Reply to: discussion on "Influence of roofing materials and lead flashing on rainwater tank contamination by metals" by Magyar M.I., Ladson A. R., Diaper C., and Mitchell, V.G. 201...

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Reply to:

Discussion on "Influence of roofing materials and lead flashing on rainwater tank contamination by metals" by Magyar M.I., Ladson A. R., Diaper C., and Mitchell, V.G. 2014. Australian Journal of Water Resources Vol. 18, No. 1, pp 71-83.

Ladson, A.R and Magyar M.I.

We thank the writer for his comments and agree with many of his points. Like the writer, we are aware that rainwater is an important source of water supply and that rainwater harvesting systems in urban areas reduce demand on mains. We acknowledge the writer's experience in the analysis of rainwater systems.

The key issue where we have different views is the ability of rainwater tanks in urban areas to reliably deliver water of suitable quality for potable use. Our paper found lead levels in tank water that exceeded drinking water guidelines. We also found high lead concentration in tank sludge. The writer correctly points out some of the weaknesses of our pilot study; we disturbed tank water more than would be common in a real situation, and the results from our model tanks and roofs may not scale up to full sized systems.

However, the results from our model tanks were consistent with results in full scale tanks, where the sediment was not disturbed prior to collection of a water column sample and where samples were always taken at least two days after a rain event. This ensured there was enough time for resettling of sediment (Magyar, et al., 2008).

In addition, our research is not unique in finding occasional high levels of lead in tank water in urban areas. In a recent literature review (Magyar and Ladson, 2015) we found 32 studies where chemical water quality issues associated with tank water were reported. In all but one of these 32 studies, lead was the main concern.

Recent studies are a more reliable guide to current risks of lead contamination because there have been interventions to reduce the amount of lead in the environment. For example, lead-free petrol was introduced into Australia in the 1980s, and mandated in 2002; lead concentration in paint has been decreased from up to 50% before 1950, to a maximum of 0.1% from 1997. We identified 6 recent Australian studies where a number of tanks were sampled (Table 1) and undertook a meta analysis to calculate the average proportion of tanks exceeding drinking water guidelines (Magyar and Ladson, 2015). On average approximately 22% of tanks sampled in urban areas in Australia in these studies had water that, at least occasionally, exceeded drinking water guidelines for lead.

Table 1 Selected studies that estimate the proportion of tanks that exceed drinking water guidelines for lead.

Study	City	No. tanks in study	No. tanks exceeding drinking water guidelines for lead (proportion)	95% confidence limits on proportion of tanks exceeding drinking water guidelines for lead
Chapman *et al*., 2008	Brisbane	30	9 (30%)	14.7%, 49.4%
Chapman *et al*. 2008	National	69	6 (9%)	3.3%, 18%
Magyar *et al*., 2008	Melbourne	49	16 (33%)	19.9%, 47.5%
Huston *et al*., 2009	Brisbane	38	5 (14%)	4.4%, 28.1%
Kus *et al*., 2010	Sydney	11	5 (45%)	16.7%, 76.6%
Rodrigo *et al*., 2012	Adelaide	19	3 (16%)	3.4%, 39.6%
Average (meta-analysis)			**21.8%**	**12.8%, 34.7%**

It should be acknowledged that not all the studies in our literature review found concentrations of lead that exceed drinking water guidelines. In particular, work undertaken by the writer in Newcastle, Australia did not find high lead concentrations in tank water (Coombes et al. 2000a, 2000b, 2002, 2005, 2006). There was also a study in Tamborine Mountain Queensland (Mark Rigby & Associates, 2002) where lead levels were not elevated. Huston (2009) speculates that there may be particular characteristics of these studies that explain the low lead concentrations. For example, in the Tamborine Mountain study, 79% of tanks were concrete and 28% contained a mixture of rainwater and other water (Mark Rigby & Associates, 2002). It is common to have low pH conditions in tank water which increases the likelihood of excursive lead concentrations (Huston, 2009); however, this is counteracted in new concrete tanks which generally have high pH water so are less likely to have metals in dissolved form.

The studies by Coombes et al. (2000a, 2000b, 2002) included tanks that had mains water top up potentially diluting contaminants in tank water. The Coombes et al. (2002) study was of a concrete tank. At Figtree place, central Newcastle, Coombes et al. (2000a, 2000b, 2005) found that rainwater entering the tank exceeded drinking water standards for lead, but tank water did not; suggesting it was processes within the tank that resulted in cleaner water for example, settling of particles (Spinks et al. 2003b). Sludge in these tanks was found to contain high lead concentrations (Spinks et al. 2005). Our work suggests that tank sediments can be resuspended when there are low water levels in tanks and the inflow rate is high (Magyar et al. 2011).

The writer quotes Morrow et al. (2007) in support of rainwater tanks providing good quality water. Our reading of the paper differs. The paper reports that 7.8% of water samples obtained from tanks exceeded the Australian Drinking Water Guidelines for lead.

Our view is that the contamination of rainwater tanks by lead is of concern if tank water is to be used for drinking. Rainwater tank design, management and maintenance in urban areas needs to be improved to focus on reliable delivery of high quality water if tank water is to be routinely used as a potable supply.

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