BEFORE THE HEARING PANEL

IN THE MATTER of the Resource Management Act 1991

AND

IN THE MATTER of Proposed Plan Change 12 to the Operative Hamilton City District Plan

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SUPPLEMENTARY STATEMENT OF EVIDENCE OF STUART JAMES EDGAR FARRANT

(STORMWATER MANAGEMENT)

Dated 11 September 2024

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INTRODUCTION

1. My full name is Stuart James Edgar Farrant.

2. My qualifications and experience are as set out in my rebuttal statement of evidence dated 14 August 2024 (**rebuttal evidence**).

3. I reconfirm that I have read and am familiar with the Code of Conduct for Expert Witnesses in the Environment Court Practice Note 2023 and I agree to comply with it.

PURPOSE AND SCOPE OF EVIDENCE

4. The purpose of this supplementary statement of evidence, which is provided on behalf of Hamilton City Council (**HCC**) as Plan Change 12 (**PC12**) proponent, is to respond to matters raised in the hearing by the Hearing Panel during the presentation of my evidence on 4 September 2024.

MATTERS RAISED

Reuse of roof derived rainwater risks

5. The Panel requested that I provide further evidence as to the public health risks associated with the reuse of roof derived rainwater for non-potable reuse. This issue was also raised by Mr Jaggard in his evidence on behalf of Kainga Ora and I had provided an initial response in my rebuttal evidence. I provide the following further clarification:

    a) As Mr Jaggard notes in his evidence, there is limited research on the health risks posed by rainwater harvesting for non-potable reuse. There is an extensive body of research on rainwater reuse for potable reuse (augmenting drinking water supply) and to a lesser extent, research on stormwater harvesting for non-potable reuse (in particular municipal spray irrigation) but it is noted that neither of these scenarios are applicable to the proposed PC12 provisions.

b) Mr Jaggard references recent research in Australia (Murphy 2017)[1] and infers that this may provide justification for additional treatment of rainwater collected from residential roofs. This research (*Current Stormwater Harvesting Guidelines Are Inadequate for Mitigating Risk from Campylobacter During Non-potable Reuse Activities)* is based on computational modelling of a range of potential water treatment approaches to be applied to harvested municipal stormwater. It is important to note that stormwater includes runoff from a wide range of surfaces (including roads, carparks and private roofs) and is also often subject to wastewater ingress through cross connections and/or leakage. It is considered that whilst this research is relevant to the wider discussion around integrated water management, it is not applicable to the PC12 provisions which have intentionally focussed on the collection of roof water only.

c) As noted by Mr Jaggard, robust research in New Zealand on rainwater reuse is limited despite the prevalence of domestic rainwater reuse in rural areas. I am advised by BRANZ that they have ceased all water-related research at present.[2] However, BRANZ did undertake research in 2015/16[3] funded by the Building Research Levy which included sampling of collected water in

[1] Statement of evidence of Philip Jaggard dated 26 July 2024, Attachment A, page 25 citing Murphy H.M, Meng Z, Henry R, Deletic A and McCarthy D.T (2017), Current Stormwater Harvesting Guidelines Are Inadequate for Mitigating Risk from Campylobacter During Nonpotable Reuse Activities, Environ Sci Technology 51(21):12498-12507. doi: 10.1021/acs.est.7b03089. Epub 2017 Oct 30.

[2] Communication with Andrew Pollard on 05/09/2024.

[3] Bint L, Siggins A, Pollard A, Water Quality in Rainwater and Greywater Systems: Preliminary Results. Sourced from: https://www.waternz.org.nz/Attachment?Action=Download&Attachment_id=1815

rainwater harvest tanks in four commercial buildings with monthly testing (by ESR) over a 12 month period (45 samples). This found that no metal levels in the water posed a risk to health. In microbiology testing, no Campylobacter bacteria were found in the samples. 18 samples were found to contain Escherichia coli (E. coli), but 11 of these came from a building that did not have an enclosed tank – a known risk for contamination. One sample out of 45 tested positive for Salmonella. The scientists calculated that, even if toilet water was ingested at every flush, the risk of Salmonella infection would still only be around one in one million. This research, albeit limited appears to support the premise that the risks of public health impacts from the capture and reuse of roof derived rainwater are very low.

d) In 2011, the British Colombian Centre for Disease Control undertook a research project titled *"Rainwater Harvesting for Non-potable Use and Evidence of Risk Posed to Human Health."*[4] It included an extensive literature review of peer reviewed journal articles on Legionella bacteria in addition to other common public health risks. This research intentionally only considered non potable reuse including toilet flushing and spray irrigation where aerosols could be a contributor to human health impacts. The study attempted to adopt a risk-based perspective which considered the likelihood of contaminants being present within rainwater collection and then the likelihood of the ultimate non-potable use of harvested rainwater causing adverse human health impacts. Where possible, this was evaluated against a risk-based threshold of one infection per 10,000 person-years (taken from Dutch drinking water standards). Based on the literature, they reported that whilst sources of contamination were present in a

[4] Struck S, Rainwater Harvesting for Non-potable Use and Evidence of Risk Posed to Human Health.

number of studies the risks to public health were below the one per 10,000 person-years (10^{-4}). It was also noted through this research that optimal growth of *Legionella pneumophila* occurs in the range of 35°C to 43°C, although it can survive between in the range of 16.5°C to 55°C (growth restricted to the range of 25°C to 45°C). Whilst robust data on water temperatures within rainwater tanks in Hamilton is not available, it is unlikely to reach 35°C and I would expect it to only exceed 25°C during the peak of summer noting that many commercially available PE tanks state an upper temperature limit of 30°C.

e) An Australian study (Coombes et al. 2000)[5] showed that while some samples of roof water and in situ tank water exceeded the Australian Drinking Water Guidelines for Total and Faecal coliforms, the highest counts occurred immediately after major rainfall events which washed organic material from the roof gutters into the tanks. The authors demonstrated a marked reduction in the bacterial counts over time suggesting that the rainwater tanks have a self-disinfection action.

6. Based on the research that I have referred to above, I consider that the risks of public health impacts from the capture and reuse of roof derived rainwater are very low.

Adverse impacts from modified urban hydrology

7. Further clarification was sought by the Panel as to the source of research relevant to adverse impacts from modified urban hydrology. I made verbal reference to the 2013 Auckland Council TR2013/33 Ecological Responses to Urban Hydrology which was commissioned to inform the

[5] (Coombes et al. 2000). Coombes, P., Argue, J. and G. Kuczera. (2000). Rainwater quality from roofs, tanks and hot water systems at Fig Tree Place. Third International Hydrological and Water Resources Symposium, Perth, 2000. 1042-1047.

Unitary Plan process. This report clearly identifies a number of impacts on ecological health from urbanisation whilst noting that it is difficult to isolate the multiple drivers which include changed hydrology, water contaminants and temperature, all of which are mitigated through the proposed PC12 provisions. The report records:

> … biological metrics are correlated with the frequency of elevated flow events. In a few studies the frequency of large floods has been the strongest correlate, while in others the frequency of small- to medium-sized events is more important. Since large floods occur occasionally in both natural and urban streams, stream biota are likely to be adapted to survive such uncommon events. In contrast, small to medium rainfall events may not produce any flow elevation in natural streams, but produce significant rise in the flow of urban streams….Therefore, the cumulative impact of more commonly occurring small- to medium-sized events is likely to be greater than large events.

8. TR2013/33 provides a good summary of the impacts of unmitigated stormwater on freshwater streams which is consistent with the large body of research available from international studies. The research uses the term "Urban Stream Syndrome" to refer to the combined adverse impacts on stream health from urbanisation.

City-wide application of requirement

9. The Panel tested whether it was appropriate to require rainwater reuse to meet hydrological outcomes where discharge was direct to the Waikato Awa via piped connection. In the hearing, I advised that the opportunity to enhance outcomes in locations where original streams or wetlands have been piped to potentially support future daylighting whilst noting that there are areas of Hamilton which have piped connections direct to the river which are not considered to be piped streams. In particular, this applies to the area around the Central Business District on the west side of the Waikato Awa which is largely in

the Central City Zone and not subject to the PC12 provisions as it is to be addressed in Plan Change 14.

10. The proportion of the Hamilton jurisdiction (including all land use designations) which connects directly to the Waikato Awa via piped connection is assessed as being approximately 10-15%, of which approximately 30% is covered by the Central City Zone. This is likely to include areas which drain to the river via historically piped streams. I consider that exemption for residential development in circumstances where reticulated stormwater pipes connect directly to the Waikato Awa (with no open stream reaches) is not warranted. Particularly when the Vision and Strategy/Te Ture Whaimana and the principles of managing the post-developed hydrology are considered.

CONCLUSION

11. I confirm my support for the proposed PC12 requirements to install rainwater reuse systems on new developments.

Stuart James Edgar Farrant

Dated 11 September 2024

Principal Ecological Engineer, Morphum Environmental