

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.

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

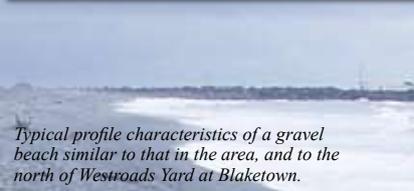
As the holes that the excavators create are in the intertidal zone (i.e. between high and low water), it is likely that these holes will be largely filled in with sand during the next high tide with no long-term impact. The exception may be during a neap tide (when the tide range is lower) and low wave conditions. In this case holes 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.

Whether the holes are considered to constitute a short-term Health and Safety hazard, we are not qualified to comment on.

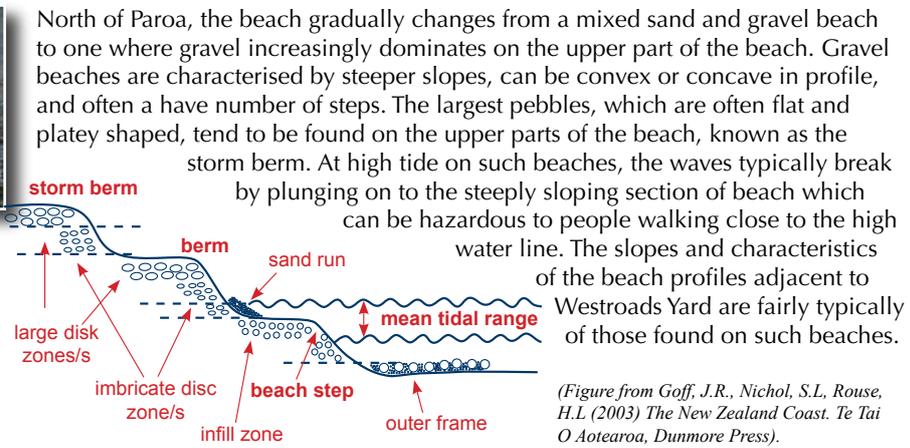
Why is the gravel beach so steep along the Blaketown Beach?

Beach slope is influenced by a range of factors but most significantly 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).

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

This 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.



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

Coastal erosion is 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.

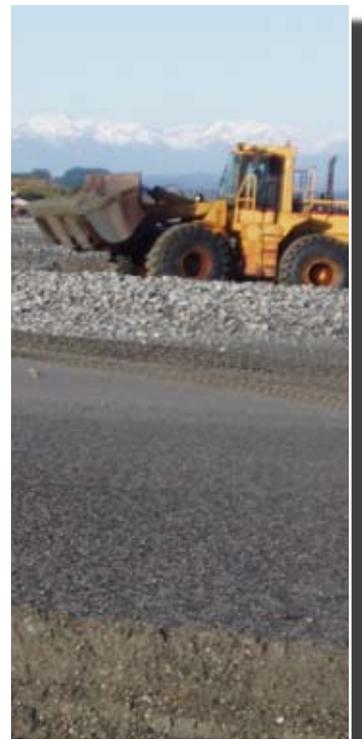
Whether coastal erosion is occurring along this section of coast can only be answered by periodic monitoring and assessment of beach volume change of the entire coastline between the Tip Heads and the southern extent of the mining licence areas. At present there is insufficient survey information to fully quantify rates and patterns of erosion and accretion along the frontage.

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. It is possible that the dominant cause of this erosion hotspot is 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). Further details are provided below.



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

As the bund itself is formed from sand and gravel, the material in the bund can be redistributed along the coastline by waves. As such it is unlikely to have any significant influence in 'blocking' gravel being moved northwards along this coastline by waves and is unlikely to exacerbate or cause localised erosion.

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

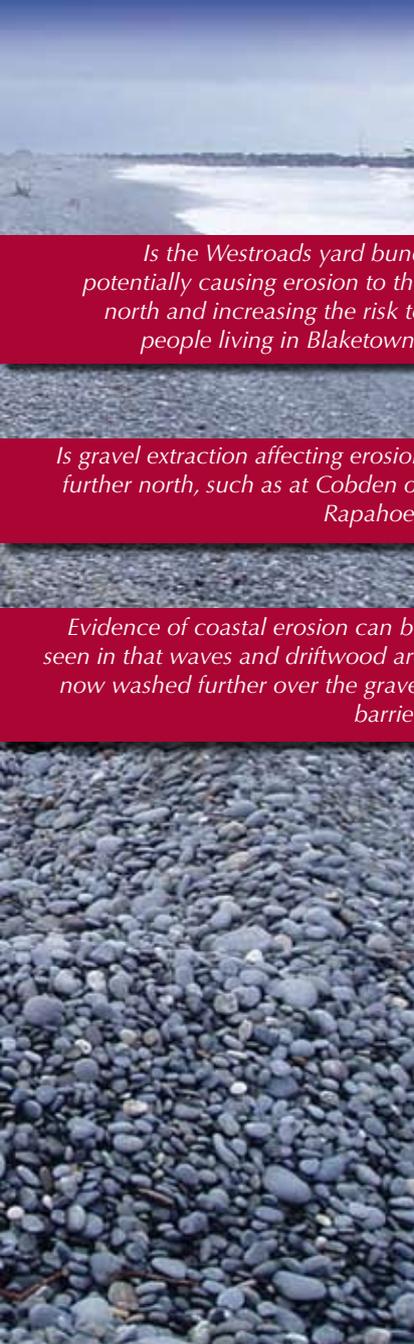
Given the long-term influence of the Tip-Heads and other naturally occurring changes, it is very unlikely that gravel extraction is playing any significant role in current erosion problems at Cobden or further to the north.

Evidence of coastal erosion can be seen in that waves and driftwood are now washed further over the gravel barrier.

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:

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

Sand bars off the beach often play an important role in localised patterns of erosion and accretion along a 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.

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

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. Rather changes are more likely to be dominated by the particular combination of wave and river flow conditions.

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

Global warming will impact on most of the natural factors that affect coastal erosion. The most common known effect is that of sea level rise. Mean sea-levels have been rising in New Zealand since the mid-1800s, with an average rise of around 0.16 m 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 the patterns of storm intensity and more commonly occurring wave conditions. 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 and tracks caused by natural climate variability.



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For more information contact West Coast Regional Council, PO Box 66, Greymouth. Tel: (03) 768 0466, Toll Free: 0508 800 118, Fax: (03) 768 7133, Email: info@wrc.govt.nz, www.wrc.govt.nz.