# Management guidelines for dune use

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Leaflet No.
V–03.3

## Re-establishment of dunes: sand dune design

### Introduction

Coastal foredunes act as protective structures that provide a buffer against wave attack and overwash. They also provide a reservoir of sand to 'feed' the beach during periods of erosion.

Prior to construction or re-establishment they need careful design, as does any structure required to provide protection from the sea. The following broad criteria should be considered by the dune designer.

### 1. Material

The sand used should be free from clay or other materials that could adversely affect dune drainage. The preferred median grain size of the sand is at least as large as that of existing beach sand sampled at about mid-tide level. If its median grain size is smaller, the sand will erode at a faster rate during storms and more sand will be required for an equivalent level of protection. Rapid wind erosion of the dune can also occur if the sand used in its construction is too fine.

If median grain size is too large, nutrient losses and poor moisture retention can severely inhibit plant growth, hindering the establishment and maintenance of the vital dune vegetation. When the median grain size is too coarse the dune must be designed so that the top 300mm of its surface consists of finer sand capable of supporting plant growth.

Coastal sand dunes should be designed to approximate natural, stable dune systems in the area.

Dredged and beach sand may have high salt levels. If this sand is used in dune construction, the salinity levels can cause problems in the establishment of vegetation, and an adequate period must be allowed for rainfall to leach the salt down through the profile. If dredged sand has a high shell content, it will have a high pH which may affect plant nutrition.

### 2. Sand volume

A foredune designed for full protection of developed areas must contain sufficient sand for the dune and adjacent beach to accommodate the erosion from a major cyclone event. This volume can be readily determined mathematically if the beach, dune and adjacent seabed topography and wave climate data are known, or by an examination of coastal behaviour using pre- and post-cyclone dune surveys. In some situations, a design based on typical dune profiles for the general area should be used.

### 3. Height and width

Wave overtopping of dunes can lead to accelerated erosion, sand overwash and inundation of hind-dune areas. For these reasons, the height and width of the foredune in developed areas should be sufficient to prevent overtopping and breaching of the dune by waves occurring during a major storm. Dune heights

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within the range of five to seven metres above Australian Height Datum are commonly adopted on exposed coasts to allow for the severe conditions likely to be encountered during a cyclone.

Other criteria such as aesthetics, loss of ocean views and cost considerations may favour a smaller dune height or width. This must be balanced against the increased risk of wave over-topping, erosion and coastline recession.

## 4. Slopes

At the construction stage, maximum dune slope will be limited by the capacity of the equipment used for dune formation and surface treatment to work safely. This also applies to machinery used for vegetation establishment. Some subsequent re-shaping of the dune can be expected from wind and sea action. Natural dunes in the area should be examined to obtain an indication of a stable dune shape under local conditions.

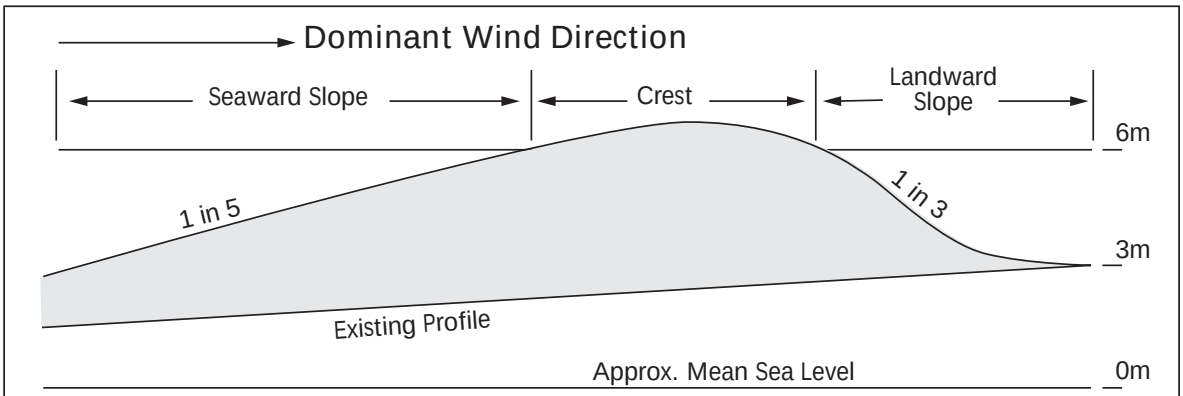
The initial dune should have an aerodynamic shape with a seaward slope of about 1 in 5 and a landward slope of about 1 in 3 (*see* diagram).

## 5. Location

The planned dune location is often determined by the location of fixed capital assets that the dune is designed to protect, but otherwise should be located to accord with the natural dune alignment of the area. Locating a dune seaward of the natural dune line will result in early failure unless artificial beach nourishment has raised the beach and off-shore levels sufficiently to re-establish an equilibrium profile and moderate wave attack on the newly constructed dune. It is also probable that the shoreline would start to return to its natural alignment over time, requiring regular nourishment of the beach to protect the re-established dune.

## 6. General

A reasonable first approach is to design the dune so that it approximates the natural dune system, if still in existence, of the local area. Natural dunes have achieved dynamic stability under the action of wind, wave and tidal forces and normally respond to these natural forces in a predictable manner. When designing sand dunes, it should not be forgotten that the design specifications can only be retained if the surface of the re-established dune is stabilised against wind erosion (*see* Leaflet No.V-03.6), planted with suitable native vegetation (*see* Leaflet No. V-04.1), and maintained in a stable, well-vegetated state.




Typical Profile for a Re-established Frontal Dune