ROWES BAY RENOURISHMENT MONITORING REPORT #2

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EXECUTIVE SUMMARY

- Monitoring of the Rowes Bay Renourishment site in April 1999 showed that the beach face had grown slightly, inc
- reasing in volume by 1348m^3. A significant berm landform had been formed by natural wave processes in the southern part of the area over the four months since the project began.

- The erosion scarp at the back of the beach face had been eroded slightly, loosing 416m^3 of sand.

- An erosion event in early August caused damage to the renourishment area. The beach face lost 2685m^3, and the scarp lost 1423m^3. This erosion was caused by king tides probably in conjunction with relatively high-energy SE-wind generated swell waves.

- During 1999, a large volume of sand has accumulated around the mouth of One Mile Creek. Currently some 4800m^3 are estimated to be in a beach and bar landform here. This is about the same volume of sand that was lost during the August erosion event. However, it is not known whether this sand deposit is entirely composed of sand eroded from the renourishment area.

- Natural recovery of the beach profiles after the August erosion event has started. Wave action is returning sand to the upper part of the beach face.

- It is recommended that the sand at the mouth of One Mile Creek be placed along the upper part of the renourishment area beach face.

- It is recommended that consideration be given to placing a further quantity of sand on the upper beach face to create a berm landform. About 10,000m^3 is suggested as a minimum amount that would go some way to forming a more self-sustaining beach system in Rowes Bay.

1. Introduction

This report documents two phases of monitoring of the Rowes Bay foreshore renourishment project. The first was carried out in late March – early April 1999 by James Cook University staff and students of the School of Tropical Environment Studies and Geography. The second was carried out in mid-September 1999 by C&B Consulting Ltd. Details on the nature of the renourishment project are contained in The Rowes Bay Monitoring Report #1 (March 1999).

The purpose of this report is to present the results of the monitoring, and interpret these in terms of the future maintenance and renourishment needs.

2. Monitoring program

The Rowes Bay foreshore renourishment was carried out in October-November 1998 when ~16,000m^3 of sand was placed on the upper beach face and in the dune area. Nine profile sites were established to monitor sand movement within and adjacent to the renourishment area. The first surveys carried out in early December 1998 documented to initial shape of the renourished beach and dune area. This is described in The Rowes Bay Renourishment Monitoring Report #1.

Surveys of the beach profile were repeated in late March – early April 1999 at the end of the 1998/1999 wet season. These document the foreshore area some four months after the disturbance of the renourishment process.

In early August a series of king tides caused erosion of the foreshore, and this prompted a partial survey (of five profiles) to assess damage to the renourishment.

3. Methods

Beach profiles were measured at 8 profile sites along the foreshore area (sites T30, T30.3, T30.5, T31, T31.6, T31.7, T31.8, T32). Full details on the locations of these sites were given in Rowes Bay Renourishment Monitoring Report #1. Raw data from these surveys is shown in the appendix. From these data transects have been drawn and these are shown in Figures 1 – 8. Measurements from the transects have been used to determine horizontal changes in the position of the various foreshore landforms, in particular the erosion scarp and beach face (Tables 1 and 3). Estimates of changes in sand volume have been derived from the changes shown on the transects (Tables 2 and 4).

4. Changes December 1998 – April 1999

The first monitoring of the renourishment area was carried out from 29/3/99 – 2/4/99. This was four months after the initial post-renourishment survey, and coincided with the end of the 1998/1999 wet season. Figures 1 – 8 show the foreshore profiles, and horizontal change data from these is summarised in Table 1. In Table 2 sand volume changes are documented. These have been calculated from the profile data averaged along the various sectors of the renourishment area. In total, these was a net accumulation of about 930m^3 of sand in the renourishment area (Table 2) due to natural wave action processes.

4.1 Erosion scarp

As noted in the Rowes Bay Renourishment Report #1, the erosion scarp along the front of the dune landform was quickly re-established. This was caused by the early January king tides that exceeded 3.5m above chart datum. By late March 1999, a further five groups of king tides had occurred but the erosion scarp was only eroded back between 0 – 0.5m. However, at sites T31.7 and T31.8, between 1 – 1.5m was lost. From Figures 6 & 7 it can be seen that this erosion only affected the lowest part of the erosion scarp causing a steepening of slope, but not damaging the dune landform behind. As a result, the overall volume of sand lost from the erosion scarp was a modest 416m^3 (Table 2), and this erosion probably all occurred during the early January king tides. The eroded sand appears to have been deposited on the beach face.

4.2 Beach face

During the four months after the establishment of the renourishment, the beach face was influenced by daily wave action, and as expected its shape altered to come into equilibrium with the wave conditions. At site T30 a prominent berm was formed. This can be seen on Figure 1 as a 6m wide ledge at about 4.2m above chart datum. It extended north for about 80m. Most of the other profile sites also show some growth, with this mostly occurring in the lower parts of the beach face. There was slight erosion at site T31 (Table 1). Table 2 shows the beach volume changes following this growth trend, with ~1350m^3 accumulating in the beach face. About 415m^3 of this would have come from the erosion of the scarp. It is not known where the remaining ~930m^3 came from, although it may have been worked onshore from sand that is carried out onto the mudflats by the flow of One Mile Creek.

TABLE 1 Foreshore changes 1/12/98 – 1/4/99

Profile #	Scarp changes (m)	Horizontal beach face changes (m)*	Vertical beach face changes (m)*
T 30	0	5.5	0.85
T 30.3	-0.5	2.5 (l); -1 (u)	0.3 (l); -0.1 (u)
T 30.5	-0.5	2.0 (l); 0 (u)	0.15 (l); 0 (u)
T 31	-0.5	-0.25 (l); -0.75 (u)	-0.1
T 31.6	0	1.0	0.15
T 31.7	-1.0	1.0 (l); 0 (u)	0.15 (l); 0 (u)
T 31.8	-1.5	1.0	0.15
T32	0		-0.1 (l); -0.05 (u)

* l = lower beach face; u = upper beach face

TABLE 2 Foreshore volume changes 1/12/98 – 1/4/99

Shoreline sector (length in metres)	Sand volume changes along scarp (m^3)	Sand volume changes along beach face (m^3)	Total sand volume changes (m^3)
T30 – T30.3 (85m)	-9	785	*776*
T30.3 – T30.5 (146m)	-16	260	*244*
T30.5 – T31 (221m)	-86	41	*-45*
T31 – T31.6 (137m)	-21	119	*98*
T31.6 – T31.7 (157m)	-38	-11	*-49*
T31.7 – T31.8 (132m)	-144	280	*136*
T31.8 – T32 (120m)	-102	-126	*-228*
TOTALS	*-416*	*1348*	*932*

4.3 One Mile Creek mouth

During the wet season, longshore drift carried sand southwards across the mouth of One Mile Creek. This natural process typically occurs in the summer months when winds tend to blow more frequently from between NW and NE directions. This process has been observed from Beach Protection Authority aerial photographs of the area, but it does not usually involve large volumes of sand. From observations

made in mid January 1999, it was estimated that about 2000m^3 had accumulated in a 120m x 30m sand bar that stretched across but did not block the mouth of the creek. The sand was relatively fine, and was thus probably not derived from the renourishment area that comprises relatively coarse sand.

5. Changes April – October 1999

The second partial monitoring of the renourishment area was carried out on 13/9/99, and 2/10/99. This was in response to an erosion event that occurred during king tides between 9 – 12. Figures 1, 3, 4, 6, & 8 show the foreshore profiles at the five sites that were surveyed, and horizontal change data from these is summarised in Table 3. In Table 4 sand volume changes are documented. These have been calculated from the profile data averaged along the various sectors of the renourishment area. In total some 4100m^3 of sand was lost, with 2/3rds of this coming from the beach face (Table 4).

TABLE 3 Foreshore changes 1/4/99 – 1/10/99

Profile #	Scarp changes (m)	Horizontal beach face changes (m)*	Vertical beach face changes (m)*
T 30	0	-3.5	0.5
T 30.3	nd	nd	nd
T 30.5	-1.5	0.5 (l); 1.0 (u)	0.1 (l); 0.2 (u)
T 31	-1.5	-0.5 (l); -2.0 (u)	-0.1 (l); -0.35 (u)
T 31.6	nd	nd	nd
T 31.7	-2.5	-1.25 (l); -3.5 (u)	-0.15 (l); -0.5 (u)
T 31.8	nd	nd	nd
T32	1.25	1 (l); 1.5 (u)	0.15 (l); 0.25 (u)

* l = lower beach face; u = upper beach face

TABLE 4 Foreshore volume changes 1/4/99 – 1/10/99

Shoreline sector (length in metres)	Sand volume changes on scarp (m^3)	Sand volume changes on beach face (m^3)	*Total sand volume changes (m^3)*
T30 – T30.3 (85m)	-25	-452	*-477*
T30.3 – T30.5 (146m)	-42	-135	*-177*
T30.5 – T31 (221m)	-266	-470	*-736*
T31 – T31.7 (294m)	-712	-1308	*-2020*
T31.7 – T32 (252m)	-378	-320	*-698*
TOTALS	*-1423*	*-2685*	*-4108*

5.1 Erosion scarp

Significant erosion of the scarp occurred in the central sectors of the renourishment area. Up to 2.5m of the scarp area was lost (Table 3), although there was only slight damage to the dune (Figures 1, 3, 4, 6, & 8). As noted above, this was caused by the early August king tides that exceeded 3.5m above chart datum. Overall some ~1425m^3 of sand was lost from the scarp, half of this in the sector between sites T31 and T31.7 (Table 4).

5.2 Beach face

The horizontal and vertical changes in the beach face (Table 3) show a typical pattern of beach response to high-energy waves. The upper part of the beach face at most of the profile sites was eroded more than the lower part, resulting in slight reductions in beach slope. The berm at site T30 was removed, but the erosion scarp behind was not damaged. Volume data (Table 4) shows that ~2900m^3 of sand was lost, with the bulk of this again being in the sector between T31 andT31.7.

It is not clear from the profiles where the eroded sand was moved. There are no new sandbars on the mudflats (Figures 1, 3, 4, 6, & 8), and the profile site to the north (T32, Figure 8) does not show significant growth. However, there has been a significant build-up of sand at the mouth of One Mile Creek as described below.

Although a considerable amount of sand was lost from the beach face at site T30, the behaviour of this part of the Rowes Bay beach demonstrates the possibilities for the improved longer-term health of the renourishment area. The sand that was lost at T30 was the berm landform that had developed in a few weeks after the renourishment sand was initially placed. This berm took the brunt of the August erosion event, protecting the more important scarp and dune area behind. It is expected that in the next few months this berm should re-form. Creation of a berm landform in front of the erosion scarp along the length of the Rowes Bay foreshore could provide a partly self-sustaining buffer against king tide and wave attack. The berm would be eroded during higher energy events, but could reform in the following months. The berm in the T30 – T30.3 area comprised ~1000m^3 of sand. Using this as a guide, about 10,000m^3 would be needed to create a berm along the 1km of eroding shoreline in Rowes Bay. This would be a minimum sized berm that should be able to accommodate the generally low energy day-to-day wave processes and occasional king tide event. However, longshore drift process would continue to slowly redistribute this sand mainly northwards, and a high-energy cyclone event would still be likely to cause considerable damage.

5.3 One Mile Creek mouth

Longshore drift has continued to carry sand southwards across the mouth of One Mile Creek, and a large volume of sand has now accumulated here. The creek mouth is completely blocked-off, and sand has accumulated in a berm landform on the beach face in front of the Rowes Bay Caravan Park. A total of about 4800m^3 has built up here, an increase of 2800m^3 since January. Most of this sand has probably come from the renourishment area as it appears to have similar size characteristics. It is possible that a large proportion of this sand was moved here during the August king tide erosion event.

6. Beach observations October 1999

By early October 1999, seven weeks after the erosion event, the beach had begun to slowly recover. A profile measured at the worst affected site T31.7, showed that about 20cm of sand had built up over the upper half of the beach face. This amounted to an increase of ~1.3m^3, which is about 25% of the sand that had been eroded from this part of the profile.

A profile was also measured at site T32 that is about 115m north of the renourishment area. There was no evidence of any beach erosion; rather this site showed a small increase in sand volume. This indicates that a small amount of sand may have been moved north out of the renourishment zone by longshore drift processes.

7. The influence of “king tides”

Erosion of the renourishment area has occurred on two occasions in 1999, early January, and early August. On both occasions this was associated with a period of king tides.

The term “King tides” is a non-scientific term, but it generally refers to higher than usual high tides that occur around Christmas. In Townsville king tides typically reach higher than 3.5m above chart datum, with the highest ever tides reaching 4.01m. These heights compare with the average high tide elevation of 3.07m. From the tide charts, it can be seen that these tides occur on several occasions throughout the

year. In 1999 57 king tides will occur in 14 groups (ie more than once per month). In the wet season these tides occur on the morning between 7am – 11am, while in the dry season they occur at night between 8pm – 11pm.

Beach erosion does not happen on every king tide as there needs to be appreciable wave action at the same time for damage to occur. In most cases local winds will generate waves inside Cleveland Bay, and these are usually quite small and unlikely to be highly erosive. However, if there have been several preceding days of strong southeasterly winds, larger swell waves may develop along the coast and enter Cleveland Bay. These are likely to cause more erosion of the beach face and scarp. The August erosion event may have been more severe due to the influence of southeasterly-generated swell waves.

8. Summary

The monitoring of the Rowes Bay Renourishment project in April 1999 showed the beach in very good condition. The wet season had been a mild one for the foreshore as there had been no cyclone activity, and few heavy rainfall events. The main influences on the site were the king tides of early January that caused a small amount of erosion of the scarp. The beach face generally accumulated a small volume of sand, and a healthy berm feature developed around site T30.

Throughout the early part of the dry season occasional beach observations showed little change to the foreshore, although some sand did drift south towards the mouth of One Mile Creek.

In early August an erosion event during a period of king tides removed a significant volume of sand from the beach face and erosion scarp. About 25% (4108m^3) of the initial renourishment volume was lost from the foreshore. Over half of this (2800m^3) appears to have been moved south across the mouth of One Mile Creek and so has not been entirely lost from the system.

Although the erosion event appears serious, it should be noted that natural wave processes have already begun to repair the damage. It is also apparent that the sand lost from the beach face and scarp has not been lost from the entire system as an equivalent volume of sand has accumulated at the mouth of One Mile Creek

9. Recommendations

1. The 4800m^3 of sand that has accumulated around the mouth of One Mile Creek should be returned to the renourishment area and placed along the top of the beach face.
2. Consideration should be given to the construction of a berm feature at the top of the beach face (at about ~4m above chart datum) along the whole renourishment area. This would require at least another 10,000m^3 of sand, and would be a good start towards creating a more self-sustaining beach system in this area. This extra volume of sand should be over and above the sand obtained from One Mile Creek.
3. Monitoring of beach behaviour after the August event should continue.

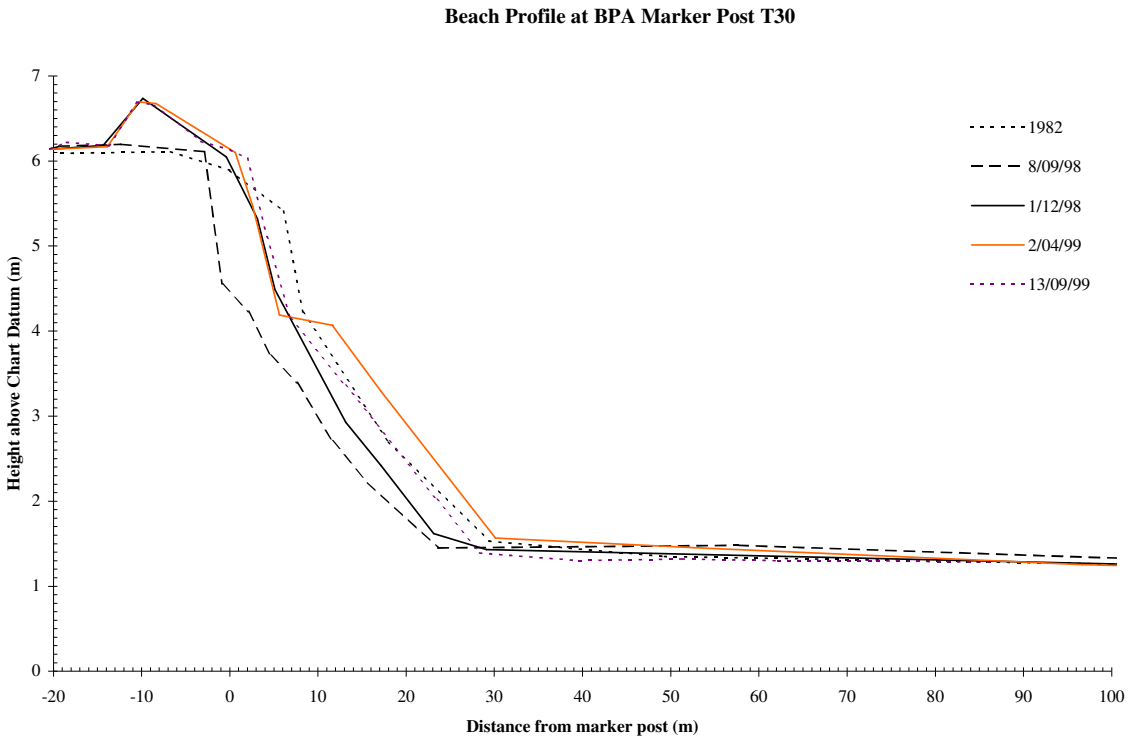

Figure 1 Shoreline Profile at Marker Point T30

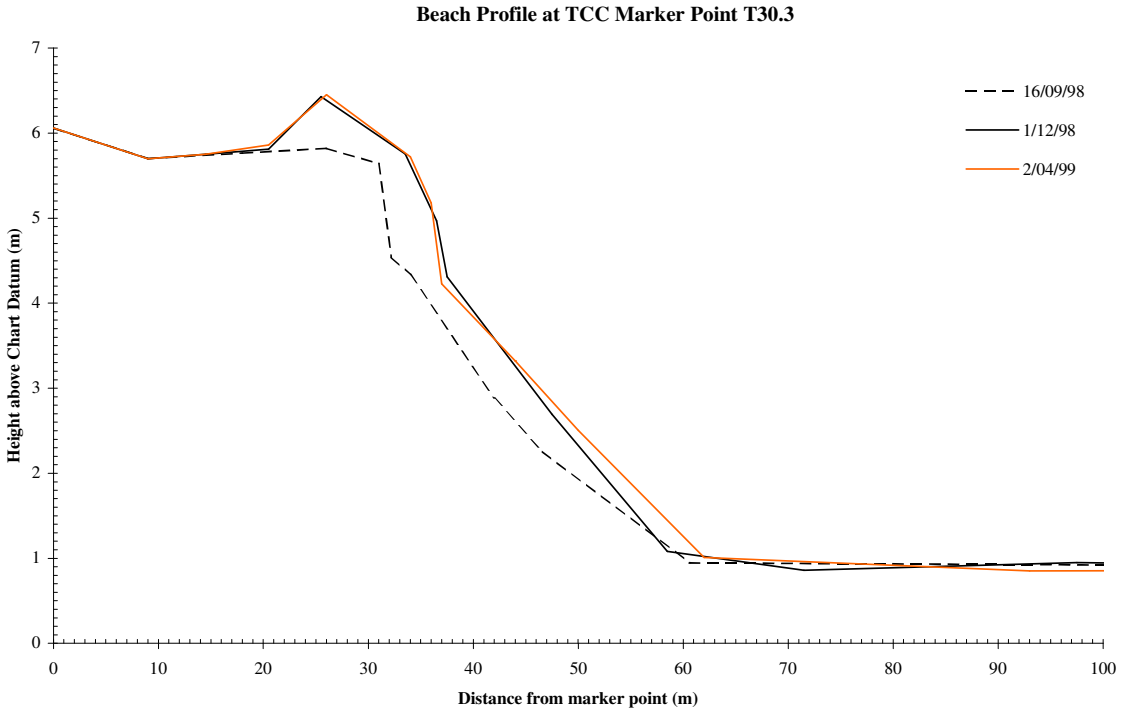

Figure 2 Shoreline Profile at Marker Point T30.3

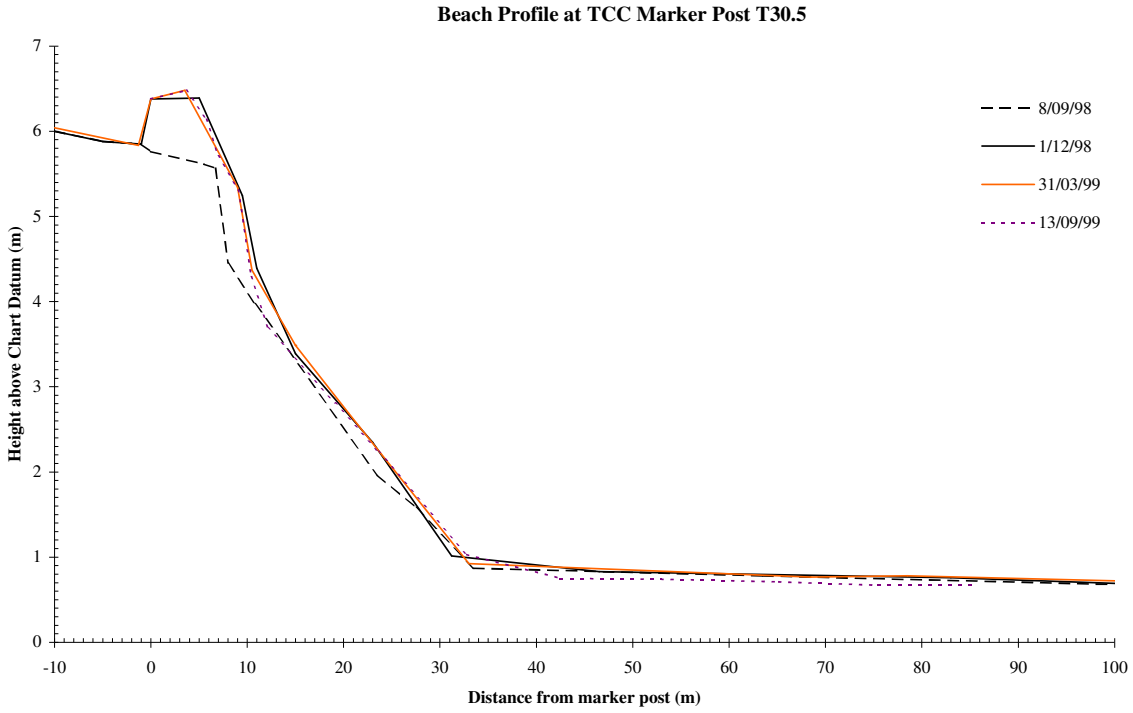

Figure 3 Shoreline Profile at Marker Post T30.5

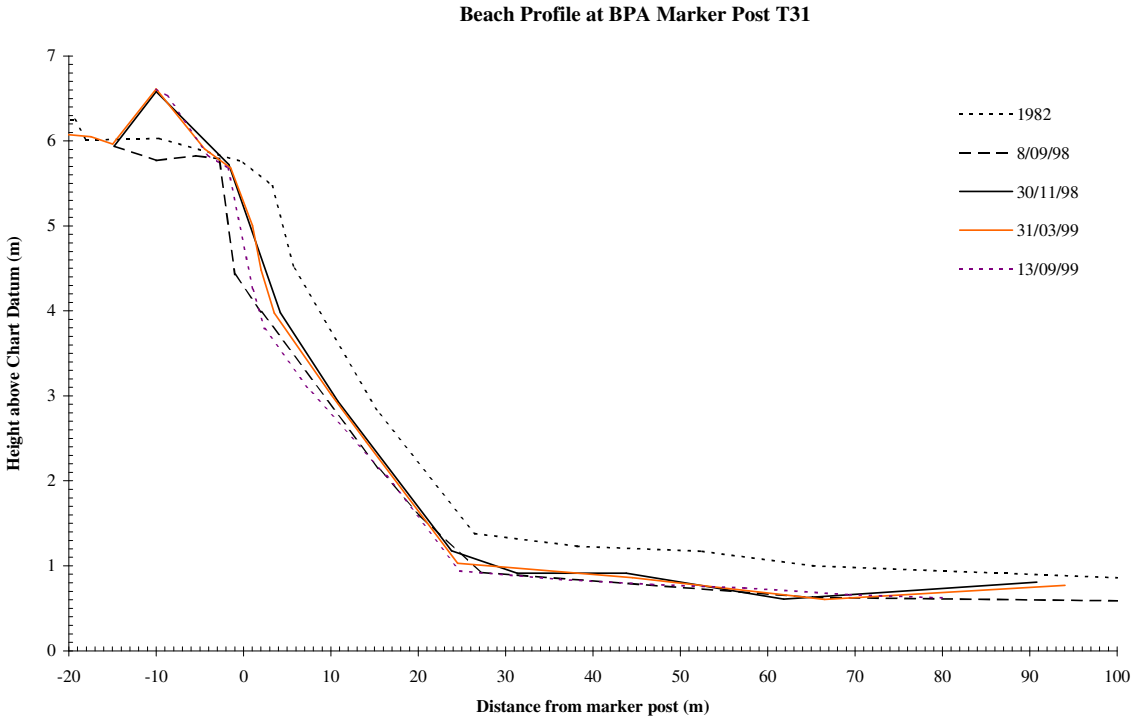

Figure 4 Shoreline Profile at Marker Post T31

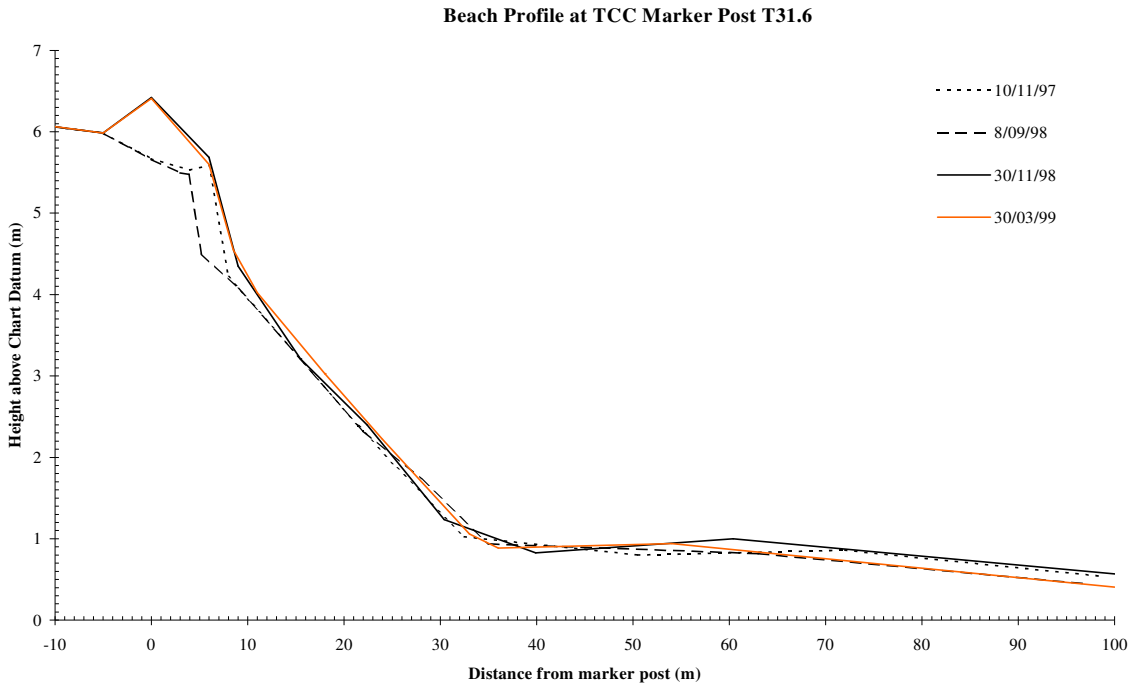

Figure 5 Shoreline Profile at Marker Post T31.6

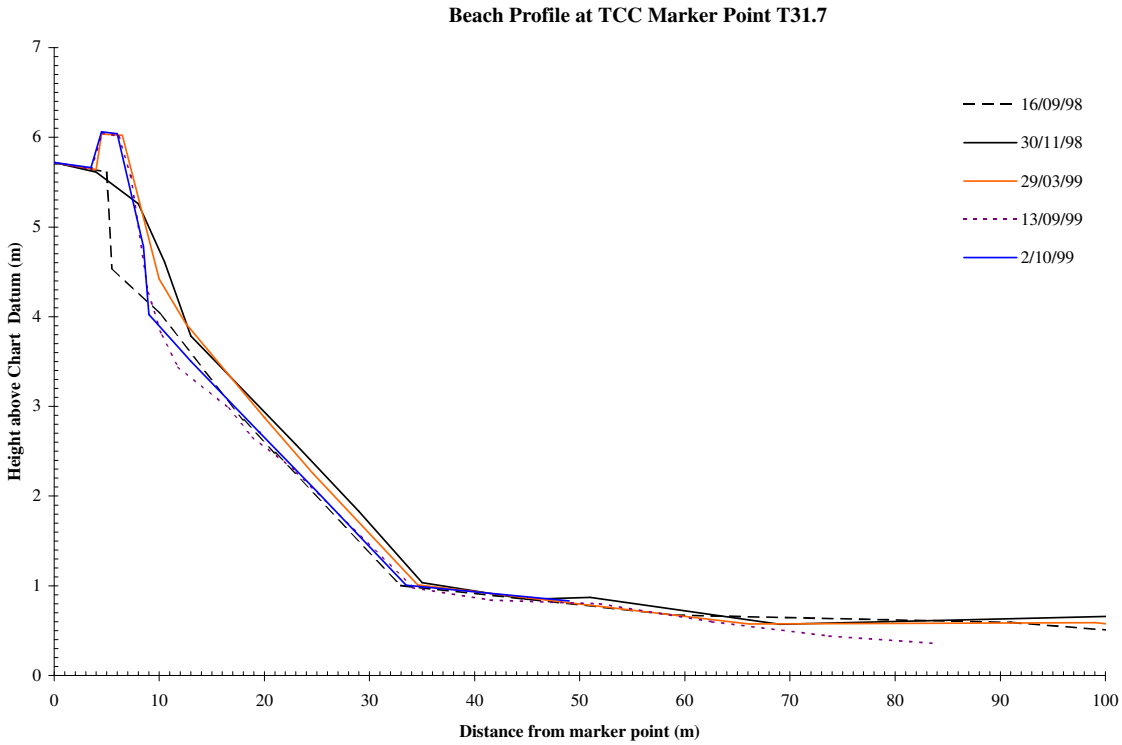

Figure 6 Shoreline Profile at Marker Point T31.7

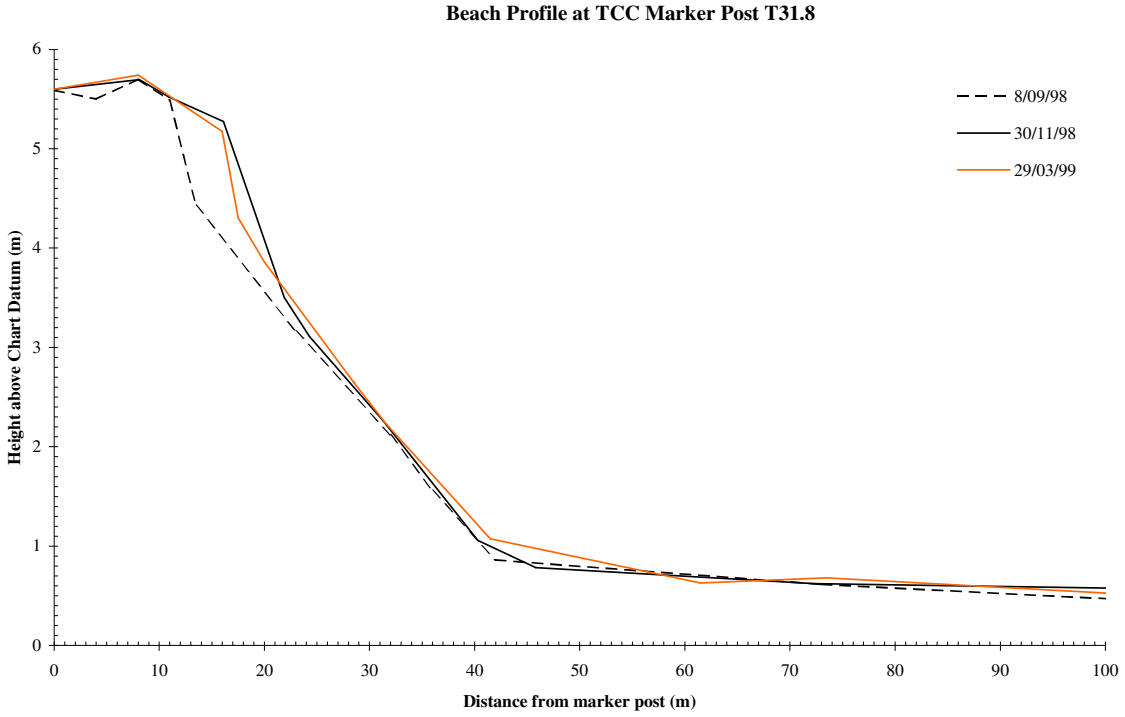

Figure 7 Shoreline Profile at Marker Post T31.8

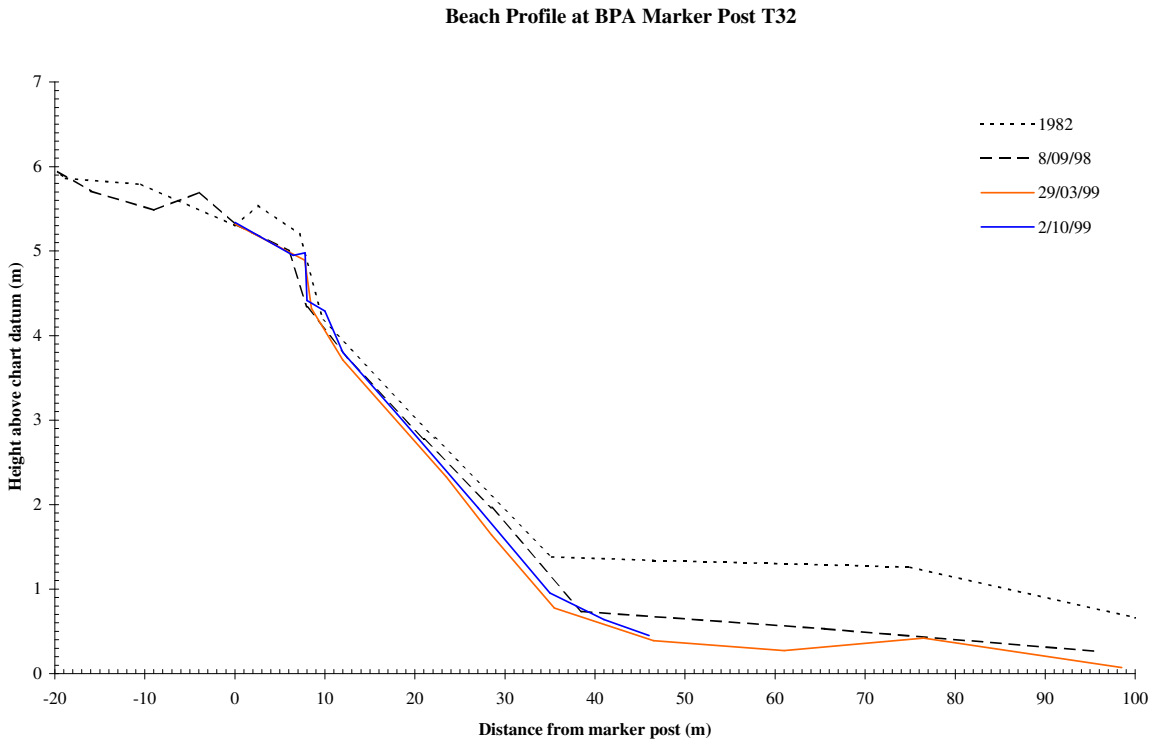

Figure 8 Shoreline Profile at Marker Point T32

APPENDIX: Beach profile data

Distance	*Height*
T30	2/4/99
-20.37	6.14
-13.87	6.17
-10.37	6.70
-8.37	6.68
0.63	6.1
2.63	5.46
5.63	4.19
11.63	4.07
11.63	4.07
17.13	3.30
30.13	1.57
52.63	1.46
96.63	1.26
162.13	1.09
T30	13/9/99
-20.37	6.14
-18.5	6.22
-13.71	6.18
-10.5	6.69
-8.52	6.66
-3.26	6.23
0.07	6.13
2.01	6.03
4.23	5.11
6.88	4.15
13.13	3.36
23.49	2.02
28.35	1.39
39.6	1.3
51.34	1.32
62.16	1.3
73.41	1.3
86.15	1.28
T30.3	2/4/99
0	6.06
9	5.7
14.5	5.75
20.5	5.86
26	6.45
34	5.72
36	5.18
37	4.23
44	3.32
50	2.51
62	1.01
93	0.85
109	0.86
146	0.88

Distance	*Height*
T30.5	31/03/99
-10	6.04
-1.3	5.84
0	6.38
3.5	6.48
9	5.34
10.5	4.37
15	3.49
20.5	2.69
33	0.93
68.5	0.77
78.5	0.78
108.5	0.70
T31	
T30.5	13/09/99
0	6.38
3.67	6.48
5.78	6.14
6.99	5.71
9.09	5.31
10.42	4.29
12.16	3.69
19.11	2.81
23.61	2.24
32.79	1.03
42.5	0.75
52.95	0.74
65.16	0.71
75.48	0.67
85.56	0.67
T31	31/03/99
-23.98	6.11
-17.48	6.05
-14.98	5.97
-9.98	6.61
-4.48	5.91
-1.48	5.68
1.02	5.01
2.02	4.48
3.52	3.98
10.02	3.02
14.02	2.46
24.52	1.03
44.52	0.86
66.52	0.61
94.02	0.77

Distance	*Height*
T31	13/09/99
-9.98	6.61
-8.74	6.53
-4.04	5.83
-1.76	5.68
1.08	4.25
2.41	3.79
7.77	3.04
16.36	2.06
24.77	0.94
36.19	0.84
46.76	0.78
57.37	0.74
69.35	
80.71	0.62
T31.6	30/03/99
-14	5.98
-10	6.07
-5	5.99
0	6.41
6	5.6
8.5	4.55
11	4.03
18	3.03
18	3.03
24	2.23
33	1.06
36	0.89
54	0.94
100	0.41
T31.7	29/03/99
0	5.72
4	5.64
4.5	6.04
6.5	6.02
10	4.42
12.5	3.93
20	2.88
24.6	2.26
34.6	1.01
66.1	0.58
99.1	0.59
116.6	0.37

Distance	*Height*
T31.7	13/09/99
0	5.72
3.53	5.64
4.58	6.05
6.16	6.01
7.28	5.57
8.94	4.27
10.25	3.79
11.81	3.44
16.58	2.98
18.87	2.66
23.05	2.27
34.1	0.98
41.5	0.84
51.9	0.8
62.58	0.6
73.74	0.44
83.56	0.36
T31.7	2/10/99
0	5.72
3.5	5.66
4.5	6.06
6	6.04
8.5	4.78
9	4.03
13	3.51
19.5	2.71
25	2.05
33.5	1.01
49	0.83
T31.8	29/03/99
0	5.6
8	5.74
16	5.18
17.5	4.31
20	3.86
28.5	2.65
28.5	2.65
31.5	2.24
41.5	1.08
61.5	0.63
73.5	0.68
111.5	0.46

Distance	*Height*
T32	29/03/99
0	5.32
7.75	4.89
8.5	4.32
12	3.71
23.5	2.33
28.5	1.64
35.5	0.78
46.5	0.39
61	0.27
76.5	0.42
98.5	0.07

T32	2/10/99
0	5.34
6.5	4.95
7.8	4.98
8	4.42
10	4.29
12	3.8
18	3.08
27	1.97
35	0.96
41	0.64
46	0.45