

**BEFORE THE ENVIRONMENT COURT
I MUA I TE KOOTI TAIAO O AOTEAROA**

AT CHRISTCHURCH **ENV-2018-CHC-29, 37, 39, 40, 47, 50**

IN THE MATTER of the Resource Management Act 1991

AND of appeals under clause 14 of the First Schedule of
the Act

BETWEEN **Aratiatia Livestock Limited**
(ENV-2016-CHC-29)
Appellant
[Continued on next page]

AND **Southland Regional Council**
Respondent

**EVIDENCE IN CHIEF OF EMILY PEARL FUNNELL
FOR DIRECTOR-GENERAL OF CONSERVATION
AS A SECTION 274 PARTY IN SUPPORT (Topic A hearing)
Dated 1 March 2019**

Department of Conservation
Planning, Permissions and Land
RMA Shared Services
Private Bag 4715
Christchurch 8140
Phone: 03 371 3700
Solicitor: Pene Williams

BETWEEN

Southland Fish and Game Council
(ENV-2016-CHC-37)

Alliance Group Limited
(ENV-2016-CHC-39)

Federated Farmers of New Zealand
(ENV-2016-CHC-40)

Te Rūnanga o Ngāi Tahu and Others
(ENV-2016-CHC-47)

**Royal Forest and Bird Protection Society of New
Zealand Inc.**
(ENV-2016-CHC-50)
Appellants

AND

Southland Regional Council
Respondent

Introduction

1. My full name is Emily Pearl Funnell.
2. I am employed by the Department of Conservation (the Department), as a Technical Advisor, Freshwater. I have worked for the Department in this position since July 2012. Previous to this role, I was employed by the Department as a Technical Support Officer in the Southland Conservancy between July 2006 – June 2012.
3. My qualifications are a Bachelor's degree in Science (Ecology and Zoology), and a Master's degree in Science (Ecology). Both qualifications were achieved at Massey University from 2001-2006.
4. My Master's thesis topic was titled '*Phylogenetics, divergence and morphology of New Zealand Eleotridae (Gobiomorphus Gill)*'. Similar morphologies have led to identification difficulties and problems with classification of fish species. However, genetic studies have contributed to resolving problems with taxonomically difficult groups by detecting diversity between morphologically similar species. Thus, the thesis employed two regions of the mitochondrial DNA (cytochrome *b* region and control region) to resolve issues surrounding species identification, morphological variation, and phylogenetic relationships.
5. Over the last 12 years of employment as a Freshwater advisor for the Department, I have had significant experience with assessing the effects of activities under the Resource Management Act 1991 on freshwater values in the Southland Murihiku Region. Applications I have assessed include:
 - a. Water permits
 - b. Discharges to water
 - c. River activities e.g. gravel extraction
6. I have carried out a range of studies in Southland's waters including investigating fish migration and habitat use in the Waituna catchment, assessment of macrophyte health, and fish distributions. I am experienced with Southland's variable freshwater environments and fish values having spent many hours in the field carrying out freshwater surveys.
7. I am also a member of the New Zealand Freshwater Sciences Society.
8. I am presenting this evidence for the Director-General of Conservation in relation freshwater values of the Southland Murihiku Region.

9. While I am employed by the Department of Conservation, and the Department has an advocacy function under the Conservation Act 1987, my role in preparing and giving this evidence is as an independent expert. In my role with the Department it is expected that I will provide advice in accordance with recognised standards of integrity and professional competence.
10. As well as having a duty to the Court (and I note below that I agree to abide by the Environment Court's Code of Conduct for Expert Witnesses), I also have a duty to be independent as an expert. It has been explained to me that, in providing evidence to the Court, I am authorised to provide any evidence that is within my expertise which goes outside the Department's advocacy function.

Code of Conduct

11. I confirm that I have read the code of conduct for expert witnesses as contained in section 7.1 of the Environment Court's Practice Note 2014. I have complied with the practice note when preparing my written statement of evidence and will do so when I give oral evidence before the Court.
12. The data, information, facts and assumptions I have considered in forming my opinions are set out in my evidence to follow. The reasons for the opinions expressed are also set out in the evidence to follow.
13. 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.

Scope

14. I have been asked to provide evidence in relation to the freshwater values of the Southland Murihiku Region;
 - a. Overview of the Freshwater Ecosystems of the Southland Murihiku Region
 - b. Overview of the indigenous freshwater species of Southland Murihiku Region
 - c. Effects of declining water quality and quantity of the Freshwater values of Southland Murihiku

15. In preparing my evidence, I have read and reviewed the following documents:
 - a. The evidence in chief of Dr Snelder, Mr Rodway, Dr Lloyd, Mr McCallum-Clarke, Mr Ward, Ms Robertson and Mr Hodson on behalf of Southland Regional Council (the Council);
 - b. The evidence in chief of Ms McArthur on behalf of Forest and Bird;
 - c. The evidence in chief of Mr Rance on behalf of the Department of Conservation;
 - d. The proposed, decisions and appeals versions of the Southland Water and Land Plan (SWLP);
 - e. The publications cited within this evidence.

Executive Summary

16. The freshwater ecosystems and the species within them in the Southland Region are diverse and extensive. There are areas such as Fiordland National Park, the Te Anau basin, Stewart Island/ Rakiura, and the Catlins that maintain high-quality freshwater and habitat for fish species.
17. The region is characterised by a few large river systems (Waiau, Aparima, Oreti, and Mataura Rivers) with braided river habitat, many hundreds of small lakes and high elevation streams, as well as extensive montane to lowland wetlands, large deep lakes, and lowland stream and shallow coastal lakes.
18. Priority catchments that have high biodiversity significance and contain freshwater ecosystems that are poorly represented in existing protected areas have been identified by the Department of Conservation. Effective management of these catchments will ensure a representative range of freshwater ecosystems and biodiversity values are maintained in Southland/Murihiku.
19. Twenty-three species of indigenous fish species have been recorded from the Southland/Murihiku Region in the New Zealand Freshwater Fish Database (NZFFD). Of these species, seven (30%) have a conservation status listing as 'Threatened'. One species is 'Threatened – Nationally Critical', with another seven categorised as 'Threatened – Nationally Vulnerable'. Six (30%) are categorised as 'At Risk'.

20. Eleven species of 'At Risk' and 'Threatened' freshwater invertebrate species are recorded in the Southland Murihiku region. Nine taxa have a conservation status as 'Threatened', with six of these ranked as 'Threatened – Nationally Critical'. A further two taxa are 'At Risk – Declining'.
21. Council evidence has shown that many of Southland's rivers, lakes, lagoons and estuaries are in a poor state with respect to water quality and ecosystem health.
22. The leading causes of decline in indigenous fish populations are; degrading water quality, water abstraction, introduced fish species, loss of habitat (e.g. wetland drainage, river modification, deforestation), and barriers to migration (Allibone et al. 2010; Joy et al. 2018).

Overview of the freshwater ecosystems of the Southland/Murihiku Region

23. The freshwater ecosystems of Southland/Murihiku are diverse and extensive, from cold glacial streams in the Southern Alps, through large order river catchments, to shallow coastal lakes, springs, wetlands and estuaries (DOC 2016).

Rivers

24. More than 18,000 square kilometres of Southland/Murihiku is covered by four major river systems – Waiau, Aparima, Oreti and Mataura Rivers (ES and TAMI 2011). These river catchments drain from the West and North of Murihiku to the Southern coast of New Zealand. In Southland/Murihiku Region there are three 6th order river systems – Hollyford, Aparima, and Freshwater Rivers, and three 7th order systems – Waiau, Oreti and Mataura Rivers (DOC 2010).
25. Southland/Murihiku river ecosystems are characterised by many high elevation small streams. Most of these streams are found in the Fiordland area, Takitimu, Garvie, and Eyre Mountains. Western Fiordland streams are a mix of glacial and non-glacial, but they are all characterised by being very cold, high rainfall, and steep gradients. Eastern Fiordland streams have moderate rainfall, inland bouldery with stable flows, and steep catchments (DOC 2010).
26. The Waiau, Aparima, Oreti, and Mataura Rivers, are all characterised by braided river habitat in parts of their catchments. The Aparima and Oreti Rivers are perhaps the most well recognised for their extensive braided riverine habitat. Braided river floodplains are some of the most biologically diverse and productive ecosystems in the world, yet they are also among the most

threatened ecosystems due to habitat alteration, and flow and flood control (Caruso, 2006).

Lakes

27. Freshwater lakes are another important feature of Southland/Murihiku. These include several large and smaller freshwater lake ecosystems, like the great Fiordland lakes (including 3 of the deepest lakes in the country), alpine lakes, shallow coastal lakes and peat lakes (DOC 2016).
28. Approximately one third of New Zealand's lakes are found in the Southland/Murihiku Region. Of these 64% are cool, moderately shallow and small glacial lakes and tarns found in Fiordland. Of the lakes found in the region less than 1% are considered large, deep, mild lakes e.g. Lakes Te Anau, Manapouri and Hauroko. 7% are of moderate size and depth e.g. Lake Poteriteri, Alabaster, and Green Lake. A further 17% are mild, shallow, small lakes e.g. Lake Shelia and Lake Vincent (DOC 2010).
29. The large lakes make up approximately 74% of the total lake area (DOC 2010), and fall within the Waiau River system, making this an important freshwater ecosystem. Lakes formed by coastal shoreline processes such as Waituna Lagoon, and Lake George make up a small proportion (6%) of the mild, shallow lakes of Southland. These lakes are poorly represented in the Southland/Murihiku Region (DOC 2010). Drake et al (2011) suggested that most shallow coastal lakes outside of the conservation estate in New Zealand are in poor condition due to human activities.

Wetlands

30. Southland/Murihiku has some examples of large intact and complex lowland wetland habitats, as well as many montane wetlands and wetlands associated with riverine systems such as those found around the Te Anau basin. The wetland ecosystem values are covered by the evidence in chief of Mr Rance and will not be repeated here.

Public Conservation Lands and Waters

31. Areas such as Fiordland National Park and the Te Anau basin provide extensive high-quality freshwater and habitat for fish species. With a network of alpine tarns, forested river catchments, deep large lakes, and many thousands of streams, shaped by high rainfall and snow melt (DOC 2016).

32. Stewart Island/ Rakiura is another area that provides high-quality freshwater and habitat for indigenous species. The freshwaters are free of impacts from introduced fish and aquatic plants (Chadderton 2000). The freshwaters are also largely free of other human induced impacts resulting in extremely diverse and intact freshwater environments, with fish communities representing what would have once been found on the mainland (Chadderton 2000).
33. All these freshwater ecosystems contribute to the natural character of Southland/Murihiku.

Freshwater Prioritisation

34. Maintenance of a representative range of freshwater ecosystems and biodiversity values in Southland/ Murihiku, requires identification and effective management of freshwater catchments outside of protected areas.
35. As described in the evidence of Ms McArthur for Forest and Bird¹ (paras 50-53), the Department has developed a national method to identify priority freshwater catchments for protection and restoration across all freshwater ecosystems (rivers, lakes and wetlands) (West et al. in press 2018). The prioritisation tool aims to represent the full range of ecosystems and species at the whole-of-catchment scale. The analysis identifies catchments that have high biodiversity significance and contain freshwater ecosystems that have low levels of representation in existing protected lands (West et al. in press).
36. The results of these outputs for Southland/Murihiku are presented in the evidence of Ms McArthur (figure 2).

Indigenous freshwater species of Southland/Murihiku Region

37. As noted in the evidence of Ms McArthur (para 40), managing freshwater to provide for ecosystem health and life supporting capacity, requires a good understanding of the indigenous freshwater fauna of Southland/Murihiku. I concur with Ms McArthur that the council evidence is focussed at the ecosystem level and water quality effects.
38. This section will describe;
 - a. The New Zealand Threat Classification System (NZTCS)

¹ Statement of Evidence of Kathryn Jane McArthur on Behalf of Royal Forest and Bird Protection Society of New Zealand Inc dated 15 February 2019.

- b. The 'Threatened' and 'At Risk' freshwater fish for the Southland/Murihiku Region, and their distribution
- c. The 'Threatened' and 'At Risk' invertebrates for the Southland/Murihiku Region

The New Zealand Threat Classification System

- 39. The New Zealand Threat Classification System (NZTCS) assigns a conservation status to a taxon (both described species and undescribed lineages) based on its risk of extinction. Assessments are made using information on the number of mature adults, number and size of sub populations, area of occupancy, and ongoing or predicted population trend (Townsend et al. 2008).
- 40. The conservation status categories are as presented in Ms McArthur's evidence (figure 1). Taxa listed as 'Threatened' face a high risk of extinction in the wild. Taxa listed as 'At Risk' do not qualify as threatened because they are buffered by a large total population size and/or slower decline rate (Townsend et al. 2008).

'Threatened' and 'At Risk' freshwater fish for the Southland/Murihiku Region

- 41. Twenty-three indigenous fish species have been recorded in the Southland/Murihiku Region in the New Zealand Freshwater Fish Database (NZFFD). In addition to Ms McArthur's list of freshwater fish species (table 2), there is one additional species to be considered. This arises as records in the NZFFD for *Galaxias* "species D" are recognised as the NZTCS indeterminate taxa *Galaxias* "Pomahaka" (*Pomahaka galaxias*).
- 42. The distribution of the 'Threatened' and 'At Risk' freshwater fish taxa in the Southland region are summarised in Table 1 and distribution maps are presented in Appendix 1 (based on NZFFD records, and Department of Conservation non-migratory freshwater fish distribution data (Dunn 2017)).

Conservation status

- 43. Of the twenty-three indigenous fish taxa in Southland/Murihiku, seven (30%) have a conservation status listing of 'Threatened'. Of these, one species is 'Threatened – Nationally Critical', with another seven categorised as 'Threatened – Nationally Vulnerable'. A further six (30%) are categorised as 'At Risk'.

Table 1. ‘Threatened’ and ‘At Risk’ freshwater fish for the Southland Region; showing species, conservation status, and distribution.

Species	Threat classification, 2017 (Dunn et al. 2018)	Life history	Distribution
Threatened			
Clutha flathead galaxias <i>Galaxias</i> “species D”	Nationally Critical*	Non-migratory	One population of <i>Galaxias</i> “species D” recognised in the Southland Regional Council boundary in the Catlins. This population was previously assigned to <i>Galaxias</i> “lower Clutha” taxon.
Alpine galaxias (Southland) <i>Galaxias</i> aff. <i>paucispondylus</i> “Southland”	Nationally Vulnerable*	Non-migratory	Confined to greywacke substratum in the upper hill country reaches of the Maitara, Oreti and Waiau River catchments. In the Oreti catchment they are found as far downstream as Lumsden, which is their southernmost distribution.
Gollum galaxias <i>Galaxias gollumoides</i>	Nationally Vulnerable	Non-migratory	Scattered throughout the Southland region with populations in the four large river catchments (Waiau, Aparima, Oreti, and Maitara), Catlins rivers, Rakiura/Stewart Island, and Waituna.
Lamprey <i>Geotria australis</i>	Nationally Vulnerable	Migratory	Throughout Southland plains in the main rivers and tributaries. Absent from upper hill country catchments

Pomahaka galaxias	<i>Galaxias</i> "Pomahaka"	Nationally Vulnerable	Non-migratory	Several populations on the edge of the Southland Regional Council boundary in the Pomahaka catchment
Shortjaw kōkopu	<i>Galaxias postvectis</i>	Nationally Vulnerable	Migratory	Restricted distribution in Southland. Only found in a few streams along the south coast of Fiordland (Waitutu)
Southern flathead galaxias	<i>Galaxias</i> "southern"	Nationally Vulnerable*	Non-migratory	Widespread within the Southland region within predominantly gravel bed reaches in the four large river catchments (Waiau, Aparima, Oreti, and Mataura), and Stewart Island/ Rakiura.
At Risk				
Torrentfish	<i>Cheimarrichthys fosteri</i>	Declining	Migratory	Throughout Waiau River and tributaries, lower Aparima River, Waimatuku, and lower Mataura River
Giant kōkopu	<i>Galaxias argenteus</i>	Declining	Migratory	Waituna catchment, Catlins Rivers, coastal lakes e.g. Lake George, widespread across coastal/lowland rivers of Southland plains
Kōaro	<i>Galaxias brevipinnis</i>	Declining	Migratory	Widespread across Southland in streams and lakes
Inanga	<i>Galaxias maculatus</i>	Declining	Migratory	Widespread across coastal/ lowland rivers and streams in Southland
Longfin eel	<i>Anguilla dieffenbachii</i>	Declining	Migratory	One of the most widespread fish species in the Southland Region.

			Found from the lowland coastal rivers, lakes and wetlands to inland and montane freshwater environments
Bluegill bully	<i>Gobiomorphus hubbsi</i>	Declining	Migratory
Giant bully	<i>Gobiomorphus gobioides</i>	Naturally Uncommon	Migratory
			Coastal streams of Southland, Waiau River
			Common in coastal streams

* **Taxonomically indeterminate:** Taxa that are legitimately and effectively published but not generally accepted as distinct, e.g. *Beilschmiedia tawaroa*; or entities that are yet to be furnished with a formal name, e.g. *Lepidium* aff. *oleraceum* (a) (AK 230459; Chatham Islands). (Townsend **et al.** 2008, p 9)

44. Three taxa in the Southland/Murihiku Region have had a change in threat classification since the 2013 Conservation Status listing (Goodman et al. 2014). Redfin bully (*Gobiomorphus huttoni*) moved from 'At Risk – Declining' to 'Not Threatened' in the 2017 assessment based on improved knowledge of population parameters (Dunn et al. 2018). However, the conservation status of two taxa worsened. Giant bully (*Gobiomorphus gobioides*) moved from 'Not Threatened' to 'At Risk – Naturally Uncommon' based on reinterpretation of available data. Southern flathead galaxias (*Galaxias* "southern") moved from 'At Risk – Declining' to 'Threatened – Nationally Vulnerable', based on interpretation of its area of occupancy and decline rate (Dunn et al. 2018).

Non-migratory species

45. the Southland/Murihiku Region has four species of non-migratory galaxias (Table 1). These species complete their life cycle within freshwater. Non-migratory species have undergone range reduction and population fragmentation as a result of habitat loss and introduced species (Allibone, 2010).

Migratory species

46. New Zealand has five migratory galaxias species – īnanga (*Galaxias maculatus*), kōaro (*Galaxias brevipinnis*), banded kōkopu (*Galaxias fasciatus*), giant kōkopu (*Galaxias argenteus*) and shortjaw kōkopu (*Galaxias postvectis*). The transparent juveniles of these five galaxiid species, which move upstream in large shoals mainly in spring, which contribute to New Zealand's whitebait fishery. The provision of high-quality adult and spawning habitat is critical to reproduction in fishes.
47. The spawning sites of inanga are in lowland sections of streams and rivers (e.g. McDowall 1990) in areas that are inundated on spring tides in tidal regions of rivers (Hickford et al. 2010). These are also the environments that are most affected by modification due to urbanisation, agriculture, horticulture and forestry. Thus, many spawning sites are degraded (Goodman, 2018). Other migratory galaxiids have been found to spawn in leaf litter, gravel and rank grass on stream margins just above stream flow indicating spawning during fresh flows or floods (Allibone and Caskey 2000; Charteris et al. 2003; Franklin et al. 2015). Loss and degradation of habitat is one of the major pressures impacting on the distribution and abundance of migratory galaxiid species (e.g. McDowall, 1990).

48. Longfin eels/ tuna are one of the most widespread species in the region (Table 1 and Appendix 1, Map 2). They can penetrate long distances inland and inhabit a variety of freshwater environments (McDowall, 1990). It was noted by Dunn et al. (2018, p. 4) in the recent conservation status for freshwater fish, that:

'the panel remains concerned about the continuing degradation of longfin eel habitat, especially in lowland areas, and on-going issues with fish passage (both upstream and downstream). Decline in water quality in many areas has resulted in the shortfin eel occupying habitat that formerly held the longfin eel.'

49. Lamprey (*Geotria australis*) (also known as kanakana or piharau), is New Zealand's only species in the *Geotria* genus. Modification of spawning habitat, drain maintenance activities, and increases in sediment in waterbodies are thought to negatively impact on the habitat of both the freshwater larval and adult lamprey life stages (Kitson, 2012).

'Threatened' and 'At Risk' freshwater invertebrates in the Southland Region

50. Eleven species of 'At Risk' and 'Threatened' freshwater invertebrate species are recorded in the Southland Murihiku region (DOC 2016; Jeffery 2016)
51. Recorded distribution maps for 'Threatened' and 'At Risk' indigenous freshwater invertebrate taxa present in the Southland region are also shown in Appendix 2.

Table 2. 'At Risk' and 'Threatened' freshwater invertebrates for the Southland Region; showing species, and threat status.

Species		Threat classification, 2018 (Grainger et al. 2018)
<i>Threatened</i>		
Stonefly	<i>Apteryoperla lakiula</i> (McLellan, 2003)	Nationally Critical
Stonefly	<i>Apteryoperla monticola</i> (Wisely, 1953)	Nationally Critical
Stonefly	<i>Apteryoperla ramsayi</i> (McLellan, 1977)	Nationally Critical
Amphipod	<i>Chiltonia rivertonensis</i> Hurley, 1954	Nationally Critical
Caddisfly	<i>Edpercivalia tahatika</i> (Ward, 2005)	Nationally Critical
Stonefly	<i>Vesicaperla dugdalei</i> (McLellan, 1977)	Nationally Critical
Mussel	<i>Echydrella aucklandica</i> (Gray, 1843)	Nationally Vulnerable
Caddisfly	<i>Edpercivalia tahatika</i> (Ward, 2005)	Nationally Vulnerable

Caddisfly	<i>Pseudoeconesus</i> n. sp. T	Nationally Vulnerable
At Risk		
Mussel	<i>Echyridella menziesii</i> (Dieffenbach, 1843)	Declining
Crayfish/koura	<i>Paranephrops</i> <i>zealandicus</i> (White, 1847)	Declining

52. Nine taxa have a conservation status as 'Threatened', with six of these ranked as 'Threatened – Nationally Critical'. A further two taxa are 'At Risk – Declining'.

Effects of declining water quality and quantity of the Freshwater values of Southland Murihiku

53. The evidence of Council experts Mr Rodway², Mr Ward³ and Mr Hodson⁴, and the evidence of Ms McArthur for Forest and Bird, provides a comprehensive assessment of the current state of water quality and ecosystem health of the freshwater ecosystems of Southland/Murihiku and will not be repeated here.
54. As noted through this evidence and that of Ms McArthur, the leading causes of decline in indigenous fish populations are; degrading water quality, water abstraction, introduced fish species, loss of habitat (e.g. wetland drainage, river modification, deforestation), and barriers to migration (Allibone et al. 2010; Joy et al. 2018).
55. Declining water quality parameters such as sedimentation, have been shown to change recruitment patterns, and decreased density and diversity of freshwater fish populations (McDowall and Eldon 1980; Ryan 1991; Richardson et al. 2001; Richardson and Jowett 2002).
56. Flow is a major determinant of the physical habitat in streams and rivers, and thereby has a major influence on aquatic communities (algae, invertebrates, fish, etc.) (Biggs et al. 2005; Poff et al. 2010). Water abstraction affects the available habitat, water temperature, food availability and migratory cues of indigenous fish populations (McDowall 1995). Flood flows stimulate the migration of several fish species both upstream and downstream – whitebait inward migration is stimulated by flood flows, as is the downstream migration of

² Statement of Evidence of Ewen Rodway on Behalf of the Southland Regional Council dated 14 December 2018

³ Statement of Evidence of Nicholas Ward on Behalf of the Southland Regional Council dated 14 December 2018

⁴ Statement of Evidence of Roger Hodson on Behalf of the Southland Regional Council dated 14 December 2018

mature eels. Reduced flows can also affect spawning and egg survival for whitebait (Franklin et al. 2015).

Conclusion

57. The freshwater ecosystems and species of the Southland/Murihiku Region are diverse and extensive. Areas such as Fiordland National Park, the Te Anau basin, Stewart Island/ Rakiura, and the Catlins maintain high-quality freshwater and habitat for indigenous freshwater species.
58. Southland Murihiku has eleven freshwater invertebrates and thirteen freshwater fish that have a conservation status of 'At Risk' and 'Threatened'.
59. Water quality and ecosystem health of many of Southland's freshwater ecosystems are documented as degraded. Two of the threats to indigenous fish populations are; degrading water quality, and water abstraction.
60. Priority catchments that have high biodiversity significance and contain freshwater ecosystems outside of protected areas require effective management to ensure a representative range of freshwater ecosystems and biodiversity values are maintained in Southland Murihiku.



Emily Pearl Funnell

1 March 2019

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Appendix 1
Threatened and At Risk freshwater fish distributions
within the Southland Region

Map 1 – distributions of non-migratory freshwater fish using Department of Conservation spatial data as described by Dunn (2017), updated as at 25 February 2019.

Map 2 – distributions of migratory freshwater fish using National Institute of Water and Atmospheric Research (NIWA) administered New Zealand Freshwater Fish Database (NZFFD), as at 25 February 2019.

Appendix 2
Threatened and At Risk freshwater invertebrate distributions
within the Southland Region

Maps 3 and 4 – distributions of freshwater invertebrates using Department of Conservation data (2016), as described by Jeffery (2016).

References:

DOC 2016: Threatened Freshwater Invertebrates Dataset. Based on data from DOC, NIWA, Lincoln University, New Zealand Arthropod Collection – Landcare Research, Museum of New Zealand Te papa Tongarewa and Auckland Museum

DOC 2019: Non-migratory freshwater fish habitat extents. As at 25 February 2019

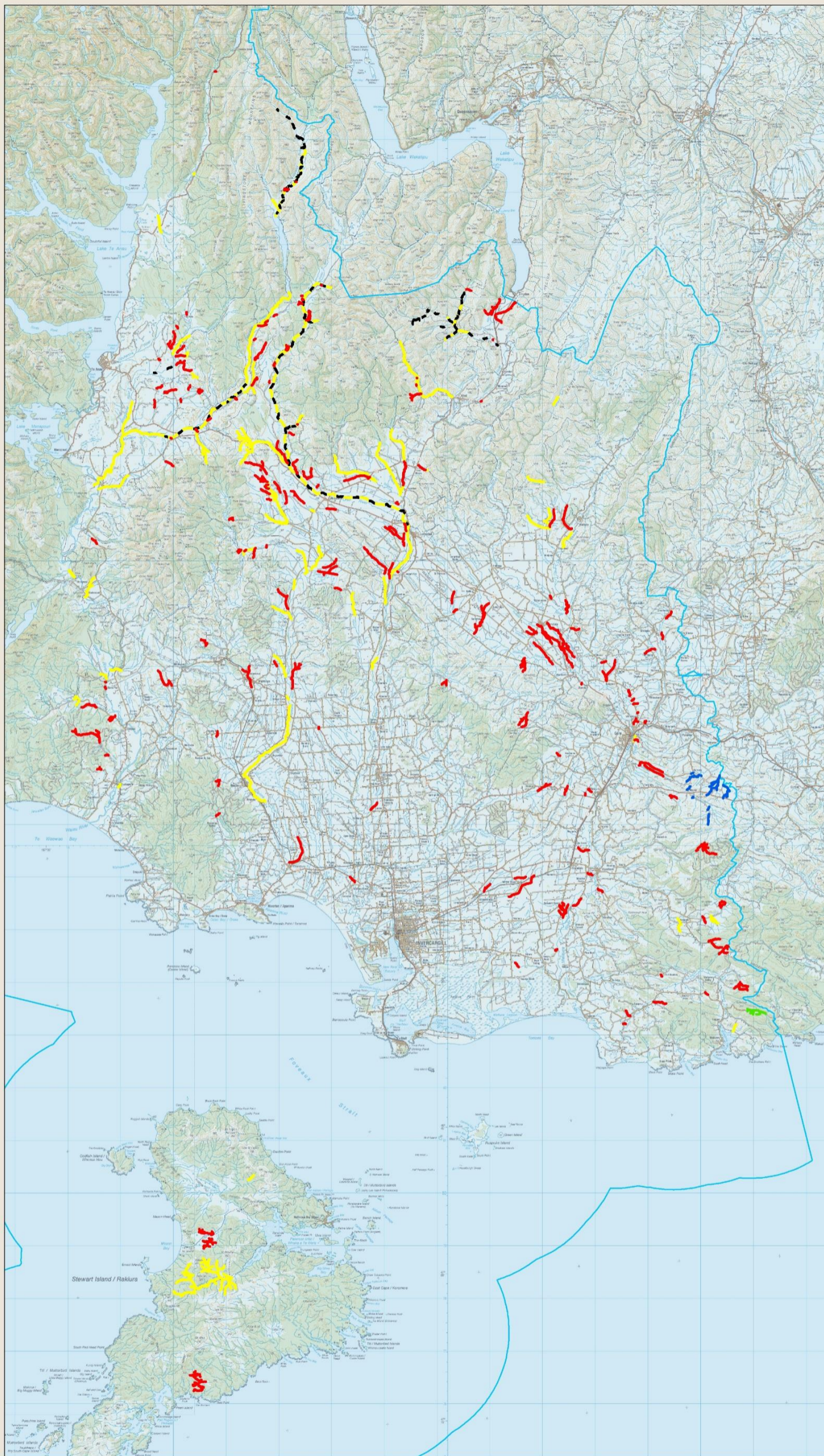
Dunn, N R 2017: Mapping of non-migratory freshwater fish habitat fragment distributions. Unpublished report, Department of Conservation, Wellington, New Zealand, 22 p.

Dunn NR, Allibone RM, Closs GP, Crow SK, David BO, Goodman JM, Griffiths M, Jack DC, Ling N, Waters JM, Rolfe JR 2018. Conservation status of New Zealand freshwater fishes, 2017. New Zealand Threat Classification Series 24. Department of Conservation, Wellington. 11 p.

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- Clutha flathead galaxias
- Gollum galaxias
- Pomahaka galaxias
- Alpine galaxias (Southland)
- Southern flathead galaxias
- South Regional Council boundary

NZGD 2000 New Zealand Transverse Mercator
 Not for publication nor navigation
 Crown Copyright Reserved,
 Fish distribution data - Department of Conservation
 Scale at A4 = 1:704,724
 Produced by: ndunn
 Date Produced: 1/03/2019
 DOC, Freshwater Team, Biodiversity Group

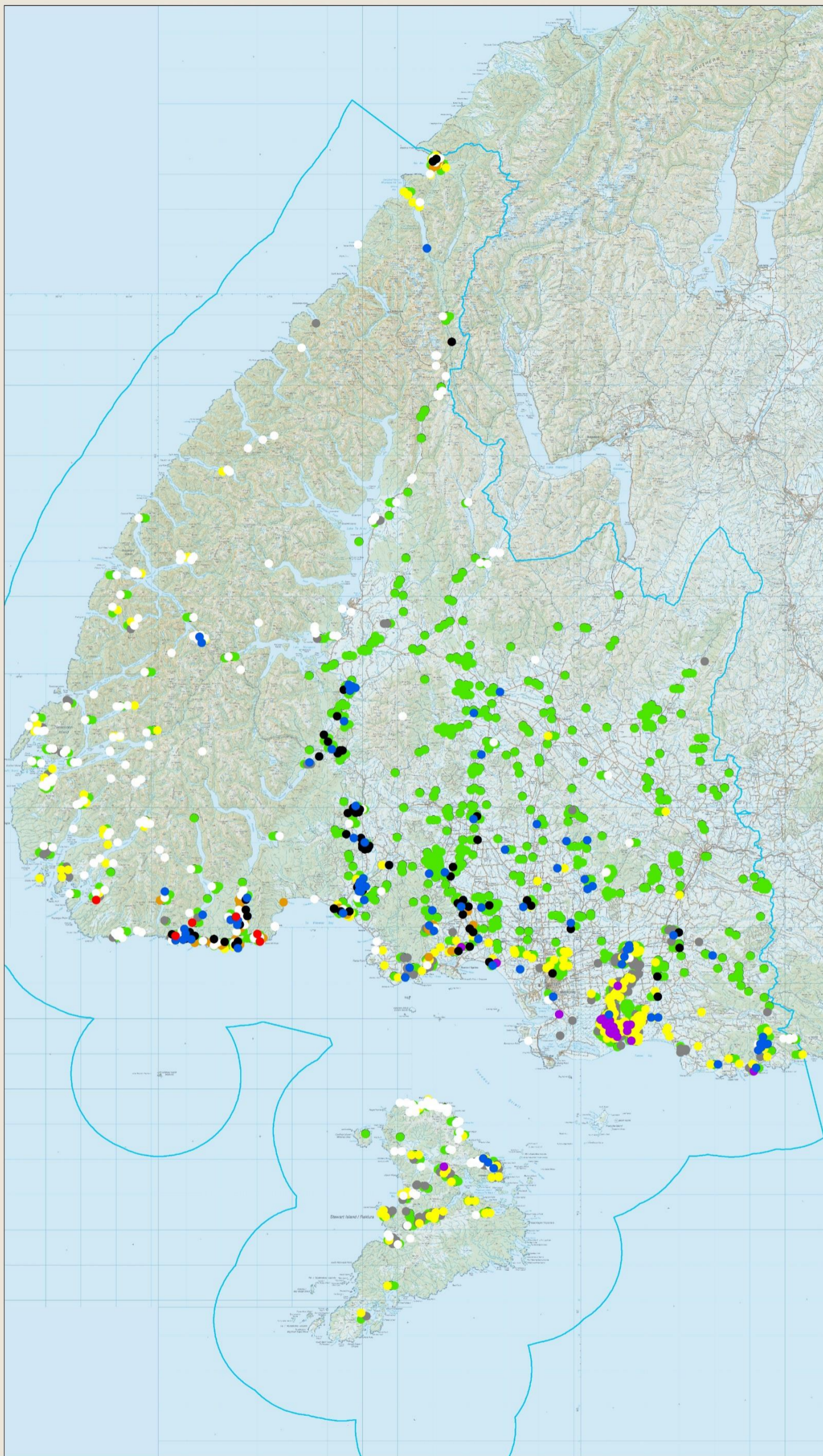
10 Km



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Map 1. Threatened non-migratory freshwater fish within the Southland Regional Council boundary



Map 2. Threatened and At Risk migratory freshwater fish within the Southland Regional Council boundary

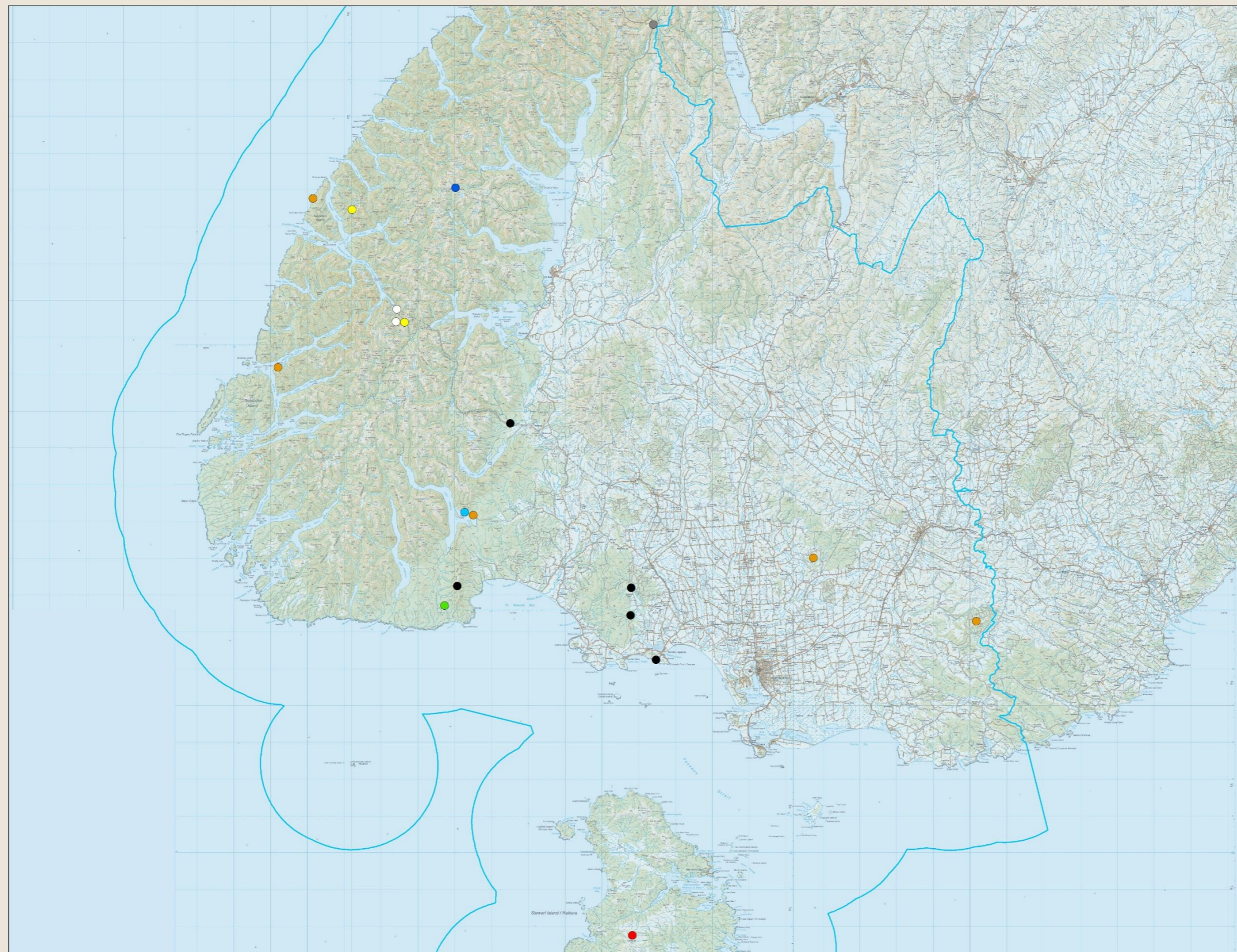
- Shortjaw kokopu
- Lamprey
- Torrentfish
- Giant kokopu
- Koaro
- Inanga
- Bluegill bully
- Giant bully
- Longfin eel
- South Regional Council boundary

NZGD 2000 New Zealand Transverse Mercator
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Fish distribution data - New Zealand Freshwater Fish
Database (NZFFD; NIWA)
Scale at A4 = 1:1,056,366
Produced by: ndunn
Date Produced: 1/03/2019
DOC, Freshwater Team, Biodiversity Group

20 Km

N

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- *Apteryoperia lakiula* (Stonefly)
- *Apteryoperia monticola* (Stonefly)
- *Apteryoperia ramsayi* (Stonefly)
- *Chiltonia rivertonensis* (Amphipod)
- *Edpercivalia smithi* (Caddisfly)
- *Vesicaperia dugdalei* (Stonefly)
- *Echyridella aucklandica* (Mussel)
- *Edpercivalia tahatika* (Caddisfly)
- *Pseudoeconesus nov. sp. T* (Caddisfly)
- South Regional Council boundary

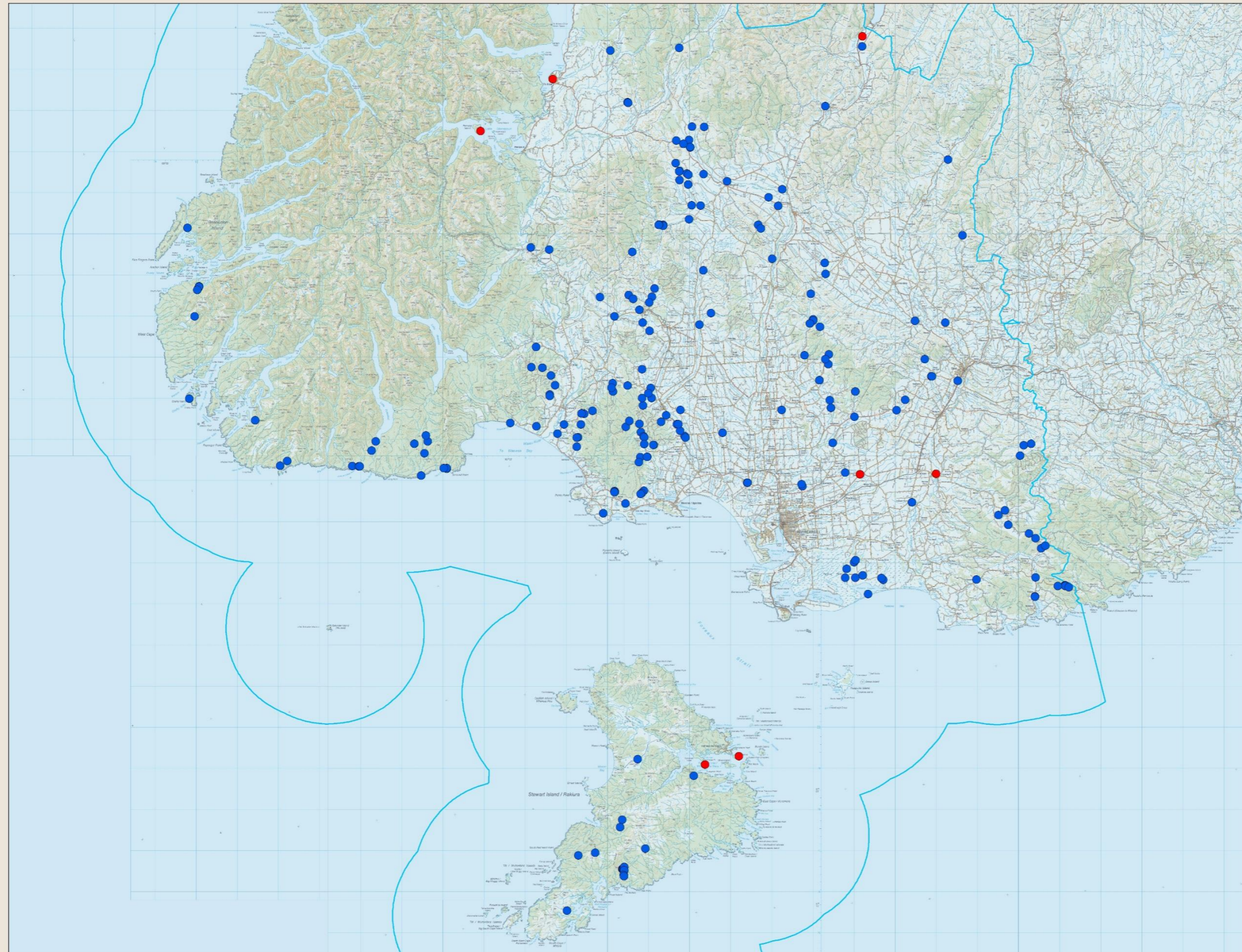
NZGD 2000 New Zealand Transverse Mercator
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 Conservation
 Scale at A4 = 1:950,407
 Produced by: ndunn
 Date Produced: 1/03/2019
 DOC, Freshwater Team, Biodiversity Group

10 Km



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Map 3. Threatened freshwater invertebrates within the Southland Regional Council boundary



● *Echyridella menziesii* (mussel)
● *Paraneopros zealandicus* (crayfish)
□ South Regional Council boundary

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Freshwater invertebrate data - Department of Conservation
Scale at A4 = 1:853,712
Produced by: ndunn
Date Produced: 1/03/2019
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Map 4. At Risk freshwater invertebrates within the Southland Regional Council boundary