Appendix 6

STANDARDS AND CRITERIA FOR ASSESSING
COASTAL HAZARD AREAS ALONG GISBORNE DISTRICT COAST

Coastal Hazard Areas within the Gisbome District will be assessed in two stages. First, an initial assessment of *Areas Sensitive to Coastal Hazards* for medium priority sections of coast. Second, a detailed assessment of *risk* within *Coastal Erosion Hazard Zones,* for *high* priority sections of coast. Priority ranking will be determined by Council staff according to the level of existing development at risk and/or the attractiveness, potential or suitability of the coastal area for future development.

A. INITIAL ASSESSMENT OF AREAS SENSITIVE TO COASTAL HAZARDS

For *medium* priority sections of coast, an initial assessment of *Areas Sensitive to Coastal Hazards* (ASCH) will be made for the major identified natural hazards of *erosion, landslip and flooding.* The basis for the assessment will be a *Coastal Hazards Database* incorporating a standardised *Coastal Sensitivity Index* (CSI) technique for ranking sections of coast with different sensitivities to coastal hazards. The CSI is determined by integrating information from the following 8 physical variables.

CSI = elevation + storm wave runup + gradient + tsunami runup + lithology + landform + horizontal trend + short-term fluctuation.

The 8 physical variables that comprise the Coastal Hazards Database including CSI values from 1 to 5 are set out in Table 1:

TABLE 1

CLASS VARIABLE	1 Very Low	2 Low	3 Medium	4 High	5 Very High
Elevation above MHWS (m)	>20.0	20.0 – 10.1	10.1 – 5.1	5.0 – 2.0	<2.0
Max. storm wave runup level above MHWS (m)	<1.0	1.0 – 1.5	1.6 – 2.5	2.6 – 5.0	>5.0
Gradient (deg)	>20	20 – 11	10 – 6	5 – 2	<2
Max. Tsunami wave runup level above MHSW (m)	<0.5	0.5 – 1.5	1.6 – 4.0	4.1 – 10.0	>10
Lithology Igneous	Plutonics. Intrusive				
Metamorphic	Metamorphics (high to medium grade)	Low grade metamorphics	Sheared metamorphics		
Volcanic	Volcanics (lava, dikes)	Very densely and densely welded ignimbrites. Volcanic breccia. Densely indurated sedimentary rocks (greywacke, solid argillite).	Partially welded ignimbrite	Non-welded ignimbrite. Consolidated volcanic ash. Lahars	Unconsolidated volcanic ash.
Sedimentary		Well cemented sedimentary rocks (limestone, quartzite)	Moderately indurated sedimentary rocks (sandstones, argillite, conglomerate)	Weakly indurated sedimentary rocks (mudstones, weak argillite, weak conglomerates). Relick sands. Lignite, Loess	Unconsolidated sediments (colluvium), alluvium, gravels, sands, silts, muds). Pea. Swelling bentonites
Natural Landform	Very hard rock platforms and sea cliffs	Hard rock platforms and sea cliffs	Moderately hard rock platforms and sea cliffs. Moraines	Soft rock platforms and sea cliffs. Alluvial deltas. Saltmarsh/mangrove	Sand barriers, beaches, dunes and spits. Gravel barriers, beach ridges and spits. River mouths. Cuspate forelands.
Long-term trend (m/year)	>+0.50	+0.50 to –0.02	-0.03 to –0.49	-0.50 to –2.00	> -2.00 retreat
Short-term fluctuation (m)	<2	2 – 5	6 – 10	11 – 30	>30

The CSIs will be derived by numerically integrating the 8 variables and ranking the number so obtained into one of the 5 sensitivity classes listed in Table 2:

TABLE 2

Very Low	Low	Medium	High	Very High
8 – 13	14 – 20	21 – 27	28 – 34	35 - 40

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Flooding
The extent of land subject to inundation by the sea and/or coastal rivers will be delineated by the contour above MSL, below which land has a high probability of being flooded by of either maximum *storm wave runup* during a one-in-100 year storm or maximum *tsunami wave runup,* coupled with rising sea-levels.

Storm Wave Runup
Is the *Maximum* elevation above MHWS of wave runup attained during a severe onshore storm with a frequency of occurrence of approximately one-in-100 years, determined by:

- Measurements made from field, anecdotal and historical evidence.

Tsunami Wave Runup
Is the *maximum* elevation above MHWS of runup attained during a local or distantly generated tsunami observed during the last century, determined by:

- Measurements recorded in published scientific papers and anecdotal evidence.

Landslip
The extent of coastal slopes subject to landslip will be identified on vertical aerial photographs and used as a basis to define ASCH widths.

Photomaps
ASCH widths will be defined on GDC Photomaps at 1:5,000 Scale, based on aerial surveys made in May 1993.

B. COASTAL EROSION HAZARD ZONE ASSESSMENT

Coastal Erosion Hazard Zones (CHZ) subdivided into *Risk Zones* and a *Safety Buffer Zone* will be assessed for the high priority areas known to be adversely affected by the identified natural hazard of sea and wind erosion, and will be based, where appropriate, on the following combination of factors:

CHZ = [(X+R) T+S+D] F+L

Where:

Factor X
Is the *Rate* in metres per year of shore retreat in response to local relative sea-level rise, determined by:

- The standardised Bruun Rule.
- Standardised estimates for potential sea-level rise by 2050 and 2100 A.D. by the New Zealand Climate Change Committee (NZCCC) and the Intergovernmental Panel on Climate Change (IPCC).
- Subtraction of local and regional effects from the projections of global sea-level rise by the NZCCC and IPCC.
- Identification of the seaward limit of onshore-offshore beach sediment movement from field evidence.

Factor R
Is the *Rate* in metres per year of long-term (historic) net shoreline advance, retreat or dynamic equilibrium for sand and gravel shores and seacliffs, determined from:

- Coastal Resource maps at 1:5,000 and 1:2,500 Scales.
- Analysis of Cadastral and Vertical Aerial surveys spanning the last century for areas not covered by the Coastal Resource maps.

Factor T
Is the *Planning Horizon* in years extending from the present up to the year 2100 A.D. for which CHZ assessments will be made.

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Factor S

Is the *Magnitude* in metres of either the *maximum* recorded short-term historic shoreline fluctuation along coasts of send or gravel, or the *maximum* extent of lend that has failed from past or present landslides along seacliffs of relatively consolidated rock, determined from:

- Coastal Resource maps at 1:5,000 and 1:2,500 Scales and Photomaps at 1:5,000 Scale.
- Analysis of survey, anecdotal and historical records.

Factor D

Is the *Magnitude* in metres of retreat of the top seaward edge of the erosion scalp cut into sand dunes as a result of slumping to attain a stable slope, determined by:

- The angle of repose of dry loose dune sand.
- The height of the dunes above Mean Sea Level (MSL).

Factor F

Is the *Safety Factor* that is expressed on a scale from 1.0 (0%) to 2.0 (100%), determined by:

- Averaging the sum of the errors for Factors **R, X, S** and **D**.

Factor L

Is the *Horizontal* distance of representative, relatively unmodified natural features such as the beach, shore platform, foredune complex or primary gravel beach ridge. Such features provide a natural protection of the land from coastal hazards and will be determined by:

- Measurements made in the field and from sequential vertical aerial photographs.

Risk Zonation

The CHZ will be subdivided into *Extreme, High and Moderate Risk Zones* and a *Safety Buffer Zone. The Extreme Risk Zone* lies adjacent to the coast and encompasses the area subject to high impact short-term shoreline fluctuations. The *High Risk Zone* lies adjacent and landward of the Extreme Risk Zone and encompasses the area subject to potential sea and wind erosion, flooding or landslip with a high probability of occurring between now and the year 2050 A.D. The *Moderate Risk Zone* lies adjacent and landward of the High Risk Zone and encompasses the area subject to potential sea and wind erosion, flooding and landslip with a high probability of occurring during the period 2050 to 2100 A.D. The *Safety Buffer Zone* lies adjacent and landward of the *Moderate Risk Zone* and allows for uncertainties in the CHZ assessment.

Reference Shorelines

The CHZ width will be measured landward from the seaward toe of the foredune or seacliff, top seaward edge of the storm berm on gravel beach ridges, or the line of MHWS where precisely defined by standard survey methods.

Wind erosion

The extent of sand dune complexes subject to wind erosion will be determined from sequential vertical aerial photographs by mapping the degree of wind erosion expressed on a scale from 0 (None) to 5 (Extreme), on the basis of percentage area of bare ground defined as follows in table 3:

Table 3

Degree of Erosion		Percentage of Bare Ground
None	0	No significant erosion
Slight	1	1 - 10
Moderate	2	11 - 20
Severe	3	21 - 40
Very Severe	4	41 - 60
Extreme	5	> 60