BEFORE THE HEARING PANEL APPOINTED BY THE CHIEF FRESHWATER COMMISSIONER FOR THE FRESHWATER PARTS OF THE PROPOSED OTAGO REGIONAL POLICY STATEMENT

Under	**the Resource Management Act 1991**
And	
In the matter of	**the parts of the proposed Otago Regional Policy Statement considered to be a Freshwater Planning Instrument**

Evidence of Dr. Marine Raphaële Amélie Richarson on behalf of the Director-General of Conservation *Tumuaki Ahurei*

[freshwater ecology]

Dated: 28 June 2023

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Table of Contents

Executive Summary

1. I invite the panel to refer to my evidence in chief related to the non-Freshwater Planning Instrument parts of the pORPS, dated 23 November 2022 (refer Memorandum of Counsel for the D-G dated 28 June 2023), as a foundation for the following evidence.

2. My evidence relates to the freshwater values present in the Otago region, with a focus on threatened habitats and fish species.

3. I note that the amended pORPS policies and methods address many of the requested amendments sought by the D-G. However, I note some of their limitations to address the specific requirements of freshwater fish species.

4. I support amending the pORPS objectives, visions and policies towards freshwater using an outcome-driven approach that is adapted to the range of life histories and needs of freshwater species and specific to individual Freshwater Management Units of the Otago Region.

5. To that end, I support the adoption of outcome statements that set clear measures of the change expected, associated timeframes and high-level results for species and ecosystems at the FMU level.

Introduction

1. My full name is Marine Raphaële Amélie Richarson.

2. I have been asked by the Director-General of Conservation Tumuaki Ahurei (Director-General, D-G) to provide expert evidence on her submission and further submission on the parts of the proposed Otago Regional Policy Statement (pORPS) considered to be a Freshwater Planning Instrument.

Qualifications and experience

3. I am currently employed as a Freshwater Science Advisor by the Department of Conservation Te Papa Atawhai (DOC). I have been in this position since April 2020.

4. I have worked as a freshwater ecologist since August 2007. My principal area of expertise concerns diadromous fish species, *i.e.*, species with a life cycle featuring both marine and freshwater phases[1], and their ecological requirements. My experience relevant to the current process includes:

   (a) *conducting applied and fundamental research in the ecology of aquatic organisms*

   (b) *providing technical and scientific advice in freshwater ecology, in matters such as environmental impact assessments, ecological surveys and monitoring in river, lake, pond and wetland systems, and fish passage provisions*

   (c) *managing research as well as operational programmes.*

5. In my current role, I lead the Department's scientific research strategy and implementation on Ngā Ika e Heke, a programme focused on native threatened diadromous species. I also provide technical support and advice for DOC's work on freshwater species and ecosystems.

6. I hold a Diplôme d'Ingénieur (Engineering Diploma) in Water Sciences and Technologies from Institut des Sciences de l'Ingénieur de Montpellier (Institute of Engineering Sciences), Université Montpellier II, which I received in 2006. I undertook an Honours programme in ecology at the Queensland University of Technology as an additional part to this curriculum. During that time, I completed a

[1] I describe the three types of diadromous life cycles known to New Zealand taxa in more detail in paragraph **Error! Reference source not found.** of my evidence in chief for the pORPS non- Freshwater parts dated 23 November 2022.

thesis on the reproduction patterns of green turtle (*Chelonia mydas*), and a thesis on the dietary ecology of sand whiting (*Sillago cilliata*).

7. I completed my Doctorate in Zoology at the University of Otago in 2020. My PhD research focused on the effects of interspecific and intraspecific interactions on ecological niches. I studied the effects of antagonistic interactions, particularly competition, predation, and their combination, on the dietary and habitat preferences of a native New Zealand freshwater fish, the common bully (*Gobiomorphus cotidianus*).

8. I am a member of the New Zealand Fish Passage Advisory Group, a group of ecologists, engineers and environmental advisors that promote, support and develop resources for fish passage, and advocate for improved fish passage management and better guidance and policy to enhance, maintain and improve the key constraints to fish passage and connectivity of waterways.

9. I am a trustee of Te Nohoaka o Tukiauau Sinclair Wetlands Trust, which administers a 315-ha portion of the Lakes Waihola-Waipori wetlands complex, south of Dunedin. In this capacity I contribute to the Trust's operational programme development and administration.

10. I provided evidence towards the Proposed Otago Regional Policy Statement 2021 (Non-freshwater parts), dated 23 November 2022. That non-Freshwater parts evidence and my subsequent opening statements[2] should be used as references for this Freshwater parts evidence.

11. I participated in conferencing between ecological experts involved in the non-Freshwater parts hearing on the proposed Otago Regional Policy Statement 2021 on Appendix 2 and I am a co-signatory of the Joint Witness Statement – ecologists dated 31 March 2023.

Code of Conduct

12. I confirm that I have read the code of conduct for expert witnesses as contained in the Chief Freshwater Commissioner and Freshwater Hearings Panels Practice and Procedures Note 2020. I have complied with the Practice Note when preparing my

[2] pORPS Hearing – Ecosystems and Indigenous Biodiversity Chapter (ECO) – Speaking Notes for Dr Marine Richarson produced 19 April 2023, and [2] pORPS Hearing – Land and Freshwater Chapter (LF) – Speaking Notes for Dr Marine Richarson dated 2 May 2023.

written statement of evidence and will do so when I give oral evidence before the hearing.

13. 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.

14. 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

15. I have been asked to provide evidence in relation to the notified Freshwater Planning Instrument parts of the pORPS, the D-G's submission and further submission[3], and the section 42A report.

16. My evidence is divided into the following sections:

    (a) *Overview of key considerations regarding native freshwater fish species of the Otago Region*

    (b) *Commentary on LF-FW-O1A, LF-FW-P7 and associated objectives, policies and methods*

Material Considered

17. In preparing my evidence I have read and reviewed the following key documents and information:

    (a) *The Proposed Otago Regional Policy Statement 2021 (pORPS), Parts considered to be a Freshwater Planning Instrument under section 80A of the Resource Management Act 1991 dated 15 September 2022*

    (b) *The section 42A report of the pORPS dated 31 October 2022 (and earlier versions), particularly Chapter 9 LF – Land and freshwater, as well as the supplementary evidence provided for these chapters*

    (c) *Te Mana o te Taiao Aotearoa New Zealand Biodiversity Strategy 2020*

[3].Submission FPI044 dated 5 December 2022 and Further submission FSPI044 dated 3 February 2023.

Methodological considerations

18. For evidence on native and taoka fish species, I used data from the New Zealand Freshwater Fish Database (NZFFD, downloaded 19 June 2023), a public repository of fish survey data.

19. Records in the NZFFD include null data points as well as data entry, formatting, or conversion errors. After close examination of the national data, 17,074 rows contained confirmed, non-null and non-contestable taxonomic data out of 21,729 records for the Otago Region. The validation steps involved verifying comments associated with taxonomic data and checking for discrepancies in the records.

20. Null NZFFD events represent events where a survey was undertaken but yielded no animal capture or observation. Contestable NZFFD events include events where discrepancies between data fields cannot be resolved (for example, where a taxon is listed but both fields 'present' and 'sought but not found' are FALSE and no size nor abundance information is available).

21. To identify species (including taxonomically indeterminate taxa among non-diadromous galaxiids) in each FMU (Table 1), I filtered out data points that featured taxa identified at the genus or family or taxonomic group level (e.g. "unidentified bully", "marine species"). Records related to taxonomically indeterminate taxa[4] were also checked and corrected where required (e.g. *Galaxias gollumoides* records in the Nevis catchment were replaced with *Galaxias* "Nevis").

22. Finally, some personally known observations in the Taiari, and Dunedin and Coast FMUs have not been entered into the database but are accounted for in my evidence.

Overview of key considerations regarding native freshwater fish species of the Otago Region

23. In my non-Freshwater parts evidence I provided a regional overview of the Otago freshwater fish and invertebrate fauna, with some ecological and management considerations (paragraphs 38-81). I focused on 30 extant taxa within the Otago region, including fifteen[5] non-diadromous[6] taxa (belonging mostly to the galaxiid

[4] see paragraph 40 of my EIC.
5 There is a counting error in paragraph 41 of my non-Freshwater part evidence: one taxon was misclassified into the non-diadromous group.
[6] i.e., spending their whole life cycle in freshwater.

family) and fifteen diadromous[7] species (**Error! Reference source not found.**). The dichotomy between diadromous vs non-diadromous life cycles in Otago fish species has important implications for their management, protection, and restoration.

24. The Otago Region is host to unique freshwater fish communities that form part of a complex landscape. Fish species present a wide variety of life histories, ecological requirements, and responses to environmental changes, which means that their responses to anthropogenic threats are also highly variable.

25. Non-diadromous galaxiids represent a significant and highly threatened proportion of the endemic fish fauna of New Zealand. Several are endemic to the Otago Region, and some are endemic to Otago and neighbouring regions. Non-diadromous galaxiids have a distribution range that is often constrained, and many are only found in one or two out of the five Otago Freshwater Management Units (FMU) (**Error! Reference source not found.**). Their populations are often fragmented and vulnerable to incursions from introduced salmonids. I refer the panel to Dr Nicholas Dunn's evidence dated 28 June 2023 for further details on non-diadromous galaxiid biology, ecology, management, and threats.

26. Diadromous fish species are widely distributed at the national scale and are generally highly mobile within and across catchments. It is to be noted, however, that some species display regional structuring, meaning in general terms that some populations present some degree of isolation. Diadromous species vary in their respective ecological requirements and life histories, but population trends are generally declining, with many species classified Threatened or At Risk.

27. The Otago Region also hosts macroinvertebrate taxa that represent significant freshwater values. As I stated in my non-Freshwater parts evidence (paragraphs 69 to 77), these taxa should be considered in policies and methods framing freshwater management in the Otago Region.

[7] i.e., presenting a life cycle with both marine and freshwater phases

Table 1- List of native fish taxa present in the five FMU of the Otago Region and their most recent year observed.

Conservation status	Taxon	Common name	Catlins	Clutha Mata-Au	Dunedin and coast	North Otago	Taiari
Nationally Critical	***Galaxias cobitinis***	**Lowland longjaw galaxias**				*2022*	
	Galaxias species D	Clutha flathead galaxias	2018	2022	2017		2018
	Galaxias "Teviot"	Teviot flathead galaxias		*2022*			2000
	Neochanna burrowsius	**Canterbury mudfish**				*2022*	
Nationally Endangered	***Galaxias* "Nevis"**	**Nevis galaxias (Nevis River)**		2022			
	Galaxias anomalus	Central Otago roundhead galaxias		2022			2022
	Galaxias eldoni	Eldon's galaxias			2019		2022
	***Galaxias paucispondylus* "Manuherikia"**	**Alpine galaxias (Manuherikia River)**		2021			
	Galaxias pullus	Dusky galaxias		2023			2022
Nationally Vulnerable	*Galaxias depressiceps*	Taiari flathead galaxias			2021	2022	2022
	Galaxias gollumoides	Gollum galaxias	2018	2023			
	***Galaxias paucispondylus* "Southland"**	**Alpine galaxias (Southland)**		2019			
	***Galaxias* "Pomahaka"**	**Pomahaka galaxias**		2023			
	Galaxias "southern"	Southern flathead galaxias	2014	2019			
	Geotria australis	Lamprey	2018	2022	*2023*	2021	2019
At Risk - Declining	*Anguilla dieffenbachii*	Longfin eel	2022	2022	2021	2022	2022
	Cheimarrichthys fosteri	Torrentfish	2012	2021		2022	
	Galaxias argenteus	Giant kōkopu	2018	2019	2019	1990	*2023*
	Galaxias brevipinnis	Kōaro	1999	2022	2021	2017	2022
	Galaxias maculatus	Īnanga	2022	2021	2020	2021	2022
	Galaxias vulgaris	**Canterbury galaxias**				2022	
	Gobiomorphus hubbsi	Bluegill bully	2018		2019	2022	
At Risk - Naturally Uncommon	*Gobiomorphus gobioides*	Giant bully	2022	2013	2018	2020	
	Stokellia anisodon	Stokells smelt				2021	*2017*
Not Threatened	*Aldrichetta forsteri*	Yelloweye mullet		1995	1984	1985	2020
	Anguilla australis	Shortfin eel	2022	2022	2020	2022	2022
	Galaxias fasciatus	Banded kōkopu	2018		2022	2017	2019
	Gobiomorphus breviceps	Upland bully	2014	2022	2020	2022	2022
	Gobiomorphus cotidianus	Common bully	2022	2022	2020	2021	2022
	Gobiomorphus huttoni	Redfin bully	2022	1995	2019	2022	1999
	Retropinna retropinna	Common smelt	2013	2019	1996	2021	1992
	Rhombosolea retiaria	Black flounder	2019	2015	2014	2021	2020

20-year old records or more are highlighted in darker shaded cells. Species in bold and with cells shaded blue are present in only one FMU, highlighting the importance of the Clutha Mata-Au and the North Otago FMU for non-diadromous galaxiids in the region.
Note that several records are not available in the NZFFD as of 26 June 2023. They have been included in this table and appear italicised:
- for the Dunedin and Coast FMU, lamprey juveniles were found in February 2023 in Careys Creek (pers. obs.)
- for the Taiari FMU, giant kōkopu were observed in March 2023 in the lower Taiari catchment in 2023 by Te Nukuroa o Matamata and DOC staff (Dr Christopher Kavazos, pers. comm.). Smelt were observed in Lake Waihola in 2017 (pers. obs.) and have likely been observed in more recent years.
- Lowland longjaw galaxias: 22/11/2022, submitted to NZFFD, record number 127444 (Daniel Jack)
- Teviot flathead galaxias: 21/11/2022, submitted to NZFFD, record number 126054 (D. Jack).
- Canterbury mudfish: 8/11/2022, submitted to NZFFD, record number 127444 (D. Jack).
- Nevis galaxias:14/12/2022, submitted to NZFFD, record number 126033 (C. Kavazos).
- Gollum galaxias: 1/02/2023, submitted to NZFFD, record number 127445 (D. Jack).
- Pomahaka galaxias: 29/05/2023, submitted to NZFFD, record number 127441 (D. Jack).

28. Freshwater ecosystems of the Otago Region host a unique native fish diversity at the national scale. Among the sixteen regions, Otago hosts the highest species richness, all native species combined at 32 extant taxa; by far it also hosts the highest diversity of non-diadromous galaxiids at 15 non-diadromous galaxiid taxa (Table 2), with Canterbury being a distant second with 27 extant taxa and 8 non-diadromous galaxiids. This uniqueness needs to be explicitly recognised in the pORPS.

Table 2-Number of extant native freshwater fish taxa per region, based on NZFFD records

Region	Total number of extant taxa	Number of non-diadromous galaxiid taxa
Auckland	19*	2
Bay of Plenty	18	1
Canterbury	27	8
Gisborne	17	0
Hawke's Bay	17	1
Manawatū-Whanganui	23	2
Marlborough	22*	4
Nelson	17	0
Northland	21*	4
Otago	32*	15
Southland	22	5
Taranaki	19*	1
Tasman	20	3
Waikato	20*	2
Wellington	21*	2
West Coast	21*	3
*While it is not accounted for in this table, NZFFD records include the Australian longfin eel Anguilla reinhardtii, a non-resident native in these regions.		

29. The diversity of life traits in Otago freshwater fish species creates a high degree of complexity that must be addressed by pORPS policies and methods, including by accounting for different spatial and temporal scales. I offer some suggestions in my non-Freshwater parts evidence and Land and Freshwater Chapter (LF) opening statement dated 2 May 2023.

Commentary on LF-FW-O1A, LF-FW-P7 and associated objectives, policies and methods

30. In the following, I focus on LF-FW-O1A – Region-wide objective for freshwater, the FMU-specific visions, and policy LF-FW-P7 – Fresh water centred on environmental outcomes, attribute states and environmental flows and levels.

31. I note the significant effort made to incorporate feedback from the consultation in the latest LF-FW – Fresh water chapter of the pORPS. However, key considerations in the submission of the Director-General around the original visions for freshwater (LF-VM-O2 to P6) were in my view only partially addressed in the s42A Freshwater parts amended pORPS.

32. In particular, the D-G requested amendments specific to the populations and habitats of native freshwater species in objective LF-FW-O8, namely:

    (a) *For non-diadromous galaxias and Canterbury mudfish populations and habitats to be protected and restored,*

    (b) *For habitats that are essential for specific components of the life cycle of indigenous species, including breeding and spawning grounds, juvenile nursery areas, important feeding areas and migratory and dispersal pathways, to be protected and restored, and*

    (c) *For desired fish species, their life stages, or their habitats, to be protected from the incursion of undesirable fish species by targeting activities that might lead to changes to flows or fish passage.*

33. Objective LF-FW-O1A and policy LF-FW-P7 do cover these points to some extent, although from a very broad and unspecified perspective. I consider some specificity is required to address issues particular to Otago fish communities. This includes providing amendments aimed at protecting and, importantly, <u>restoring</u> populations, and adding more focus on critical habitats (or habitats for critical life stages). Adding the notion of habitat and population restoration in policy LF-FW-P7 would provide consistency with other key strategic documents, such as Te Mana O Te Taiao.

34. Policy LF-FW-P7 (2) considers the protection of habitat but does not include any notion of protecting populations. As such, this policy might therefore fail to trigger any (or any timely or appropriate) intervention, for instance, should a salmonid incursion occur in a protected non-diadromous galaxias habitat. Population restoration is addressed to some extent in LF-FW-P14(3), albeit with a focus on restoring fish passage or using fish barriers where appropriate, as requested by the D-G and in accordance with the NPS-FM. The D-G's submission however goes a step further by requesting the explicit protection and restoration of non-diadromous galaxiids (which include non-diadromous galaxias species and Canterbury mudfish). While I consider habitat protection and restoration paramount in ensuring thriving fish populations,

other management tools, such as population reintroductions or translocations, might be used to restore populations in specific areas.

35. Further, the term ‘habitat’ is overly broad and as such may cover every aquatic environment at any point in time. Providing blanket protections under this general definition might be impossible to implement. It might also fail to address transient (e.g., migration corridors) or temporary habitats (e.g., riparian vegetation in which diadromous galaxiid species may spawn). Fish utilise different habitats across species, life stages, life events, and activity (e.g., foraging, resting).

36. Focusing on critical habitats or critical life stages is in my view a more suited, more adaptive management strategy, provided policies and associated methods are designed carefully. For example, riparian vegetation control in īnanga spawning habitat may have minor impacts on the species if undertaken outside of the spawning season and if allowing time for the vegetation to establish prior to peak spawning season.

37. I consider specific policies are required at the FMU level, to be associated with FMU-specific objectives. This should address the differences between each FMU in terms of fish assemblages.

Considerations on time scales

38. Freshwater fish species in the Otago Region present a wide variety of life traits, including age at maturity and life spans. The latter can range from one year (e.g., īnanga) to several years (most native fish species) to even several decades (e.g., eels, giant kōkopu, dusky galaxias). They may vary within species (e.g., between populations) or between sexes (female eels for instance tend to have a higher longevity than males). In addition, spawning and recruitment success tend to be highly variable in aquatic habitats regardless of management conditions at site, particularly among diadromous species (see paragraphs 150-151 of my non-Freshwater parts evidence for an example).

39. Objectives LF-VM-O2 to O6 and policy LF-FW-P7(3) provide variable timeframes (2030, 2040, 2045 and 2050) to achieve outcomes at the FMU level. While there is a lack of consistency across FMUs, these timeframes are on par for instance with those sought in Te Mana o te Taiao, which provide the Department of Conservation’s strategic direction for the 2020-2050 period at a national scale. However, a key

difference is that the latter provides strategic goals set for 2025, 2030 and 2050. I provide a few examples of these goals for freshwater ecosystems in Table 3.

Table 3 – Three examples of Te Mana O Te Taiao objectives and goals related to freshwater ecosystems

2050 Objective	2025 goal	2030 goal	2050 goal
10. Ecosystems and species are protected, restored, resilient and connected from mountain tops to ocean depths	10.7.1 There have been no known human-driven extinctions of indigenous species	10.7.2 Populations of all indigenous species known to be at risk of extinction are being managed to ensure their future stability or an improving state	10.7.3 Indigenous species have expanded in range, abundance and genetic diversity and are more resilient to pressures, including climate change
	No goal	10.3.2 There has been no loss of the extent or condition of indigenous land, wetland or freshwater ecosystems which have been identified as having high biodiversity value	10.3.3 An interconnected series of indigenous land, wetland and freshwater ecosystems have been restored to a 'healthy functioning' state and are connected to marine and coastal ecosystems
12. Natural resources are managed sustainably	12.5.1 The most appropriate places for the protection and restoration of indigenous biodiversity and areas that are suitable for other uses have been identified	12.5.2 Implementation of an integrated spatial plan for land, freshwater and marine use has ensured no net loss of areas of high biodiversity value	12.5.3 The connectivity of indigenous ecosystems has been improved through targeted restoration from mountain tops to ocean depths (ki uta ki tai)

40. These goals show a steady progression through time: for instance, some may start with a stocktake of the current situation by 2025, aim for the status quo by 2030 and move towards a restored state by 2050.

41. In my non-Freshwater parts evidence, I said I was in favour of this type of paced, outcome-driven approach, which provides explicit steps, associated with appropriate indicators of success (paragraphs 142-143 and 157). Such an approach is consistent with clause 3.19(1) of the NPS-FM 2020 on assessing trends in attribute states[8]. Outcomes of management actions might take some time to become apparent, particularly if measured only through, for instance, presence/absence data or indices of population abundance.

42. Fish populations will not respond to management efforts in the same way or within the same timeframes. For long-lived species, long-term management strategies and trend monitoring need to be set across decades; for shorter-lived organisms, a finer timescale might be more appropriate. Progress indicators set within appropriate timeframes[9] must therefore be chosen carefully and this is why the more detailed

[8] For fish in rivers, the explicit attribute unit is the Fish Index of Biotic Integrity (F-IBI). This index, as developed by Joy and Death (2004), has limitations - discussed in Takada et al (2019). It has been modified and adapted over time, to better suit regional needs (for instance in the Bay of Plenty (Suren, 2016) and the Waikato (Joy, 2007) regions).
[9] As an example, a 3-year timeframe is used for general freshwater monitoring by the Department of Conservation. For more targeted objectives, this timeframe might be reduced or extended.

drafting that the D-G included in her submission on LF-FW-O8 (see paragraph 32 above) is important.

43. I would recommend further reflection on the outcomes sought in visions LF-VM-O2 to O6. In LF-VM-O2(8):

(a) *Providing geographically explicit, location-based visions, as is the case for the Taiari FMU, is extremely useful. I would recommend similar details to be provided for the other FMUs and rohe.*

(b) *For the Upper Lakes rohe, protection and improvement of the water quality is sought to be achieved by 2030. In the Catlins FMU, the same timeframe is chosen to achieve the preservation of naturalness of the water bodies and ecosystem connections, as well as high freshwater quality standards. By contrast with the point above, these are ambitious goals that would warrant strong policies enacted in a timely manner.*

(c) *Similar ambitious goals are proposed for the North Otago, Taiari, and Dunedin and Coast FMUs, on much longer timeframes. These are areas in which providing a timebound progression of the goals would be warranted.*

44. There are some limitations to the approach that are worth noting, notably linked to data availability and quality. For instance, as underscored in paragraph 19, the NZFFD comprises numerous errors. In addition, it compiles records of observations conducted for a variety of reasons – in the Clutha Mata-Au FMU, for example, individual sites have been surveyed on average 1.7 times in the 1922-2022 period, only fourteen sites have been surveyed at least 20 times. The highest number of observations are for the Benger Burn, surveyed 44 times all between 1983 and 1984. There also appears to be a bias in observations, slanted towards rare species as common or broadly distributed species such as shortfin eels and īnanga tend to make only a few percentage points of observations.

45. In sum, while the NZFFD is a broadly utilised and well-established database of fish records, it does not allow establishing trends for fish communities nor individual species. Good baseline and monitoring data are therefore required in each FMU to allow for robust progress indicators on freshwater values.

Conclusion

46. The amended pORPS offers a decent management framework which broadly considers the issues and threats facing freshwater values in the Otago Region.

47. Specific, outcome-driven policies, objectives and methods for each FMU would be useful to address taxon-specific issues and deliver an RPS that is sufficiently adaptive to tackle anthropogenic pressures and threats facing the region's biodiversity.

Marine Richarson

DATED 28 June 2023

References

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