22 May 2006

Hawke's Bay Regional Council
Private Bag 6006
Napier

Attention: Anna Madarasz

CAWTHRON

RE: Envirolink, Beach Monitoring and Management Plan

Dear Anna,

Accompanying this letter is the initial advice on setting up a beach monitoring and management plan for the Hawke's Bay region. As you will see, the plan consists of a simple set of tools that will allow resource managers to classify beaches and develop defensible and cost-effective monitoring programmes without the need for additional expertise. At this initial stage it is semi-complete and could be completed through another Envirolink grant.

Feel free to contact me if you have any questions or comments regarding the approach.

Regards,

Dr Barry Robertson
Manager and Scientist – Coastal & Estuarine Group
Cawthron Institute

Reviewed by Leigh Stevens, Coastal Group Scientists, Cawthron Institute

Monitoring and Managing Beach and Dune Condition, Hawke's Bay Region

Hawke’s Bay Regional Council March 2006 Envirolink Funded Project

1 Brief

Through the Envirolink Fund administered by FRST, Hawke’s Bay Regional Council (HBRC) has sought expert advice from Dr Barry Robertson and Leigh Stevens (Cawthron Institute) on how to best develop a defensible and cost effective monitoring programme for sandy/gravel beaches in the Hawke’s Bay Region. The focus of the project will be to define a monitoring programme includes the most appropriate sites, parameters, and temporal scales for monitoring. Particular focus will go onto how to assess and monitor the impacts of coastal developments. The programme will be developed using existing information, including the “National Estuary Monitoring Protocol” (Robertson et.al. 2002), the “Broad Scale Mapping of the Coastline of the Hawke’s Bay Region” (Stevens and Robertson 2005) and other Envirolink funded coastal monitoring work being completed for Environment Southland. The outcome will be a simple set of tools that will allow resource managers to classify beaches and develop defensible and cost-effective monitoring programmes without the need for additional expertise.

2 Introduction

The HBRC has the mandate to monitor and manage coastal resources (which includes beaches) such that they are utilised in a sustainable fashion. Such sustainable use is particularly important in the face of increasing coastal zone development and the increasing vulnerability of coastal systems to environmental disturbance. A recent review of the NZ Coastal Policy Statement (Risier 2004) found Regional Council’s to be poor at monitoring the condition of coastal resources (e.g. beach ecosystems in response to property development and other stressors) and assessing the degree to which Council’s plans and policy statements have influenced their condition.

To effectively monitor and manage coastal resources a Regional Council must monitor environmental pressures and the condition of at-risk coastal resources, and assess results against defensible guideline criteria. If the criteria are breached, the Council must identify and undertake appropriate management. For example, if development plans impinge into shoreline areas and cause adverse effects that exceed guideline criteria, then restrictions will need to be imposed such that management criteria are met. At present Regional Council’s may impose restrictions but often don’t monitor to check that restrictions effectively protect the beach ecosystem.
An effective monitoring, assessment and management programme for sandy/gravel beaches requires a number of steps to be followed. These are outlined in Figure 1 and include: identifying the habitats and their characteristics, their values, stressors, risks,

indicators, guideline criteria and management options. The following sections provide a preliminary review of beach and dune characteristics followed by an outline of each of the steps, including an integrated set of decision matrix tools or tables (as yet only partially completed), one of which accompanies each of the major steps. By using the tables and following through the steps a defensible and cost-effective beach monitoring and management plan is produced. It is anticipated that the final plan will be refined and completed in a second stage.

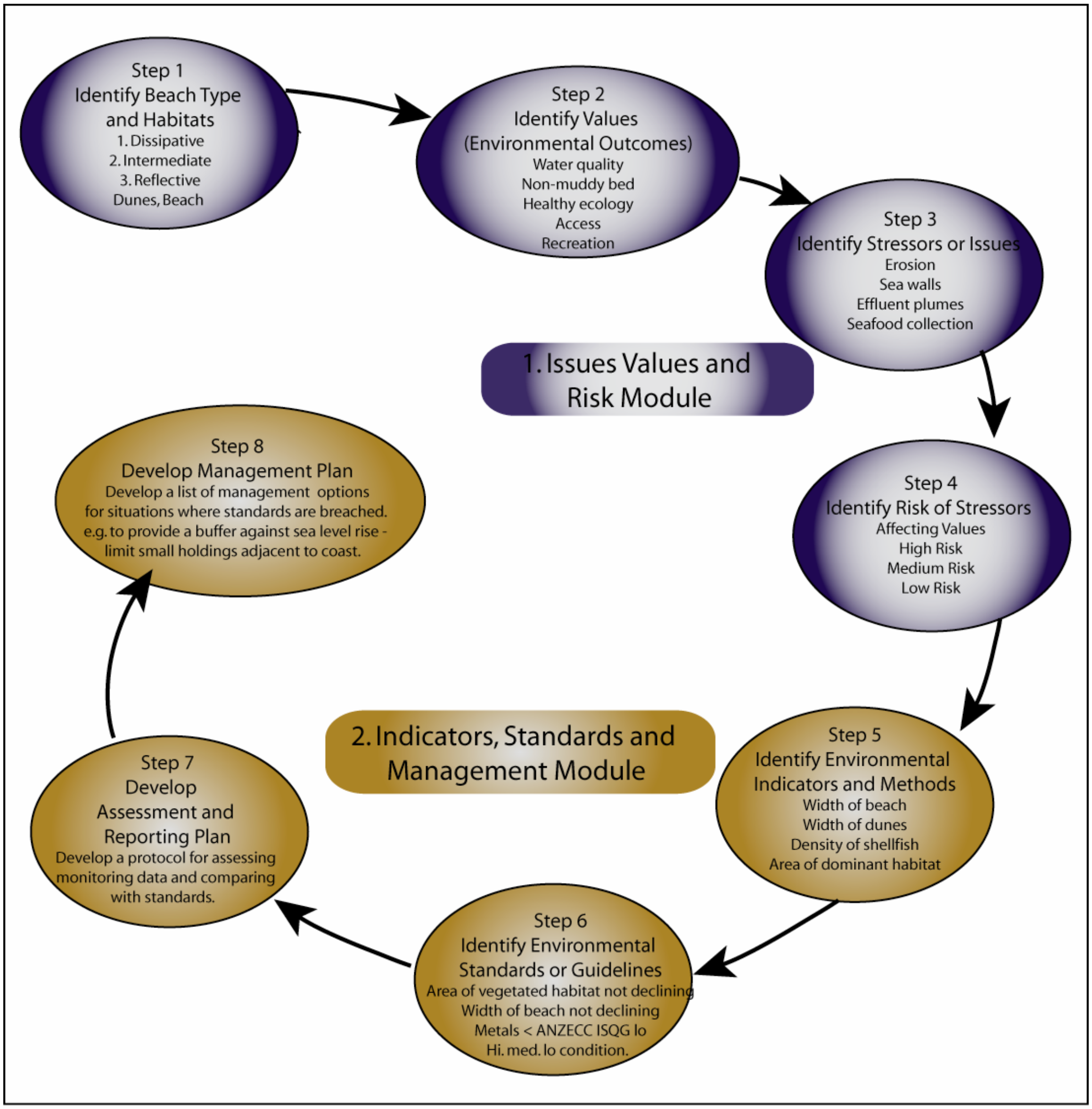

Figure 1. Steps in developing a monitoring, assessment and management plan for sand/gravel beaches in Hawkes Bay region

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3 Beach and Dune Characteristics

3.1 Regional Significance

Beaches and their associated sand dune systems are fragile, dynamic resources that are regionally significant. Throughout the Hawke's Bay region, sandy/gravel beaches (Fig 2) make up approximately 83 km of shoreline, encompassing a wide variety of exposures and beach types (Stevens and Robertson 2005). Approximately 30 percent of the shoreline north of Clifton consists of sandy/gravel beaches, in contrast to 7 percent of the shoreline of the southern Hawke's Bay coast. Most of the sand beaches are located on the Mahia Peninsula and south of Clifton. The coastline behind the beach is generally either bounded by a steep sea cliff or a complex series of undulating sand dunes.

Figure 2. Foreshore erosion at Waimarama Beach (photo supplied by HBRC).

3.2 Typical Beach Features

The general features of a typical beach profile are shown in Figure 3. The beach may be divided into a backshore and a foreshore. The backshore is a terrace above the high water line that slopes gently seaward. It is often convoluted by a series of ridges, or berms, that represent the wash limits of previous storms. The foreshore lies seaward of the backshore. The foreshore is the region of active beach that lies above the low tide line. The lower margin is periodically inundated and exposed by the rise and fall of the tides; the upper margin is bounded by the most seaward berm crest. The foreshore is also called the beach slope or face; it inclines seaward at a steeper angle than does the backshore.

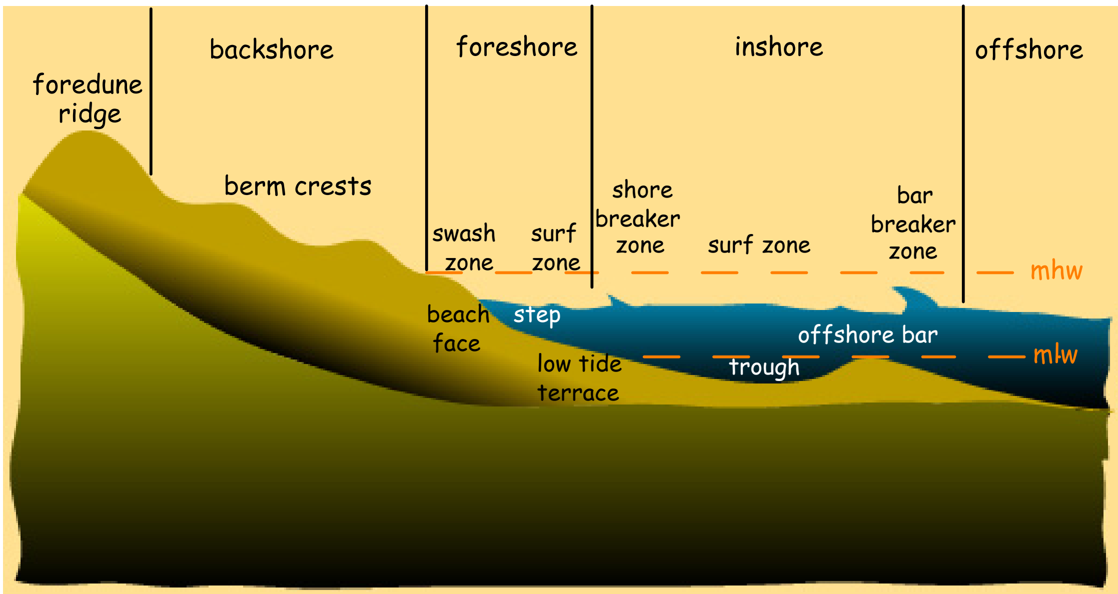

Figure 3. Typical beach profile.

The offshore, or submarine beach, extends from the low tide line to the limits of surf-induced sediment movements. The submarine beach is usually convoluted by one or more sand bars that parallel the shoreline and alternate with deeper troughs. These long-shore ridges may be exposed slightly during low tide.

Coastal sand (and sometimes gravel) dunes form landward of beaches and often have a linear ridge, called a fore dune, that parallels the beach. Landward of the fore dune are back dunes or secondary dunes that have a variety of shapes and relief. Back dunes tend to be lower in height than the fore dune.

Fore dunes act as barriers against the action of waves, tides and salt wind and are a source of sand for the beach during periods of erosion. Their colonisation and consolidation by plants gives them a flexible function as sand traps and self consolidation after exposure to heavy storm waves. Fore dunes that are densely vegetated can protect hind dune habitats and promote more complex and diverse plant communities, however, they may also hinder the natural rolling dune process of dune formation.

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Secondary and tertiary dunes are the products of uninterrupted succession. These provide further protection and the establishment of those critical ecological conditions conducive to promoting the most stable of all stages, the coastal climax forest.

In NZ history, early heavy grazing of dunes resulted in disappearance of dune cover and sand movement inland. To stop the perceived march inland, dune reclamation and boundary plantations were undertaken. Following this stage, and fuelled primarily by the boom in coastal property development, the attention progressed to stopping erosion from the sea-ward side. Dunes in many places are now being actively replanted and sea walls erected.

4 Step 1: Identify Beach Types

In terms their morphology, sand/gravel beaches are defined by just three factors - tide regime, particle size and wave energy – and occur as a range from reflective to dissipative types (Table 1). The type of beach is important in determining beach ecology (Defeo and McLachlan 2005). For example, the number of species decreases as the beach slope and grain size increases. Since macrofauna show clear patterns of response to beach type, we can expect large natural variability in macrofauna populations throughout the beaches of the Hawke's Bay region. In addition, there is generally strong natural variation in abundance within a beach, with greatest numbers in the centre and fewer at the boundaries, even though environmental gradients (e.g. wave exposure and salinity) can cause asymmetries (Defeo and McLachlan 2005).

Table 1 Categories of beach type.

Beach Type	Physical Characteristics	Ecological Characteristics
Dissipative (e.g. ? Beach)	Erosional type of beach. It is generally flat and fronted by a wide surf zone in which waves dissipate much of their energy. It is formed under conditions of large tidal range, high wave energy, fine sand, and tends to be more prevalent at higher latitudes. Its sediments are well sorted (usually fine to medium sand), and it has weak rip currents with undertows. The tidal flat is at the extreme end of dissipative beaches.	Interactions within and between species generally more intense. High level of primary production and a much higher diversity and biomass of macrofauna. Exporters of organic matter. More highly regulated by biological interactions.
Intermediate (e.g. Waimarama Beach)	There are a variety of intermediate state beaches which are characterized by plunging & spilling breakers, steeper than dissipative beaches but less steep than reflective beaches, very mobile, often have rhythmic topography (cusps, welded bars), rip-currents are common, well developed cell circulation.	Intermediate species richness.
Reflective (e.g. mixed sand/gravel beaches Clifton to Whakaari)	Accretional type beach and is formed under conditions of small tides and waves and coarse sand (not very mobile). It has no surf zone and wave energy is reflected back to the sea from waves breaking directly on the steep beach face.	Low primary production and impoverished macrofauna. Lowest species richness. Populations mainly physically controlled. Rely on organic material imported from sea.

Such zonation is generally highly dynamic and not sharply defined. This is attributed to short (hourly) or medium term (seasonal) reactions to environmental conditions, passive transport and sorting by the swash (e.g. pipi recruits getting washed up to the least preferable high tide sands during storms), active micro- habitat selection (e.g. pipi adults digging in to preferred habitat) and interactions within and between species. Such high natural variability means that the design and interpretation of any ecological monitoring must consider carefully the establishment of reference sites and baseline conditions. Intermediate beaches are spatially and temporally the most dynamic (Wright and Short 1984). They can undergo rapid changes as wave height fluctuates, causing reversal in onshore/offshore and alongshore sediment transport.

In order to easily identify the beach type, a simple tool (Tool 1 Beach Type Identifier) has been partially developed.

Tool 1 Beach Type Identifier.

Beach Name	Mean Wave height	Substrate Composition	Width of beach (m)	Slope of Beach Face	Beach Type
Waimarama	Mod	Sand	50m	Moderate	Intermediate

Keys					
Keys	High	Sand	>150m	Flat	Dissipative
	Mod	Mixed	30-150m	Moderate	Intermediate
	Low	Gravel	<30m	Steep	Reflective

4.1 Step 2. Identify Beach and Dune Values

Sandy/gravel beaches and dunes are highly valued for a number of reasons:

- Ecology
    - Sandy/gravel beach communities offer a dynamic arena for the interaction of marine and terrestrial ecosystems.
    - They harbor high densities of detritus, and sediment-dwelling organisms (including shellfish) that supply food and habitat for marine and terrestrial organisms.

    - Many bird species utilize sand beaches as nesting and foraging habitat.
    - Terrestrial mammals and birds prey and scavenge on resident and transient organisms residing on sand beaches.
  - Recreation
    - Surfing and swimming
    - Walking and relaxing
    - Boating
    - Fishing
  - Source of food (e.g. fish and shellfish)
  - Aesthetics of an ocean view and natural character
  - Barrier against storm and preventing the flooding of coastal properties
  - Spiritual - ability to raise consciousness of people above the material plane and more towards that of spirit or Soul.
  - Many individuals may never visit or see the beach, but it may be important for them to know it's there and healthy, and is not being polluted.

In summary, beaches are particularly valued because they uplift people, they act as natural barriers that protect the shoreline from storm events, they are sources of food, they have great scenic and aesthetic characteristics and they provide vital habitat for a variety of plants and animals and unsurpassed recreational opportunities.

In order to easily identify the beach values, a simple tool has been developed which forms part of the risk matrix table outlined in Step 5.

4.2 Step 3 Identify Beach and Dune Stressors

Currently, huge pressures are facing our coastal beach environments from a number of sources including:

- coastal development (for example, marinas and marine farms), subdivision
- sea level rise
- increased wave action from climate change
- erosion control sea walls and other structures
- wastewater discharges
- sediment and runoff from upper catchment land use
- introduced plant and animal pests and
- demands for recreational space.

Table 2 and 3 provide a summary of the various stressors and related issues for beach and dune environments in Hawke’s Bay.

Table 2. Summary of major stressors affecting beach systems in Hawke's Bay region.

Beach and Offshore Water Stressors	
Wave Action	The main factor controlling NZ sandy-beach ecology and driving ecological processes is wave action. The characteristics of the beach system depend essentially on interactions between particle size parameters and wave action, with tides also playing a part. These physical interactions result in beach types ranging from reflective to fully dissipative, these two extremes representing different ecosystems and ecosystem functioning. A modeling study concluded that the nearshore wave climate at open coast locations, south of Cape Kidnappers, to be predominantly from the south with a mean height of 1.0m and 10.5s period (HBRC 2004). North of Cape Kidnappers it increases to the east towards Mahia Peninsula with mean height of 0.9m at Mahia Peninsula and 0.46m at Westshore. Maximum significant wave heights varied from around 5.5m at the northern end of Hawke's Bay to 3.3m in the lee of Cape Kidnappers. Observed storm wave heights are typically in the range 4.5 to 9.0m.
Sea Level Rise	The magnitude of shoreline retreat due to accelerated sea level rise is predicted to be 3-13m (HBRC 2004). The sea level has risen 0.3 m since the mid 1800s. This rise is expected to continue and accelerate (Bell et. al. 2001). Relative sea-level rise in New Zealand is most likely to be 0.14 to 0.18 m by 2050 and 0.31 to 0.49 m by 2100. Parts of the coastline have historically been eroding or retreating, and climate change will exacerbate these trends. Sea-level rise will eventually lead to permanent inundation of very low-lying margins, episodic sea flooding of higher margins, increased coastal erosion, salinisation of adjacent freshwater, drainage problems in adjacent low-lying areas, and further coastal squeeze where shorelines are held and constrained by structures such as seawalls and stopbanks.
Sea Temperature Rise	Sea temperature has risen by 0.4 to 0.5°C since 1870 and this rise is expected to continue and accelerate. Between now and 2080 a rise in mean air temperature of 1.6 to 2.2°C (winter) and somewhat less in summer will increase sea temperatures in estuaries and coastal waters, affecting aquatic ecosystems (Bell et. al. 2001).
Water Quality	Water quality of coastal beaches can be degraded if located within the effects-plume of rivers draining developed catchments and point source wastewater and stormwater effluents. The major issues are generally disease risk, excessive nutrients, lowered clarity and toxicity. In addition, algal blooms (some of which may be toxic) can also detrimentally affect water quality. Generally, the cause of such blooms originates from excessive nutrients either from land runoff or marine sources.
Erosion	For Hawke's Bay, a regime of ongoing shoreline retreat has been predicted for many places (HBRC 2004). Coastal erosion hazard widths for Hawke's Bay sandy/gravel shores have been estimated out to 2100 and range from approximately 40 to 180m. These rates take both sea level rise and long-term rate of erosion into account. River mouths, spits and bars are typically more sensitive areas. In terms of sand/gravel beach ecosystems, the coastal hazard assessment (HBRC 2004) is helpful in that it provides a coarse indicator of the likely spatial extent of habitat changes due to erosion throughout the region over the next 100 years.
Sea Walls	Seawalls are a relatively common form of coastal armouring in the Hawke's Bay region. However, current engineering practice tends to favour other options. Seawalls reflect waves onto the beach causing sand to be scoured away and they cut off the natural supply of sand to the beach from the sand dune behind the wall. A recent proposal to protect the Waimarama Beach from erosion (HBRC 2006) addresses current policy.
Currents	Currents in the area are generally insufficient to transport fine sands (<0.05m/s; HBRC 2004) except in breaking wave situations. Currents, are therefore expected to play a minor part in the local migration of sands at Hawke's Bay beaches.

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Table 3. Summary of major stressors affecting dune systems in Hawke's Bay region.

Dune Stressors	
Erosion and accretion.	• Seaward edges of dunes generally highly mobile, unless artificially constrained by sea walls or plantings. • Greater stability further inland. • Majority of NZ dunes demonstrate net erosion due to insufficient sand supply. • Changes cyclical, both seasonally and over longer periods of time. • Landward movement of mobile dunes often entails loss of vegetated habitat. • For dunes to be able to repair themselves and to transport excess sand inland, dunes must be able to roll. Plantings or sea walls in the foredune area tend to build up the height of the seaward edge which stops the natural rolling action.
Grazing	Historical overgrazing and then dune reclamation for grazing result in adverse impacts and loss of dune habitat Parts of some stabilised dune systems have been entirely converted to agricultural use, resulting in almost total loss of the conservation interest.
Recreation	Recreation is a major land use on sand dunes. Many dune systems are used extensively by holiday-makers, mostly on foot but also for parking cars and in some cases for driving four-wheel-drive vehicles or motorcycles. Moderate pressure by pedestrians may cause little damage but excessive pedestrian use, as on routes between car parks and beaches, and vehicular use in particular, have caused significant erosion on many dune sites.
Sea defence and stabilisation	Many dune systems are affected by erosion protection works or artificial stabilisation measures such as sand fencing and marram planting. These practices are particularly prevalent on the more developed coastlines where drifting sand may be perceived as a threat to urban or holiday developments. While carefully applied dune management measures can help to counteract severe erosion which may threaten the existence of a dune, engineered defence systems usually reduce the biodiversity inherent in the natural dynamism of dune systems, and may cause sediment starvation down-drift. Many NZ dunes as a whole suffer from over-stabilisation and poor representation of the mobile phases.
Beach management	The seaward accretion of dune systems takes place through the accumulation of wind-blown sand caught by plants or debris along the driftline; the initial accumulations are colonised by pioneer plant species and form embryo dunes. On some heavily used beaches this process is inhibited by pressure of pedestrian or vehicular traffic, or by beach cleaning using mechanical methods, where the organic nuclei for sand deposition may be removed. These factors may remove the minor obstacles which would catch the sand initially, or destroy the embryo dunes at an early stage in their formation. In either case a dune system in a location where the physical conditions exist for accretion may actually be static or eroding.
Falling water tables	Low lying depressions support characteristic communities dependent on a seasonally high water table. In some dune systems a long term fall in the water table has led to loss of the specialist flora and invasion by coarse vegetation and scrub. The long-term causes are believed to be local extraction of water and/or drainage of adjacent land used for agriculture or housing.
Forestry	Afforestation of dunes has had a major effect on large areas of dune landscape. Some sites hold large conifer plantations which have the effect of suppressing the dune vegetation communities and lowering the water table.

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Increased Urbanisation	Property developments (e.g. housing, industrial, waste disposal) are common both adjacent to and on sand dunes and have both direct and indirect effects.
Climate change (sea level rise and more storms)	As sea levels rise and storminess increases, coastal habitat will be at risk in areas where cliffs or artificial barriers, such as sea walls, may narrow the zone where natural coastal processes may take place (coastal squeeze).
Invasive weeds and pests	Marram, pampas, boneseed, boxthorn, maritime pine, introduced grasses and other weeds threaten native communities in duneland areas. Some native coastal plants, such as pingao, shore spurge, sand daphne and sand bidibid, are in danger of extinction from the combined effects of weed invasions, human settlement and the clearing of coastal vegetation.
Offshore dredging	There is a potential for cumulative and long-term effects on sand dunes from offshore dredging.

In order to easily identify the beach stressors, a simple tool has been developed which forms part of the risk matrix table outlined in Step 5.

5 Step 5 Environmental Risk Identifier

The major environmental outcomes or aims of successful beach and dune monitoring and management can be listed as follows:

- Healthy beach and dune ecological condition
- High quality coastal water
- Public access to all beaches from the landward side
- Natural character maintained

Determining where monitoring effort is placed is best achieved through the use of a decision matrix. Tools 4a, 4b and 4c have been developed to provide a risk analysis for a stressor affecting a particular environmental outcome for the 3 major beach types, dissipative, intermediate and reflective. In these tables a high (red), medium (yellow) or low (green) risk is assigned to each stressor/environmental outcome combination, as well as to the likelihood of the stressor occurring and affecting habitat, the frequency of occurrence, the percentage of habitat currently affected and the recovery time once the stressor is removed. The latter combinations provide a foundation to help assess the risk to the former, i.e. the environmental outcomes. It is envisaged that these will be filled in by Council's coastal specialist on a beach by beach basis using the 3 beach type templates as guides. The aim is to identify high-risk values or environmental outcomes and the stressors driving that risk. These are the values and stressors that should be targeted in the following sections of the monitoring and management programme.

Tool 4a. Sandy/Gravel Beach Risk Analysis

Type: Dissipative (Sand)

Name: ??? Beach

Habitat	Stressor	Likelihood of Stressor occurring and affecting habitat (high, med, low)	Frequency (continuous, 3-4 times/yr, 1x every yr or 2)	% of habitat or resource currently affected (high, med, low)	Recovery Time once stressor removed (long, med, short).	Values/Environmental Outcomes - risk of stressor causing impact to value (high, med, low)								Comments
						Walking, picnicing	Natural character	Water Quality	Boating/Fishing	Public Access	Barrier from storms	Spiritual	Ecosystem	
Inshore Water and Sediment	Erosion control - Sea Wall													
	Contaminated plume, river or ocean outfall													
	Property Development													
	Climate change													Difficult to remove climate change therefore recovery long.
	Vehicles													
	Seafood collection													Trawling, Surf fishing
	Invasive weeds/pests													Harmful Algal Blooms
	Extreme storm surf													
Beach	Erosion control - Sea Wall													High potential for coastal squeeze
	Contaminated plume, river or ocean outfall													
	Property Development													Beach ecology impacted
	Climate change/erosion													
	Vehicles													
	Seafood collection													Surf Fishing, no shellfish
	Invasive weeds/pests													HABs
	Extreme storm surf													
Dunes	Erosion control - Sea Wall													High potential for coastal squeeze
	Contaminated plume, river or ocean outfall													
	Property Development													Dune ecology impacted
	Climate change													Migration
	Vehicles													
	Seafood collection													
	Invasive weeds/pests													
	Extreme storm surf													

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Tool 4b Sandy/Gravel Beach Risk Analysis

Type: Reflective (Gravel/Sand)

Name: Napier to Clifton Beach

						Values/Environmental Outcomes - risk of stressor causing impact to value (high, med, low)								
Habitat	**Stressor**	**Likelihood of Stressor occurring and affecting habitat (high, med, low)**	**Frequency (continuous, 3-4 times/yr, 1x every yr or 2)**	**% of habitat or resource currently affected (high, med, low)**	**Recovery Time once stressor removed (long, med, short).**	**Walking, picnicing**	**Natural character**	**Water Quality**	**Boating/Fishing**	**Public Access**	**Barrier from storms**	**Spiritual**	**Ecosystem**	**Comments**
Inshore Water and Sediment	Erosion control - Sea Wall													
	Contaminated plume, river or ocean outfall													
	Property Development													
	Climate change													Difficult to remove climate change therefore recovery long.
	Vehicles													
	Seafood collection													Trawling, Surf fishing popular
	Invasive weeds/pests													
	Extreme storm surf													
Beach	Erosion control - Sea Wall													Minor potential for beach migration
	Contaminated plume, river or ocean outfall													
	Property Development													
	Climate change/erosion													Minor beach migration
	Vehicles													
	Seafood collection													Surf Fishing, no shellfish
	Invasive weeds/pests													
	Extreme storm surf													
Dunes	Erosion control - Sea Wall													Lowered access to beach
	Contaminated plume, river or ocean outfall													
	Property Development													
	Climate change													Minor migration
	Vehicles													
	Seafood collection													
	Invasive weeds/pests													
	Extreme storm surf													

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Tool 4c Sandy/Gravel Beach Risk Analysis

Type: Intermediate (Sand/Gravel)

Name: Waimarama Beach

						Values/Environmental Outcomes - risk of stressor causing impact to value (high, med, low)								
Habitat	**Stressor**	**Likelihood of Stressor occurring and affecting habitat (high, med, low)**	**Frequency (continuous, 3-4 times/yr, 1x every yr or 2)**	**% of habitat or resource currently affected (high, med, low)**	**Recovery Time once stressor removed (long, med, short).**	**Walking, picnicing**	**Natural character**	**Water Quality**	**Boating/Fishing**	**Public Access**	**Barrier from storms**	**Spiritual**	**Ecosystem**	**Comments**
Inshore Water and Sediment	Erosion control - Sea Wall													
	Contaminated plume, river or ocean outfall													
	Property Development													
	Climate change													Difficult to remove climate change therefore recovery
	Vehicles													
	Seafood collection													Trawling, Surf fishing popular
	Invasive weeds/pests													Harmful Algal Blooms possible
	Extreme storm surf													
Beach	Erosion control - Sea Wall													High potential for coastal squeeze
	Contaminated plume, river or ocean outfall													
	Property Development													Beach ecology impacted
	Climate change/erosion													
	Vehicles													
	Seafood collection													Surf Fishing, no shellfish
	Invasive weeds/pests													HABs
	Extreme storm surf													
Dunes	Erosion control - Sea Wall													High potential for coastal squeeze
	Contaminated plume, river or ocean outfall													
	Property Development													Dune ecology impacted
	Climate change													Migration
	Vehicles													
	Seafood collection													
	Invasive weeds/pests													
	Extreme storm surf													

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6 Step 6 Environmental Indicators, Guideline Criteria and Management Options Identifier

The next step in the programme is to identify the following;

- the indicators that will be used to monitor both the high risk environmental outcomes and their stressors
- the guideline criteria or thresholds that will be used to assess environmental condition and need for management and
- options for management.

In order to easily identify the beach stressor indicators, guideline criteria and management options another tool has been developed (Tool 5). This provides a partially completed list of the key stressor indicators for each of the key values. Also listed in the tables will be methods, guideline criteria and management options.

Tool 5: Sandy/Gravel Beach Management - Stressor Indicators

	Level	#	Indicator	Method	Guidelines	Management Options
Erosion and Climate Change	Erosion/Climate Change	1	**Coastal Erosion Indicator**	GIS Profiles,	Beach and backbeach squeeze < 10%	No further coastal property development within the 2100 designated erosion hazard zone.
	Erosion/Climate Change	2	**Erosion Control - Sea Wall**	Broad scale Map	Minimize sea-wall use to ???	Provide management options that maximize
	Climate Change	3	**Sea Surface Temperature Indicator**	National??	Assess and manage	
	Climate Change	4	**Sea Level Indicator**	National sea level	Assess and manage	
Water Quality	Disease/Contamination	5	**Intensively developed catchment**	Broad scale map catchment landuse linked with river plume dilution	Lowered WQ Classifications in plumes (Mixing Zone concept).	Point and nonpoint source controls in Plans
Water Quality	Disease/Contamination	6	**Effluent Plume Presence**	Effluent quality linked with plume dilution model	Lowered WQ Classifications in plumes (Mixing Zone concept).	Point and nonpoint source controls in Plans
Vehicles	Vehicle Damage	7	**Area exposed to vehicles**	Broad scale map	No vehicles on beaches or	
Mining	Gravel/sand extraction	8	**Area exposed to gravel/sand extraction**	Broad scale map	Extraction must not exceed natural rate of accretion.	No extraction from areas actively eroding.
	Property development	9	**Intensive property development within coastal margin**	Broad scale map		
	Shoreline Structures	10	**Marina, port, jetty developments**	Broad scale map		

In order to easily identify the beach environmental indicators, guideline criteria and management options another tool has been developed (Tool 6). This provides a partially completed list of the key monitoring indicators for each of the key values. Also listed in the tables will be methods, guideline criteria and management options.

Tool 6: Sandy/Gravel Beach Management - Environmental Indicators, Guidelines and Management Options

	Level	#	Indicator	Method	Guidelines	Management Options
Habitat	**Broad Habitat**	**1**	**Shoreline Type Indicator (e.g.Dissipative sandy beach)**	Broad scale mapping	Length of each beach type	Allows planning at other levels.
	Broad Habitat	**3**	**Shoreline Habitat Boundaries**	Broad scale map	Develop Ecological Health Index based on 1) quality of habitat, 2) status of 'indicator' species, 3) maintenance of species richness, and 4) management practices.	
Erosion	**Erosion**	**4**	**Coastal Erosion Indicator**	Detailed low level rectified photographs recorded on GIS.	Beach and backbeach squeeze < 10%	No further coastal property development within the 2100 designated erosion hazard zone.
	Erosion Response		**Erosion Response Indicator.** How well Regional Council policies and procedures limit the extent of shoreline armoring, e.g. are regional oceanfront construction setbacks used to site new development?	Possible quantitative measures for this indicator include the number of new structures located within setback areas, number of damaged structures reconstructed in identified erosion zones, number of instances where alternatives to 'hard' shore protection were employed, the number of shoreline structures permitted under 'emergency' provisions, and the number of permits for shoreline structures reviewed, approved or denied.	Minimize	
Water Quality	**Disease/Contamination**	**5**	**River/Effluent Plume Presence**	River/Effluent Plume Model to provide risk boundaries	Lowered WQ Classifications in plumes (Mixing Zone concept).	Point and nonpoint source controls in Plans
	Disease Risk	**6**	**Faecal Indicators**	Faecal coliform and enterococci indicators	Meet Bathing andshellfish criteria.	A study cited in the EPA's draft guidance document on water quality found that surfers and divers are at greater risk of illness from contact with contaminated beachwater than are swimmers or waders.
	Harmful Algal Blooms	**7**	**Harmful Algal Bloom Indicator**	National/ Presence/Abundance	Assess and manage	
Sediment Quality and Ecology	**Contamination**	**8**	**Contamination in Bottom Sediments Indicator**	TOC,TN,TP, Metals, SVOCs	No greater than 20% change from natural background up to ISQG Low (ANZECC 2000)	
	Eutrophication	**9**	**Areas With Depleted Oxygen Indicator ("at risk brackish areas" only)**	RPD sediment	RPD difference between reference and impact site <10%.	
	Benthic Biota	**10**	**Condition of Bottom Dwelling Animals**	Survey methods need to be tailored for the site. Because of high variability at small and large scales, method likely to entail 10 x 1 m2 quadrats (or 20 odd 0.25m2 quadrats) at 3 tidal heights.	No greater than 20% change from natural background in abundance and diversity of key indicator species	
	Shellfish Beds	**11**	**Shellfish Bed Condition Indicator**	Broad scale map/size/density. Pathogen monitoring. Toxins.	Maintain sustainable shellfish communities.	
	Invasive Weeds	**12**	**Invasive weeds Indicator**	Broad Scale Map	Assess and manage	
	Invasive Weeds/Pests	**13**	**Invasive Weeds/Pests Subtidal**	BNZ notification	Assess and manage	
	Unusual Marine	**14**	**Unusual Marine Mortalities**	Reported	Assess and manage	
Spiritual	**Spiritual**	**15**	**Spiritual Condition Indicator**	Method under development (Robertson 2006)	Maintain and/or enhance spiritual value of all areas.	
Access	**Beach Access**	**16**	**Areas where access is limited**	Broad scale map	Access must be available to all beaches.	No-one claiming or possessing the frontage of tidal lands of a beach shall be permitted to exclude the right of way to such an area for any public purpose.

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7 Conclusions and Recommendations

The first stage in developing a defensible beach monitoring and management plan has been outlined. It is built on the premise that beaches vary in their values and response to stressors and therefore must be considered on a site-specific basis. The Stage One output includes a partially completed set of tools from which a user will develop a defensible monitoring, assessment and management plan on a beach by beach basis.

An early summary preview of the likely monitoring required for the Hawke's Bay beaches is shown in Table 4.

The next step in the development of the programme is to seek stakeholder support and refine and complete the various incomplete sections of the tools. It is envisaged that this could be completed through another Envirolink grant in the 2006-7 year.

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Table 4. Preliminary summary of likely beach monitoring for Hawke's Bay region.

Beach Type	**Character-istics**	**Recommended Monitoring**	**Indicators and Methods**
Mainly gravel beaches (reflective type);	Limited ecological value and low susceptibility to erosion	**Gravel Beaches bathed by contaminated effluent or river plume and used for bathing or surfing.** e.g. Te Awanga. In addition, any beaches with access issues through private property ownership.	**Water**: Representative high risk as well as baseline sites sampled and analysed for: **Faecal Indicators**; Faecal coliforms, *e.coli* . **Clarity or turbidity** in and out of plume areas. **Nutrients** as a baseline. **Contaminants** in bottom sediments. **Beaches with Access Denied:** Recorded if brought to attention of Council and Mapped
Firm sand beaches and dunes (intermed-iate and dissipative types);	High ecological value	Monitoring required at high risk locations (choose representative beaches only; **Intensive Shoreline Development** Possibly choose Waimarama **Sea-Wall Area** This could be in front of Waimarama **Non Sea-Wall Area** This could be along beach at Waimarama **Vehicle Usage Allowed Beach** **Vehicle Usage not Allowed Beach** **Shellfish Bed Beach** **???** **Beach within river plume** Porangahau north **Representative Undeveloped Beach** With good example of rolling dune as reference site In addition, any beaches with access through private property issues.	**Beach:** **Benthic macrofauna;** 10x0.25m^2 quadrats at mid-low water (in line parallel to water-edge- fixed site GPS located) to 15cm depth. Sieve on site through 1 mm mesh, sort, identify and preserve any unknowns. Undertake Feb-March each year until baseline established. Then every 3-5 years. **Contaminants and particle size in sediments**: Metals (Cu, Cd, Pb, Cr, Ni, Zn), particle size and SVOCs (3 replicates composited into 1 sample from mid-low water). **Grain Size**: One sample analysed for grain size. **Width of beach.** Broad scale map each 5 years. **Dunes**: **Broad scale vegetation and habitat mapping** – once every 5 years as per Stevens and Robertson (2005). **Width of Dunes**; measure at key locations. **Water**: **Faecal Indicators**; Faecal coliforms, *e.coli* . **Clarity or turbidity** in and out of plume areas. **Nutrients** as a baseline. **Contaminants** in bottom sediments. **Beaches with Access Denied:** Mapped

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