Australian Government
Bureau of Meteorology

Tropical Cyclone *Emma*

26 February – 1 March 2006

Perth Tropical Cyclone Warning Centre
Bureau of Meteorology

A. Summary

Emma was a monsoonal-type low reaching category 1 intensity before crossing the coast near Mardie on 28 February, then moving to the south southeast and eventually passing near Esperance late on 1 March.

The main impact was rainfall, initially in the Karratha/Dampier region and then over inland areas. The heavy rain in the headwaters of the Murchison River caused the highest recorded flood along the river. More than 20 pastoral properties reported significant damage and heavy infrastructure losses combined with significant scouring of the Murchison floodplain. Floodwaters peaked at Kalbarri at about midnight on 15 March. Although the sandbar was washed away and riverside and low-lying parts of the town were flooded, a significant sandbagging exercise protected the town centre from inundation.

B. Meteorological Description

A low developed within an active monsoon trough in the vicinity of 12S 114E well to the north of NW Cape on 25 February. Convection remained unorganised and pulsed diurnally peaking around 0000 UTC 26 February for example. Although day-time visible images showed increasing rotation, convection remained unorganised overnight. Quickscat at 2245 UTC 26 February showed the centre further to the south southwest than the previous day possibly suggesting some re-organising of the LLCC. Convection became more sustained to the south and east but quite removed from the centre.

Quickscat at 0952 UTC 27 February indicated gales well to the south and east but marginally less than 50 per cent surrounding the centre and well removed. Sustained observations of gales at Barrow and Legendre Is confirmed the Quickscat signal and cyclone intensity was estimated at 1200 UTC 27 February.

This is despite convection remaining unstructured by satellite imagery and conventional Dvorak intensity remained less than 3.0 throughout Emma's lifetime. While this is not unusual for monsoon systems, it does highlight the importance of observations (surface and Quickscat) in intensity analyses. Gales extended as far east as Port Hedland (measured by Port Authority and suggested by 50 knot gradient winds at Port Hedland).

Emma passed near to Varanus Is at about 2200 UTC 27 February where the pressure fell to 991.2hPa. Based on pressure gradients the minimum pressure for Emma was estimated at 990 hPa. Note that the standard Atkinson-Holliday Pressure-Wind relationship was not used in the best track analysis given the availability of observations (although for a max wind of 40 knots and an environmental pressure of 1006 hPa the A-H pressure of 988 hPa is close to the estimated pressure of 990 hPa).

Emma crossed the Pilbara coast near Mardie at about 1000 WST 28 February and was estimated at below cyclone intensity by 0600 WST. None of the land-based observing sites Karratha, Roebourne, Mardie, Onslow etc recorded gales.

The low then accelerated to the south southeast passing near Meekatharra at midnight (28 February) and then near Esperance at 2100 WST 1 March. Despite a ragged satellite image - convection well to the south, the pressure fell to 988 hPa at Meekatharra and also to 993 hPa at Esperance suggesting minimal weakening of the circulation. Surface friction and stabilization of the boundary layer is estimated to have kept surface winds below gale force. Both Meekatharra and Esperance were on the eastern side of the low as it passed by in the area most likely to experience the strongest winds given the forward speed of the low.

A storm surge of about 0.8 m was recorded at Dampier occurring just after low tide at 0600 WST 28 February. The surge at the noon high tide was 0.6 m but the overall storm tide of 5.0 m was well less than the HAT and as such there was no damage from storm surge.

C. Impact

Heavy rainfall occurred as ex-TC *Emma* moved across WA. Six occupants were lucky to escape when their two vehicles were washed away on a flooded creek crossing south of Karratha. People from Yarraloola homestead were airlifted as floodwaters on the Robe River rose about them. Mileura Homestead on Ero Creek, about 70 km northwest of Meekatharra, was flooded, apparently for the first time in 120 years. Strong winds brought down power lines and damaged vegetation in the Goldfields including Kalgoorlie where a couple narrowly escaped injury when a tree fell on their car while they were driving.

The heavy rain in the headwaters of the Murchison River caused the highest recorded flood along the river (previous highest was 1960). More than 20 pastoral properties reported significant damage and heavy infrastructure losses combined with significant scouring of the Murchison floodplain. The pre-1900s Berringarra, Manfred and Billabalong homesteads and Murchison House sustained extensive damage. Floodwaters peaked at Kalbarri at about midnight on 15 March. Although the sandbar was washed away and riverside and low-lying parts of the town were flooded, a significant sandbagging exercise protected the town centre from inundation.

D. Observations

Gales were measured at several offshore locations including Barrow Island, as shown in Fig. 2.

Karratha registered 170 mm in 12 hours, and a total of 305 mm throughout the event (see Fig. 3). The 12 hour maximum fall had an Annual Exceedance Probability (AEP) of 5-10 per cent or an Average Recurrence Interval (ARI) of between 10 and 20 years. The weekly rainfall distribution is shown in Fig. 4.

E. Forecast Performance

The first TC advice was issued for a developing tropical low at 0900 WST on Sunday 26 February for areas between Whim Creek and Coral Bay. This reflected the forecast track that favoured a more westerly track than actually eventuated. Few of the model runs reflected any eastward component and a crossing point west of Onslow was suggested prior to 0000 UTC 1 March. The eastern boundary of the warning zone was extended to Port Hedland at 0300 WST on Tuesday (28th) and briefly further to Pardoo. Following the crossing at around noon the warning was cancelled at 1500 WST.

For what is believed to be the first time in Australia, MODIS satellite imagery was used to accurately forecast travel time and the extent of inundation along the Murchison River. There is only one river level site in the 90,000 sq kilometre Murchison River catchment. This allowed estimates to be made on the peak river height at the coastal town of Kalbarri. This gave FESA confidence that the height of the temporary levee bank would be sufficient to keep the town and essential services clear of the floodwaters.

Table 1. Best track summary for Tropical Cyclone *Emma,* 26 February-1 March 2006.

Year	Month	Day	Hour	Position Latitude S	Position Longitude E	Position Accuracy nm	Central Pressure hPa	Max Wind 10min knots	Max Gust knots	Radius Gales knots	Radius Max Winds (RMW)
2006	2	25	18	12	114.4	50	1000	20	45		
2006	2	26	00	12.2	114.4	50	998	25	45		
2006	2	26	06	12.4	114.2	50	998	25	45		
2006	2	26	12	13.3	113.9	50	996	30	45		
2006	2	26	18	14.7	114	50	996	30	45		
2006	2	27	00	16.6	114.4	50	996	30	45		
2006	2	27	06	17.1	114.9	40	996	30	45		
2006	2	27	12	18.3	115.2	30	992	35	50	80	140
2006	2	27	18	19.4	115.5	25	990	40	55	75	90
2006	2	27	21	20	115.6	25	990	40	55	70	70
2006	2	28	00	20.6	115.7	25	990	40	55	60	60
2006	2	28	03	21.3	115.9	25	990	35	50	50	40
2006	2	28	06	22.1	116.2	30	990	30	45		
2006	2	28	12	24.1	117.2	30	988	30	45		
2006	2	28	18	26.5	118.2	25	988	30	45		
2006	3	1	00	28.9	119	30	990	30	45		
2006	3	1	06	31.2	120.2	30	990	30	45		
2006	3	1	12	33.4	121.4	25	992	30	45		
2006	3	1	18	35.6	122.1	30	992	30	45		

Figure 1. Track of Tropical Cyclone *Emma,* 26 February-1 March 2006.
All times in WST.

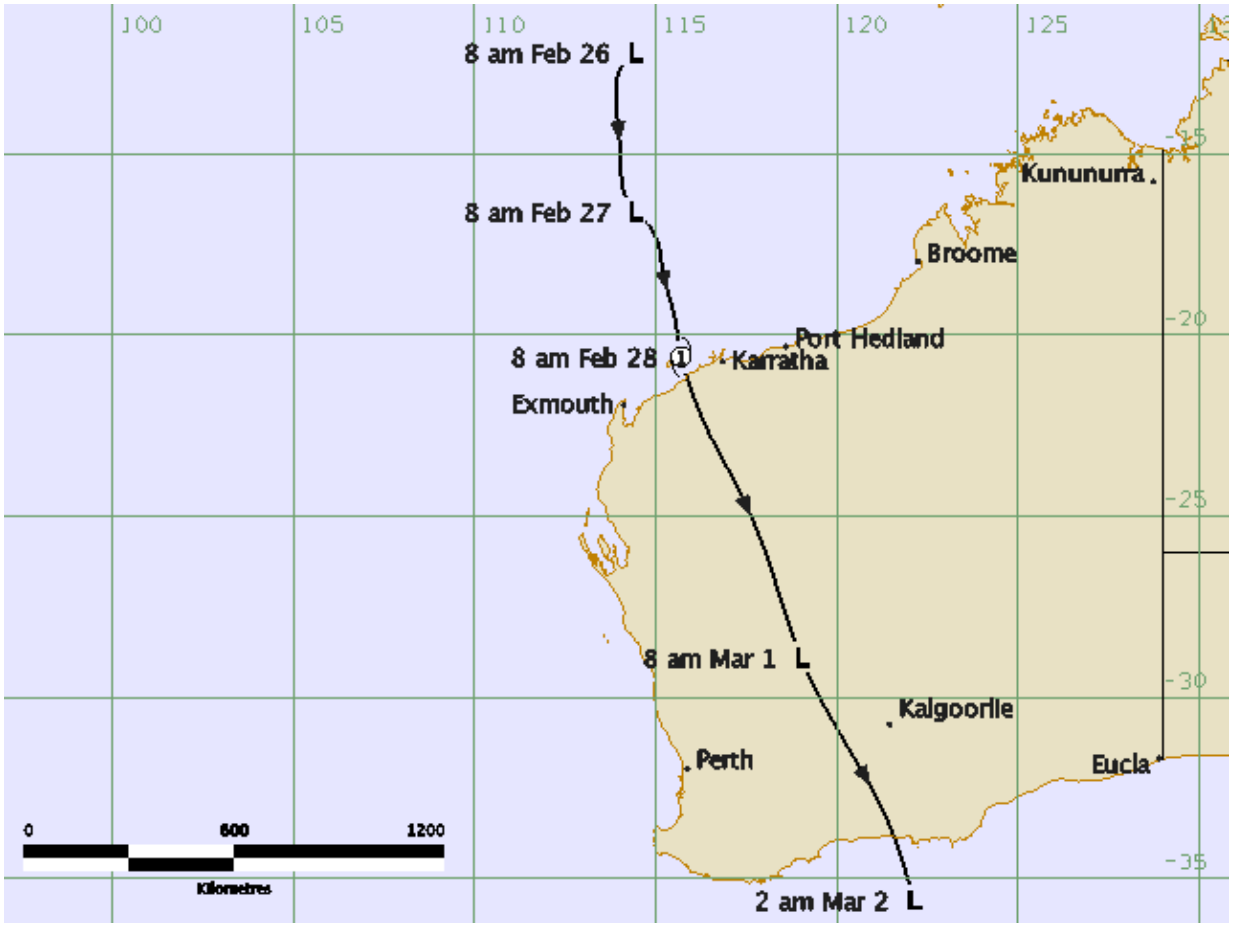

Figure 2. Barrow Island winds 27-28 February.

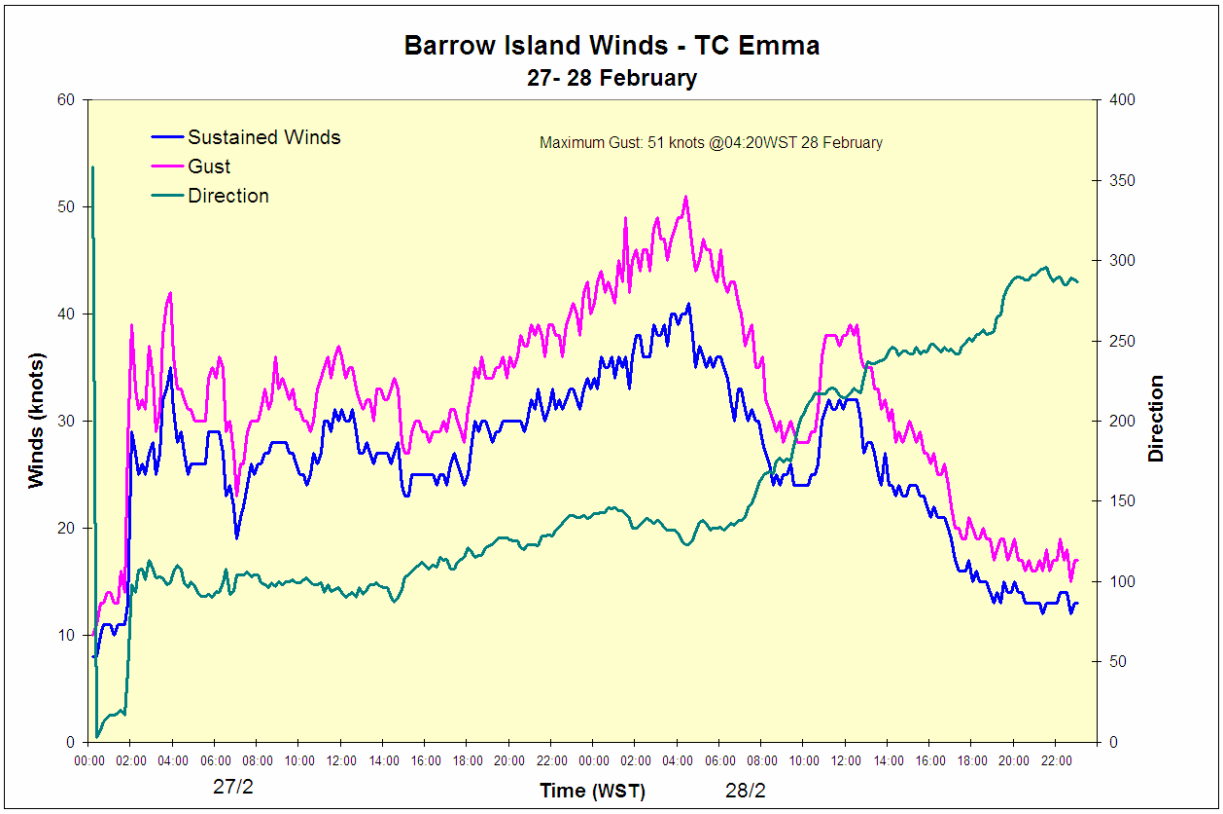

Figure 3. Karratha rainfall, 27-28 February.

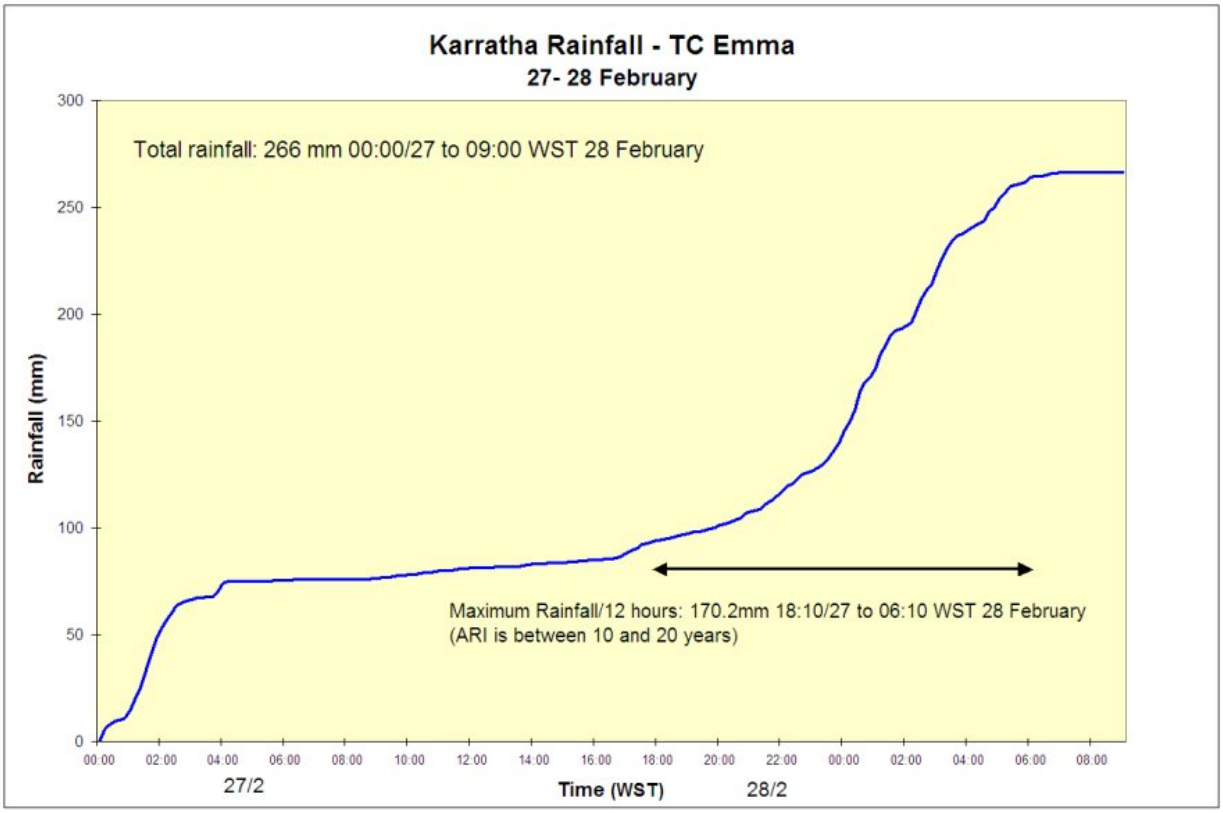

Figure 4. Weekly rainfall distribution to 2 March.