BEFORE THE HEARING PANEL

AT HAMILTON

IN THE MATTER	of the Resource Management Act 1991
AND	
IN THE MATTER	of the Proposed Waikato Regional Plan Change 1 Waikato and Waipā River Catchments
AND	
IN THE MATTER	of Variation 1 to the Proposed Waikato Regional Plan Change 1 Waikato and Waipā River Catchments

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STATEMENT OF FURTHER SUPPLEMENTARY EVIDENCE OF KATHRYN JANE MCARTHUR FOR THE DIRECTOR-GENERAL OF CONSERVATION

ERRATUM TO WRC RESPONSE TO HEARING PANEL QUESTIONS – 17 JULY 2019

23 July 2019

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Submission Number 71759

INTRODUCTION

1. My full name is Kathryn Jane McArthur.

2. I have been engaged by the Director-General of Conservation to provide evidence on freshwater management, water quality and ecosystem health, with a particular focus on streams and rivers, for the hearing on proposed Plan Change 1 for the Waikato and Waipā Rivers (PC1).

3. I am the Practice Leader – Water, at The Catalyst Group, an environmental consultancy based in Palmerston North.

QUALIFICATIONS AND EXPERIENCE

4. My qualifications and experience are set out in my Evidence in Chief dated 15 February 2019.

CODE OF CONDUCT

5. I have read the Environment Court "Code of conduct for expert witnesses", and I agree to abide by it. I have prepared this Statement in accordance with that Code. I confirm that my evidence is within my area of expertise. I have not omitted to consider any material facts known to me that alter or detract from the opinions I express in this Statement. I have acknowledged the material used or relied on in forming my opinions and in the preparation of this Statement.

SCOPE OF EVIDENCE

6. The scope of this supplementary evidence is in response to the erratum on the response memo from Waikato Regional Council (WRC) to question 14 from the hearing panel, namely īnanga spawning habitat protection and mapping.

MAPPING AND PROTECTION OF ĪNANGA SPAWNING HABITAT

7. I have read the erratum of Mr McCallum-Clark for WRC dated 17 July 2019. I have also thoroughly reviewed the technical report referenced in the erratum by Jones and Hamilton (2014).

8. The Waikato River is one of New Zealand's largest rivers and as such has the potential to provide a proportionately large areal amount of īnanga spawning habitat nationally, although flood protection of farmland significantly reduces the area of tidal inundation of suitable habitat. Thus, the remaining available īnanga spawning habitat in the lower Waikato River (and in suitable spawning habitats associated with lakes Whangape, Waahi and Waikari; David et al. 2019) is of critical importance for the survival and recruitment of īnanga and other large bodied Galaxiid fish at both the regional and national levels. Jones and Hamilton (2014) note: "*Restoration of spawning habitat is likely to be particularly important for large rivers such as the Waikato, into which juvenile īnanga migrate in large numbers, only to struggle to find suitable habitat for spawning on maturity several years later*."

9. The technical report of Jones and Hamilton (2014) undertook hydro-dynamic and inundation modelling (using a high-resolution digital elevation model or DEM) in addition to field work on salinity, water levels, temperature, dissolved oxygen and bathymetry of the Waikato Delta to calibrate and validate the models, providing a level of detail above and beyond the approach taken in Canterbury. In my opinion, the inundation DEM developed by Jones and Hamilton (2014) and held by WRC is completely fit for use in PC1 to map potential īnanga spawning habitat, in conjunction with the requested PC1 provisions to protect īnanga spawning habitat.

10. Jones and Hamilton (2014) state: "*The Waikato River estuary and delta is surrounded by an extensive floodplain that is now in farmland and protected from inundation by a series of stopbanks and floodgates. Assessing the potential for inundation under high spring tides, and therefore potential whitebait spawning habitat, requires accurate, high-resolution topographic and bathymetric elevation data, and the ability to query spatial datasets across the entire area. To this end, a high-resolution Digital Elevation Model (DEM) for the estuary, delta, river and floodplain was constructed by combining bathymetry data from the hydrographic survey with LiDAR data collected for areas above the low tide mark. The DEM was used as the basis for GIS modelling to identify and quantify potential whitebait spawning habitat based on variables*

such as elevation (relative to height of spring tides), and the location of stopbanks and floodgates which would impede fish passage."

11. The GIS model of Jones and Hamilton (2014) enabled assessment of potential inundation of tidally influenced water across a large area (c. 100 km^2), whilst also being able to allow identification of small-scale features that may be amenable to restoration due to the high resolution (2 m x 2 m) of the DEM (Figure 1). Saltwater intrusion into the estuary and delta was found to occur up to the mid-islands region, c. 10 km from the river entrance, on the neap (lowest) tide survey and in the upper islands, c. 13 km from the river entrance, on the spring (highest) tide survey, which is further than has previously been reported. Across the full range of river flows saltwater intrusion may range from close to the entrance to at least 13 km upstream, which is broadly consistent with the location of known īnanga spawning sites.

12. Jones and Hamilton (2014) found that: "*Model simulations indicate that there is a marked effect of tidal height and freshwater discharge on inundation and salinity distribution in the estuary and delta, and that even under similar tidal conditions, the extent of saltwater intrusion may vary by up to 3 or 4 km. When flows in the Waikato River are high (c. 800 m^3/s at Mercer) the interface between fresh and saltwater may be in the mid-upper estuary but extend as far as the mid-islands of the delta when flows are low (c. 250 m^3/s at Mercer).*"… "*It is clear that with stopbanks located very close to the banks of the rivers and tributaries the spatial scale of any potential habitat becomes very limited. Furthermore, when river flows are high and much of the land on the river/estuary side of the stopbanks is inundated then this potential habitat will become even further constrained."*

13. The 4.5km^2 of likely īnanga spawning habitat at low river flow may be reduced to only 1km^2 when river flows are higher, further limiting potential spawning habitat area. Given the potential for high flows following a spawning event to wash away eggs before they are fully developed, it would also be prudent to provide suitable habitat in tributaries and side streams that are tidally influenced, which may be less prone to flooding than the main river. This indicates that restoration and protection of spawning habitat should occur over a large extent of

the estuary and delta if īnanga spawning is to continue at all in the Waikato River.

14. Jones and Hamilton (2014) concluded that restoration of whitebait spawning habitat will likely need to include sites extending from the mid-estuary to upstream of the delta, and at each site there should be habitat spanning a range of elevations to account for variable water levels. Suitable habitat may need to be present across a wide area, both longitudinally (e.g., from the mid-upper estuary to the upstream extent of the delta) and vertically (at least from c. 1.5 to 2.5 m above sea level) to ensure that there are places for whitebait to spawn regardless of environmental conditions (e.g., tidal heights and river flows). The modelled spawning habitat was likely to be an underestimate of the actual range of spawning habitat available. They also recommended that consideration is given to the effects of future climate change, particularly sea level rise, on whitebait spawning habitat. Rising sea levels will lead to increased inundation of low-lying areas surrounding the estuary and delta, which will decrease available whitebait spawning habitat if access to suitable areas (both in terms of inundation at high spring tides and vegetation type) is limited.

15. Areas of farmland affected by tidal inundation and potentially suitable as īnanga spawning habitat are less likely to be highly productive as pasture grasses are already periodically subject to tidal inundations and salinity.

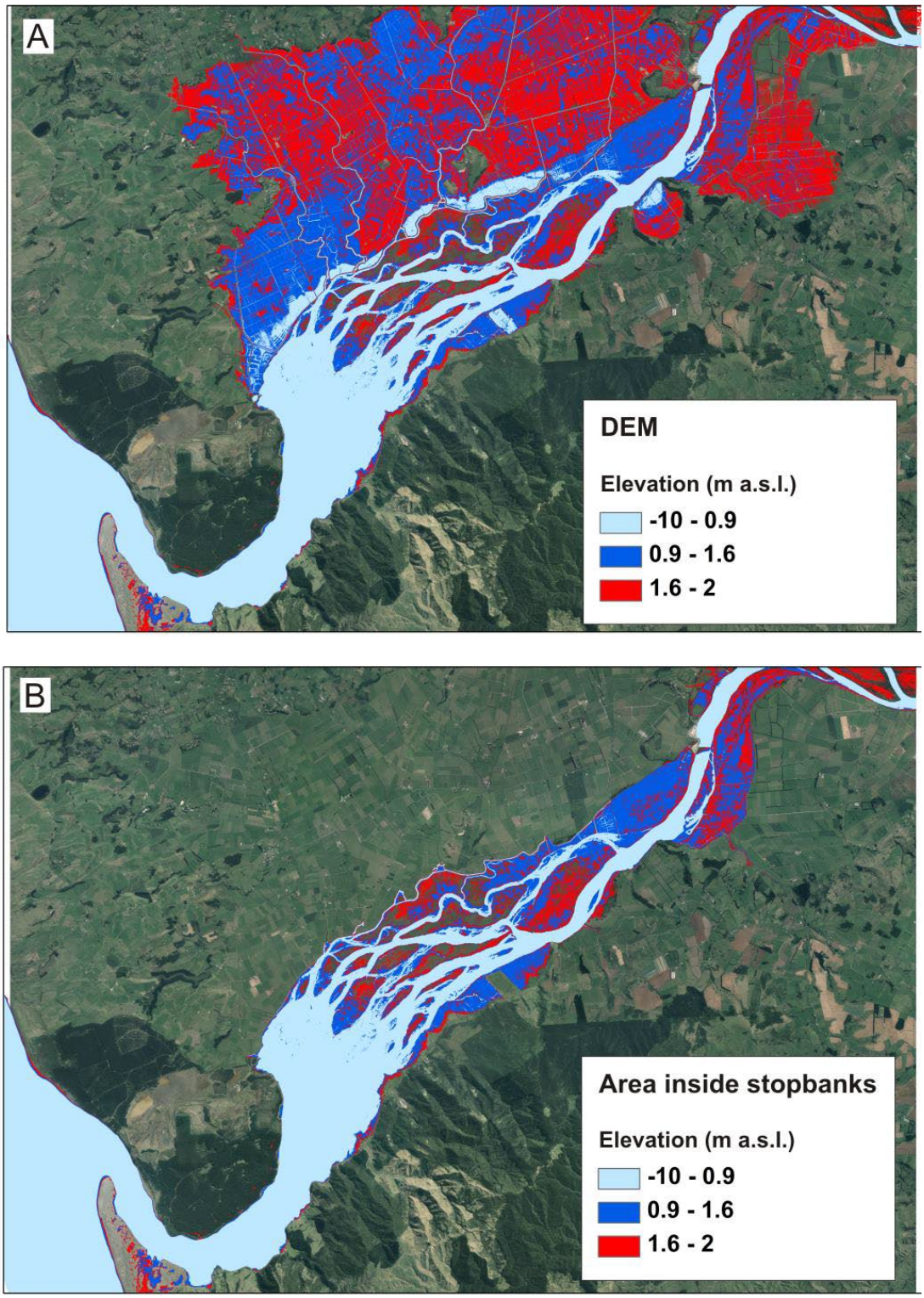

Figure 1 (Figure 23 from Jones and Hamilton 2014): A) Waikato River estuary, delta and floodplain DEM, and (B) DEM clipped to include only the area that is inside the stopbanks, and thus subject to tidal and riverine inundation. In both figures the DEM has been classified into bins corresponding to the area below MHWN (i.e. 0.9 m a.s.l.; in light blue), between MHWN and MWHS (i.e. between 0.9 and 1.6 m a.s.l.; in dark blue) and between MHWS and HAT (i.e. between 1.6 and 2 m a.s.l.; in red). (Note areas above 2 m a.s.l. not shown). *Note added: Areas in blue are potential habitat available for spawning, areas in red are most likely to provide inundation conditions for spawning.*

16. In my opinion, provisions for īnanga spawning habitat can and should be included in PC1 now and not in the next plan. The DEM provided by Jones and Hamilton (2014), clipped to account for current stopbanks and flood protection schemes, should be used to identify the most likely areas available for īnanga spawning in the lower Waikato River. Potential īnanga spawning habitat should be protected through riparian set backs (as discussed in my Block 2 evidence in chief) and policy direction (as discussed in the Block 2 evidence of Ms Kissick). This is particularly important as the current area of potential īnanga spawning is significantly reduced from the natural state (c. 7.5% habitat remaining) and īnanga are an at-risk indigenous species, currently in national decline.

17. Regardless of whether maps of potential īnanga spawning habitat are included in PC1 (which in my opinion they should be), effective provisions to protect that habitat from stock trampling, grazing and cultivation should be included in PC1 policies and FEPs directed to consider these areas. Identification of potential spawning habitat through mapping would clearly signal where restoration efforts (via riparian set backs) are most needed.

Kathryn Jane McArthur

23 July 2019

REFERENCES

Jones HFE, Hamilton DP 2014. *Assessment of the Waikato River estuary and delta for whitebait habitat management: field survey, GIS modelling and hydrodynamic modelling*. Prepared for Waikato Regional Council.

Environmental Research Institute Report No. 27, University of Waikato, Hamilton. 79 pp.