REPORT

Gisborne District Council

Wainui Beach Management Strategy
Detailed screening of potential options

Tonkin & Taylor

ENVIRONMENTAL AND ENGINEERING CONSULTANTS

REPORT

Gisborne District Council

Wainui Beach Management Strategy - Detailed screening of potential options

Report prepared for:

GISBORNE DISTRICT COUNCIL

Report prepared by:

Tonkin & Taylor Ltd

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Executive summary

This report was commissioned by Gisborne District Council to assist the Council to identify options to manage erosion at Wainui Beach. It is intended to inform the review of the Wainui Beach Management Strategy (WBMS), which is to address this issue.

The report provides a detailed screening of potential options, focusing on engineering options ('hard' and 'soft') that provide protection against erosion following on from initial screening that has already been completed. The following options were considered the most likely based on the results of the preliminary screening (in decreasing order):

- Prohibition of new development to areas landward of the 100 year Hazard Zone
- Cobble berm revetment
- Dune enhancement
- Emergency geobag protection
- Asset relocation/abandonment
- Rock revetment
- Beach nourishment.

The options were assessed against the following criteria:

- implementation timescale (0-20, 20 to 50, 50 to 100 years)
- effective life
- "laws of the coast" (consider the whole beach)
- "laws of the coast" (maintain and enhance sand flow)
- enhance and maintain public and private access
- public and private property protection
- protection of natural environment dunes/backshore
- protection of natural beach/offshore (including surf breaks)
- cultural/heritage values acknowledged
- relative cost per 100 m
- supported by research evidence.

The resulting assessment is included in a table in Appendix B for further consideration by the committee. This report also identifies that additional studies and investigations would be required to further refine design and costs.

1 Introduction

This report was commissioned by Gisborne District Council to assist the Council to identify options to manage erosion at Wainui Beach. It is intended to inform the review of the Wainui Beach Management Strategy (WBMS), which is to address this issue.

The report provides a detailed screening of potential options, focusing on engineering options ('hard' and 'soft') that provide protection against erosion. It is expected that other work will be done to investigate landuse options to avoid and reduce exposure to the hazards e.g. prohibiting new development and asset relocation.

A preliminary screening of options has already been undertaken by the Council-community working group for the strategy, from which a number of engineering options have been discounted. This detailed screening of engineering options provides further information to identify potential 'better' options for further consideration.

2 Detailed Screening of Potential Options

2.1 Area delineation

The zones identified in the original WBMS have been reviewed and revised based on a combination of geology, levels and erosion evidence. Reliance has been made of the hazard assessment reports of Gibb (2001), beach profile data received from GDC and the results of the Working Group Meeting. We have identified which existing beach profile data provide an indication of shoreline movement within each delineated area.

- Section 1 – Unchanged from WBMS. Sea cliff area south of the old steel groyne no. 28. No representative surveyed profiles.
- Section 2 – Unchanged from WBMS. Sea cliff area between groyne no. 28 and the Tuahine Crescent accessway. Representative Beach Profile No. 1.
- Section 3A – Tuahine Accessway to 44 Murphy Road. Inferred narrow sand dune backed by sea cliff. Representative Beach Profile No. 2.
- Section 3B – 44 Murphy Road to Wainui Stream Centreline. Southern portion of the lower lying sandy stream delta. Representative Beach Profile No. 3.
- Section 4A – Wainui Stream to 28 Pare Road. Northern portion of the lower lying sandy stream delta. Representative Beach Profile No. 4.
- Section 4B – 28 Pare Road to Oneroa Road. Inferred predominantly sandy dune. Representative Beach Profile No. 5.
- Section 5 – Oneroa Road to 123 Wairere Road. Representative Beach Profile No. 6, 7 and 8.
- Section 6 – 123 Wairere Road to Hamanatua Stream. Representative beach profiles No. 8a and 8b.
- Section 7A – Hamanatua Stream to Beach Profile 10. Representative Beach Profile No. 10.
- Section 7B – Beach Profile No. 10 to Makorori Headland. Representative Beach Profile No. 11, 12, 13 and 14.

A figure showing the area delineation is included in Appendix A. We note that the specific location of the zones may vary dependent on more detailed investigations, such as establishing the ground conditions landward of the dune systems may result in a change in the sea cliff/sand transition.

2.2 Options to consider from preliminary screening

The following options were considered the most likely based on the results of the preliminary screening undertaken by the Council-community working group:

- Prohibition of new development to areas landward of the 100 HZ
- Cobble berm revetment
- Dune enhancement
- Emergency geobag protection
- Asset relocation/abandonment
- Rock revetment
- Beach nourishment.

These options are described in the following section in relation to the assessment criteria. As stated, the focus of this report is on the engineering options.

2.3 Assessment criteria

A survey of Key Stakeholder Forum (KSF) members was completed and they wereasked them to try to prioritise the issues that they had identified previously. The survey also asked what the KSF thought was important for the strategy to provide.

From these surveys and other KSF agreements, the following criteria have been selected to be used when assessing the better options:

- implementation timescale (0-20, 20 to 50, 50 to 100 years)
- effective life
- “laws of the coast” (consider the whole beach)
- “laws of the coast” (maintain and enhance sand flow)
- enhance and maintain public and private access
- public and private property protection
- protection of natural environment dunes/backshore
- protection of natural beach/offshore (including surf breaks)
- cultural/heritage values acknowledged
- relative cost per 100 m
- supported by research evidence.

It is anticipated that further detailed consideration will be made of the better options identified in this report against the community and legislative criteria.

Summary details of the assessment are included in the spreadsheet included in Appendix B and on Figures A1 and A2 in Appendix A. A discussion of each option is also included below.

2.4 Discussion of Options

2.4.1 Landuse Options to Avoid and Reduce Exposure

It is understood that the Council-community working group for the WBMS will be investigating existing and potential landuse options to avoid and reduce the exposure of the community to erosion, e.g. prohibiting new development and relocating/abandoning assets.

Such options have not been considered in detail as the focus of this report is engineering options. However, they must be considered alongside engineering options.

As preliminary comments we note that strategies to reduce increasing the risk, e.g. by preventing further development in hazard zones, are fundamental and supported by the New Zealand

Coastal Policy Statement (NZCPS). Consideration should be given to ensure the effectiveness of existing planning controls. Asset relocation and abandonment is likely to need serious consideration, particularly in the longer term and in the extreme risk hazard zone. Due to the coastal processes evident, asset relocation and abandonment is unlikely to be required in the central beach area (Sections 5 to 7A) for the next few decades, but is possibly required to be considered 20 to 50 years from the present.

2.4.2 Cobble berm revetment

A cobble berm revetment replicates the natural cobble beach that exists under parts of the beach at present and based on anecdotal record, was more significant, particularly towards the southern end of the beach. This option was discussed in the previous report and has been referred to as the Komar cobble berm. However, we would be proposing a more dynamic revetment, constructed with uniform rocks which could deform and adjust with the wave climate. The advantage of this system is that it is able to adjust its profile to wave energy and provides a dynamically stable energy dissipater at the top of the beach. It requires suitable sized rock preferably rounded cobbles, but graded quarried rock could be used. The availability of the material may affect costs. Rock size is smaller than required for revetments, which are required to be statically stable and not move. As this option most closely represents the natural system that was originally present, consenting should be more straightforward than as with conventional structural protection options.

This option has the potential to comply with the majority of statutory requirements, provided it was used along areas with a relatively small sand storage landward (i.e. adjacent to sea cliff or predominantly sea cliff material) or was of sufficient height to provide dune toe support, rather than full protection against wave forces).

We note that the cobbles are likely to be quarried and therefore will be considerably more angular than existing sea cobbles. This may have a negative impact on public access when beach levels are low. Assuming a crest elevation of around 2.5 m and a 5 m wide berm and 5(H):1(V) slopes extending to around the 1 m depth contour, some 7.5 m^3 to 10 m^3/linear m of cobbles would be required. Works would need to include removal of existing structures, forming the subgrade and placement of a geotextile filter fabric prior to placing the cobbles. Based on local advice from Downers graded rock costs would be in the order of \$90/m^3 (placed). A linear rate, including the other factors would be in the order of \$1,500 to \$2,500/linear m. Planting of the bank above the cobble revetment should be carried out. This is not included in the above rate, but we would anticipate a similar cost range for the dune planting identified above.

In the first instance we see this option being most appropriate in those sea cliff backed areas of Section 2 and 3A in the short term (year 0 to 10), although it is likely that this approach would soon be extended to include areas 3B to 4B (in years 10 to 20), although this would depend on the stream training works that may reduce the need of the cobbles in the vicinity of the stream mouth (Section 3B and 4A). The revetment is considered compliant with the assessment criteria in areas where erosion is acting on the sea cliff sediments, but less appropriate in areas where dunes and sandy backshores are present due to the impoundment of sand behind the revetment.

If erosion continues as a result of ongoing sea level rise, and this is not offset by the dune enhancement works in these areas, this management approach may need to be extended further to the north and south providing time for land based management approaches to occur.

2.4.3 Dune enhancement

Dune enhancement by dune shaping and planting enables the trapping of wind-blown sand to occur within the dynamic beach/dune system and hence reducing sand loss by Aeolian transport.

This option has relatively low costs and is a proven approach to improve dune resilience and store sand to respond to storm erosion events. It is consistent with the NZCPS (2010). Costs of this option will vary depending on the effort required to remove inappropriate vegetation, shaping of the dune, the number of plants and whether this is done under commercial contract or with community involvement (volunteers). It is also assumed that a minimum extent of around 100 m would need to be done. Cost ranges of between $100 and $300 per linear metre are possible.

Dune enhancement is less suitable both in areas subject to long-term erosion trends and in areas where there is insufficient sand in the system or available area (due to dwellings etc). It may become less effective over time because of increasing relative sea levels. However, it meets the majority of the assessment criteria requirements.

Dune enhancement is only considered viable in areas where there are reasonable sand volume and space landward of the existing dune toe, although this space could be private or public land. Therefore this is primarily limited to Sections 4B to 7A, although if required 7B could also be considered. Dune enhancement would be immediately initiated in these areas to increase the buffering ability and resilience of the dune and to retain sand in the upper beach system.

2.4.4 Emergency geobag protection

Geobag walls are sand filled geotextile containers that are stacked to form a wall. Due to their relatively low impermeability they perform similarly to a near vertical impermeable seawall constructed from grouted rock, concrete or timber. They have similar characteristics as conventional seawalls and require adequate foundations, end details to prevent end effects and a reasonable crest elevation to prevent overtopping scour and toppling failure.

They have a shorter design life compared to conventional seawalls as a result of fabric deterioration due to UV and they are prone to damage and can be vandalised. They are also more suitable in areas of reasonably low wave height (H_s < 1.5 m). However, they may be included as part of an overall management strategy to address localised rip and storm erosion effects. If used in this way they would have a relatively low cost as they would only be applied to those critical erosion areas to provide protection over a relatively short time period which would be appropriate given their relatively short design life. As part of a wider management strategy, the use of short-term structures would be consistent with statutory requirements.

From a constructability perspective this option would need heavy duty geotextile filter fabric to reduce the risk of migration of fines between the stacked bags. It is assumed that a wall of at least 100 m long would need to be provided for and at least 3 to 4 bags high (retained height of 2.0 m to 2.6 m) of the 2.5 m^3 Elcorock bags (i.e. 180 to 230 bags). These bags need special filling and lifting equipment that can be fitted to conventional hydraulic excavators and would need to be filled from a land based sand source (i.e. not taking sand from the beach). However, for emergency response a stockpile of bags would be required in close proximity, with the bags protected from UV and a lifting arm also available at short notice.

Installation would need to be done during the storm events at periods of low tide when access is possible. A construction risk would be high tide damage of the placed bags and the need to restack/protect the placed bags. Based on previous costings this structure could cost in the order of $250,000 to $350,000 for a 100 m length ($2,500 to $3,500 per linear metre). It is likely that these structures would be retained, rather than removed when sand returned to the system, so in effect would become permanent installations.

While noting our concerns on the constructability and cost of this type of emergency protection system, it is an option that could be considered as a current method to protect localised areas of the shoreline that become an erosion focus due to rip currents and/or storm events. This option would apply to Sections 2 to 7A, but would not be necessary in Section 1 or 7B.

2.4.5 Rock revetment

A rock revetment formed from a geotextile filter fabric overlain by a cushioning layer of small rock and protected from wave energy by rock armour placed on a slope is a traditional solution to managing shoreline erosion. They are conventional land protection structures that have been used widely internationally and there are detailed standards for their design. The high porosity provided by the voids between the rock, together with the slope provide energy dissipation to wave energy reducing the reflected wave and wave overtopping. Rock armour slopes of around 3(H):1(V) to 4(H):1(V) perform similar to natural beach systems with regard to energy dissipation and wave reflection characteristics.

The available rock has low density and low durability. It is likely that these structures will need frequent maintenance. Capital costs are likely to be slightly greater than the cobble berm as grading for the larger rock may be more time consuming. A linear rate of between $2,000 and $3,000 has been assumed.

Structural protection is considered the least preferred approach by the NZCPS (2010) and consent approval can be difficult. The revetment is considered compliant with the assessment criteria in areas where erosion is acting on the sea cliff sediments, but less appropriate in areas where dunes and sandy backshores are present due to the impoundment of sand behind the revetment.

The timing and considerations for implementation of this option is the same as that of the cobble revetment. In the first instance we see this option being most appropriate in those sea cliff backed areas of Section 2 and 3A in the short term (year 0 to 10), although it is likely that this approach would soon be extended to include areas 3B to 4B (in years 10 to 20), although this would depend on the stream training works that may reduce the need of the revetment in the vicinity of the stream mouth (Section 3B and 4A). If erosion continues as a result of ongoing sea level rise, and this is not offset by the dune enhancement works in these areas, this management approach may need to be extended further to the north and south providing time for land based management approaches to occur.

2.4.6 Beach nourishment

Beach nourishment requires the importing of sand to increase the volume of sand stored on the beach and dunes. The volumes required to provide an erosion buffer would be significant at Wainui and there is no readily available source, so cost for this option would be high. Based on our previous beach nourishment experience, unit rates could vary from $50/$m^3$ to more than $100/$m^3$. Examining beach profile fluctuations, some 50 to 100 m^3 per metre of beach would be required to provide for the average to maximum range of natural fluctuations observed from 2000 to the present and this would need to be placed at least over 1000 m to 1500 m of shoreline (i.e. 75,000 m^3 to 100,000 m^3 sand volume required). A linear rate of between $4,500/m and $6,500 m would be expected, if a reasonable source of suitable sand from outside and offshore from the existing beach system was available. Otherwise, rates could be considerably higher if the sand source was further away.

While beach nourishment is a proven option and meets the majority of the assessment criteria, it is likely that storm and rip induced erosion would still occur. Beach nourishment may have a negative impact on existing bars and shoals and nearshore ecology and cultural values impacts would need to be carefully considered.

This option is suitable with other works, such as dune enhancement and emergency response. However, it would be necessary to have an ongoing supply to provide protection against sea level rise effects. There may be issues with the placed sand having an impact on existing sand bars and there may be consenting risks associated. Therefore, this option is unlikely to provide an immediate solution. Taking into account the studies, analysis and consenting process that would

be required for this option, consideration of this approach as part of the strategy would take place 20 to 50 years from the present, although it is possible that this option may prove impractical.

2.4.7 Training groynes

Training groynes are possible options around the mouths of the existing streams to reduce the range of movement at the stream mouth. This will assist in dune development adjacent to the structures, as evident from the southern training of the Hamanatua Stream.

The structures should not extend significantly onto the beach system and preferably extend to the toe of the adjacent dune systems. This will reduce the design forces and also reduce effects on the adjacent coastal processes. Costs for these structures are expected to be in the order of $1,000 to $2,000 per linear metre.

These structures are considered relatively neutral in terms of coastal process effects and have a localised benefit to property and the dune systems. These training works should be considered in the first 10 years of the strategy.

3 Monitoring and further studies and investigations

The overall strategy should provide both a temporal and spatial set of approaches. We believe it should focus on landuse/planning to avoid and reduce exposure to the hazard and dune management, but with some areas of physical works required in the first 10 years to protect against the most significant erosion issues. We understand further consideration will be given to the landuse/planning options.

Further information is required to confirm the ground conditions and the volume and location of sand in the backshore area, as cobble and rock revetments placed along a predominantly sea cliff backed shore will have much less adverse effect than in areas where these structures could impound significant sand volumes that would otherwise be released to the beach.

Existing beach monitoring should be continued and focussed on the representative beach profiles within each section. This will enable an evaluation of effects and changes of the various parts of the management strategy and also to determine when physical works may be required.

Climate change monitoring, particularly with regard to ongoing sea level rise and the potentially offsetting geological uplift should also be carried out. It is not expected that Council undertake this monitoring directly, but remain engaged with other groups (such as the Port company, GNS, NIWA and the Intergovernmental Panel on Climate Change) who are collating such data.

Depending on the options selected there will also be a need for more focussed studies on their costs and benefits and consistency with the community and legislative criteria.

4 Applicability

This report has been prepared for the benefit of Gisborne District 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 Ltd by:
.....	.....
Richard Reinen-Hamill	Tim Fisher
Senior Coastal Engineer	Project Director

RRH

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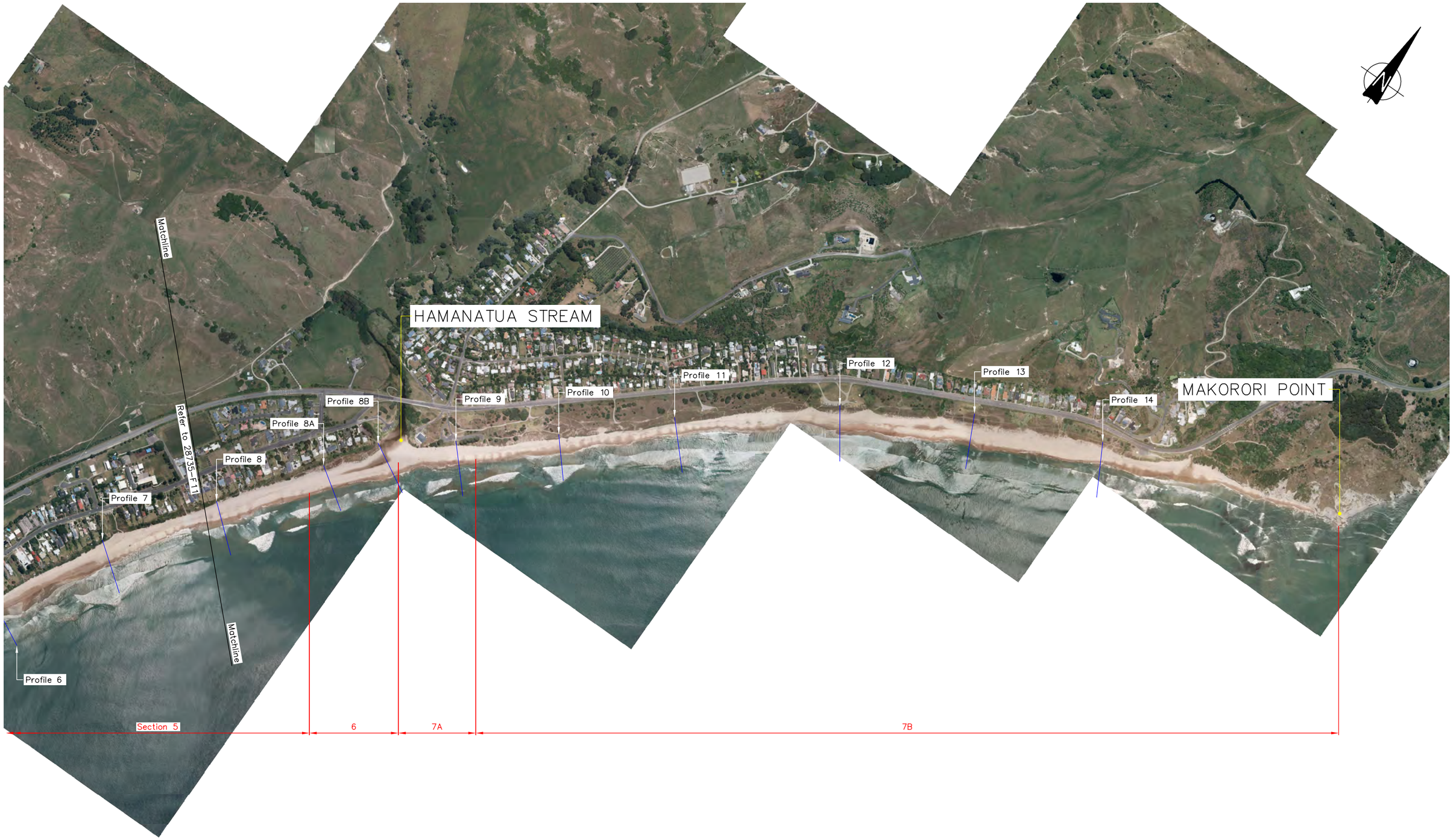
Appendix A: Plan



NOTES:

1. Aerial photo supplied by Gisborne District Council

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GISBORNE DISTRICT COUNCIL
WAINUI BEACH MANAGEMENT STRATEGY

Plan – Sheet 2

FIG. No. Figure A2

REV. 0

NOTES:

1. Aerial photo supplied by Gisborne District Council

SCALE 1: 10,000

0 100 200 300 400 500 (m)

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GISBORNE DISTRICT COUNCIL
WAINUI BEACH MANAGEMENT STRATEGY

Plan – Sheet 1

FIG. No. Figure A 1

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Appendix B: Summary spreadsheet

Area	Description	Options	Appropriate for this section	Timescale	Effective life	Consider the whole beach	Enhance and maintain public and private access	Maintain and enhance sand flow	Property protection	Dune and backshore	Beach and offshore	Cultural/ heritage	Relative cost ($/lin m)	Research evidence
Section 1	Eroding seacliff with no substantial beach system and mainly cobble foreshore	Prohibition of new development	Yes	0 - 100	100+	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes
		Cobbble berm revetment	Yes	20 - 50	20 - 50	Yes	Maintain	Maintain	Yes	N/A	Yes	Yes	$1500 to $2500	Yes
		Dune enhancement	No	N/A									$100 to $300	
		Emergency geobag protection	No	N/A									$2500 to $3500	
		Asset relocation/abandonment	Yes	0 - 100	100+	Yes	Yes	Yes	No	Yes	Yes	Uncertain		Yes
		Rock revetment - full	Yes	20 - 50	20 - 50	Yes	Maintain	Maintain	Yes	N/A	Yes	Yes	$2000 to$3000	Yes
		Beach nourishment	No	N/A									$4500 to $6500	
		Other - stream training	No	N/A									$1000 to $2000	
Section 2	Erodible seacliff with no substantial dune system	Prohibition of new development	Yes	0 - 100	100+	Yes	No	No	No	No	No	Uncertain		Yes
		Cobbble berm revetment	Yes	0 - 10	20 - 50	Yes	Yes	Maintain	Yes	Planting possible	Yes	Yes	$1500 to $2500	Yes
		Dune enhancement	No	N/A									$100 to $300	
		Emergency geobag protection	Possible	0 - 50	<5	No	Yes	No	Yes	Yes	No	Uncertain	$2500 to $3500	Yes
		Asset relocation/abandonment	Yes	20 - 50	100+	Yes	Yes	Yes	No	Yes	Yes	Uncertain		Yes
		Rock revetment - full	Yes	0 - 10	20 - 50	Yes	Maintain	Maintain	Yes	Yes	Yes	Yes	$2000 to$3000	Yes
		Beach nourishment	No	N/A									$4500 to $6500	
		Other	No	N/A									$1000 to $2000	
Section 3A	Narrow dune fronting seacliff, ephemeral beach	Prohibition of new development	Yes	0 -100	100+	Yes	No	Yes	Yes	Yes	Yes	Yes		Yes
		Cobbble berm revetment	Yes	0-10	20-50	Yes	Maintain	Maintain	Yes	Yes	Yes	Yes	$1500 to $2500	Yes
		Dune enhancement	No	N/A									$100 to $300	
		Emergency geobag protection	Possible	0 - 50	<5	No	Yes	No	Yes	Yes	No	Uncertain	$2500 to $3500	Yes
		Asset relocation/abandonment	Yes	20 - 50	100+	Yes	Yes	Yes	No	Yes	Yes	Uncertain		Yes
		Rock revetment - full	Yes	0 - 10	20 - 50	Yes	No	Yes	Yes	N/A	Yes	Yes	$2000 to$3000	Yes
		Beach nourishment	Possible	20 - 50	<10	Uncertain	Enhance	Enhance	No	Yes	Uncertain	Uncertain	$4500 to $6500	Unproven
		Other	No	N/A									$1000 to $2000	
Section 3B	Southern edge of Wainui Stream delta	Prohibition of new development	Yes	0 -100	100+	Yes	No	No	No	No	No	Uncertain		Yes
		Cobbble berm revetment	Yes	10 - 20	20 - 50	Yes	Maintain	Maintain	Yes	Planting possible	Yes	Yes	$1500 to $2500	Yes
		Dune enhancement	No	N/A									$100 to $300	
		Emergency geobag protection	Possible	0 - 50	<5	No	Yes	No	Yes	Yes	No	Uncertain	$2500 to $3500	Yes
		Asset relocation/abandonment	Yes	20 - 50	100+	Yes	Yes	Yes	No	Yes	Yes	Uncertain		Yes
		Rock revetment - dune toe	Yes	10 - 20	20 - 50	Yes	No	Maintain	Yes	Yes	Yes	Yes	$2000 to$3000	Yes
		Beach nourishment	Possible	20 - 50	<10	Uncertain	Enhance	Enhance	No	Yes	Uncertain	Uncertain	$4500 to $6500	Unproven
		Other - stream training	Yes	0 - 10	20 - 50	Local effect	Maintain	Maintain	Yes	Yes	Neutral	Uncertain	$1000 to $2000	Yes
Section 4A	Northern edge of Wainui Stream delta	Prohibition of new development	Yes	0 -100	100+	Yes	No	Yes	Yes	Yes	Yes	Yes		Yes
		Cobbble berm revetment	Yes	10 - 20	20 - 50	Yes	Maintain	Maintain	Yes	Planting possible	Yes	Yes	$1500 to $2500	Yes
		Dune enhancement	No	N/A									$100 to $300	
		Emergency geobag protection	Possible	0 - 50	<5	No	Yes	No	Yes	Yes	No	Uncertain	$2500 to $3500	Yes
		Asset relocation/abandonment	Yes	20 - 50	100+	Yes	Yes	Yes	No	Yes	Yes	Uncertain		Yes
		Rock revetment - dune toe	Yes	10 - 20	20 - 50	Yes	No	Maintain	Yes	Yes	Yes	Yes	$2000 to$3000	Yes
		Beach nourishment	Possible	20 - 50	<10	Uncertain	Enhance	Enhance	No	Yes	Uncertain	Uncertain	$4500 to $6500	Unproven
		Other - stream training	Yes	0 - 10	20 - 50	Local effect	Maintain	Maintain	Yes	Yes	Neutral	Uncertain	$1000 to $2000	Yes
Section 4B	Predominantly sand dune and sandy beach	Prohibition of new development	Yes	0 -100	100+	Yes	No	No	No	No	No	Uncertain		Yes
		Cobbble berm revetment	Yes	10 - 20	20 - 50	Yes	Maintain	Maintain	Yes	Planting possible	Yes	Yes	$1500 to $2500	Yes
		Dune enhancement	Yes	0 - 50	5 - 10	Yes	Yes	Yes	Limited	Yes	Yes	Yes	$100 to $300	Yes
		Emergency geobag protection	Possible	0 - 50	<5	No	Yes	No	Yes	Yes	No	Uncertain	$2500 to $3500	Yes
		Asset relocation/abandonment	Yes	20 - 50	100+	Yes	Yes	Yes	No	Yes	Yes	Uncertain		Yes
		Rock revetment - dune toe	Yes	10 - 20	20 - 50	Yes	No	Maintain	Yes	Yes	Yes	Yes	$2000 to$3000	Yes
		Beach nourishment	Possible	20 - 50	<10	Uncertain	Enhance	Enhance	No	Yes	Uncertain	Uncertain	$4500 to $6500	Unproven
		Other	No	N/A									$1000 to $2000	
Section 5	Predominantly sand dune and sandy beach	Prohibition of new development	Yes	0 - 100	100+	Yes	No	No	No	No	No	Uncertain		Yes
		Cobbble berm revetment	Yes	20 - 50	20 - 50	Yes	Maintain	Limited	Yes	Yes	Limited	Yes	$1500 to $2500	Yes
		Dune enhancement	Yes	0 - 50	5 - 20	Yes	Yes	Yes	Yes	Yes	Yes	Yes	$100 to $300	Yes
		Emergency geobag protection	Possible	0 - 50	<5	No	Yes	No	Yes	Yes	No	Uncertain	$2500 to $3500	Yes
		Asset relocation/abandonment	Yes	50 - 100	100+	Yes	Yes	Yes	No	Yes	Yes	Uncertain		Yes
		Rock revetment - dune toe	Yes	20 - 50	20 - 50	Yes	No	Limited	Yes	Yes	Limited	Yes	$2000 to$3000	Yes
		Beach nourishment	Possible	20 - 50	<10	Uncertain	Enhance	Enhance	No	Yes	Uncertain	Uncertain	$4500 to $6500	Unproven

		Other	No	N/A			Maintain						$1000 to $2000	
Section 6	Sandy dune accreted as a result of Haumanatua Stream training	Prohibition of new development	Yes	0 - 100	100+	Yes	No	No	No	No	No	Uncertain		Yes
		Cobbble berm revetment	Yes	50 - 100	20 - 50	Yes	Maintain	Limited	Yes	Yes	Limited	Yes	$1500 to $2500	Yes
		Dune enhancement	Yes	0 - 50	20 - 50	Yes	Yes	Yes	Yes	Yes	Yes	Yes	$100 to $300	Yes
		Emergency geobag protection	Possible	0 - 50	<5	No	Yes	No	Yes	Yes	No	Uncertain	$2500 to $3500	Yes
		Asset relocation/abandonment	Yes	50 - 100	100+	Yes	Yes	Yes	No	Yes	Yes	Uncertain		Yes
		Rock revetment	Yes	50 - 100	20 - 50	Yes	No	Limited	Yes	Yes	Limited	Yes	$2000 to$3000	Yes
		Beach nourishment.	Possible	20 - 50	<10	Uncertain	Enhance	Enhance	No	Yes	Uncertain	Uncertain	$4500 to $6500	Unproven
		Other - stream training	Yes	0 - 10	20 - 50	Local effect		Yes	Yes	Yes	Neutral	Yes	$1000 to $2000	Yes
Section 7A	Sandy dune	Prohibition of new development	Yes	0 - 100	100+	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes
		Cobbble berm revetment	Yes	50 - 100	20 - 50	Yes	Limited	Limited	Yes	Yes	Limited	Yes	$1500 to $2500	Yes
		Dune enhancement	Yes	0 - 50	20 - 50	Yes	Yes	Yes	Yes	Yes	Yes	Yes	$100 to $300	Yes
		Emergency geobag protection	Possible	0 - 50	<5	No	Yes	No	Yes	Yes	No	Uncertain	$2500 to $3500	Yes
		Asset relocation/abandonment	Yes	50 - 100	100+	Yes	Yes	Yes	No	Yes	Yes	Uncertain		Yes
		Rock revetment	Yes	50 - 100	20 - 50	Yes	No	Limited	Yes	Yes	Limited	Yes	$2000 to$3000	Yes
		Beach nourishment.	Possible	20 - 50	<10	Uncertain	Enhance	Enhance	No	Yes	Uncertain	Uncertain	$4500 to $6500	Unproven
		Other - stream training	Yes	10 - 20	20 - 50	Local effect	Yes	Yes	Yes	Yes	Neutral	Yes	$1000 to $2000	Yes
Section 7B	Sandy dune	Prohibition of new development	Yes	0 -100	100+	Yes	No	No	No	No	No	Uncertain		Yes
		Cobbble berm revetment	No	N/A									$1500 to $2500	
		Dune enhancement	Yes	20 - 100	20 - 50	Yes	Yes	Yes	Yes	Yes	Yes	Yes	$100 to $300	Yes
		Emergency geobag protection	No	N/A									$2500 to $3500	
		Asset relocation/abandonment	Yes	50 - 100	100+	Yes	Yes	Yes	No	Yes	Yes	Uncertain		Yes
		Rock revetment	No	N/A									$2000 to$3000	
		Beach nourishment.	Yes	50 - 100	<10	Uncertain	Enhance	Enhance	No	Yes	Uncertain	Uncertain	$4500 to $6500	Unproven
		Other	No	N/A									$1000 to $2000	

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