BEFORE THE ENVIRONMENT COURT

Under	the Resource Management Act 1991 ("Act")
In the matter of	appeals under clause 14 of the First Schedule to the Act concerning the Proposed One Plan for the Manawatu-Wanganui Region and the topic of Biological Diversity
between	**FEDERATED FARMERS OF NEW ZEALAND** ENV-2010-WLG-000148
and	**MERIDIAN ENERGY LTD** ENV-2010-WLG-000149
and	**MINISTER OF CONSERVATION** ENV-2010-WLG-000151
and	**PROPERTY RIGHTS IN NEW ZEALAND** ENV-2010-WLG-000152
and	**HORTICULTURE NEW ZEALAND** ENV-2010-WLG-000155
and	**WELLINGTON FISH & GAME COUNCIL** ENV-2010-WLG-000157
and	**MANAWATU-WANGANUI REGIONAL COUNCIL** Respondent

Statement of Evidence in Chief of
AMY LAURA HAWCROFT
on behalf of the Minister of Conservation and Wellington Fish & Game Council

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Dated: 17 February 2012

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STATEMENT OF EVIDENCE IN CHIEF OF AMY LAURA HAWCROFT

1 QUALIFICATIONS AND EXPERIENCE

1 My full name is Amy Laura Hawcroft.

2 I am employed as a Technical Support Officer by the Department of Conservation, Tongariro-Whanganui-Taranaki (TWT) Conservancy. I have been employed by the Department of Conservation since 2002. I hold a BSc (Hons) in Geography from the University of Auckland and an MSc in Geography from Otago University, where I completed a thesis investigating the influence of adjoining landuses on weed invasion into forest remnants under a range of tenures.

3 I am familiar with forest ecology and the assessment of indigenous habitat to which these hearings relate. Since 2002 I have worked in the TWT and earlier Wanganui Conservancies, which largely overlap with the western Horizons Region. I have become familiar with a range of forest and other habitat types in the Conservancy, primarily by providing technical assistance to vegetation monitoring programmes. This work has included designing projects to measure the outcomes of the Department's management actions and fieldwork to establish and remeasure permanent forest and grassland plots and to assess pest animal impacts on forest and grassland habitats. This work also involves data analysis and preparation of reports describing vegetation status and trend (often in relation to management invention). I was recently seconded to the Department's National Office as a senior Technical Support Officer to coordinate development of the Inventory and Monitoring Toolbox (an on-line resource for DOC staff); deliver a field audit programme on behalf of the Department; and help design and plan for the implementation of the Department's new Inventory and Monitoring framework.

4 I am familiar with the Horizons One Plan ("One Plan"), having been involved in commenting on the One Plan for the Department since 2008.

5 I have read the Environment Court's Code of Conduct for Expert Witnesses (2011), and I agree to comply with it. I confirm that the issues addressed in this brief of evidence are within my area of expertise.

6 I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed.

1.1 Scope of evidence

7 The Table of Contents below sets out the matters my evidence will deal with:

2 THE STATUS OF BIODIVERSITY IN HORIZONS REGION

2.1 Biological values of Horizons Region

8 The Horizons Region includes a wide range of physical environments. Climates range from the typically mild temperatures and high rainfall of inland Whanganui to the cold winters and summer aridity experienced in Taihape and in the Wairarapa. Underlying geology ranges from central North Island volcanic andesite to ancient marine limestones to post-glacial beach deposits (Suggate 1978). Landforms may be high mountain ranges, deeply dissected, steep hill country or rolling plains. Soils range from deep, highly fertile volcanic ash deposits to recently formed sandy soils. This diversity of environments supports many different habitat types and species.

9 The Region's biodiversity also reflects history - in terms of land formation, climate change and species evolution and dispersal - effects which take place over many thousands of years. The Region captures the "floristic gap" in the lower North Island (roughly between the southern Ruahine and central Tararua Ranges) which marks the southern distributional limit of many central or northern species, the northern limit of various southern species, and the absence of others that might be expected because they are found to the north and south (Rogers 1989). Some of these gaps in a species' expected range are related to the absence of particular alpine habitats from much of the lower North Island (e.g. high-altitude ephemeral wetlands). Other cases, where species are absent from apparently suitable habitat, reflect pre-historic periods of high sea level (species remained in places above sea level) or tectonic uplift (species remained in places that were less disturbed during mountain building events) (Rogers 1989). Recent historical events such as pre-European fires, are also important, and created – for instance – much of the distinctive character of the Central Plateau (e.g. the red tussock grasslands).

10 The extent of Horizon's Region, the wide range of geology, landforms and climate regimes it captures, and the historical processes that have taken place here mean that many of the habitats and species present in the Horizons Region are of national importance. Some of these are adequately protected in

the public conservation estate, but others are found primarily on private land. Various inventories have identified nationally significant habitats which occur on private land in Horizons Region. These include, most notably, lowland forest remnants, wetlands, dune ecosystems (Partridge 1992) and some karst systems (Worthy 1990).

11 The Horizons Region supports nationally important populations of many rare and endangered plants and fauna. The botanical province "Lower North Island" (which also includes Wellington) supports 142 threatened and uncommon plant species (de Lange et al. 2004).

12 Some plant species with strongholds in Horizons Region are endemic to the "floristic gap" area: examples are a kowhai (*Sophora godleyii*) (Heenan et al. 2001), Gardner's tree daisy and the creeping herb *Mazus novaezeelandiae* ssp. *novaezeelandiae*. Others are sand dune specialists, such as native daphne (*Pimelea actea)* and the creeping herb (*Selliera rotundifolia*). All of these occur on private land, and the latter four are threatened species. Other threatened species that were once more widespread, such as *Sebaea ovata*, another dune herb, are now limited to the Region.

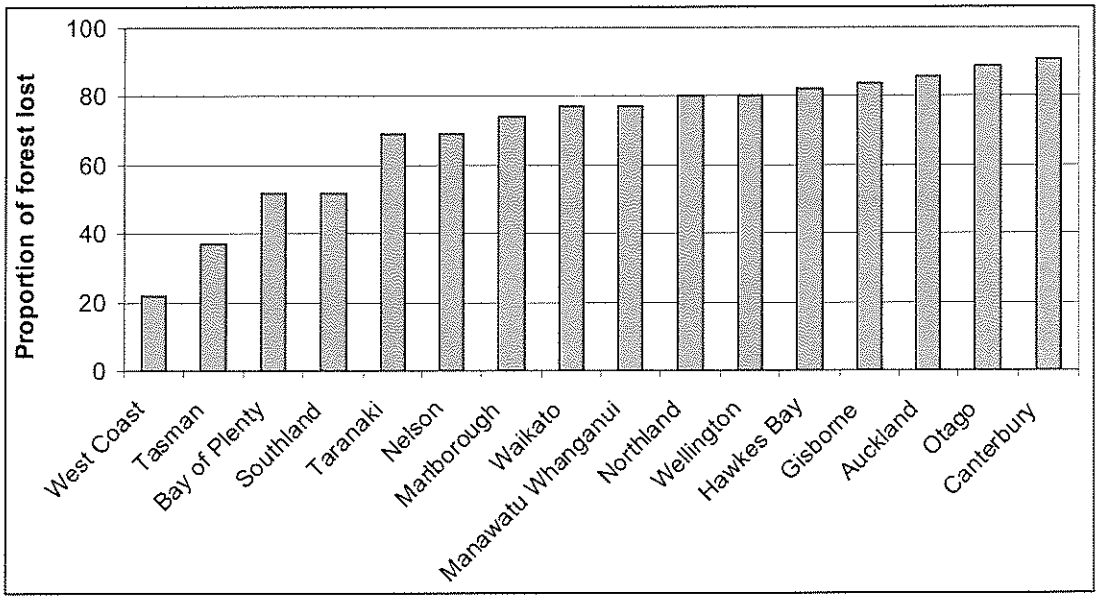
13 Horizons is also a stronghold for threatened animal species such as the small-scaled skink (*Oligosoma microlepis*), giant landsnails (*Powelliphanta marchanti and P. traversi tararuaensis*) and whio (*Hymenolaimus malachorhynchos*), as well as supporting important populations of other species including North Island Western brown kiwi.

2.2 Extent remaining and rates of loss

14 New Zealand's biodiversity has been significantly compromised by historic habitat loss, largely through vegetation clearance, and is continuing to decline because of ongoing habitat loss and competition and predation from introduced weed and pest species (Craig et al. 2000). This has been partially mitigated by the successful management of threats to individual species and restoration of small areas of habitat. However, outside of a few intensively managed sites, biodiversity continues to decline. Continued habitat loss has contributed to decline in threatened species of birds (Innes et al. 2010a), fish (Allibone et al. 2010) and plants (De Lange et al. 2009).

15 Originally, 82% of New Zealand was forested, now 24% is (Ewers et al. 2006). This loss has been uneven across the landscape. Walker et al (2006) quantified indigenous vegetation remaining in Land Environments of New Zealand (LENZ) level IV environments[1] (Leathwick et al. 2003) and found that 284 of the 500 of these Land Environments have less than 30% of their original cover left. This means that 42% of New Zealand's land area has less than 30% remaining of its original vegetation cover. Further 22% of New Zealand's area has less than 10% of its original vegetation cover remaining.[2] Vegetation has been disproportionately cleared from lowland and coastal areas, and from highly productive agricultural land.

16 Horizon's Technical Report (Maysek 2007) shows the extent and distribution of habitat loss in the Horizons Region resembles this national trend: only 23% of the pre-human vegetation cover remains in the Region, and vegetation has been disproportionately cleared from flatter, more fertile and more accessible areas suitable for agriculture and development, such as coastal land and river terraces. The chart below compares the proportion of forest loss from pre-human extent to 2002 extent for each political region in New Zealand (data taken from Ewers et al 2006).



[1] Land Environments are a way of describing parts of New Zealand's land area that are similar in terms of the physical characteristics that drive biological diversity – rainfall, temperature, geology, topography and so on. Level IV Environments are defined by breaking the whole of New Zealand into 500 types. Places which are mapped as being in the same Land Environment have more in common than places in different Environments.

[2] I.e.158 out of 500 LENZ level IV Land Environments.

17 The Department of Conservation's Protected Natural Area Programme (PNAP)[3] reports for specific Ecological Districts (ED) or Regions have quantified habitat loss at a local scale. The same patterns are evident. For example, the Eastern Wairarapa ED (largely lowland and coastal) was estimated to have only 11% of its original vegetation cover remaining (Beadel et al. 2004). In contrast, in Taumaranui ED (inland, lowland and submontane) 25% of original vegetation cover remains, mostly on steep slopes and at higher altitude. Less than 10% remains on the terraces, plateaus, rolling plains and other flat landforms in the Taumaranui ED (Bibby et al. 2000).

18 Little of the remaining habitat in the highly productive lowland EDs, is protected in the public conservation estate. To take examples of the EDs within Horizons Region; at the time of their PNAP surveys, land administered by the Department of Conservation covered nearly 15% of the Taumaranui ED and 31% of the Matemateaonga ED, but less than one percent of the districts dominated by lowland areas: Eastern Hawke's Bay and Manawatu Plains EDs (Maxwell et al. 1993; Ravine 1995; Ravine 1996; Bibby et al. 2000)

19 In summary, local as well as regional and national analyses, show that lowland and coastal areas have little natural vegetation cover remaining compared to pre-European times. Further, these areas are less likely to be protected in the public conservation estate.

20 Plant diversity decreases as altitude increases, so lowland vegetation communities have high species richness as compared to upland communities (Ogden 1997; Bellingham et al. 1999; Ohlemuller & Wilson 2000). Thus the disproportionate loss of these habitats has made a large number of species vulnerable to extinction. The lowland and coastal zones support more than half New Zealand's acutely threatened plant species (de Lange et al. 2004).

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[3]The Protected Natural Areas Programme began in 1982 in order to identify areas of indigenous habitat on private land which could be targeted for inclusion into the protected areas network (e.g. by purchase by DOC or by Covenant) to ensure that representative examples of the full range of New Zealand's landscapes, ecosystems and communities were protected (Myers, S.; Park, G.N.; Overmars, F.B. 1987: New Zealand Protected Natural Areas Programme: a guidebook for the rapid ecological survey of natural areas. New Zealand Biological Resources Centre Publication. Department of Scientific and Industrial Research, Wellington. 92 p.)

21 Ms Maseyk in her evidence describes some of the effects of biodiversity loss in the Horizons Region in terms of particular species.[4] These effects include the extinction of species from the Region including huia, tieke and complete loss of ecosystem types such as kahikatea-totara dominated forest. Other species, such as northern rata and kereru have experienced significant reductions in numbers.

22 Loss of indigenous vegetation and habitats through clearance is an ongoing threat to biodiversity. Walker et al (2006) compared land cover measured in 1996 and in 2001 and estimated that 17,204 ha of indigenous vegetation (including forest, shrubland and tussockland) was cleared. Most of the individual areas cleared were less than 5ha (Ewers et al. 2006). Most indigenous vegetation clearance also occurred in places which already had little remaining (Walker et al. 2006). Loss of indigenous vegetation from central Rangitikei District during that time shifted one Land Environment[5] from the 'chronically threatened' to 'acutely threatened' category' as less than 10% of indigenous vegetation now remains for that Land Environment (Walker et al. 2008). These studies suggest that the various protection measures applied over that time did not succeed in halting the loss of indigenous vegetation, and that losses primarily occurred through the cumulative effects of small losses, rather than through large-scale clearances.

23 Indigenous vegetation clearance is often conceived as deforestation. However, loss of non-forest habitats has also been significant. My colleague Dr Gerbeaux will give evidence about the reduction in extent of wetlands. Another striking example from this region is loss of sand dune habitat. More than 80% of active duneland identified in aerial photographs of the Manawatu Region from the 1950s had been lost by the mid-1990s, the highest of any region in New Zealand. This was largely due to sand dune stabilisation and conversion from low statured indigenous vegetation and bare substrate to dense marram and pine forest (Hilton et al. 2000).

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[4] *Section 42A Report of Fleur Maseyk on behalf of Horizons Regional Council* e.g. at paragraphs 86 on page 27 and 66 on page 28.

5 Land Environment F1.3d: steeply rolling hills of sandstone and mudstone, well drained soils, cool winters and dry summers Leathwick, J.R.; Morgan, F.; Wilson, G.; Rutledge, D.; McLeod, M.; Johnson, K. 2002: Land Environments of New Zealand: technical guide. Ministry for the Environment, Wellington. 238 p..

24 It is therefore appropriate that the One Plan recognises that the loss of habitat can occur not only by way of vegetation clearance activities, but also through other activities such as disturbance of the land; cultivation of land for the purposes of forestry, crop or pasture growth and taking, diversion, damming or discharges of water.

2.3 Tangible effects of the loss of indigenous biological diversity

25 As well as the intangible effects of the loss of indigenous biodiversity, indigenous habitats provide a range of *tangible* benefits which are collectively called 'ecosystem services'. As I will explain in this section of my evidence, services provided by terrestrial habitats in Horizons Region include maintaining air and water quality, hazard mitigation and providing resources for harvest. Important cultural benefits also accrue from maintenance of indigenous vegetation in the landscape.

26 Forests regulate air quality, by both intercepting particulate matter and absorbing gases. These effects are widely reported internationally and have been demonstrated in New Zealand.[6] New Zealand's indigenous forests are a significant store of carbon dioxide and other greenhouse gases (Price et al. 2004; Ministry for the Environment 2011) . Clearance of indigenous forest cover has implications for national carbon accounting. Under the Kyoto protocol, New Zealand is obliged to report on indigenous forest loss as an effective emission of carbon. The most recent annual report available used specific land use and carbon storage ('LUCAS') data generated from satellite images and confirmed clearance of at least 500ha of natural forest[7] in 2008 and 2009. This ongoing deforestation indicates that the concern expressed by authors (Ewers et al. 2006) - that current approaches to management will not maintain biodiversity - was well-founded.

27 Regenerating indigenous forests (those that have grown since 1990) have financial value under the current emissions trading regime, they generate

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[6] E.g. a Christchurch study found that particulate matter concentrations decreased with increasing distance from a built up area into forest Cavanagh, J.; Zawar-Reza, P.; Wilson, J.G. 2009: Spatial attentuation of ambient particulate matter air pollution within an urbanised native forest patch. *Urban Forestry and Urban Greening 8*: 21-80.

[7] i.e. indigenous forest that was mature prior to 1990. This excluded other indigenous habitats such as shrubland and tussockland.

tradeable "carbon credits" as well as providing biodiversity benefits (Carswell & Burrows 2006).[8]

28 Indigenous vegetation in stream headwaters and on riparian margins helps to maintain water quality (McAlpine & Wotton 2009). Indigenous vegetation around streams and rivers retains water quality by filtering fertiliser runoff and shading waterways, preventing nuisance growths of algae (Parkyn et al. 2000; Hansen et al. 2010) and maintaining cooler temperatures (Boothroyd et al. 2004). As described by Dr Gerbeaux, wetland habitats are important contributors to both water quality and flood mitigation.

29 Indigenous woody vegetation on hillslopes also helps mitigate erosion risks. A study of the distribution of slips in the Whanganui papa country after the 2004 February storm event found that forest reduced landsliding probability by 90% (Dymond et al. 2006). This reduced sediment load also reduces the risk of siltation and flood events in downstream areas.

30 Sand dunes mitigate hazards in the coastal zone, providing a buffer of sediment that protects the hinterland from storm erosion and inundation (Everard et al. 2010).

31 Indigenous vegetation provides resources for harvest. Examples of direct resource provision in Horizons Region are collection of manuka or bush honey by commercially managed honeybee hives. This is a growth industry. DOC monitors beekeeping operations within a short distance of conservation land and there are now at least 30 operations in Whanganui Area, a 3-fold increase over the past three years.

32 In addition to commercial harvests, indigenous habitats also provide for culturally important harvest of pingau, koromiko and other species used in traditional art, construction or rongoa (medicine).

33 A socially important harvest in the Region is that of freshwater fish, such as longfinned eels and whitebait. Adult whitebait species, which include banded and giant kokopu, prefer stream habitat in forested catchments (Department of

[8] MFE report that even mature indigenous forests actively take-up carbon, but this has not yet been quantified as the field data collection is ongoing Ministry for the Environment 2011: New Zealand's Greenhouse Gas Inventory 1990-2009. Ministry for the Environment, Wellington.

Conservation 2005). Allowing for elevation and distance from the sea, streams from catchments where the predominant land use is indigenous forest have the most intact communities of indigenous fish and have tended to improve over the past three decades. This trend was not seen for any other land uses examined (Joy 2009). Thus, maintaining indigenous habitat at stream margins and headwaters maintains a harvestable resource.

34 Examples of indirect resource provision are the pockets of indigenous habitat that provide the seeds, spores and dispersing birds and invertebrates to colonise nearby developed lands such as plantation forests, which can be important reservoirs of indigenous biodiversity (Brockerhoff et al. 2008), or riparian margins and other restoration projects.

35 These and other reported tangible outcomes of maintaining indigenous biodiversity in the Region are important, however it is also important to acknowledge the other benefits that biodiversity brings, such as the spiritual or emotional reward that New Zealanders experience listening to bellbird song, or walking under tall rimu trees.

3 NEW ZEALAND GOVERNMENT RESPONSE TO BIODIVERSITY LOSS: *HALTING THE DECLINE*

36 New Zealand is signatory to four international conventions that deal with primarily with presevation of indigenous biodiversity: the 1992 UN Convention on Biological Diversity, the Apia Convention on the Conservation of Nature in the South Pacific, the Bonn Convention on the Conservation of Migratory Species, and the Ramsar Convention on Wetlands. New Zealand has also endorsed a number of non-binding agreements with implications for biodiversity, including the Rio Declaration, Agenda 21 and Forest Principles (which all concern aspects of sustainable development).

37 The NZ Biodiversity Strategy, released by the Government in 2000, has as its goal halting the decline of indigenous biodiversity in New Zealand, expressed as follows:

"*Maintain and restore a full range of remaining natural habitats and ecosystems to a healthy functioning state, enhance critically scarce habitats, and sustain the more modified ecosystems in production and urban environments and do what else is necessary to maintain and restore viable populations of all indigenous*

species and subspecies across their natural range and maintain their genetic diversity."

38 In 2005, the five-year review of the New Zealand Biodiversity Strategy (Green & Clarkson 2005) identified significant challenges that still need to be addressed, including:

- Ongoing loss of rare and threatened biodiversity from private lands;
- Dominance of economic drivers that favour the degradation of ecosystems (such as wetlands), rather than their active maintenance;
- Adverse impacts of animal pests on threatened species and forest ecosystems; and the continuing spread of other invasive species, notably weeds and pest fish; and
- Serious declines in the status of many acutely or chronically threatened species.

39 In 2007 Cabinet introduced the policy document *Protecting our Places: Statement of National Priorities for Protecting Rare and Threatened Native Biodiversity on Private Land* (Ministry for the Environment 2007). This was an important part of the Government's response to the findings of the review of the NZ Biodiversity Strategy. It seeks to specify vulnerable ecosystems and habitats. By providing this information to regional and local government this Statement is intended to help deliver the New Zealand Biodiversity Strategy goal – 'to halt the decline in New Zealand's indigenous biodiversity'.

40 The *Statement of National Priorities* identifies the environments and ecosystems that are most vulnerable to ongoing loss. The intent is to identify the habitats most at risk nationwide. The national perspective is important because distribution of habitats is typically patchy. An ecosystem or community may appear locally common, but be nationally very rare. Habitats which may give this impression in Horizons Region are the extensive dunes of the Foxton sand country or the steep, low altitude, hill country forests inland from Whanganui.

41 However, the *Statement* also notes:

"focusing entirely at a national level may not identify indigenous biodiversity that should be protected at a regional or local scale because it is locally or regionally rare, threatened or valued by that community.

For these reasons, the statement of national priorities does not aim to identify all native biodiversity that is to be maintained by councils under sections 30 and 31 or identified as significant under section 6(c) of the Resource Management Act."

(My emphasis).

42 The *National Priorities* are:

1. To protect indigenous vegetation associated with land environments (defined by Land Environments of New Zealand at Level IV), that have 20% or less remaining in indigenous cover.
2. To protect indigenous vegetation associated with sand dunes and wetlands; ecosystem types that have become uncommon due to human activity.
3. To protect indigenous vegetation associated with originally rare terrestrial ecosystem types not already covered by priorities 1 and 2.
4. To protect habitats of acutely-threatened or chronically-threatened species.

43 As recommended in the review of the New Zealand Biodiversity Strategy, a National Policy Statement (NPS) on Biodiversity has been proposed under section 46 of the Resource Management Act, and the Government called for and received submissions on that proposed NPS. The *National Priorities*, including the use of the 20% threshold for original vegetation cover remaining, are consistent with the proposed NPS on Biodiversity. Policy 2 of that proposed NPS would provide that, in addition to any area of significant indigenous vegetation or a significant habitat of indigenous fauna identified in the regional policy statement, regional or district plan, that the following should be regarded as such:

a. the naturally uncommon ecosystem types listed in Schedule One of the proposed NPS;

b. indigenous vegetation or habitats associated with sand dunes;

c. indigenous vegetation or habitats associated with wetlands;

d. land environments, defined by Land Environments of New Zealand at Level IV (2003), that have 20 per cent or less remaining in indigenous cover; and

e. habitats of threatened or at risk species.

44 I have been asked to comment on the application of Policy 11 of the New Zealand Coastal Policy Statement (NZCPS) 2010. This operative national policy statement identifies priorities for biodiversity protection for the coastal environment. Policy 11(a) (i) requires the *avoidance* of adverse effects on threatened or at risk indigenous species ("taxa") that are listed in the New Zealand Threat Classification Systems Lists. As I explain below, the approach of the One Plan, as endorsed by DOC, is to protect the *habitat* of these species, rather than the species *per se*. For the most part, the outcome of this approach will be similar and I do not consider that it is necessary to contain species lists in the One Plan in order to fulfil this policy in the NZCPS.

45 Avoidance of adverse effects is also required for "*indigenous ecosystems and vegetation types that are threatened in the coastal environment or are naturally rare*[9] (Policy 11 (a) (iii) of the NZCPS). In my view this Policy is intended to capture the same habitats as those which are scheduled as threatened and rare in the One Plan. I say this because, although a quantitative definition is not offered in the NZPCS, I believe that there is general agreement amongst ecologists as to the meaning of "threatened" and "naturally rare" in this context, as follows:

1. Threatened = less than 20% remaining.

2. Rare = listed in Williams et al 2007 (or subsequent work) to show that the habitat occupied less than 0.5% of NZ's land area prior to habitation.

46 These are the same meanings as used in the One Plan. Their general acceptance is displayed in the adoption of these meanings in the national

[9] Defined in the glossary to the NZCPS as "rare before the arrival of humans in New Zealand".

documents such as the *National Priorities*, the draft NPS on Biodiversity and the Threatened Environment Classification developed by Landcare Research[10].

47 In contrast, Policy 11(b) of the NZCPS, captures habitats that will typically fit the "at-risk" definition in the One Plan e.g. habitats that provide resources for species at certain times or that contribute to landscape connectivity. This Policy requires significant adverse effects on certain areas to be avoided, and non-significant effects to be avoided, remedied or mitigated. I note that Policy 11(b)(iii) refers to ecosystems vulnerable to modification, including "coastal wetlands" and "dunelands" which may give the impression that those habitats are better treated as 'at risk' than 'threatened' in the One Plan. However, Ms Maseyk has shown that those habitats are regionally threatened, having less than 20% of original extent remaining (Maseyk 2007 Appendix 1), and so would fall under Policy 11 (a) (iii) as described above.

4 THE REGIONAL RESPONSE: HORIZONS ONE PLAN SCHEDULE E

48 Horizons' approach to biodiversity in the One Plan is an excellent reflection of the Government's *Statement of National Priorities for Protecting Rare and Threatened Native Biodiversity on Private Land*[11]. As Ms Maseyk explains (Maseyk 2008) the approach that the Regional Council has utilised in developing the biodiversity sections of the One Plan is innovative, compared to most historical approaches that have largely relied on mapping areas of known significance based on field surveys.

49 However, the use of national spatial datasets (LENZ[12] and the Land Cover Database[13]) to determine the current extent of indigenous vegetation cover compared to original extent, reflects best practice and is increasingly being utilised as a robust method to assess the threat status of certain habitats (see examples in paragraph 55 below). The Department of Conservation was

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[10] T.E.C. as explained below at paragraph 55.

[11] Refer paragraph 39.

[12] Above footnote 1.

[13] The Land Cover Database uses satellite imagery to classify and map New Zealand's current land cover (such as, urban areas, mines, wetlands and native forest).

consulted at an early stage and supported the approach adopted by Horizons because:

- Schedules based on field surveys are expensive and time consuming.
- Schedules based on field surveys may mistakenly exclude significant habitats, especially of habitat types that are not readily apparent from inspection of aerial photographs or if surveyors are refused access. For example, a recent PNAP report (typical of this type of survey) explicitly states "*It is important to note that as with any large scale survey, some significant natural areas may have been overlooked.*" (Holland 2011 p. 3)
- Schedules based on field surveys become outdated as land uses change. This is especially a risk given the long lag between field data collection and application of the results in a district or regional plan.

50 All ecologists agreed at expert conferencing that "*mapping habitat is not possible nor cost effective at the regional scale*" (Memorandum regarding record of technical conferencing on Monday 30 January 2012 on Biodiversity). I understand that all ecologists giving evidence for this hearing support the approach Horizons has adopted for maintaining indigenous biodiversity at a regional scale by describing notable habitats based largely on predictive modelling, as distinct from mapping significant areas.

51 Another alternative raised during early discussions between DOC and Council was a *general* rule against vegetation clearance throughout the Region. Although this may be considered acceptable for some other districts or regions, this approach runs the risk of unduly protecting areas of little importance for biodiversity. It also runs the risk that important types of habitat which are not easily characterised in a rule (e.g. sedgelands and scrublands that do not meet criteria about height or density of woody stems) are not protected.

4.1 Distinguishing 'at risk','rare' and 'threatened' habitats

52 Ms Maseyk's evidence sets out the methodologies that were used to define threatened, rare and at risk habitats in Schedule E to the One Plan. Part 8 of

her evidence explains the 'thresholds' used to categorise habitats into the threatened and at-risk categories in Schedule E.[14]

53 The main basis for the identification of threatened and at-risk habitats in Schedule E is a predictive model that uses information about current forest tree distributions and environmental drivers (soil type, rainfall and temperature as summarised in LENZ) to predict what assemblages of trees (forest types) would have occupied particular land environments in the past. Some corrections are also made for known distributional limits related to plant dispersal after pre-historic disturbances such as sea level rise (Leathwick 2001; Leathwick et al. 2004).

54 Comparison of the predicted area of each forest type with current remaining indigenous vegetation in those areas was used to derive an estimate of threat status for each type.

55 As stated, this modelling approach is now widely used. Comparison of potential and actual vegetation cover (as a indicator of biodiversity) using Land Environments (to represent environmental diversity) and the Land Cover Database (LCDB, to represent the current extent of indigenous vegetation) is an accepted technique (Walker et al. 2008) which was applied to develop the Threatened Environment Classification (T.E.C)[15], promoted by the *Statement of National Priorities for Protecting Rare and Threatened Native Biodiversity on Private Land* and has been incorporated, as further source of data, into recent reports of field surveys to identify priority habitats e.g. in Northland Region (Smale et al. 2009).

56 Habitats in the One Plan were classified as threatened if less than 20% of the original extent of the habitat remains, and at risk if less than 50% of the original extent of the habitat remains. Classification of habitats as threatened if less than 20% of the original extent remains is a well-supported threshold (Walker et al. 2008). As noted above, this threshold is the same as that used in Priority 1 *National Priorities,* and in Policy 2 of the Proposed NPS on Biodiversity. It is

[14] Section 42A Report of Fleur Maseyk on behalf of Horizons Regional Council Part 8.

[15] TEC is a publically available mapping tool designed to help land managers identify habitats which have been disproportionately cleared and/or are least protected in the conservation estate

based on the 'species-area curve'[16], which shows a sharp decline in the number of species likely to survive if more than 80% of original habitat is lost; and various fragmentation thresholds, such as the increased likelihood of isolation of remnants if more than 70% of habitat is lost (Walker et al. 2008). Even very small losses of habitat below the 20% threshold can significantly impact on species' ability to survive (ibid).[17]

57 However, some authors advocate a 30% threshold (Leathwick et al. 2003; Ewers et al. 2006). It's a curve, not a step: some species will go extinct before the 20% point on the curve. Species which require large areas of habitat such as the kaka will become locally extinct even where there is *over* 20% of the original extent of their habitat remaining. Kaka have very large home ranges, and it is estimated that more than 500m^2 of lowland forest is needed to maintain a viable population (Leech et al. 2008). Other species, such as short-tailed bats, exclusively use extensive mature forest habitats and are unlikely to survive in highly fragmented areas (O'Donnell et al. 2006).

58 Another argument for a higher threshold is that remnants of habitat in landscapes where more than 70% of indigenous habitat has been cleared are likely to be small, isolated and largely composed of 'edge', and this likelihood increases rapidly as more habitat is lost (Ewers et al. 2006). The various threats fragmentation poses to species persistence become more important; and overall habitat quality decreases more rapidly than indicated by the rate of clearance. I will explain this phenomenon further in the next section of my evidence.

59 I will discuss the inclusion of rare habitats in Schedule E in Part 4.3 of my evidence below. Rare ecosystems often support a range of specialist species that are not found outside of these limited habitats which meet the species' particular needs (Williams et al. 2007). Because these habitats are so spatially limited, and the species that rely on them are often unable to move into adjoining (unsuitable) habitat, disturbance of rare habitats is very likely to

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[16] Explained in *Section 42A Report of Fleur Maseyk on behalf of Horizons Regional Council* paragraph 79 and Figure 6 on page 32.

[17] Refer also *Section 42A Report of Fleur Maseyk on behalf of Horizons Regional Council* paragraph 98: stating that at the 20% remaining threshold, even small losses of that habitat have disproportionately negative effects.

reduce biodiversity in the area, by local extinction of those species (Rogers & Walker 2002) or of that ecosystem type.

4.2 Ongoing threats to Schedule E habitats

60 In addition to the direct effect of vegetation clearance, much remaining habitat in the Horizons Region is at risk from more insidious damage. This is the lag effect of vegetation clearance and habitat fragmentation across the landscape and includes exposing remaining habitat to the effects of introduced mammals (stock and feral animals), weed invasion, and changes to ecosystem processes such as altered hydrological regimes and soil fertility (Burns et al. 2010).

61 Outcomes of habitat fragmentation may not be evident for generations after the initial clearance (Ewers et al. 2006). Fragmentation refers to the breaking up of once contiguous habitat into smaller units set in a matrix of a different habitat type (often developed land). I use the term here to mean both a change in configuration and a reduction in extent. After fragmentation, factors such as patch size, shape, and surrounding land use (e.g. indigenous scrub, pasture or production forestry) all influence habitat composition (Ohlemuller et al. 2004)

62 Small habitat patches are strongly influenced by conditions in the surrounding landscape. The edges of habitat patches in pastoral landscapes are lighter, drier, windier and more prone to temperature extremes than interior habitat (Norton 2002). They can also have higher levels of available nutrients such as phosphorus, calcium, magnesium and potassium due to fertiliser application on adjoining land (Stevenson 2004). This promotes development of different vegetation and animal communities in edge habitat (Ewers et al. 2007). Where patches are small, these conditions may influence much of the habitat and will alter vegetation composition and the quality of habitat for fauna (Ewers & Didham 2006).

63 Habitat remnants are often unprotected from browsing stock. Recent research (Smale et al. 2008) has shown that isolated patches of indigenous forest in pasture landscapes which are open to grazing stock have:

- Shorter and more open canopies;
- More open understoreys;
- Scarce groundcover vegetation and leaf litter;

- Fewer species, including absence of orchids and ferns that require high humidity; and
- More large, old trees, and fewer young trees to replace them (instead a small suite of short shrubs and tree ferns dominate)

64 As well as reducing plant diversity, these changes affect the quality of the habitat for fauna. A King Country study found that North Island robins are more often found in forest patches with a high canopy and tall understorey plants.

65 Some of these effects are reversible and forests will likely recover after fencing (Smale et al. 2005). However, recent research suggests that reversals are not straightforward and unanticipated outcomes may occur.

66 In addition, forests will not recover a full complement of species if the species' ability to re-occupy the site is compromised by loss of connectivity. The most important predictors of robin presence in the study I mentioned above were were patch size and linkages to other forest (Richard & Armstrong 2010).

67 Natural processes, which maintain genetic diversity and allow species to adapt and evolve, are compromised if individuals cannot move between patches (Armstrong & De Lange 2005; Walker et al. 2006). If significant mortality takes place (whether through predation or natural causes such as disease or severe weather), new individuals will not be able to re-colonise isolated fragments.

68 Exotic plant species such as wandering willie, *Tradescantia,* have significant effects on indigenous vegetation structure and composition (Standish et al. 2001) and on invertebrate communities (Toft et al. 2001). Where these pests become established, active intervention may be needed to restore the full range of biodiversity in a habitat. The conditions that prevail at habitat edges facilitate the growth of weeds at the expense of indigenous plants (Hawcroft 2002). Consequently, small habitat patches with little surrounding indigenous habitat are susceptible to weed invasion (Ohlemuller et al. 2006), especially seral (successional) habitats such as grassland (Ecroyd & Brockerhoff 2005).

69 Indigenous fauna in small, fragmented habitat patches may face increased risk of predation and competition from introduced species. However, this predation relationship has not yet been documented in fragmented New Zealand forests, possibly because many of predators (cats, mustelids and rodents) are

widespread in a range of habitats, possibly because little research has been conducted (Boulton et al. 2008)

70 Extensive forests are often a mosaic of different stages of vegetation development, some patches may be dominated by very large, mature trees, others covered by a dense stand of young trees regenerating after a slip or wind damage. This mosaic of habitats contributes to overall diversity (Ogden 1997). Fragmentation breaks up this mosaic and reduces the chances of species that rely on seral habitat, like some threatened mistletoes, being able to colonise new sites. This can lead to local extinction (Sawyer & Rebergen 2001).

71 Ms Maseyk also describes these indirect effects of vegetation clearance in Part 6 of her section 42A Report (Maseyk 2008). These indirect effects contribute to the highly vulnerable status of many rare or threatened habitats, and need to be considered during management decisions affecting those habitats.

72 The pro-active management approaches described in the Chapter 7 of the One Plan should help manage some of these threats to indigenous biodiversity. In particular, the 'non-regulatory' Policies 7-4 (c) and 7-6 (a) and methods 7-1 to 7-4 inclusive have potential to secure improvements in the status of vulnerable habitats.

73 I agree with Ms Maseyk that non-human impacts from invasive pest species are the greatest current threat to remaining biodiversity in the Region.[18] However, there are two important caveats to this agreement, one is that I assume current constraints on habitat disturbance and vegetation clearance continues (as unconstrained deforestation could cause immediate mortality of some species (eg *Powelliphanta*) whereas invasive species' effects will be culmulative over a long time). The other caveat is that this risk should be seen in the context of fragmentation effects, such that further fragmentation will exacerbate the threat that these species pose. Although not able to be regulated for in the One Plan, non-human impacts certainly require a separate policy response.

[18] Key Message 5 on page 34 Section 42A Report of Fleur Maseyk on behalf of Horizons Regional Council.

74 Even small or degraded habitat remnants can add considerably to biodiversity. For instance very small stands of forest have greatly increased invertebrate diversity relative to open ground (Harris & Burns 2000). In addition, small or degraded patches of habitat indirectly add to landscape biodiversity – by buffering the edges of other remnants or significant waterways, by contributing to corridors for wildlife movement and by providing food for mobile species at a certain time of year (Norton & Roper-Lindsay 2004).

75 Those remnants are also nodes for future habitat restoration or enhancement. Managing threats in an existing area of habitat is easier than building a habitat from scratch. Clearly, habitat creation is more expensive than habitat enhancement: fencing and weed control of an existing strip of riparian forest has a cost; but planting, fencing and weed control of a riparian area currently in pasture has a longer lag time before benefits are realised, and a higher cost. Various studies illustrate that the greater the linkages to existing habitat, whether proximity to existing patches that act as seed sources to supplement artificial planting (Sullivan et al. 2009) or similarity to pre-disturbance soil and litter characteristics (Watts et al. 2008), the better the restoration outcome.

4.3 DOC involvement in the development of Schedule E

76 Ms Maseyk's evidence describes the process that occurred around the refinement of Schedule E to the One Plan.[19] This process involved caucusing during the Council-level hearings process between all ecologists engaged by parties at that level. Three significant changes were made:

1. Inclusion of some habitat types not predicted by the model used to determine original extent of forest communities;

2. Inclusion of some additional rare ecosystem types; and

3. Removal of Table E3 and associated inclusion of two additional at-risk habitat types to protect habitat of highly vulnerable species with strongholds in Horizons Region.

77 At the culmination of that process there was broad agreement that Schedule E reflected a robust and accurate approach to identifying rare, threatened and at-

[19] Part 10 of *Section 42A Report of Fleur Maseyk on behalf of Horizons Regional Council* and pages 9 – 54 of *Evidence and Supplementary Recommendations of Fleur Maseyk for the Biodiversity Hearing.*

risk habitats. Some further changes were made at Environment Court mediations to meet concerns of the New Zealand Defence Force regarding the identification of *Indigenous Tussock below the Treeline* as an at-risk habitat.[20]

78 A habitat-type is only a rare, threatened or at-risk habitat under Schedule E if it (a) is identified as such in Table E.1 of the Schedule; (b) meets at least one of the criteria in Table E.2(a) for the relevant habitat-type; and (c) is not excluded by Table E.2(b). This is explained at the beginning of Schedule E in the One Plan.

79 Several refinements to Table E1 of this Schedule were agreed by the ecologists involved after notification of the One Plan. In particular, broadbrush modelling based on predicted potential vegetation can overlook some important rare, seral (successional) and very spatially limited habitats. While several rare habitats and one seral habitat were identified by Ms Maseyk via her consultation with local ecologists and DOC staff, during initial drafting of Schedule E, others were overlooked. Evidence at the Council level hearing proposed that the habitat classification provided in Table E1 be supplemented to recognise two habitats that were not captured by the predictive model of previous vegetation extent but characteristic of Horizons Region and important contributors to regional biodiversity[21] and a number of originally rare habitats[22] that were not included in the first version of the Schedule. These were accepted and added to Table E1.

80 Definitions and descriptions of three rare habitat types that were included were based on a national review by Williams et al (2007) of originally rare or uncommon ecosystems. However, for simplicity, experts agreed to combine some of these ecosystem types.

81 Definitions and descriptions of the two threatened habitats that were not predicted by the model used to map original habitat extent were drafted by the ecologists during council-level caucusing.

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[20] By Mediation Memorandum 17 June 2011 the following was agreed to be added as an additional exclusion in Table E.2(b): *"Red tussock regenerating through pasture dominated by exotic grass species"*.

[21] *Tussock grassland below the treeline* and *Kowhai forest or treeland.*

[22] *Cliffs, scarps and tors*; *Karst systems*; and *Screes and boulderfields.*

82 As stated, I understand that all these habitat-types in Schedule E have now been agreed, however below in paragraphs 102-108. I explain some matters in relation to the Williams et al (2007) rare habitats that were included within Schedule E.

83 Table E.2(a) describes size criteria that must be met for different habitat types. By way of example, for Forest, Treeland, Scrub or Shrubland habitats in Schedule E that are classified as threatened, the habitat must be an area of continuous indigenous vegetation and cover at least .25 ha or, if discontinuous, cover at least 1 ha. Other size limits apply to different habitats such as tussockland, wetland and rare habitats. During the process DOC recommended improvements to Table E2(a) that accounted for the small size and importance of bare substrate and non-woody vegetation as components of some of the newly added habitats (originally size thresholds were restricted to areas of woody vegetation or wetland habitat).

84 The inclusion criteria in Table E2(a) provide guidance to determine whether a site is a significant habitat (e.g. a kahikatea forest remnant or three trees sitting in a paddock). It is expected that habitats below these thresholds are of low value, and unlikely to persist in the landscape for long. However I should acknowledge that there are some examples of rare wetland or coastal turf habitats where areas of less than $10m^2$ support important populations of threatened species. It is unfortunate that in setting reasonable limits, some important small habitats will inevitably be overlooked

85 The exclusion criteria in Table E2(b) recognise that areas of indigenous habitat may exist in the landscape because they were created by individuals with an expectation of a particular continued use (e.g. a pond created in order to provide drinking water for stock may meet a wetland habitat definition, but is specifically excluded).

86 I agree with Ms Maseyk's statement that *"Table E.2 of Schedule E provides a second set of thresholds which in effect ensures non-significant sites are likely to be filtered out, by providing criteria that considers size, degree of fragmentation, grazing pressure and position in the landscape."*[23]

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[23] Paragraph 84 Evidence and Supplementary Recommendations of Fleur Maseyk for the Biodiversity Hearing.

87 The One Plan as notified contained Table E3 which was a list of 131 threatened species known to occur in the Region. The Department's original submission sought 22 additions to this list. However, pre-hearing caucusing identified some problems with the Table's application, as the species listed were often hard to find and difficult for a lay-person to identify. Some of the species listed would also be difficult for many field ecologists to identify and would require collection and microscope examination. In addition some species would not be present or visible at all times of the year (e.g. plants which are winter dormant or can only be identified during flowering or fruiting, animals who use habitats in certain seasons), potentially requiring multiple site visits to confirm their presence or otherwise.

88 Removal of Table E3 however raised concerns as the remaining Schedule E focussed on broad-scale habitats characteristic of the Region rather than particular species of threatened fauna and flora, which often have very specific habitat requirements.[24] A compromise was reached through deletion of Table E3 but addition of two at-risk habitat types for threatened species[25] and recognition that other habitat types gave sufficient flow-on protection to species which utilised that habitat. Experts also agreed that for some species, protection could be best achieved through active management intervention in already protected habitats and through targeted non-regulatory methods.

89 I agree with the final approach in Schedule E, which protects *species* through protection of the given *habitat* types, and that non-regulatory methods can be used to fulfil any shortfalls or gaps in this approach. The protection of habitat types will generally protect the species that rely on those habitats.

90 Habitats that are not rare, threatened or at-risk under the One Plan have a 'no threat' status and are not protected through regulatory means under the Plan. There was a concern by DOC in the development of the One Plan that habitats not included in Schedule E could be significant within the meaning of section 6(c) of the Act. These were mostly habitats adequately covered in other parts of the plan (e.g. aquatic ecosystems), but also those such as alpine

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[24] Bearing in mind that section 6(c) of the Act refers to "significant habitat of indigenous fauna" as well as "significant habitat of indigenous flora".

[25] *Indigenous forest, treeland or scrub on alluvial terrace, floodplains, shingle fans or sand dunes supporting divaricating plant species* and *Indigenous forest or scrub containing Powlliphanta landsnails.*

ecosystems and some montane forests, which are almost all contained within the conservation estate. Sites on private land may be significant where they are contiguous with those on the conservation estate and form part of the homeranges of threatened fauna or support good populations of threatened flora. A critical site, such as a bat roost or kiwi nest, may be on public or private land. However, recognising many of these habitats are quite likely not to be significant, and the costs associated with determining which species are dependent on which parts of a habitat, we agreed that those sites could be best secured by other approaches.

4.4 Significant areas under section 6(c) of the RMA 1991

91 Ms Maseyk sets out in her evidence how Horizons' framework for categorising rare, threatened and at risk habitats compares with assessment of ecological significance for the purpose of section 6(c)[26]. I largely agree with her analysis, and with her Table 8 on pages 43-44 of her evidence. On the basis of this analysis, all rare and threatened habitats in the One Plan are determined to be significant for the purposes of section 6(c), and at-risk habitat types require further consideration against significance criteria in order to determine whether they are "significant" for the purposes of that section of the Act.

92 My only reservations with Ms Maseyk's analysis are:

1. that there is potential for rare habitats to also meet the *Ecological context* criteria (in addition to the *rarity* criteria), particularly where they form part of a mosaic with other habitat types (typical of dune wetlands); and

2. that there is potential for rare, at risk and 'no threat category' habitats to meet the *Representativeness* criteria, by being a particularly large, intact and functioning example of a habitat type.

93 Policy 12-6 of the One Plan is a list of criteria that will be applied to:

[26] Part 9 of Section 42A Report of Fleur Maseyk on behalf of Horizons Regional Council.

- Determine whether at-risk habitats are significant at the time of consenting; and
- Determine the degree to which a proposed activity (in rare, threatened and at-risk habitats) will have adverse effects on the values that contribute to the sites' significance.

94 I agree with Ms Maseyk that these criteria (as agreed during expert conferencing) are necessary and are a standard, appropriate method for assessing significance.

95 These criteria were agreed by all ecologists during conferencing. Conferencing on this Policy 12-6 was undertaken to address the Minister of Conservation's appeal point that the words "*functioning ecosystem processes*" should be removed from the Policy. The Minister of Conservation sought the removal of the requirement for an area of indigenous vegetation to have "functioning ecosystem processes" in order to be considered significant under the 'representativeness' part of the criteria in Policy 12-6(a)(i)(C).

96 The term 'functioning ecosystem processes' is ambiguous. It does not indicate whether the site needs to demonstrate all expected ecosystem processes, or only one or two. The former is very likely to be impossible as some processes operate at landscape scales and will be compromised by past landuse changes and essential management (e.g. flood mitigation, fire control) outside the site. The latter is almost always going to be the case, as simple processes such as pollination of some flowers, seed germination and tree mortality, will always take place.

97 More importantly however, the term 'functioning ecosystem processes' may be interpreted as a 'sustainability' or 'viability' criteria that must be met in addition to the criteria in part (i) of the Policy that captures as 'significant' all habitat with 20% or less of known or likely former natural cover remaining. This is not appropriate for assessment of significance in terms of section 6(c) of the Act. As discussed earlier, many habitats in the region which are threatened (i.e. there is 20% or less of that habitat remaining), are highly vulnerable to ongoing degradation.

98 Failure to retain those most vulnerable habitats would cause a decline in regional biodiversity. For example, given the speed and effectiveness with

which invasive marram grass can spread (Hilton 2005), all of the Manawatu-Whanganui dunelands are imminently threatened by this weed, which at high densities will significantly reduce their natural character (ibid). However, failure to maintain these sites as best possible would result in regional extinction of this ecosystem type.

99 I therefore agree with Ms Maseyk's evidence that a criterion related to inherent viability/sustainability to qualify "threatened" (or rare) habitat types, and which is additional to the minimum size thresholds in Table E.2(a), should not be included.[27]

100 It was generally agreed in conferencing that the intention of including the words 'functioning ecosystem processes' was to include sites of habitat which are not particularly uncommon, but which are particularly good examples, including the species, communities and ecological processes that would be expected in that habitat. It was therefore agreed that "functioning ecosystem processes" should not be a qualifier on habitats that have 20% or less natural cover remaining, but could remain as a qualifier in relation to (a)(i)(B) of the Policy which, as explained by my colleague Dr Gerbeaux, is the part of the Policy that would generally be categorised as criteria relating to more common habitats that should be protected because they are "representative". I support this approach.

101 I also agree that a criterion related to the *quality* of ecosystem processes within a habitat (sometimes referred to as 'condition' or 'sustainability' of a habitat) could be included to inform management options for a site, *after* it has been determined whether the site is "significant".[28] In this respect, a site visit may be necessary to evaluate the *impact* of a proposed activity on the values which make the site "significant". This is provided for under Policy 12-6(b) in the One Plan.

102 In response to concerns raised by Mr Parks, in the preparation of my evidence I have had cause to reconsider whether there are some rare or threatened habitats within Schedule E to the One Plan which may not meet the criteria for

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[27] Refer Evidence and Supplementary Recommendations of Fleur Maseyk for the Biodiversity Hearing paragraphs 61-67.

[28] I am in agreement with Ms Maseyk on this point: Evidence and Supplementary Recommendations of Fleur Maseyk for the Biodiversity Hearing paragraph 59.

significance agreed within Policy 12-6. Generally, under the criteria agreed for Policy 12-6, all rare and threatened habitats in Schedule E will be determined to be significant because the methodology for identifying rare and threatened habitats in Schedule E closely matches the criteria agreed for significance in Policy 12-6. That is, threatened habitats are generally those habitats that have 20% or less of remaining natural cover[29], and rare habitats were those that were originally uncommon within New Zealand (i.e. in pre-human times) and support an indigenous species or community of indigenous species[30].

103 In my view, a habitat that is described as rare in Schedule E could only be found not to meet the criteria in Policy 12-6 if the underlying framework used to test the criteria during creation of Schedule E was incorrect. For instance, the Schedule may identify an ecosystem type as originally rare, and it may be later proved to be more common than first thought. This could affect the application of criterion (a)(ii)(E) in Policy 12-6[31].

104 As stated, the originally rare habitat descriptions in Schedule E draw on a publication from 2007 – Williams et al. In 2009, when Schedule E was finalised, this represented the best available knowledge about the nature and extent of originally rare ecosystems in New Zealand. However Williams et al (2007) did indicate that some ecosystem types in the publication would require further research to confirm their status.

105 Three ecosystem types are relevant to rare habitat descriptions in the One Plan:

1. The ecosystem-type *screes of acidic rock* (including greywacke, sandstone, papa and other sedimentary rocks) included in Schedule E as part of *Screes and boulderfields*;

2. The ecosystem type *cliffs, scarps and tors of acidic rock* included in Schedule E as part of *Cliffs, scarps and tors* (although note that this encompasses all rock types); and

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[29] Criterion 12-6(a)(i)(A).

[30] Criterion 12-6(a)(ii)(E).

[31] Policy 12-6(a)(ii)(E): "*was originally (ie., prehuman) uncommon within New Zealand, and supports an indigenous species or community of indigenous species*".

3. The ecosystem types *active sand dunes* and *stable sand dunes* included Schedule E as *Active dunelands* and *Stable dunelands.*

106 *Screes and boulderfields* and *Cliffs, scarps and tors* are habitat types that may be better treated as at-risk, as further data collection may be needed to confirm their significance e.g. by ascertaining geology and species composition.

107 *Active Dunelands* and *Stable Dunelands* are habitat types that may be better treated as threatened given the uncertainty about their status as originally rare ecosystems, but also the working presented in (Maseyk 2007) and (Hilton et al. 2000) which show that less than 20% of these habitats remain in the Region.

108 I am not recommending that these alterations be made to Schedule E at this stage as Schedule E reflects our current understanding of originally rare habitats in New Zealand. However if there is scope within appeals then Horizons may wish to make the change from rare to at-risk in relation to the categories *Screes and boulderfields* and *Cliffs, scarps and tors*, if on further reflection it is felt there is not sufficient certainty that these habitats were originally uncommon or rare in New Zealand.

109 At-risk habitat types may be significant. This will be determined by a site assessment. For example, fragments of at-risk habitat may be:

- Highly 'representative' examples of the original species composition, structure and processes of the ecosystem type.
- Important contributors to landscape level biodiversity by providing buffering or connectivity for protected indigenous habitat.
- Important habitat for rare or threatened species. In the case of the habitat types defined by the presence of species, examples where *Powelliphanta* (for e.g.) are found to be present will be nationally significant.

110 This approach efficiently uses Council resources so that field assessments focus on sites which are close to the borderline of significance (at-risk habitats) but do not waste time visiting many sites that have already been determined to be significant (rare and threatened habitats).

111 The distinction between rare, threatened and at-risk habitats is important, because it allows for a two-tiered approach to management. Rare and

threatened habitats which are determined to be significant – because the criteria used to identify those habitats in Schedule E are based on the criteria used to assess significance in Policy 12-6 – are strictly protected because of the high likelihood that any land disturbance or vegetation clearance would have significant impacts. At-risk areas which are likely to be significant, but may prove not to be, or where there is a lesser chance than some activities will compromise their value, will be assessed against the standard criteria in Policy 12-6 in order to determine significance. Once significance has been determined, the appropriate management response for all these categories of habitats will be determined through the consenting process, with the more stringent requirements for significant habitats as distinct from non-significant habitats. I endorse this approach.

5 THE RISKS OF TRADING HABITAT LOSS WITH MANAGEMENT TO ENHANCE VALUES ELSEWHERE

112 All ecologists agreed in conferencing that the use of the term "biodiversity offsets" in the One Plan should be consistent with the definition of the principles of the BBOP[32].

113 The record of conferencing[33] contains the following under *"Topics addressed by Experts and not Agreed"*:

> *"Meridian & Trustpower and HRC are concerned that there is a need for flexibility to apply mitigation options on a site by site basis recognising for site based values, whilst taking into consideration that some habitats are not replaceable. Where does biodiversity offsets fit within avoid, remedy, mitigate framework and what is the trigger for applying biodiversity offsets.*
>
> *The MoC concern is that flexible mitigation options could result in loss of rare or threatened habitat without a demonstrated equivalent gain."*

5.1 The need to monitor outcomes of management choices

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[32] The Business and Biodiversity Offsets Programme principles are described in the evidence of my colleague Mr Clubb.

[33] Memorandum Regarding Record of Technical Conferencing on Monday 30 January 2012 on Biodiversity.

114 Drawing on my expertise in the field of monitoring biodiversity outcomes, I have been asked to discuss the implications of accepting BBOP Principle 8: "*Long Term Outcomes*". This Principle relates closely to the following principles that the Minister of Conservation is recommending be included in the One Plan to apply to offsets:

- providing for a "net indigenous biological diversity gain"; and
- the gain: *"having a significant likelihood of being achieved and maintained in the long term and preferably in perpetuity*".

115 Principle 8 requires that offsets should be designed and implemented within an adaptive management framework, incorporating monitoring and evaluation, with the objective of securing outcomes that last at least as long as the project's impacts and preferably in perpetuity. Mr Clubb's evidence discusses this Principle and he states (his paragraph 56):

"Failure to implement, monitor, fund and where necessary, enforce agreed conservation outcomes risks failure to achieve no net loss of biodiversity."

I will now explain some reasons for the necessity of monitoring the outcome of management choices.

116 In terms of biodiversity monitoring, we often distinguish between 'input', 'result' and 'outcome' monitoring. *Input* monitoring is checking the planned work is carried out. This is fundamental monitoring, and easy to achieve as it simply requires documenting the management actions as they happen. *Result* monitoring is the direct change achieved by the work. For instance, measuring possum numbers before and after the trapping period. This monitoring is additional work to the actual management intervention and may require a higher level of skill (e.g. the person who conducts the population measurement would need to be a National Possum Control Agencies certified operator). Interpretation of findings may also be less straightforward as results could change for reasons unrelated to the effectiveness of the management e.g. possum numbers may be artificially low before control begins because of bad weather restricting their movement during the monitoring period.

117 *Outcome* monitoring would involve comparing the state of the forest canopy before and after the control event. This is further additional work and requires

another skill set. It is likely that outcomes – changes in the biodiversity value we are trying to protect – may not be evident until some time after a management intervention. In the case of possum control, a 'lag' of two or four years before recovery of canopy condition is not atypical. Different management actions and monitoring techniques have different associated lag times and may vary from overnight to more than 40 years.

118 Interpretation of outcome monitoring findings may be difficult as it is likely that factors other than the management action will influence observations. For instance, in February 2012 I measured forest canopy condition in part of the 'Kia Wharite project area' in the Whanganui National Park, where various management actions to enhance indigenous biodiversity are undertaken by DOC, Council, iwi and local stakeholders. We observed considerable dieback – large numbers of dead, broken branches in the canopy. This is likely unrelated to possum control, but a result of the unusual snow fall the area experienced last winter.

119 Monitoring can be a challenging component biodiversity management projects. It is sometimes costly, takes time and skills which may need to be secured from external sources, and outcomes can be slow to eventuate, ambiguous or difficult to interpret. But it is also a critical component.

120 Without monitoring, we run the risk of wasting resources on management actions that do not achieve expected results or desired outcomes. Investment in biodiversity monitoring is increasing, as required by various international agreements[34]. DOC recently adopted a new, framework for inventory and monitoring (Allen et al. 2009) which is being extended to Regional Councils.

121 It is often assumed that some management actions will necessarily have a positive outcome, and that monitoring can be minimal (i.e input monitoring only). This pragmatic choice is sometimes justified, especially where the management is low cost, and monitoring would greatly increase the project's expense, or where the management regime is the same as other sites which

34 Monitoring status and trend in biodiversity is required by several international agreements (notably the Convention on Biological Diversity mentioned above, and the Montreal Process) and by various pieces of national legislation Lee, W.G.; McGlone, M.; Wright, E. 2005: Biodiversity Inventory and Monitoring: a review of national and international systems and a proposed framework for future biodiversity monitoring by the Department of Conservation. Landcare Research, Wellington. 216 p.

are monitored (and we can take those monitoring findings to be representative of a wider set of sites).

122 However, this is inappropriate in the case of proposals to impact rare, threatened or otherwise significant habitats. Vegetation clearance or land disturbance in significant habitats, in situations where the effect is more than minor, will inevitably result in a loss of biodiversity value. A frequently proposed 'trade-off' is to accept some loss of a degraded habitat, in return for fencing of another habitat which is then expected to gain value. However the hoped for outcomes are not inevitable, and without a robust approach to monitoring the outcome and adapting management as needed, there will be no certainty that net biodiversity will be maintained (even where the two habitats are alike). Even for other habitats (assessed not to be significant), if there are to be significant effects on that habitat then the need for monitoring inputs, results and/or outcomes of any enhancement proposal needs to be well-considered. Pragmatic approaches in those circumstances (i.e. for non-significant habitats) will only be acceptable when justified according to the particular circumstances, and the nature of the management proposed.

123 For example, two recent papers discuss unexpected outcomes of fencing forest remnants in the Waikato. One found that, while fencing had positive outcomes in terms of increased leaf litter depth, thickness and complexity of understory vegetation, it also resulted in increased abundance of ship rats, which are effective predators of indigenous invertebrates like weta and small birds like tomtits (Innes et al. 2010b). Thus, fencing to exclude stock (without rat control as well) may result in loss of valuable species from forest remnants. Another study showed that fencing resulted in a substantial increase in thickness of understorey vegetation, but frequency of juvenile canopy forming trees (like tawa) only increased where possum control was also implemented. Further, the authors noted that even with both these actions, numbers of juvenile canopy trees were too low to replace the existing canopy, and that the fragments require still further management to achieve the desired outcome (Burns et al. 2010).

124 In summary, monitoring is essential whenever managers exchange the certain loss of some biodiversity values for the uncertain gain of values elsewhere. Monitoring is the only way to know whether that gain is being realised and to ensure that management is adaptive, and – if necessary - changes are made to

ensure that the inputs are being secured, results are positive, and outcomes are achieved.

5.2 Distinguishing between ecosystems and habitat types

125 Changes proposed by the Minister of Conservation and the Wellington Fish & Game Council to Policy 12-5(d) would provide that biodiversity offsets *"not be allowed where inappropriate for the ecosystem or habitat type by reason of its rarity, vulnerability or irreplaceability"*.[35] (My emphasis)

126 I understand that Ms Barton for the Horizons Regional Council has proposed different wording, which would require decision-makers to have regard to *"whether offsets are inappropriate for the ecosystem (or habitat) type by reason of its rarity, vulnerability or irreplaceability"*[36]. (My emphasis)

127 I have been asked to clarify a distinction between habitat types and the broader term 'ecosystems', two words that are proposed to be used in this Policy.

128 Habitat types as defined in the One Plan are a specific assemblage of taxa occurring in a particular abiotic environment. Ecosystem is a broader term which covers networks of species and abiotic factors interacting at a range of spatial and temporal scales. A typical definition is "*Any interrelated and functioning assemblage of plants, animals and substrates (including air, water, soil) on any scale, including the processes of energy flow and productivity*" (Myers et al. 1987). This breadth of scale is an important component of the ecosystem concept (Park 2000).

129 Thus, ecosystems may comprise more than one habitat type (in the One Plan sense) e.g. patches of *Active dunelands*, *Stable dunelands* and *Dune Slack wetlands* habitats could all form part of a single ecosystem. It is important that assessment consider the values, irreplaceability and vulnerability of both the habitat type and the wider ecosystem that may encompass it. However the words *"ecosystem (or habitat) type"* as recommended by Ms Barton are not appropriate because an ecosystem is not generally classified according to

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[35] Evidence of Ms Helen Marr for the Minister of Conservation and the Wellington Fish & Game Council.

[36] Memorandum Regarding Record of Technical Conferencing on Monday 30 January 2012 on Biodiversity.

"type". It would be preferable to use the word "ecosystem" in the relevant part of the Policy without this qualifier.

6 SUMMARY

130 In summary, Horizons Region is an area of high biological value with many outstanding examples of indigenous vegetation, habitats and species. Unfortunately, a large proportion of these values have been lost, and the remaining vegetation is unevenly distributed across the landscape. Because of the ongoing and pervasive threats to biodiversity in the Region, both preservation and enhancement of remaining habitat will be necessary to maintain the tangible and intangible benefits of indigenous biodiversity in the landscape.

131 Analysis of losses to biodiversity on private lands in the Horizons Region largely reflects national analyses. The New Zealand Government has responded by promulgating several national-level policy documents, including the New Zealand Biodiversity Strategy (*"Halting the Decline"*), the *Statement of National Priorities for Protecting Rare and Threatened Native Biodiversity on Private Land* and the National Policy Statement on Biodiversity proposed under the Resource Management Act 1991.

132 The One Plan is an innovative and effective approach to identifying and providing for the protection of significant habitats. It is largely consistent with the most recent national policy directions and methodologies for identifying areas of significance. I endorse the Plans' ability to discriminate between areas of significance based on known rarity or threat from areas that may be significant but require further evaluation. This distinction will provide for an efficient use of Council resources, and for strong protection of those habitats where there is a high likelihood that any disturbance will compromise important values. As my evidence has shown, this is almost certainly the case for rare and threatened habitats identified under the One Plan. The same may be said of at-risk habitats which are found to be significant.

133 Even very small losses of rare or threatened habitats can have significant impacts, including on species' ability to survive. Loss of habitats through

clearance and disturbance is an ongoing threat, and it appears that this current loss is largely the cumulative effects of small actions, not large-scale clearances. It must also be recognised that loss of habitat has both immediate and delayed effects. Fragmentation across the landscape exposes remaining habitat to the effects of introduced mammals, weed invasion, and changes to ecosystem processes - the outcomes of which may not be evident for some decades.

134 Great care needs to be taken in balancing a known loss for an uncertain gain in biodiversity value. I have provided some examples of the potential for unexpected outcomes of basic habitat enhancement measures. Robust monitoring is essential to inform this response and may require an adaptive management approach. Without this rigour there can be no certainty that biodiversity across the Region will be maintained in the longer term and for future generations.

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