BEFORE THE ENVIRONMENT COURT OF NEW ZEALAND
CHRISTCHURCH REGISTRY
I MUA I TE KŌTI TAIAO O AOTEAROA
KI ŌTAUUTAHI

	ENV-2018-CHC-0037 **ENV-2018-CHC-0050**
UNDER	the Resource Management Act 1991
IN THE MATTER OF	an appeal under clause 14 of Schedule 1 of the RMA in relation to decisions on the Proposed Southland Water and Land Plan
BETWEEN	ROYAL FOREST AND BIRD PROTECTION SOCIETY OF NEW ZEALAND INC
	Appellant
AND	SOUTHLAND FISH AND GAME COUNCIL
	Appellant

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274 PARTY EVIDENCE OF KATHRYN JANE MCARTHUR

Dated 4 February 2022

AND	SOUTHLAND REGIONAL COUNCIL
	Respondent

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INTRODUCTION

1. My full name is Kathryn (Kate) Jane McArthur. I am an independent freshwater ecologist and water quality scientist based in Kahuterawa near Palmerston North. My qualifications and experience are as set out in my evidence in chief dated 20 December 2021.

2. I gave expert evidence on behalf of the Royal Forest and Bird Protection Society Incorporated of New Zealand (Forest and Bird) and the Director-General of Conservation before the Environment Court in the Topic A hearings and participated in all technical expert conferencing associated with Topic A[1] and Topic B[2], providing evidence in chief on Topic B dated 20 December 2021.

CODE OF CONDUCT

3. I confirm that I have read the code of conduct for expert witnesses as contained in the Environment Court's Practice Note 2014. I have complied with the Code when preparing this written statement and will do so when I give oral evidence before the Court.

4. The data, information, facts, and assumptions I have considered in forming my opinions are set out in this statement to follow. The reasons for the opinions expressed are also set out in the statement to follow.

5. Unless I state otherwise, this evidence is within my sphere of expertise, and I have not omitted to consider material facts known to me that might alter or detract from the opinions that I express.

6. As a member of the New Zealand Freshwater Sciences Society, a constituent organisation of the Royal Society of New Zealand - Te Apārangi, I am also bound by the Royal Society of New Zealand Code of Professional Standards and Ethics in Science, Technology, and the Humanities.[3]

[1] Joint witness statements (JWS) on water quality and aquatic ecology were produced from expert conferencing on 7 – 10 May, 4 September, 14 – 16 October and 20 – 22 November 2019. These are hereafter referred to as the May, September, October and November JWS.
[2] I participated in Topic B expert conferencing for Farm Systems, Ecology and Science in November 2021. These are hereafter referred to as the Farm Systems 2021, Ecology 2021 or Science 2021 JWS.
[3] https://royalsociety.org.nz/assets/Uploads/Code-of-Prof-Stds-and-Ethics-1-Jan-2019-web.pdf

SCOPE

7. I have been asked by the Royal Forest and Bird Protection Society of New Zealand Inc (Forest & Bird) and the Southland Fish and Game Council (Fish and Game) to provide evidence in respect of their s 274 party interests in appeals by Beef + Lamb NZ Limited (Beef and Lamb), Federated Farmers of New Zealand Inc, the Director-General of Conservation (DOC) and Waihopai Rūnaka, Hokonui Rūnaka, Te Rūnanga o Awarua, Te Rūnanga o Oraka Aparima, and Te Rūnanga o Ngāi Tahu (Ngā Runanga). My evidence relates to water quality and ecosystem health with respect to the Topic B provisions of the proposed Southland Water and Land Plan (pSWLP).

8. I have also read the evidence in chief of Dr Depree for Dairy NZ and Fonterra (the dairy interests) dated 20 December 2021. As that evidence directly relates to the appeals of Forest & Bird and Fish and Game I will respond to the issues he raises in rebuttal evidence.

9. This statement of evidence should be read in conjunction with my evidence in chief dated 20 December 2021, my Topic A evidence and the Joint Witness Statements for Topics A and B to which I am a signatory, and covers the following themes:

a. The effects of drain and weed clearance on the habitats of threatened and taonga indigenous freshwater species;
b. Response to evidence on farming restrictions;
c. Physiographic zones;
d. Sediment loss from cultivation at high slope and buffers/setbacks;
e. Management of contaminants from sheep and wetlands; and
f. Support for inclusion of Ngāi Tahu indicators of health and a holistic approach to determining the need for improvement.

DRAIN CLEARANCE

10. Rule 78 of the pSWLP allows weed and sediment removal for drain and weed clearance as a permitted activity subject to conditions. As stated in my evidence in chief the Ecology experts agreed[4] that the proposed permitted conditions are not sufficient to avoid or minimise effects on indigenous and taonga species because the permitted rule still allows for high levels of disturbance to waterways that are inhabited by indigenous

[4] Ecology 2021 JWS response to question 2, page 4.

species. The affected drainage network is extensive across Southland and includes the habitats of most of Southland's freshwater indigenous species, including threatened species. A higher level of protection is required, and the proposed permitted activity does not address many of the effects identified by the experts.[5]

11. I have read the evidence in chief of Ms Funnell and Ms Kirk for DOC. Ms Funnell's evidence is focussed on the known habitats of five threatened non-diadromous galaxias freshwater taxa in Southland. I have previously analysed freshwater fish database records for Southland in my evidence in chief to Topic A (paragraphs 42 and 43 and Table 2). Southern flathead galaxias, Alpine galaxias and Gollum galaxias are threatened non-diadromous galaxias that are widespread across freshwater habitats in Southland. Although their habitats are widespread in Southland, their population numbers are often very low and habitat range has reduced, becoming more restricted and fragmented over time. Ms Funnell details the habitat types and threats in her evidence in chief, paragraphs 12 to 14, identifying Gollum galaxias and Southern flathead galaxias as having habitat coinciding with 'drains' (modified stream and wetland habitats) that may be subject to Rule 78.[6] Ms Funnell then goes on to recommend that these habitats require a higher level of protection through a discretionary activity status applying to mapped habitats scheduled in the pSWLP and appends analysis by Dr Dunn in support of her evidence.

12. Whilst I support the need for increased protection of the habitats of threatened non-diadromous galaxiids, I have the following concerns with the approach set out in the DOC evidence:

a. Other threatened freshwater species (such as kanakana/lamprey) and taonga species (such as waikākahi and kōura) that commonly have habitats in modified streams are not proposed for the same level of protection and were not included in the analyses;

b. The analyses of Dr Dunn rely on records of the *known* habitats of threatened species, which the experts agree is an area in which our knowledge is patchy[7]

[5] Ecology 2021 JWS response to question 2, page 5.
[6] Although as I understand it the drainage network analysed by Dr Dunn and included in Ms Funnell's evidence does not encompass all the modified stream network (aka 'drains') in private ownership/management which could be subject to Rule 78 when drain maintenance and weed removal is undertaken. Thus, the analysis provided by DOC underrepresents the potentially affected habitat.
[7] Ecology 2021 JWS response to question 5, page 9.

and there are risks that important habitats may be excluded from protection where surveys have not been conducted;

c. The mapped network of 'drains' in the DOC analyses may exclude other modified streams and water courses on private land outside of Environment Southland drainage schemes and still subject to Rule 78. Thus, the approach will not protect those habitats and also therefore likely underestimates the described degree of effect on non-diadromous galaxiids (and other taxa).

13. Whilst restricting drain maintenance from the mapped habitats of some threatened species may reduce the impact on some populations and individuals within mapped areas, the experts recognise[8] that unmapped (and unmonitored) habitats will still be at risk. Some species, such as kanakana (lamprey) and waikakahi (freshwater mussels), are very difficult to map as these species are rarely detected using standard freshwater survey methods. Dr Kitson identifies evidence of the impacts of drain clearance on these species. Mapping may reduce the spatial extent of permitted drain maintenance but will not avoid significant adverse effects on some habitats of threatened and taonga species. I agree with Dr Kitson that the permissive nature of drain maintenance rules that do not prioritise the health and well-being of waterbodies and ecosystems does not give effect to Te Mana o te Wai.

14. Furthermore, although I generally support the need to avoid or limit gravel removal, I do not see practically how the 5% limit on gravel removal can be achieved, measured or monitored. Determining what proportion of total sediment is comprised of gravel cannot feasibly occur unless the total sediment to be removed and the relative size classes of that sediment are known in advance of the activity being undertaken (which I find unlikely) or the proportion of different sediment size classes is determined on completion of works, in which case the sediment has already been removed from the stream. Removal of gravel habitat must be avoided or significantly limited to protect instream habitat and freshwater taxa. In my opinion, the permitted activity conditions proposed by Council for Rule 78 (including limitations on gravel removal) remain inadequate to avoid the significant adverse effects of drain maintenance activities on indigenous aquatic life.

[8] Ecology 2021 JWS response to question 5, page 8.

15. In summary, I make the following points:[9]

a. Drains in Southland are potentially former critically threatened habitats as they are the residue of wetlands;

b. Drains in Southland are extensive, many of which are the habitats of threatened and taonga species;

c. Southland waterways provide a stronghold for many threatened and taonga species, containing nationally significant populations and habitats;

d. Drain clearance as proposed (including mapping suggested by DOC) will still result in significant adverse effects on aquatic life, including threatened species; and

e. Even with all best practice mitigations in place there is no guarantee that significant adverse effects on these species will be avoided.

RESTRICTIONS ON FARMING

16. I have read the evidence in chief of Bernadette Hunt, Geoffrey Young and Peter Wilson on behalf of Federated Farmers, dated 20 December 2021. Ms Hunt makes a number of statements that are not supported by expert evidence. I comment on the matters raised in her evidence and the evidence of Mr Wilson below where they relate directly to water quality and ecosystem health.

17. Ms Hunt and Mr Wilson observe that positive changes in farming practice, behaviour and mindset are now commonly seen in Southland and have been occurring over the last ten years. However, in spite of such changes occurring I note that data shows water quality (including sedimentation) remains degraded over that time period.

18. Mr Wilson at his paragraph 2.5(f) supports the dairy interests' proposal for Schedule X and mapping of 'catchments requiring improvement' to be based on Macroinvertebrate Community Index (MCI). I disagree with this approach; I comment on it briefly below

[9] Supported by the Ecology 2021 JWS response to question 2, pages 4 and 5; Ecology 2021 JWS response to question 3, page 5; and Topic A evidence in chief of Kathryn McArthur, paragraphs 41 to 43.

where it relates to the need for an holistic approach and will address this issue in detail through my rebuttal evidence.

Physiographic zones

19. Ms Hunt (at her paragraph 36) states that "*assumptions made about the risk of nitrate leaching in a particular physiographic zone do not consider the ability of the soil to hold on to nitrogen, or the ability of the plants to uptake the nitrogen in the soil."* My understand of the physiographic zone 'model' is that it does account for the way contaminants (including nitrogen) are attenuated and transported over and through soils and into ground and surface waters, therefore I do not think the statement above is factually correct. Furthermore, I do not share Ms Hunt's broader view of the utility of the physiographic zones and I support the inclusion of provisions in the Plan that enable management of contaminant transport using physiographic zone information. My support for the use of physiographic zones in the pSWLP is detailed in my evidence in chief for Topic A, paragraphs 82 to 89. There I also address the manner in which the limitations of using physiographic zones at the property scale can be overcome.

Sediment loss from cultivation and buffers/setbacks

20. Mr Wilson proposes cultivation at slopes greater than 20 degrees could proceed without generating significant sediment effects on waterways if only 'no till' or 'minimum till' practices are applied. I am not aware of any research which evaluates sediment loss from no till/minimum till practices at slopes greater than 20 degrees. Whilst these practices may generate less sediment loss than full tillage ploughing, direct drilling at slopes greater than 20 degrees still requires the use of heavy machinery which will disturb soil and methods requiring spraying reduce vegetative cover at the soil surface. The general relationship for greater risk of sediment loss at higher slopes still holds and some sediment loss may still be generated by these practices. However, I am unable to quantify to what degree this might differ from standard full tillage cultivation methods.

21. I do not agree with Mr Wilson's interpretation[10] of the expert evidence and Science JWS 2021 that buffers between IWG and water bodies that effectively capture and attenuate sediment on land with slopes less than 10 metres may not need to be a full 10 metres. The flux of sediment flowing from the land is a function of slope, hydrology, soil type etc as described in the Science JWS and in my evidence in chief at paragraphs 49

[10] Topic B evidence in chief of Peter Wilson, paragraph 6.7.

and 50. Although some of the planners agreed to increasing the buffer width from 5 to 10 metre buffer between IWG and rivers and lakes,[11] in my view, given the risk of sediment transport during winter conditions and the known adverse sedimentation effects of IWG on waterbodies in Southland a 20 metre buffer is more appropriate, particularly for standing waterbodies such as lakes and lagoons.

Sheep and E. coli

22. Ms Hunt is incorrect in her assertions that sheep are not a source of *E. coli* contamination in Southland waterways. Whilst it is correct that routine *E. coli* monitoring does not identify the source of faecal microbes in water, Faecal Source Tracking investigations have been undertaken that identify sheep as important sources of microbial contaminants in some catchments in Southland.[12]

23. I have read the evidence in chief of Mr Orchiston for Beef and Lamb and I agree that fencing of waterways is unlikely to be effective at reducing *E. coli* contamination from sheep as overland flow is the key transport mechanism. I also agree that management of CSA and other factors outlined in Mr Orchiston's evidence are important management approaches where sheep are a key source of *E. coli* contamination.

24. Mr Wilson seeks to permit stock within natural wetlands under some conditions. I do not agree that sheep should be permitted in natural wetlands due to the potential for adverse effects on these ecologically and culturally important ecosystems[13]. I generally agree with the conclusions at Mr Orchiston's paragraph 41 that in general all stock should be excluded from natural, unmodified wetlands that are typically in a wet or saturated state and mainly comprise indigenous wetland species.

NGĀI TAHU INDICATORS OF HEALTH AND HAUORA

25. I have read the evidence of Dr Kitson and Ms Cain for Ngā Rūnanga and I support and agree with their evidence that the Ngāi Tahu indicators of health need to be included in the Topic B provisions of the pSWLP to begin to implement Te Mana o te Wai and

[11] Planning JWS dated 10 December 2021.
[12] Ecology 2021 JWS response to question 1, page 3; Moriarty E (date unspecified) Sheep as a Potential Source of Faecal Pollution in Southland Waterways. Report prepared for Environment Southland by ESR. Client Report: CSC17002. Pp. 23; Coxon S (2020) An introduction to E. coli as a water quality indicator: Information for the Southland Regional Forum. ESR Client Report: CSC20016 prepared for Environment Southland. Pp. 39.
[13] The Ecology 2021 JWS identifies the adverse effects of sheep on wetlands in the response to question, page 3.

move Southland's waterbodies towards a state of hauora, consistent with decisions on Topic A provisions.

26. I agree with Dr Kitson at her paragraph 18 that "To assess hauora requires consideration of many attributes together and understanding the natural characteristics of that particular water body." The same is true conceptually for an assessment of ecosystem health,[14] which is a component of hauora. Ms Cain also describes the requirement for consideration of a combination of waterbody attributes to provide for hauora and a holistic picture of the health and well-being of waterbodies. I therefore do not support the proposal of Dr Depree and the dairy interests to use only the MCI as an indicator of where improvement is required. A combination of multiple Ngāi Tahu indicators of health, including ecosystem health indicators is needed to assess the current state of waterbodies in Southland, to determine whether they are culturally and ecologically degraded (i.e., require improvement) and to measure changes in progressing towards hauora. This approach is encapsulated by 'Principle A' of Bartlett et al. (2020).[15]

27. A key principle of ecological science is that everything is connected with everything else, acknowledging that relationships within ecological systems are inherently complex, and components of ecosystem structure and function are very often interrelated. Thus, even though the Clapcott et al. (2018) framework identifies five distinct biophysical components and a range of different attributes associated with each component of ecosystem health, all components and many attributes are inextricably interrelated. There is no discrete or defined sub-set of 'indicators' and 'drivers' as Dr Depree suggests. One component and its associated attributes are not more indicative of ecosystem health than any other. All are needed to contribute to a healthy ecosystem and assessment of that state of health is inherently holistic. As indicated above I will respond directly to Dr Depree through rebuttal evidence.

Kathryn Jane McArthur

4 February 2022

[14] The five components of ecosystem health are described by Clapcott et al. (2018) as: water quality, water quantity, physical habitat, aquatic life and ecological processes. Each component can have multiple associated attributes/indicators.

[15]

REFERENCES

Bartlett M, Kitson J, Norton N, Wilson K 2020. Draft Murihiku Southland Freshwater Objectives: Providing for hauora, the health and well-being of waterbodies in Murihiku Southland. Environment Southland and Te Ao Marama Incorporated Report. Publication No. 2020-06.

Clapcott J, Young R, Sinner J, Wilcox M, Storey R, Quinn J, Daughney C, Canning A 2018. Freshwater biophysical ecosystem health framework. Prepared for Ministry for the Environment. Cawthron Report No. 3194. 89 p. plus appendices.