Tropical Cyclone Yasi and its predecessors

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1. Introduction

The following information was taken from the Bureau of Meteorology (BOM) webpage: http://www.bom.gov.au/cyclone/history/yasi.shtml (see also Figure 1).

Severe Tropical Cyclone Yasi began developing as a tropical low northwest of Fiji on 29 January 2011 and started tracking on a general westward track. The system quickly intensified to a cyclone category to the north of Vanuatu and was named Yasi at 10pm on 30 January by the Fijian Meteorological Service. Yasi maintained a westward track and rapidly intensified to a Category 2 by 10am on 31 January and then further to a Category 3 by 4pm on the same day. Yasi maintained Category 3 intensity for the next 24 hours before being upgraded to a Category 4 at 7pm on 1 February. During this time, Yasi started to take a more west-southwestward movement and began to accelerate towards the tropical Queensland coast.

Yasi showed signs of further intensification and at 4am on 2 February it was upgraded to a marginal Category 5 system. Yasi maintained this intensity and its west-southwest movement, making landfall on the southern tropical coast near Mission Beach (138 km S of Cairns) (Figure 1) between midnight and 1am early on Thursday 3 February 2011. Being such a strong and large system, Yasi maintained a strong core with damaging winds and heavy rain, with a lowest central pressure of 929 hPa. It tracked westwards across northern Queensland and finally weakened to a tropical low near Mount Isa around 10pm on 3 February.

A 5.0 m tidal surge was observed at the Department of Environment and Resource Management (DERM) storm tide gauge at Cardwell, which is 2.3 m above Highest Astronomical Tide (HAT). The anomaly occurred at about 1.30am on a falling tide, averting more serious inundation. Some significant, yet far less substantial sea inundation occurred on the late morning high tide on 3 February between the Cairns Northern Beaches and Alva Beach, with peak levels measured at DERM's Townsville tide gauge close to the expected 0.6m above HAT causing inundation of parts of the city.

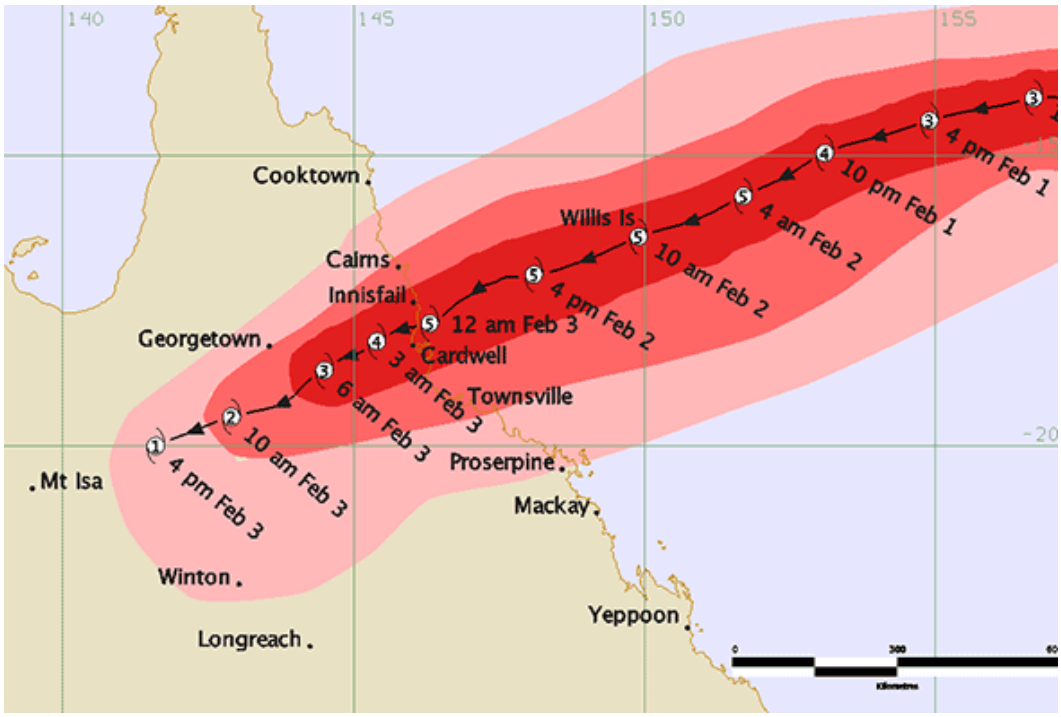

Figure 1: Track and Intensity Information for Severe Tropical Cyclone Yasi

According to BOM there have been 207 known impacts from tropical cyclones along the east coast since 1858. Major east coast tropical cyclones impacts include 1890 Cardwell; 1893 Brisbane; 1898 NSW; 1899 Bathurst Bay; **March 1918 Innisfail**; 1918 Mackay; 1927 Cairns and inland areas; 1934 Port Douglas; 1949 Rockhampton; 1954 Gold Coast; 1967 Dinah, Southern Queensland; 1970 Ada, Whitsunday Islands; 1971 Althea, Townsville; 1974 Wanda, Brisbane; and **2006 Larry, Innisfail** (http://www.bom.gov.au/cyclone/about/cyclones-eastern.shtml). Of these, the 1918 Innisfail and 2006 Larry are probably the most significant predecessors in the area affected by Tropical Cyclone (TC) Yasi (Figure 2). TC Winifred (February 1986) came on land close to Cowley Beach and should also not be dismissed as an important precursor. It caused $130-150 million worth of damage and three deaths (http://www.bom.gov.au/cyclone/about/cyclones-eastern.shtml).

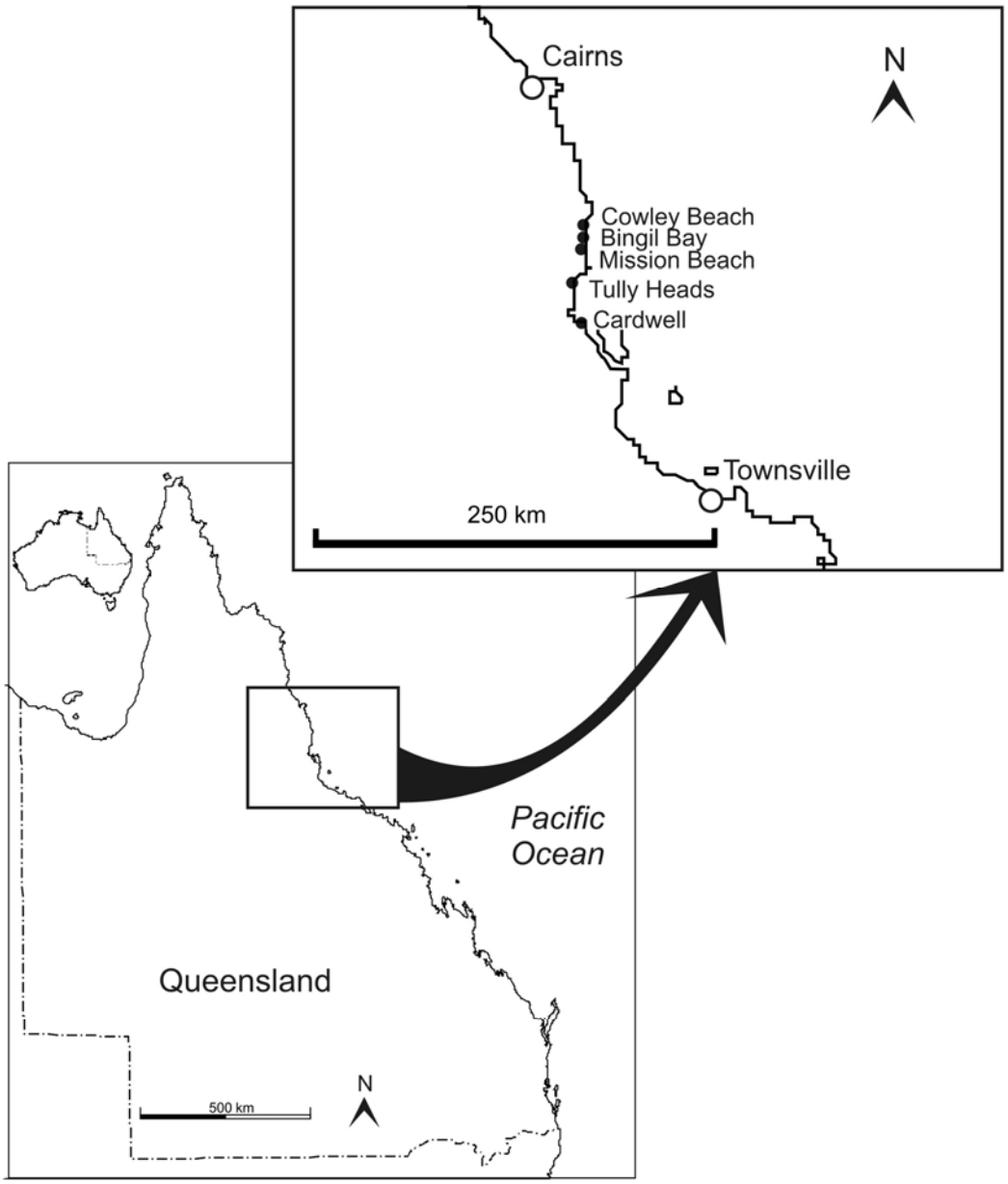

Figure 2: Map of Queensland showing main study area between Cardwell and Cowley Beach

2. Report

The full team carried out a survey of the sedimentary deposits of TC Yasi between February 14 and 18, 2011. Earlier work by Nott and others between February 4 and 12 does not form part of this report. Fieldwork focused on the coast affected by the eye of the cyclone, between Cardwell in the south and Cowley Beach in the north (Figure 2). These sites include Cardwell, Tully Heads, Mission Beach, Clump Point Jetty, Bingil Bay and Cowley Beach, A brief summary of the findings is given below:

2.1. Cardwell (Figures 3-5)

Our first visit identified a coarse sand to fine gravel deposit on the seaward side of the main road at the southern end of the settlement. Unfortunately, the next day this section of the deposit had been removed as part of the clean-up process and we selected a site some 100 m further south. The deposit overlies an old shoreline track which was being exhumed during our study.

Figure 3: Cardwell – overview of TC Yasi deposit looking north.

Figure 4: Cardwell – overview of TC Yasi deposit looking seaward from the snout of the deposit.

Figure 5: Cardwell – Seaward end of the TC Yasi deposit showing numerous planar laminations.

Trenches were dug at seaward, ridge top and landward locations with samples taken for grain size, microfossil and geochemical analyses.

2.2. Tully Heads (Figures 6-10)

This site was the most devastated with severe damage to buildings and reworking of the boulder seawall. The sandy TC Yasi sediment deposit was sampled here along the spit that extends south from the seawall. The landward section of the deposit overlies low energy waterlain deposits that may have been emplaced during TC Larry. Trenches were dug at seaward, ridge top and landward locations with samples taken for grain size, microfossil, geochemical and chronological analyses.

The lack of salt-burned vegetation even within the limit of sediment/boulder deposition was notable (see Fig. 6), as opposed to observations immediately following tsunami inundation.

Figure 6: Tully Heads – Looking north towards the boulder deposit sourced from adjacent seawall.

Figure 7: Tully Heads – Looking south along seawall towards sand spit sampled for TC Yasi sediments.

Figure 8: Tully Heads – Seaward end of the TC Yasi deposit showing numerous planar laminations.

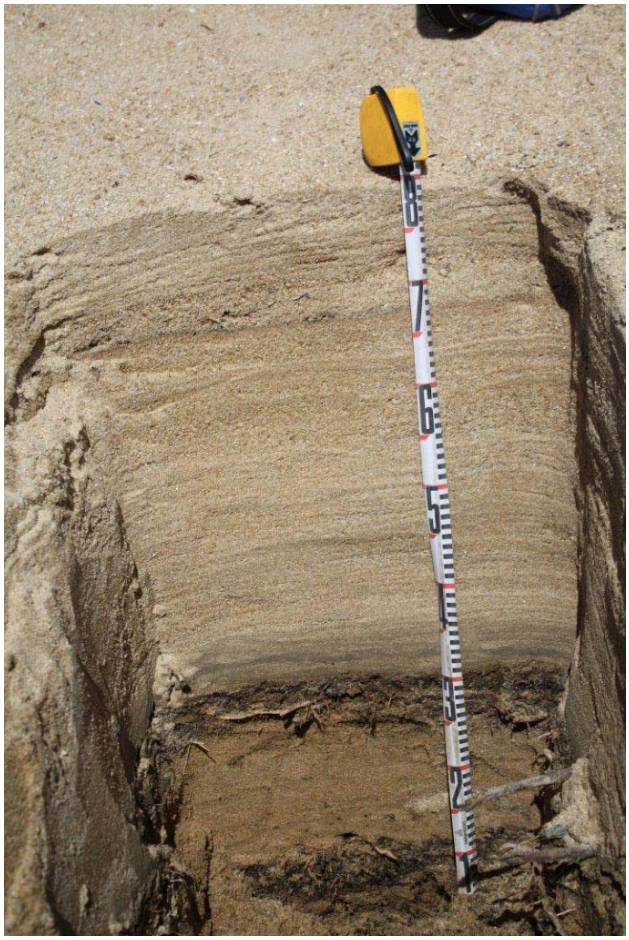

Figure 9: Tully Heads – Towards the landward end of the TC Yasi deposit where it overlies low energy waterlain sediments. The lower contact is with a buried soil possibly formed after TC Larry in 2006. This in turn overlies an earlier soil, possibly formed following TC Winifred.

Figure 10: Tully Heads – Closer to the landward end of the TC Yasi deposit (grey sand) where it overlies a very thin buried soil possibly formed after TC Larry in 2006 (yellow sand). The underlying soil overlies another old sand layer, possibly deposited by TC Winifred.

2.3. Mission Beach (Figure 11)

A site visit revealed that the beach is sediment starved and as such while there was considerable coastal erosion, sedimentary evidence was sparse. No further work was carried out at Mission Beach.

Figure 11: Mission Beach – Showing coastal erosion along the shoreline.

2.4. Clump Point Jetty (Figure 12) - north end of Mission Beach

A brief visit to this site revealed significant sand deposition under the bridge at Clump Point Jetty. Prior to the clearance of debris in the area, the deposit was traced by Nott and others to the landward side of the road. No further work was carried out here.

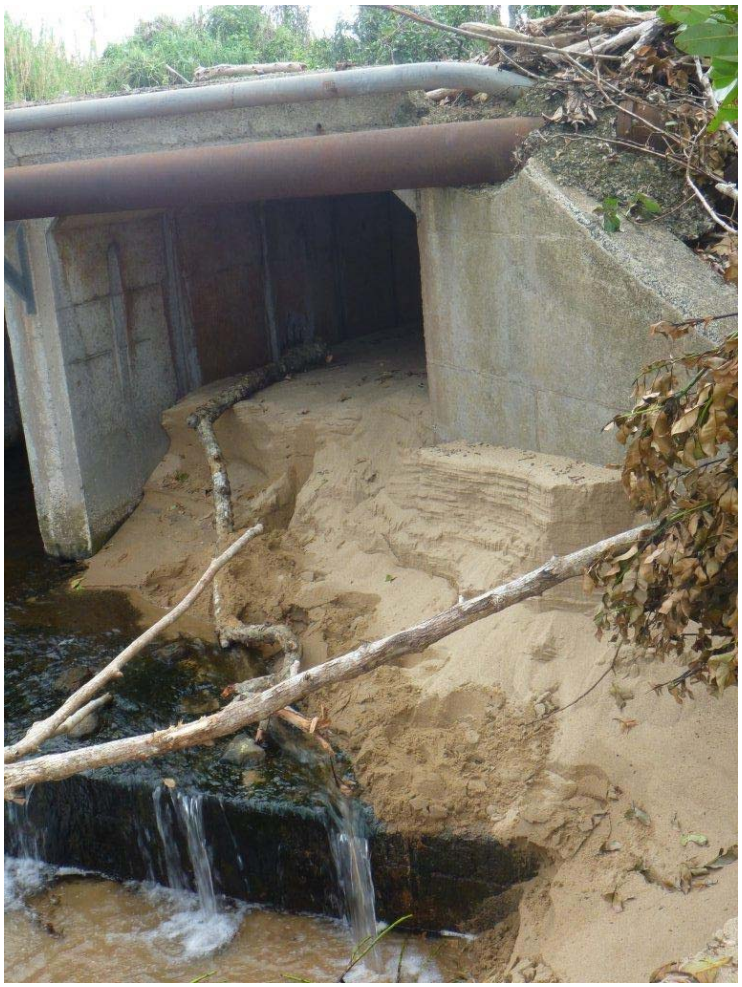

Figure 12: Clump Point Jetty – Sand deposition beneath the road bridge.

2.5. Bingil Bay (Figure 13)

To the north of Clump Point there was evidence for TC Yasi inundation at Bingil Bay. Due to time constraints only a brief reconnaissance survey was undertaken.

Figure 13: Bingil Bay – Showing erosion of the shoreline – sediments extend landward across the road backing the beach.

2.6. Cowley Beach (Figures 14-17)

Cowley Beach marked the northern extent of the study area – that most affected by the eye of the cyclone. A long trench was dug from the shoreface to the ridge crest, with three smaller trenches completing the remainder of the landward sequence. Most notable here were the clearly defined underlying deposits, most probably associated with TC Larry and the Innisfail cyclone, although TC Winifred cannot be ruled out. Each deposit is separated by soil. At this main study site the soils were well defined, but there were varying degrees of soil development at other sites about 100 m apart on the ridge crest. At all sites however, at least one additional underlying deposit was visible. A similar trench dug into the next landward ridge indicated that there were at least two stacked deposits. Samples were taken for grain size, microfossil, geochemical and chronological analyses.

Figure 14: Cowley Beach – Looking seaward from the crest of the ridge. This shows the trench dug from the shoreface to the crest. There is a marked scarp visible about 2/3 of the way along the trench (see Figure 15). At least two buried soils are visible in the foreground with the lower sand unit commencing seaward of the trowel (see Figure 16).

Figure 15: Cowley Beach – Pre TC Yasi scarp shown by the marked dip in the underlying soil. This marks the old erosional scarp of TC Larry.

Figure 16: Cowley Beach – A second sand unit is visible about 2.40 m landward of the scarp eroded by TC Larry. This is the TC Larry deposit which is noticeably more weathered than the overlying sands of TC Yasi. The TC Larry sediments overlie another buried soil beneath which is a heavily weathered sand that we tentatively associate with the 1918 Innisfail cyclone (see Figure 17).

Figure 17: Cowley Beach – Trench dug landward of ridge crest. There is evidence of three buried soils, the lowest appearing as an approximately 10 cm thick grey-brown unit. This overlies sands that we interpret as beachface material. Sediments from TCs Yasi and Larry are approximately the same thickness here and are separated by a thin soil. The third sand layer is tentatively attributed to the Innisfail cyclone.

3. Comments

Two key points arise from this work. First, that the deposits for TC Yasi are highly variable along the worst affected section of coastline. Second, there is clear evidence for predecessor events underlying TC Yasi deposits. Careful site selection should enable researchers to identify the optimum sites for studying the history of past TCs in the region and to gain a better understanding of cyclone ridge formation.

4. References

http://www.bom.gov.au/cyclone/about/cyclones-eastern.shtml. Tropical Cyclones in Queensland. Accessed 20 February 2011.

http://www.bom.gov.au/cyclone/history/yasi.shtml. Severe Tropical Cyclone Yasi. Accessed 20 February 2011.