

Ventus Energy Ltd

**Proposed Wind Farm
Turbine Sites 18-22
Assessment of Ecological Effects
December 2005**



**Kessels
& Associates Ltd**



ecology & environmental planning

Table of Contents

1	INTRODUCTION.....	3
2	METHODOLOGY.....	3
2.1	METHODS.....	3
3	RESULTS.....	4
3.1	PHYSICAL CHARACTERISTICS.....	4
3.2	VEGETATION.....	4
3.2.1	RIDEGELINE VEGETATION.....	4
3.2.2	FOREST VEGETATION.....	5
3.3	BIRDS.....	6
3.4	FISH.....	6
3.5	REPTILES AND AMPHIBIANS.....	6
3.6	MAMMALS.....	6
3.7	INVERTEBRATES.....	6
4	ASSESSMENT OF ECOLOGICAL EFFECTS.....	7
4.1	SUMMARY OF POTENTIAL ECOLOGICAL EFFECTS.....	7
4.2	EW REGIONAL POLICY STATEMENT ECOLOGICAL SIGNIFICANCE ASSESSMENTS.....	7
4.3	EFFECTS ON INDIGENOUS FAUNA.....	9
4.3.1	INDIGENOUS BIRDS.....	9
4.3.2	BATS.....	10
4.3.3	NATIVE FROGS.....	10
4.3.4	AQUATIC BIOTA.....	10
5	CONCLUSIONS & RECOMMENDATIONS.....	11
5.1	SUMMARY.....	11
5.2	RECOMMENDED AVOIDANCE, REMEDIATION AND MITIGATION MEASURES.....	11
6	REFERENCES AND BIBLIOGRAPHY.....	12
	Appendix I Plant Species	
	Appendix II Animal Species	
	Appendix III Photos	

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Te Pahu Road

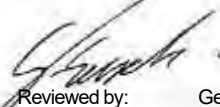
R.D.5

HAMILTON

Version: Draft 1.2 9 December 2005



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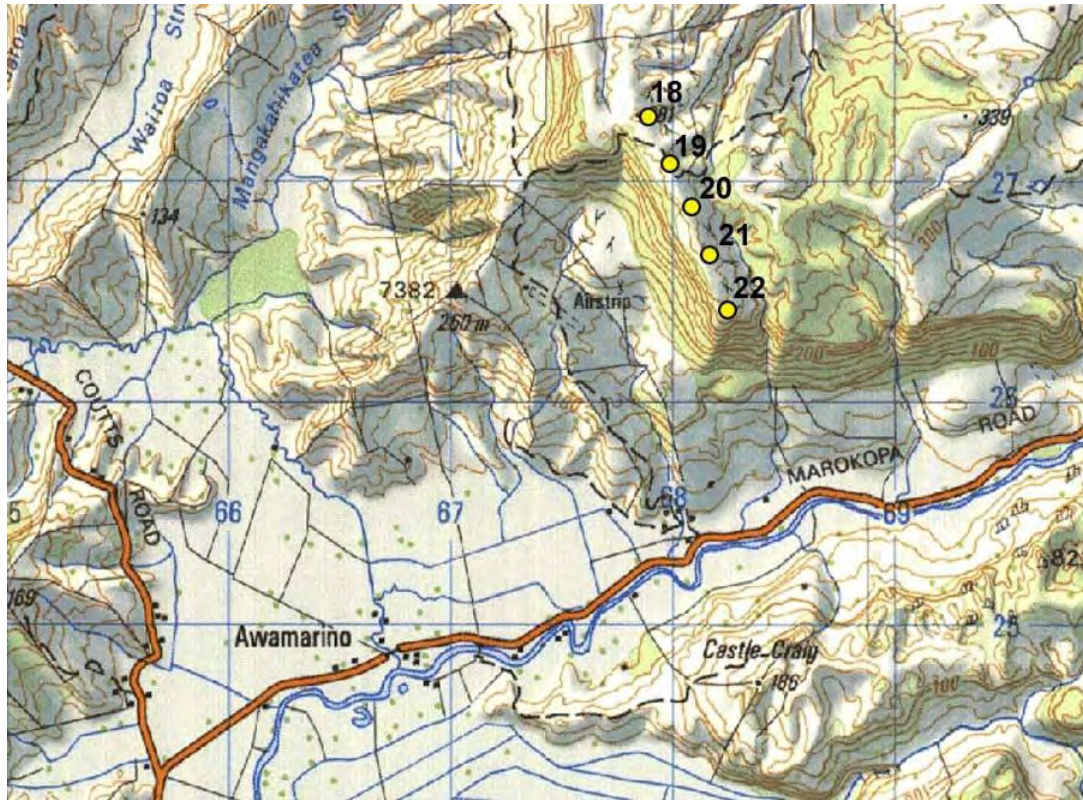
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1 Introduction

Ventus Ltd is planning to develop a wind farm on land between Taumatatotara Rd and Marokopa Rd in the western King Country. Kessels and Associates Ltd were commissioned to investigate the ecological values and potential ecological effects of the southern end of this project, in the vicinity of proposed turbine sites 18-22, on the Hamilton property, accessed via 290 Marokopa Rd. The location of the site is shown in Figure 1.

Figure 1. Location of Turbine Site 18-22.



Methodology

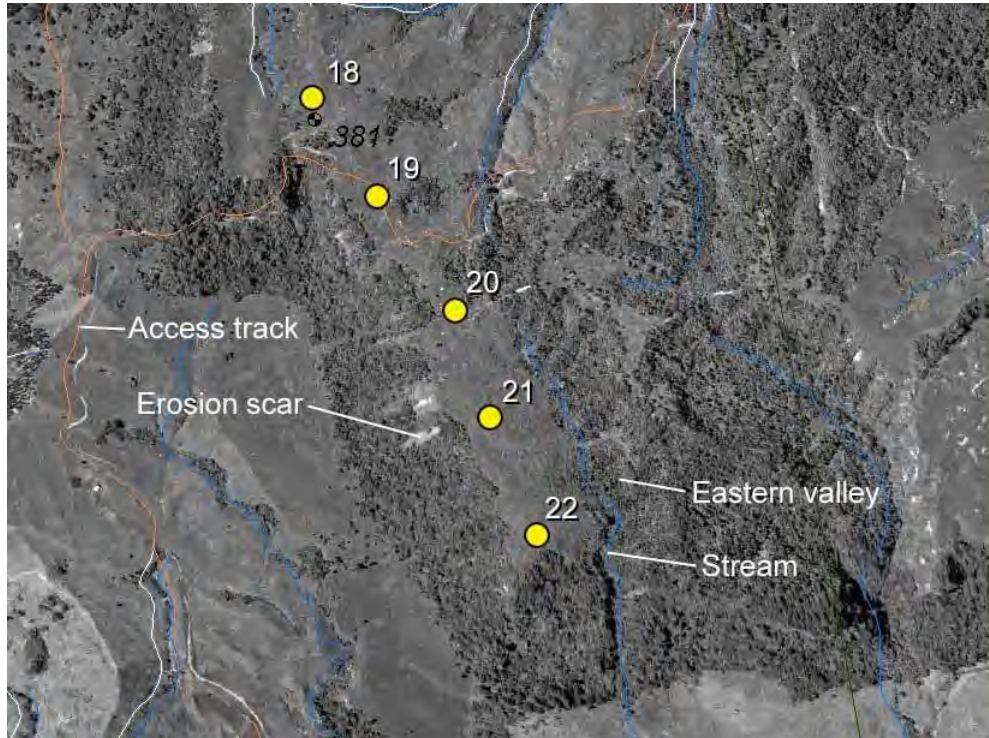
2.1 Methods

A walk-over survey was conducted on 1 December 2005 to identify plant and animal species within the area of the wind farm proposal and in forested areas immediately adjacent to this area.

Results

Distribution of vegetation and other physical characteristics are shown in Figure 2.

Figure 2. Aerial photograph of proposed turbine sites.



3.1 Physical characteristics

The proposed turbine sites lie along a ridge running north-south at an altitude of 300-380m. The land falls away very steeply to an altitude of approximately 100m to the west and south. A relatively shallow valley runs along the eastern side of the ridge; a small stream rises in this valley, then falls in a steep cascade down the steep drop-off to the south, to join the Marokopa River. This stream has a substrate of boulders, cobbles and gravel, and is lightly silted; the water is almost clear, with a slightly milky turbidity.

The ridge continues, in a less clearly defined manner, northwards from site 18. The rather thin topsoil overlies limestone, which shows through as bare patches in a few places. Occasional small limestone outcrops occur along the sides of the ridge.

3.2 Vegetation

3.2.1 Ridge Line Vegetation

The ridge along which the proposed turbine sites occur is closely grazed pasture of ryegrass, *Poa* spp., browntop, white clover and other exotic herbs and grasses. Thistles (mostly Scotch, wing and Californian, with lesser amounts of nodding) and foxglove are widespread, as is the indigenous rush *Juncus gregiflorus*. The midline of the ridge is closely grazed, relatively clean pasture, while weeds generally increase towards the margins. A high number of shade-tolerant and moisture-loving species growing in the open suggests cloud often covers the ridge top. Shaking brake (*Pteris tremula*) occurs in patches, particularly where the logs which dot the area lie particularly densely, and three other ferns, *Histiopteris incisa*, *Blechnum fluviatile* and *Paesia scaberula*, are widespread; *Diplazium australe* is less common and occurs mainly along the forest edge. In rough,

marginal areas and where fallen logs are dense hedge woundwort grows, along with *Hydrocotyle moschata*, creeping buttercup, and *Coprosma rhamnoides*, which has a strongly divaricating habit as a response to browsing. A broad gully running down from the ridge east of site 21 has been cleared comparatively recently and still has upright stumps of tree ferns among numerous logs. Foxglove, *H. incisa*, woundwort, *B. fluviatile*, *C. rhamnoides* and creeping buttercup grow profusely here.

Scattered along the ridge are a few large trees. These are mostly rimu, but kahikatea, rewarewa, miro and pigeonwood are also present.

Two rare ferns, *Asplenium lyallii* and *A. trichomanes*, are almost entirely confined to limestone outcrops (Clarkson *et al.*, 2002). These were searched for on the few small outcrops along the sides of the ridge, but were not located. Instead, common fern species such as *Pteris macilenta*, *P. tremula*, *Paesia scaberula*, *Blechnum filiforme* and *Adiantum cunninghamii* grew rather sparsely on these sites.

3.2.2 Forest Vegetation

The forest canopy is very diverse, and not dominated by any single species, although tawa is probably the most abundant tree. Mostly the canopy is little more than 10m high; tree ferns, particularly whe and wheki, are prominent (ponga and mamaku are more common towards the northern end of the ridge), and many rewarewa emerge above the surrounding trees. Most of these are broadleaf species, including pukatea, pigeonwood, *Hoheria sexstylosa*, lancewood, heketara, mangeao, and hinau. Podocarps are uncommon within the main bush, having presumably been mostly logged out, but several miro occur along the bushline, along with some kahikatea and rimu. Nikau occasionally reaches to the canopy, but more generally forms part of a rather open subcanopy. Other large shrubs/small trees are *Coprosma grandifolia*, karamu, mahoe, kawakawa and hangehange.

The understorey has been heavily browsed and is quite open, apart from numerous supplejack vines. There is also little groundcover, other than sparse clumps of bush rice grass and a few scattered ferns; these include *Doodia media*, *Blechnum filiforme*, *B. chambersii*, *Pteris saxatilis*, *Anarthropteris lanceolata*, *Leptopteris hymenophylloides*, and *Asplenium bulbiferum*. Close to the stream there is some parataniwha, but this only develops any density where the stream tumbles down the steep south slope, where it is less accessible to browsers. There are a few seedlings of pukatea and other canopy trees, though few of these manage to grow taller than a few centimetres, and occasional patches of spider orchids (*Corybas trilobus* agg.).

In contrast to the groundcover, epiphytic growth is lush, again suggesting frequent cloud cover. *Griselinia lucida* is conspicuous, and *Astelia solandri* and *Collospermum hastatum* are common. Also present are *Winika cunninghamii*, *Asplenium polyodon*, *A. flaccidum*, and filmy ferns. Vines are also abundant, including the ratas *Metrosideros perforata*, *M. diffusa* and *M. fulgens*, kiekie, supplejack, and the climbing ferns *Pyrrosia eleagnifolia*, *Microsorium scandens* and *M. pustulatum*.

The steep nature of the terrain, in conjunction with the high degree of browsing, has resulted in several erosion scars down the ridge face. Most of these are now old and healed over with a canopy of tree fern; however a fresh scar is present just west of site 21, adjacent to a steep, cleared grassy area.

Two outlying forest remnants on the north side approximately level with sites 18 and 19 are broadly similar to the main forest block, with canopies of tawa, pukatea, rewarewa, whe etc., above a heavily browsed understorey.

3.3 Birds

Nineteen bird species, 11 indigenous and eight exotic, were seen or heard, and it is likely that many more utilise the area. Chaffinch was the most frequently heard species. Of the natives, tui were singing conspicuously, and were occasionally seen flying across the ridge. Other species, including eastern rosella, harrier, blackbird and magpie were also seen to fly across the ridge occasionally. Kingfisher were quite conspicuous along the forest edge. Within the forest itself there was little birdsong, with grey warbler being the indigenous species encountered most frequently. Kereru, fantails and tomtits were scarce. Whiteheads were not encountered, but they occupy similar habitat 4km away at Piripiri (*pers. obs.*) and are likely to be present.

3.4 Fish

The small stream which rises in the valley east of the ridge falls steeply to the Marokopa Valley below, in a cascade which would restrict the passage of most species. One 250mm longfin eel was observed, however. The only other species likely to be present in this locality is koaro, which is capable of climbing substantial waterfalls (McDowall, 2000).

3.5 Reptiles and Amphibians

The numerous logs scattered along the ridgeline appeared to be suitable habitat for lizards, which in this part of the country could potentially include threatened or uncommon species such as *Oligosoma striatum* or *O. infrapunctatum* (Pickard and Towns, 1988). Approximately 20 minutes of search effort located a single copper skink (*Cyclodina aenea*), the commonest North Island skink.

The stream in the eastern valley was searched for Hochstetter's frogs (*Leiopelma hochstetteri*) as it appeared to be possibly capable of supporting this species. None were located, however.

3.6 Mammals

Besides the sheep which were grazing the ridgeline, two groups of feral goats were encountered – a small family group and a larger herd of more than a dozen individuals. These animals are clearly very abundant and are probably responsible for much if not most of the conspicuous browse and depleted state of the forest understorey. Rabbit and possum sign was also noted commonly along the ridge.

3.7 Invertebrates

A number of invertebrates were noted under the logs while searching for lizards. The most common were slaters (*Porcellio scaber*), amphipods, slugs and snails (*Agriolimax reticulatus*, *Helix aspersa* and *Oxychilus cellarius*) and small crickets (*Pteromobius* sp.). Also present were spiders, including the large and spectacular tunnelweb, *Hexathele hochstetteri*, and several centipedes and millipedes. Most significant among these was a medium-sized (120mm) specimen of the giant centipede, *Cormocephalus rubriceps*. These animals can grow to over 200mm, but almost never reach this size on the mainland due to predation by rats.

The stream has an apparently healthy macroinvertebrate fauna, including the mayflies *Coloburiscus humeralis* and *Zephlebia* sp., which are both species with low tolerance for habitat disturbance. Carabid ground beetles and raphidophorid (“cave”) wetas are common along the stream margins; water spiders (*Dolomedes aquaticus*) are also present.

Assessment of Ecological Effects

4.1 Summary of Potential Ecological Effects

Potential impacts of wind farms on indigenous vegetation and wildlife can be divided into two groups – direct impacts and indirect impacts:

Direct impacts could include:

- habitat loss and damage, and destruction of plants and other wildlife, in the course of wind farm and road realignment construction;
- sediment run-off from road and turbine construction affecting waterways;
- collision mortality of individual birds, flying insects (and perhaps bats) with the turbines or associated wind farm structures.

Indirect impacts could include:

- disturbance either from the wind farm and associated activities (noise, visual);
- reduced breeding success of individual birds or other wildlife nesting in close proximity to the wind farm;
- increased predation and scavenger pressure in treeless, unbuilt-up areas and adjoining fauna habitats, as the wind farm may provide suitable perches and shelter predators that previously did not inhabit the area.

4.2 EW Regional Policy Statement Ecological Significance Assessments

Representativeness: The first criterion assesses the contribution the vegetation makes to the conservation of all indigenous ecosystems present in the natural landscape. The vegetation in the immediate vicinity of the proposed pylon sites is grazed pasture of predominantly exotic species of little value for the conservation of indigenous ecosystems. The forest on the sides of the ridge and in the eastern valley appears to have been cut over and has been extensively impacted by browsers, but still has a reasonably diverse canopy of indigenous species. Other, comparable or larger patches of forest are well represented within the Herangi Ecological District (Harding, 1997 & Leathwick et al, 1995).

Diversity and pattern: The ridge top is mostly open pasture, with a few scattered indigenous trees. The ridge sides and eastern valley have cut-over broadleaf forest with healed-over erosion scars supporting tree fern.

Rarity/special features: No rare species were identified. The giant centipede, *Cormocephalus rubriceps*, has declined in average size, abundance and range due to rat predation, but remains widespread in the North Island, and is not listed as threatened by Hitchmough (2002).

Naturalness/intactness: The proposed turbine sites have highly modified, predominantly exotic vegetation. The adjacent forest has had millable trees largely removed, and browsing animals, particularly goats, have extensively damaged the understorey and groundcover.

Size and shape: The forest adjacent to the proposed turbine sites is considered of sufficient size to be self-sustaining.

Inherent ecological viability/long-term sustainability: In the long term browsing by goats, possums and farm livestock will probably cause a continuing decline in the quality of the forest vegetation. The ridge is very steep and prone to erosion, and further slips are inevitable; these will probably eventually support tree fern scrub of lower diversity than the current vegetation.

Buffering/surrounding landscape/ connectivity: The western King Country is a mosaic of agricultural land and forests. The forest surrounding the proposed turbine sites can be regarded as an outlier of the extensive forests which run south from Kawhia Harbour, and the Whareorino

Forest is only a few kilometres away to the south. Highly mobile species such as tui and kereru are resident, and probably breeding. Tomtit and probably whitehead are also present, and kaka would be likely to visit. The small stream that rises in the eastern valley drains to the Marokopa River. It is likely to provide a limited extent of habitat for migratory native fish species; in the vicinity of the proposed turbine sites these would probably be restricted to longfin eel and koaro.

Fragility and threat (threat process and agents, effects of proposed modification): At present the greatest threat to the forest vegetation is from goats, wandering livestock and possums. Exotic plant species are largely confined to the margins. The wind farm proposal risks introducing further weed species, causing siltation of the stream, reducing habitat for copper skinks, giant centipedes and other invertebrates under logs, and causing increased bird mortality through collision with turbine blades.

Management input (nature and scale/ intervention necessary/restoration potential): Fencing to exclude stock and control of possums would be the most important management efforts, while formal protection (eg a QEII open space covenant) would secure their long-term sustainability. Earth moving machinery should be cleaned thoroughly before being brought on site to reduce the risk of introducing weed species.

Table 1 assesses the area with regard to the EW Regional Policy Statement Criteria for assessing ecological significance.

Table 1: Assessment of the Site against Environment Waikato RPS Criteria for Significant Indigenous Ecosystems, Taumatotara

Specific Criteria (see key below)	Significant under this criterion? Y/N/NA	REASONS
1	N	
2	N	
3	N	
4	N	
5	N	
6	N	
7	N	
8	Y	Small stream has eels and probably other native fish
9	Y	Forest areas require protection from browsers
10	N	
11	Y	Helps link forests south of Kawhia with Whareorino forests

Key to Column 1. Full criteria wording is provided in the RPS. A summary is presented here:

1. It is indigenous vegetation or habitat that has been specially set aside by statute or covenant for protection and preservation, unless the site can be shown to meet none of Criteria 3-11.
2. It is indigenous vegetation or habitat recommended for protection by the Nature Heritage Fund or Nga Whenua Rahui committees, or the Queen Elizabeth the Second National Trust Board of Directors, unless the site can be shown to meet none of Criteria 3-11.
3. It is vegetation or habitat that is currently habitat for indigenous species or associations of indigenous species that are: threatened with extinction, or endemic to the Waikato Region
4. It is indigenous vegetation or habitat type that is under-represented (10% or less of its known or likely original extent remaining) in an Ecological District, or Ecological Region, or nationally.

5. It is indigenous vegetation or habitat that is, and prior to human settlement was, nationally uncommon, such as geothermal, Chenier plain, or karst ecosystems
6. It is wetland habitat for indigenous plant communities and/or indigenous fauna communities¹ that has not been created and subsequently maintained for or in connection with: waste treatment; or wastewater renovation; or hydro electric power lakes²; or water storage for irrigation; or water supply storage; unless in those instances they meet the criteria in Whaley *et al.* (1995).
7. It is an area of indigenous vegetation or naturally occurring habitat that is large relative to other examples in the Waikato Region of similar habitat types, and which contains all or almost all indigenous species typical of that habitat type.
8. It is aquatic habitat that is a portion of a stream, river, lake, wetland, intertidal mudflat or estuary, and their margins, that is critical to the self sustainability of an indigenous species within a catchment of the Waikato Region and which contains healthy, representative populations of that species.
9. It is an area of indigenous vegetation or habitat that is a healthy, representative example of its type because: its structure, composition, and ecological processes are largely intact, and if protected from the adverse effects of plant and animal pests and of adjacent landuse (e.g. stock, discharges, erosion), can maintain its ecological sustainability over time.
10. Is it an area of indigenous vegetation or habitat that forms part of an ecological sequence that is either not common in the Waikato Region or an ecological district, or is an exceptional, representative example of its type.
11. It is an area of indigenous vegetation or habitat for indigenous species (which habitat is either naturally occurring or has been established as a mitigation measure) that forms, either on its own or in combination with other similar areas, an ecological buffer, linkage or corridor, and which is necessary to protect any site identified as significant under Criteria 1-10 from external adverse effects.

4.3 Effects on Indigenous Fauna

4.3.1 Indigenous Birds

While any tall structure poses some risk to birds, the impact of wind turbines on bird mortality rates is very small if careful consideration is given to the wind farm location in respect of the natural ecology of the area. Available overseas evidence indicates that any impacts of wind farms in wildlife tend to be limited where wind turbines are sited to avoid flight paths and significant habitats (Crockford, 1992).

The bush areas adjacent to the proposed wind farm sites contain the more “common” species one would expect to find in forest areas of their size and at that latitude. None of these species are likely to spend much time on the open farmland where the wind generators are likely to be sited. Tui, Shining Cuckoo, bats (if present) and Kereru are the species most likely to venture far enough from the forest to possibly come within range of the wind generator blades.

Generally, noise generated by the turbines is considered unlikely to disturb forest birds within the vicinity of the turbines, apart from those present along the immediate boundary and then only until they become habituated to the presence of the wind turbines. Overseas studies suggest that the disturbance effect of wind turbines on breeding and roosting birds in adjacent areas is negligible (Benner, 1993). Of course this depends on the behaviour of each particular species, but ecologically important birds such as Bellbird, Tui and Kereru appear to adapt to noise

¹ Does not include exotic rush/pasture communities.

² Does not include Lake Taupo.

associated with roads and urban environments which are likely to be louder than wind turbines (personal observations).

The ability of these key indicator species to adapt to the turbines and become accustomed to associated noise and movement should not be underestimated. The birds would easily be able to fly around the turbines to gain access to other remnant bush areas within the locality.

While the regular occurrence of NZ falcon within the study area is unlikely, this species has been recorded as being present in the locality in the past (Moynihan, 1986). The foraging behaviour of the NZ falcon and its flying characteristics in relation to wind turbines (flight height, distance of flying birds to turbines and turbine blades, and frequency of perching on turbine structures) are unknown and may or may not make this species susceptible to collisions. Nonetheless, combined with the birds rarity and threatened status, even occasional mortalities may be significant.

Biosystems Analysis (1992) found that the highest wind turbine collision rates for raptors in the US were when the wind farm was located in important foraging habitat. The proposed wind farm is not located in known important foraging habitat for the NZ falcon. The US study also found that mortality rates were also significantly higher in close proximity to canyons than those farther away (Biosystems Analysis, 1992). Both wind farm sites would be situated on ridge tops are not near any major “canyons” (gorges, large gullies). Given these mitigating factors, it is considered that the risk of NZ falcon striking a turbine is minimal.

4.3.2 Bats

It is possible that long-tailed bats exist in the forest adjacent to this site (Moynihan, 1986). It is possible that bats could hunt at night for insects in the vicinity of the turbines. However, bats are extremely agile and have the assistance of echolocation to help them to capture prey and avoid obstacles, so the risk of them hitting the structures, blades or power lines is considered to be extremely low.

4.3.3 Native Frogs

Native frogs (*Leiopelma hochstetteri* & *L. archeyi*) are present in the nearby Herangi Range. Therefore, these were searched for briefly; none were located, however, nor was any suitable habitat for these species identified.

4.3.4 Aquatic Biota

No significant streams or wetlands would be directly affected by the proposed wind farm. However, there is a risk that sediments from track upgrades and turbine site construction could enter waterways and adversely affect aquatic macroinvertebrate or fish and their habitats. Provided standard good practice silt control techniques are implemented during construction, these effects will be no more than minor. Furthermore, the streams are already somewhat impacted by day-to-day farming operations and thus already modified to a significant extent.

Conclusions & Recommendations

5.1 Summary

In conclusion, the proposed works involve the removal of virtually no areas of indigenous vegetation (although several individual trees may have to be removed), most of which is already degraded by stock access and possum browsing and well represented elsewhere within the Herangi Ecological District.

The wind farm would not involve the removal of any significant indigenous vegetation or habitats of significant indigenous fauna.

The wind farm *may* increase the incidence of bird strike or impede the movement of resident or migratory bird species but currently available information suggests that the site is not within important resident or migratory wader flight paths. Overseas evidence indicates that any impacts of wind farms on wildlife tend to be limited and minor, where the wind farm is not situated within an important migratory path or part of habitat ecological significance.

Therefore, effort toward fauna habitat replacement is not considered to be necessary provided no nesting or roosting sites of threatened species are found within the extension footprint during construction.

The stream in the eastern valley, though small and somewhat silted owing to disturbance from farming activities and feral goats, has a healthy invertebrate fauna and provides habitat for long-finned eels and, probably, koaro. Care should be taken during the construction phase to restrict erosion of sediment into this catchment.

Consequently, the proposed wind turbine construction, track upgrades and ongoing operation are expected to result in minor, insignificant adverse ecological effects provided that suitable mitigation measures are undertaken as detailed in this report.

5.2 Recommended Avoidance, Remediation and Mitigation Measures

The following good practice performance standards should be adopted during road widening and turbine construction:

Construction Phase

- Install appropriate sediment control geo-textile or hay-bale swales when working near or in waterways and wet areas;
- Ensure all machinery is thoroughly cleaned before being allowed on site to prevent introduction of weeds;
- Where possible, turbines pylons, access tracks and wires should be placed so as not to require removal of native trees.
- Few species of indigenous fauna utilise the area in the vicinity of the proposed turbine sites. Other than birds, most are confined to the logs which are scattered through the pasture; the most significant of these are copper skinks and giant centipedes. Many logs can probably be left undisturbed as they are mostly to be found along the marginal areas away from the turbine sites and access track. Where it is necessary to move logs it would be preferable to retain them in the vicinity rather than trucking them away, so as to maintain habitat.

Operational Phase

- Specific mitigation for any *potential* adverse effects on indigenous fauna or flora is considered to be unnecessary. However, fencing off of the remnant forest adjacent to the turbines from stock should be considered (where practical) and long-term formal protection of this bush area would be worthwhile.

References and Bibliography

- Benner, J.H.B. 1993. Impact of wind turbines on birdlife: an overview of existing data and lacks in knowledge. European Community Wind Energy Conference, 8-12 March, 1993. Lubeck-Travemunde, Germany. Pp 20-23.
- Biggs, B. 1989. Wind Energy and Birds. *Wind Directions* Vol. XIV, No. 2.
- Biosystems Analysis, Inc. 1992. Wind Turbine Effects on Avian Activity, Habitat Use, and Mortality in Altamont Pass and Solano county Wind Resource Areas, 1989-1991. Consultants Report for the California Energy Commission.
- Brandon, A.; de Lange, P.; Townsend, A. 2004: Threatened Plants of Waikato Conservancy. Dept of Conservation, Wellington. 92p.
- Clegg, SE. 1993. Coast Reserves between Kawhia & Awakino. An Assessment of Conservation Values. Depart. Of Conservation, Hamilton.
- Crockford, N.J. 1990. A review of the possible impacts from wind farms on birds and other wildlife. Joint Nature Conservation Committee report No. 27. Joint Nature Conservation Committee, Peterborough, UK.
- Department of Conservation. Waikato Conservation Management Strategy Vol. II. Dept. Of Conservation, Hamilton.
- Harding, M. 1997: Waikato Protection Strategy: A report to the Forest Heritage Fund Committee. Forest Heritage Fund, Wellington. 87p.
- McDowall, R. M. 2000: The Reed Field Guide to New Zealand Freshwater Fishes. Reed, Auckland. 224p.
- Moynihan, KT. 1986. Wildlife and Sites of Special Wildlife Interest in the Western Waikato Region. Fauna Survey Unit report No 41, Wildlife Service, Dept of Internal Affairs, Wellington.
- Pickard, C. R.; Towns, D. R. 1988: Atlas of the Amphibians and Reptiles of New Zealand. Conservation Sciences Publication No. 1. Dept of Conservation, Wellington. 59p.
- Whaley, K. J.; Clarkson, B. D.; Leathwick, J. R. 1995: Assessment of criteria used to determine 'significance' of natural areas in relation to section 6(c) of the Resource Management Act(1991). Unpublished Landcare Research Contract Report LC9596/021 to Environment Waikato. 34 p.

Appendix I

Plant Species

Scientific Name**Common Name****Gymnosperms**

Dacrycarpus dacrydioides
Dacrydium cupressinum
Prumnopitys ferruginea

Kahikatea
Rimu
Miro

Flowering Trees/Shrubs

Beilschmiedia tawa
Coprosma grandifolia
Coprosma rhamnoides
Coprosma robusta
Cordyline australis
Elaeocarpus dentatus
Geniostoma rupestre
Griselinia lucida
Hedycarya arborea
Hoheria sexstylosa
Knightia excelsa
Laurelia novae-zelandiae
Litsea calicaris
Macropiper excelsum
Melicytus ramiflorus
Olearia rani
Pseudopanax crassifolius
Rhopalostylis sapida
Schefflera digitata

Tawa
Kanono
Karamu
Cabbage Tree
Hinau
Hangehange
Puka
Pigeonwood
Lacebark
Rewarewa
Pukatea
Mangeao
Kawakawa
Mahoe
Heketara
Lancewood
Nikau
Pate

Climbers

Clematis paniculata
Freycinetia banksii
Metrosideros diffusa
Metrosideros fulgens
Metrosideros perforata
Parsonsia capsularis
Rhipogonum scandens

Clematis
Kiekie
Rata Vine
Rata Vine
Aka
New Zealand Jasmine
Supplejack

Herbs/Grasses

**Agrostis capillaris*
Astelia solandri
**Bellis perennis*
**Cardamine* sp.
**Carduus nutans*
**Carduus tenuiflorus*
Carex dissita
**Cerastium glomeratum*
**Cirsium arvense*
**Cirsium vulgare*
Collospermum hastatum
Corybas trilobus agg.
**Digitalis purpurea*
Elatostema rugosum
**Galium aparine*
**Geranium molle*
Hydrocotyle moschata
Juncus gregifforus
**Lolium perenne*
**Medicago lupulina*
Microlaena avenacea
**Plantago minor*
**Poa annua*
**Poa trivialis*
Pratia angulata
**Ranunculus repens*
**Ranunculus sardous*

Browntop
Daisy
Spitweed
Nodding Thistle
Wing Thistle
Mouse-eared Chickweed
Californian TThistle
Scotch Thistle
Spider Orchid
Foxglove
Parataniwha
Cleavers
Dove's Foot
Ryegrass
Black Medick
Bush Rice Grass
Narrow-leaved Plantain
Creeping Buttercup
Hairy Buttercup

**Sonchus oleraceus*
**Stachys sylvatica*
**Stellaria media*
**Trifolium repens*
Winika cunninghamii

Sow Thistle
Hedge Woundwort
Chickweed
White Clover
Bamboo Orchid

Ferns/Fern Allies

Adiantum cunninghamii
Anarthropteris lanceolata
Asplenium bulbiferum
Asplenium flaccidum
Asplenium polyodon
Blechnum chambersii
Blechnum filiforme
Blechnum fluviatile
Cyathea dealbata
Cyathea medullaris
Cyathea smithii
Dicksonia fibrosa
Dicksonia squarrosa
Diplazium australe
Doodia media
Histiopteris incisa
Hymenophyllum sp.
Lastreopsis hispida
Leptopteris hymenophylloides
Lycopodium volubile
Microsorium pustulatum
Microsorium scandens
Paesia scaberula
Pteris macilenta
Pteris saxatilis
Pteris tremula
Pyrosia elaeagnifolia

Maidenhair
Hen and Chicken Fern
Drooping Spleenwort

Ponga
Mamaku
Whe
Whekiponga
Wheki

Water Fern
Filmy Fern

Houndstongue
Fragrant Fern
Ring Fern

Shaking Brake

* Adventive species

Appendix II

Animal Species

Birds

<i>Tadorna variegata</i>	Paradise Shelduck
<i>Circus approximans</i>	Harrier
<i>Meleagris gallipavo</i>	Turkey
<i>Hemiphaga novaeseelandiae</i>	Kereru
<i>Halcyon sancta</i>	Kingfisher
<i>Platycercus eximius</i>	Eastern Rosella
<i>Chrysococcyx lucidus</i>	Shining Cuckoo
<i>Hirundo tahitica</i>	Welcome Swallow
<i>Gerygone igata</i>	Grey Warbler
<i>Petroica macrocephala</i>	Tomtit
<i>Rhipidura fuliginosa</i>	Fantail
<i>Turdus philomelos</i>	Song Thrush
<i>Turdus merula</i>	Blackbird
<i>Carduelis carduelis</i>	Goldfinch
<i>Fringilla coelebs</i>	Chaffinch
<i>Emberiza citrinella</i>	Yellowhammer
<i>Zosterops lateralis</i>	Silvereye
<i>Prosthemadera novaeseelandiae</i>	Tui
<i>Gymnorhina tibicen</i>	Magpie

Reptiles

<i>Cyclodina aenea</i>	Copper Skink
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Fish

<i>Anguilla dieffenbachii</i>	Long-finned Eel
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Invertebrates

<i>Dolomedes aquaticus</i>	Water Spider
<i>Hexathele hochstetteri</i>	Tunnelweb Spider
<i>Steatoda capensis</i>	False Katipo
<i>Coloburiscus humeralis</i>	Mayfly
<i>Zephlebia</i> sp.	Mayfly
Rhaphidophoridae	Weta
Carabidae	Ground Beetle
<i>Pteromobius</i> sp.	Cricket
<i>Cormocephalus rubriceps</i>	Giant Centipede
Chilopoda indet.	Centipedes
Diplopoda indet.	Millipedes
<i>Porcellio scaber</i>	Slater
Amphipoda indet.	
<i>Helix aspersa</i>	Garden Snail
<i>Oxychilus cellarius</i>	Snail
<i>Agriolimax reticulatus</i>	Slug

APPENDIX III Photos



Bush remnant east of site 19, thistles and pasture of ridgeline in foreground



Eastern gully. *Juncus gregiflorus* and *Pteris tremula* among pasture, with logs



Side gully east of Site 21 with foxglove, tree fern stumps and logs



Forest interior near top of stream cascade, with supplejack and parataniwha



Stream in eastern gully



Ridge from access track – note fresh slip and old erosion scars with tree ferns



Site 18 – Open pasture with *Juncus gregiflorus*



Limestone outcrop on side of ridge



Feral goats



Tunnelweb spider (*Hexathele hochstetteri*) under log



Copper Skink (*Cyclodina aenea*)