BEFORE THE GREATER WELLINGTON REGIONAL COUNCIL

IN THE MATTER	of the Resource Management Act 1991
AND	of proposed Change 1 to the Wellington Regional Policy Statement.

Evidence of Dr Nixie Cara Morris Boddy on behalf of the Director-General of Conservation / *Tumuaki Ahurei* Hearing Stream 5 Freshwater and Te Mana o te Wai dated 3 November 2023.

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Introduction

1. My full name is Nixie Cara Morris Boddy.

2. I have been asked by the Director-General of Conservation /*Tumuaki Ahurei* ('the D-G') to provide technical freshwater evidence on the Wellington Regional Policy Statement Change 1 ('WRPS PC1').

3. This evidence relates to Hearing Stream 5 Freshwater and Te Mana o te Wai.

Qualifications and experience

4. I am employed by the Department of Conservation (DOC) in Christchurch as a Freshwater Science Advisor in the Biodiversity System and Aquatic Unit of the Biodiversity, Heritage and Visitor Group. I have held this role since September 2019 and have worked for DOC since 2018 as a Freshwater Technical Advisor (October 2018-September 2019). I spent my first year at DOC as a Freshwater Technical Advisor providing technical and scientific advice to RMA processes, particularly in the areas of water allocation and the impact of river flows on indigenous freshwater fish populations.

5. I hold a Bachelor of Science degree from the University of Canterbury (2012) double majoring in Biology and Geography with endorsements in Ecology and Environmental Science.

6. I hold a Bachelor of Science with Honours (First Class) degree in Ecology from the University of Canterbury (2013). My BSc (Hons) thesis investigated the interacting impacts of river temperature, introduced trout and patchy habitat on the distributions of indigenous non-diadromous alpine galaxias fishes (*Galaxias paucispondylus*).

7. I hold a Doctor of Philosophy degree from the University of Canterbury (2018). My PhD thesis investigated the role of large-scale heterogeneity in flow disturbance regimes in moderating interactions between indigenous non-diadromous galaxias species and introduced trout. I looked particularly at the importance of the spatial configuration of heterogeneity in mediating indigenous and introduced fishes' interactions, the temporal stability of populations, and species interactions in heterogeneous and homogenous riverscapes.

8. I am a member of the New Zealand Freshwater Sciences Society.

9. In my role as Freshwater Science Advisor for DOC, I lead the Critical Ecosystem Pressures Research Programme (CRESP). This national programme involves producing research to address critical knowledge gaps to underpin and improve DOC's advocacy and management of freshwater ecosystems and species. The CRESP research programme covers the pressures of changing water levels and flows, sediment and nutrients, fish passage and critical habitat loss. I have also acted as the DOC freshwater lead for climate change for the past five years.

10. In collaboration with the University of Canterbury I am currently undertaking research on the effectiveness of different baffle types in facilitating indigenous fish passage through culverts, and work looking into the characteristics of natural and built barriers to exclude target fish to protect threatened indigenous non-diadromous fish populations above barriers.

11. I am also collaborating with the University of Canterbury and the Cawthron Institute to understand the effects of extreme flow events on indigenous non-diadromous galaxias species and if those are exacerbated by the presence of non-native trout.

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 and Procedures Note when preparing my 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 my 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 of evidence

15. This evidence related to Hearing Stream 5 Freshwater. I have been asked to provide evidence in relation to Policy 14, Policy 18, Policy FW3 and Policy 42 in the following three areas:

a) Allowing rivers to move naturally.

b) Fish passage.

c) Daylighting streams.

Material Considered

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

a) Wellington Regional Policy Statement Proposed Change 1;

b) The s32 Evaluation Report dated August 2022;

c) The s42A report dated 16 June 2023;

d) The National Policy Statement for Freshwater Management 2020;

e) Resource Management (National Environmental Standards for Freshwater) Regulations 2020.

I have not undertaken work, including site visits, previously in the Wellington Region relevant to this evidence.

ALLOWING STREAMS TO MOVE NATURALLY (Policies 14, FW3 and 42)

17. Historically, we have protected communities and assets from flooding using engineering to constrain rivers to large drain-like channels in a static position (e.g. Figure 1). These are typically artificially straightened, of consistent depth and are lined with hard structures like concrete, rock groynes or stop banks. While engineered hard structures work for controlling smaller floods, they increase the risk of flooding from large rainfall events when the design levels of flood management structures is exceeded (Kreibich et al. 2022). Extreme flood events are expected to intensify by an order of magnitude in the next century (IPCC 2021). As climate

change continues, more frequent extreme rainfall events are predicted to occur across New Zealand, leading to a greater frequency of extreme flooding. This needs to be seriously considered when managing rivers for flood control.

18. Hard-engineered riverbanks provide no to minimal habitat for indigenous fish, birds and insects. Hard engineering comes with loss of wetlands and disconnection of rivers from their floodplains and groundwater systems. The loss of habitat and biodiversity is a result of a lack of heterogeneity in river depth, water velocity, substrate size and connection to vegetated riparian margins, all of which provide habitat for different species and life stages of freshwater fish, invertebrates and birds.

19. Rivers are naturally dynamic and river ecosystems are healthier if they can evolve and change over time (Clearwater et al. 2022). With this in mind, restoration and management actions need to consider the restoration of processes rather than creating a specific state (Clearwater et al. 2022). Re-establishing or avoiding further loss of meanders, braided river plains, and connection between wetlands and rivers throughout the catchment may slow sediment movement, reduce flooding, increase climate change resilience and improve biodiversity (Clearwater et al. 2022).

20. Network analysis can help identify locations within catchments where processes can be enhanced or restored to reduce pressures, such as connection with remnant wetlands, or planned retreat of development from floodplains in key areas. For restoration efforts to be successful and restore river functionality, a whole of catchment approach is required or continuing impacts in part of the catchment will reduce the abilities of connected, restored areas to return to natural function in terms of form and flows (Tunnicliffe and Brierley 2021).

21. Rivers adapt differently to changing flow or sediment conditions depending on their morphology. Geomorphological approaches that work with river processes to build ecological networks, increase nutrient exchange and develop diverse habitat for different fauna are key to the success of restoration and conservation management practices (Tunnicliffe and Brierley 2021).

Figure 1: The natural flow of the Hutt River has been constrained by urban development over the past 80 years. Still from video. Source: Wellington Regional Council.

22. Extreme flood events are expected to intensify by an order of magnitude in the next century (IPCC 2021). As climate change continues more frequent extreme rainfall events are predicted to occur across New Zealand, leading to a greater frequency of extreme flooding. This, combined with altered runoff regimes in drained and channelised lowland waterways may lead to enhanced erosion in lower river sections (Tunnicliffe and Brierley 2021).

23. For example, the subdivision development in the lower Wai-o-Hata/Duck Creek in Porirua has reduced the creek in length, and it is now constrained by adjoining subdivisions. While attempts were made to give the stream a natural-type look, including designing meanders and a small flood plain in the active channel, there are places along the stream where it is clearly eroding and the local council is having to intervene to protect properties. Because the creek does not have enough space to move or erode naturally, hard engineering (in this case rock lining), has been required to keep it within its designated channel. This remediation has significantly narrowed the stream in one location, speeding up the river flow and increasing the likelihood of further erosion problems in future (Figures 2 and 3). This has also caused issues for both the stream morphology and habitat, for example by removing bank undercuts which are great habitat for tuna/eels (*Anguilla spp.*).

Figure 2: Wai-o-Hata/Duck Creek catchment, red lines show extent of rock lining. Source: Natasha Petrove, DOC Technical Advisor Freshwater, based in Wellington.

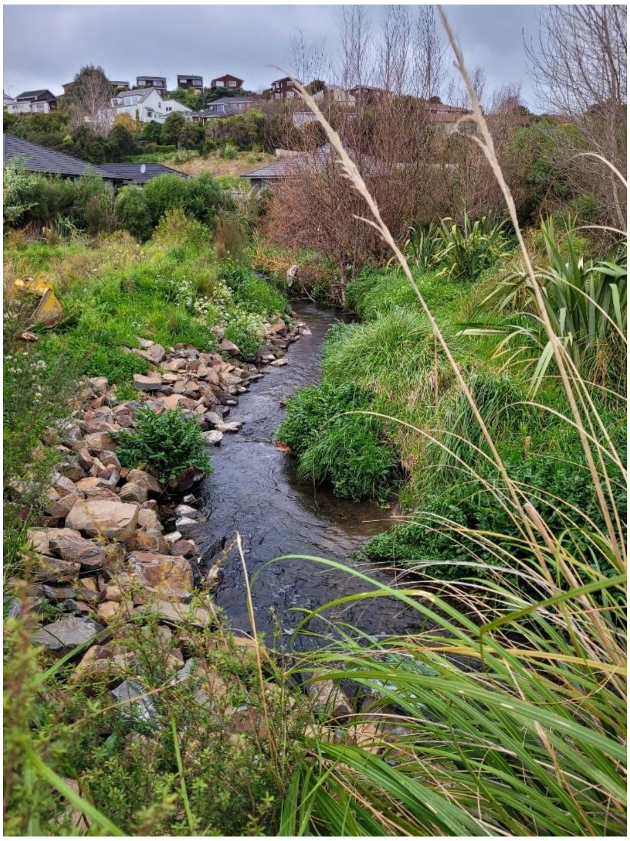

Figure 3: Rock lining in Wai-o-Hata/Duck Creek catchment to protect subdivision. Source: Natasha Petrove, DOC Technical Advisor Freshwater, based in Wellington.

24. There is obvious conflict, particularly in the lower reaches of catchments, between restoring natural flow and character to the river and protecting existing communities and infrastructure. Opportunities exist, however, for a win-win, and finding those will be important with more extreme rainfall events in our future (Clearwater et al. 2022).

25. Based on the above reasoning and example, I support the new sub-clauses to Policies 14, FW3 and 42 sought in the Director-General's submission that "Require urban development is located and designed to allow water bodies to meander and move naturally." I note that the Council's s42A Report has recommended different wording, and this is addressed in Mr Brass's evidence.

FISH PASSAGE (Policy 18)

26. Nineteen species of indigenous freshwater fish are found in the Wellington Region, 79% of which (15 species) are diadromous species that require unobstructed access to migrate to and from the sea to complete their life cycles. Almost half of these species are threatened or at risk of extinction (Table A1).

27. In-stream structures that prevent or limit fish passage are a significant threat to indigenous freshwater fish in New Zealand. Structures such as culverts, dams and weirs can create barriers to fish passage, reducing the abundance and distribution of migratory fish in waterways, and potentially declines or loss of populations of some species from the rivers and streams upstream of the barrier (e.g. (e.g., Boubée et al. 1999; Franklin & Bartels 2012; Jellyman & Harding 2012).

28. Instream structures at different flows can be barriers to different fish species, and at different life stages. This is due to differing morphologies, swimming styles and abilities that determine their proficiency at passing barriers (Franklin et al. 2018). For example, kōaro (*Galaxias bevipinnis*) and tuna/eels (*Anguilla* spp.) are able to 'climb' vertical surfaces as long as they are wet, īnanga (*Galaxias maculatus*) and smelt (*Retropinna spp.*) rely on bursts of high-speed swimming to get though fast-flowing areas but require regular low velocity resting zones. While introduced trout can leap up waterfalls or drops provided there is a deep pool at the bottom for them to gain enough momentum to jump (Mitchell & Boubée 1989).

29. While most indigenous freshwater fish in the Wellington Region are diadromous and require full access to and from the ocean to complete their life cycles, there are four species that are non-diadromous and live their whole lives in the freshwater environment. Two of these species (dwarf galaxias (*Galaxias divergens)* and brown

mudfish (*Neochanna apoda*)) are at risk of extinction (Table A1). These species are negatively affected by introduced fish species such as trout through competition and predation (Jones & Closs 2015; McDowall 2006; McIntosh et al. 2010). Physical barriers that prevent the migration of target fish species such as trout into critical habitats for dwarf galaxias and brown mudfish can protect populations by creating safe refuges within which they can thrive. For example, the New Zealand Fish Passage Guidelines (Franklin 2018) state that both dwarf galaxias and brown mudfish would likely persist without fish passage barriers but in a smaller (and possibly more fragmented) distributional range than with the help of barriers, and having built or natural fish passage barriers would be advantageous to prevent extinction. When installing or maintaining barriers, consideration should be given to the species and habitats present, life history (Jones and Closs 2015) and impacts of facilitating or preventing fish passage, such as loss or fragmentation of populations (Woodford and McIntosh 2013).

30. Built barriers include installing new structures and maintaining or enhancing existing structures or natural barriers to exclude target species and protect vulnerable indigenous fish populations upstream. This can be in the form of a total fish passage barrier or a partial barrier that is designed to allow the passage of specific species and not others (Franklin et al. 2018), for example maintaining a shallow wetted area for indigenous climbing fish but no plunge pool, preventing trout from jumping. Several fish passage barriers have been successfully designed and installed to protect indigenous non-diadromous fish in New Zealand (Bowie et al. 2013, Charters 2013, Ravenscroft 2013, Gumbley & Daniel 2015). Some of these were combined with trout and/or kōaro removal operations to expand the area of protected habitat for threatened non-diadromous fish species.

31. Fish passage should be maintained/restored where appropriate, which will be the majority of streams in the Wellington Region, however the removal of instream barriers is not always appropriate to protect indigenous freshwater fish, as in the case of the non-diadromous species described above.

32. In the NPS-FM 2020 subpart 3.26 every Regional Council must include the following fish passage objective (or words to the same effect) in its regional plan:

> *"The passage of fish is maintained, or is improved, by instream structures, except where it is desirable to prevent the fish passage of some fish species in order to protect desired fish species, their life stages, or their habitats."*

33. Due to both the positive and negative impact of fish passage barriers for different indigenous fish species, I support the Policy 18 amended clause (r) *"restoring and maintaining indigenous fish passage, except where it is desirable to prevent the passage of some fish species in order to protect desired indigenous species, their life stages and habitats."*

DAYLIGHTING STREAMS (Policy FW3)

34. Stream daylighting is the practice of removing rivers and streams from underground pipe networks and restoring them to open air. Stream daylighting projects can restore streams to a naturalised state and, when done well, the environmental benefits can be grouped into: improved habitat, increased biodiversity and improved water quality. It provides an opportunity for natural habitat restoration with the added benefit of reducing flash flooding (Pinkham 2000).

35. Streams in underground pipe networks are a widespread issue in the Wellington Region. For example, it has been estimated there may be as many as 700kms of piped streams within the Wellington City limits and only around 60kms of streams open to the air (MacManus, 2021), so there is plenty of scope for daylighting streams in this region.

36. Daylighting projects have been found to reduce flooding problems by removing under-capacity culverts, re-creating floodplains and reducing runoff velocities and erosion through channel meandering (Pinkham 2000). This should be a major future consideration with more frequent extreme flood events predicted with climate change. Water quality is improved through exposure to sunlight, air, vegetation and soil, which can help remove pollutants via binding them up in soils and uptake by aquatic plants (Pinkham 2000). Biodiversity is increased through the re-creation of aquatic habitat (including riparian vegetation) and improvement of fish passage (Pinkham 2000) through the increase in habitat variation, for example resting pools. Furthermore, daylighting streams with a source to sea approach has significant benefits for migrating freshwater invertebrates, which have much lower survival and migration success when streams are piped, even for short sections of the catchment (Blakely et al. 2006).

37. While most daylighting projects do increase biodiversity and habitat availability, the degree to which a daylighting project can be deemed a success is highly variable (Sinclair 2012). For stream daylighting projects globally, the term can mean very

different things and thus have very different ecological outcomes. For example, some projects restore a natural substrate to the stream and some use concrete channels which provide no habitat (Sinclair 2012). Other projects are too squeezed for space, not leaving room for natural channel geometry and a vegetated riparian corridor (Pinkham 2000). There also needs to be consideration of capturing contaminated runoff and building new stream channels in contaminated sediments under urban centres to ensure water quality goals are met (Sinclair 2012).

38. Internationally, successful daylighting projects exposed whole catchments or sub-catchments (creating a connected network of open habitat from the sea), provided buffer zones for riparian vegetation alongside the waterway, had indigenous riparian vegetation and created habitats suitable for the indigenous species present in that area (Jones 2001, Sinclair 2012). An important consideration is the connectedness of river networks, and in stream daylighting processes a catchment approach should be taken to maximise benefits.

39. For example, 15km long Oakley Creek in Waterview, Auckland has had seven previously piped sections of river successfully daylighted. The project was designed to protect 200 houses from flooding, and has had some ecological benefits, including: nesting indigenous water birds in the riparian vegetation, and the presence of tuna/longfin eel (*Anguilla dieffenbachii*) (Hutching 2018, Killick 2022). Furthermore, the La Rosa reserve stream daylighting project in Auckland was completed in 2014, aiming to restore habitats, enhance stormwater management and has been an asset for the community, including in environmental education, with fish surveys, planting days and ongoing care for the stream (Landezine 2016).

40. Given the above, I support amendment (p) of Policy FW3 to *“promote daylighting of streams where possible*” and the movement of this to Policy 14 to cover regional plans rather than district plans. In my opinion, I would advocate suggest stronger wording, for example “*promote <u>and enable</u>*” stream daylighting, with the suggestion to be specific in how stream daylighting is implemented to ensure the desired outcomes are achieved.

Nixie Boddy

DATED this 3rd day of November 2023

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APPENDIX 1: Indigenous freshwater fishes in the Greater Wellington Region

Table A1: Indigenous freshwater fish species found in the Wellington Region, and their conservation status (Dunn et al. 2018).

Common name	Scientific name	Conservation Status
Diadromous species		
Shortfin eel	*Anguilla australis*	Not Threatened
Longfin eel	*Anguilla dieffenbachii*	At Risk: Declining
Torrentfish	*Cheimarrichthys fosteraei*	At Risk: Declining
Giant kōkopu	*Galaxias argenteus*	At Risk: Declining
Kōaro	*Galaxias brevipinnis*	At Risk: Declining
Banded kōkopu	*Galaxias fasciatus*	Not Threatened
Īnanga	*Galaxias maculatus*	At Risk: Declining
Shortjaw kōkopu	*Galaxias postvectis*	Threatened: Nationally Vulnerable
Lamprey	*Geotria australis*	Threatened: Nationally Vulnerable
Common bully	*Gobiomorphus cotidianus*	Not Threatened
Giant bully	*Gobiomorphus gobioides*	At Risk: Naturally uncommon
Bluegill bully	*Gobiomorphus hubbsi*	At Risk: Declining
Redfin bully	*Gobiomorphus huttoni*	Not Threatened
Common smelt	*Retropinna retropinna*	Not Threatened
Black flounder	*Rhombosolea retiaria*	Not Threatened
Non-diadromous species		
Dwarf galaxias	*Galaxias affinis divergens “Northern”*	At Risk: Declining
Cran’s bully	*Gobiomorphus basalis*	Not Threatened
Upland bully	*Gobiomorphus breviceps*	Not Threatened
Brown mudfish	*Neochanna apoda*	At Risk: Declining
‘Marine wanderer’ species		
Yelloweye mullet	*Aldrichetta forsteri*	Not Threatened
Grey mullet	*Mugil cephalus*	Not Threatened