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Tonkin and Taylor Ltd



TAFATAFA BEACH SHORELINE ANALYSIS

Aerial photographs were obtained for Tafatafa from MNRE Technical Services for 1954 (1:18,000 scale) and 1999 (1:10,000 scale). Additional satellite imagery was obtained from DigitalGlobe for 2004, 2010 and 2014. This imagery was georeferenced to a consistent geographical location using geological and anthropogenic control such as rock outcrops, bridges and houses. Shorelines were then digitised using the vegetation-front as indicator, this being normal practice when using such data for shoreline analysis. Allowance was made for overhanging vegetation by interpolating between adjacent overhang-free locations. Other short-term irregularities were removed by shoreline smoothing across 50 m in the longshore direction. The detected shoreline accuracy (including georeferencing errors) is estimated to range between +/- 2 m and +/- 5 m. Historical imagery with superimposed digitised shorelines are overlaid upon the May 2014 satellite image in Figure 1. The measurement transects are marked 1 to 7, these sites being chosen to represent variation in coastal setting observed to occur within the area of interest. The shoreline time-series are depicted in the 7 graphs shown in Figure 2. Note these graphs all have the same horizontal and vertical scales enabling direct comparison when inspecting. The rate of change analysis (average annual change) for the 1954 to 2014 period, and also for the more recent 1999 to 2014 period, were determined using linear regression modelling. The derived values for each site, together with the corresponding net shoreline change distance for the two time spans, are listed in Table 1. The probability of the derived rates of change being statistically valid (80% likelihood) were calculated and are identified by the green highlighting in Table 1.

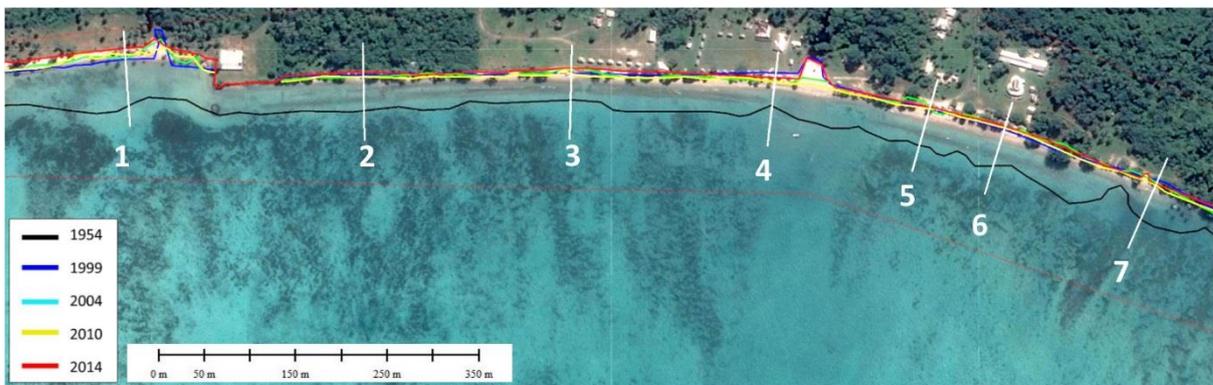


Figure 1 Historical shorelines overlaid upon the May 2014 satellite image. White lines locate measurement transects for Sites 1 to 7.

The results show that this coast is dominated in the longer-term (1954 to 2014) by systematic shoreline retreat with the highest erosion value occurring at the western end: 61 m at Section 1. The remaining 6 sites to the east have shoreline retreat values ranging between 34.8 m and 46.2 m. A marginally significant longshore trend is evident ($p = 0.21$) with retreat increasing from east to west. The more recent analysis (1999 to 2014) produced 5 erosional and 2 accretional results ranging from -12.3 m at Site 1 to +4.1 m at Site 7; however, the green highlighting in Table 1 shows that only the Site 1 value is statistically significant. This result is expected as since 1999, Site 1 has been in the lee of a seawall (and until 2010 there was also a groyne at its western end); these structures would be expected to induce erosion on the downdrift (western) beach. The larger

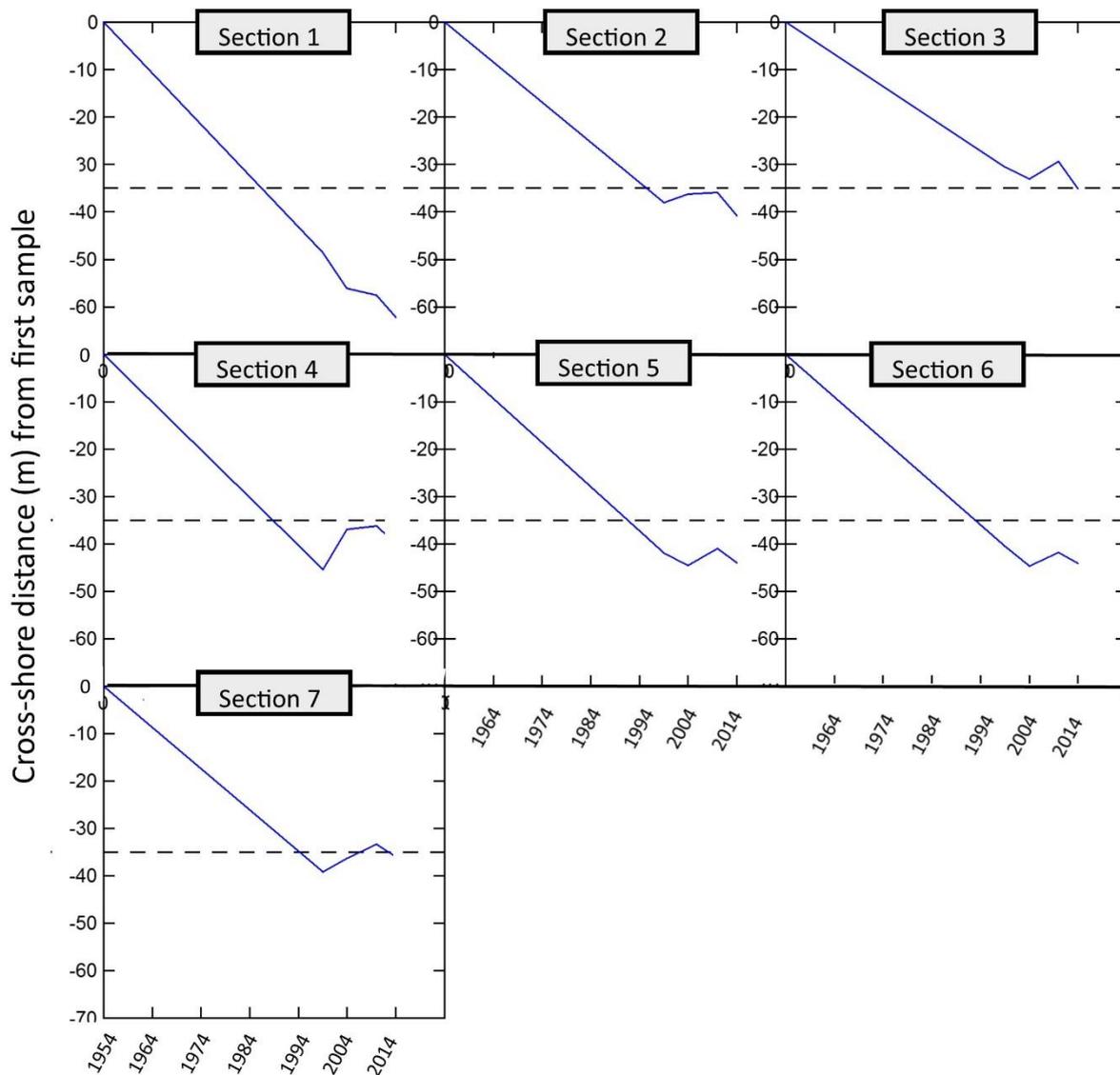


Figure 2 Shoreline time-series for the 7 sectional transects marked in Figure 1. The distance and time origins are from the first (1954) sample. Negative values relate to erosion (shoreline retreat) and positive to accretion (shoreline advance).

erosion value for Site 1 in the longer-term data sets (1954 to 2014) therefore appears to result from anthropogenic causes. If Site 1 is removed from the longshore analysis the trend (from linear regression analysis) actually reverses and is highly insignificant. Inspection of the imagery suggests that the longer-term variations between the Site 2 to 7 data may result from the distribution of beach rock locally modifying the wave regime (which drives the shoreline processes).

Table 1 Shoreline net change and average annual (rate of) change for the 7 measurement sites at Tafatafa

Section	1954 to 2014		1999 to 2014	
	Net Change (m)	Rate (m/yr)	Net Change (m)	Rate (m/yr)
1	-66.0	-1.10	-12.3	-0.82
2	-40.8	-0.68	-2.1	-0.14
3	-34.8	-0.58	-2.6	-0.17
4	-41.4	-0.69	+5.4	+0.36
5	-46.2	-0.77	-0.5	-0.03
6	-46.2	-0.77	-2.1	-0.14
7	-37.8	-0.63	+4.1	+0.27

Note: Green highlight refers to statistically significant rates of change at the 80% level, i.e. $p < 0.2$.

Roger Shand
Coastal Scientist