REPORT

HAWKE'S BAY REGIONAL COUNCIL

Revised Hazard Zone Determination for Northern and Southern Hawke's Bay Beaches

Report prepared for:

HAWKE'S BAY REGIONAL COUNCIL

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Table of contents

1 Introduction

Hawke's Bay Regional Council (HBRC) commissioned Tonkin & Taylor Ltd (T&T) to complete a coastal hazard assessment for the entire Hawke's Bay region using existing published data and information. The regional coastal hazard assessment and mapping was completed in February 2004. The report identified that there was little data/information for the northern and southern beaches of the region.

Southern beaches included: Kairakau, Mangakuri, Aramoana, Pourerere and Blackhead. Northern beaches included: Opoutama, Mahia and Mahanga.

Setback distances for the southern beaches were calculated in the 2004 report using profile data collected from Waimarama Beach further north, assuming similar beach behaviour.

Since the completion of the coastal hazard assessment, additional data has become available that can be used to re-evaluate set back distances for the northern and southern Hawke's Bay beaches. The additional information was combined with site visits and meetings with local property owners along the southern beaches to obtain anecdotal and historic information.

This report sets out the investigations and analysis of the additional data and the outcomes of the re-appraised hazard assessment based on new, site specific information and data.

1.1 Scope of works

The scope of works for this site specific hazard assessment included the collation, review and analysis of new, site specific data and then using this data to evaluate the coastal hazard erosion risks using the same methodology as used for the original hazard assessment.

Additional information for northern beaches included:

- recent aerial photography
- historical aerial photographs of Opoutama.

New information for southern beaches included:

- LiDAR (Aerial surveying techniques)
- historic aerial photography
- offshore bathymetry and habitats
- side scan sonar
- beach profile data
- public consultation for historic data and anecdotal information
- additional site visits.

2 Northern Hawke's Bay beaches

2.1 Summary of new information

Little new information for the northern beaches has become available since the completion of the hazard assessment. New information consists of recent aerial photography of the Opoutama, Mahia Beach and Mahanga Beach areas and historical (1950's) aerial photo of the Opoutama area.

Shoreline change summary for Opoutama Beach is included in Table A3 (Appendix A).

2.2 Assessment

Because of a lack of new information set back distances for the northern beaches remain unchanged.

3 Southern Hawke's Bay beaches

3.1 Summary of new information

Since the completion of the coastal hazard assessment, additional data has become available to better assess set back distances for the southern Hawke's Bay beaches. The data contained below has been derived from a number of sources.

While this new data has increased our knowledge base, continued data collection should continue to enable revision of hazards in the future.

3.1.1 LiDAR

Hawke's Bay Regional Council commissioned a LiDAR (Light Detection And Ranging) Survey between 26th July and 2nd July 2003. LiDAR produces points approximately 1.8 m apart containing horizontal and vertical (x,y,z) data. From this data a DEM (Digital Elevation Model) is produced in GIS to visualise and analyse topography (terrain). The accuracy of the x,y,z data is < 0.55m in the horizontal (x,y) and between 0.11 m and 0.15 m in the vertical (z).

The survey covered the beach areas of Blackhead, Aramoana, Pourerere, Mangakuri and Kairakau beaches.

3.1.2 Historical aerial photography

Aerial photography from the 1950's from New Zealand Aerial Mapping (NZAM) enabled comparison of shoreline position with aerial photographs from the 1990's.

3.1.3 Habitat mapping surveys (off Shore bathymetry, side scan sonar and video)

The Department of Conservation East Hawke's Bay Conservancy commissioned habitat mapping of two areas along the southern Hawke's Bay coastline. The mapping identifies sub tidal marine habitats within existing and proposed marine reserve areas. The surveys conducted by ASR (2004) and NIWA (2005) included the offshore areas of Blackhead, Aramoana, Mangakuri (northern extent) and Kairakau Beach.

The surveys by ASR off shore of Mangakuri and Kairakau consisted of bathymetry and a drop camera survey. Offshore of Blackhead and Aramoana NIWA conducted bathymetry, video drop camera and side scan sonar.

Habitat mapping enabled identification of any offshore features (reefs, sand and rocks etc) that may affect local coastal processes particularly wave processes and sediment transport. Offshore bathymetry data allowed determination of the offshore profile for Bruun rule calculations.

3.1.4 Beach profile data

Beach profile transects have been established at Blackhead, Aramoana, Pourerere, Mangakuri and Kairakau since the regional hazard assessment. The initial surveys were completed in January 2005 and ongoing surveys have been carried out at 2 month intervals. Of note is the capture of the effects of 2 major storm (wave) events that struck the East Coast on 17 March and 16 June 2005.

3.1.5 Public consultation (anecdotal evidence)

Since the publication of hazard zones along the Southern Hawke's Bay several property owners have questioned the position of setback zones. Of main concern was the use of data from Waimarama beach profiles to determine set back distances of the southern beaches. Public perception indicated that coastal processes at Waimarama did not reflect local coastal processes.

Site visits and meetings with local property owners at Blackhead, Pourerere, Mangakuri and Kairakau on 23 August 2005 provided more information on individual beaches. Much of the information was anecdotal and of a historical nature, such as photographs.

3.1.6 Addendum to Shoal Beach Subdivision – Assessment of Beach Erosion Risk, OPUS International Consultants.

The OPUS document queries the shoreline accretion rates and inundation levels at Aramoana. Section 3.4.4 of this report addresses shoreline accretion and long term shoreline movement rates.

Wave setup, wave run up and sea level rise parameters used in determining inundation levels have been questioned and refined for Aramoana by OPUS.

A 0.35 m wave set up was calculated by OPUS using Coastal and River Engineering Support System (CRESS) software. The equations used a 5.4 m wave and 10.4 sec period. It is unsure how this number for wave set up was derived. If using the correct equation/procedure from CRESS online manual, the wave set up equation for a regular wave is stated as:

Wave set-down at the breaking point (for regular waves):

$$n_b = -\frac{1}{16} \cdot \gamma \cdot H_b$$

Equation 1

Maximum wave set-up (for regular waves):

$$n_{max} = \frac{5}{16} \cdot \gamma \cdot H_b = -5 \cdot n_b$$

Equation 2

With:

$$\gamma = \frac{H_b}{d_b}$$

Equation 3

In which:

- db = water depth at location of the breaking point of the waves = 5.4/0.78 = 6.9 [m]
- Hb = wave height before reaching the breaking point of the waves = 5.4 [m]
- nb = wave set-down at the breaking point [m]
- γ = breaker index = Hb/db = 0.78

Using Equation 2 maximum wave set up (for regular waves) using a 5.4 m wave with 10.4 peak period equals 1.31 m. This set up figure compares well with the wave set up height of 1.41m derived in the initial Tonkin and Taylor assessment.

A wave run up estimate of 1.9 m by OPUS for a 5.4 m wave using run up equations by Mase (1989) in the Coastal Engineering Manual (CEM) does not state which formulae was used. The CEM offers wave run up equations for Max, 2% exceedance, 1/10, 1/3 and mean run up distributions. Therefore, direct comparison with Tonkin and Taylor values cannot be under taken.

OPUS also assumes an offshore reef which dissipates much of the wave energy and bases their run up figures on waves reforming at half the original height. However, the extent of the offshore reef and influence on wave dissipation is unknown. Therefore the assumption that wave height over the reef is approximately halved should not be used.

3.1.7 Critique of Regional Coastal Hazard Assessment Report – Michael Smith

Mr Smith's report focuses on long term and short term erosion rates and application of Waimarama data to southern Hawke's Bay beaches, specifically Mangakuri. The application of long term and short term parameters is discussed in section 3.4 of this report. The applicability of using central Hawke's Bay data for southern Hawke's bay beaches is also discussed in section 3.4.

Mr. M Smith provided a critic of the coastal hazard assessment report. A copy of his issues are included in Appendix D. His key concerns include:

- the use of data from Waimarama profiles to represent beach fluctuation at Mangakuri
- the conservative statistical approach providing a return period of greater than 1 in 11,300 years
- the use of additional factors of safety
- the applicability of the Bruun Rule and it not taking into account sediment supply or accretion.
- conservative storm surge of 0.9 m
- overestimation of wave run-up.

3.1.7.1 Waimarama Beach profile use

As discussed in Section 3.4.1, the profile data available at Mangakuri suggests similar orders of magnitude of fluctuation to those at Waimarama and no compelling justification to alter the original findings. We also note that the average movement of profiles at Waimarama was used, rather than the maximum. In our view this is a moderate, not over-conservative approach, recognising there may be larger fluctuations at Waimarama due to the lack of reef edge.

3.1.7.2 Statistical approach

Mr Smith relies heavily on detailed statistical analysis to evaluate a return period of shoreline movement. In our opinion, the application of pure statistics is not meaningful as there is limited information to base statistics. We are also aware that various climate shift factors also affect beach movements and that these beach movements cannot be estimated without a longer data set.

We have used statistics as a tool to determine likely fluctuations in beach profile in support of our coastal engineering judgement. A comparison of the observed fluctuations at Waimarama and other Hawke Bay beaches shows that the orders of magnitude fluctuations do occur around the MHWS mark.

That said, Mr Smith is correct that the 740 year return period event required to create 42 m erosion is statistically correct based on 3 standard deviations. However, when evaluating risk, it is important to understand the relationship of the risk of encountering an extreme event during the period of concern, which in this case is the 100 year planning period used for the hazard assessment.

The risk of a 1%AEP event occurring during a 100 year period is 63% and there is around a 40% risk of the same event occurring during a 50 year period. This means that a 1% AEP event is more likely than not to occur during the 100 year design period. To ensure that there was only a 1% chance of the extreme event occurring during the planning life (i.e. the design risk), would require consideration of an extreme event with a probability of occurrence of around 0.011%AEP (a return period of around 9,435 years). The Dutch commonly design for a 10% risk of an event occurring during the design life of a structure. In this instance the return period event is around 0.11%AEP or around a 943 year return period event. This exercise illustrates the need to provide a precautionary approach in the evaluation of hazards, due to the probability of the design event and more extreme events, occurring during the 100 year planning period (even excluding for climate change and sea level rise effects).

3.1.7.3 Additional factors of safety

The 1.25 factor of safety was not applied to the southern Hawke Bay beaches. This was a judgement call based on the potential benefits of the nearshore reef edge that was assumed to be present along the southern beaches. No other additional factors of safety were applied to those used on the Hawke's Bay beaches.

3.1.7.4 Bruun Rule

The use of the Bruun rule is commonly used, although there is also criticism as to its applicability. However, the latest publication from Erosion (2004), a European Union collective providing advice on coastal erosion, confirms the continuing applicability of this rule.

The identified limitations of Mr Smith in terms of shoreline change and sediment supply have been assessed. Historic accretion has been taken into account by the location of the hazard line origin at the edge of the current beach vegetation line. The assumption has been made that there is a balance in longshore sediment supply, with the same volume entering the system as there is leaving. In this case there is no additional modification required to the Bruun Rule.

We have not included tectonic effects, or adjustments for historic sea level rise. We believe this to be a conservative approach which is why there is no additional factor of safety included in our hazard zone width.

A key point which we agree with, is that the Bruun Rule assumes a sandy backshore. In areas where there is more competent material the Bruun Rule obviously is not applicable. This is one of the reasons we included the provision for site specific assessments. If geotechnical evidence (scala, borehole, augers, etc) show that the land within the hazard area is of a more competent nature (i.e. rock, etc), then the extent of shoreline change due to sea level rise effects could be reduced.

3.1.7.5 Conservative storm surge factor

We accept that the storm surge factor of 0.9 m may appear conservative. However, recent analysis of the Port of Napier data by Worley, as reported by Paul Komar (2004) identified a storm surge residual of 0.93 m for a 2%AEP event and 0.95 m for a 1% AEP event. Adding this value to MHWS may be conservative as the surge may not occur at MHWS. However, the Monte Carlo simulation approach by Worley suggested a 1%AEP water level of 0.16 m lower than occurs when 0.9 m is added to MHWS.

We note that our wave height used in combination with storm surge was not extreme. It was based on computer modelling which generally under-predicts extreme wave heights. This is confirmed by recent measurements of wave height at the port gauge, which recoded significant wave heights of 4.7m and 4.2 m during two storms on 03/04/2002 and 17/03/2005. These wave heights are higher than the 4.1 m wave height used to assess run-up levels off HB12, just south of the port. Based on an extreme value analysis of waves as measured by the Port of Napier buoy (reported in Komar, 2004), the 4.1 m significant wave height has a return period of 2 years, while a 50 year return period wave height has a height of 5.94 m. Therefore, using the 4.1 m to evaluate wave run-up and set-up is not conservative, but in combination with the storm surge provides a level in the correct order of magnitude for this hazard assessment, but possibly under conservative.

3.1.7.6 Wave run-up

As discussed in section 4.5 above, we do not believe the inundation levels are over conservative. We note that Mr Smith used the run-up formula correctly but applied a flatter beach slope than is required for the assessment of wave run-up. For run-up we need to consider the steeper beach face, typically from MHWS or the dune toe to the beach crest as this is the slope of the face the waves are running up against, as opposed to set-up where the slope within the intertidal/surf zone is more appropriate. At Mangakuri the slope from MHWS to the dune crest based on the new beach profile data is around 30:1 and the slope from the dune toe to the dune crest steeper still. Using this steeper slope provides run-up levels of 0.6 m. This is similar to the value of 0.7 m used in the 2002 hazard assessment. Based on the likely non-conservative wave heights used to assess run-up, we do not believe the run-up values should be decreased from those reported. We note that Council is instigating a new programme to include wave run-up assessments on all beaches being monitored and this will provide useful data on run-up levels.

3.2 Methodology to determine hazard zone widths

As set out in the regional hazard assessment (T&T, 2004), the methodology to delineate coastal hazard areas included an assessment of erosion and inundation hazards for the current situation and taking into account future climate change to 2100. Setback distances were therefore calculated for the current situation (CERZ), for climate change to 2060 (2060 ERZ) and to 2100 (2100 ERZ).

Setback widths were determined by summing the expected landward retreat that could be expected from the main processes affecting beach stability. In simple terms the key processes can be characterised by the following equation:

Hz = ST+SE+DS+SL+LT

Where:

Hz = is the width of the hazard zone (m)

ST = Horizontal short-term fluctuations (m), equal to two times the standard deviation of annual shoreline movement at each profile measured 1.0 m above MSL (taken to be equivalent to MHWS of 11 m above HBRC datum)

SE = the shoreline response to Storm Erosion (m), equal to the standard deviation of annual shoreline movement at each profile measured at 1.0 m above MSL

DS = distance from 1.0 m above MSL (i.e. 11 m above HBRC Datum) to the active dune/beach crest, effectively providing the width of the existing sub-aerial beach which is assumed to remain constant in width even with ongoing shoreline retreat

SL = the magnitude of shoreline retreat (m) due to possible accelerated sea level rise based on the Bruun Rule approach excluding allowance for local relative sea level rise change due to tectonic activity

LT = the long term rate of horizontal shoreline movement (m/year) taking into account abrasion, cross-shore and longshore losses based on the greater of the long term trend of beach profile data or inferred by expert judgement from aerial photographs (where available).

To provide sufficient time scale for planning and accommodating development a 100-year planning horizon has been considered. For long-term consistency the year 2100 was used as the actual terminal date of the analysis.

To provide a delineation of risk three hazard lines were derived as set out below:

Current Erosion Risk Zone (CERZ): This zone includes those areas that are subject to storm erosion, short-term fluctuations, and dune instability (eg, (SE+ST)*1.25+LT (10) +DS). This area includes all the land presently at risk from shoreline change erosion, with a factor of safety of 1.25 applied to the short term fluctuation. An allowance of ten years of erosion trend (LT(10)) was also applied to take into account the long term trend associated with adjacent cliff retreat rates.

2060 Erosion Risk Zone (2060ERZ): This zone includes the CERZ and additional areas that are predicted to be subject to shoreline movements due to the long term rate of erosion and SLR to the year 2060. This provides councils with assistance in terms of Building Act reviews.

2100 Erosion Risk Zone (2100ERZ): This zone includes the CERZ and those areas predicted to be affected by shoreline movements due to both the long-term rate of erosion and SLR from 2060 to 2100.

3.3 Geomorphology of southern Hawke's Bay beaches

The geomorphology of the southern Hawke's Bay beaches is very similar. Each beach is bounded landward by a very steep cliff; a low vegetated dune exists in front of the cliff then a low sloping beach face. Seaward of the beach is either a wave cut shore platform or a gently sloping profile of sand sediments.

Figures C1 – C4 (Appendix C) show onshore (LiDAR) and offshore (Bathymetry) beach profile data.

Unmeasured portions of beach profile, generally from about 10 m to 5 m RL (which is from around Mean Sea Level to 4 m metres below Chart Datum) for the four measured beaches.

A continuation of the beach profile from the landward end of the offshore profile suggests that the beach slope may continue to the seaward extent of the LiDAR data. Therefore, an assumption that the beach profile is consistent with a profile where cross shore exchange of sand occurs could be made.

However should there be a rock shore platform, this may impede cross shore exchange of sediment with sediment moving off shore, but not able to return onshore due to sharp elevation change of the shore platform. In this situation a net loss of sediment from the beach system could occur. The extent of any shore platform (if present) is unable to be quantified due to lack of data.

Navigational hazards (shallow water depth near shore and submerged rocks) are an impediment to near shore bathymetry survey. Future remote sensing rtechniq

Grain size analysis of beach sand samples taken at approximately 3/4 tide elevation on 23 August 2005 are shown in Table 3-1. Samples were dry sieved and statistics obtained using 'method of moments' analysis. The similarity of grain sizes between all of the southern beaches indicates a similarity in wave energy reaching the beach profile. This similarity in grain size can also indicate similar sources of sediment for the beaches and similar transport pathways.

Table 3-1 Grain size for southern beaches

	Blackhead	**Aramoana**	**Pourerere South**	**Mangakuri**	**Kairakau**
Mean (phi)	2.33	2.25	2.28	2.33	2.21
Mean(mm)	0.18	0.20	0.19	0.18	0.20
SD	0.37	0.36	0.32	0.37	0.49

There is very little sand buffer protection from the low lying dunes or vegetated back shore area. This lack of fore dune suggest that the sand budget is either very small and there is no excess sand to form dunes or the low lying areas have historically been prone to inundation and erosion.

Vegetation of the low lying dune/backshore area is a contributing factor to the shoreline building phase experienced over the last few decades. This increase in dune/backshore width has increased the buffer against coastal erosion and inundation. Although the buffer has increased, there is still risk from erosion and inundation. Active dune management through community groups should be promoted.

Although some areas, mainly near the controlling northern and southern headlands have some protection due to the shore platform, the centre areas of the beaches have little or no protection from easterly storms. The unprotected areas are the controlling factor in determining risk to coastal hazards for the beach, in keeping with the regional scale of the hazard zones assessment.

The following sections provide an added description for beaches visited on 23 August 2005.

3.3.1 Blackhead Beach

Blackhead beach is typical of the southern beaches with controlling north and south shore platforms, unprotected centre beach and low lying vegetated dune/backshore area. Three small streams flow onto the beach face. A meandering stream is located towards the southern end of the beach. This stream can cause a cut back of the low lying dune during rain events. Local property owners redirect the stream when cut back occurs.

3.3.2 Aramoana Beach

Slightly larger than Blackhead beach, Aramoana exhibits similar features to Blackhead with an exposed centre area and controlling north and south shore platform and low lying vegetated dune. A significant feature is a stream in the centre of the beach which can meanders along the beach face.

3.3.3 Pourerere Beach

Pourerere beach consists of a thin strip of low lying dune/backshore at the base of significant coastal cliffs. At the northern end a stream exits through more extensive low lying area. The coastal strip along Pourerere ‘south’ is at risk from both coastal hazards and landslip hazards. While rock shore platforms do provide some protection from storm events the strip of low lying topography is still at risk from coastal erosion and inundation.

3.3.4 Mangakuri Beach

Mangakuri is similar to the southern portions of Pourerere where the coastal margins are very low lying and backed by steep topography. This steep topography is prone to land slip. Active accretion of the low lying areas have occurred and is well vegetated with Maram grass. Development is mostly confined to elevated areas at the base of the slope. It is unknown if the elevated geology is dune deposits or cliff material.

3.3.5 Kairakau Beach

Kairakau is differentiated from the other southern beaches due to the sediment input of the Mangakuri River and off shore rock and reefs that form the Hinemahanga Islands. The increase in sediment to the beach system from the river has resulted in elevated dune levels approximately 2.5 m higher than other southern beaches. However, inconsistent sediment loads from the river and changes in local wave climate induces periods of fluctuating beach levels. Sand cover over the intertidal shore rock platform fluctuates from bare rock to approximately 1 m over periods of 2 to 3 years.

Coastal erosion north of the Mangakuri River has resulted in removal of dwellings along the frontal dune from about the 1950's. A concrete seawall was constructed in the 1960's north of the river mouth. Other ad hoc coastal protection still remains along the dune face

3.4 Reanalysis of hazard widths

The additional data and information obtained during this study was used to either refine or support each parameter in determining set back widths. The following is a summary of the parameter assessment.

3.4.1 SE and ST horizontal shoreline fluctuation

The initial determination of the SE parameter for the southern beaches was determined from beach profile data from Waimarama Beach and was equal to the standard deviation of annual shoreline movement at each profile measured at 1.0 m above MSL. Similarly, ST was equal to two standard deviations.

To validate the use of Waimarama data for the southern beaches a comparison of beach profile data was undertaken. Horizontal changes of the 11 m elevation position along each profile were compared over approximately 5 months. Within this time period significant storm events occurred along the east coast which affected both sets of beaches.

Wave events causing significant property damage at Haumoana occurred on 17 March and 16 June 2005.

Table 3-2. Summary of Port of Napier Wave Buoy data

	Buoy Recording Frequency (mins)	Average Daily Wave Height , Have (m)	Average Daily Max Wave Height , Hmax (m)	Average Daily Significant Wave Height, Hsig, (m)	Average Daily Significant Wave Period, Tsig (s)	Average Daily Magnetic Direction (degrees)
17th March 2005	30^	2.04	4.79	3.25	12.56	73.47
16th June 2005	30^	1.76	4.68	2.89	11.74	71.43
Note: ^Data measured continuously but recorded (summarised) only every 30mins.						

To confirm the validity of using Waimarama data for the southern beaches requires similar beach responses to wave events with the southern beaches.

Table A1 in Appendix A, shows the position of the 11 m elevation mark relative to each profile origin (benchmark). Waimarama profiles 10 and 12 where chosen as best representing the southern beaches. The selected survey's 1, 2 and 3 are taken from a larger dataset and represent profiles taken at similar times both at Waimarama and the southern beaches.

While differences do occur between Waimarama and the southern beaches, generally, beach response for the southern beaches is very similar to Waimarama. There is little indication that the two areas are totally dissimilar in terms of beach response to wave events.

Although the period of profile data for the southern beaches is short and firm conclusions can not be made at this point in time, the profile data available still suggests similarity to Waimarama and no compelling justification to alter the original findings.

Therefore we recommend the initial determination of SE and ST based on Waimarama data remain until at least 5 years of data is recorded along the southern beaches, including changes resulting from a significant storm.

3.4.2 DS

Originally the distance from MHWS to the dune was not available for the southern beaches and was not used in the calculations. Instead, setback distances were relative to the shoreline (vegetation line) that existed in the late 1990's taken from aerial photographs. It is noted that this approach includes the historic accretion that occurred from the 1930's to the late 1990's. Beach profile data from the southern beaches has now been used to determine the distance from MHWS to the active dune face and set back distances relative to the origin. The difference between the set back widths derived by the two methods is minor and does not contribute to any change in location of the hazard lines.

3.4.3 SL

The Bruun rule requires beach profile data from the highest dune elevation out to a calculated closure depth. LiDAR data and offshore bathymetry has allowed better determination of dune elevation and distance of a calculated closure depth for Blackhead, Aramoana, Mangakuri and Kairakau.

An assumption of the Bruun rule is the unimpeded cross shore exchange of sand along the beach profile. Figures B7 – B10 (Appendix B) show sub tidal areas off shore of each beach in the vicinity of measured beach profiles used for Bruun rule calculations. Section 3.3 describes beach profile data and implication of cross shore sediment exchange. LiDAR and bathymetry profile data were used to determine distance from dune crest to closure depth.

While the existence of shore platforms or reefs may impede cross shore exchange of sediment, exchange is still assumed to occur. Therefore the Bruun rule is still the preferred method to estimate shoreline movement due to sea level rise.

At the northern end of Mangakuri there appears to be a reef/rock formation towards the landward end of the off shore profile. However, if the average beach slope seaward of the reef/rock formation is applied to the unmeasured portion a good estimate of the beach profile is still achieved. Cross shore exchange of sand could still occur along this beach profile even with the rock\reef feature.

Similarly, Kairakau has offshore reef/rock features; however the closure depth is land ward of these features. There is evidence of a rock shore platform

Because of similar geomorphology and coastal process between the southern beaches, an estimation of dune crest – closure depth distance for Pourerere was based on averaged distances from the measured beaches.

Table A2 (Appendix A) summarises revised Bruun rule calculations.

The parameter with the greatest change from initial calculation is the distance from the origin (dune crest) to the closure depth. Bathymetry data show that the distance from the origin to the closure depth increases between ~150 – 400 m. This parameter causes the greatest change in set back width, increasing shoreline retreat based on the Bruun rule for a 100 year rise in sea level by up to 14 m.

3.4.4 LT

The original long term shoreline movement trend was based on the inferred rate of adjacent cliff retreat. This was based on the assumption that embayed beaches were headland controlled, and as the headlands retreat due to cliff erosion the beaches will retreat at the same rate.

The original approach to establish long term retreat rates was based on the measurement of the shore platform width and dividing this distance by the period sea levels have remained relatively constant (approx. 6,500 years). In this present study, aerial photography from the 1950's, 1990's and LiDAR from 2003 was used to analyse long term shoreline trends of the beaches.

To determine long term shoreline movement rates, the seaward vegetation line for each aerial photograph was mapped in GIS and defined as the shoreline for the period. From site investigations the seaward vegetation line also coincided with the dune toe along each beach. Therefore, the LiDAR derived toe of dune contour was also used as a representative shoreline.

A number of shore normal transects were cast in GIS to measure the change in shoreline along each beach. Generally, during the period from 1950's to 1990's the shorelines along most of the beaches have been moving seaward at between 0.08 and 0.82 m per year. From the 1990's to 2003 the rates have been less consistent both along individual beaches and when compared between beaches.

Figures B1 – B6 (Appendix B) and Table A3 (Appendix A) show shoreline changes resulting from this assessment.

As stated above, the historic accretion observed between the 1950's and the 1990's has been taken into account as the origin of the shoreline is based on the 2003 shoreline position. However, the more recent time period (1990 to 2003) shows more of a fluctuating beach, rather than an ongoing accretion system.

As the rate of change has not been consistent between the recent analysis periods we do not recommend extending any historic accretion rates into the future. Also, indications are that we are coming into a phase of climate change that produces more easterly winds across New Zealand compared with the last few decades. This change in climate from the previous decades indicates a change in coastal process for the future (next 10-20 years), causing doubt in the reliability of using the measured long term trend as an indication of future shoreline movement. Therefore, it is recommended that the LT parameter remain unchanged.

3.5 Set back widths

Set back widths to take into account the current situation (CERZ) and sea level rise to 2060 and 2100 have been recalculated using additional information for the southern Hawke's Bay beaches. Generally the CERZ set back widths remain unchanged, however the 2060 ERZ and 2100 ERZ have increased due to the use of actual offshore profile data used in the Bruun rule indicating a greater extent of shoreline retreat due to sea level rise.

Table 3-3 shows a summary of revised set back widths for the southern beaches.

In cases where the beach is backed by cliff or elevated ground, the landward movement of the 2060 and 2100 ERZ is inconsequential as the land area demarked by these zones may not be soft shore area.

Areas in the vicinity of stream or rivers that exit along the coast are susceptible to potentially greater hazards due to meandering mouths, flooding and river bank erosion. Within these areas, the combined effects of river and coastal processes on erosion and inundation hazards are difficult to predict. Therefore, the estimates of the CERZ, 2060 and 2100 ERZ set backs around stream or river mouths may be inaccurate.

To account for these inaccuracies, no set backs zones have been delineated in these areas. Instead, a zone representing hazards due to the combined estimated effects of river and coastal processes is established. Within these zones any new development should require a specific site investigation.

The set back distances compare well and are realistic with on site observations and geomorphology of the southern beaches.

4 Revised GIS data sets

Using the methods described in the previous sections new setback zones have been created in GIS. These electronic files are contained in a CD accompanying this report. The CD contains ESRI Shape files representing revised Soft Shore Hazard Zones and River Mouth Hazard zones. More specific information on the data format is contained in the 'read me' file on the CD.

Additional Cliffed Shore Hazard Zones and Transitional Hazard Zones have also been created to complete the hazard assessment for the Hawke Bay region. These zones are described and contained on CD in the Cliff Hazard Zone Delineation report (EMT 05/08, HBRC Plan No. 3823) by Tonkin and Taylor (2006)

5 Conclusions

Data availability is still an issue for northern Hawke's Bay beaches. Set back distances for these beaches are based on available information only and have not been altered.

There is similarity of geomorphology and coastal process for the southern beaches. This similarity enables a consistent approach when determining parameters used in set back distances.

The original general assumption of assessing set back widths based on profile data from Waimarama is validated using new beach profile information. The behaviour of recently established beach profiles of the southern beaches appears similar to that experienced at

Waimarama during storm events. However, ongoing profiling of these beaches should be continued to increase reliability of this data set in the future.

The assumption of using cliff retreat rates as a controlling mechanism for future long term shoreline movement remains a prudent and precautionary approach.

Potential effects of climate change as predicted by the Bruun Rule show increased extents of erosion hazard based on the site specific bathymetry. We note that the sea level rise estimates are under regular review and should be reviewed periodically.

The set back distances derived from available data is in keeping with the regional scale of the coastal hazard assessment.

Areas surrounding river or stream mouths can be prone to greater erosion or inundation hazards.

Further refinement of hazard set back distances would require detailed site specific investigations of near shore bathymetry, extent of near shore rock platform and beach/backshore geology. Any further refinement is not expected to greatly alter set back distances.

6 Applicability

This report has been prepared for the benefit of Hawke's Bay Regional Council with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose without our prior review and agreement.

TONKIN & TAYLOR LTD

Environmental and Engineering Consultants

Report prepared by: Authorised for Tonkin & Taylor by:

....

Rick Liefting Richard Reinen-Hamill

Coastal Scientist Senior Coastal Engineer

hccl

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Table 3–3 Revised Set back distances for Southern Hawkes Bay Beaches

	CERZ						2060 ERZ			2100 ERZ		
Location	Profile	Distance from 11 m contour to origin (m)	LT(10) (m/yr)	SE+ST+LT(10) (m)	DS (m)	Total (m)	LT (m)	SLR (m)	Total (m)	LT (m)	SLR (m)	Total (m)
Blackhead	XS 02	-86.3	0.9	42.5	86.3 *(ND)*	42	5.1	14.0 *(8.2)*	62 *(56)*	3.6	21.0 *(12.3)*	85 *(71)*
Aramoana	XS 01	-143.3	1.1	42.7	143.3 *(ND)*	43	6.3	13.6 *(8.2)*	63 *(57)*	4.4	20.5 *(12.3)*	86 *(73)*
Pourerere	XS 02	-41.5	1.8	43.4	41.5 *(ND)*	43	10.3	13.4 *(8.2)*	67 *(62)*	7.2	20.2 *(12.3)*	93 *(80)*
Mangakuri	XS 01	-119.8	1.4	43.0	119.8 *(ND)*	43	8.0	13.3 *(8.1)*	64 *(59)*	5.6	19.9 *(12.1)*	88 *(75)*
Kairakau	XS 03	-74.9	1.4	43.0	74.9 *(ND)*	43	8.0	9.2 *(8.1)*	60 *(59)*	5.6	13.8 *(12.1)*	78 *(75)*

Note: Figures in brackets show original values, if changed.

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Appendix A: Tables

- **Beach Profile comparison**
- **Sea Level Rise Prediction Based on the Bruun Rule**
- **Summary of shoreline change for Southern beaches and Opoutama**

BEACH/TRANSECT	11 m elevation distance from origin (m)					Change Survey 1 - Survey 2	Change Survey 2 - Survey 3	Change Survey1 - Survey 3
	Survey 1		Survey 2	Survey 3				
	23/03/2005	31/03/2005	10/05/2005	25/07/2005	2/08/2005			
ARAMOANA XS 01		155.34	152.57		143.27	-2.77	-9.30	-12.07
ARAMOANA XS 02		226.10	228.30	226.30		2.20	-2.00	0.20
BLACKHEAD XS 01		43.81	42.85	41.30		-0.96	-1.55	-2.51
BLACKHEAD XS 02		102.56	94.26	86.32		-8.29	-7.94	-16.24
BLACKHEAD XS 03		66.97	64.61	64.67		-2.36	0.06	-2.30
PORANGAHAU XS 01		55.31	50.30	48.21		-5.00	-2.09	-7.10
PORANGAHAU XS 02		152.16	150.29	135.79		-1.87	-14.50	-16.37
PORANGAHAU XS 03		232.65	231.00	227.34		-1.65	-3.66	-5.31
POURERERE XS 01		49.41	52.35	47.44		2.93	-4.91	-1.97
POURERERE XS 02		53.59	48.88	41.52		-4.71	-7.36	-12.08
POURERERE XS 03		No data	72.45	58.98		-	-13.48	-
WAIMARAMA XS 10	50.22		37.43	38.25		-12.79	0.81	-11.97
WAIMARAMA XS 12	35.54		31.66	33.31		-3.88	1.66	-2.22

Table A1 Distance of 11 m elevation distance from origin for southern beaches (no survey data for Kairakau and Mangakuri) and Selected Waimarama profiles. Positive change indicates accretion, negative change indicates erosion.

Location	Profile	Highest elevation (m)	Seaward crest elevation (m)	Distance from origin to crest (m)	Distance from origin to closure (m)	Hs (mean), from SWAN results (m)	Closure depth, di (m)	Length from crest to closure, L (m)	Slope	SLR 1999 to 2060 (m)	SLR 2060 to 2100 (m)	Shoreline change, 1990 to 2060 (m)	Shoreline change, 2060 to 2100 (m)	Shoreline change, 1990 to 2100 (m)
Blackhead	BLACKHEAD XS 02	12.83	12.83	0.00	890.00	5.25	0.13	890	0.01	0.2	0.3	14	21	35
Aramoana	ARAMOANA XS 01	14.13	14.13	0.00	955.00	5.25	0.13	955	0.01	0.2	0.3	14	20	34
Pourerere	POURERERE XS 02	13.70	13.70	0.00	911.33	5.25	0.13	911	0.01	0.2	0.3	13	20	34
Mangakuri	MANGAKURI XS 01	13.30	13.30	0.00	889.00	5.375	-0.09	889	0.02	0.2	0.3	13	20	33
Kairakau	KAIRIKAU XS 03	15.59	15.59	0.00	721.90	5.375	-0.09	722	0.02	0.2	0.3	9	14	23

Table A2 Sea level rise prediction based on the Bruun rule.

	1950's - 1990's						1990's - 2003					
	Shoreline Change (m)			Rate (m/y)			Shoreline Change (m)			Rate (m/y)		
	Min Range	Max Range	Average	Min	Max	Average	Min	Max	Average	Min	Max	Average
Pourangahau	-12.81	89.31	13.60	-0.25	1.72	0.26						
Blackhead	17.76	44.90	34.08	0.38	0.95	0.72	-33.18	15.83	-4.75	-8.29	3.96	-1.19
Aramoana	-16.58	79.21	15.34	-0.35	1.68	0.33	-41.24	13.85	-4.89	-9.50	3.19	-1.13
Pourerere south	5.54	21.14	14.55	0.12	0.45	0.31	-9.84	4.22	-1.09	-2.27	0.97	-0.25
Pourerere north	4.26	23.95	16.28	0.09	0.51	0.35	-12.87	16.60	-0.71	-2.96	3.82	-0.16
Mangakuri	17.51	63.59	36.82	0.39	1.41	0.82	-3.01	19.31	6.33	-0.47	3.04	1.00
Kairakau	2.45	4.97	3.65	0.05	0.11	0.08	0.65	5.53	3.79	0.10	0.87	0.60
Opoutama	-6.32	118.71	48.56	-0.12	2.24	0.92						

Table A3 Summary of shoreline change for Southern beaches and Opoutama (-ve =erosion, +ve= accretion)

Appendix B: Set back distance and historic shoreline position

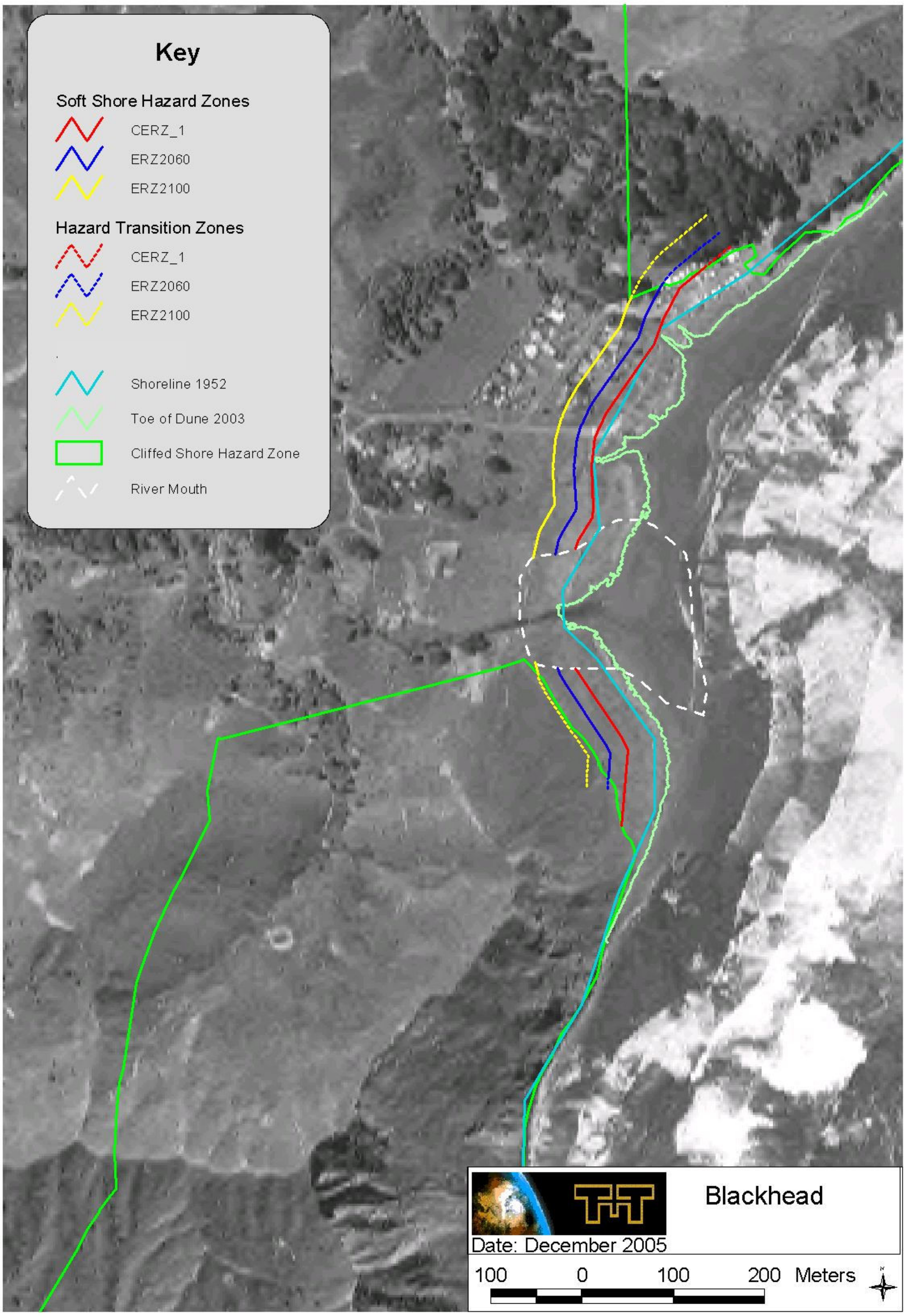

Figure B1 Set back zones and shorelines for Blackhead Beach. Aerial photo taken 1998.

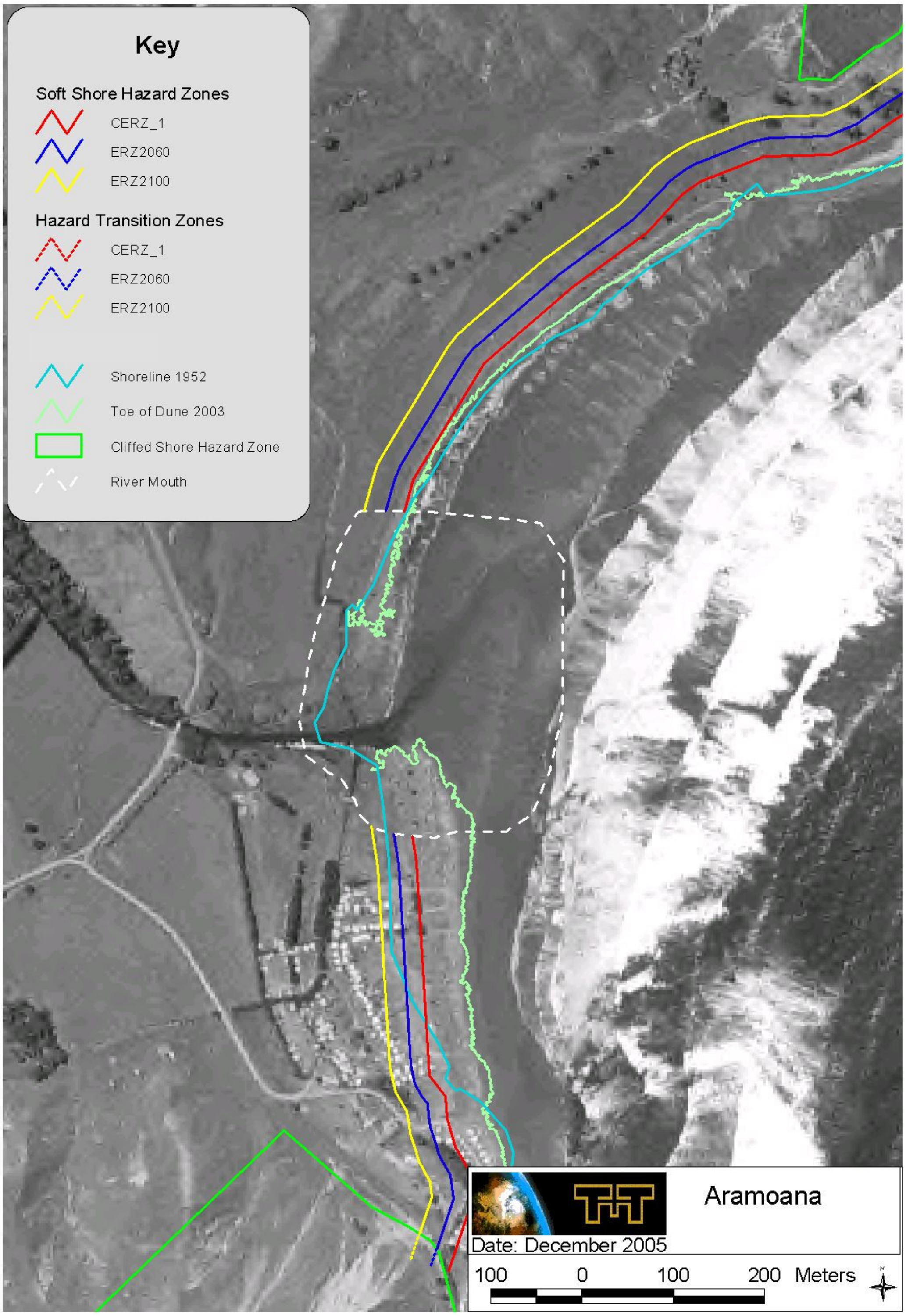

Figure B2 Set back zones and shorelines for Aramoana Beach. Aerial photo taken 1998.

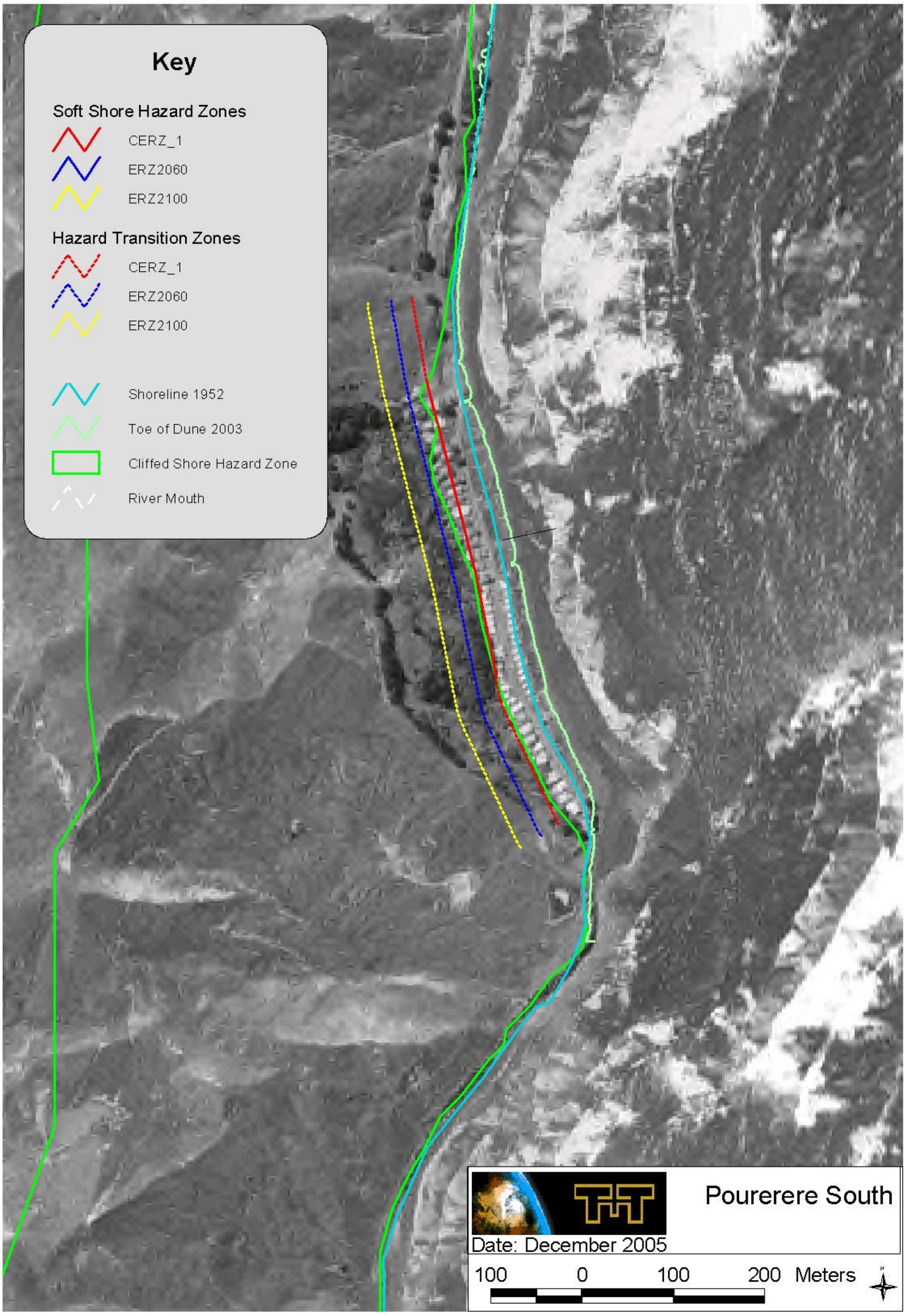

Figure B3 Set back zones and shorelines for Pourerere South. Aerial photo taken 1998.

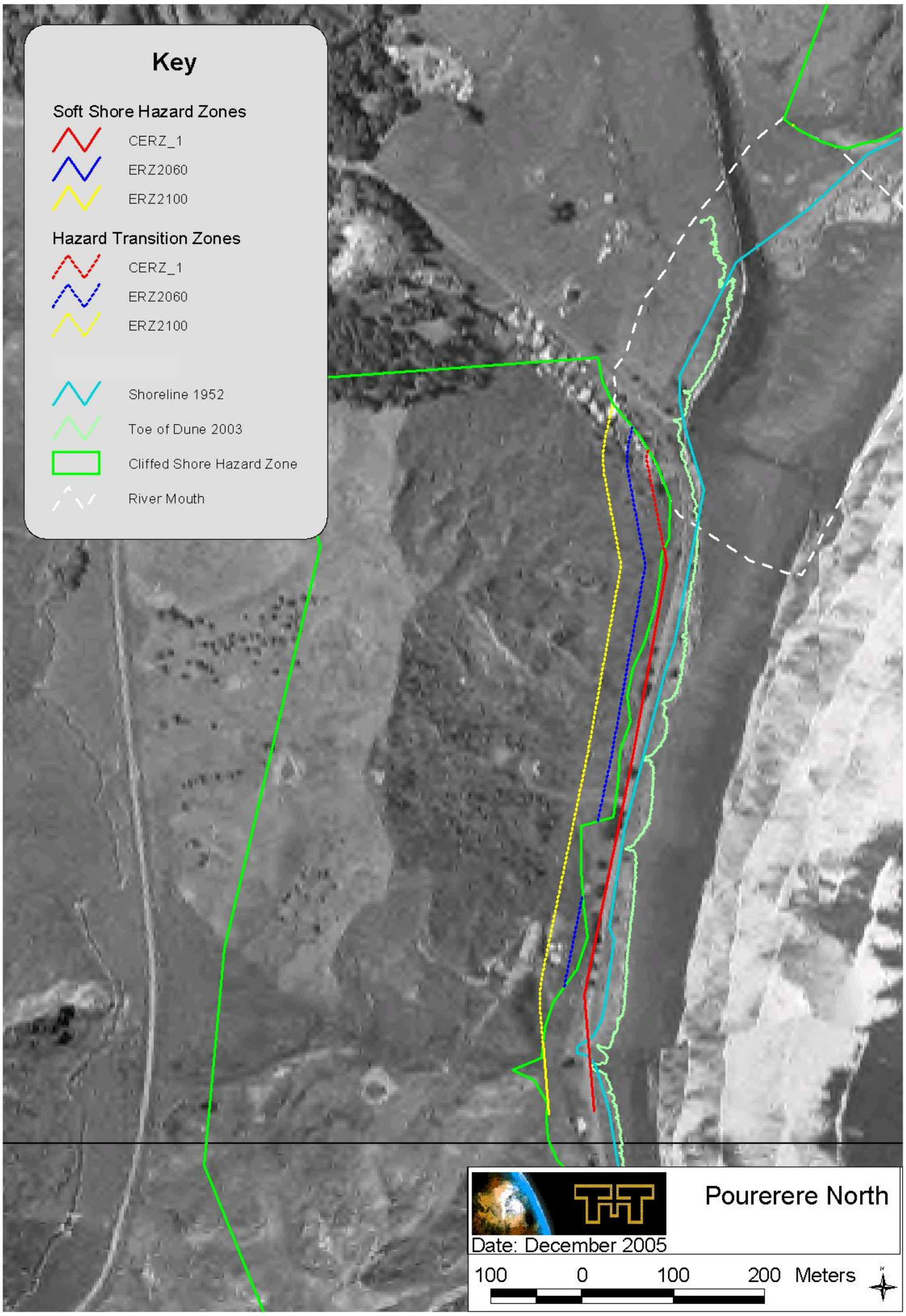

Figure B4 Set back zones and shorelines for Pourerere North. Aerial photo taken 1998.

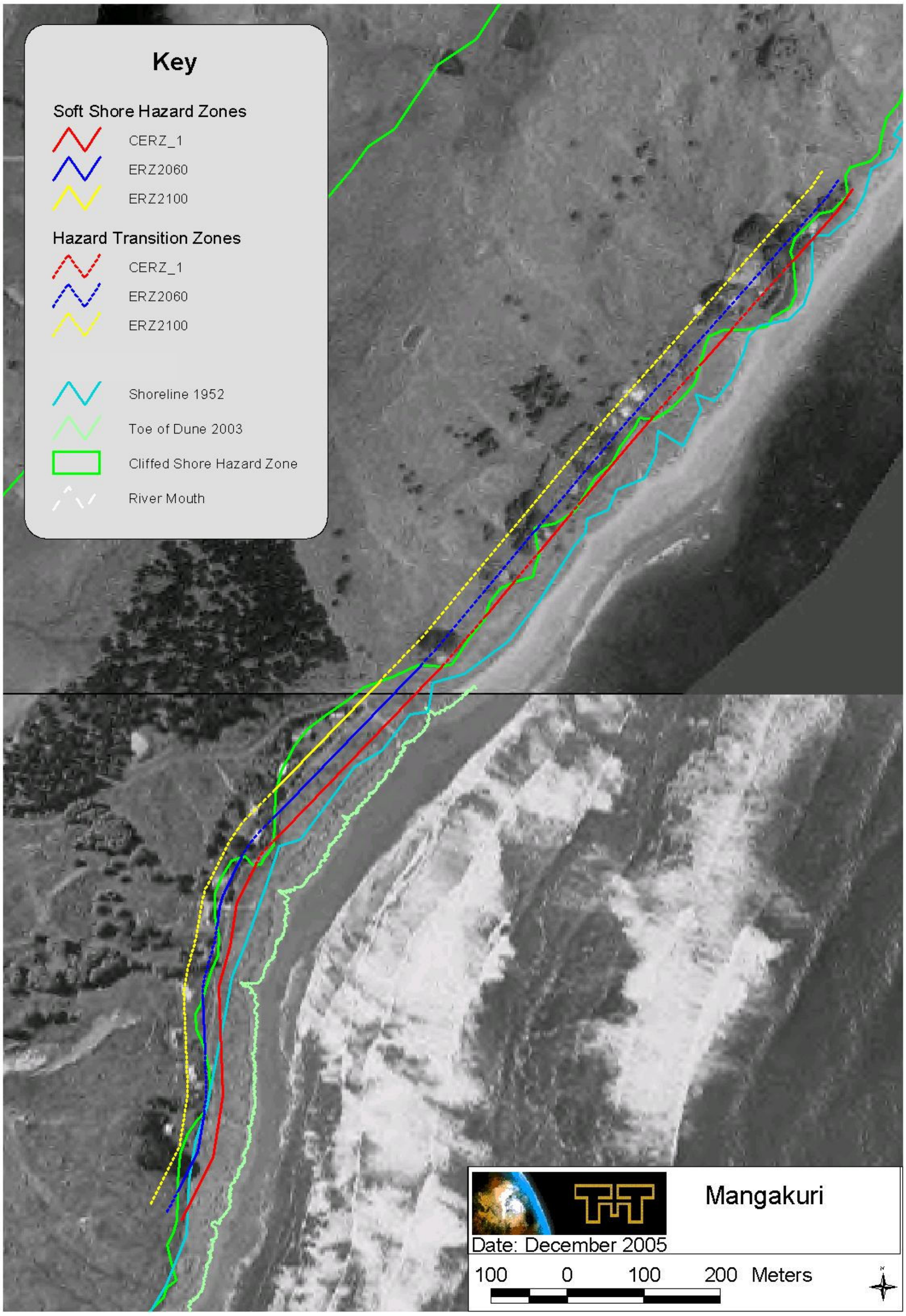

Figure B5 Set back zones and shorelines for Mangakuri Beach. Aerial photo taken 1998.

Figure B6 Set back zones and shorelines for Kairakau Beach. Aerial photo taken 1998.

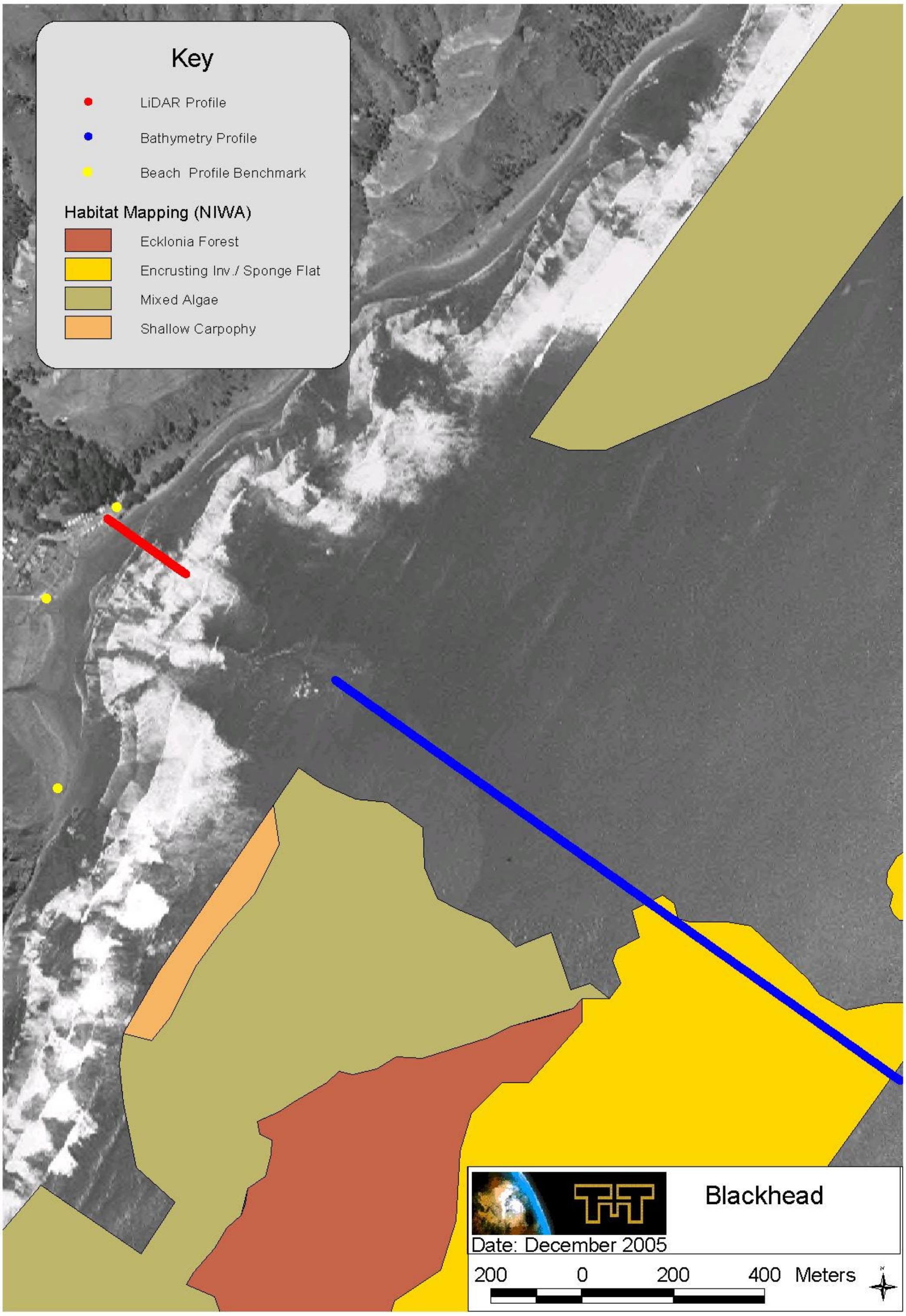

Figure B7 Offshore habitat mapping and beach profile transects derived from LiDAR and Bathymetry.

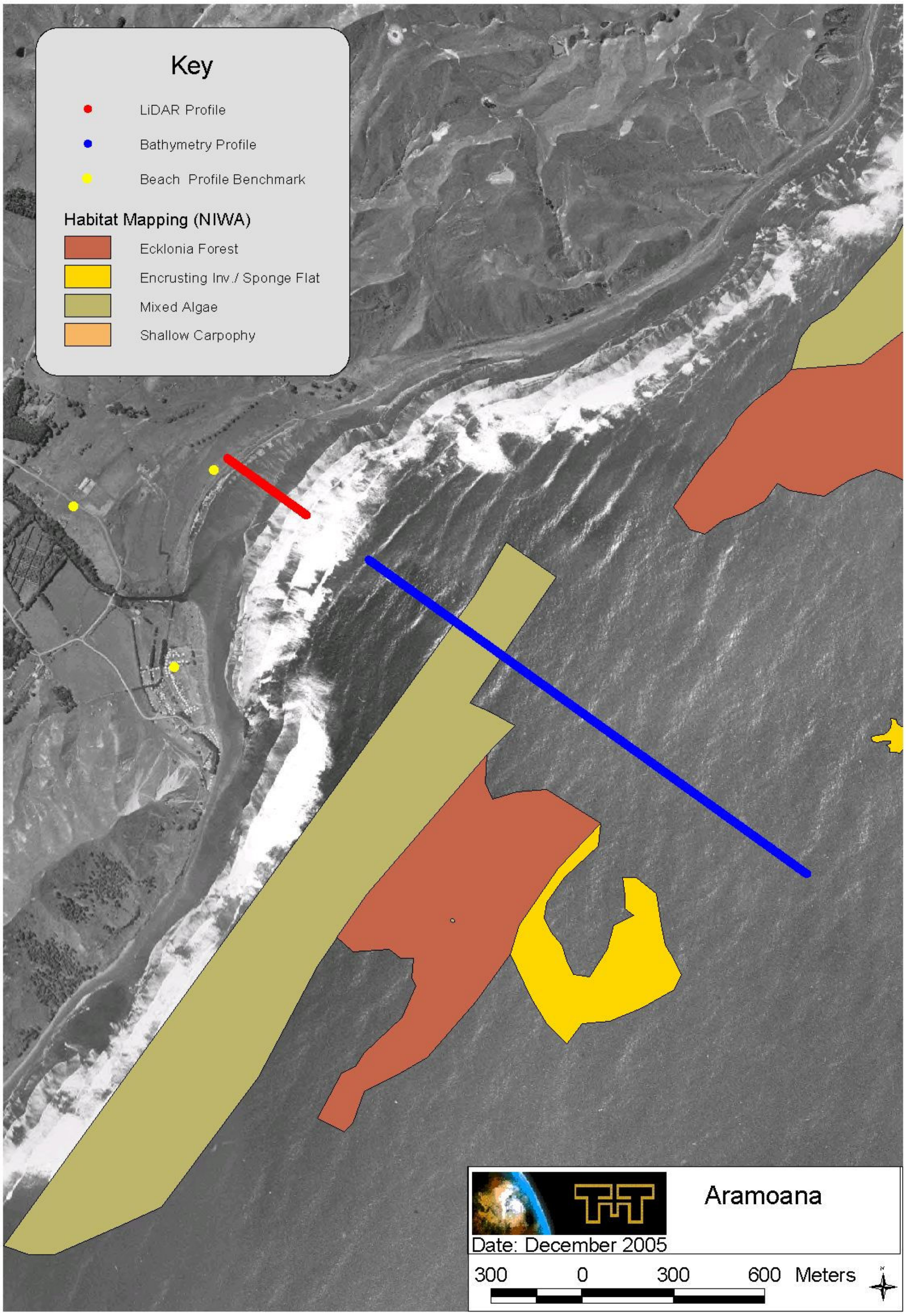

Figure B8 Offshore habitat mapping and beach profile transects derived from LiDAR and Bathymetry.

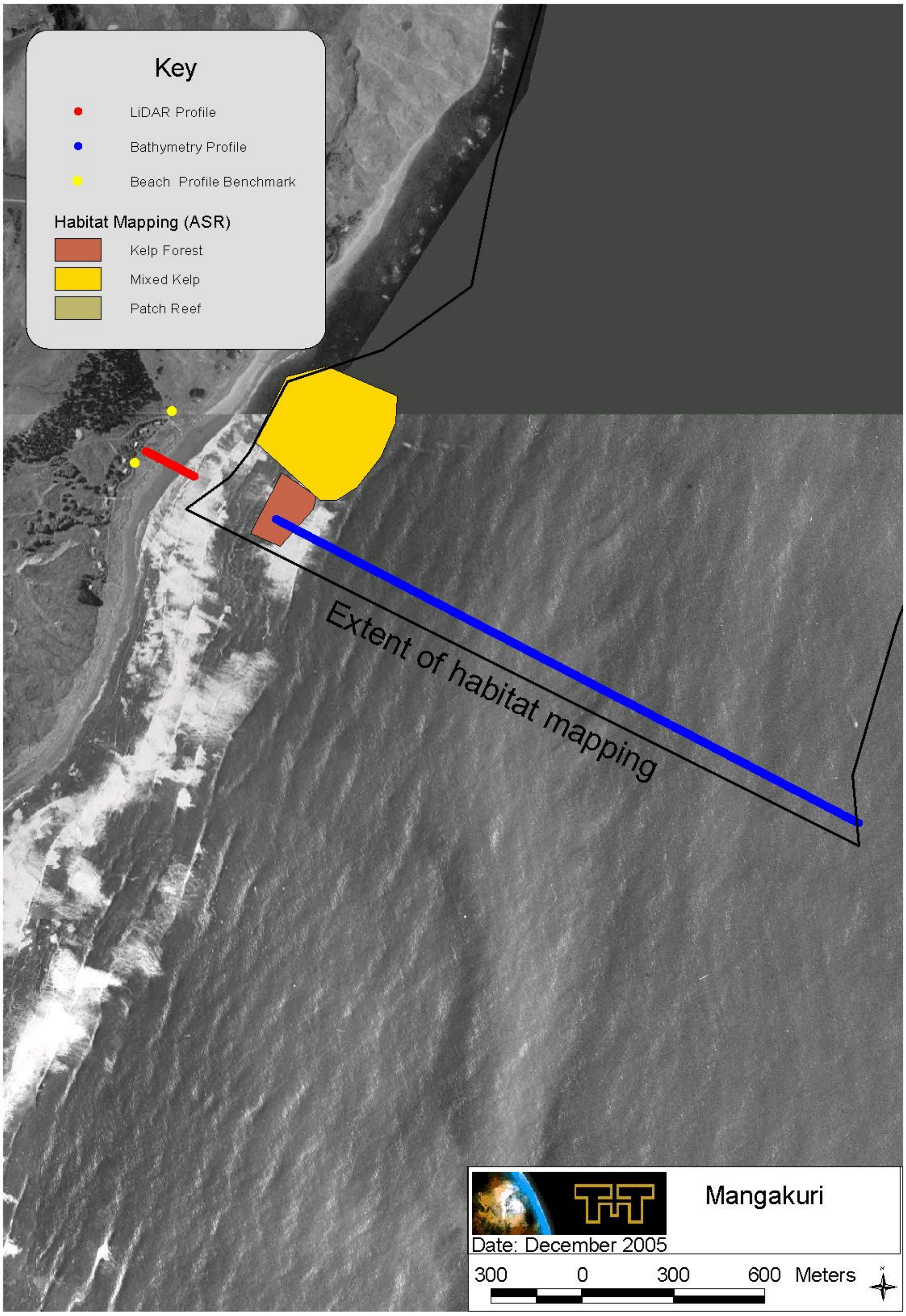

Figure B9 Offshore habitat mapping and beach profile transects derived from LiDAR and Bathymetry.

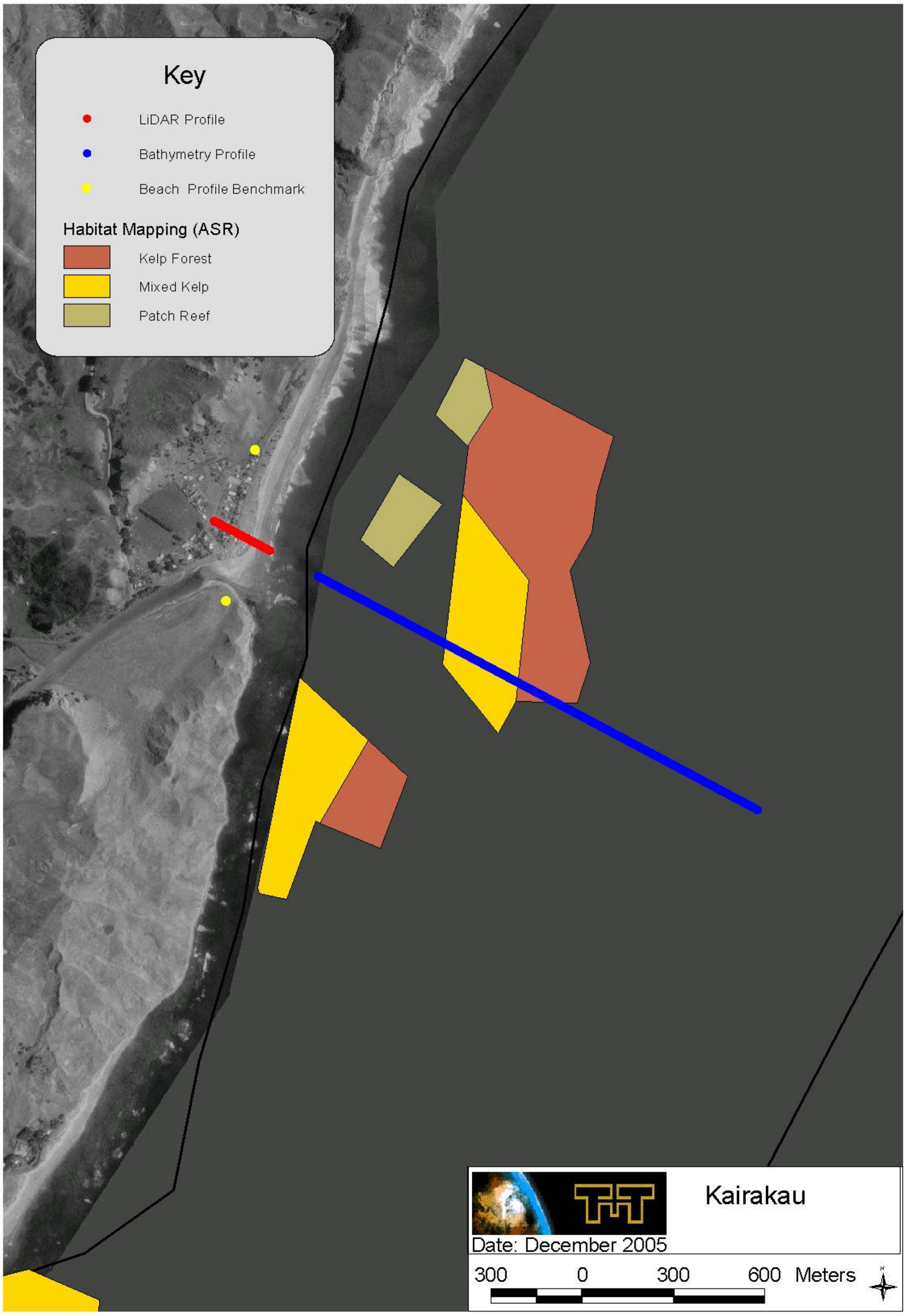

Figure B10 Offshore habitat mapping and beach profile transects derived from LiDAR and Bathymetry.

Appendix C: Beach Profiles

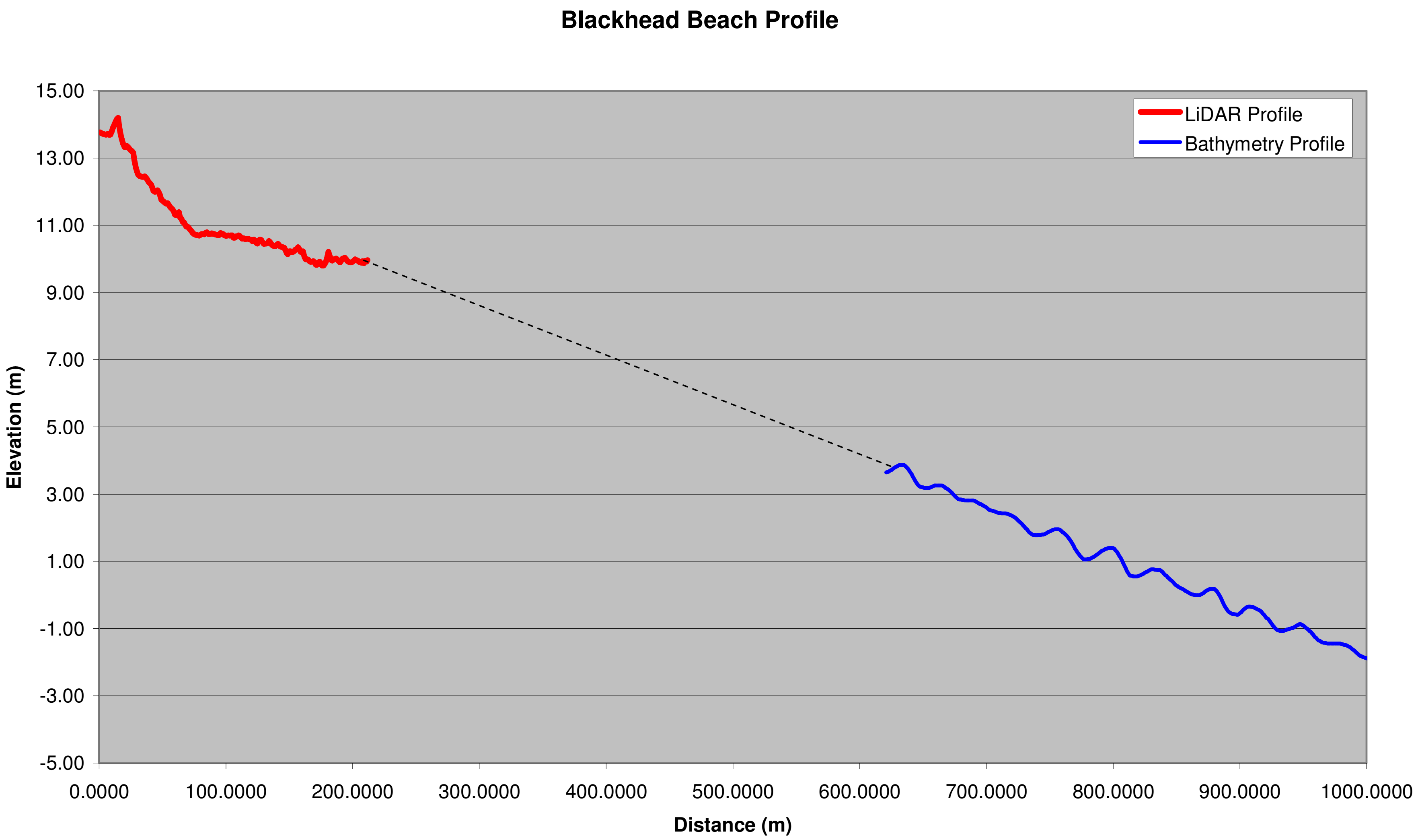
Blackhead Beach Profile
15.00
13.00
11.00
9.00
7.00
5.00
3.00
1.00
-1.00
-3.00
-5.00
Elevation (m)
0.0000
100.0000
200.0000
300.0000
400.0000
500.0000
600.0000
700.0000
800.0000
900.0000
1000.0000
Distance (m)
LiDAR Profile
Bathymetry Profile

Figure C1

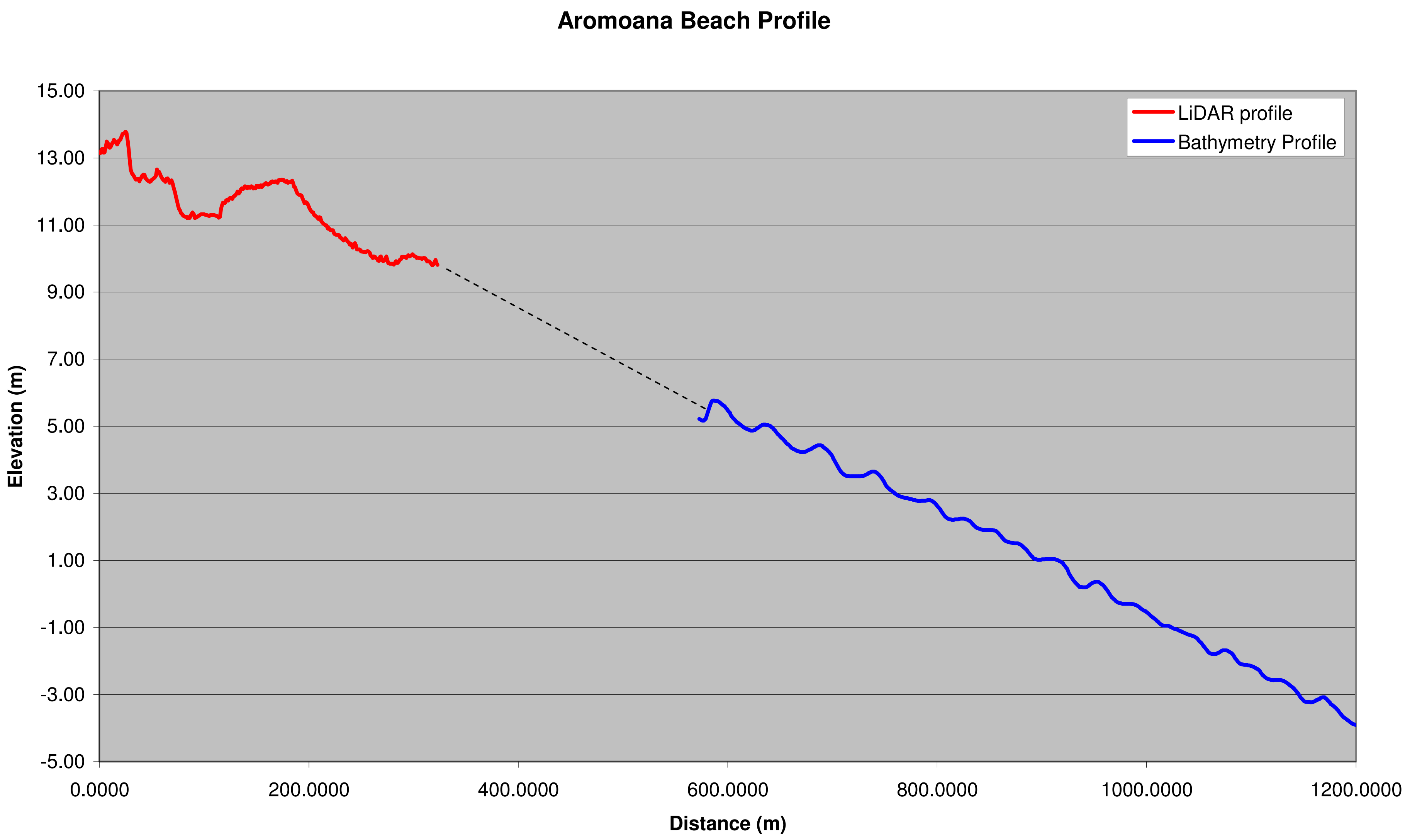
Aromoana Beach Profile
LiDAR profile
Bathymetry Profile
15.00
13.00
11.00
9.00
7.00
5.00
3.00
1.00
-1.00
-3.00
-5.00
Elevation (m)
0.0000
200.0000
400.0000
600.0000
800.0000
1000.0000
1200.0000
Distance (m)

Figure C2

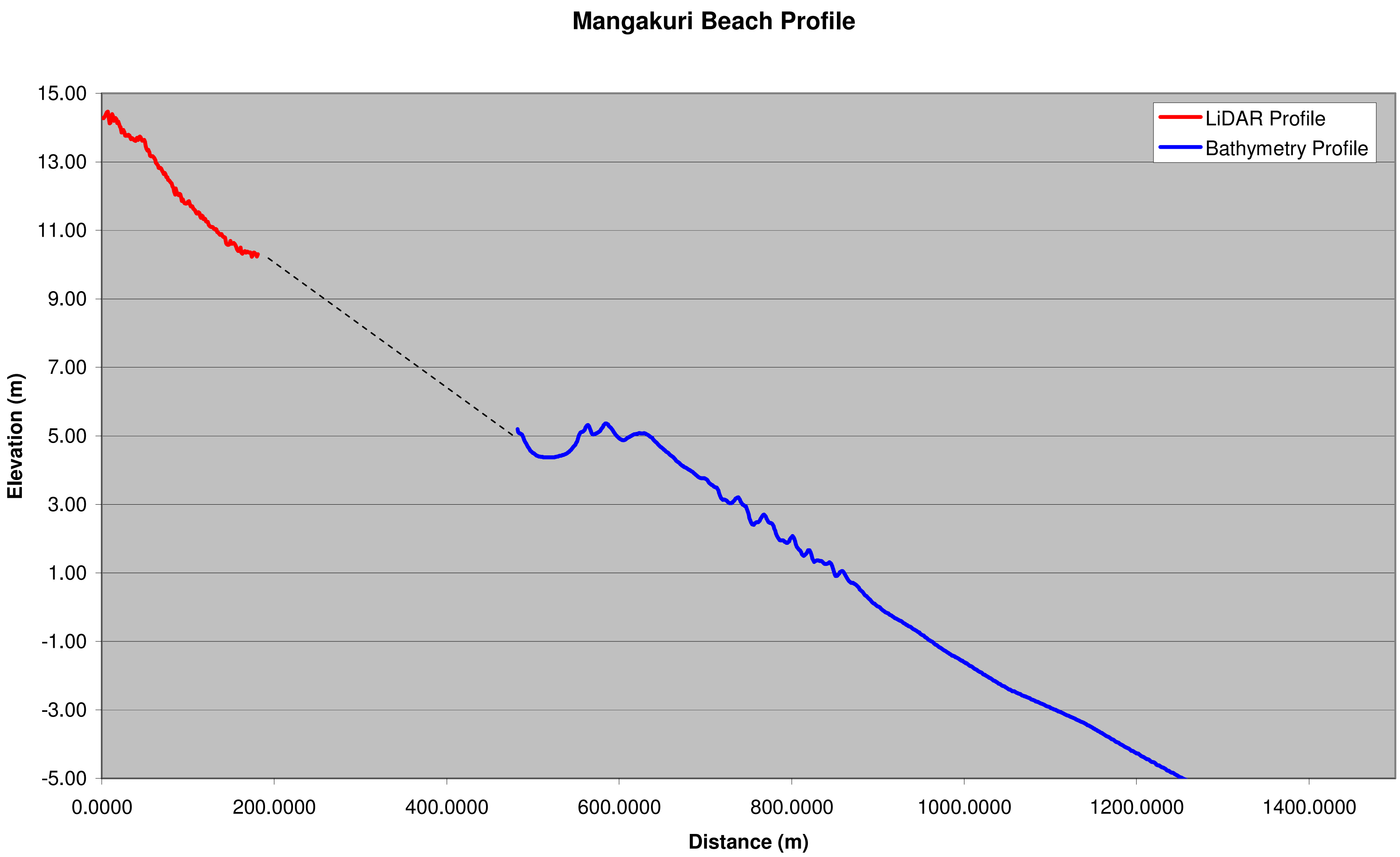
Mangakuri Beach Profile
LiDAR Profile
Bathymetry Profile
15.00
13.00
11.00
9.00
7.00
5.00
3.00
1.00
-1.00
-3.00
-5.00
Elevation (m)
0.0000
200.0000
400.0000
600.0000
800.0000
1000.0000
1200.0000
1400.0000
Distance (m)

Figure C3

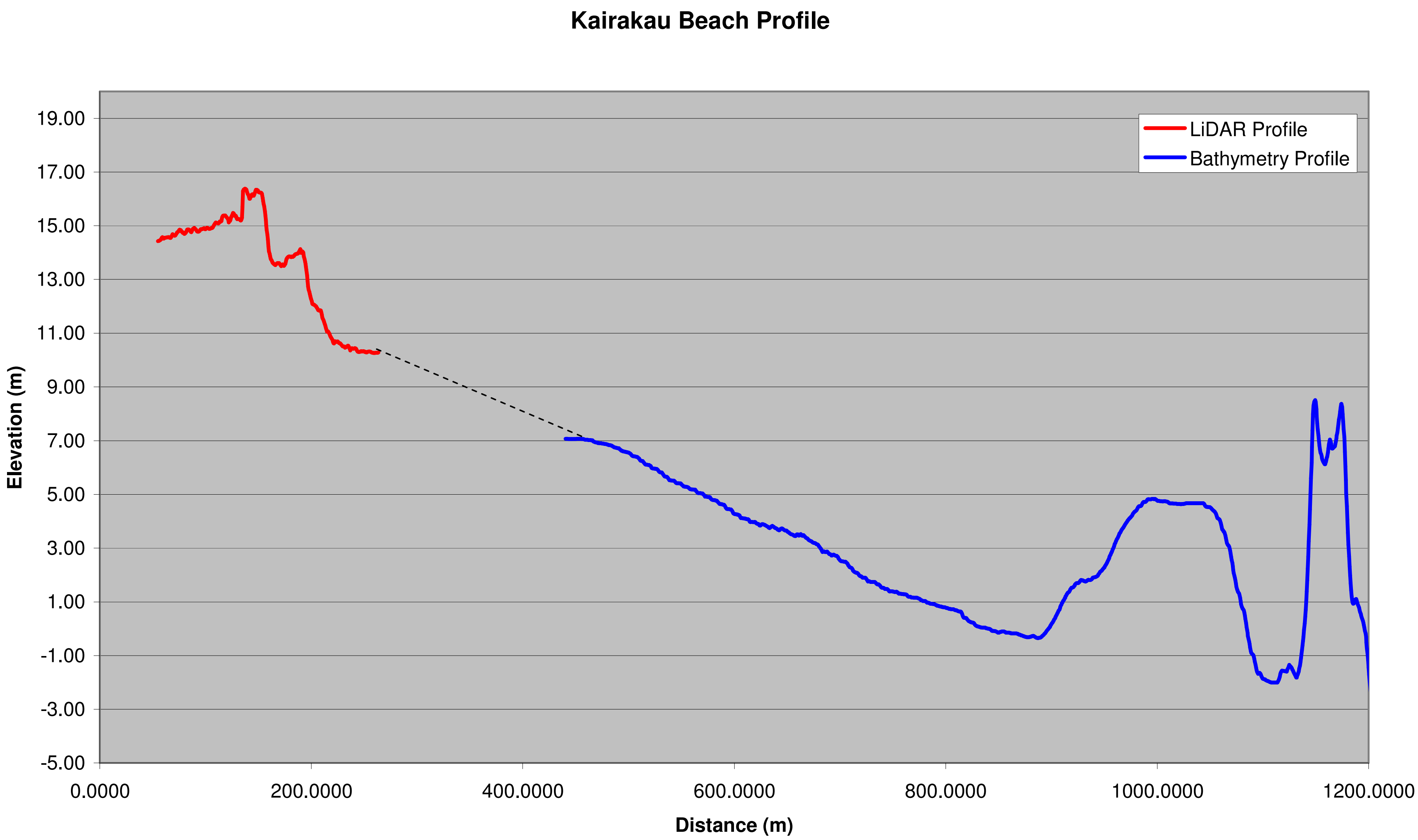
Kairakau Beach Profile
Elevation (m)
19.00
17.00
15.00
13.00
11.00
9.00
7.00
5.00
3.00
1.00
-1.00
-3.00
-5.00
0.0000
200.0000
400.0000
600.0000
800.0000
1000.0000
1200.0000
Distance (m)
LiDAR Profile
Bathymetry Profile

Figure C4

Appendix D: Comments on Tonkin & Taylor summary report for southern beaches by Michael D. Smith

Comments on Tonkin and Taylor Summary Report for Southern Beaches

By
Michael D Smith

Introduction

Tonkin and Taylor have completed a review of the regional coastal hazard assessments for the southern beaches using additional data made available to them since the original assessment. This review is reported in **summary** format only at this time, meaning that a meaningful review of the conclusions presented is not possible.

The following are comments intended to offer a level of balance to the conclusions in light of local experience, and try to put the engineering conclusions drawn into a context of local experience. The overall intention is to try and establish if the conclusions seem reasonable in light of observed behaviour at one of the beaches in question (Mangakuri).

It must be noted that I do not claim to be a coastal scientist or engineer. I am an offshore structures engineer employed in the oil industry and have a very good understanding of the offshore environment. However, the discussion below should not be taken as an engineering report, or engineering recommendations. The review conducted could have been done by anyone with an internet connection, a reasonable ability in mathematics and a desire to understand what Tonkin and Taylor are recommending. All facts and information presented are derived from either the T&T report itself, from the papers referenced in the report or other scientific papers that are publicly available. A list of references is given at the end of this document.

Hazard Zone Widths

The hazard zones are determined by the following formula:

$$Hz = ST + SE + DS + SL + LT$$

The terms are defined in the Tonkin and Taylor report, but are basically as follows:

ST = Short term fluctuations in the high water mark
SE = Storm erosion allowance
DS = beach width above the high water mark
SL = Erosion due to sea level rise

LT = long term erosion, given as metres/year. Note that LT(10) means 10 years of erosion at the long term annual rate.

Current Erosion Risk Zone

The Current Erosion Risk Zone (CERZ) is given as:

CERZ = (ST + SE)*1.25 + DS + LT(10)

ST and SE in this formula were derived from profiles measured at Waimarama and have been applied to the southern beaches since there is no measured data at these beaches. The summary report states that profiles at the southern beaches have been measured, at two monthly intervals, since January 2005. It is further stated that comparison of these measurements confirms that the Waimarama results are similar to the results and the other beaches, thus confirming the assumption in the original hazard assessment report. There is no data provided in the summary report to validate this conclusion. Given the enormous variability that apparently occurs at Waimarama, and the lack of observed variability at Mangakuri over 40 years, this conclusion seems incongruous.

The values for ST and SE that have been used are 28 metres and 14 metres respectively. Assuming that the Waimarama results are indeed valid for the southern beaches, these figures imply that the high tide mark could move by 52.5 metres ((28+14)*1.25) from where it is today by this time next year (i.e. in the next 12 months). Assuming the statistics are correct, this event has an Annual Exceedance Probability (AEP) of 0.0088%, or is likely to occur only ONCE in approximately 11,300 years.

The factor of 1.25 included in the above equation is not actually included in the calculation completed by T&T for the southern beaches, implying that they have more confidence in the Waimarama data, or they simply made a mistake. Assuming that the reason is the degree of confidence, then the AEP for a movement of the high tide mark by 42 metres is 0.135%. This means that the high tide mark is likely to move this much only once in 740 years.

In either case, given that the design basis is to account for hazards with an AEP of 2%, the figures presented by T&T are very conservative. To comply with the AEP of 2%, the CERZ width would need to be reduced to 28.75 metres, and for an AEP of 1% the CERZ width would need to be 32.5 metres.

With respect to the long term rate of erosion (LT), T&T state that there has actually been accretion observed at the southern beaches between the 1950s and the 1990s, although there has been more fluctuation in the beaches since then. The rates of accretion are stated to have been in the range of 0.08 to 0.82 metres per year. They then go on to dismiss this information as irrelevant due to the inconsistent results in the last 10 years and that we are "coming into a phase of climate change that produces more **easterly** winds across New Zealand ..". This last statement appears to be in contradiction to the advice provided by the NZ Climate Change Office (May 2004):

"The average **westerly** wind component across New Zealand may increase by approximately 10% in the next 50 years. As a result, there would be an increase in the frequency of heavy seas and swell along western and southern coasts ..."

2060 and 2100 Erosion Risk Zones

The 2060 and 2100 Erosion Risk Zones are developed using the Bruun Rule that describes erosion as a result of sea level rise. This rule assumes that the sediment only moves perpendicular to the coast line and does not allow for sediment transport along the coast. The problem is that "if there is a net ... gain or loss of sand on the profile from any source .... then any observed change in the profile could be due to something other than sea level rise." The requirement for a closed system such as this is "likely impossible to occur in nature, and if it did, would not be able to proved." (Cooper, 2004).

Major sources of additional sediment for the profiles are a river and a coastal current. Both of these sources are present on the East Coast of the North Island. With regards to rivers, the sediment transport in the regions rivers is recognized by the HBRC themselves on their website (http://www.hbrc.govt.nz/DesktopDefault.aspx?tabid=254) where the following is stated:

"Rural runoff also impacts our coastal waters, mostly via our rivers. Huge quantities of sediment are eroded into the rivers and ultimately end up in our estuaries and coastal areas."

Further, the Bruun Rule is not applicable in areas that have rocky outcrops. These two criteria eliminate all the southern beaches as potential locations for application of the Bruun Rule. Even the MfE advises that the Bruun Rule is of limited reliability (MfE, September 2001).

It must also be noted that the Bruun Rule does not allow for any accretion on the coast, it is purely an erosion model. Given that the sea level has been rising by 1.7 mm/yr on average (Bell, 2000), this means that the sea level has risen by 85 mm in the last 50 years. Using the T&T model, this implies that the Mangakuri beach has eroded by 13 metres in that time, yet T&T state that the beaches have actually been moving seaward since the 1950s. From the range of accretion rates given by T&T Mangakuri beach has actually moved seaward by between 4 and 41 metres.

All of the above leads to the reasonable conclusion that erosion due to sea level rise is far more complex than the simplistic Bruun Rule implies, and the use of anything less than a sediment budget method is of questionable validity at the southern beaches.

Inundation Levels

The inundation levels recommended by T&T are based on the following formulae:

EIRZ = MHWS + SLF + SS + SU + SLR2100 + RU

And

MIRZ = MHWS + SLF + SS + SU + SLR2100

Where:

MHWS = Mean High Water Spring (taken as 11 metres above HBRC datum)

SLF = long term sea level fluctuation, taken as 0.2 metres

SS = Storm surge, taken as 0.9 metres

SU = Wave set up

SLR2100 = sea level rise to 2100, taken as 0.5 metres

RU = wave run up, taken as 70% of the significant wave height.

It is assumed that the EIRZ (Extreme Inundation Risk Zone) is intended to be an area that is very likely to be inundated in an extreme storm. The MIRZ (Moderate IRZ) is assumed to mean the zone that is likely to be inundated, but has a lower probability than the EIRZ. A definition is given in the T&T Coastal Hazard Assessment report, but it is not clear what the definition means in practical terms – hence the above assumptions.

The MHWS figure is taken as 1.0 metres above mean sea level and is an HBRC assumption. It is noted that the highest astronomical tide is only 1.05 metres above mean sea level (MSL), and tidal assessments suggest that the MHWS is 0.91 metres above MSL (T&T, 2004) and therefore the HBRC assumption must be considered conservative.

The storm surge figure of 0.9m is taken from Bell et al (2000), and is recommended by the NZ Climate Change Office for areas where no specific data exists. However, it should be noted that this is intended to be split 50:50 between wind driven surge and atmospheric surge. At atmospheric surge of 0.45m requires an air pressure of 967 mbar. This is to be compared to Cyclone Giselle (Wahine storm) which had a low pressure of 963 mbar and Cyclone Bola with a lowest pressure of approx 980 mbar. Note that this pressure must be in the area of interest (i.e. over the southern beaches) for the surge to be of the magnitude assumed.

The wind driven surge component is dependent on the seabed profile for miles offshore, but is particularly dependent on how quickly the seabed rises. Using a simplified surge assessment given in "Introduction to Coastal Engineering and Management" by J.W. Kamphuis, and using a seabed profile derived from the LINZ hydrographic chart NZ56, the required wind speed to develop a 0.45 metre surge is in excess of 150 km/h – which are hurricane force winds.

The conclusion from the above is that the 0.9 metre figure used is very conservative.

The wave setup figure is calculated from the US Army Corps of Engineers (USACE) Coastal Engineering Manual, but the run up figure is taken as 70% of the significant wave height. This is apparently on the recommendation of the MfE in their 2003 draft guidance document. However, the latest version of the same document now recommends that the methodology given in the USACE manual (Document EM 1110-2-1100 Part II, Chapter 4, Page 18) for wave run up should be used. A quick calculation based on the USACE manual shows that wave run up is closer to 35% of the significant wave height for the beach slope at Mangakuri as presented by T&T. The USACE manual also states that the run up calculation INCLUDES the wave set up. Using a significant wave height of 5.4 metres, this means that T&T have used a figure of 3.8 metres for combined run up and set up. Using the 35% figure derived from the USACE manual, this figure may be as low as 1.9 metres, which is significantly less than T&T's recommendation. Furthermore, the USACE manual recognizes that the calculation is itself very conservative, and may **overestimate** the actual run up by a factor of 2 as the formulae have been derived for planar, **impermeable** sandy beaches. Obviously most sandy beaches are not impermeable!

For Mangakuri, the EIRZ level recommended by T&T is 16.3 metres. This implies that waves are running up into a majority of the houses at the beach. In the last 40 years the wave run up has got no further than the dune area except in a few isolated areas (access tracks, low lying breaks in the dunes), and that includes during Cyclone Bola. The area behind the dunes is higher than the beach area, so there has been very little flooding behind the dunes. The T&T conclusion, therefore, does not seem reasonable in light of actual experience at Mangakuri.

Further comparison is made with a design completed by T&T for Moanataiari subdivision in Thames where the 1 in 50 year inundation level was calculated to be 4.1 metres above MSL (Duder et al (2000)), compared to the 6.3 metres proposed for Mangakuri and the 5.4 metres proposed for Napier.

The conclusion from the above is that the inundation levels recommended by T&T are extremely conservative. Based on observations by local residents over 40 – 50 years, these inundation levels do not seem reasonable. Based on publicly available information, there may be better ways to model the inundation zones that with the simplistic assumptions made to date (Cheung et al (2003))

Conclusion

Having reviewed the results presented by Tonkin and Taylor, and completed some research based on their reference documents, it is quite evident that the recommended hazard zones are very conservative. The CERZ, as currently proposed, allows for a level of annual erosion that can be expected to occur only once in 740 years. If the factor of safety, as defined by T&T, is applied then the level of annual erosion will only occur once in almost 11,300 years. This compares with the Building Act requirements of designing for 1 in 50 year events, and various council plan requirements of designing for 1 in 100 year events. All of the above also assumes that the statistics from Waimarama are applicable to the southern beaches, which has not been conclusively proven yet.

With respect to the inundation levels it is also evident that T&T have used simplified assessments, and made very conservative assumptions. A relatively straightforward calculation, using the MfE recommended information source, shows that the proposed inundation levels may be overestimated by 1.9 metres, or even more.

Overall the proposed coastal plan will impose restrictions on property owners at the beaches if they happen to own property within the defined hazard zones. These restrictions will have a significant impact on the lifestyle choices of the property owners, and their ability to upgrade their properties. These hazard zones have been defined very conservatively and it is suggested that the council must be confident that the impact they will have on the lives of the local residents is fully justified.

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"You can get anything off the internet!"

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