PART TWO

Report on effects of Tropical Cyclone *Fran* March 1992

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1. INTRODUCTION

Heron Island is located in the southernmost portion of the Great Barrier Reef Marine Park (Figure 1). One of the most visited reef islands, it is the site of a tourist resort, a marine research station and a national park.

During late 1987, the then existing boat harbour, which had been constructed twenty years earlier by dredging a channel and mooring basin through the western end of the reef flat, was enlarged by further dredging and excavation. Considerable environmental disturbance was caused by silt released during this operation.

Material dredged from the harbour was deposited in a spoil dump which formed a reclamation on the southwestern shoreline of the island (Figure 2). The material stored in the spoil dump included some silt which was a cause for concern as subsequent natural events, including tropical cyclones, could erode the spoil dump and release further quantities of silt to contaminate the adjoining reef-top environment.

The Great Barrier Reef Marine Park Authority commissioned the authors of this report to undertake a monitoring programme of the spoil dump which continued until mid 1991. The results of that programme have been reported in a comprehensive report (Gourlay and Jell 1992) as well as in several shorter papers or articles (Gourlay 1991a, 1991b and Gourlay 1992).

This report deals with a subsequent extension of the original monitoring programme and concerns the effects of tropical cyclone *Fran* (March 1992) upon the spoil dump and adjoining reef flat. Monitoring of these areas after any severe event was recommended in the original report (Gourlay and Jell 1992, section 7.1).

For ease of comparison with the report on the previous monitoring programme, the same sequence and, where possible, the same headings and the same formats as were used in the previous report, are used to present the results of the cyclone *Fran* monitoring. However, matters common to both investigations, such as the history of the boat harbour and the geomorphic setting of Heron Island, as well as the details of the methods used in the various investigations, are not repeated in this report. For this information the reader should refer to Gourlay and Jell (1992).

3. INVESTIGATIONS

3.1 Objectives

The objective of the monitoring programme described in this report was to determine the effects of tropical cyclone *Fran* (March 1992) upon the shoreline and reef at Heron Island with regard to the following matters:

(i) conditions affecting the spoil dump;

(ii) quantity of material stored in the spoil dump;

(iii) changes in shoreline in vicinity of spoil dump;

(iv) changes in reef-flat sediments.

3.2 Field Work

As in the previous monitoring programme, field work for this project was undertaken in two different ways:

(i) special site visit;

(ii) daily observations on site by Heron Island Research Station (HIRS) personnel.

Following cyclone *Fran* a site visit was made during 20 to 24 April 1992 by Dr Jell, assisted by laboratory technician Marshall Butterworth, and three final year civil engineering students, Darryl Bruce, Bobby Chisholm and Graham Jenkin.

Dr Jell and Marshall Butterworth collected sediment samples from the reef flat and boat harbour while the three students resurveyed the spoil dump. The latter work, together with other aspects of this monitoring exercise, forms the basis of the students' final year thesis project supervised by Dr Gourlay.

3.3 Sediment Analyses

Sediment analyses were undertaken to determine the nature of sediments on the reef flat and in the boat harbour after the cyclone, particularly the presence and extent of fine silt deposits.

A total of 145 samples was collected along traverses similar to those of the previous monitoring programme (Gourlay and Jell 1992, Figure 4) and ten were collected along the boat harbour and channel (Figure 17). Sampling and analysis procedures were also similar (Gourlay and Jell 1992, section 3.3).

3.4 Surveys of Spoil Dump Size and Shape.

The survey of the spoil dump size and shape was undertaken to determine the changes in its volume and shape since the previous survey in June 1991.

Survey methods and analysis were similar to those described in Gourlay and Jell (1992, section 3.4).

3.5 Hydraulic and Meteorological Data Analyses

The hydraulic and meteorological data analyses were undertaken to determine the actual conditions occurring during cyclone *Fran* so that the processes causing the observed changes to the shoreline and reef flat could be understood.

Continuing visual observations at stations 1 and 2 and at the jetty (Figure 2) were available for the period during which the cyclone affected the island. The quantities observed and other aspects of these observations are given in Gourlay and Jell (1992, section 3.5).

Additional meteorological data concerning cyclone *Fran* was obtained from the Bureau of Meteorology, Brisbane as well as the normal three hourly wind speeds and directions and daily rainfall data from the Heron Island automatic weather station. As previously, tide heights at Heron Island were predicted using Queensland Department of Transport tide tables. It should be noted that the tide board, installed on one of the jetty piles during April 1989 for this investigation, disappeared some time shortly before the night (or during the night) of 1-2 May 1992[1]. It has subsequently been reinstated.

The actual visual observations of the spoil dump and conditions affecting it have continued and are continuing since the cessation of the previous monitoring programme on 30 April 1991. Apart from examination of the conditions occurring during cyclone *Fran*, no significant analysis of this data has been or is likely to be undertaken in the near future because of lack of funds to do so.

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1 Delton Chen, University of Queensland, Department of Chemical Engineering. Personal Communication 16 June 1992.

Table 1. Quantity of Material in Spoil Dump

DATE	Volume relative to August 1984 m^3	Volume change m^3	Volume change since Dec. 1987 m^3
7 December 1987	14860		0
		-940	
14-17 May 1988	13920		-940 (6%)
		-300	
1-5 April 1989	13620		-1240 (8%)
		-390	
3-5 January 1990	13230		-1630 (11%)
		-70	
18-22 June 1991	13160		-1710 (11%)
		-600	
20-24 April 1992	12560		-2300 (15%)

There also has been some mechanical removal of material from the spoil dump. For example, the hole from an excavation made in the top of the spoil dump for fill to restore the eroded beach in front of the resort swimming pool can be clearly seen on Figure 6. The volume of this excavation is, however, quite small, i.e. about $4m^3$.

Volume change calculations have now been extended eastward from the spoil dump for a distance of 80m (four profiles at 20m spacing) almost to the western end of the beach rock. Figure 8 shows the total volume of sediment stored within the spoil dump and the adjoining beach in front of the research station. The baseline and baselevel for the calculations and the scales of the graphs (Figures 7 and 8) are the same.

Apart from June 1991, the total volume of sediment in the extended area has remained virtually constant. The difference between the maximum and minimum volumes is $318m^3$ which is 0.6% of the total volume or 2.1% of the initial spoil dump volume. It is also less than the average annual loss of $340m^3$ from the spoil dump. However, the increase in volume between June 1991 and April 1992 indicates that there has been a net gain of material in the extended area during that period. Comparison of the three graphs, Figures 7, 8 and 9, shows that this accumulation has largely taken place within the additional 80m east of the spoil dump, below the research station. Still further east of the spoil dump, Figure 46 in Gourlay and Jell (1992) indicates that there was an overall small accumulation of material in the area examined between the time of construction of the spoil dump and March 1990. The rate of this accumulation has varied and has been shown to be event dependent.

Considering the spoil dump only, Figure 9 shows that, between June 1991 and April 1992, material was removed from the central portion between profiles 4 and 7 and that a smaller amount of material was deposited at both ends.

4.3 Changes in Spoil Dump Shoreline during Tropical Cyclone *Fran*

Between June 1991 and April 1992 there has been significant re-alignment and re-shaping of the spoil dump beach (Figures 10,11 and 12). This includes erosion in profiles 1 to 7, particularly of the spoil dump surface and the upper beach, and deposition in profiles 1 to 3 and 8 to 10. The 4m contour has retreated between profiles 4 and 7 by up to 5m. The erosion has continued to expose the fine silt layers in low escarpments near the jetty.

Some of the vegetation growing on the spoil dump in 1991 was no longer there in April 1992. The 1992 survey records only one *Casuarina* whereas three were recorded in June 1991. It is known that one of these disappeared during cyclone *Fran*.

cyclone is in the vicinity of the island (e.g. cyclone *Fran* - March 1992) or from heavy swells produced by distant weather systems (e.g. cyclones *Aivu* - April 1989 and *Joy* - January 1991). Furthermore, there has been no build up of fine material on the reef-top as a consequence of the cyclone. On the contrary cyclone *Fran* has continued the process of removing fine material from the reef-top.