DUNE RESTORATION TRUST OF NEW ZEALAND

Technical Article No. 9.1

The Role of Fences

- on coastal sand dunes

INTRODUCTION

Without fencing, damage to vulnerable sand binding vegetation on dunes from pedestrians in high use areas can lead to significant erosion.

Significant damage to dune vegetation can occur from human-induced disturbance. This can take the form of moderate to heavy usage by beach goers including pedestrian and vehicle traffic, and grazing and trampling by domestic stock. To prevent damage to dune vegetation and to give any damaged dune areas a chance to recover, it is often necessary to fence off the damaged or vulnerable parts of a dune system.

Fencing can be expensive to construct and maintain, can be intrusive where natural values are important, and on unstable sand dunes, fences are a solid construction that can modify sand movement. It is therefore essential that consultation and planning is carried out before embarking on a fencing project on any coastal sand dune.

This article covers the many issues that coastal communities and managing agencies should consider when planning protective fencing on their dunes. This includes careful consideration of the purpose of fencing, appropriate location for erecting fences, and a range of options for fence types, designs and construction. The article focuses on fencing that is appropriate for both the dynamic frontal dunes and the semi-stabilised landward dunes.

Fencing on most coastal sand dunes where access is required to the beach, should always be considered in conjunction with providing accessways. For options for establishing and managing accessways on dunes, refer to the Dune Restoration Trust of New Zealand Technical Handbook Article No.9.2.

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PURPOSE OF FENCING

Fences are erected in coastal zones for a number of reasons (Hill et al., 1988). The main purposes of fencing on coastal sand dunes include:

- Providing a guide and a barrier leading to and along accessways for beach users particularly in high use areas where frontal dunes and their vegetation cover are vulnerable to traffic;
- Providing protection of newly planted foredunes and backdunes from beach users;
- Controlling vehicle use, including motorbikes, on dunes by limiting use to formalised vehicle accessways and providing a barrier to prevent driving on vulnerable frontal dunes; and
- Excluding grazing stock from foredunes and other erosion-prone sand dune sites in rural areas.

Fences therefore vary widely in design and construction to meet the objectives above and details on these aspects are provided in this article. Sand-trap fencing, designed to assist dune building by interrupting the wind flow and aid build-up of wind-blown sand, or used for reducing sand movement is a further type of fence. Sand-trap fences have been used extensively in the past and continue to be used in some regions. Use and design of sand-trap fencing is a major area of interest, but is not covered in this article. Information on use and design of sand-trap fences is provided in Hill et al., (1988) and Soil Conservation Service of NSW (1990).

RURAL vs URBAN SANDY COASTLINES

Most people in New Zealand live in towns or cities situated on or near the coast. Popular resorts and seaside towns attract thousands every year for recreation and leisure. Coastal sand dunes adjacent to beaches in urban or developed areas are, therefore, heavily influenced directly by human activities, especially access over the dune system to the beach, as well as recreational activities on both the dune system and the beach. Fencing to control beach users in the most highly used areas of urban sandy coastlines is therefore an increasing requirement.

While not as high profile as urban coastlines, sandy shores along productive farmland and forestry and along coastal reserves are also highly modified by human activities. While fencing is not required for all rural coastlines, fencing that excludes grazing stock is essential where pastoral farming occurs. In addition, barriers in the form of fencing may be required at popular pressure points even in remote locations to prevent damage to dune systems by beach users.

ARE FENCES ALWAYS NECESSARY?

Not all beaches will require fencing to protect existing dune vegetation cover. Dune systems with light usage are not likely to have erosion problems associated with beach user access or activities and will not require fencing. Even heavily used beaches may not need fencing along entire lengths of foredune. In practice however, as many of our beaches become increasingly used for recreation, it is inevitable that some form of protection is required for parts of popular beaches.

While fencing will be inevitable on many of our most popular beaches, it may not be necessary along entire lengths of foredune. At Whangamata, fencing is not required along the front of the foredune where a healthy cover of native sand binding plants occurs despite high use during summer months.

There are many examples where foredunes have been destroyed by uncontrolled access and indiscriminate use. Without management, including the use of fencing, natural recovery can be slow or ineffective. With loss of vegetation cover from trampling, wind erosion can be severe and result in loss of sand, including scouring leading to wind funnelling of large amounts of sand by prevailing onshore winds. This can lead to major blowouts with sand deposited on vegetated dunes inland. These problems can occur within weeks on dynamic exposed coastlines.

CONSULTATION AND EDUCATION

Constructing fencing on dune systems is often not readily accepted especially by long-time residents or visitors to beaches. This is particularly evident where there has been no or minimal management of dune vegetation and access in the past. However, with increasing pressure on our beaches leading to destruction of dune vegetation and dune erosion problems, management of beach users, including the use of fencing, is inevitable.

As with any management programmes of public areas, involvement of local communities and end users is essential in implementing new strategies. This includes providing information on the ongoing effects of uncontrolled access over dune systems on vegetation cover and sand stability, and on the advantages of implementing agreed management policies and actions.

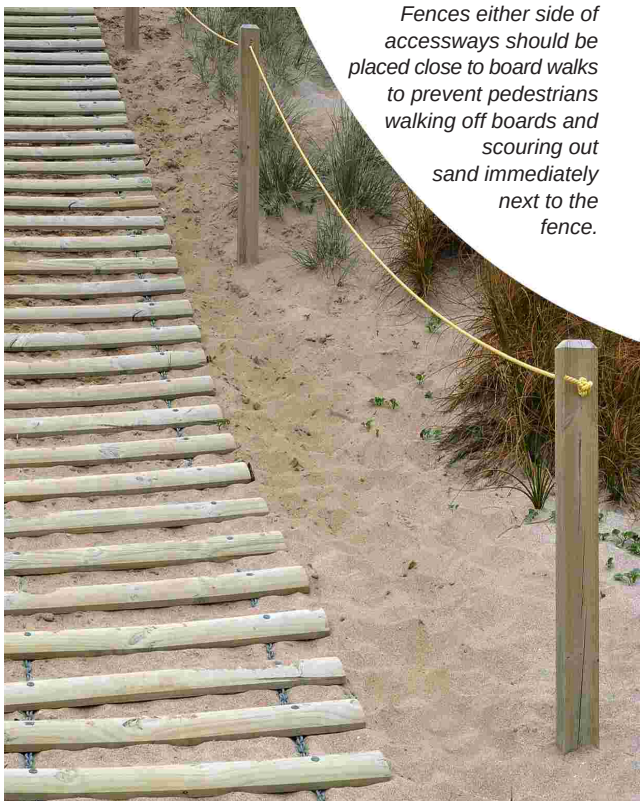
FENCE LOCATION

As any structure on the most seaward parts of the foredune is vulnerable to burial by windblown sand, or erosion by wind and wave action, it is important to carefully consider the location of any fencing. Where fencing is considered necessary along the toe of the dune to protect existing or newly planted vegetation, fences should be located above high water mark following the natural line of the dune toe. Tall fence posts will be required to allow for changes in sand levels by wind or wave erosion.

FENCES

Fences on landward dunes are usually used in association with access fencing to control traffic over dunes (Soil Conservation Service of NSW, 1990). Their location will vary depending on the landform, existing vegetation, and developments such as carparks. Fencing will allow restoration of a vegetation cover by planting or natural regeneration. Developing vegetation can soften fencelines or even partially screen fences. Where a dense cover of vegetation does develop, the fence may not require eventual replacement.

Fences erected along boarded walkways on the surface of frontal dunes should be located immediately adjacent to the boards. For board and chain walkways, some allowance (approximately 100 mm) is required between the ends of the boards and the fence to enable the boards to be lifted. However, too much room will allow pedestrians to walk off the boards adjacent to guiding fences which in turn leads to lowering of the sand level and eventual sand drift problems along the accessway.



Fences either side of accessways should be placed close to board walks to prevent pedestrians walking off boards and scouring out sand immediately next to the fence.

In areas of low usage and dense dune vegetation where complete fencing of the dunes is not required, fenced 'wings' can be constructed to direct traffic to the accessway. These 'wings' can run for 10-20 m either side of accessways ending in the surrounding vegetation (Soil Conservation Service of NSW, 1990).

A short section of fence either side of the ends of accessway, or 'wings' may be all that is necessary to encourage pedestrians to keep to formal tracks.

FENCING DESIGN

Selecting the right fence

Fencing to protect dune vegetation, including guiding fences along formalised accessways, can vary from simplified low-cost construction to elaborate expensive structures. In some backdune situations, barriers such as large rocks or planted areas may be a suitable surrogate for fencing. Choice of an appropriate design for a fence will be governed by a range of factors including:

- the degree and type of beach usage (e.g., low, medium or high pedestrian and/or vehicular traffic);
- the type of beach and dune system (e.g., steep vs low angle slopes);
- the dynamics of the dune system (e.g., degree of sand movement);
- the location of the fence (e.g., foredune toe, backdune or sides of accessways);
- vulnerability and stability of the site (e.g., well vegetated site vs eroded site);
- aesthetics (e.g., low impact designs vs taller standard fencing designs);
- resources available to erect a fence (e.g., both materials and labour – volunteers or contractors, utilising local materials); and
- resources for and commitment to ongoing maintenance (e.g., shifting or removal of fences as dunes are eroded or as sand accumulates).

In most cases it is not necessary to build extravagant major stock-proof type wire fencing for the control of pedestrian or vehicular traffic on most public beaches, particularly in urban areas. Protective fencing on dunes should be regarded as a means to guide beach users along practical routes across dunes to and from the beach.

It is usually not necessary to erect a stock-proof type fence on dunes to control pedestrian traffic. Most beach users will not enter fenced areas when even the most basic fence construction is used, and especially if sufficient, well signposted accessways are provided.

Minimising impact

Choosing fencing and construction options that have a minimum impact on the natural dune form and function is advisable. To be effective, fences must have a low wind resistance so that they will not accumulate windblown sand. Simplified fences on mobile parts of the dune system, and in particular along the seaward toe of the foredune, where there is a high risk of damage or complete removal by high seas, are likely to be the most practical. This includes the use of fences that are designed to have a low wind resistance resulting in less accumulation of sand or scouring around large fixed objects.

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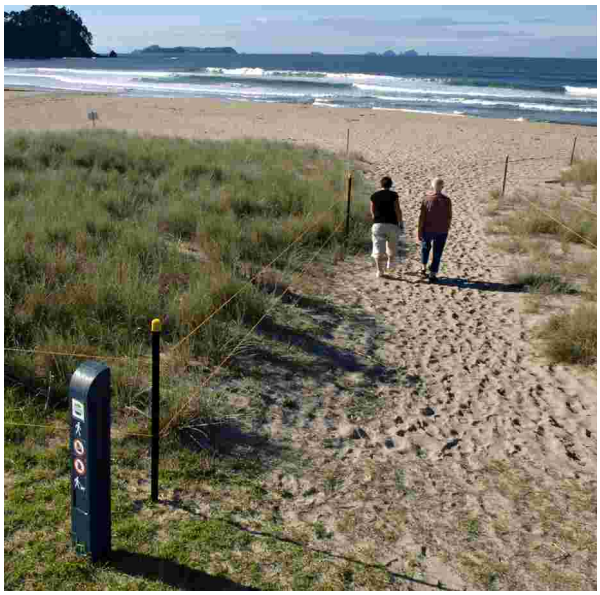
Use of simple design and construction using natural corrosion resistant materials such as these wooden half round rails is often acceptable in coastal landscapes. Encroaching vegetation on landward sites can 'soften' or partially hide fences on dunes.

Use of natural materials for the construction of fences that fit within the local landscape is likely to be aesthetically acceptable to local residents and users of the beach. Construction should use materials capable of withstanding corrosion and sand blasting (Beach Protection Authority of Queensland, 1981).

Importance of accessways and signage

Most beach users will respect even the most basic simple fence especially if this is used in conjunction with an adequate number of well defined and well sited formal accessways. Fences to control beach users therefore do not need to be substantial stock-proof type fences. One rail or a conspicuous single cord or wire is often all that is necessary to prevent beach users traversing dune vegetation or sensitive dune areas.

In addition, signs indicating accessways and requesting respect for the dune vegetation or local dune planting programmes will discourage beach users from jumping fences. In high use areas larger signs explaining dune processes and local restoration initiatives can be effective.



A fence design that has minimum impact on the environment and is easy and low cost to erect and maintain may be all that is required in even high use areas. This low cost fence comprises waratahs placed 10 m or more apart with two conspicuous yellow cords, is easy to maintain and move as the dune vegetation expands or the dune erodes. In addition, accessway signs encourage pedestrians to keep to formalised routes to and from the beach.

FENCE TYPE AND CONSTRUCTION

The range of fence types for sand dune systems is listed in Table 1. Construction specifications, recommended location and purpose, advantages and disadvantages of each type of fence, and comparative costs for each option are given in the table.

Foredune fencing options

For seaward zones, where foredunes are vulnerable to wind and wave erosion, fences that have a minimum of materials and are low cost to erect are recommended. This includes fences constructed of post or waratah with wire or conspicuous coloured plastic covered cord. Such fences can be recovered or shifted relatively easily as the dune toe retreats inland with erosion or as the vegetated dune advances seaward.

Half round or small round treated posts with two or three galvanised wires strained between accessways is the most common method of fencing along the toe of foredunes to protect native sand binding vegetation including new plantings.

Combinations of fence types are likely to be practical on many sites. For instance, a post and rail fence can be constructed either side of an accessway on the seaward face of the foredune with a bollard and rope fence further landward.

Extensive elaborate structures such as post and rail and expensive large dimension bollards are not practical, other than for short sections at very high-use pressure points at selected urban beaches. Post and rail fences on relatively stable foredunes along accessways can meet up with post and wire fencing that may be along the toe of the dune.

For localised very high use areas, sand binders can be demarcated by bollards and rope. Some excellent examples exist of garden-type plots of native sand binding species and backdune species protected by bollards and rope whilst allowing for angled accessways to and from the beach. For instance, 'leaf-shaped' plots using bollards and rope have been installed along the most heavily used parts of Mount Maunganui beach, Tauranga, to deter trampling and have proved very effective in allowing establishment of dense areas of native sand binding vegetation (Greg Jenks, formerly Environment Bay of Plenty, pers. comm.).

Table 1: Fence type and specifications, advantages and disadvantages, and comparative costs of fencing on coastal sand dunes.

Fence Type	Fence Specifications	Recommended Location and Purpose	Advantages	Disadvantages	Comparative Costs
Wooden post and wire	No. 3 (small) strainers at ends of fence; No. 3 treated round, half round or ¼ round posts (smallest) placed 5 m apart or more; standard high tensile wire strained and stapled; cord or tape less suited to long distances	Along seaward side of foredunes; along backdunes; guiding fences along low- to medium-use accessways; practical where long lengths of straight fencing required such as along foredune toe	Readily acquired materials; easily constructed by skilled workers or under supervision; taller than bollards so not as quickly covered by sand accumulation; height affords greater deterrent; easy to maintain	Wire can rust leaving safety hazard; significant work to move fence as dune toe moves; materials can be undermined and lost by high seas; inconspicuous wires may be a safety hazard on some sites if fence not obvious or poorly maintained	Moderate cost if using smallest round or ¼ round posts at $5 each; strainers at least $20 each; skilled fencing contractor usually required
Waratah with wire or cord	Steel waratah but sometimes plastic available placed at 5 m intervals or less; thread wire or plastic coated cord (often yellow) through holes	Practical for long distances along seaward side of foredunes; temporary fencing elsewhere on dune to protect vulnerable vegetation or new planting	Easy to erect; more easily moved or removed as dune toe moves compared to wooden posts; conspicuous yellow plastic cord easy to see by beach users	Steel waratahs rust and plastic waratahs become brittle and break leaving a potentially significant safety hazard; wire difficult to see for beach users	Steel waratahs relatively expensive at $8 each; community can erect at minimal cost; wire or cord low cost
Bollard and rope	Machined bollards 15-25 cm in diameter and up to 1.8 m; thick rope minimum of 25 mm threaded through holes and nailed or bolted to each bollard; rope sags between bollards for visual effect; smaller diameter posts with rounded tops prepared by hand tools are a lower cost option	Practical only in very high use areas due to cost; both along front of dunes and landward locations; use along high-use accessways as alternative to post and rail	Very attractive in high use areas; can be designed to create garden-like appearance; can be kept low to minimise disruption to views; short chunky bollards and thick rope adds to a nautical or marine element	Significant installation works requiring skilled contractors; major work to move fence as dune toe moves; materials can be undermined and lost by high seas; short bollards quickly buried by sand and difficult to remove or relocate; can attract children to swing on ropes; theft of rope can occur	Specially shaped bollards and thick rope expensive to supply; specialist contractor skills required to erect; lower cost second-hand rope may be available from local ports and boat yards; lower cost alternatives of hand machined, smaller diameter posts and rope available
Wooden post and rail	No. 2 or 3 tanalised round, half round or ¼ round posts at 2-3 m spacing at standard fence height; robust half round top rails nailed to top of posts; handrails to be smooth and splinter free; can have 1-2 wires or boards beneath handrail	Along sides of moderate to high use accessways; extensive fences only justified in high use areas; best where low risk of wave damage or sand burial; useful to provide 'wings' either side of ends of accessways to guide beach users; use on semi-stable sites, less suitable where wind or wave erosion expected	Useful handrails along either side of accessways for beach users; attractive designs; natural colours; low maintenance where sand level is relatively stable	Top rails will be used for sitting and standing on; good quality timber and high number of posts required to support rails to avoid breakage; difficult to retrieve when buried by windblown sand	Expensive to supply large quantities of treated timber; skilled contractors required; costly maintenance if used on unstable dune sites
Temporary stake and string/cord	Can use wooden stakes or even driftwood with string or plastic cord	On foredunes to protect small-scale newly planted areas of sand binders; practical short-term demarcation of sensitive areas of dune vegetation	Can be kept low and non-intrusive; easy to maintain and move or replace if dune toe erodes or foredune moves seaward	Only temporary; easily vandalised; will require regular inspection and maintenance	Very low cost; use local materials such as driftwood or garden stakes; low cost string or cord
Standard farm fence	Permanent standard 7-9 wire battened fence preferable to lower cost alternatives such as electric	Along the rear of the frontal dune system in rural areas; preferably erected as landward as possible on stabilised dunes	Excludes grazing farm stock and large animal pests permanently if full seven to nine wire fence used	Requires stable landward site; monitoring essential to prevent fences being undermined if located on erosion-prone sites; electric alternatives will require greater monitoring	Expensive to erect permanent standard fence; requires skilled fencing contractor

Low wooden bollards with rope are excellent for protecting dune vegetation. Bollard and rope fences are proving effective at the heavily used Mount Maunganui beach both along the landward side of the zone of sand binders (left) and along the toe of the foredune (right).

Temporary fences such as low wooden pegs, stakes or driftwood with cord, string or tape may be all that is necessary on foredunes to alert beach users to local restoration initiatives or areas vulnerable to erosion. While vulnerable to vandalism, such cheap alternatives can be easily replaced.

Even driftwood and cord or string can be used to indicate to beach uses to keep off vulnerable parts of the dune or recently planted sites.

Tape and wooden stakes and occasional small signs may be all that is required to alert beach users to avoid disturbing foredune sites.

Fencing on the highly dynamic foredunes will be impractical. For instance, fencing on the exposed foredunes along many west coast beaches of the North Island or on dunes immediately adjacent to highly dynamic meandering stream or river mouths will be subject to large changes in sand level due to both severe wind and wave action.

Landward fencing options

Substantial fencing options such as post and rail or bollard and rope are often used in high use areas on semi-stable dunes landward of mobile foredunes, but expense can confine their use. Post and wire fences are usually more cost effective in most situations, especially if long fencelines are required. Only two or three wires will be required to guide most beach users along a track and to discourage indiscriminate traversing of dune systems.

Where sand dunes are backed by pastoral farming, standard permanent 7-9 wire fences will provide permanent protection. Electric fencing options that have posts at wider spacing and a limited number of wires are likely to be vulnerable to breaching by stock. Coastal zones are particularly corrosive on wire and staples so regular maintenance will be essential.

While standard stock-proof farm fencing can reduce disturbance by pest animals such as deer and feral farm stock, it is very difficult to use fences to exclude smaller grazing pest animals such as rabbits and hares other than on stable dune sites. Rabbit fencing on a large scale is expensive and will require constant monitoring and maintenance.

BARRIER OPTIONS

Alternatives to constructing a standard fence design to reduce damage to dune systems by beach users include the use of physical barriers or the use of appropriate vegetation cover. Recommended locations for the use of these options including advantages and disadvantages of each option are given in Table 2.

Physical barriers

Barriers such as placement of large rocks, driftwood or logs, or the erection of heavy timber or concrete structures are often used to demarcate carparks or road ends. The larger and heavier these barriers, the less vulnerable they are to vandalism and moving by vehicles. Gaps will allow access for pedestrians and careful design and placement of structures will be required to reduce access for motorbikes.

Low fixed wooden barriers placed around carparks on dunes prevent vehicles accessing dune systems.

Table 2: Barrier options for controlling beach users on dune sytems.

Barrier Option	Fence Specifications	Recommended Location and Purpose	Advantages	Disadvantages	Comparative Costs
Physical barrier such as wooden or concrete bollards, logs, telegraph poles, rocks, driftwood or	Large heavy objects placed by machines; large dimension materials fixed to ground to prevent vandalism; keep low to ground	Around carparks that are located on foredunes and backdunes to prevent vehicles encroaching on dunes; at ends of access roads to beaches	Heavy, large dimension materials less vulnerable to vandalism; low barriers avoid interrupting any views; use local rock if available; low maintenance	Unsightly construction if barriers too high or materials are incompatible with natural surroundings; installation with heavy machines may cause localised disturbance	Significant cost to supply and transport large dimension material; skilled contractors required with machinery; expensive to install but low maintenance
Vegetation cover along sides of tracks	Dense cover of dune vegetation that acts as barrier to either pedestrian and/or vehicle traffic	Only practical on landward dunes where a dense cover of ground cover, shrub or trees occurs naturally or can be established; sufficient number of accessways and routes in appropriate locations will reduce users starting new tracks	Most natural option where local native species dominate; preserves and enhances native biodiversity; the most common option to control use on backdunes provided dense vegetation cover continues to exist	Any increase in beach user pressure may see trampling of ground cover vegetation and opening of gaps in shrub cover; not practical in high use areas particularly on foredunes where sand binding species are vulnerable to any disturbance	Lowest cost where beach users continue to keep off existing vegetation cover; cost for supply and planting of seedlings for degraded sites where vegetation cover to be established or enhanced

Vegetation on landward dunes

One of the most common methods for keeping beach users off sand dune systems is to maintain a dense cover of vegetation including ground cover, shrub and tree species. Beach users tend to avoid traversing over or through dense vegetation on dunes. Vegetation is the most practical and low cost option for stable back dunes where it exists, or where it can be restored if the dune has been degraded by previous use.

Maintaining a dense cover of vegetation along either side of a track is all that is required in many coastal areas. Monitoring of such tracks will be required to ensure that any increased usage does not result in excessive widening of the track or development of new access routes that may lead to opening up of the vegetation cover and wind erosion. Angles in the track will also reduce wind funnelling and erosion of sand.

Using a diverse mix of local native plant species also maintains and enhances the natural character of the dune system and increases biodiversity, including habitat for native fauna. Maintenance requirements will include ensuring any gaps are quickly planted up and any potentially invasive exotic species are replaced by appropriate native plant species. Monitoring will be required to ensure any increase in use of the dunes and beaches does not lead to beach users straying from established tracks through the vegetation. Where this occurs, further accessways or fencing options may need to be considered to protect the dune systems.

As the sand binding grass and sedge vegetation cover critical to foredunes is highly vulnerable to human disturbance, vegetation alone is not enough to prevent damage in this zone in medium to high use areas. Fencing therefore may only be required over the vulnerable foredune zone while a dense cover of backdune species on landward zones is likely to be sufficient to restrict beach users to formalised accessways.

Combinations of fence types and use of vegetation as a barrier are used on many sites. A post and rope fence has been constructed on the seaward face of the foredune to protect highly vulnerable native sand binders but landward no fence is required where dense vegetation effectively defines the walking track.

MONITORING AND MAINTENANCE

There are many examples of poorly maintained fences on dune systems. Burial of fences represents a loss of materials and effort that went into original construction. Buried fences can also end up as potential hazards if rusting steel or wire components are uncovered by subsequent erosion. Materials from fences that have been undermined by erosion can be washed away. Poorly maintained fences will allow disturbance of once protected vegetation as beach users have ready access to these sites.

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Regular inspection and maintenance of all fence types is essential so that they continue to protect dune vegetation from pedestrian and vehicular traffic effectively. Where sand is accumulating, bollards and posts will require lifting. Broken rails will require replacement and broken wires or cord restraining.

All fences should be subject to an ongoing maintenance programme. Inspections and repairs on both a regular basis and after storm periods should be undertaken to ensure that fences are kept in good repair and that they retain their function of protecting vegetation. Monitoring will allow evaluation of the success of fencing including the choice of design and construction materials as well as their location. Experience gained from monitoring the effectiveness of existing fences will guide the choice of fence type if replacement is required or for fencing similar sites.

If foredunes are building up and advancing seaward as a result of the protection of sand binding plants, it may be prudent to move fences seaward to protect newly vegetated dunes. Along the beach, public tend to use the beach up to the fence where spinifex runners extending seaward of the fence are highly vulnerable to damage from foot and vehicular traffic.

Fences subject to sand burial need regular lifting and restraining once sand has accumulated around the fence. As soon as lower rails or wire are buried, these will require lifting to avoid a major task of finding and retrieving buried materials. Fencing designs that don't have lower rails or wires will require less maintenance where sand accumulation occurs. If access allows, and resources permit, machinery may be more practical for lifting partially buried fence posts compared to hand methods.

Fences repaired quickly after vandalism or breakages from normal wear and tear will remain functional and tidy for beach users. Regular maintenance will reduce the cost of complete replacement, increase the life expectancy of fence materials and maintain the protective function of fences (Soil Conservation Service of NSW, 1990).

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"To see the majority of New Zealand dunes restored and sustainably managed using indigenous species by 2050".