BEFORE THE RODNEY DISTRICT COUNCIL

IN THE MATTER	of the Resource Management Act 1991
AND	
IN THE MATTER	of the Hearing of a Private Plan Change Application by Te Arai Lands Trust, Proposed Plan Change 105 to the Operative District Plan (1993) and Proposed Variation 62 to the Proposed District Plan (2000)

Evidence of James Dahm

A Introduction and Scope of My Evidence

1. My name is James (Jim) Dahm and I am a coastal scientist with a Masters degree in Earth Sciences specialising in coastal processes. I have 25 years work experience in applied coastal processes and management, including work for consultancies and for central and regional government. I have owned and operated my own consultancy specialising in coastal processes and management for the past 9 years.

2. My evidence to this hearing focuses on the coastal dune management and restoration proposed as part of the Special Zone. I also provide brief overview comment in relation to coastal hazards and processes at this site.

3. In terms of my experience in the areas I am giving evidence, I have specific university training to post graduate level in coastal processes and I have worked extensively with coastal hazard assessment and management and with coastal dune management and restoration over the past 18 years.

4. In relation to coastal hazards, I have completed coastal hazard assessments and management recommendations (including setbacks and a wide range of management strategies) for well over 100 sites - including all the settlements on the eastern and western Coromandel, the open coast settlements of Opotiki District; rural areas of the Franklin District (as part of their Rural Plan change); the coast of the Otorohanga District (current work) and numerous site specific assessments and management strategies throughout the North Island. I have also been extensively involved in preparation of national, regional and local guidelines and policy, peer review, university lecturing and national training courses and seminars in coastal hazard assessment and management.

5. In relation to coastal dune management and restoration, I was responsible for initiating community based dune management (often known as Beachcare or Coastcare programmes) in New Zealand; have managed the Environment Waikato Beachcare programme since inception in 1993 (this programme now involves dune restoration and management at 20 coastal communities); and have been extensively involved in dune management at other sites throughout New Zealand. I was a founding member of the Coastal Dune Vegetation Network (now the Coastal Dunes Trust) and am a current trustee of the Dunes Trust (Dune Restoration Trust of New Zealand). I have also had extensive involvement in dune restoration research and preparation of publications and guidelines; and I am the joint (and primary) author of the national guidelines on community based dune management recently produced for the Ministry for the Environment (2005).

6. I have been provided with a copy of the Code of Conduct for Expert Witnesses in the Environment Court (Practice Note, 31 March 2005). I have read and agree with this code. Except where I state that I am relying upon the specified evidence of another person, my evidence in this statement is within my area of expertise. I have not

neglected to consider material facts known to me that might detract from the evidence I present.

7. In this statement of evidence, I provide an overview of coastal processes and hazards at Te Arai, followed by an outline of the proposed dune restoration within the Coastal Park.

B Brief Overview of Coastal Processes and Hazards at Te Arai

8. **Part of larger beach system:** The beach and dunes of Te Arai are part of the larger Mangawhai-Pakiri sand system – an embayment of approximately 30km length extending between the rocky headlands of Bream Tail and Cape Rodney. The sand system includes some 25km of sandy beaches backed by dune fields, extending up to 2km inland in the centre of the embayment (Hume et al. 1998a).

9. **Sediment supply to the beach:** The Mangawhai-Pakiri sand system is essentially a closed sediment system with available information suggesting only minimal ongoing net sand supply (Hilton, 1995; Hume et al. 1998a; Eco Nomos, 2005). Most of the existing Holocene beach and dune sands were derived from offshore sources; sediments deposited on the continental shelf during periods of lowered sea level and then reworked onshore after sea level reached its present elevation about 7000 years ago. The primary ultimate source is believed to be the ancestral Waikato River, which discharged into the Hauraki Gulf via the Firth of Thames up until about 20,000 years ago (Hume et al. 1998a,b).

10. **Beach and dune sand reserves:** The onshore movement of sands to form the beach and dunes resulted in the beach prograding seaward by up to 150-200m from the original shoreline (Healy et al. 1996; Hume et al. 1998a, b). In many places, the width is less and the Holocene beach sands form only a veneer some metres thick over older surfaces, with some of the older surfaces even exposed in places along the beach (Healy et al. 1996; Hume et al. 1998a, b). Geotechnical investigations conducted by Earthtech as part of the Te Arai project indicate that the beach and dune sands at Te Arai in fact overlie older (Pleistocene) dune sands. These Pleistocene beach and dune sediments were probably deposited the last time sea level was at or about existing levels (approximately 120,000 years ago).

11. **Historic dune modification and wind erosion:** The dunes (including dune landforms and vegetation) at Te Arai have been significantly modified by human activities over an extended period of time. This modification includes removal of the original native vegetation cover; serious human-induced wind erosion and associated transgressive dunes; sand extraction, and dune stabilisation with marram and pine forestry.

12. For instance, the removal of the original native dune vegetation and a wide variety of subsequent human pressures (e.g. stock, fire) during early Maori and European

settlement led to serious wind erosion over the dunes of the Mangawhai-Pakiri sand system. This resulted in extensive modification of the original dune landforms and significant volumes of beach and dune sands being blown inland. Geotechnical investigations by Earthtech show wind blown sand up to 1800m inland, overlying what appear to be quite extensive former swamp/wetland deposits.

13. Severe human-induced wind erosion of this nature was common in New Zealand in the 1800's and early to mid 1900's. The dunes in the Mangawhai and Te Arai area were subsequently stabilised by marram plantings and subsequent pine afforestation. This work commenced in the 1930's; though most of the pine planting occurred after 1963 (McKelvey, 1999). Some recovery of native dune vegetation has since occurred along the frontal dunes but the dune vegetation remains extensively modified. There are also ongoing pressures associated with increasing human use and with animal pests. (The existing state of dune vegetation and associated issues are discussed in more detail later in this evidence).

14. **Coastal erosion:** Analysis of shoreline changes using historical surveys and photographs and beach profile data suggests the Mangawhai-Pakiri beach system is presently in dynamic equilibrium – the shoreline simply fluctuating backwards and forwards over time (Nichol et al. 1996).

15. Existing work suggests the high water mark can fluctuate by up to 40m along most of the beach, though duneline movements are generally less than 10-20m (Nichol et al. 1996). However, it is probable that duneline fluctuations of up to 30m can occur, with the most severe erosion probably cumulating over a number of storm events during climate cycles with a higher than usual frequency of storm events. Therefore, even serious dune fluctuations only affect the seaward edge of the proposed 200m wide Coastal Park.

16. Larger shoreline fluctuations occur in the vicinity of the stream entrance towards the south end of the proposed Coastal Park. Field evidence and aerial photography indicate that this steam entrance can wander alongshore – eroding the duneline up to 100m inland. The foreshore affected by stream migration lies south of the proposed Special Zone, being the foreshore area up to 1-1.2 km south of the present stream entrance. This area is to be retained in production forestry. The impact of the erosion is also limited to the area of the proposed Coastal Park and does not extend sufficiently far landward to affect the proposed dune trail network within the Forest Production Zone.

17. In the longer term, erosion could be aggravated by changes likely to accompany projected global warming - including projected sea level rise. The most recent assessment by the Intergovernmental Panel on Climate Change (IPCC) projects upper limit sea level rise ranging from 0.38-0.59m by the 2090's (the upper limit varying with different scenarios modelled). However, these projections exclude some factors that may apply, which would slightly increase the projected rise. The recent

(July 2008) Ministry for the Environment Guidance Manual "Coastal Hazards and Climate Change" recommends allowing for a base value of 0.5m; together with assessment of the potential consequences of a range of higher sea level rises up to at least 0.8m. I believe this is more consistent with the need for a precautionary approach. At this beach, sea level rise of 0.5-0.8m could result in permanent landward retreat of between 25-50m. Combined with the (up to) 30m duneline erosion associated with existing rare and severe storms, the area potentially at risk from erosion over the next 100 years is therefore assessed at being in the order of 55-80m.

18. The protective dune zone proposed seaward of the "Special Zone" development has a minimum width of 200m. Therefore, even considering the worst erosion likely to occur with such upper limit sea level rise projections to 2100, the proposed development would still be protected by a wide vegetated coastal buffer (>120m wide). Therefore, the proposed "Special Zone" enjoys a very high level of protection from coastal erosion. The setback far exceeds those associated with most historic settlements and new development along the east coast.

19. **Coastal Flooding:** Rodney District Council has recently commissioned an analysis of coastal inundation risk for their District; undertaken by Tonkin & Taylor Ltd.

20. The report by Tonkin & Taylor Ltd concludes that during extreme storms a combination of tides, storm surge and wave runup could result in 1%AEP inundation (wave runup) hazard to elevations of RL 5.9m (with respect to mean sea level) along the exposed coast. Projected sea level rise could increase the inundation levels by 0.2m by 2050 and 0.5m by 2100.

21. The frontal dunes along the Te Arai shoreline are well in excess of the elevation of maximum storm wave runup. Therefore, together with the considerable width (>200m) this dune protection provides total protection from coastal flooding associated with such rare and severe storms.

C Proposed Dune Management and Restoration

Outline of proposed dune management and restoration

22. It is proposed to set aside a wide (approximately 200m) strip of duneland as a Coastal Park along the full length of the proposed Special Zone. A conservation programme will be developed to manage this area to maintain and enhance the natural character and values of the dunes and the adjacent shoreline through restoration of native coastal vegetation sequences – including gradual removal of the pine trees and their replacement with appropriate native forest in those parts of the coastal park that are contiguous to the Forest Recreation Zone (see 11.17.4(c)). The following sections outline this proposed dune restoration programme.

23. In addition to revegetation, the dune care programme will include active management of human use to prevent damage to sensitive dune vegetation. Among other things the programme will involve:

    a. Carefully controlling access to the beach to maintain and enhance amenity and natural character of the foreshore.

    b. Access management will include:

        i. Provision of defined (if necessary, fenced) walkways to guide pedestrians to the beach and to discourage the development of multiple access points.

        ii. Appropriate surfacing of paths where appropriate and required (in many areas the low level of use will mean that sand paths will be adequate).

        iii. Barriers to prevent vehicular (including motorbike) access to the beach from the land.

        iv. Prominent and informative signage.

24. In broad outline, the proposed progressive rehabilitation and restoration includes:

    a. Initial maintenance of existing pine forest to completely screen development in the “Special Zone” from the shoreline and beach.

    b. Restoration and enhancement of primary and secondary native dune vegetation communities seaward of the forest.

    c. Gradual replacement of the pine forest in the coastal park with appropriate native species to restore an appropriate native coastal forest sequence. This replacement will be undertaken in a staged manner so as to maintain an adequate forested screen at all times.

25. The restoration is of regional significance and species to be used in each area are discussed later in my evidence. However, in order to ensure successful outcomes and to design the most appropriate and cost effective approach for this work, various preliminary planting and monitoring will be undertaken to refine and finalise appropriate rehabilitation and restoration strategies for different sub-environments within the dunelands of the Coastal Park Area. The investigations will confirm the most appropriate species mixes and treatments to maximise biodiversity values, survival, growth rates and long term outcomes in different areas.

26. The initial planting investigations are not required to confirm the restoration is practical but rather to identify the most appropriate species mixes and treatments for different areas and to enable the work to be done in the most cost-effective manner. I

am very confident the proposed restoration is practical and will set a new benchmark in coastal dune rehabilitation. For instance, there is abundant evidence in the scientific literature (e.g. from palynological studies) of coastal forests on dunelands and ample field evidence of early stages of regeneration in many backdune areas. I have also successfully undertaken extensive backdune planting in the Environment Waikato Beachcare programme (which I developed and have managed since inception in 1992) using a wide range of native ground covers, shrubs and trees. This experience includes more exposed and hostile sites than Te Arai.

27. Dr David Bergin and I who will undertake the investigations also both have extensive experience with such work. We have undertaken similar investigations for over 16 years and developed planting guidelines that have been very successfully used for dune restoration in Beachcare and Coastcare programmes since 1992.

28. The following sections discuss the proposed dune restoration work and the planting investigations in more detail.

Existing Dune Vegetation Zones

29. The existing dune vegetation can be broadly subdivided into three vegetation zones (Figure 1):

    a. **Spinifex dominated zone** extending over most of the width of the frontal dune to the swale behind, with other native species including occasional pingao, knobby club rush, sand convolvulus, and the indigenous grass *Deyeuxia billardieri*.

    b. **Secondary vegetation area,** presently characterised by low vegetation and incomplete cover and typically extending from the swale on the landward margin of the spinifex zone to the crest of the second dune. Existing vegetation is dominated by sparse spinifex and the exotic yellow primrose with common sand convolvulus and occasional knobby club rush, low pohuehue, and infrequent colonies of sand coprosma. Rare tauhinu and individual gorse plants also occur, the latter usually low and wind/salt shorn.

    c. **Pine forest,** typically extending from the landward side of second dune crest inland.

    While the above descriptions are typical, there is variation in some areas where the frontal dune is unusually high. In these areas, the spinifex zone and the secondary vegetation zone can occur on the seaward face of the dune, with the pine forest extending seaward to the top landward edge of the dune crest (Figure 2; Figure 3a).

30. The following sections discuss the existing condition and outline the proposed restoration work in each of the above 3 broad zones– including the planting

investigations and associated monitoring that will be completed to confirm the most appropriate and effective approach to restoration in different areas.

Spinifex Dominated Zone

31. The vegetation in this area is critical to natural dune repair following storm wave erosion. Maintenance of the vegetation cover is also important to avoid serious issues with wind erosion – including dune blowouts.

32. The primary management objectives in this area are to maintain a good cover of appropriate native sand binding species on the seaward dune face (including management of human pressures to avoid disruption of this vegetation), and to enhance dune biodiversity with appropriate planting.

33. In general, this zone is presently in good condition with a coherent cover of spinifex and occasional patches of pingao. The native sand convolvulus also occurs.

34. However, there are localised areas of minor vegetation damage associated with various human uses – including vehicles, pedestrians and horse riding. These issues will be addressed by the dune management plan which will provide for improved management of pedestrian access and will exclude vehicles. Community based approaches have proved effective at many other coastal communities (e.g. the Beachcare and Coastcare programmes along the Waikato and Bay of Plenty coasts) and there is potential to establish similar approaches here involving the wide beach user community. .

35. **Restoration proposed.** The existing condition limits the requirement for restoration planting. Nonetheless, there are opportunities to significantly enhance native biodiversity through plantings of various species including pingao (*Desmoschoenus spiralis*), sand tussock (aka sand fescue) (*Austrofestuca littoralis*) and possibly (in more landward and open areas of the zone in the swale behind the dune crest) sand pimelea (*Pimelea arenaria*). Therefore, further plantings of these species are proposed – as briefly discussed in the following paragraphs. **Pingao:** Previous restoration efforts have established pockets of this species along the frontal dune. However, more extensive planting is proposed to extend these pockets and to secure restoration of this endangered species. The planting proposed is essentially inter-planting among the existing spinifex cover. Planting will primarily be placed on the seaward dune face as the species prefers active sand movement – but will be located sufficiently far landward to prevent excessive losses from relatively minor dune erosion events. Further pockets will also be established in appropriate areas on the rear of the frontal dune to ensure the plantings are not entirely lost during rare and severe dune erosion events.

36. Operational techniques are well-established for pingao, and this species has been a major component of successful dune restoration plantings along the east coast of the

North Island since the early 1990's. However, species establishment can be limited by rabbits and field examination indicates a significant rabbit population on the dunes at this site. Therefore, a comprehensive rabbit control programme will be undertaken before operational plantings commence.

37. Plantings will be sufficient to establish significant clumps of this species along the full coastal frontage of the park adjacent to the development – with total plantings in the order of 15000.

38. **Sand tussock:** This species typically occurs on coastal dunes along the east coast of the North Island. However, field inspections indicate the species is relatively rare at this site (no occurrences were noted but isolated plants may occur). This is probably a consequence of the severe dune degradation that has occurred in the past, including stock grazing (the species is very palatable) and severe wind erosion. Plantings are proposed to re-establish this species within the Coastal Park Area.

39. The species is a common component in dune restoration and planting guidelines are well established. However, the most suitable locations for planting of this (typically sparse) species can vary from site to site and the initial operational plantings will be monitored to confirm the most suitable sub-environments at this site.

40. This species, while important to dune biodiversity, is typically sparse and therefore total operational plantings of 5000 will be sufficient to re-establish a natural and viable population of the species at this site.

41. **Sand pimelea:** This species was once widespread on coastal dunes but is now extremely rare, and in places regionally extinct. It is among the most severely endangered of all dune vegetation species and is listed as chronically threatened and gradually declining by de Lange et al (2004).

42. The species was not noted in field inspections at Te Arai but, based on my experience at other sites, the dunes do appear to contain some areas that may provide suitable habitat. Therefore, plantings of this species will be undertaken to establish a sustainable population at this site. The species has very specific micro-site requirements and pilot plantings will initially be undertaken to confirm the best locations.

43. Rabbit control will also be undertaken prior to operational plantings, and ongoing pest control will probably be critical to successful establishment of the species.

44. Total operational planting requirements for sand pimelea are difficult to estimate until the preliminary planting and monitoring is completed. However, I anticipate that total plantings could be up to 5000 over a period of years. This will ensure reasonable clumps of the species can be established along the coastal frontage of the park.

45. On the basis of my experience elsewhere with this species, I anticipate that sourcing large numbers of appropriately eco-sourced plants will be a challenge and so significant plantings of this species are likely to be undertaken over several planting seasons. This is not a concern and I believe it is even desirable for a rare species of this nature - as it will enable the planting and location of the population to be continually improved on the basis of experience with earlier plantings.

46. If a useful population of this species is able to be established on the dunes at Te Arai, it will be a very significant ecological and biodiversity outcome given the severely threatened and presently declining nature of existing populations (de Lange et al. 2004; Dawson et al. 2005).

Secondary and low vegetation zone

47. Native dune vegetation in this zone is widespread and includes common spinifex (becoming more sparse landward), isolated patches of healthy sand coprosma, widespread knobby club rush, areas of low pohuehue, and rare *Coprosma propinqua*, tauhinu and other native shrubs.

48. The existing native cover is typically limited and patchy, and contrasts with the dense communities of native backdune species that would normally be expected in this environment. The reasons for this are unclear but animal pests appear to be a key factor, with widespread pig rooting and rabbit browsing evident in the area (Figure 4). This may also be a factor favouring the widespread distribution of the exotic evening primrose (*Oenothera stricta*) which is dominant over much of this zone. The effect of pig and rabbit damage is also evident on the trunks of several native trees. In areas where animal damage is less evident, quite dense communities are often observed; most typically knobby club rush, sand convolvulus and pohuehue (e.g. Figure 5).

49. It appears that elimination of pigs and rabbits will be required to facilitate significant improvement in dune ecology and biodiversity. Therefore, elimination and ongoing control of these pests is a key element of the dune restoration proposed.

50. It is anticipated that pest control will ensure significant natural recovery of most existing species. However, plantings of some species are likely to be required where existing populations are small – particularly sand coprosma. In addition, it should be possible to introduce other appropriate backdune species to enhance biodiversity once pest control has been implemented.

51. Investigations have commenced to evaluate the effect of pest removal, with establishment of fenced areas to exclude rabbits and pigs. Initially, the focus in these areas will be on natural recovery of existing native species, particularly sand coprosma, pohuehue and knobby club rush. However, other appropriate native backdune species will also be planted in these areas to investigate the potential for establishment of other species to enhance native biodiversity.

Pine forest

52. A critical component of the proposed “Special Zone” is the maintenance of a wide vegetated screen to enhance the natural character of the beach. Initially, the screening will be provided by maintaining the existing pine forest between the development and the sea. However, as part of the development and ongoing management of the site, it is proposed to gradually replace the pines within the Coastal Park and to restore a native coastal sequence, including appropriate coastal dune forest.

53. The restoration outcome will considerably enhance ecological and biodiversity values, as well as natural character and coastal amenity. It is clear from palynological and other evidence that coastal forests once existed in backdune areas along the North Island – though most were cleared by early human settlement. There are now very few intact sequences from primary sand binders through to mature coastal lowland forest left in New Zealand and none in the North Island. They are among the rarest of New Zealand’s ecosystems.

54. A native coastal sequence in selected areas seaward of the development will also offer a more sustainable long-term forest than pine. In addition, fire risk will be substantially reduced.

55. The restoration and planting strategy will ensure success and avoid significant losses from salt and wind influence. Many species suitable further landward are quite inappropriate in this area, including standard nurse species widely used in other environments. Previous plantings and scientific trials have also established that growth rates can be very slow in the harsher nearshore areas - so careful species selection has been made to ensure timely outcomes. The preliminary planting and monitoring will further confirm opportunities to enhance survival and growth rates (e.g. selective clearance of existing pines – providing openings for native plantings while also maintaining sufficient pine cover to provide shelter to the establishing natives).

56. Preliminary planting and monitoring investigations are currently in an advanced stage of design and will be established this year (2009) and further expanded in 2010 if the plan change is approved.

57. Previous investigations involving native coastal trees and shrubs in nearshore coastal locations on exposed ocean beaches indicate the preliminary planting and monitoring should extend over 3-4 years

58. Monitoring will consist of detailed annual measurements looking at survival, height, breadth and vigour – with every tree individually measured and monitored. Detailed statistical analysis of the monitoring results will be conducted to determine the

relevant planting strategies – which are likely to vary according to exposure across the park area.

59. The pilot plantings have been designed to complement existing information from previous scientific trials involving coastal dune shrubs and trees, including extensive trials in Whitianga (established and monitored since 1995) and Ohiwa (now in their third year). There is also considerable information available from community based dune restoration programmes – many of which have been involved in extensive tree and shrub planting in exposed dune areas for 10-12 years and more (e.g. Kuaotunu West Beachcare on the Coromandel). Historic plantings of various native shrub and tree species at Te Arai have also been investigated and evaluated, together with examination of natural regeneration and human plantings in nearby dune areas.

60. There is limited information on the original native dune forests in this area prior to human settlement of New Zealand. However, available information suggests the original forests were probably lowland podocarp-broadleaf forests and/or coastal forest. Lowland forest canopy in Northland is dominated by rimu and taraire with wide variety of other conifer (including matai, miro and totara) and broadleaf tree and shrub species (e.g. tawa, hinau, maire, kohekohe, mahoe). Coastal forest is dominated by pohutukawa with other shrub and tree species including karo, ngaio, taupata, and (further inland) puriri and karaka as well as a wide variety of shrub species.

61. Future climate change could also affect forest type and species composition in the longer term and the design of the plantings will therefore include sufficient diversity to allow the forest to evolve and adapt to climate change. It would be relatively simple to establish a forest cover using known hardy species but this would provide little scope for long term resilience. Means of maximising diversity in the plantings will be a key focus of the preliminary planting and monitoring. It is probable that some of the more sensitive species will only be appropriate towards the more landward and sheltered margins of the park. These design aspects reflect the commitment to the long term restoration outcome.

62. As noted earlier, a sufficient width of pines will be maintained at all times to screen the proposed “Special Zone” until the native trees and shrubs achieve sufficient height. Ideally, the native species used to achieve canopy closure will include a significant component of species that can grow to heights of at least 15m over 20-30 years. As with most natives, the timeframes for such growth is greater than associated with exotics such as pine. Nonetheless, the growth rates achieved with pohutukawa in this area (e.g. around car park at Te Arai Point) indicate that useful rates can be achieved with suitable shelter and other considerations. An initial native forest cover can therefore be established relatively quickly. This will enable remaining pines (i.e. those left to retain the visual screen between the housing and the sea) to be removed and replaced with natives within a reasonable timeframe.

63. At this early stage, it is envisaged that the initial forest outcomes will probably be dominated by pohutukawa and other coastal forest species (some of the more sensitive of which will probably only be practical in more landward areas). Existing pohutukawa in similar backdune environments suggest that reasonable heights (i.e. 10-15m) can be achieved in 20-30 years. Examination of other Northland dunes also suggests that kanuka may provide a moderate cover and height in some areas; though probably only in landward and sheltered areas it is known from previous trials that this species is not suitable in more seaward and exposed areas. The staged planting investigations will confirm and refine the most appropriate species mix for the different areas.

64. The seaward edge of the pines is generally strongly related to dune morphology, located on the landward side of the dune crest – which can be the most seaward dune in high dune areas (e.g. Figure 2; Figure 3a) but is more typically the second major dune crest and sometimes the third dune (Figure 3). In general, the seaward edge of the pines varies from 30-100m inland from the seaward toe of the dune being typically 50-70m (Figure 3). Plantings of native trees and shrubs will adopt the same seaward edge as the existing pine forest - since previous native tree and shrub plantings (including karo, pohutukawa and taupata) in more exposed areas to seaward have generally experienced only very slow growth rates.

65. The seaward edge of the pine forest is strongly affected by wind and salt burn, with trees increasing in height landward and the most seaward trees often less than 1m high (Figure 3). Partially to severely defoliated tree crowns are common. This area of significant exposure and salt influence, with tree heights progressively increasing inland is often referred to as the “veg-wedge”. This “veg wedge” is very important as it protects vegetation further inland from wind and salt damage.

66. A similar “veg wedge” feature is likely to be evident in the native forest sequence once it is established, though the profile shape may well vary from the pines according to the hardiness of the species used. If the preliminary planting and monitoring identifies suitable native species that enable a relatively steep “veg wedge” of suitable height to be developed relatively quickly, this will considerably assist the progress of forest establishment. (It will provide a protective screen along the seaward margin of the forest, providing plantings further landward with enhanced shelter from salt and wind).

67. Native tree and shrub plantings in the more seaward and exposed zone will need to emphasize the use of hardy, salt tolerant species to cope with the significant salt levels experienced during coastal storms with strong onshore winds. The most appropriate species will be confirmed by the monitoring of preliminary plantings but will probably include species such as taupata, coastal five finger, karo, pohutukawa and (possibly) ngaio (ngaio is softer than the earlier named species).

Planting Timelines

68. Extensive operational planting is likely to be practical from the first year in the most seaward (i.e. the spinifex and low vegetation) areas as many of these plantings involve established techniques. Pest control will be undertaken in the first year and this work should also encourage natural regeneration of natives in many areas. Planting investigations in the most seaward areas will be largely completed within the first 2-3 years and therefore all operational planting in these areas can proceed within 3-4 years.

69. Preliminary planting and monitoring will also be undertaken within the pine forest areas of the coastal park in the first two years. These plantings will probably need to be monitored for up to 3-4 years to confirm operational planting details. Therefore, significant operational planting within the pine areas should be completed within 5 years, probably in years 4 and 5. It is anticipated however that significant operational plantings in some areas (e.g. salt resistant trees and shrubs along the seaward margin of the forest restoration area) can commence earlier (probably Year 3 - subject to results from monitoring of preliminary planting).

70. Accordingly, significant operational planting work in the first 3 years is likely to focus on the more seaward zones with the main shrub and tree planting in the pine area occurring from Year 4 onwards.

71. The operational planting replacing the pines may need to occur in two stages in order to maintain some pines as a plant screen until the early native plantings develop to sufficient height. If so, the planting will be designed to ensure only the minimum necessary pine width is left so that the first stage of operational planting is the more extensive. However, we will also be closely examining opportunities for planting strategies involving inter-planting with the pines. i.e. thinning the pines sufficiently to allow the natives to develop while also leaving sufficient density of pine to maintain a screen. Given the 200m width of the coastal park this strategy may prove practical. If so, most of the operational planting can probably be completed in years 4 and 5. The remaining pines would be either removed or killed in situ once the native trees develop to sufficient height to maintain the screening of the development from the beach.

72. Naturally, actual timelines for operational work will be dependent on monitoring outcomes and will commence as soon as appropriate. Monitoring results will be discussed with Rodney District, ARC and DoC staff each year

D Summary

73. Extensive dune management and restoration work is proposed within the Coastal Park area along the seaward margin of the proposed “Special Zone” – including effective management of human pressures, significant enhancement of native

biodiversity in the primary and secondary dune vegetation zones, and staged replacement of the pine forest with appropriate coastal dune forest.

74. The proposed dune management is far more ambitious and extensive than any dune restoration programme so far undertaken in New Zealand and will be preceded by carefully designed scientific pilot plantings and monitoring to ensure successful and cost effective outcomes.

75. The programme will result in very significant ecological and biodiversity gains, and will restore a habitat that is among the most rare and degraded of all natural ecosystems in New Zealand. Native coastal dune vegetation sequences from spinifex through to coastal forest are extremely rare on the NZ coastline and very especially along the eastern coast. There is also potential for restoration in accordance with the plan change/variation to establish significant populations of both rare and declining dune vegetation species (e.g. sand coprosma; sand pimelea). In my opinion, the ecological gains are certainly of regional and probably of national significance. I am extensively involved with dune restoration and as a trustee on the Dunes Trust I am very familiar with work around New Zealand. I know of no historic or presently proposed project of similar scale and significance.

76. The tree plantings will be managed (e.g. weed release) until canopy closure is achieved. We anticipate that will occur within 3-5 years of the operational planting work. Thereafter, the forest will be self sustaining.

77. Climate change may have a significant influence on the final forest outcomes over the next 1-2 centuries and beyond. Therefore, sufficient diversity will be included in the restoration plantings to enable the forest to adapt to climate change.

78. There is also opportunity for significant involvement of the local and beach user community in the dune restoration work Community involvement has proved very successful in developing an appropriate dune care ethic in other coastal communities and locations. Given the significance of the revegetation, I anticipate significant community interest from the local and wider area.

79. In my opinion, the proposed dune management and restoration will maintain the natural and wilderness character of the beach and significantly enhance natural and ecological values of the dunes. It will also help ensure that the local community in this area and Te Arai beach users are increasingly well informed and empowered to protect and enhance this special coastal area – reversing the clear evidence of steady degradation presently evident.

Jim Dahm

February 2009

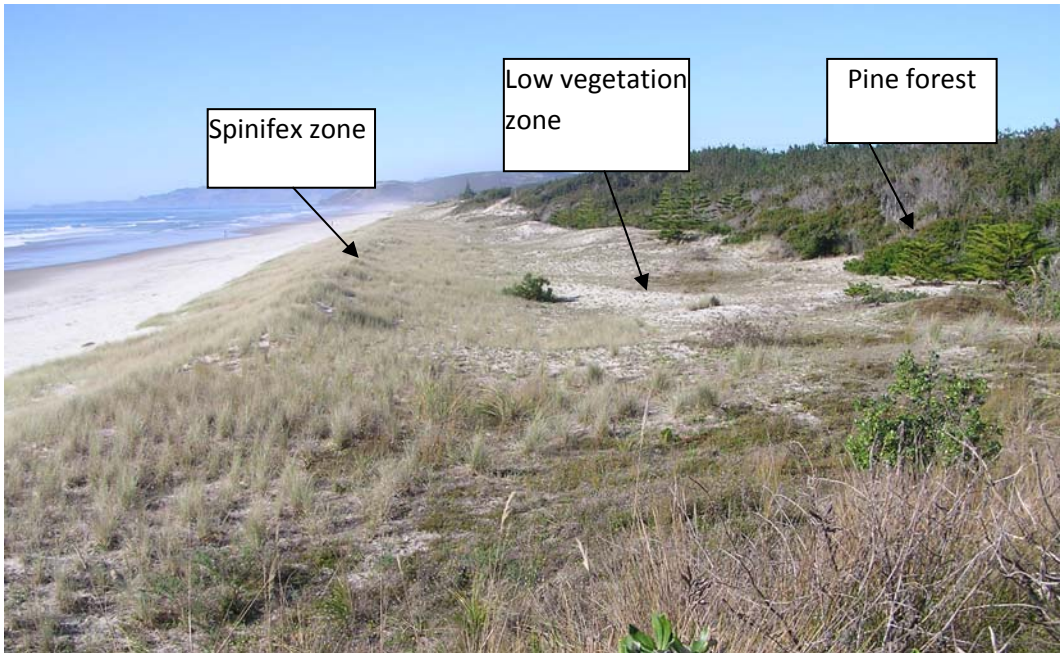

FIGURE 1: Typical broad vegetation zones evident on seaward dunes

FIGURE 2: Note forest zone higher and closer to sea behind the larger frontal dune (arrowed in background) compared to typical situation with lower dune (foreground)

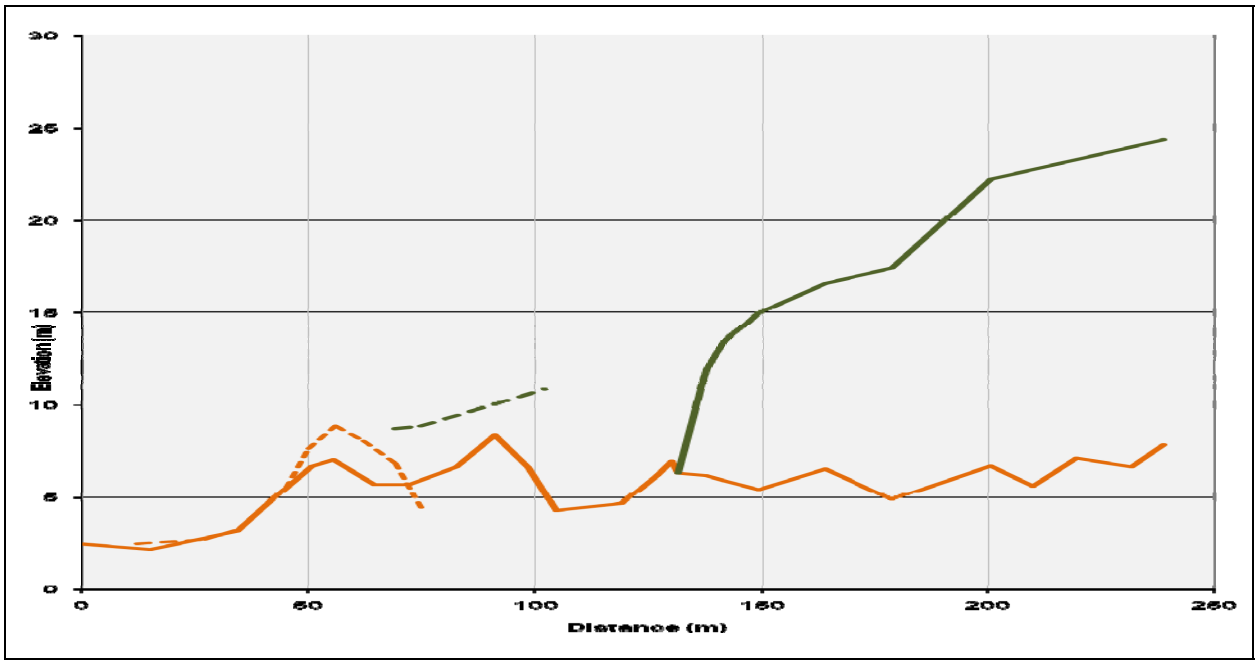

FIGURE 3A: Cross sections showing dune (orange) and pine canopy (green) profiles in areas where the pines are unusually close (dashed line) and distant (solid line) from the sea . Distances are measured from the seaward edge of the high tide beach.

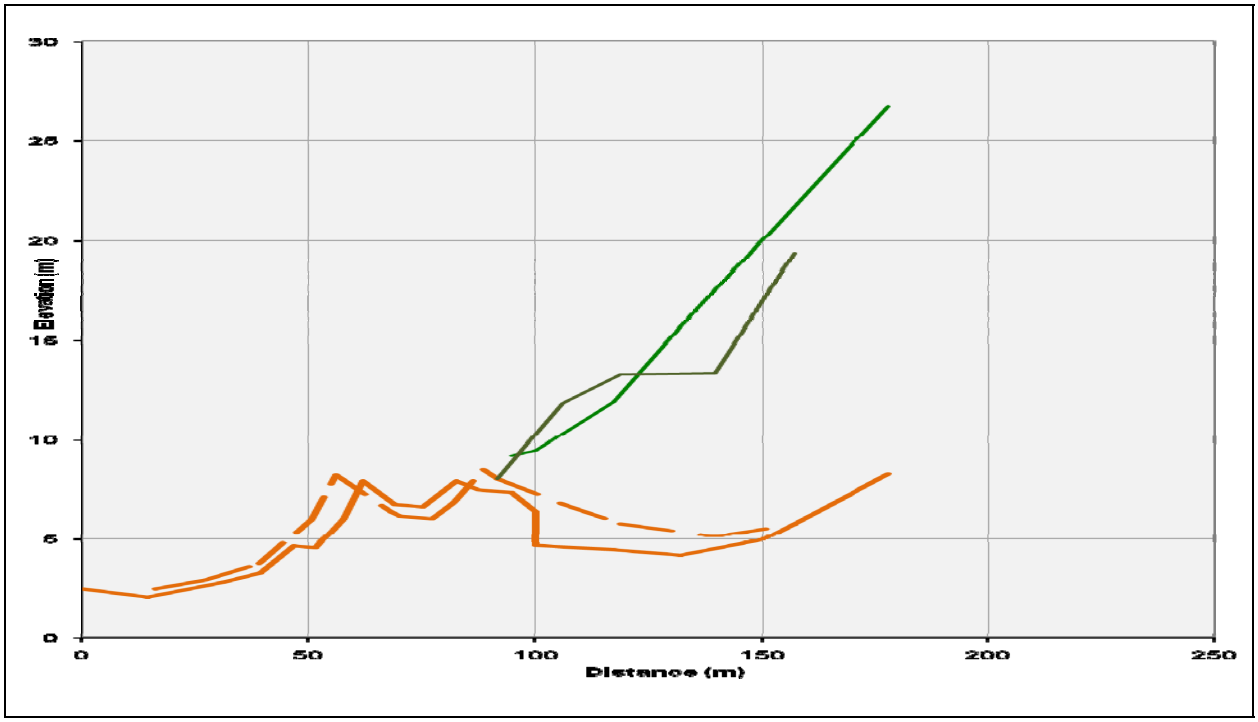

FIGURE 3B: Surveyed cross sections showing typical dune (orange) and canopy (green) profiles. Distances measured from seaward edge of high tide beach

FIGURE 4: Pig rooting damage – common in the existing low vegetation zone landward of the spinifex zone. Reasonably dense native communities would normally be expected in these areas (e.g. Figure 5).

FIGURE 5: Dense community of native backdune vegetation (knobby clubrush, pohuehue and sand convolvulus) immediately landward of the spinifex zone in an area without pig damage.