Wainui Beach Management Strategy (WBMS) – Summary of Existing Documents

The Erosion of Wainui Beach, Gisborne – Causes and Mitigation

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Scope –

Dr Komar was commissioned by Gisborne District Council to analyse the processes causing erosion at Wainui Beach and offer suggestions for possible remedial measures and management strategies.

His report draws significantly on the information gathered by Dr Gibb about beach processes. Dr. Komar also carried out two site visits to better understand the erosion processes and impacts.

The report is in four sections. The first section provides background information on the beach and its history of beach protection works from the 1930's to the 1990's. The second section summarises beach and erosion processes, drawing on previous studies. The third section provides an analysis of potential water elevations achieved during storms and applies this to assessments of beach erosion. The final section discusses possible mitigation measures and the need for additional investigations.

Key Coastal Hazard Components –

History of Beach Protection Works

- A concrete retaining wall was built south of Oneroa road prior to 1930 and other walls date from the 1940s. They projected out into the active beach with progressive retreat of adjacent unprotected areas and the oldest wall failed in 1994.
- A railway and timber structure was built along the south end of the beach in 1960.
- In 1961-62 a series of 28 sheet-pile spur groynes were constructed, each approximately 20m long and 80m apart. Most have been removed or were replaced with concrete or wooden structures.
- Gabion baskets filled with cobbles from the beach and held by timber posts were installed in 1975-76, following erosion of the toe of the bluff and dunes backing the beach. 40m of the protection works collapsed during storms of 1977 and 1978. Iron rail tracks were driven into the works to prevent further collapse and the works were extended to the north. The works have been repaired from time to time.
- 1982-1984 rocks were placed behind the log-rail seawall at the south end of the beach. Rock revetments were placed behind the earlier works.

Beach and Erosion Processes

- Drawing on the work by Dr Gibb, Komar notes the following about sand composition at Wainui Beach
    - Biogenic sources (shells derived from adjacent shore platforms) form 38-63% of the beach sand
    - Offshore seabed sediments (sourced from volcanic deposits) form close to half the sand
    - Sands derived from tertiary strata from the Points contribute only 5-10% of the sand (sediment from the Points is generally too fine to be a source of sand)
    - Erosion of old dune sands in the bluff backing the beach also contributes sand to the beach.
- Sand movement around Makorori point cannot be ruled out but Makorori Reef appears to act like a giant groyne to isolate the two pocket beaches.
- It hasn't been possible to develop a 'budget of sediments' for Wainui Beach that quantitatively assesses sand losses and gains and we cannot be certain whether the exchange is negative or positive. However, it is apparent that input of 'new' sand is small.
- The accumulated dunes serve as a valuable reservoir of sand, which can be added to the beach during a storm. With the return of quiet conditions following the storm sand is blown back into the dunes.
- In some places cobbles form a layer beneath the sand of the beach. The presence of the cobbles is most relevant during an erosion event, when storm waves remove the upper sand layer. According to resident accounts, there used to be large quantities of stone on the beach but they were removed in the early 1960's for use in the Gisborne Harbour works.
- Previous studies suggest rare storms can generate significant wave heights of up to 9-10m, with a few occurrences between 7-8m. More common are significant wave heights of 6m or less. However these are visual estimates only and their reliability is uncertain. By extrapolating data collected over two years, rough approximations are given for the 100 year wave height (7.4-9m) and 50 year wave height (7.1-8.4m).
- Large storms tend to approach from the SE-S and erosion events tend to be associated with SE storms. During SE storms waves break at an angle to the shoreline along the south end of the beach and transport sand toward the north; so the north end of the beach may gain sand and become wider. In such conditions significant sea-cliff and bluff erosion can occur in the south, while minimum erosion occurs in the north.
- Various evidence suggests a north-south oscillation of longshore sand movement. However there is no evidence for a long-term net longshore sediment transport.
- The channels of the streams can be deflected by sand movement, causing local erosion.

- When waves approach from the East they break parallel to the shore and can generate 'cell circulation', which can cause strong rip currents. The currents can hollow out embayments into the beach, at times cutting back into the bluff to cause property erosion. Commonly, rip currents combine with storm waves to cause erosion that may occur anywhere along the beach.
- Tides affect the run-up of waves and whether they are able to reach the toe of the bluff or sand dunes to cause erosion. The predicted extreme tide 'Highest Astronomical Tide' is about 1.2m above MSL, but actual extreme tides vary according to climate conditions and currents.
- The condition of the beach is important in acting as a buffer between the storm waves and properties. Successive storms act to cut back the beach profile, so later storms can cause property damage even though the storms are not as severe as earlier storms.

Sea Level and Land Elevation Changes

- Sea level and land elevation changes due to tectonic processes are likely to be important in the long-term erosion of Wainui Beach, but it is difficult to establish the role of these processes. Dr. Gibb's research suggests that in the long-term the land has been rising faster than the global increase in sea level. However uplift tends to occur in large movements and in between these events the land may subside.

Impacts of Shore-Protection Structures

- A variety of beach protection structures have been used at Wainui Beach. Structures may temporarily have succeeded in reducing erosion but eventually nearly all have failed.
- Groynes are generally used to capture sand on long beaches where there is a significant net longshore transport of sediment. Groynes are probably not suited to Wainui Beach, except perhaps to reduce longshore migrations of Wainui and Hamanatua Streams. Groynes can enhance the offshore flow or rip currents, thereby causing increased erosion.
- Evidence from a range of studies suggests seawalls and revetments enhance erosion of the fronting beach and also of unprotected nearby properties. They can result in greater wave reflection and greater turbulence that can scour the beach at the base of the wall, sometimes leading to failure. Studies suggest that where walls are built in front of foredunes, and thereby deny dune sand being returned to the beach during storms, an approximately equal amount of sand is eroded from nearby unprotected properties.
- The use of gabions for beach protection is unusual. They have rapidly degraded in the high-energy environment of the beach. Observations indicate they have had a negative impact by inducing scour of the old estuarine mud layer underneath the sand. With a lowered elevation, the beach is less effective as a buffer between storm waves and properties backing the beach.

Water Elevations and Beach Erosion

- Komar provides an analysis to estimate wave run up (i.e. the elevation the wave swash actually reaches on the beach) for the 50-year and 100-year wave heights stated earlier. He assumes the storms strike at an extreme tide to give a worst case scenario. He estimates water elevation would reach about 5m above MSL for the 'major' 50-year storm. The 'extreme' 100-year storm would reach an elevation of 7.2m, which is above the beach profile, implying extensive bluff and dune erosion would result. However there is significant uncertainty in the calculations due to limited data on wave heights. Moreover, the conservative assumptions used and the complexity of other factors affecting the waves mean the actual water elevations may be higher or lower.

Mitigation Options

Do Nothing

- Does not preclude efforts to stabilise the dunes using natural vegetation and controlling human traffic to stop damage to the dunes and dune vegetation.

Retreat or Relocate

- Involves moving structures away from the danger area.
- Often cheaper than protection works

Beach Nourishment

- Involves introducing sand to the beach from an outside source in order to widen and elevate the beach to provide an enhanced buffer for protection of property. Can also involve introduction of gravel/cobbles.
- A viable option for Wainui Beach because there appears to be little loss of sand to deep-water.

Hard Structures

- Involves structures used to 'harden' the shoreline in order to reduce or prevent erosion.
- While offering temporary protection, past structures have failed. Failure is due to inadequacies in design, partly due to cost restraints and from using unconventional methods (gabion baskets) unsuited to the high energy environment.
- Komar's analysis of wave run up suggests past structures have been placed at too low elevations so they are overtopped, making them less effective in protection and also more susceptible to failure.
- Can enhance erosion of adjacent properties and affect the fronting beach.
- Need to consider whether structures impound dune sand that serves as a sediment source to the beach.
- Properly designed structures can be an effective and appropriate response where retreat or relocation is not viable/acceptable.

Specific Coastal Hazard Action Points –

Komar recommends the following management strategies:

- Will probably need to use a range of responses; no one response suitable for entire beach.

South End

- Hard structures are likely to be required in the south but retreat and relocation should be encouraged.
- A piecemeal approach is likely to fail and a uniform structure should be used along the stretch of sea cliff.
- Past failed structures should be removed. Cobles contained in the gabions should be returned to the beach.
- It may be possible to leave some seawalls that still offer some protection to properties and incorporate them into a new structure.
- Recommends consideration of a hybrid structure consisting of conventional rock revetment together with nourishment of fronting gravel beach.

Between Wainui Stream and Hamanatua Stream

- Hard structures should not cut off the modern dunes as they are a source of sand to the beach. Efforts should be made to retreat homes that have not yet been moved. Any hard structures should be allowed to fail without efforts made to repair them and should then be removed.

North of Hamanatua Stream

- 'Do nothing' option is appropriate as there is little development. Efforts should be directed at dune protection.

Komar suggests that due to the limited data on storms, tides, etc. additional efforts are needed towards data collection and analysis to better understand erosion hazards at Wainui Beach.

Potential Implications for the Wainui Beach Management Strategies –

Komar's analysis suggests erosion events in recent decades have occurred with only moderate storms and erosion under extreme storms is likely to be substantially greater.

He also recommends where protection works should and shouldn't be used and what type of protection works should be considered at the south of the beach.

The report provides an extensive summary of information on coastal processes, which can be used to inform the strategy.