BEFORE THE ENVIRONMENT COURT
CHRISTCHURCH REGISTRY

ENV-2016-CHC-47

IN THE MATTER	of an appeal under Section 120 Resource Management Act 1991
BETWEEN	**BLUESKIN ENERGY LIMITED**
	Appellant
AND	**DUNEDIN CITY COUNCIL**
	Respondent

BRIEF OF EVIDENCE OF JOHN LAURENCE CRAIG

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STATEMENT OF EVIDENCE OF JOHN LAURENCE CRAIG

INTRODUCTION

1. My name is John Laurence Craig. I have a BSc (1st Class Honours) in ecology from Otago University and a PhD in ecology from Massey University. I have 46 years' experience working in New Zealand environments, both as a researcher and as an expert witness relating to terrestrial ecology, especially birds. I was Professor of Environmental Management at the University of Auckland until my retirement in December 2009.

2. My specialist areas of research and teaching within environmental management are biodiversity conservation, restoration ecology, animal behaviour, birds and sustainability. I taught and researched animal behaviour, especially bird behaviour for 20 years. I also have 15 years' research experience on rodent ecology, and have been involved in the assessment of conservation options in relation to pest control. I am currently the organiser of a community-wide pest control programme covering an area of approximately 800 hectares with Northland Regional Council, and was the manager for 11 years of a 300 ha property which has an active and successful native re-vegetation and pest control programme.

3. My experience includes the assessment of ecological effects associated with proposed wind farms (Mahinerangi, Taharoa C, Hauāuru Mā Raki, Puketoi and three others that have not yet sought consent), subdivisions, mines, sustainable native forestry, motorways, bridges, reserve designs and various private and public developments. I have acted for Councils, Government Departments, Iwi, NGOs, companies and private citizens. I have also prepared assessments of resource consent applications for Councils. Whilst the majority of these have been in the upper North Island, a number have been in the South Island.

4. I have received honours from the Society for Conservation Biology, the Royal Society of New Zealand and the International Ornithological Congress. The Royal Society award was the Charles Fleming medal for my contributions to the New Zealand environment. The Society for

Conservation Biology recognised my contribution to the special conservation issues of New Zealand with a Distinguished Achievement Award. I was also made a life member of the New Zealand Ecological Society in 2008. I received an ONZM for services to conservation in the 2012 New Year's honours.

5. My specific research on avifauna includes work on the ecology, behaviour, and genetics of many species, especially wetland and forest species. I have also supervised more than 20 graduate student research projects for the University of Auckland, which were predominately related to birds including waders. I have published over 100 refereed scientific papers and edited two books on nature conservation. I am also familiar with the activities of, and priority setting by, Department of Conservation Recovery Groups. I have been a member of the Stitchbird Recovery Group, and have attended recovery meetings for Takahe and Kakapo. I am also a former member of the Auckland Conservation Board.

6. I have extensive experience in the planning and development of sites with the specific aim of enhancing both biodiversity values (especially birds) and integrating human activities. I was co-originator of the successful restoration of Tiritiri Matangi Island from a disused farm into an open sanctuary which has developed international renown. I have also been involved in developing restoration plans for Motuora, Motutapu-Rangitoto, Pakatoa, Rotoroa and Motuihe Islands, and was the ecologist on the design team for the redevelopment of Waiatarua Reserve in Remuera, which is increasingly considered an important spot for birdwatchers. I have acted as a reviewer and adviser for other sanctuary developments, and am currently involved in the development of a private coastal property as an ecotourism development that involves a range of threatened species including 23 bird species with some form of threat status.

7. I managed the Contact Energy wader breeding surveys in the Upper Rangitata for the spring and summer of 2011 – 2013. This involved measuring reproductive productivity of wrybill and South Island pied oystercatchers to determine the levels of pest control needed to offset the predicted bird kills from the proposed HMR windfarm.

8. In December 2015, I was engaged to review and support the ecological assessment of the Blueskin Bay wind farm proposal. I used information

from other wind farms to provide guidance on the likely effects of the three proposed turbines on birds. I have adopted the same process to assess the likely to effects of the single turbine now proposed.

9. I lived in Dunedin for eight years and spent considerable time looking at birds (including a thesis) but while I have visited Mt Cargill and Blueskin Bay on numerous occasions, and Orokanui once, I had not previously been to Porteous Hill and would have difficulties understanding why anyone would choose it as a site to look for birds. I visited the site prior to the Council hearing and assessed it in terms of likely bird movements.

10. For the purpose of preparing my analysis and this statement of evidence, I have also read:

    (a) numerous refereed articles from scientific journals;

    (b) Department of Conservation publications;

    (c) Reports prepared by international wind farm bird specialists;

    (d) Unpublished records of windfarm mortality at a number of New Zealand wind farms; and

    (e) The ecological assessment by Dixon & Mitchel as well as the submissions both for and against the proposal.

11. I confirm that I have read the 'Code of Conduct for Expert Witnesses' contained in the Environment Court Consolidated Practice Note 2014. My evidence has been prepared in compliance with that Code. In particular, unless I state otherwise, this evidence is within my sphere of expertise and I have not omitted to consider material facts known to me that might alter or detract from the opinions I express. Where I rely on the opinions of another person I have made that plain.

SCOPE OF EVIDENCE

12. My evidence will cover the following matters:

    (a) The effects of wind turbines and transmission lines on birds in an international context;

    (b) A discussion of these effects in the New Zealand context;

(c) An outline of what is known from other New Zealand wind farms;

(d) An overview of the effects of other human activities on bird deaths;

(e) What are the likely effects of the proposed turbine on Porteus Hill;

(f) Suggested mitigation.

SUMMARY OF CONCLUSIONS

13. Birds are killed by wind turbines but likely effects vary with the size of the wind farm, the type of turbines used, the characteristics of the site, and the specific bird species involved. Early international wind farms in specific locations typically associated with known bird migration sites and involving large numbers of turbines had high bird mortality. Subsequent data collection and the development of collision risk modelling allows predictions of likely kill rates. Post construction monitoring has allowed testing of the veracity of these models and shown which bird species are most at risk as well as the level of this risk.

14. Data are available from a number of large wind farms in New Zealand. These provide sufficient information to estimate the likely effects of the proposed single turbine wind farm on Porteous Hill. Consideration of all factors suggests that there is no concern for bird kills at the site. The low bird numbers with just a single turbine mean that even if considerable sampling had been undertaken, the numbers would be too small to allow statistically meaningful modelling. Ecological effects will be less than minor.

BIRDS AND WIND TURBINES

15. All human constructions in the landscape are known to result in some bird deaths (Erikson et al. 2005). Wind farms have been recorded as killing large numbers of birds (Langston & Pullam 2003, Barrios & Rodrigues 2004, Powlesland 2009) and in some cases the mortality rate was so high in some species that the population was deemed at threat. Results vary markedly between wind farms and between species so it is important that the results for the minority of especially at risk species are not generalised across all species.

16. The majority of information on the effects of wind farms and transmission lines come from continental situations such as North America and Europe where winter conditions mean that large numbers of birds of many species migrate seasonally and hence millions of birds fly through particular regions. This migratory behaviour along with the design of older wind farms where turbines were smaller and closer together meant that they imposed barriers for bird movement. Modern wind farms typically include much larger turbines that are spaced further apart. Not only are they above the majority of bird movement, they are also spaced so that there is a much greater distance between turbines than is covered by the rotating blades and hence there is a far higher opportunity for birds to avoid individual turbines. Night migrating birds such as passerines that for all other stages of their life cycle are only active during the day and also soaring less agile birds with large wing spans relative to body size appear more vulnerable to collision mortality. In contrast with those examples, passerines in New Zealand rarely migrate and do not do so at night and we do not have any comparable large winged soaring species.

17. Similarly with transmission lines, the large number of bird flights across large areas of land during migrations means that the chance of striking lines in North America and Europe is greater than in New Zealand where few birds migrate seasonally across land. Also, the previously typical design of power lines whereby the wires are connected to insulators positioned above cross bars on power poles provided a chance for larger birds to be electrocuted if they spread their wings while perched. Hanging wires below cross bars, as is now the common design in New Zealand eliminates this problem.

18. The relatively recent emphasis on developing wind farms as a sustainable and economically viable form of renewable energy generation has resulted in planning for a large increase in wind farms in many countries. This has prompted a number of investigations into actual and potential effects of wind farms on birds (e.g. Drewitt & Langston 2006; Madders & Whitfield 2006; MacIntosh & Downie 2006, Powlesland 2009). In addition, there is considerable information from individual wind farms in many countries, as well as recommendations on how best to plan to minimise effects on birds. Recent assessments have considered available information on both direct mortality from collisions, and displacement of birds as a result of habitat changes. Results are variable both for locations

and for different bird species. While data for some more recent wind farms is sparse, there are some general patterns that allow assessment of risk and the provision of guidelines to mitigate potential risk to birds.

19. Bird death as a result of collision with either towers or rotor blades is the most obvious effect of some wind farms. Effects of transmission lines are not specific to wind turbines and do occur. Where blade collisions have been recorded, rates per turbine vary from 0.01 to 23 bird collisions annually (Drewitt & Langston 2006; Powlesland 2009). In reality, the rates for particular turbines can be markedly higher as placement of individual turbines can greatly influence the magnitude of the problem. None of the high rates have been recorded in New Zealand but the effects of older wind farms generally appear well known and influence public perceptions of wind farms. One submitter even used an international publication on bird risks in support of their objection.

20. The international wind farms with high bird mortality rates are rare and found in particular situations. Altamont Pass in California, Tarifa and Navarre in Spain and a number in Belgium, Denmark and Netherlands are the worst known sites. All are on migration routes for very large numbers of birds and occur in particular topographical situations (such as steep ridge tops, mountain passes and coastal sites) which increase the likelihood of bird interactions.

21. Not all bird species are equally at risk. Raptors (which includes falcons and hawks), large waterfowl and night feeding shorebirds such as terns appear especially at risk. As some raptors tend to be naturally found in low numbers, where even a small mortality risk can adversely influence population viability, it is raptors that have seen disproportionate attention in the literature.

22. Displacement of birds as a result of changes in habitat and visual disturbance is a further potential impact from wind farms, which can have both negative and positive effects. From the international experience there is not a clear pattern of habitat and visual disturbance effects on bird species. Some raptors and a range of other species are displaced from areas with turbines and hence preferentially feed elsewhere. A few other land birds appear to increase in the vicinity of turbines. Clearly, displacement from the area can reduce the probability of collisions.

23. Birds are known to actively avoid wind farms on a range of scales (Desholm 2006). Some avoid the whole site as in displacement mentioned above. Some avoid groupings of turbines, some individual turbines and some avoid the rotating blades. Where avoidance behaviour has been observed and recorded, it is known that of all the birds flying through a wind farm, at least 95% successfully avoid collision (Scottish Natural Heritage 2005) and for most species rates of greater than 99% are known (Whitfield & Madders 2006). Some soaring raptors are known to have the lower rates of 95%.

24. The results of international studies have helped provide a set of guidelines that can assist the interpretation of bird data from sites of potential wind farms and have provided clear guidelines for avoidance and mitigation of potential effects (Drewitt & Langstone 2006, US Fish & Wildlife Service 2007). Similarly, rigorous statistical methods have been developed in New Zealand to minimise the inclusion of subjective estimates of caution (see Craig et al. 2015).

APPLICATION TO NEW ZEALAND

25. It is important to put New Zealand birds into context to assist an understanding of potential effects of the proposed Blueskin Bay turbine. The relatively small fluctuations in seasonal climate in New Zealand means that most birds in our islands do not migrate between breeding areas and wintering areas unlike the situation found where the majority of wind farm bird strike is reported. The few New Zealand species that do migrate (such as wrybill, South Island pied oystercatchers, bar-tailed godwits) do so predominantly along coastlines. The exceptions include cuckoos, of which New Zealand has two species, which are both present at Blueskin Bay. However, there is no evidence that these species disperse high above the canopy or away from trees where they would be more likely to encounter turbines. Some seasonal movement of local species such as tui, bellbird, fantail, silvereye and kereru will occur but again dispersal well above the canopy or outside the forest is unlikely.

26. In some seasons, tui can move on a regular basis between feeding areas and they have been seen flying high above the canopy, circling and then flying together to the new food source (Stewart & Craig 1985). Tui are currently present only in low densities at Blueskin Bay, and it is not known

if they behave this way at that site and it is unlikely that they do at ridge lines hence the risk of turbine strike is likely low. Kereru also make courtship flights above the canopy at nesting areas and will also fly over open ground when moving between seasonal food resources. There is no information about their movements at Blueskin Bay although this behaviour is unlikely at blade height on ridges (above 27m) where the turbine will be sited. Given current knowledge (see below), bird strike of native species at inland wind farms in New Zealand is considered minimal and is especially unlikely at the proposed Blueskin Bay site.

27. It is also important to acknowledge that some of the wind farms that were known for high bird deaths (associated with bird strike) internationally have reduced these significantly by altering turbine design and location. Many of the early turbines were small and consequently their rotor blades were closer to the ground and turned faster. Also large banks of small turbines were needed to achieve the power output presenting walls of blades for dispersing birds. Repowering with new and larger turbines where the rotor is higher and slower as well as fewer of them to allow avoidance (as is planned at Blueskin Bay) has greatly reduced bird deaths (California Energy Commission 2005).

EVIDENCE FROM OTHER NEW ZEALAND WIND FARMS

28. Evidence of the effects of other wind farms in New Zealand is limited. Dixon and Mitchell (whose report was included with the Blueskin Energy Limited resource consent application) report results from Mahinerangi and West Wind and I will not repeat these here. Wind farms north of the proposed Blueskin Bay site including Tararua, Te Apiti, Te Rere Hau, which are some of the few sizeable wind farms, now have a requirement for ongoing monitoring of bird kills. Prior to 2007 10 deaths were reported from these wind farms over a period of five years. All deaths were introduced magpies, despite native birds such as paradise duck, tui, kereru, falcon and harrier hawk using the area. This is a death rate of approximately 0.02 per turbine per year. It should be noted that this is below the reported lower end of the range for turbine deaths worldwide. Between late July and early November 2007, nine bird strikes were recorded – still a death rate of 0.02 deaths per turbine. While the majority of these were also magpies, two ducks and one native, a harrier hawk, were also killed.

29. In addition, I have been advised by Meridian Energy that there were 14 bird deaths (being thirteen magpies and one native kingfisher) associated with the Te Apiti Wind Farm between July 2004 and June 2006. This is a death rate of 0.05 per turbine.

30. The Brooklyn wind turbine, which is located immediately adjacent to the Karori Wildlife Sanctuary, similarly has no formal requirement for reporting. However, after being in operation for seven years it has recorded only one blackbird death (Rodgers 2006).

31. Most of the bird deaths noted above have been recorded incidentally by workers regularly visiting turbines. While detailed and systematic mortality searches have only recently begun in New Zealand, these are showing only marginally higher death rates and a greater range of birds killed, most are small introduced finches (although a native silvereye has been found). It is especially important to note given the seemingly greater risk to raptors that only one Australasian harrier has been reported killed even though these are common through most open country in New Zealand and would be present at all existing wind farms.

32. No other New Zealand wind farm site is required to keep records of bird deaths, although several other consented, but not yet commissioned, wind farms have a requirement to do so. The report by Dixon and Mitchell give such results for West Wind. There is value in requiring annual reporting of bird strike where there are more than 40 turbines or sites of known high bird activity because voluntary reporting from the older wind farms does not provide standardised data nor is it readily available.

33. One of the earlier consented but not yet constructed wind farms, Taharoa, on the coast south of Raglan, was to construct 27 turbines adjacent to a major migration path for a number of species of shorebirds. Despite more than 70,000 South Island Pied Oystercatchers passing the site, deaths from turbine collisions were estimated to be less than 30 a year, a number that will have no effect at the population level (Fuller et al. 2009). Immediately north of this at the HMR site, similar numbers of birds are passing a proposed site of 168 turbines and with the revised information from international studies, estimated deaths were also predicted to be well below 30 a year.

OTHER HUMAN EFFECTS:

34. Vehicles, buildings, communication towers, transmission lines and agricultural machinery are all known to kill birds internationally and in New Zealand. Beauchamp (2009) estimates that at least 675,000 birds are killed annually on sealed roads in New Zealand. Erikson *et al.* (2005) estimate that vehicles and human structures kill up to 1,284 million birds annually in the USA and that wind farms account for 0.01 – 0.02% of these. Erickson *et al.* (2005) suggest wind farms in the USA account for 0.003% of estimated bird deaths. Of all species killed at the thousands of wind turbines, 0.2% were shorebirds (waders), 31% were passerines and 34% raptors.

35. My house is situated in an area of intensive pest control and the glass kills more than 20 birds a year. With the exception of silvereyes and one kingfisher, all are common introduced species such as house sparrows and thrushes.

ASSESSING EFFECTS AT BLUESKIN BAY

36. Standard practice for determining effects at most wind farms has involved regular, at least monthly, records of the numbers of different species present and the flying heights they have been seen using. Where very large numbers of birds are known to use the vicinity of larger proposed wind farms, vertical and horizontal radar has been used. The costs of this have been large. These numbers are then put into collision risk models to estimate the likely kill rate. Many consents have also included a need to monitor actual kill rates to verify the veracity of the predictions.

37. For small proposals such as Blueskin Bay, there is only a need to undertake extensive data collection if the proposed site has a high number of a threatened or at risk species known to be susceptible to blade mortality. This does not apply to this application and using the results from other windfarms allows predictions on the species most at risk and how likely rarer species known to be in the wider area may be affected.

38. Collision Risk Modelling is used to determine how many birds may be killed. It takes the proportion of flights that occur in the zone of the turning blades, includes flying speed, the probability that the bird will avoid the

wind farm, a turbine or the blade as well as body size and other factors that will influence the likelihood of the bird being struck with a turning blade. The Scottish National Heritage revised its default avoidance rate for all birds where information is not available from 95% to 98 - 99% with most birds having known rates as high as 99.9%.

39. The most common species in the vicinity of Porteus Hill as mentioned in the Ecology Report (Dickson & Mitchell 2015, Appendix E) and in Onley's submission are introduced, open country species such as goldfinches, chaffinches, redpolls, starlings, blackbirds, thrushes, sparrows, and magpies. A few natives such as silvereyes are also likely to be common. All of these species are likely to have a low rate of death resulting from the presence of turbines but none have been modelled as their deaths are not considered consequential because they are so common, are not unique to New Zealand and not protected.

40. The topography of Porteous Hill is also important in determining likely effects on birds. There is considerable scientific literature on the energy expenditure of birds. Migrating birds typically move large distances and have reduced time for feeding. As a result they make considerable use of valleys and passes when travelling across land in order to conserve energy. Hence when considering likely bird movements across Porteous Hill, apart from birds such as magpies and finches that make use of the local pasture for feeding, any traversing bird is likely to fly around the hill to save energy. To suggest that they will fly over the high point of the hill and do so at a height of at least 27m in order to encounter the turbine blades is counter to published information on bird movements. Despite this, it is useful to use existing information from other existing and proposed windfarms in the unlikely event that birds behave differently at Porteous Hill.

41. Tui and kereru are also present and there is history of modelling for these species from HMR. There with estimated population sizes in the vicinity of turbines of 300, deaths of a maximum of 4 kereru and 5 tui were predicted annually. Given that the local populations are likely only 10% of these, predicted annual deaths would be less than 0.02 birds. Moreover, these birds are present in the area of a large number of wind farms in New Zealand but no death has been recorded so there is little reason to believe that any deaths will occur at Blueskin Bay.

42. Falcons and Harriers are members of the raptor family that have been disproportionately represented in blade strike statistics for a number of international wind farms (Langston & Pullan 2003, Barrios & Rodrigues 2004). It is important to distinguish characteristics of both turbine layout and turbine size as well as the body form and hunting style of the raptors before deciding on the potential threat from blade strike mortality. International wind farms associated with considerable raptor losses were typically on the migratory route of the raptors, consisted of multiple lines of small and immediately adjacent turbines. These older design of wind farms gave little chance of avoidance as the rotor swept height was as low as 10m above ground level (whereas Blueskin Bay turbine will be 27m above ground), turbines had little distance between them and there was another row close behind (whereas Blueskin Bay will have a solitary turbine). These and some wind farms with larger turbines disproportionately killed larger soaring species of raptor that preferentially eat carrion. Despite the seemingly high vulnerability of many raptors, the avoidance rates published by Scottish Natural Heritage show that even larger soaring and hovering species typically have minimum avoidance rates of 98 – 99% (SNH 2010) at modern wind farms. This figure is the verified frequency that birds flying at RSA (rotor swept area) are known to avoid injury when flying in the immediate vicinity of modern wind turbines.

43. Eastern Falcon are present at Blueskin Bay. They are also present at Mahinerangi, Turitea, HMR (rare), and Puketoi. Indeed nests were found within the windfarm envelope at Mahinerangi and Puketoi. Raptors, the family of birds that includes falcons are considered a group especially at risk because of results from Europe and USA. However, this risk preferentially affects large soaring species and is extremely rare among the faster flying species such as Eastern Falcon. Indeed there is no recorded collision of an Eastern Falcon with a turbine in New Zealand although there is one known death of an Australasian harrier. Collision Risk Modelling at Puketoi predicted that the 52 turbines would need to operate for at least 100 years before there would be one falcon death. Even if the population using Blueskin Bay bred nearby to the turbines which they currently do not, using similar modelling predicts that one falcon death would require more than 5000 years of continuous operation of the turbine.

44. Waders such as Eastern Bar-tailed godwit and Oystercatchers tend to occur in large groupings and have received considerable attention in windfarm proposals. This is largely because of the annual migration of South Island Pied Oystercatchers between the breeding grounds of Southland, North Otago and Canterbury to the harbours of Northern New Zealand. Godwits breed in Siberia and Alaska and many winter in New Zealand. A minority of both species will migrate along the Otago coast in the vicinity of the proposed turbine. Using the modelling from HMR (Craig et al. 2015) and making the highly unlikely assumption that they fly inland over Porteous Hill near the proposed turbine rather than along the coast, likely annual deaths for godwit and oystercatcher would be less than 1 bird every three decades.

45. Black Billed gulls do use the adjacent coast. Submissions and evidence presented at the Council hearing raised this threatened gull as a species of potential concern. Dr McClennan recorded 7000 in Blueskin Bay (Table 3) and commented that they may use or fly over areas such as Porteous Hill. However, land counts from 50 stations failed to record any sight or sound of this gull. Mr Onley (a resident with ornithological expertise) records numbers regularly around 700 in Blueskin Bay and suggests that "it is not inconceivable that they fly overland" in the vicinity of Porteous Hill.

46. This gull is slightly smaller than South Island Pied Oystercatcher and able to fly slightly faster so is likely to have a lower risk of being killed by turbine blades. Modelling from HMR can be used to demonstrate the likely predictions after undertaking counts that show a presence of this gull at Porteous Hill. There is a bi-annual migration of up to 70,000 SIPO past the proposed 168 turbines which produced an estimate of 27 deaths a year. If we take the 7000 black-billed gulls mentioned by Dr McClennan that may be in the vicinity of the proposed turbine, this would give an annual predicted death rate of less than 0.02 gulls a year. If we take the 700 figure from Mr Onley the predicted death rate becomes less than 0.002 birds a year or one black-billed gull every 500 years.

47. If the observed kill rate of other New Zealand windfarms is used to estimate likely deaths of all bird species at the Blueskin Bay turbine, that rate of 0.05 – 0.02 birds/turbine/year would mean one bird killed every 20 – 50 years. That bird will likely be a magpie or a small introduced finch.

RECOMMENDED MITIGATION

48. Even a single turbine such as is proposed for Blueskin Bay will very occasionally kill birds. The most important issue is that no birds of special conservation significance will be killed except at frequencies that are insignificant relative to population size or the effects of other human structures such as houses, powerlines and cars on roads. However, every loss in the natural ecosystem requires mitigation in my view. The concept of net biodiversity gain is a reasonable expectation for all communities if we are ever to reverse the current declines in native biodiversity (Craig et al. 2013).

49. The greatest threat to New Zealand birds are introduced predators especially the mammals such as possum, feral cat, stoat, weasel, ship rat and Norway rat. Appropriate mitigation, if considered necessary, for the small effects of the turbine could be an annual contribution to one of the existing pest control programs in the Blueskin Bay area.

John L Craig
January 2017

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