maximum winds remained less than 30km. At the time of maximum intensity the radius of gales was 130 km, and the radius of hurricane-force winds was 30 km.

In the initial stages of development near gale-force monsoonal west to northwesterly winds occurred over a large area to the north. As the system developed the wind field around became more symmetrical. As *Chris* neared the WA coastline gales developed well to the south of the system as a result of interaction with the continental east southeasterly flow. Gales commenced at Bedout Is (19.6°S 119.1°E) at 1800 WST 4 March, when *Chris* was some 280 km to the north. At the same time winds at Broome, only 140 km to the east southeast of the centre, were just 16 knots. The southerly extent of gales is likely to have been a result of an increase in the pressure gradient due to rain-induced higher pressures over the inland eastern Pilbara region (at 1800 WST on 4 March the temperature was 25°C at Telfer compared to 37°C at Port Hedland).

Chris temporarily developed a ragged eye pattern on infra-red imagery between 1000 WST on 3 March and 0100 WST on 4 March An eye became more apparent on the afternoon of 4 March and developed further in the following 24 hours. The eye diameter remained quite small at just 20km.

The Port Hedland radar was used to detect the radius of maximum winds as *Chris* approached the coast. A reflectivity maximum was observed southwest of the centre to a distance of about 30 km. Pardoo roadhouse was about 30 km from the centre at its closest point putting it at the edge of radius of maximum winds.

C. Impact

Wind
Fortunately, the cyclone crossed a sparsely populated area of the coastline. However, Pardoo roadhouse suffered significant damage as the cyclone passed about 30 km to the east (see Figure 8). Radar imagery suggests that the roadhouse experienced close to the maximum winds of the system.

Residents sheltered in the chiller room and were unharmed. Although Pardoo Station (about 60 km to the west southwest of the cyclone crossing location), escaped with only minor damage, widespread cattle losses occurred. Pardoo and Wallal stations lost 1000 to 1500 of cattle each and 13 windmills each. About 160 km of fencing was destroyed at Pardoo station.

Flooding
The worst flooding occurred at Nullagine (230 km SE of Port Hedland) on the Nullagine River. Heavy rain upstream at Bonney Downs (306mm) caused the Nullagine River to burst its banks, inundating the town in the early hours of the morning of 7 March. Despite the extent of the flooding no injuries occurred. The remote Aboriginal community at Jigalong also received flooding on 7 March. Apart from the exceptional rain at Bonney Downs, reported rainfall in the eastern Pilbara was generally between 100 and 200 mm. However, it is likely that the actual rainfall near the immediate track of the storm was much greater. Heavier falls exceeding 200 mm were recorded in the West Kimberley owing to several days of heavy rain from rain bands emanating from TC *Chris*. Derby received a three-day total of 288 mm.

Storm surge
TC *Chris* crossed the coast at close to the time of high tide. A post event survey of the coastline near where TC *Chris* crossed the coast indicated an inundation of 4.2 metres which eroded foredunes and surged inland for over 100 m from the shore. The wave run-up increased the inundation level by approximately 30 percent of the storm tide. Excluding wave run-up this equates to a storm surge of 3.5 m. Figure 6 is an aerial shot showing the general dune erosion east of the crossing point. Figure 7 shows a debris line on the third row of dunes back from the beach.

D. Observations

Wind/Pressure
Unfortunately there were no observations near the cyclone centre near peak intensity. Marble Bar recorded gales between 0800 and 1600 WST 6 February. The maximum sustained wind was 45 knots (83 km/h) at 1410 WST 6 March with gusts to 64 knots (119km/h) and a minimum pressure of 979.5 hPa (see Fig. 4).
Bedout Island recorded gales during a 36 hour period between 1800 WST 4 February and 0600 WST 6 February peaking at 46 knots (85 km/h) with gusts to 55 knots (102km/h) at 0620 WST 5 March.
Unofficially Pardoo Station recorded a low pressure of 975 hPa.

Rainfall
The highest daily rainfall was 306 mm at Bonney Downs (inland Pilbara) recorded to 0900 WST 7 March.
Fig. 4 shows the rainfall distribution for February 2002.

Table 1. Best track summary for Chris 2 – 7 February 2002.
Note: Add 8 hours to convert to WST. Refer to best track database for complete track details.

Year	Month	Day	Hour (UTC)	Position Latitude S	Position Longitude E	Max wind 10min knots	Central Pressure hPa	Rad. of Gales nm
2002	02	2	0400	13.1	120.8	25	1003	
2002	02	2	1000	13.5	122.2	25	1001	
2002	02	2	1600	14.4	122.0	30	998	
2002	02	2	2200	15.0	121.6	35	995	95
2002	02	3	0100	15.3	121.4	40	992	95
2002	02	3	0400	15.5	121.2	40	990	80
2002	02	3	0700	15.7	121.1	45	988	80
2002	02	3	1000	15.9	120.9	50	985	80
2002	02	3	1300	16.0	120.8	55	980	80
2002	02	3	1600	16.1	120.8	60	975	80
2002	02	3	1900	16.2	120.9	60	975	80
2002	02	3	2200	16.4	121.0	65	970	80
2002	02	4	0100	16.6	121.1	70	965	80
2002	02	4	0400	16.9	121.0	75	960	80
2002	02	4	0700	17.3	121.0	80	955	80
2002	02	4	1000	17.6	120.9	85	950	80
2002	02	4	1300	17.8	120.6	90	945	95
2002	02	4	1600	17.9	120.4	95	940	110
2002	02	4	1900	18.0	120.3	95	935	110
2002	02	4	2200	18.1	120.2	100	930	110
2002	02	5	0100	18.2	120.2	105	925	110
2002	02	5	0400	18.4	120.3	105	925	95
2002	02	5	0700	18.7	120.3	105	920	95
2002	02	5	1000	18.9	120.4	105	920	90
2002	02	5	1300	19.2	120.4	110	915	80
2002	02	5	1600	19.5	120.3	110	915	75
2002	02	5	1900	19.8	120.1	110	915	70
2002	02	5	2200	20.1	120.0	105	920	70
2002	02	6	0100	20.4	119.8	95	940	55
2002	02	6	0400	20.8	119.7	75	960	45
2002	02	6	0700	21.2	119.6	60	975	30
2002	02	6	1000	21.6	119.6	50	985	20
2002	02	6	1600	22.0	119.3	30	998	
2002	02	6	2200	22.1	119.1	25	1000	
2002	02	7	0400	22.3	119.0	25	1002	

Figure 1. Track of Tropical Cyclone *Chris,* 2– 7 February 2002.
All times in WST.

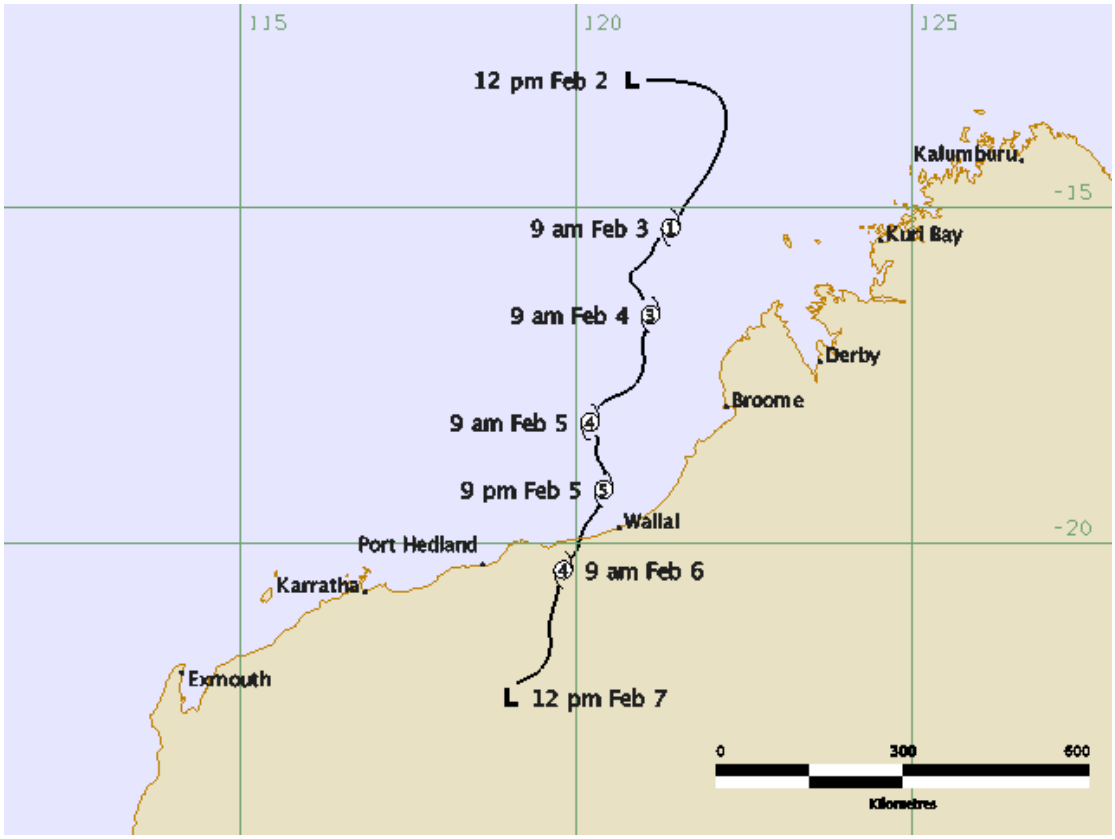

Figure 2. Port Hedland radar image at 0400 WST 6 February as Chris crossed the east Pilbara coast.

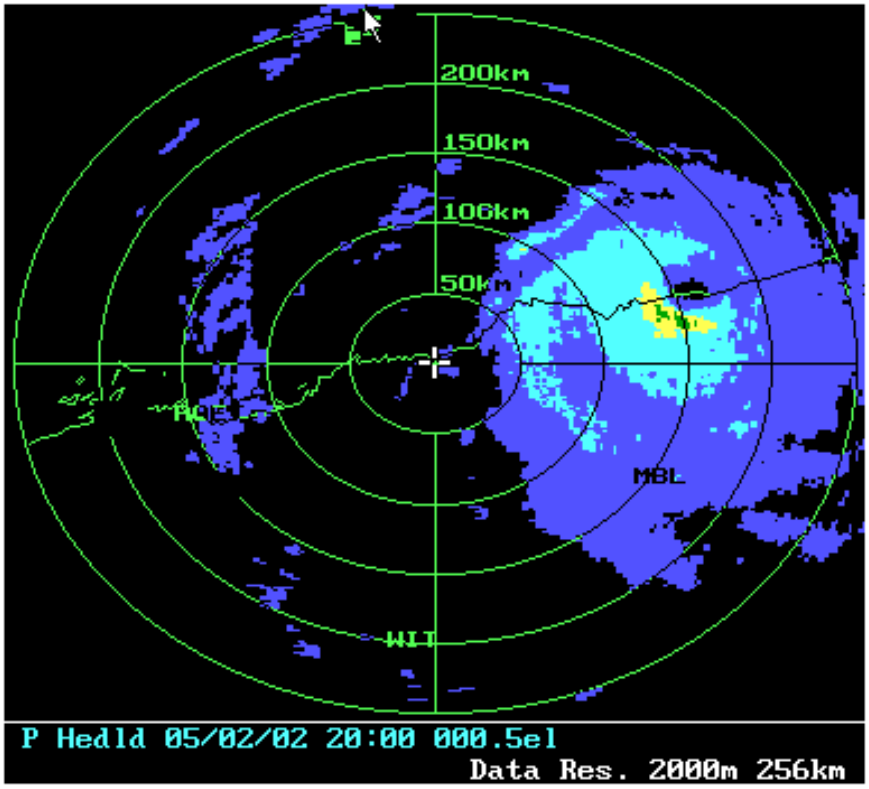

Figure 3. SSMI 85GHz Microwave image at 2138 UTC 5 February showing TC Chris just after making landfall east of Port Hedland.

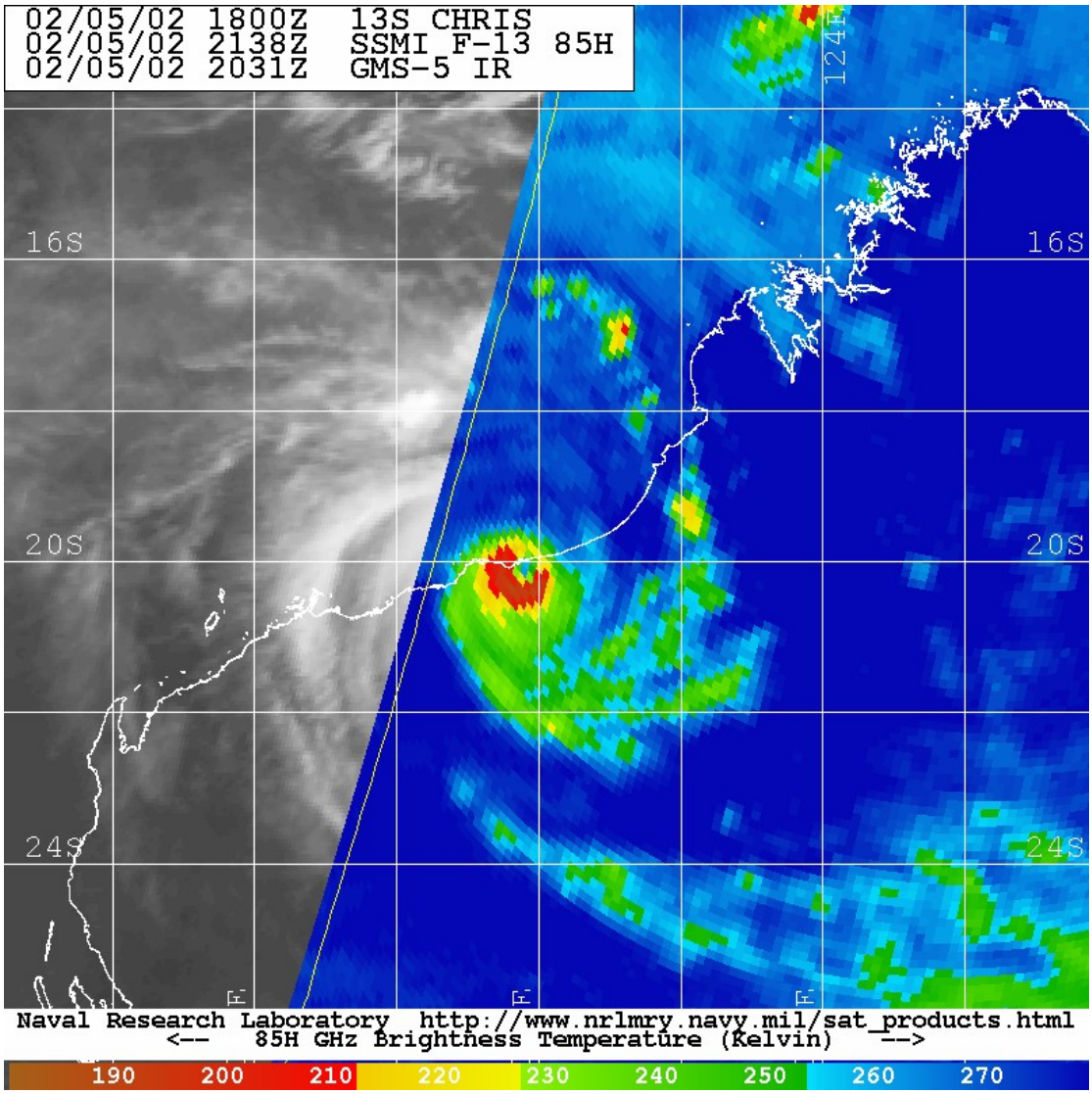

Figure 4. Marble Bar wind and pressure observations 6 February 2002 during TC *Chris*.

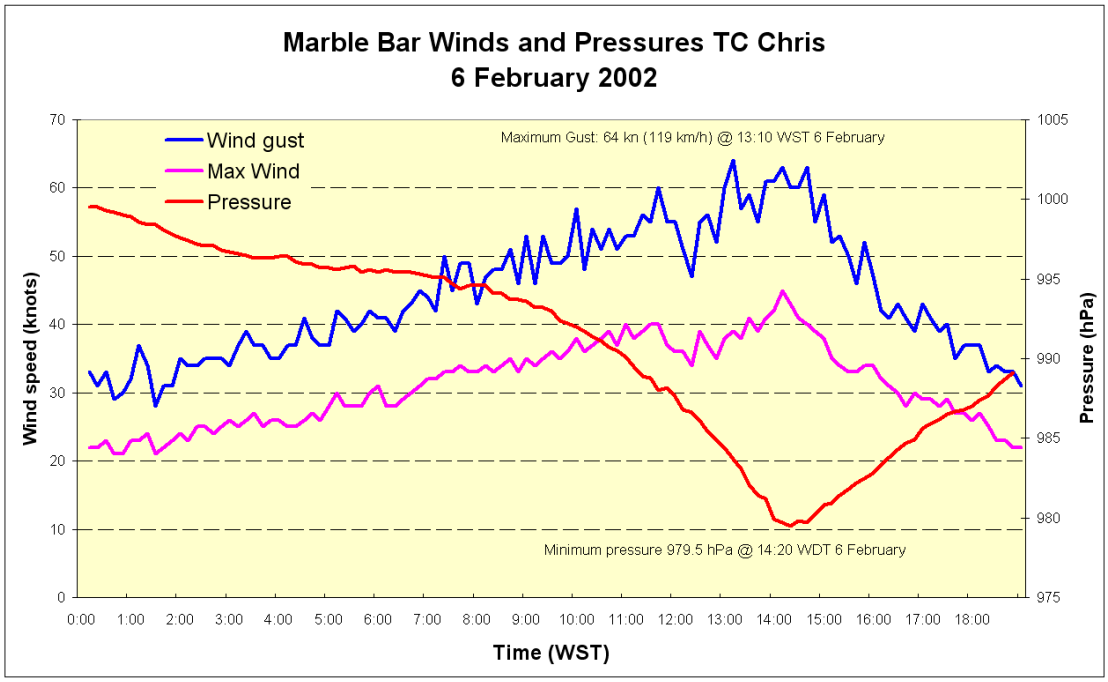

Figure 5. Rainfall distribution, February 2002. Note: almost all the rainfall in the west Kimberley and east Pilbara was attributed to TC *Chris*.

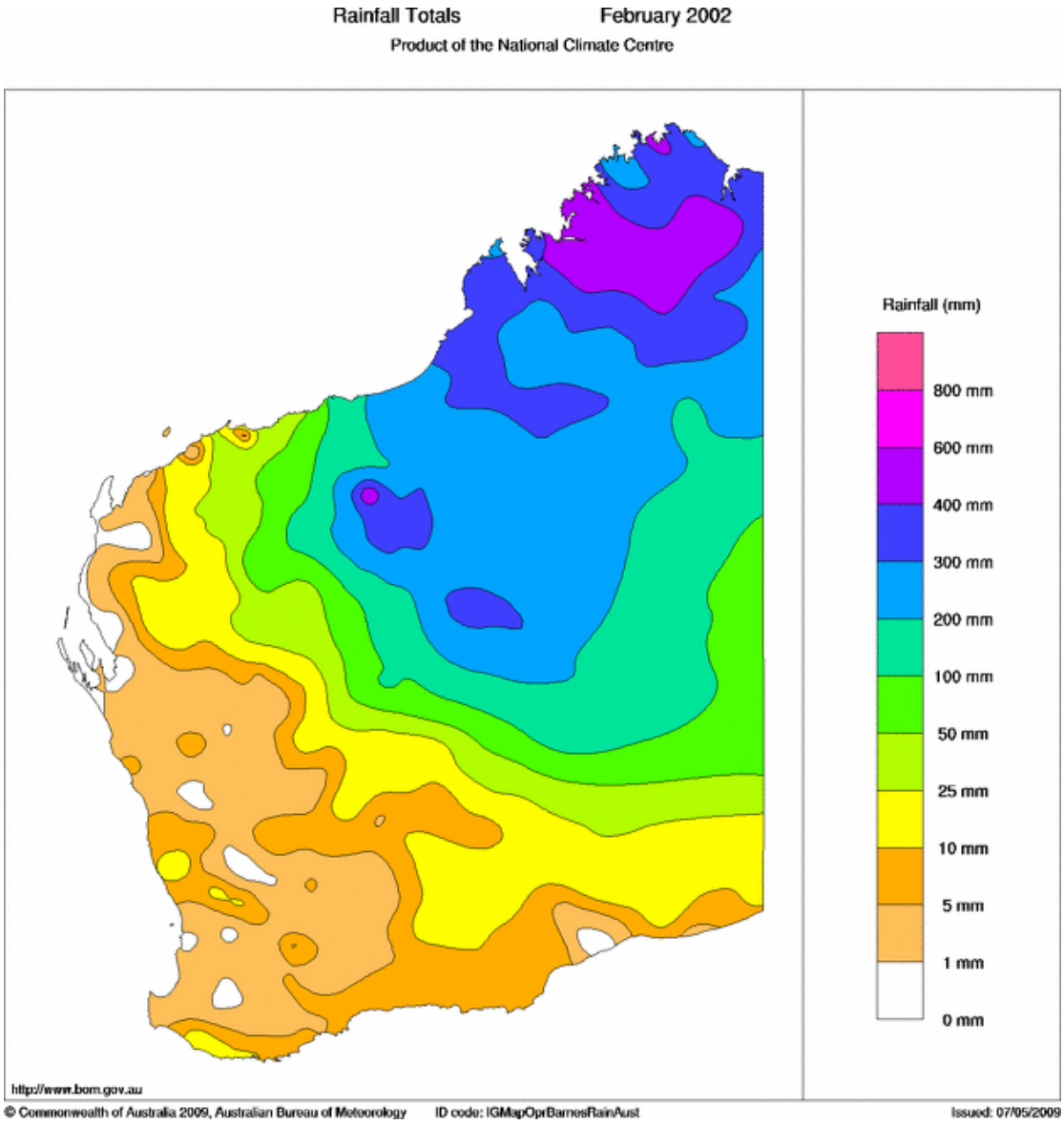

Figure 6. Storm surge impact along 80 Mile Beach. The dark dots near the waters edge are dead cattle. Photo Andrew Burton, Bureau of Meteorology.

Figure 7. Storm surge impact along 80 Mile Beach. Dead cow in eroded opening into third row of dunes. Photo is taken looking seaward towards second row of dunes. Photo Jonathon Nott.

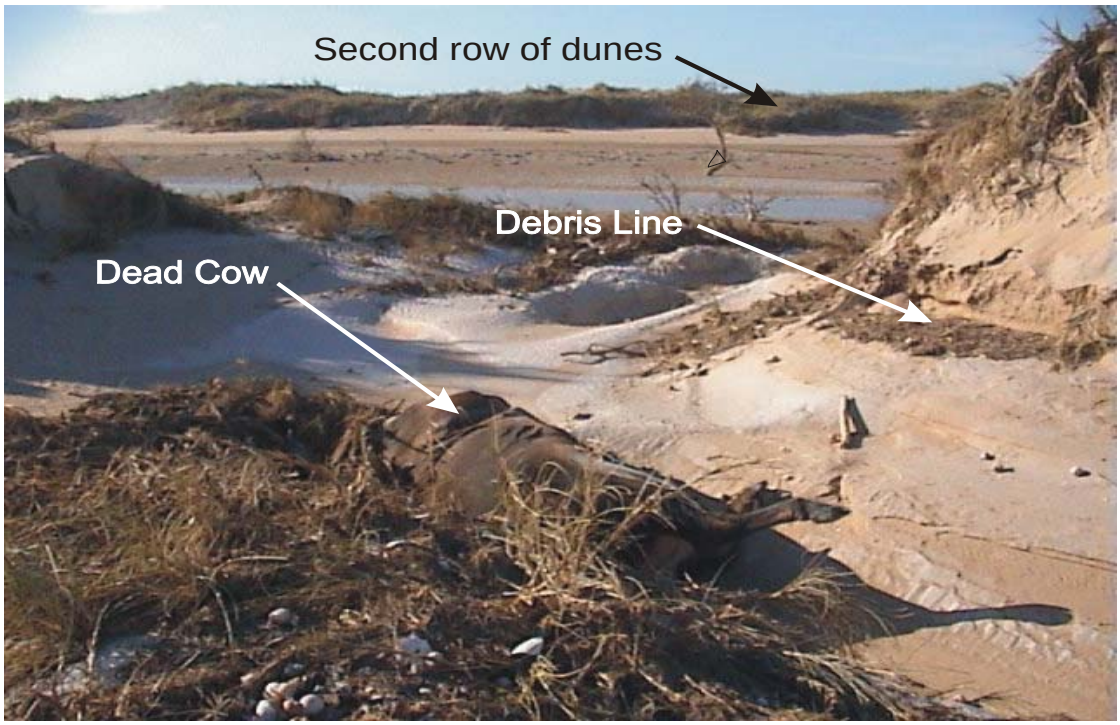

Figure 8. Damage at Pardoo station after the passage of TC Chris.
Photo Andrew Burton, Bureau of Meteorology.