BEFORE THE CANTERBURY REGIONAL COUNCIL

UNDER THE	Resource Management Act 1991
AND	
IN THE MATTER	of application CRC190445 by the Christchurch City Council for a comprehensive resource consent to discharge stormwater from within the Christchurch City area and Banks Peninsula settlements on or into land, into water and into coastal environments

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REBUTTAL EVIDENCE OF
PAUL CAMERON KENNEDY FOR CHRISTCHURCH CITY COUNCIL
Dated 30 October 2018

CHRISTCHURCH CITY COUNCIL
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INTRODUCTION

1. My full name is Paul Cameron Kennedy. I here provide rebuttal evidence for the Christchurch City Council (**Council**) in relation to the evidence of other experts on the Council's application for a comprehensive stormwater network discharge consent (**Application**). My qualifications and experience are as stated in my evidence in chief dated 15 October 2018.

2. I again confirm that I have read and agree to comply with the Code of Conduct for expert witnesses contained in the Environment Court Practice Note (dated 1 December 2014). I confirm that the issues addressed in the statement of evidence are within my area of expertise. I have not knowingly omitted to consider facts or information that might alter or detract from the opinions expressed. The Council as my employer has agreed to me giving this evidence on its behalf.

EVIDENCE RESPONDED TO IN THIS REBUTTAL EVIDENCE

3. I here respond to the evidence of

   - Mr Marcus Cameron on behalf of New Zealand Steel.
   - Ms Andrea Rickard on behalf of New Zealand Steel.

EVIDENCE OF MARCUS CAMERON

4. Mr Cameron identifies four concerns in his evidence and I have responded to each of these below.

Concerns with the accuracy and application of the contaminant load model:

5. In Paragraph 7.1, Mr Cameron has commented on the accuracy of the C-CLM without identifying any specific concerns and in paragraph 7.2 questions the ability of the model to predict current and future contaminant loads. In my evidence in chief and the evidence of Mr Van Nieuwkerk, we have identified the

base of the inputs used for the C-CLM. It was also identified that the model was used to compare the influence of treatment and management strategies on zinc yields based on a series of defined catchment source and yield parameters. For any given set of source types, areas and yields, the model will provide contaminant loads determined by the load reduction factors. As I described in my evidence in chief, the model can be improved to bring the pre-treatment yields closer to the true catchment or subcatchment yield by adjusting the source areas, yields from the sources and the treatment efficiencies (load reduction factors).

6. The C-CLM was set up to provide information about contaminant loads (and therefore discharge concentrations) and how these can be improved through treatment or management. The model was not set up to provide receiving environment contaminant concentrations to compare with attribute target limits (ATLs). The C-CLM does inform the catchment stormwater management plans (SMPs) as to how the ATLs can be met. Contaminant load modelling has been used previously to generate downstream concentrations as noted in my evidence in chief, but it is more appropriate to undertake receiving environment monitoring over time (as Council is currently undertaking and will undertake as set out in the Environmental Monitoring Plan described in the evidence in chief of Dr Margetts) to identify any measured change in environmental concentrations (in relation to the ATLs) and feed this back into the long-term catchment management strategy. As described in the evidence of Dr Margetts (Paragraph 27.7), Council is looking to assess the implementation of a receiving environment contaminant model.

The lack of a clear link between sources of contaminants and the proposed management response

7. Mr Cameron identifies that there does not appear to be a clear link between sources of contaminants and management response in relation to increased contaminant loads. I have assumed that the statement was made as a generic one given the use of the word “contaminants”. In my opinion the statement does not provide recognition of the large amount of information that there is available between specific contaminants, their chemistry, toxicology and the actual effects. Given the presence of a contaminant (e.g., zinc or copper or any other contaminant) derived from an identified source, then there is potentially a

defacto relationship between the source and a potential effect (assuming that toxicity and fate of the specific contaminant combine to have an effect). Classic examples that have been to the fore in New Zealand include the relationship between lead in various products like paint and children's toys; house wall paints and human health (associated with house renovations etc); mercury in fish and human health. I have identified these just to provide more visible examples.

8. Analysis of zinc concentrations in the runoff from roofing products has shown that there are significant differences in the concentrations discharged (both first flush and steady state) from different metal-based roofing materials. The differences are greatest when the discharge concentrations from historic "galvanised iron" is compared with more recent metal roofing materials (these include metal tile, painted aluminium zinc alloy coated steel, unpainted aluminium zinc alloy coated steel), all produced in the last 20 years. Shedden (2015) indicated that the zinc loss rates used in the CLM were reasonable figures. Due to the significant difference between the zinc yield for galvanised iron in various states of weathering compared to the more recent roofing materials (refer Kingett Mitchell 2004), it is my opinion that the identified proportion of older galvanised iron within catchments can have a significant influence on zinc loads as 1 m^2 of older galvanised iron can contribute seven to ten times that of the more recent metal roof types. Secondary to the identification of areas of older galvanised iron is identifying the proportion of other steel roof types as in some catchments with significant roofing areas, the contaminant load contribution can be significant.

9. Mr Cameron has been involved in a range of studies over the years that have examined the presence of the key urban trace elements copper and zinc in Auckland sediments (e.g., Mills et al. 2012, who described trends in coastal sediment contaminant concentrations up to 2010 in Auckland). That monitoring work focussed primarily on copper and zinc as elevated concentrations had been observed in urbanised estuaries. In Paragraph 8.2, Mr Cameron refers to the evidence presented by Dr Ogilvie to the Proposed Unitary Plan Hearings (Ogilvie 2015) "that there is already a generally decreasing load of zinc to urban waterways". Dr Ogilvie in his evidence refers to the evidence of Dr Shedden presented to the same hearing (Shedden 2015) who, "confirms an overall decreasing trend" [in stream water concentrations]. It should be noted that the trends described by Dr Shedden (based on Shedden 2014) were for total zinc

and no trend analysis was carried out for dissolved zinc. The analysis carried out in Shedden (2014) did assess the effects of flow as flow and associated suspended solids changes are covariates that may influence trend detection. However, examination of the trends seen in zinc concentrations in Auckland stream does not in my opinion provide direct evidence of changes associated with changes in roofing materials as the Auckland monitoring of stream water quality sampling was carried out predominantly under normal stream flow conditions. Information linking changes in stormwater quality arising from changes in roofing types could have only come from stormwater discharge monitoring within catchments where roofing types were known. As far as I am aware no such monitoring has been carried out over time. Overall, the trends described in the evidence referenced b Mr Cameron do not in my opinion directly demonstrate that presumed changes in roof types in urban areas have already been reflected in stream concentrations in Auckland (and therefor potentially in Christchurch). It is likely however that re-construction post-earthquake in Christchurch has resulted in changes in zinc yield in some subcatchment where older iron roofing has been replaced with modern roofing materials.

10. Dr Shedden made similar comments about zinc in coastal sediment trend data comparing his assessment with that of Dr Cameron (on behalf of Auckland Council) to the same hearing. The overall comment made was that most marine sites in Auckland (50 of 61 sites monitored) do not display significant changes in zinc concentrations. However, many of the sites that fall into the no-change category are either rural, have residential only catchments or have sediment with low mud content. That is, many sites would not be expected to exhibit changes. Any assessment has to be made based on partitioning the sites into subgroups based on catchment type. Mills et al. (2012) discussed difficulties in data variability that influence trend determination. As I noted earlier, the sediments described by Dr Shedden were coastal. Dr Margetts described the information collected by Council to date on contaminants in Christchurch stream sediments in her evidence.

11. The zinc yields used in the CLM are derived from data obtained from real roofs and artificial roofs (field trials of new roofing types). The older weathered galvanised iron data comes from real roof information. Most of the data for newer roof types comes from artificial roofs. It is my opinion that the CLM does

not account for the weathering/aging of newer roof types and as a result it is likely that there is some under-estimation of zinc yields from newer roof types. This may under-estimate roofing related zinc yields in the future scenarios assessed by the C-CLM. I note that although Shedden (2015) states that weathering of aluminium zinc coated surfaces reduces yields, it is likely that there are a range of factors influencing long term yields from newer steel roofing products.

12. Overall, in relation to Mr Cameron's comment about the lack of a clear link between sources of contaminants and the proposed management response, it is my opinion, that there is there is sufficient information to indicate that the major sources contributing to stormwater zinc concentrations are roofing and road related sources. Management strategies to reduce zinc on the basis that zinc is a contributor to increased contaminant concentrations in waterways (especially sediment) should in my opinion include consideration of the most appropriate ways to reduce the loads.

The blanket approach to a limited number of drivers of ecosystem health

13. In paragraphs 9.1 through 9.3 Mr Cameron considers that there is a blanket approach to using a limited number of contaminants in modelling and monitoring without addressing other drivers that have known effects on aquatic well-being. He considers that this narrow focus may render some management approaches ineffective and not provide the outcomes sought by the community.

14. It is correct that in dealing with key stormwater contaminants the Council has focussed on suspended solids, copper and zinc. This is not unusual and in dealing with contaminants this was the focus the Auckland Council has taken. Many catchment management assessments in the Auckland region used these contaminants to map potential changes over time (for example refer Moores & Cameron 2015). Those catchment management assessments did not ignore other upstream factors such as erosion, fish passage etc. that influence overall ecosystem health within stream environments. Council includes a range of environmental drivers through proposed water, sediment and ecological quality monitoring as described by Dr Margetts.

Other sources of zinc

15. I agree with Mr Cameron that there are many sources of zinc in the environment. Urban sources of zinc have been overviewed in reviews such as Golding (2006), Kennedy & Sutherland (2008) and CSQA (2015) and estimates of where the zinc load in stormwater is derived from are based on mass loads utilising a wide range of data and load estimate methods. The proportional estimates derived however, all have some degree of catchment specificity depending on the landuse and the presence of major roads and motorways within the catchment. For example, Kennedy & Sutherland (2008) provide estimates of zinc load contributions for three catchments of different land-use in Auckland that indicate that the roofing associated load ranged from 42.5 to 75 % of the total. The contributions from other major sources had high levels of uncertainty. NCWM (2008) examined diffuse sources of zinc in the Netherlands. They estimated that the total stock (zinc contributing surfaces) in 2006 (expressed as surface area) ranged from 27 km^2 for building roofs, 10.7 km^2 for highway barriers to 19.7 km^2 for all other sources (construction uses, facades, greenhouses, nuts and bolts, street furniture, fencing and vehicles and trailers). Overall zinc related roofing made up 47 % of the zinc sources on a surface area basis. It should be noted that not all sources of zinc contribute directly to stormwater. Water running off many galvanised surfaces (fences, building sides etc.) may discharge in some locations to ground. Overall in any subcatchment the roofing related contribution varies significantly from a low proportion to a high proportion (e.g., in an industrial catchment). I agree that stormwater contaminant at source or treatment efforts need to be proportionate to source contributions.

16. Finally, in paragraph 10.3, Mr Cameron, restates Dr Ogilvie's 2015 evidence (Ogilvie 2015) that restrictions on the use of certain roofing materials would result in only a marginal zinc reduction compared to market driven change. As I described earlier, it is my opinion that management of older forms of galvanised steel are likely to be more important in the short to medium term in terms of reducing zinc yields within catchments from building products. Although market driven change will slowly reduce the proportion of older roofing materials, there is no control over the timelines involved. This is not in my opinion an effective way to meet the objectives of improving downstream water quality and ecosystem health.

EVIDENCE OF ANDREA RICKARD

17. In the introduction of Ms Rickards evidence, I noted the statement in para 9.4 that "*there is little or no clear evidence of a linkage between relative sources of contaminants and their actual and potential environmental effects*". This statement was also made by Mr Cameron in his evidence. I provide my response to this statement in my rebuttal evidence above, where I have indicated that the statement made by Mr Cameron is very generic and is not supported by environmental information on the negative roles that contaminants such as zinc have in receiving environments when they are present in higher concentrations.

18. In paragraph 17 of her evidence Ms Rickard notes that "in relation to the iterative process for the development of SMPs, there appears to be a degree of detailed reliance on the C-CLM to assist Council in understanding effects from stormwater runoff and treatment device efficacy over time" and that this will inform "formulation of the SMPs and determine achievement of detailed load reduction targets". To clarify, the C-CLM does not provide direct information on effects, and the C-CLM does not provide information on the actual effectiveness of installed treatment as that is determined through field investigation and that data used in the C-CLM. Instead, the direct information on effects comes from the receiving environment monitoring, which are part of the proposed conditions of the application. The C-CLM is well placed to inform the SMPs as the model looks at hypothetical improvements across a catchment from combinations of planned stormwater infrastructure. The model can only provide data on potential improvements in stormwater contaminant loads that may then be seen as downstream improvements (measured through monitoring being carried out by Council as a condition of consent).

PAUL CAMERON KENNEDY

30 October 2018

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