

**BEFORE THE ENVIRONMENT COURT
AT CHRISTCHURCH**

**ENV-CHC-2009-193, ENV-CHC-
2009-175, ENV-CHC-2009-181,
ENV-CHC-2009-183, ENV-CHC-
2009-184, ENVOCHC-2009-187,
ENV-CHC-2009-190, ENV-CHC-
2009-191, ENV-CHC-2009-192**

IN THE MATTER of the Resource Management Act
1991

AND

IN THE MATTER of appeals under clause 14(1) of the First Schedule to
the Act in relation to decisions on Plan Change 13 to
the Mackenzie District Plan

BETWEEN **FEDERATED FARMERS OF NEW ZEALAND
(INCORPORATED) MACKENZIE BRANCH**
**HIGH COUNTRY ROSEHIP ORCHARDS LIMITED AND
MACKENZIE LIFESTYLE LIMITED**

(continued next page)

**STATEMENT OF EVIDENCE OF BRUCE ALLAN ON BEHALF OF
THE MACKENZIE GUARDIANS INCORPORATED**

DATED: 09 SEPTEMBER 2016

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MOUNT GERALD STATION LIMITED

MAKENZIE PROPERTIES LIMITED

**MERIDIAN ENERGY LIMITED AND GENESIS ENERGY
LIMITED**

THE WOLDS STATION LIMITED

FOUTAINBLUE LIMITED & OTHERS

**R,R AND PRESTON AND RHOBOROUGH DOWNS
LIMITED**

HALDON STATION

Appellants

AND

MACKENZIE DISTRICT COUNCIL

Respondent

INTRODUCTION

1. My full name is Bruce Edgar Allan. I hold a Masters in Biochemistry from Lincoln University specialising in the nutritive value of tussock grasslands, and a PhD, also from Lincoln, specialising in tussock grassland pasture ecology. I have 20 years of tussock grassland research and consultancy experience, initially at Tara Hills High Country Research Station (formally MAF and then AgResearch – 14 years), and then at AgResearch Lincoln.
2. I grew up on a high country property in the Upper Rangitata gorge. Since 1996 I have lived at Peel Forest, South Canterbury where I farm in partnership with my wife a 55 hectare property, and from where I have undertaken occasional tussock grassland research contracts, field studies and consultancy.
3. While at Tara Hills Research Station my research work of particular relevance encompassed: techniques of tussock grassland intensification; subsequent grazing management; and farm systems analysis (much of it in or at least relevant to the Mackenzie Basin).
4. Pastoral intensification research focussed on the ‘improvement’ techniques most suited to various land types, (including aerial oversowing of seed and topdressing with fertiliser, direct drilling with and without herbicide use), and the subsequent herbage production, including that from cultivated pasture with and without irrigation.
5. Grazing management research centred on semi-intensified tussock grassland, looking comprehensively at long-term effects of various domestic (merino sheep) stocking rates and the extent of subdivision fencing.

6. Farm systems analysis included sustainability modelling of the whole-farm enterprise, with particular focus on integration of the various farm land types within the farm.

7. I have been a research scientist and consultant on tussock grassland intensification for the past twenty years. Work of particular relevance includes:
 - a) Pastoral advice for tussock grassland intensification on relevant high country properties including: Irishman Creek, Pukaki Downs, Glenrock, Simons Hills and Lochabor.
 - b) Ongoing monitoring of tussock grassland flora (20 Sites) for the Upper Rangitata Gorge Landcare Group.
 - c) Member of the Parliamentary Commissioner for the Environment Team for the review of the High Country Tenure Review Process.
 - d) Member of the Working Party for Variation 18 of the Timaru District Plan, representing the Peel Forest Enhancement Group.
 - e) Contracted by the Timaru District Council along with Boffa Miskell ecologists to formulate Significant Indigenous Vegetation Definitions for Variation 18 of the Timaru District Plan

8. I have been engaged by the Mackenzie Guardians to provide evidence on pastoral intensification in relation to the post-consultation version of Plan Change 13 to the Mackenzie District Plan (PC13 **(s 293V)**).

9. I have read the code of conduct for expert witnesses contained in the Environment Court Practice Note 2014. I have complied with it in preparing this evidence and I agree to comply with it in presenting evidence at this hearing. The evidence that I give is within my area of expertise except where I state that my evidence is given in reliance on another person's evidence. I have considered all material facts that are known to me that might alter or detract from the opinions that I express in this evidence.

10. In preparing this evidence I have been made aware of and viewed the following material:

- a) PC13 Section 293 Package (November 2015);
- b) The statements of evidence of Mr Harding, Ms Harte, Mr Fairgray and Mr Densem on behalf of the Mackenzie District Council ('MDC');
- c) Statements of evidence on behalf of appellants (19 August 2016).
- d) Submissions received by Council on the proposed amendments to PC13.

SCOPE OF EVIDENCE

11. In this evidence I provide a brief overview of the Mackenzie basin from a pastoral perspective, consider what constitutes pastoral intensification, describe methods of exotic seed and fertiliser introduction, discuss the various levels of pastoral intensification in terms of effects on indigenous vegetation and how these have contributed to the landscape and environment we see today, and based on my experience I offer some management recommendations that may help contribute towards the maintenance of desired landscape and ecological values.

OVERVIEW OF THE MACKENZIE BASIN FROM A PASTORAL PERSPECTIVE

12. Present day farming in the Mackenzie basin, and the South Island high country in general, differs greatly from that throughout the rest of New Zealand. The term 'high country' is difficult to define but is characterised by cold winter temperatures restricting pasture growth throughout the winter months, the risk of significant snow, and a complex blend of land types in terms of altitude, aspect, rainfall, soil and vegetation.

13. High country soils developed from parent rock through processes of erosion, deposition, weathering and leaching, and were further influenced by the evolving indigenous vegetation (Floate and Cossens 1992). They vary from deep and fertile fan soils, especially in terms of natural phosphate levels, to shallow young outwash soils with low inherent fertility and very low moisture holding capacity.

The lack of indigenous legumes meant all high country soils were low in nitrogen, hence the tawny-brown landscapes that are synonymous with the natural high country.

14. A strong rainfall gradient overlays these various soils and land types, with high precipitation in the northwest (1000mm+/annum) to low in the southeast (450mm). As a general rule of thumb, the rainfall gradient lines run parallel with the southern points of lakes Tekapo, Pukaki and Ohau. Temperature decreases considerably with increase in altitude. This complex blend of soil characteristics, varying moisture and temperature conditions has dictated the style of tussock grassland farming in the Mackenzie basin.

15. The vegetation evolved largely in the absence of grazing, although no doubt there was some influence from browsing birds. Those who introduced the first domestic stock in the 1850s were greeted with large expanses of tall and short tussock grasslands¹, with some shrublands including mountain totara and kowhai. Only in the wetter north-western parts of the basin would they have been confronted by beech dominated forest.

PASTORAL INTENSIFICATION

16. Modification of the natural vegetation started prior to European settlement, but accelerated markedly with the introduction of grazing animals. In my opinion pastoral intensification can be quantified by the intent to carry more stock on any given area, to ultimately produce more exportable animal product from that area. Land activities undertaken to help achieve this intent include the use of domestic grazing animals, fire, exotic flora, fertiliser, herbicide, fencing and irrigation.

¹ In this context the use of the term 'grassland' refers to a mixed vegetation type that may include species other than grasses.

17. Domestic animals, together with fire, were the first activities of pastoral intensification. Fire was used to reduce 'scrub and speargrass' and 'open up' tall tussock land to render the vegetation more palatable to stock. Merino sheep, and later and more significantly cattle, were also used with similar intent to induce areas of short-tussock and associated native grasses.
18. Next a range of exotic pasture and other flora were introduced, many intentionally, some inadvertently. Lower fertility exotic grasses such as browntop and sweet vernal dispersed adventitiously. Nitrogen fixing legumes (some annuals but mostly white and red perennial clover) became a key precursor to soil improvement, allowing subsequent establishment and maintenance of higher fertility exotic grasses such as cocksfoot, dogstail, Yorkshire fog and perennial ryegrass. Specialist species such as lucerne, ryecorn, annual ryegrasses and brassicas were introduced to better soils to provide winter and early spring feed. More recently perennial lupin has been promoted as a low-fertility legume.
19. Artificial fertiliser is used, particularly where seed is introduced, to help correct nutrient deficiencies. This practice became more refined as research clarified nutrient limitations for the different soils types. High sulphur content superphosphate is used on soils with naturally high levels of phosphorus and low levels of sulphur. Soil trace element deficiencies such as Molybdenum and Selenium were identified and easily corrected, leading to greatly improved animal production.
20. The strategic use of herbicide, particularly glyphosate, has become a modern form of vegetation clearance, resulting in more successful pasture establishment when direct drilling (and more recently when oversowing –see paragraph 35 in my evidence), and for scrub clearance to facilitate stock access.
21. Fencing was initially used for extensive management, stock containment and rabbit exclusion. More intensive subdivision fencing, made economically more

attractive with electric innovation, is now an integral part of modern intensification.

22. The introduction of seed and fertiliser and good management can lead to a marked increase in pastoral production over the unimproved grassland (4 to 6 fold for example), depending on the land type and state of depletion. However this increase can be again dramatically increased (a further 2-4 fold over dryland improvement for example) with the addition of irrigation. This potential from irrigation is especially true for large areas of the south-eastern Mackenzie basin.

METHODS OF EXOTIC SEED AND FERTILISER INTRODUCTION

23. Early pastoral intensification using seed and fertiliser centred around the use of traditional cultivation methods on the more favourable soils, often in close proximity to the homestead. This practice, usually ploughing or multiple disking together with fallowing, aimed to create a vegetation-free seedbed.
24. Prior to the 1950's innovative ways to surface-spread seed by hand and vehicle on land less suited to cultivation were devised. Anecdotal stories abound, such as seed sacks with a small hole being tied to sheep leaving the shearing shed. Post world-war two technology brought about aerial oversowing and topdressing (applying seed and fertiliser onto the ground surface), resulting in a dramatic increase in hill and high country intensification. The timing of oversowing and topdressing is critical (generally done in early spring) and success depends on establishment conditions, existing vegetation, and soil type. The degree of success from oversowing and topdressing is reduced in lower rainfall areas.
25. The development of direct drilling technology allowed seed to be placed in the ground, and fertiliser to be more strategically located near the seed. This gave more assured establishment than oversowing and topdressing and so became the preferred form of intensification on land types accessible to machinery but less suited to conventional cultivation. The type of direct drill used can vary from

low soil-disturbance disc-drills through to those that partially cultivate the surface such as slot drills or rotodrills.

26. Seed coating with nutrients, inoculants and insecticides also assisted pasture establishment (Lowther and Douglas 1992). The use of herbicide to reduce resident vegetative competition when direct drilling became a common practice, especially where resident vegetation was dominated by exotic browntop and/or hieracium (i.e. hawkweed).

EFFECTS OF PASTORAL INTENSIFICATION ON INDIGENOUS VEGETATION

27. The ecology and landscape of the Mackenzie basin has reached a highly modified state today as a result of a complex interplay of: natural forces; pre-european occupation; almost one and three quarter centuries of pastoral farming; the introduction of weed and pests, and the steady increase of non-pastoral activities including forestry, residential growth, hydro-electric development, recreation and tourism.
28. Pastoral intensification has been the major player in this modification, particularly in relation to degradation of indigenous vegetation. However the vegetative degradation has been long and complex, and pastoral and non-pastoral impacts are inextricably linked. There are factors outside (but associated with) pastoral intensification such as rabbit infestation and the ingress of woody weeds that have and potentially will continue to add to the depletion of indigenous vegetation in the Mackenzie basin. Such factors have been well covered in Mike Harding's evidence for Mackenzie District Council, with which I confer.
29. I will focus on the impacts directly resulting from the various forms of pastoral intensification as outlined earlier in my evidence. I will address these effects on a continuum of increasing pastoral intensification, from traditional and extensive practices through to more intensive 'high-input' development. I include management recommendations based on my experience.

30. A relatively large area of the Mackenzie basin remains 'unimproved grassland'. This land is extensively farmed and has a long history of depletion, particularly on the south-eastern side. While these areas contain a mix of indigenous and exotic species, particularly browntop in the northwest and hieracium (hawkweed) in the southeast, they help create the open landscape features that are typical of the Mackenzie basin. They also hold most of the remaining ecological values.
31. I believe careful extensive grazing of these areas with domestic animals, especially sheep, has and could continue to help maintain landscape values in a practical way by reducing the threat of woody weed species including wilding pines. Existing ecological values of this land are likely to be continually compromised by this grazing approach, again particularly in the unimproved eastern areas of the basin. However indigenous biodiversity is not excluded altogether.
32. It is my opinion the maintenance or return of ecological values in such areas will require land management that includes low stocking rates, maybe approaching zero, together with rabbit and woody weed control. This opinion is supported by evidence of vegetation recovery within the Lake Tekapo Scientific Reserve (Walker *et al* 2016), where grazing was excluded, and rabbits and wilding pines were controlled.
33. Such management would aim at land stewardship rather than viable pastoral production. In such cases it would be unfair to expect land owners to totally finance effective weed and pest management. So if maintenance or return of ecological values is desired in such areas, then I believe there would have to be change in objective from pastoral production to pastoral stewardship, where external (off-farm) funding would be required to partially or in some cases totally cover ongoing management costs, principally weed and pest control.

34. Any change in stock class from the traditional merino sheep will impact on the indigenous vegetation. Cattle grazing for example can be more detrimental than sheep on indigenous flora, especially for tall and short tussock species, wetlands and riparian vegetation. The grazing behaviour of domestic deer differs considerably from that of sheep and beef cattle. Deer typically walk or 'pace' fencelines, and this behaviour, together with their desire to wallow in wet areas, can be detrimental to vegetation, soils and waterways. Dairying demands high infrastructural cost and therefore is associated with higher system inputs and higher stocking rates. It is my opinion a change of stock class from traditional sheep and beef cattle to deer farming or dairying should be considered as a different form of pastoral intensification.
35. Traditional oversowing (that without herbicide use) and topdressing generally results in a vegetative mix of existing indigenous plant species, particularly where tussock is present, and a reasonable cover of perennial clover (for example 10 – 30% ground cover). Exotic grasses generally do not establish successfully until the soil nitrogen levels have been raised by the introduced clovers. The long-term effects of traditional oversowing and topdressing on indigenous vegetation will depend on the ongoing management and fertiliser input. Where improved areas are maintained with regular fertiliser, the more adapted exotic species tend to dominate at the expense of the less competitive indigenous species. However, with effective subdivision fencing and moderate stocking levels, a mix of exotic and indigenous species can be maintained. The effect of such well managed oversown and topdressed country on the landscape may well be acceptable and sustainable. Both overgrazing and undergrazing of oversown and topdressed tussock country will result in a decline of the indigenous vegetation component.
36. The recent reduction in the cost of glyphosate herbicide has in some situations allowed its economic use as a 'vegetation displacer' when oversowing and topdressing. When herbicide is used in conjunction with oversowing and

topdressing, the effects on indigenous vegetation can potentially be similar to that stated for cultivation (see paragraph 38 of my evidence).

37. The effect of direct drilling on the existing vegetation will depend on the type of drill and methods used. Disc type direct drills are least destructive on existing vegetation, while others such as slot-seeders or the rotodrill effectively cause various degrees of cultivation. Also the addition of herbicide, particularly glyphosate, to reduce vegetative competition can result in varying degrees of residual vegetation displacement, depending on the rate applied. Thus the vegetation resulting from direct drilling could be similar to that following traditional oversowing and topdressing (paragraph 35) on the one hand, through to that following cultivation (paragraph 38) on the other.
38. Cultivation was the traditional form of pastoral intensification (refer to paragraph 23 of my evidence) and tends to be used to replace or renovate 'run out' pastures, and establish green feed crops. However advances in direct drilling technology and in particular the use of herbicide rather than physical soil disturbance to reduce competition has meant direct drilling has in many situations replaced cultivation. The effect of direct drilling in these circumstances, as with cultivation, is total displacement of existing vegetation, whether indigenous or exotic. Unlike the unimproved grasslands (refer paragraph 30) and to a lesser extent the areas oversown (paragraph 35) and direct drilled (paragraph 37), the effect of cultivation on indigenous vegetation and associated ecological values is irreversible.
39. Cultivation was traditionally practiced on the amenity paddocks, often close to the homestead (Farm Base Areas) and on the deeper fan soils. These cultivated areas, although traditionally relatively small in the Mackenzie basin², were a valued integral component of extensive pastoral farming. From a visual point of view they were generally associated with buildings and shelter trees, and

² A survey by Kerr and colleagues (1979) describe less than 3% of the Mackenzie basin (Canterbury moist zone) under cultivated dryland pasture at that time.

resulted in seasonal greening. While these 'traditional' cultivated areas have now increased somewhat, it is my opinion that this relatively small-scale form of pastoral intensification should be regarded as a 'cultural imprint' and as such is an acceptable component of the Mackenzie landscape.

40. Irrigation of cultivated pasture enables continual summer pasture growth, and therefore constant visual spring to autumn greening. As with dryland cultivated pastures, traditionally irrigated pastures in the Mackenzie basin were also relatively small in area and associated with the farm base, but they provided a reliable source of much needed out of season stock food. While these areas have also increased in recent times, it is my opinion that where their function remains in the traditional role described, then they also fit well into the Mackenzie landscape as an acceptable cultural imprint.
41. The availability of water from the hydro-electric power schemes together with modern centre-pivot technology means larger scale irrigation in the Mackenzie basin is potentially possible. A shift from the traditional integrative role of irrigation in high country farming as described in paragraph 40 to that described here would involve considerably more cultivation with its associated effects on indigenous vegetation. I believe such a shift would constitute a new form of pastoral intensification.
42. Large-scale irrigation to the extent where the majority of the farm becomes irrigated pasture, is new to the Mackenzie and neighbouring high country areas. This is intensification on a much greater scale, requiring large areas of cultivation, considerable earthworks and associated infrastructure such as roading, underground piping, overhead structure, buildings and effluent structures. The high setup costs would only be justified by high intensity farming with associated high inputs (stock, seed, fertiliser, and labour) and high outputs (product and nutrient waste management). In my opinion such development would constitute a different and far more intensive form of pastoral intensification than that

described in paragraphs 39 and 40, triggering new landscape and ecological considerations.

SUMMARY OF OPINIONS

43. The type and scale of pastoral intensification in the Mackenzie Basin have shifted considerably in the last two decades, and are now poised to shift at even greater speed. This shift has also brought new effects to the landscape and ecology of the basin.

44. 'Traditional' oversowing and topdressing without the use of herbicides, and associated extensive sheep grazing, was the main form of large-scale intensification and was less damaging to indigenous vegetation than most modern methods of pastoral intensification. Permanent change to the vegetation resulted, but some native plant species survived and the effects could be reversed over time to some extent. Effects on the landscape were also relatively minor, because the modified vegetation remained relatively natural-looking.

45. The landscape and ecological values that remain on the unimproved Mackenzie basin are under threat, particularly from woody weed invasion and rabbit infestation. The maintenance of these values can be met to some extent by traditional extensive pastoral methods, but true stewardship of this land will require a compromise of pastoral production goals together with management investment from outside the basin.

46. The small-scale use of cultivation and irrigation to supplement the 'traditional' extensively management pastoral run resulted in confined effects on ecological values and small acceptable effects on the landscape. This differs to the larger-scale use of cultivation and irrigation in modern and more intensive farming, especially dairying and dairy support, where the impact on landscape and ecology is potentially greater.

47. Cultivation results in major, irreversible effects on indigenous vegetation, including the complete displacement of native species. Modern methods of pastoral intensification now involve large machinery with advanced drilling techniques, often accompanied by herbicide and insecticide use, plus irrigation. These new methods allow larger areas to be intensified and tend to be associated with more intensive subdivision fencing, changes in stock type, earthworks and an increase in infrastructure.

Bruce E. Allan
9 September 2016

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