Impacts of gravel removal from the coastline between Paroa and Blaketown

This document has been produced to answer a number of issues raised by local residents concerning ongoing gravel removal from four mining licence sites along the Blaketown-Karoro-Paroa coastline. The discussion below is based on visits to this coastline on a number of times over the last year by NIWA coastal staff, review of available documents relating to the mining activities and of the beach processes operating along this coastline, and discussions with WCRC staff and a number of concerned local residents.

Why is the gravel beach so steep along the Blaketown Beach?

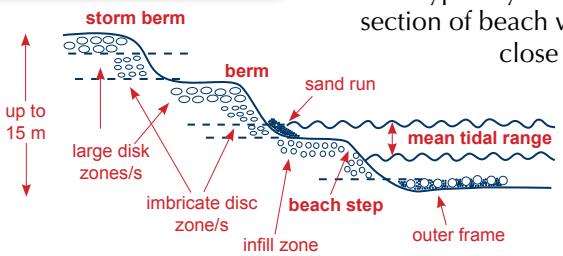
The beach at Blaketown is steep chiefly because of the size and shape of beach sediment, and the wave conditions at the beach. Where beaches are composed of fine sediment such as sand, the beach slope tends to be very shallow and where composed of larger material, such as gravel, much steeper.

The characteristics of the beaches change between Paroa and the Tip Heads. Around Paroa the beach is defined as a mixed sand and gravel beach, and here the intertidal and upper beach has a shallower slope and a convex profile. Occasionally such beaches can have a steeper step, at the point where waves break at high tide.

Typical profile characteristics of a gravel beach similar to that in the area, and to the north of Westroads Yard at Blaketown.

(Figure from Goff, J.R., Nichol, S.L, Rouse, H.L (2003) The New Zealand Coast. Te Tai O Aotearoa, Dunmore Press).

North of Paroa, the beach gradually changes from a mixed sand and gravel beach to one where gravel increasingly dominates on the upper part of the beach. Gravel beaches are characterised by steeper slopes, can be convex or concave in profile, and often have a number of steps. The largest pebbles, which are often flat and platey shaped, tend to be found on the upper parts of the beach, known as the storm berm. At high tide on such beaches, the waves typically break by plunging on to the steeply sloping section of beach which can be hazardous to people walking close to the high water line. The slopes and characteristics of the beach profiles adjacent to Westroads Yard are fairly typically of those found on such beaches.



Could the Blaketown beach be flattened out to make it safer and easier to walk along?

Flattening out Blaketown Beach for easier foot travel would likely only assist in the short term. Wave action would tend to sort the sand and gravel, pushing the larger gravel back up the beach and reforming the beach profile as shown in the figure above. This may take a number of successive storms but ultimately the steeper beach slopes and steps will reform.

The exception is where unwanted sand/gravel is pushed back over the beach in front of Westroads Blaketown yard (noted on a previous visit in November 2005). This activity creates a very steep and 'cliffed' seaward face, i.e., a vertical face, as the waves 'eat' in at the base, and which takes some time to be reworked by waves in to a more naturally occurring profile. Ensuring that the return material is not just simply pushed back over the beach but profiled to a safer slope for other beach users would not appear to be an unreasonable request.

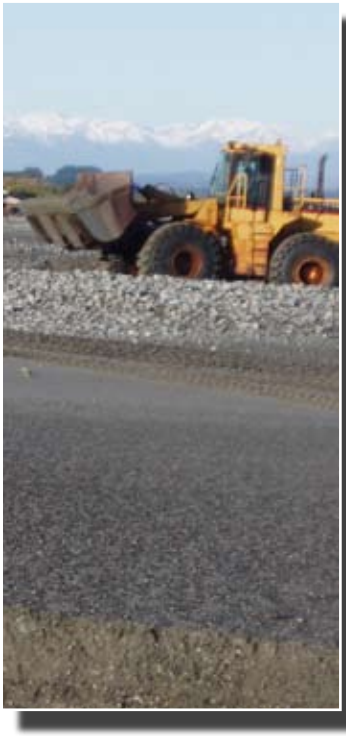
Are the depressions that the excavators create when collecting beach sediment likely to cause long term problems?

The depressions caused by the excavation of beach gravel are not likely to cause long term problems. As the work is being carried out in the intertidal zone, it is likely that these depressions will be largely filled in with sand during the next high tide with no long-term impact. The exception may be during a neap tide (when the tide range is lower) and low wave conditions. In this case depressions may be left stranded above the level of the tide and wave run-up and may not be filled in until tide levels increase again over the following few days.

Is the gravel extraction causing coastal erosion between Paroa and the Tip Heads?

Coastal erosion occurs where there is a temporary or permanent landward movement of the shoreline and depends on the balance between sediment entering, e.g., transported by waves along the coast from the south, and sediment that is lost, e.g. due to both natural processes and due to gravel extraction, from the beach system.

For Blaketown Beach there is insufficient data available to make a definitive statement about coastal erosion. A clear statement about this could be made if periodic monitoring and an assessment of beach volume change of the entire coastline between the Tip Heads and the southern extent of the mining licence area, was carried out. However, a visual comparison of aerial photographs taken in 1995 and 2005 does not identify any retreat of the vegetation line between Merrick Street and the Tip Heads. This is consistent with the findings of an assessment of the impacts of gravel extraction carried out for the Department of Conservation in 2003[1].



Is the Westroads yard bund potentially causing erosion to the north and increasing the risk to people living in Blaketown?

The Westroads yard bund is unlikely to be having any significant influence in 'blocking' gravel being moved northwards along this coastline by waves. As the bund material is just sand and gravel, it can be redistributed along the coastline by waves.

Along the Blaketown frontage there is a wide buffer zone between the beach and the residential housing. The buffer is narrowest at the southern end of Doyle Street, but has still increased in width since the late 1950s and early 1960s when this housing was built.

Are the maps showing the green (accretion) and red (erosion) areas indicative of long-term erosion / accretion patterns and rates?

The maps show change in beach elevation between two points in time. The changes are not only influenced by gravel extraction but by the particular patterns of natural variability in coastal processes between the two dates of the survey, with the pattern potentially changing over relatively short timeframes in response to wave conditions. To begin to build a picture of the net changes, and variations in beach volume between the Tip Heads and Paroa would require a few more surveys at periodic intervals to be able to define any trends.

Is gravel extraction specifically the cause of recent erosion at the southern end of the airport?

It is difficult to identify why there has been loss of land at the southern end of the airport. Recent aerial photographs show a distinct indentation of the line of the coast. However, it is unlikely that the erosion is specifically due to gravel extraction given that the southern end of the Merrick Street – Karoro Aerodrome licence area is a few hundred metres to the north, and the northern extent of the Karoro Aerodrome – Jacks Road licence area about 1 km to the south, but some impact cannot be ruled out. The cause of this erosion hotspot may be related to changes in the patterns of offshore sand bars which can cause localised erosion and accretion cycles (i.e., over a number of years). It may also be due to the way gravel is moved northwards along this coastline, which tends to be in 'slugs', related to both the supply of gravel to the coastline during episodic large flood events in the Taramakau River, and how gravel is moved northwards along the coast, which again tends to be episodic occurring during larger wave conditions from the south-west.

1 Benn, J; Todd, D. (2003). The effect of beach gravel mining in the Greymouth environs. DTEC Consulting Ltd report for the Department of Conservation, Hokitika.

Is gravel extraction affecting erosion further north, such as at Cobden or Rapahoe?

It is very unlikely that gravel extraction is playing any significant role in current erosion problems at Cobden or further to the north, given the long-term influence of the Tip-Heads and other naturally occurring changes.

Waves and driftwood have recently been washed further over the gravel barrier, is this not proof of erosion?

This is not necessarily evidence of coastal erosion. The natural elevation of the crest of a gravel beach is such that it will be occasionally overtopped by storm waves (typically around 2-4% of the time). The occurrence of wave overtopping and overwashing of driftwood observed recently, are more likely to be related to a number of significant natural events that have occurred over this winter, including:

- 6 May - where a rapidly moving low pressure system south of New Zealand created a train of long-waves. This is known as a Rissaga, or "meteorological tsunami" as the wave conditions exhibit similar characteristics to a small tsunami. Large swell was also occurring that day, which would have produced very confusing seas and surging in and out at the coast. Wave run-up on the beach and overtopping is very sensitive to these long–period waves, with significant overtopping occurring at many locations in the West Coast region and also in Southland during this event.

- 12 June – where large wave conditions coincided with a high spring tide. The consequences, such as overtopping, of a storm event on the coast is highly dependent on the event coinciding with a high sea levels.

Occasionally severe storms and events that cause damage to the coastline do occur and are not necessarily indicative of a long-term problem. Of course if such events do become more frequent over a period of time they may be indicative of changes either in the hazard "drivers" (e.g. wave and water level conditions) or a reduction in the level of protection afforded by the beach.

The beach profile along the Paroa to Tip Head frontage does undergo considerable short-term fluctuations in response to periods of stormier conditions. The assessment by Benn and Todd measured these fluctuations and showed that beach sediment tends to be moved offshore and the beach drawn down under stormy conditions, and built back up again during calmer periods. This is a common feature of beach systems often seen in an annual cycle where beaches are drawn down during the more stormy winter conditions and built back up again during the summer months.

The sand bars off the coast are changing. Is this due to gravel extraction?

Whether or not gravel extraction is having any effect on the sandbars at Blaketown is difficult to identify. This is because there are many other factors which also come into play. Generally sand bars off a beach often play an important role in localised patterns of erosion and accretion along that coastline.

Off the Paroa to Blaketown coast, the location of these bars can be seen where swell waves break seaward of the low tide mark. The interactions between offshore bar movements and beach changes are as yet poorly understood but bars on coastline such as this will be continually shifting both alongshore and offshore due to natural variability in wave conditions.

One characteristic of such bars is that they often tend to migrate offshore over time (which can be over a period of many years). As the bar migrates offshore, a deep channel typically forms between the bar and the beach. As a result larger wave conditions can reach the beach often leading to localised erosion hotspots along parts of the beach corresponding to where a particular bar has migrated offshore (possibly a reason for the localised erosion at the southern end of the aerodrome). Once the bar migrates sufficiently far offshore it gradually disappears and a new bar typically begins to form closer inshore to the beach. This has the opposite effect by reducing the wave conditions reaching the intertidal beach, resulting in beach recovery or accretion. As these bars are all at different offshore positions relative to the beach along the coast, they play an important role in the variation in the response at different locations along the beach under storm conditions. Such patterns are extremely complex occurring over different temporal and spatial scales and one of the primary factors making it difficult to identify and isolate the potential effects due to gravel extraction.

NIWA
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Is the gravel extraction affecting the gravel bar at the tip-head end of the licences?

Changes to the gravel bar at the tip-head are more likely to be caused by the interactions between wave and river flow conditions than the effects of gravel extraction. The interaction between coastal and river processes, and the resulting impact on sediment movements at the mouth of the Grey River are extremely complex. Whilst there may well be some offshore movement of smaller sized gravel during stormier conditions it is not thought that the bar at the Grey River mouth will be significantly impacted by gravel removal.

What are the effects of sea-level rise and global warming and are these relevant during the life of the gravel licences?

Global warming has already had an impact on a number of factors which are linked to coastal erosion. This includes sea-level rise. Mean sea levels have been rising in New Zealand since the mid-1800s, with an average rise of around 16 cm over the last 100 years. Climate change will also alter rainfall and river flow patterns (which cause a change in sediment supply) and possibly cause changes in storm intensity and wave climate. However, these are long-term changes. Of more importance over the period of gravel extraction are the year to year changes in sea-level (which can be as much as ± 25 cm), rainfall and hence sediment supply, wave climate, and storm occurrence caused by natural climate variability.

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