IN THE MATTER OF	Of the Resource Management Act 1991 (the Act) and the Local Government (Auckland Transitional Provisions) Act 2010
AND	
IN THE MATTER OF	The Proposed Auckland Unitary Plan Topic 033 and 034 – RPS General Coastal Marine Zone and Activities AND Other Coastal Zones Mangrove Removal
SUBMITTER	Omaha Beach Community (submission 2970)

PRIMARY EVIDENCE OF DR GRANT SPENCER DUMBELL (ECOLOGY) ON BEHALF OF OMAHA BEACH COMMUNITY

2 MARCH 2015

QUALIFICATIONS AND EXPERIENCE

1. My full name is Grant Spencer Dumbell. I am a self-employed ecologist based in Auckland and have been in private practice since 1988. I hold a Ph.D. degree in Zoology from The University of Auckland from where I graduated in 1987. I also hold first class B.Sc. (Hons) and B.Sc. degrees from Victoria University of Wellington, both majoring in Zoology. Over the past 36 years I have worked as a conservation and restoration ecologist in many parts of New Zealand with the former New Zealand Wildlife Service, the former Department of Scientific and Industrial Research, private conservation charities, the Department of Conservation and a wide range of public and private clients.

2. Since 2010 I have been intimately involved with the planning, consenting and project management of what I believe to be the largest single site mangrove removal project in the country, which has been carried out in the Kaipara Harbour. This project has to date removed over 40 hectares of dense recently colonised mangrove forest.

3. Prior to this I have worked in mangrove habitats as a result of my research on the ecology of the New Zealand brown teal, pateke, (*Anas chlorotis*) in both Northland and on Great Barrier Island and although this research did not focus on mangroves it was partially undertaken in mangrove and salt-marsh habitats.

4. As a result of the planning for the Kaipara mangrove removal I have become familiar with a selection of other mangrove removal sites including a sub-estuary of the Tauranga Harbour and the Pahurehure Inlet and Auckland Airport removal sites on the Manukau Harbour.

5. For the Kaipara Harbour mangrove removal I also undertook benthic and avifaunal surveys at the project site, produced a model for the estimation of mulch volumes that would be produced by the mechanical mangrove removal and reviewed tidal and wind drift data collected by coastal engineers to model the off-site dispersal of the mangrove mulch to understand potential impacts on adjacent shorelines. This project was also intertwined with a concomitant project to eradicate *Spartina* cord-grass from the project site. This introduced aquatic weed is recognised as being one of the most invasive saltwater weeds in the world and was planted on the project site, probably during the

1970's in an attempt to reclaim areas of the intertidal foreshore. The *Spartina* eradication is being undertaken in conjunction with biosecurity staff from Auckland Council under the auspices of the Auckland Regional Pest Management Strategy. This recognises the project site as probably the largest infestation of this weed in the Auckland region and project planning has needed to remain cognisant of the interactions between the *Spartina* and the mangroves. It involved extensive spray trials to satisfy the conditions of the two relevant resource consents, one to aerially spray *Spartina* and the other to mechanically remove mangroves.

6. I have been engaged by the Omaha Beach Community to provide expert advice on mangrove distribution and colonisation in the Whangateau Harbour, to review the organisation's Proposed Auckland Unitary Plan (PAUP) submission on the plan's proposed policies and rules regarding mangrove removal, to represent the community at the PAUP mangrove mediation held on January 14 and to prepare this brief of evidence. Additionally, I have also participated in an expert conference with Dr Carolyn Lundquist at the request of Robert Scott as the consultant Council Planner at the PAUP mangrove mediation.

CODE OF CONDUCT

7. I have read and agree to comply with the Environment Court's Code of Conduct for expert witnesses outlined in the Environment Court's Consolidated Practice Note 2011. I have complied with this practice note in preparing this statement of evidence. I also confirm that my evidence is within my area of expertise except where I state that I am relying on what I am being advised by another person or the evidence of another expert. I also confirm that I have not omitted to consider material facts known to me that might alter or detract from my expressed opinions.

SCOPE OF EVIDENCE

8. For this engagement I have undertaken a qualitative assessment of mangroves in the Whangateau Harbour over a full tidal cycle, I have searched and interpreted a range of historic aerial photos of the harbour and its environs, I have reviewed a number of Auckland Regional Council technical publications, mostly produced by the National

Institute of Water and Atmospheric Research (NIWA), regarding both mangroves and the Whangateau Harbour, and have undertaken a quantitative survey of large mangroves in both the Omaha River and the smaller stream estuaries along the northern shoreline of the harbour.

THE WHANGATEAU HARBOUR

9. The Whangateau Harbour is recognised as one of Auckland's least modified estuarine harbours (Aquatic Environmental Sciences, 2014), which has been able to maintain high water quality and a diversity of terrestrial, intertidal and sub-tidal habitats (Cole et.al, 2009); Kelly 2009). This is partly due to it having a relatively small catchment, which is predominantly rural without urbanisation, and a high tidal flushing rate, which sees approximately 90% of its water volume change on each tidal cycle.

10. The harbour essentially has two main arms reaching inland from its mouth in the north-east of the harbour.[1] A larger southern arm extends southward to the west of the Omaha sandspit and is bisected by an artificial causeway constructed in 1971 to give road access to the Omaha residential development. South of this causeway I refer to the harbour as the Waikokopu Estuary. A smaller second arm of the harbour reaches westward up the Omaha River. These two arms are separated by Point Wells.

11. Along the northern shoreline of the harbour are a number of sub-estuaries formed in the tidal reaches of streams that drain the higher and steeper parts of the catchment to the north of the harbour. At least one of these has been bisected by a roading causeway for the main road to Leigh.

12. Tide charts show that under normal tidal conditions the harbour has a tidal range between approximately 1.4m and 2.0m between neap and spring tides but this can extend as high as 2.8m on king tides. At low tide the harbour is dominated by broad sandy intertidal flats with permanently flooded sub-tidal channels extending up each arm of the harbour. These are in places several meters deep but at high tide the sand flats are mostly covered by water that is less than two metres deep. On-site observations show that at mid-tide the water has begun to flood out of the main

[1] Attachment 1.

channels and inundate the sandflats but significantly less than 50% of the sandflats are flooded.

NATURE AND CHARACTERISTICS OF MANGROVES

13. The Grey Mangrove is the only species of mangrove present in New Zealand. It is a native woody tree that shows considerable variation in size across its range. At the southern extent of its range in the Ohiwa Harbour at Ohope it is less than one metre tall and cannot grow sufficiently dense to form a closed canopy. Further north in the Tauranga Harbour, mangroves grow to approximately two metres tall and form a dense shrubby canopy. In Auckland, mangroves grow up to five metres tall and can be large substantial long-lived trees. If they grow in isolation they can have a spreading habit and their spread can be up to three times their height. In a dense stand they have a much more columnar growth form as adjacent trees compete aggressively for light. In the Hokianga Harbour in Northland, mangroves can grow as high as 10 metres.

14. Mangroves grow on soft sediment shorelines and are generally limited to the upper half of the tidal range as their roots must be above water for approximately six hours on each tidal cycle. They are supremely well adapted to this habitat as they possess specialist aerial roots called pnematophores that protrude vertically above the substrate so their roots can respire in the waterlogged sediment. They also have specialist adaptations to be able to handle the concentration of salt in the water they transpire and they have a specialised reproductive mechanism whereby viable seeds germinate on the parent plant before dispersing as a propagule by floating on the tide. Once these become stranded on suitable substrate the rootlet can gain a toehold between subsequent high tides to prevent the propagule being washed away.

15. These characteristics of the species are important as they allow generalised conclusions to be made about past and future patterns of mangrove colonisation within the harbour.

PRESENCE AND EFFECT OF MANGROVES IN THE WHANGATEAU HARBOUR

16. Historic aerial photography for the Whangateau Harbour extends back to 1953[2] for vertical aerial photography and at least 1948 for oblique aerial photography.[3] These records prove conclusively that the historic distribution of mangroves was severely restricted in the harbour and concords with field data collected from a survey of large mangrove trees.

17. The assessment of mangroves throughout the harbour showed that in areas of open harbour, such as the Waikokopu Estuary, mangroves establish as single trees that grow into large free-standing individuals. A count of trunk rings on a large mangrove felled on the southern (upstream) side of the causeway gave an age of approximately 40 years, suggesting this particular tree established in the first half of the 1970's, which is very soon after the construction of the causeway in 1971.

18. A vertical aerial photo from 1973[4] shows no mangroves in the area where the trunk was found and supports the conclusion that the construction of the causeway changed the tidal flow dynamics of the Waikokopu Estuary by reducing the energy of the tidal flows across the intertidal sandflats allowing mangrove propagules to strand and colonise where before the causeway they would have been swept into the lower reaches of the harbour and out into the open sea as a result of the near complete flushing of the harbour on each tide.

19. Today the Waikokopu Estuary supports a large number of quite large mangrove trees. Site photographs on the incoming tide demonstrate that the bulk of these individual trees is now sufficient to change the local wave climate around each tree with the result that wave refraction is leading to sand accretion in the lee of trees.[5] This has the effect of shallowing the high tide water depth and with the shadowing and wave dampening effects of the large trees it promotes the establishment of further mangrove seedlings around each large mangrove.

20. This process is further encouraged by the large mangrove pnematophore field, which can extend many metres beyond the drip line of each tree.[6] These further dampen wave energy and provide entrapment sites for floating propagules. The result is that each tree becomes a centre of colonisation for further mangroves and over time a

[2] Attachment 2.
[3] Attachment 3.
[4] Attachment 4.
[5] Attachment 5.
[6] Attachment 6.

patch develops with progressively younger trees on the margin of each patch. Over time these patches coalesce to form a closed canopy forest.

21. On the eastern shore of the Waikokopu Estuary is an extensive area of salt-marsh habitat associated with a large remnant of coastal native forest. This habitat complex shows textbook zonation of habitats across the terrestrial / estuarine ecotone and is protected by the Department of Conservation as a Scientific Reserve, one of the highest status reserves under New Zealand law. Below high tide the vegetation is herbaceous salt marsh vegetation, however, this is now gradually being invaded by mangroves as floating propagules become entrapped in the vegetation.[7] The process will lead to the replacement of this significant habitat with a tall woody mangrove forest as the trees grow and shade out the salt marsh vegetation.

22. This pattern of colonisation is also evident in the Omaha River and the northern shoreline stream estuaries, although in these areas it is rather more advanced and is a potent for the future of the Waikokopu Estuary. An assessment of mangrove forest patches in these parts of the harbour showed these closed canopy mangrove patches were composed of several discrete age classes of trees, suggesting that recruitment has been episodic rather than continuous.

23. The quantitative large mangrove survey also confirmed this pattern. This survey recorded the trunk diameters and heights of a sample of mangroves at each of 14 survey points spatially positioned using GPS. Seven points were in the Omaha River and a further seven distributed throughout the major sub-estuaries along the northern shore of the harbour. This allowed the survey points to be plotted onto a georeferenced aerial image of the harbour and compared with the historic mangrove distribution recorded in historic aerial photographs.[8]

24. Trunk diameters were closely correlated with tree height (r=0.87) and the largest trees also exhibited a very open growth, spreading habit with large multiple branched trunks indicated they had established as solitary trees but over time had become embedded into large mangrove patches as younger trees grew up around them. The position of these large trees also coincided with the small and limited size mangrove patches evident on the earliest aerial photos of the harbour. This pattern was further reinforced

[7] Attachment 7.
[8] Attachment 8.

by the frequency distribution of trunk diameters, which was right skewed with some atypically large outliers.[9]

25. The conclusion drawn from this qualitative and quantitative information is that in the Whangateau Harbour mangrove colonisation is progressing as solitary trees becoming centres of colonisation of mangrove patches that over time coalesce into large, dense mangrove forest monocultures. This pattern is most advanced in the upper Omaha River but has also occurred in the northern shoreline stream estuaries, on the western side of Horseshoe Island and is now occurring in the Waikokopu Estuary, principally as a result of the construction of the causeway to Omaha.

26. This process has not yet become established in the lower reaches of the harbour, however, the relative position of the mid-tide line indicates that significant areas of the intertidal sand flats of the lower harbour are at risk from mangrove colonisation, especially the inshore extent of the intertidal flats. Swales et.al (2009) provide evidence that the extent of mangrove distribution within the Whangatea Harbour could at least double from its current state.

27. While annual propagule production is variable, the 2014/15 propagule fall appears akin to a mast year with local Omaha residents reporting they have never seen the mass of mangrove propagules on the high tide line that they are recording this summer, nor have they previously seen the sheer number of seedlings that are becoming established on the lower harbour intertidal sandflats. This pattern is also consistent with the discrete age classes of mangroves recorded in the Omaha River.

28. Mangroves are a native species that are increasingly generating polarised debate, especially around their management. In general, mangroves are portrayed as being passive responders to exogenic landscape processes and come with benefits such as increased habitat diversity, coastal protection and the amelioration of climate change through carbon sequestration.

29. In any ecosystem, ecology is about understanding the interactions of plants and animals both between themselves and their abiotic environment. It is more than just identifying and enumerating plants and animals, it requires an understanding of biological and physical processes as it is these that shape the attributes of each ecosystem.

[9] Attachment 9.

30. It is widely held that mangrove expansion in Auckland's harbours and estuaries is a result of increased sedimentation that has led to the deposition of mud onto which mangroves have naturally spread. The conclusion that flows from this is that mangrove expansion cannot be arrested until sediment runoff from surrounding catchments is significantly curtailed, therefore mangrove expansion is a function of terrestrial land use changes.

31. While this argument is partly true it does not, in my view, give sufficient consideration to underlying natural processes that are occurring in these habitats, and the Whangateau Harbour demonstrates some of the weakness of this argument.

32. Using the above argument, and given the unmodified state of the Whangateau Harbour, this harbour should not be experiencing mangrove expansion, but it is, and it is likely accelerating. In the Whangateau Harbour mangroves are establishing on sandy substrates and promoting the deposition of fine, muddy sediments rather than establishing as a response to the deposition of mud.

33. In any estuarine system, the sediment characteristics are a function of the parent geology and the energy of the tidal flows which sort and shift the sediment. When sediment inflows exceed the capacity of tidal flows to mobilise and transport the sediment the excess is deposited. When the reverse occurs shoreline erosion is the result as the tidal flows carry away previously deposited sediment. These processes can build and destroy massive structures such as dunes, spits, deltas and bars, therefore an estuary maintains a dynamic equilibrium between its sediment budget and sediment transport capacity.

34. With historic land clearances in New Zealand, terrestrial sediment flows would have massively increased with the removal of the catchment forest cover. It will also episodically increase with storm events such as floods. Over time it can be expected that as sediment runoff stabilises to its new equilibrium that tidal processes may be able to 'catch up' and remobilise and remove the excess sediment that has been deposited. The largely unmodified state of the Whangateau Harbour suggests this dynamic equilibrium is currently balanced so as to prevent the deposition and accumulation of muddy sediments.

35. The effect of the colonisation and expansion of mangroves is twofold; if mangroves colonise deposited muddy sediments they act to bind these in place and prevent their

remobilisation by dampening tidal processes. Secondly, this dampening actually contributes to the deposition of muddy sediment, which in turn promotes more aggressive mangrove expansion.

36. In my view mangroves should not be seen as a passive response to fine sediment deposition, they should be seen as aggressive ecological colonists with the capacity to significantly shift the ecological trajectory of upper shore intertidal areas away from diverse open sandflats and saltmarsh to tall woody closed canopy monocultural forest.

37. It is also my opinion that insufficient weight is given to the adverse effects of mangrove colonisation as a result of the habitats they replace. Intertidal sand flats support dense beds of benthic shellfish in addition to saltmarsh and seagrass vegetation, which do not coexist with mangroves.

38. When the tide is out these areas are feeding grounds for a highly diverse assemblage of bird species (Wildlands,2015), the effects of which extend as far northwards as Siberia and Alaska by virtue of New Zealand being at the southern extent of the East Asian flyway along which tens of thousands of migratory waders travel annually to overwinter during our southern summer before returning north to breed in the northern summer.

39. Flocks of these birds are present in the Whangateau Harbour and they are replaced in wintertime by flocks of domestic migrants of South Island Pied Oystercatchers who over winter in northern harbours. Additionally the Omaha Spit is also recognised in the PAUP as a critical breeding area for New Zealand dotterel, a threatened endemic species that is reliant on the littoral margin for feeding and nesting habitat.

40. When the tide is in these intertidal flats become feeding areas for a range of fish species while the saltmarsh and riparian vegetation provide spawning sites for freshwater fish species such as galaxiid whitebait.

41. In contrast, my experience with ecological assessments of recently colonised mangrove forests in the Kaipara Harbour show these habitats support a depauperate avifaunal species diversity with very low abundance. While birds do use mangrove forests, these do not provide primary habitat for any native species. Mangrove forest benthic epifauna is dominated by mud crabs and mud whelk molluscs, with the complete absence of benthic infauna. These habitats can be described as simplistic both structurally and functionally compared to what they have replaced.

42. Some commentators have pointed out that data suggests that banded rail that inhabit saltmarsh vegetation adjacent to mangroves spend more time foraging and extend their foraging further away from the saltmarsh when mangroves are present compared to when they are not. On the face of it this might suggest a significant benefit for the presence of mangroves, however, an alternative hypothesis is that the feeding habitat quality of mangroves is poor compared to open intertidal flats with the result that the birds are forced to spend much more time and have to travel greater distances to satisfy their feeding requirements. I am not aware that beyond direct observation there are any studies that have falsified this alternative interpretation.

ECOLOGICAL RESTORATION

43. The Society for Ecological Restoration (SER, 2002) defines "ecological restoration" as:[10]

> *An intentional activity that initiates or accelerates the recovery of an ecosystem with respect to its health, integrity and sustainability…. Restoration attempts to return an ecosystem to its historic trajectory.*

44. The Omaha Beach Community contends that allowing mangrove colonisation to continue unchecked within the Whangateau Harbour will significantly affect the natural character of the harbour and that far from it being a natural process it is one that is largely a result of human induced change with the result that the harbour and its natural processes will move from its historic ecological trajectory to an altered trajectory in much the same way that most other Auckland harbours and estuaries have with a concomitant loss of biodiversity and significantly reduced amenity value.

45. The PAUP proposes that permitted activity mangrove removal can be undertaken to reinstate the situation as at 1996, subject to rules and methodologies. However, in the case of the Whangateau Harbour there is compelling historic evidence and an understanding of operative ecological processes to demonstrate

that although present, mangroves have not naturally been a significant ecologically element in the harbour.

46. Accordingly, the community has proposed that the permitted activity provisions for mangrove removal in the harbour be based on a baseline of 1948 rather than 1996 to allow ecological restoration to return the harbour to its original ecological trajectory.

47. This position has been supported by both Robert Scott, the Council's consultant planner (see para 142 of his evidence) and Dr Carolyn Lundquist, the Council's independent marine ecologist (see para 7.12 – 7.15 of her evidence). It is noteworthy that Dr Lundquist says in her evidence that in her opinion, mangrove removal undertaken in accordance with the proposed permitted activity provisions of the PAUP "is likely to have only minor impacts" and "is also likely to have long-term success at halting mangrove expansion".

48. I note that Dr Lundquist has also attached to her evidence, as Attachment C, the record of the expert conference undertaken to independently consider the community's proposal for a 1948 baseline date. On this basis I prepared, as requested, the plan attached to Robert Scott's evidence delineating the extent of the zone within which the 1948 baseline will apply.

CONCLUSION

49. It is my opinion that the implementation of the proposed 1948 baseline for permitted activity mangrove removal in the Whangateau Harbour, rather than the proposed 1996 baseline, is not only desirable but critically necessary for the recognised ecological and amenity values of this harbour to be protected and for the advancing and accelerating mangrove colonisation to be successfully managed to restore and preserve the natural character and ecological integrity of the harbour.

Dr Grant Spencer Dumbell
2 March 2015

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