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

---

STATEMENT OF EVIDENCE OF DR BELINDA ISOBEL MARGETTS FOR CHRISTCHURCH CITY COUNCIL

Dated 15 October 2018

CHRISTCHURCH CITY COUNCIL
PO BOX 73015
Christchurch 8154
Solicitor Acting: Brent Pizzey
Tel 64-3-9415550
Brent.Pizzey@ccc.govt.nz

TABLE OF CONTENTS

INTRODUCTION

1. My full name is Belinda Isobel Margetts. I have been requested by the Christchurch City Council (**Council**) to give evidence in relation to the application for a comprehensive stormwater discharge consent.

2. I hold a Bachelor of Science First Class Honours degree (majoring in Zoology) from Canterbury University and a PhD in Ecology from Lincoln University.

3. I am employed as a Waterways Ecologist with Council. I have worked in the role for the past five years. My work is centred on managing the waterway ecology monitoring programme, and providing advice on ecological effects on waterways (including coastal areas) and how to improve waterway health.

4. I have over fifteen years' experience working as an ecologist in research institutes, consultancies, and regional and local councils, within New Zealand, Ireland and Africa. The majority of this work has been in the realm of freshwater ecology research and resource management. I am a member of the New Zealand Freshwater Sciences Society.

5. I have particular experience in assessing the effects of stormwater discharges on receiving environments. I was a consent planner at Environment Canterbury for a number of years, where I specialised in processing consents for discharges to land and into water, including stormwater discharges. I have also been required to assess and advise on stormwater effects and monitoring through my role at Council, which has developed my knowledge base further.

6. I have been asked by Council to provide advice on the effects of the proposed discharges on surface water quality and ecology. In particular, I have developed the sections of the proposed conditions (e.g. those relating to mitigating effects on the receiving environment and the associated Schedules) and Environmental Monitoring Programme (**EMP**), a draft of which was provided with the Application, relevant to waterways and coastal areas. I have been involved in the

Comprehensive Stormwater Network Discharge Consent (referred to throughout my evidence as the **Application**) since its inception.

7. I 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 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 has agreed to me giving this evidence on its behalf.

SUMMARY OF EVIDENCE

8. My evidence relates to effects on surface water quality and ecology of waterways and coastal waters, and the related proposed conditions, including the EMP, of the Application.

9. My evidence does not extend to groundwater and springs, which is covered by the evidence of Mr Peter Callander.

10. In particular, this evidence covers:

    10.1 An overview of the state of the receiving environment;

    10.2 An overview of the effects of stormwater discharges on aquatic ecosystems;

    10.3 The philosophy of the proposed conditions and the EMP, and how these will give certainty that the effects of stormwater on waterways and coastal waters will be minor, when assessed against the existing state of the receiving environment;

    10.4 A discussion on the likely recovery of the receiving environment, due to ongoing reductions in contaminant loads;

    10.5 Comments on particular planning issues;

10.6 Responses to issues identified in the submissions and the Canterbury Regional Council (**Environment Canterbury**) s42A report, relevant to surface water quality and ecology;

10.7 An update on the mana whenua values monitoring gaps;

10.8 The proposed changes to the conditions and the EMP to address issues identified (1) in the s42A report, (2) during discussions with Mahaanui Kurataiao Limited (Mahaanui) and (3) during the preparation of this evidence. No changes are proposed in response to any of the lodged submissions;

10.9 An assessment of the appropriateness of the proposed consent duration; and

10.10 An overall conclusion regarding the effects on waterways and coastal areas due to the proposed consent.

11. I have read the following documents when preparing this evidence:

11.1 The Application, further information and amendments;

11.2 Relevant scientific and technical documents, with the pertinent ones referenced within this evidence;

11.3 Council and non-Christchurch City Council stormwater consent documents (e.g., Tauranga City Council, Invercargill City Council and Dunedin City Council);

11.4 Relevant planning documents, including, but not limited to, the Canterbury Land and Water Regional Plan (**LWRP**) (Environment Canterbury, 2018), Waimakariri River Regional Plan (**WRRP**) (Environment Canterbury, 2017) and Regional Coastal Environment Plan (**RCEP**) (Environment Canterbury, 2005);

11.5 The submissions relevant to surface water quality and ecology (as well as others); and

11.6 The Environment Canterbury s42A report, including the associated supporting technical reports.

12. In summary, to assess effects on the receiving environment for a specific individual discharge, one would assess likely concentrations of contaminants, the levels following mixing at a specific location in the receiving environment, and whether the resultant concentrations would meet the respective guidelines or standards. Given the Ōtautahi/Christchurch and Te Pātaka o Rākaihautū/Banks Peninsula (**BP**) wide approach of this consent application, I cannot specifically assess likely effects at every given discharge location into the receiving environment. Instead, I have summarised what the current issues are within the receiving environment, what levels under the proposed consent would indicate whether effects are mitigated (the Attribute Target Levels (**ATL**)), as measured at the representative sites in the EMP, and relied on the best practice measures of the 'mitigation toolbox' (as described in the following sections) to address the meeting of these ATL.

13. Given the current state of the receiving environment, and the 'mitigation toolbox' proposed, which will result in an overall improvement in contaminant loads from stormwater discharges, I consider there will be minor effects on surface water quality, instream sediment, aquatic ecology, and mana whenua values (including mahinga kai) of waterways and coastal areas. This is especially true in areas where maximum development is already occurring with predominantly untreated stormwater discharges, and retrofitting of treatment devices and source control will occur (e.g., the Avon River catchment).

14. I consider that a consent duration of 25-years is appropriate, with regard to matters that are within my area of expertise. This is due to:

14.1 the appropriateness of the proposed 'mitigation toolbox';

14.2 the responses to the monitoring condition requiring any issues in the receiving environment to be addressed at the time; and

14.3 the likely timeframe for the receiving environment to recover.

STATE OF THE RECEIVING ENVIRONMENT

15. The Application provides detailed background information on all the receiving environments for the proposed activity within Ōtautahi/Christchurch and BP. This information is therefore not repeated here. However, **Appendix A** of this evidence provides (1) updated monitoring information since the application was lodged, and (2) additional information that I consider important to the application. This assessment is based on the guidelines and ATL lodged with the consent Application in July, not the proposed changes detailed throughout the evidence to address any concerns raised following this (e.g. in the s42A report). A brief summary of this information is presented below.

16. Surface water quality monitoring of Ōtautahi/Christchurch river catchments indicates that the contaminants of greatest concern are nitrogen, phosphorus and *Escherichia coli*, and that 98% of sites do not meet the guideline level for at least one of the parameters assessed (Margetts & Marshall, 2018). Water quality monitoring in BP Rivers indicates issues with phosphorus and *E. coli* in rural and urban areas (Environment Canterbury, *unpublished data*[1]). Water quality in the Ihutai/Avon-Heathcote Estuary and Pegasus Bay ranges from 'very poor' to 'very good' (Bolton-Ritchie, 2017). A pilot study of BP coastal waters generally recorded low levels of dissolved metals and Total Suspended Solids (**TSS**) (Christchurch City Council, *unpublished data*).

17. Instream sediment quality monitoring of Ōtautahi/Christchurch River catchments indicates that contaminants of greatest concern are zinc, lead and Polycyclic Aromatic Hydrocarbons (**PAH**). Sediment quality was generally worst in the Ōtākaro/Avon River catchment, with 33% of samples not meeting the 'guidelines for copper, zinc, lead or PAH. Metals in the Ihutai/Avon-Heathcote Estuary

[1] Sourced from Land, Air, Water Aotearoa website

sediments were all below the respective guidelines; however, the guideline for PAH was exceeded at some sites (Christchurch City Council, unpublished data 2016; Bolton-Ritchie & Lees, 2012). There is no available instream sediment data for BP waterways.

18. Based on the Quantitative Macroinvertebrate Community Index (**QMCI**), the majority of sites in Ōtautahi/Christchurch Rivers are of 'poor' quality (QMCI of <4.00); however, a small number of sites are of 'good' (QMCI of <5.00-5.90) or 'excellent' (QMCI of >5.99) quality. There are a number of biota present within Ōtautahi/Christchurch waterways that fall within the 'Threatened' or 'At Risk' categories of the Threat Classification System (Dunn *et al.*, 2018; Grainger *et al.*, 2014). Invertebrate species present in the Ihutai/Avon-Heathcote Estuary are snails/shellfish, worms, crustacea, anemones, sea spiders and ribbon worms, while the most abundant fish were either pelagic or flounder (Woods *et al.*, 2016; Bolton-Ritchie, 2016).

19. Overall, the issues facing Christchurch waterways are not unique. The state of the receiving environment is typical to that recorded worldwide in urban areas, with ecological degradation recorded in waterways that drain urban land (Walsh *et al.*, 2005).

POTENTIAL EFFECTS ON THE RECEIVING ENVIRONMENT

20. Hydrocarbons, metals (such as copper, lead and zinc), sediment, nutrients (nitrogen and phosphorus) and faecal bacteria are often prevalent in urban stormwater (Sansalone & Buchberger, 1997; Vaze & Chiew, 2002; Packman, 2014). Ammonia, pesticides and trace organics (such as plasticisers and surfactants) can also be present, depending on the surrounding land use. Stormwater can also affect the general chemistry of the water, such as dissolved oxygen, pH, temperature and biochemical oxygen demand levels.

21. Within aquatic ecosystems, these parameters can have short-term (acute) and long-term (chronic) adverse effects on biota (e.g., ammonia, copper, zinc, sediment, dissolved oxygen, pH, temperature and biochemical oxygen demand),

encourage the proliferation of aquatic plants and algae (e.g., nitrogen and phosphorus), indicate human health risks from contact recreation (e.g., *E. coli*), and affect water clarity and aesthetics (e.g., sediment) (Margetts & Marshall, 2018).

22. Metals can be toxic to aquatic organisms, negatively affecting fecundity, maturation, respiration, physical structure and behaviour (Harding, 2005). These are essential trace elements for animals, plants and micro-organisms, but at high concentrations have toxic effects that can be lethal (causing death) or sub-lethal (e.g. causing reduced growth or deformities). With respect to the key stormwater contaminants of copper and zinc:

    22.1 Copper toxicity affects a range of biochemical processes in animals and prevents photosynthesis and growth in plants, while zinc toxicity occurs by interfering with calcium transport in the body (Gadd, Milne & Hickey, 2017). Different species have varying tolerance to copper and zinc. Sensitive species are no longer able to survive as concentrations increase, therefore impacting on the diversity and functioning of an ecosystem.

    22.2 Copper is more toxic than zinc for algae, invertebrates and fish. For copper, the most sensitive taxonomic groups are algae and the larval stage of freshwater mussels (Glochidia) (Gadd, Milne & Hickey, 2017). For zinc, water fleas are the most sensitive taxonomic group followed by fish (Gadd, Milne & Hickey, 2017). Copper and zinc toxicity varies with water chemistry, with factors such as water hardness, the amount of dissolved organic matter, and pH levels all affecting how easily copper and zinc can be taken into the organism to cause toxic effects (Gadd, Milne & Hickey, 2017).

    22.3 Unlike other contaminants, metals such as copper and zinc do not breakdown over time. Various proportions of the copper and zinc released in stormwater will remain in the water column, accumulate in the bottom (benthic) sediments of streams and estuaries, or build-up within organisms themselves. It is important to reduce the concentration of copper and zinc in stormwater discharges so that the water and benthic sediment concentrations in streams and estuaries are low, allowing sensitive species

to remain and thrive, thus protecting aquatic biodiversity and ecosystem resilience (Gadd, Milne & Hickey, 2017).

23. Sediment, the other key stormwater contaminant for the monitoring proposed for this consent, can decrease the clarity of the water and can adversely affect aquatic plants, invertebrates and fish (Crowe & Hay, 2004; Ryan, 1991). For example, sediment can affect photosynthesis of plants and therefore primary productivity within streams, interfere with feeding through the smothering of food supply, and can clog suitable habitat for species (Crowe & Hay, 2004; Ryan, 1991). Sediment can also accumulate contaminants, such as metals. When contaminated sediments reach toxic levels, the abundance and diversity of the community can be affected (Gadd & Sykes, 2014; ANZECC, 2000a).

24. The effect of high levels of contaminants on an organism can be dependent on whether the exposure is acute or chronic. Biota can generally tolerate higher contaminant levels during acute exposure, due to the shorter timeframe, but effects can be lethal. Chronic effects are usually more subtle, and can manifest through reduced growth rates and reproductive impairment (Gadd, Milne & Hickey, 2017).

25. Urbanisation and associated stormwater discharges can also affect the normal flow rates of a waterway. Urban streams tend to be 'flashier' than non-urban streams, meaning that they have more frequent and larger flow events, with faster ascending and descending hydrograph limbs (Walsh *et al.*, 2005). Studies have shown that peak flows increase, minimum flows are more variable, duration of near-bankfull flows decline and flow variability increases (Poff, Bledsoe & Cuhaciyan, 2006). The driver behind these flow changes is increased areas of impervious surfaces and more efficient transport of runoff from these surfaces by stormwater systems that drain directly to streams (Walsh *et al.*, 2005; Elliot *et al.*, 2004). These large flows can also have erosive effects (Walsh *et al.*, 2005; Elliot *et al.*, 2004). Reductions in baseflows of waterways can also occur due to reduced infiltration from increased catchment imperviousness, which can in turn affect water quality in such ways as increasing water temperature and reducing oxygen levels (Walsh *et al.*, 2005; Elliot *et al.*, 2004), as well as reducing available habitat for biota. Over time, stormwater discharges can also affect the morphology of

waterways, in response to long-term sediment supply and flow regimes (Walsh *et al.*, 2005; Elliot *et al.*, 2004). Flow is considered one of the most important variables for stream ecosystems, because flow affects so many aspects of stream habitat, such as water chemistry, water depth and channel form, and some species cannot tolerate high velocities and are washed away (Elliot *et al.*, 2004). Invertebrate communities in New Zealand are dominated by organisms that can tolerate extremes of both low base flows (with associated high temperatures, low dissolved oxygen, and excessive algal or macrophyte growth) and high flood flows (with associated sedimentation and scouring, high velocities and lack of instream shelter) (Suren, 2000).

26. A literature review on the ecological responses to altered flow regimes worldwide concluded that 'flow alteration is associated with ecological change and that the risk of ecological change increases with increasing magnitude of flow alteration' (Poff & Zimmerman, 2010). A number of generalised effects were recorded in response to the removal of extreme low and high flows, changes in peak flows, a reduction in the duration of floodplain inundation and shifts in the seasonality of peak flows. These effects included:

- A reduction in available habitat;
- The loss of sensitive and native species, reduced diversity, altered community structure and dominance of taxa, reduced abundance, and increased abundance of non-native species;
- Life cycle disruption, disrupted spawning cues, reduced reproduction and recruitment, and changes in juvenile fish assemblage.

PHILOSOPHY OF THE CONDITIONS AND THE EMP

Basis of Proposed Approach

27. With respect to the effects on the receiving environments of waterways and coastal waters, the philosophy of the conditions and the EMP are based on that of

previous stormwater consents, such as the Styx Stormwater Management Plan (**SMP**) and the South-West SMP. The approach is also based on monitoring that has been undertaken by Council for decades, which has primarily occurred for consent compliance (e.g. stormwater consents), but also state of environment monitoring. Monitoring in the past has typically focussed on regular monitoring of waterways within Ōtautahi/Christchurch and the Ihutai/Avon-Heathcote Estuary, as well as one-off studies within other coastal waters and waterways of BP. The Application further builds on this basis by providing:

27.1 More detailed conditions and information around proposed Attribute Target Levels (**ATL**);

27.2 Monitoring of more receiving environments (e.g. Council has not previously monitored coastal environments or BP waterways as part of a stormwater consent);

27.3 Additional monitoring of sites in receiving environments that the Council already monitors and moving of some monitoring sites to provide more useful overlap in monitoring aspects (i.e., aligning of water quality, instream sediment and ecology);

27.4 More up-to-date and detailed scientific techniques for monitoring;

27.5 A detailed mana whenua values monitoring programme;

27.6 Responses to monitoring if certain ATL are not met; and

27.7 A stormwater quality investigation programme to further enhance the current understanding of how to mitigate the effects of stormwater on receiving environments. Of particular relevance to effects on waterways and coastal waters is the:

- Development of an instream contaminant model that builds on the Christchurch Contaminant Load Model (**C-CLM**), to determine

contaminant concentrations (and therefore effects) in the receiving environment (Condition 37, Items 1-3 of Table 3);

- Study into predicting responses in the receiving environment to changes in contaminant loads (Condition 37, Items 4-5 of Table 3) – I will be leading this study; and

- Study into how the Council might address adverse effects on the receiving environment due to sediment cover and contamination (Condition 37, Items 7-8 of Table 3) – I will also be leading this study.

Key Conditions of Consent

28. The key conditions in the consent relating to the effects of stormwater on waterways and coastal waters are (referring to the Application numbering):

28.1 Condition 20 (including Schedules 4 and 5):

The consent holder shall use reasonable endeavours to mitigate the effects of the discharge of stormwater on surface water quality, instream sediment quality, aquatic ecology health and mana whenua values. The extent of mitigation of effects shall be measured by the Receiving Environment Objectives and Attribute Target Levels monitoring described in Schedules 4 and 5;

28.2 Conditions 42 – 48, which pertain to the EMP, and how it will be implemented and updated where required to remain relevant. The purpose of the EMP is to determine whether Condition 20 (specifically the ATL) are being met;

28.3 Condition 51, which details what the responses to monitoring will be if key ATL (TSS, copper, lead and zinc) are not met, initially starting with investigations and reporting, and then carrying out remediation where relevant (this is discussed in further detail in the sections below); and

28.4 Condition 53 (a,b,l and m), which details how the monitoring and investigations will be reported annually.

29. Schedules 4 and 5 of the consent conditions pertain to the Receiving Environment Objectives and ATL. The philosophy behind these schedules was to have:

29.1 An overarching objective to be clear what the Council is aiming to achieve;

29.2 An attribute, which is a specific variable of the objective that can be measured;

29.3 An ATL, to give an indication of whether the objective has been met; and

29.4 A basis (or source) for the target, so that (1) it is clear where the targets have come from without having to source original consent documents or read the EMP, and (2) some background information is provided on what broad measures would be required to improve attribute levels to meet the targets.

30. Mitigation of flow effects on waterways, as discussed in the 'Potential Effects on the Receiving Environment' section, will be addressed in the SMPs through best practice stormwater mitigation, such as ensuring pre-development flows and baseflows to streams are maintained, and discharging to ground where possible. This is addressed in part in the evidence of Mr Norton, Mr Cantrell and Mr Callander.

31. The EMP also includes detailed monitoring of a range of many other attributes that are not included in Schedules 4 and 5 of the consent conditions. These include additional water quality monitoring (e.g. of ammonia, nitrogen and phosphorus) of waterways and coastal areas, and habitat, fish and invertebrate monitoring of waterways. This additional monitoring provides useful extra information on the state of the receiving environments. The consent annual monitoring report will also incorporate a summary of this extra monitoring – including comparisons to guidelines levels, and spatial and temporal trends.

32. In my opinion, it is not reasonably possible to monitor the receiving environment at every location affected by stormwater discharges, or even every receiving body given the large number of waterways present. I also note that many waterways, such as the Avon and Heathcote River, have many stormwater outfalls, so the concept of monitoring effects of individual discharge locations is challenging. As such, the proposed sites under the EMP are representative sites that give an indication of effects across the City. These sites are a combination of hotspot areas where effects from stormwater discharges are known to be high (e.g., Curletts Road Stream and Haytons Stream) and areas where ecological values are known to be higher (e.g., Cashmere Stream).

33. I consider this representative monitoring will provide a good overall indication of how well the 'mitigation toolbox' (as described in the section below) is mitigating effects on the receiving environment. It will allow areas subject to high levels of contamination to be identified and prioritised, with our knowledge further growing from these case studies. The monitoring will allow the effects within key sub-catchments and land use types to be identified, and will generally allow reasonable conclusions to be drawn about changes over time due to reduced stormwater loads. The breadth of the monitoring allows all aspects of the receiving environment to be assessed. In particular, monitoring of both surface water and instream sediment will improve the Council's ability to identify short-term (within the surface water) and long-term (within the instream sediment) changes when they occur.

34. The proposed monitoring under the EMP (and even the monitoring that occurs currently for consenting and state of environment purposes) is one of the most detailed programmes in New Zealand to my knowledge. This monitoring gives a comprehensive understanding of our receiving environments not just for Council, but Environment Canterbury and other stakeholders. For example, it is proposed to monitor 53 surface water quality sites, 45 instream sediment quality sites, 75 aquatic ecology sites and 35 mana whenua values sites, at a substantial cost to Council (further additions to this monitoring is proposed throughout this evidence to address recommendations of the s42A reports). This demonstrates the significant importance and commitment Council puts towards understanding the health of the receiving environment and how effects of activities may be mitigated.

Past monitoring has given us a unique amount of very detailed and useful information for this consent application.

Mitigation Toolbox Approach

35. There are a number of best practice mitigation measures proposed in the consent conditions that I collectively refer to as the 'mitigation toolbox'. Each one in isolation has benefit, but together, I consider they provide a robust approach to mitigate the effects of stormwater on aquatic ecosystems, given the complexity of doing so. These measures include:

    35.1 SMPs and their best practice approach to the treatment of stormwater;

    35.2 An implementation plan to allow effective execution of the SMPs;

    35.3 Stormwater contaminant load modelling through the C-CLM, which will allow a relative understanding on whether the quality of the discharge is improving and what scenarios will yield the best load reduction;

    35.4 The Other Actions detailed in Conditions 35-38, which include items such as stormwater quality investigations, source control lobbying and educational programmes;

    35.5 Specific measures to address erosion and sediment control, which is important given the frequent incidences of sediment discharges and the effects this can have on receiving environments;

    35.6 The responses to monitoring conditions, to ensure that potential effects in the receiving environment due to the key stormwater contaminants of sediment, zinc and copper, are identified, prioritised and remediated as soon as practicable; and

    35.7 Engagement with stakeholders, including papatipu rūnanga, zone committees, and community boards, allowing the incorporation of community knowledge and expectations.

Appropriateness of the Attribute Target Levels

36. I consider that the proposed ATL, and the methods of measuring these attributes and others as set out in the EMP, are the most appropriate way of determining the health of the receiving environment and whether the effects of the proposed stormwater discharges have been mitigated. In particular, I note:

36.1 For attributes included in the LWRP or the RCEP, the ATL are the standards in those respective plans. For waterways, these standards under the LWRP often vary depending on the classification of the waterway, which is largely based on the relative sensitivity and ecological value of the receiving environment. For example, waterways classified as 'Banks Peninsula' waterways in the LWRP require higher standards to be met than those classified as 'spring-fed – plains – urban' waterways (e.g. the Avon and Heathcote Rivers). These variations are reflected in the ATL;

36.2 Where an attribute is not included in the LWRP or RCEP, the ATL is developed from other relevant guidelines, or the targets have been developed specifically for this consent where no guidelines are available. The source of each ATL is detailed in the 'Basis for Target' information within Schedules 4 and 5. The exceptions of note to the regional plans are:

- The ATL for TSS in surface water for coastal waters: no guidelines from any source were available. Following consultation with Dr Lesley Bolton-Ritchie (Senior Scientist at Environment Canterbury), an ATL of no statistically significant increase in concentrations was proposed by the Council. I consider this is a conservative proposal to ensure that stormwater discharges do not have an adverse effect on the receiving environment. In contrast, the Tauranga, Invercargill and Dunedin City Council stormwater consents do not have a target for TSS. The ATL for this consent application can be updated to account for the development of a guideline level in the future as per Condition 46;

- The ATL for TSS in surface water for waterways: this level is based on a non-LWRP guideline of 25 mg/L (Hayward, Meredith & Stevenson, 2009; Stevenson, Wilks & Hayward, 2010), which I consider is conservative from an effects perspective. As such, this guideline has been proposed as the ATL for baseline conditions, but a target of 100 mg/L during wet weather was also proposed, due to naturally more turbulent conditions and background concentrations during wet weather. I note that the Tauranga City Council stormwater discharge consent had a less conservative target of 150 mg/L. The Invercargill and Dunedin City Council stormwater consents do not have a target for TSS. If a more appropriate guideline becomes available in the future, the ATL can be updated as per Condition 46 of the consent. I also note that the Applicant has proposed an additional ATL of no statistically significant increase in concentrations, to ensure that even if levels are below the above ATL, levels do not increase. I consider this is a very conservative proposal that will ensure that any additional effects on the receiving environment will be identified early;

- Zinc, copper and lead concentrations in surface water for waterways: The LWRP standards are the default, non-hardness modified versions of those detailed in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC, 2000b), which is the principal guidelines document in New Zealand for freshwater and coastal areas. Hardness affects the toxicity of metals and therefore the Guidelines recommend modifying these targets to account for local hardness levels to determine a more appropriate site-specific target (ANZECC, 2000b). This approach has been used for many years by Council and is considered acceptable by Environment Canterbury. The methodology for hardness modification follows a specific technique ANZECC (2000b), as detailed in Appendix C of the EMP; and

- Mana whenua values: there are no guidelines available for these ATL. I discuss development of these targets in further detail below;

36.3 The Ōtūkaikino River is covered by the WRRP instead of the LWRP. However, the standards in the WRRP in my opinion are predominantly descriptive, less measurable and less guidelines based than the LWRP (although the LWRP does include similar descriptive standards as well). For example, the WRRP states that 'there shall be no statistically measurable impairment of the reproductive ability of fish or of the food of fish', rather than providing specific standards for toxicants. Meeting the LWRP standards will in my opinion mean that the overarching intent of the WRRP standards will also be met. I also consider it would be confusing to have a separate set of ATL and guidelines for this catchment alone. For these reasons, the proposed conditions classify these waterways into the most likely LWRP classification (spring-fed – plains) and incorporate them into the same monitoring framework as the other waterways; and

36.4 The WRRP states that the predecessor of the LWRP, the Natural Resources Regional Plan, covers the Styx River catchment. However, the LWRP has incorrectly classified the Styx River waterways as being covered by another plan and therefore no stream classification is given for this catchment. These waterways were classified as 'spring-fed – plains' in the NRRP and therefore they have been considered as such in the Application.

37. The Council has taken an additional conservative approach towards the ATL for TSS, copper, lead and zinc in surface water for waterways and coastal waters (Schedules 4 and 5 of the conditions). Not only are there targets relating to guideline levels, but the Applicant also proposes to have ATL of no statistically significant increase in levels. This will ensure that the quality of the receiving environment does not degrade, even if the ATL relating to guidelines are met.

38. Ms Stevenson considers that because the dissolved metal concentrations in the LWRP are based on chronic guidelines, these standards are most appropriate for comparison to the baseline monthly monitoring (email from Environment Canterbury (Michele Stevenson) to CCC (me), 2018). No acute guidelines are

currently available for wet weather monitoring assessments, and therefore use of the chronic standards for the wet weather monitoring is useful, but not required from a regulatory context (Email from Environment Canterbury (Michele Stevenson) to CCC (me), 2018). I consider use of the chronic standards for the wet weather monitoring would be very conservative, due to (1) comparisons being for one concentration from one event, instead of 95th percentiles of a longer dataset, such is the case with the monthly monitoring, and (2) it being more appropriate to compare to acute guidelines, which would likely be higher (i.e. less conservative) than chronic guidelines. For these reasons, I consider the proposal by Council to compare wet weather monitoring to the current chronic guideline levels, but that exceedances do not trigger the responses to monitoring condition, is appropriate. If acute guidelines are developed in the future, these can be incorporated, as per Condition 46 of the consent. I recommend that the Council proposes an amendment to the conditions to make it clearer that wet weather monitoring does not trigger the responses to monitoring condition. I do not recommend a change to the EMP, as this already refers to comparison to the monthly monitoring data only.

39. I have discussed the ATL and EMP with Environment Canterbury scientific staff (Dr Bolton-Ritchie and Ms Stevenson) throughout the Application process. I have recommended to the Council amendments to address any concerns raised by them throughout this process. Council has accepted these recommendations. The new or outstanding issues are detailed in the section of my evidence below regarding the s42A report.

40. The guidelines and ATL used within the Application (including those derived from the LWRP), are based on the best available information, but in some cases there is limited data and they are often not specific to Ōtautahi/Christchurch receiving environments. For example, some guideline values compare to a reference waterway where human impacts are low and therefore the guideline value level is considered to mean that adverse effects are unlikely; however, the actual ecological consequences at certain concentrations are unknown (ANZECC, 2000a). The ANZECC (2000) guidelines in particular are currently being updated to be more scientifically robust. Most of these guideline levels also do not indicate that an effect is occurring if they are not met, but that there is an increased risk,

and the next step is to carry out additional investigations to confirm this. This is made particularly clear within the ANZECC (2000) guidelines, with additional steps detailed on what these investigations might entail. This is an important distinction – not meeting targets does not necessarily mean an effect, just a higher risk of an effect, and further investigations are required to determine this. I have advised the Council to frame the conditions, including the ATL, in that context.

Responses of the Receiving Environment within the Scope of the Stormwater Consent

41. The ATL proposed in this consent cover a range of waterway health issues. Not all attributes will be affected specifically by stormwater discharges, or when they are, it is in conjunction with other influencers outside the control of Council. It is therefore difficult to determine causative links for these attributes and difficult to determine the effectiveness of specific mitigation instigated. In particular:

    41.1 QMCI and mana whenua values encompass effects on biota. Biota within receiving environments can be adversely affected by stormwater discharges. However, they can also be severely affected by the loss of favourable habitat, through such things as channelisation, the loss of riparian margins (Quinn *et al.*, 1992), and barriers to movement, such as culverts and weirs (Blakely *et al.*, 2006; Franklin *et al.*, 2018);

    41.2 Nitrogen and phosphorus contribute to the proliferation of aquatic weed (macrophyte) and periphyton (algae). Contaminated groundwater from instream springs is a major contributor of nitrogen within waterways, whereas stormwater typically has low levels (refer to **Appendix A** for more information); and

    41.3 Faecal source tracking has shown that waterfowl are the major contributor of *E. coli* within waterways (refer to **Appendix A** for more information).

42. The ‘Responses to Monitoring’ condition (Condition 51) requires investigations to be carried out if certain ATL are not met. This could be a significant cost to the Council to determine the causes and carry-out remediation, but is an important feedback loop that was not present in previous Council stormwater consents. Due

to many of the ATL being outside the control of the Council, the responses to monitoring condition only pertains to the attributes directly affected by stormwater discharges – TSS, copper, lead and zinc in surface water. Lead is typically no longer an issue in surface water since the introduction of unleaded petrol (Margetts & Marshall, 2018). TSS is still affected somewhat by other factors outside the control of Council, such as private land use on the Port Hills or waterway bank instability.

43. The Council also used sediment, copper and zinc for the C-CLM for the same reasons. In addition, some of the attributes are not related directly to contaminant loads and are therefore unable to be modelled in the C-CLM (e.g., QMCI and sediment cover of the streambed).

44. These four key contaminants have the added benefit of giving an indication of hotspots of general contamination – effectively acting as overall indicators for areas where effects are occurring. In particular, these parameters correlate well with high levels of contamination from industrial and commercial land use, development and roadways as shown by the monitoring described in **Appendix A**. These contaminants can also be easily modelled and monitoring is relatively straight-forward. This indicator concept is also discussed in the evidence of Mr Clint Cantrell for Council. Although I note that they are not relevant as indicators for all contaminants, such as atypical contaminants potentially from the 'high-risk' and HAIL sites discussed in the Application.

45. Given the widespread deposits of sediment on the streambed (i.e., in some cases the entire lengths of waterways are affected), rather than including these attributes in the responses to monitoring condition, the Council proposes an investigation and potential remediation programme to mitigate these effects (Condition 37, Items 7-8 of Table 3). The investigation is also required as the potential ecological effects of sediment removal may outweigh the benefits or will need to be carefully mitigated. This covers the attributes of sediment cover of the streambed, and zinc, copper and lead concentrations in instream sediment. It is important to note that sediment cover and contamination are heavily impacted by historical accumulations and therefore there is a legacy component to addressing these stormwater effects, which is also outside the scope of this consent.

RECOVERY OF THE RECEIVING ENVIRONMENT

46. It is not straight-forward to assess how the receiving environment might respond specifically to reductions in contaminant loads from stormwater discharges. Whilst Council may be able to demonstrate that the quality of stormwater has improved through the C-CLM and that contaminant levels in surface water have reduced, this does not necessarily mean that the overall objectives, such as enhancing ecological and mana whenua values, will be realised. As discussed earlier in this evidence, the response of biota will be influenced by other factors, such as available habitat and barriers to movement, which are not effects of stormwater discharges. This may mean that even if stormwater has no contaminants present, biota will still be impacted due to other pressures and Council's goals of waterway health will still not be achieved. In addition, the current poor state of some of Ōtautahi/Christchurch's receiving environments means that even if Council avoids all effects on waterways, it may be difficult for source populations of biota to re-colonise areas.

47. The evidence of Mr Cantrell also discusses the complexity of causative connections between contaminant loads, flow changes and ecological benefits, based on his international experience in this space. His evidence builds on my own and I agree with his conclusions.

48. All this aside, this does not mean that research cannot provide useful information that could help guide how well the Council is doing in mitigating the effects of stormwater and when a response might occur in the receiving environment. As discussed in Mr Cantrell's evidence, there are some case studies to build on, such as those from Melbourne and Sydney. As such, the Council has proposed a similar investigation programme (Condition 37, Items 4-5 of Table 3). I consider this is an innovative proposal for a stormwater consent and is outside what would normally be required, given that it gives consideration to effects not attributable to stormwater alone.

49. It may take some time for aquatic ecosystems to respond to the reduction in contaminant loads. The timeframe for this is unknown, but it could take a decade or more for a shift to occur. There is not much information in the literature to guide

on expected timeframes for aquatic ecosystems to recover. I would expect this to be species, site and contaminant specific in any case.

50. One example is an American study that found that selenium in wastewater released to a lake from a coal electric generating facility in 1974-1985 caused severe reproductive failure and deformities of fish (Lemly, 1997). A survey eleven years after the ceasing of the discharge showed that contamination within the environment and the food chain had reduced, but the overall hazard risk had only dropped from high during the period the contaminant was released, to medium. Developmental abnormalities and reproductive impairments were still occurring, with concentrations of selenium in the food chain sufficient to cause mortality of fish. It was concluded that recovery was slow and that the contaminant was likely to be a significant issue to fish and aquatic birds for years to come.

51. Another example relevant to Ōtautahi/Christchurch waterways is the removal of leaded petrol in 1996. Council generally no longer records lead in surface water (Margetts & Marshall, 2018). However, lead is still present within instream sediments above guideline levels (Blakely, 2016; Gadd & Sykes, 2014; Gadd, 2015; Noakes, 2017; Burrell, 2018), therefore potentially adverse effects on biota are still occurring. The introduction of unleaded petrol as a case study is also discussed in the evidence of Mr Paul Kennedy.

PLANNING CONTEXT

52. I have detailed in the following sections my conclusions on particular issues relevant to the evidence of Ms Jane West.

53. Section 107(1)(c) to (g) of the Resource Management Act states that a discharge permit shall not be granted if the discharge, after reasonable mixing, is likely to give rise to any of these effects in the receiving water:

(a) the production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials;

(b) any conspicuous change in the colour or visual clarity;

(c) any emission of objectionable odour;

(d) the rendering of fresh water unsuitable for consumption by farm animals;

(e) any significant adverse effects on aquatic life.

54. However, Section 107(2) of the Act states that consent can be granted if these effects from a discharge are temporary in nature. I consider that once the 'mitigation toolbox' is implemented across each catchment, it is unlikely that the discharges will give rise to the above effects on a permanent basis after reasonable mixing (as defined in the LWRP).

55. Policy 6.1 of the WRRP states:

- protect the natural state of the water in lakes and rivers upstream of the confluence of the Waimakariri with the Otukaikino Creek;

- ensure water quality is suitable for drinking water for animals, contact recreation, fisheries, fish spawning, aquatic ecosystems and is not altered in those characteristics that have a direct bearing upon the aesthetic values of water or cultural values in the mainstem of the Waimakariri River downstream of the confluence with the Otukaikino Creek;

- ensure water quality is suitable for drinking water for animals, fisheries, fish spawning, aquatic ecosystems and is not altered in those characteristics that have a direct bearing upon the aesthetic values of water, in Otukaikino Creek downstream of the Groynes picnic area; and

- ensure that in the Otukaikino Creek and its tributaries at, and upstream of, the Groynes picnic area: water quality is suitable for drinking water for animals, fisheries, fish spawning, and aquatic ecosystems; the natural water quality with respect to organisms of public health significance is maintained; and water quality is suitable aesthetically and visually for contact, and other forms of, recreation.

56. I consider that the adoption of the proposed conditions, particularly the ATL (which determine the threshold of effects) and the 'mitigation toolbox', will mean that the Application is consistent with this policy.

57. Policy 4.16(e) of the LWRP states that the SMPs should demonstrate a commitment to progressively improve the quality of the discharge to meet the water quality outcomes, standards and limits for waterbodies set out in the LWRP, as soon as practicable, but no later than 2025. Of relevance to this Application are Tables 1 (Freshwater Outcomes for Canterbury Rivers), 10(a) (Freshwater Outcomes for Lake Forsyth / Wairewa Catchment Rivers to be achieved by 2030) and 10(d) (Water Quality Limits for Rivers in Wairewa Catchment), and Schedules 5 (Mixing Zones and Receiving Water Standards) and 8 (Region-wide Water Quality Limits) of the LWRP.

58. As discussed previously, these outcomes, standards and limits cover a range of waterway health issues. Not all attributes will be affected specifically by stormwater discharges, or when they are, it will be in conjunction with other influencers.

59. In my opinion, the range of measures proposed by the Council in the proposed consent conditions undoubtedly demonstrate a commitment to progressively improve the quality of the discharge. The key direct stormwater receiving environment standards referred to in this policy (sediment cover of the streambed, and copper and zinc within surface water), at the very least are currently not being met in some locations. Those proposed conditions commit the Council to significant work to reduce these contaminant loads, through both treatment devices and source control. Even with the instigation of these measures, it is very unlikely that Council will be able to meet these targets by 2025 or even in a medium term. Especially as I consider sediment removal may be required to meet the sediment cover target (see proposed mitigation in Condition 37, Table 3, Items 7 and 8).

60. The National Policy Statement for Freshwater Management 2014 (**NPSFM**) has not been specifically referenced in the proposed conditions and EMP in regards to receiving environment standards. This is because I consider adoption of the

LWRP standards, where they are available, is more appropriate for this consent application, and this will also generally be sufficient to address the NPSFM. I note that:

60.1 The NPSFM specifically instructs *regional councils*, in consultation with their communities, to set objectives and limits on resource use for waterways in their regions, to achieve the requirements of the policy.

60.2 The NPSFM requires objectives and limits to be implemented in the policies and plans of regional councils. These objectives need to include the compulsory values of the NPSFM (but these can be above the national bottom lines) and may also include any other values the regional council considers appropriate.

60.3 The relevant river NPSFM attributes to this consent application include periphyton, nitrate, ammonia, dissolved oxygen and *E. coli*.

60.4 These five NPSFM attributes are included in the LWRP, although some have different measurement techniques. The standards within the LWRP are in my opinion generally well ahead of the game, up with the latest guidance on environmental effects and are more conservative than the NPSFM. For example, the NPSFM has a national bottom line (based on annual medians) for nitrate of 6.9 mg/L and the LWRP has a standard of 3.8 mg/L. The LWRP also includes many more aspects than just these five NPSFM attributes.

60.5 I am aware that Environment Canterbury are assessing the compliance of the LWRP with the NPSFM (discussion between Environment Canterbury (Michele Stevenson) and CCC (me), 2018). Any amendments made to the LWRP to further address the current or amended NPSFM, or for any other reason, which consequently affect any of the proposed ATL of this consent, could be incorporated as an amendment to the EMP, as per proposed Condition 46.

RESPONSES TO SUBMISSIONS

61. I have grouped my responses to submitters together by issue rather than submitter. Therefore, some submitters appear more than once in the following section.

Avon – Heathcote Estuary/Ihutai Trust (AHEIT)

62. The AHEIT opposes the Application. Although they support the Receiving Environment Objectives, they would like the Council to commit to improving surface water quality, as maintaining the current poor quality is not considered acceptable.

63. The Council is no longer proposing to only maintain surface water quality in some catchments, as was proposed in the original application. The current proposal is to meet the ATL in all catchments, with responses to modelling and monitoring if targets directly related to stormwater (TSS, copper, lead and zinc) are not met.

Avon – Otakaro Network, Combined River Care Networks and Cashmere Stream Care Group (CSCG), Kyle Sutherland, and Joint Submission by Avon Otakaro Forest Park, Avon Otakaro Network, Greening the Red Zone and Travis Wetland Trust

64. These submitters all oppose the Application and disagree that the adverse effects on the receiving environment will be minor, as they believe this assessment should be based on the natural state of these environments, not the currently degraded habitat. They therefore consider the effects are significant. I note this is primarily a planning baseline issue, and is therefore discussed in further detail within the evidence of Ms Jane West and will be addressed in the legal submissions of Mr Brent Pizzey.

CSCG and Opawaho Heathcote River Network (OHRN)

65. Both of these submissions oppose the Application and state that using the current condition of the receiving environment is not an appropriate benchmark for setting standards for the next 25 years. I note the following points in response.

66. The proposed conditions do not measure against the current quality of the receiving environment, but to the ATL. These ATL are based on relevant guidelines that give an indication of potential effects, as discussed earlier in this evidence (including the exceptions to these).

67. It would not be appropriate to have conditions requiring sediment levels to be the same as pre-European levels (what constitutes European levels was not defined in the submission) as additionally suggested by the CSCG, as there will be some level of tolerability of biota, and the targets should be directly related to potential adverse effects. This aligns with the international philosophy of using guideline levels, rather than requiring no increase above 'natural' levels.

OHRN

68. The OHRN opposes the Application and seeks a condition requiring in-pipe monitoring of stormwater contaminants, including copper, zinc and TSS, to enable the actual contributions from pipes to be established. They request this monitoring as they consider the receiving environment represents a diluted contaminant level, as opposed to a true measurement of the source. They also believe that the Council wastewater network does such in-pipe monitoring. I note the following points in response.

69. I agree that knowledge of stormwater contaminants in stormwater itself is important to have an overall understanding of discharges into the receiving environment. However, the presence of contaminants in stormwater may not reflect an actual adverse effect on the receiving environment, due to such things as dilution and flow dynamics. This is why monitoring of the receiving environment is the best way to understand effects – although it is noted that it is sometimes difficult to determine causative links, as mentioned elsewhere in this evidence and the evidence of Mr Cantrell. I note that the Council has undertaken monitoring within stormwater pipes in the past to a limited degree, which has provided useful information (see the summary within **Appendix A**). However, this monitoring is time-consuming and logistically difficult, due to the need to catch 'storms'. Due to these reasons, I have not recommended to the Council that it propose in-pipe stormwater monitoring in the EMP. However, I consider there will be scope to carry

out such monitoring on an ad-hoc basis as part of SMP development, the stormwater quality investigations, or the responses to monitoring or modelling, where this would provide useful information. I also note that the Council is proposing to monitor the receiving environment during wet weather, when stormwater inputs are at the highest levels, which is a more appropriate way to assess effects. This type of monitoring is also logistically challenging, so there are limitations on what can be carried out. Collectively, I believe this is a more appropriate focus for monitoring, rather than having a routine stormwater pipe monitoring programme. Further support for not using end of pipe monitoring for general state monitoring is provided in the evidence of Mr Cantrell and Mr Kennedy.

70. I also note that the Council wastewater network monitors water flows within wastewater pipes in a small number of locations on a permanent basis. It does not monitor water quality, which is far more difficult as mentioned above.

71. The OHRN also seeks clarification that the monitoring under the EMP is the primary method to measure waterway health. I can confirm that the ATL proposed in the consent conditions are the primary method of measuring waterway health. The EMP sets out how measurement of these targets will be carried out. As mentioned previously, there are responses to monitoring if the targets specifically relating to stormwater contaminants are not met.

Department of Conservation (DoC) and OHRN

72. The OHRN opposes the application and DoC supports in part. The OHRN states that the ATL for the Ōpāwaho/Heathcote River are less conservative than the other waterways. Both submitters request that the conditions and monitoring align with the LWRP.

73. I disagree that the ATL are less conservative for the Ōpāwaho/Heathcote River and not aligned with the LWRP. The confusion may be due to the hardness modification of metals, as discussed previously in this evidence (and Paragraph 124 of the s42A report of Ms Stevenson for Environment Canterbury). For the

other ATL, the standards taken from the LWRP are based on the classification of this catchment in the LWRP.

74. The ATL proposed in the consent are based on relevant guideline levels as previously discussed. These are the LWRP standards where they are available, and where they are not, they are supplemented by other relevant guidelines.

DoC

75. DoC supports the application in part, but states that the activity should have regard to the New Zealand Coastal Biodiversity Action Plan 2016-2000. I have read this plan and note that it is a high-level document. Of particular note to waterway health is Policy 11 (Indigenous biological diversity), Policy 22 (Sedimentation) and Policy 23 (Discharge of Contaminants), although not all these issues are within the scope of a stormwater consent. I consider that having regard to the LWRP and the RCEP, which have more specific requirements, will result in consistency with the New Zealand Coastal Biodiversity Action Plan.

76. It is also requested by DoC that the conditions are consistent with the NPSFM, and that monitoring and reporting of *E. coli*, nitrate, ammonia, dissolved oxygen, and any other attributes required by the NPSFM 2017, be carried out. This has been addressed in Paragraph 60 of this evidence. In summary, I consider that the conditions are consistent with the NPSFM, by specifically addressing the LWRP standards, which in my opinion are more conservative and detailed.

77. This submission also queries whether the water quality standards will be met in the receiving environment by 2025. This has been discussed previously in Paragraph 57-59 of this evidence. In summary, not all of these standards are affected solely by stormwater effects and it is unlikely that these standards will be met by 2025.

78. DoC states it is not clear how other contaminants not included in the C-CLM will be modelled. The reasoning why only TSS, zinc and copper are being modelled has been previously covered in Paragraph 43 of this evidence. The primary

reasons are because these are the key stormwater contaminants within the scope of this Application and are able to be modelled.

Martin Fraser and Fiona Fraser

79. Martin Fraser and Fiona Fraser seek that consent be declined, but state if this is not possible that stringent monitoring of the consent conditions should occur at a suitable cost to the applicant, as a deterrent for polluting.

80. I consider that the consent conditions proposed by the Council, including a detailed EMP, ensure that Council will measure, and take responsibility for, the effects from stormwater. The Council has a good track record with complying with previous stormwater consent monitoring conditions, such as that within the Styx SMP and South-West SMP consents. Mr Dale McEntee's evidence covers the Council compliance record in more detail.

Lyndsay Walton

81. This submitter opposes the Application, with the primary concern being that the Application will result in a substantial increase in contamination discharged into the Avon River.

82. I consider that the 'mitigation toolbox', including the Avon SMP, and the EMP are structured in such a way as to prevent this from occurring, with responses to monitoring if ATL for key stormwater contaminants are not met. I note that the majority of this catchment is developed and therefore it is unlikely that surface water quality will get significantly worse. With the planned retrofitted stormwater facilities, water quality will improve.

Southshore Residents Association Incorporated, Glen Menzies, Jacob Wright and Dr Dick Ongley

83. These submitters oppose the Application, with general concerns regarding reducing discharges and preventing the degradation of waterways.

84. I note that it is not feasible to prevent stormwater from being discharged into the receiving environment. The 'mitigation toolbox', including a detailed EMP and responses to monitoring if ATL are not met for key stormwater contaminants, in my opinion ensure that the quality of the receiving environments will not be degraded.

Avon Rowing Club Incorporated

85. The Avon Rowing Club is satisfied that the Application can be granted, subject to the Council's proposed conditions. A high level of water quality is important for their recreational activities and they consider the application seeks to improve this aspect. The EMP is also considered suitable in ensuring water quality outcomes are achieved for the duration of the consent.

Proposed Changes to Conditions and EMP

86. Given my explanations above, I do not propose any changes to the conditions or the EMP in response to these submissions.

RESPONSES TO S42A REPORT

87. I consider that the s42A report, and the accompanying report of Ms Michele Stevenson and Dr Lesley Bolton-Ritchie, are thorough and well considered. I am in general agreement with the assessments that cover the areas of my evidence. I consider the recommendations and issues in these reports can be separated into three categories, those that (1) are useful review comments and I agree are appropriate for the Council to propose in the conditions and/or the EMP, (2) are based on a misunderstanding that I will clarify, and (3) I am not recommending to adopt in the conditions or EMP (but some only in part). The following paragraphs address these three issue areas.

Areas of Agreement – Proposed Changes

88. I am in agreement with the following issues raised in these reports, and I have recommended changes to the EMP and the conditions in response to these:

88.1 Timeframe for investigation reports under Condition 51 (Paragraphs 241, 502(d) and 522 of s42A report, Paragraph 112 of Ms Stevenson's report, and Paragraph 64 of Dr Lesley Bolton-Ritchie's report). The sites to investigate will be identified in the annual report due by 30 June each year. I agree with Ms Stevenson's recommendation to include the investigation report in the annual report the year following site identification. I note that the annual report condition (Condition 53) already includes a requirement to supply a summary of these responses to monitoring investigations, so this ties in nicely. Twelve months is a suitable timeframe, as the investigations may involve a range of desktop and environmental monitoring, so sufficient time is needed to determine appropriate responses. No changes are required to the EMP;

88.2 Note at the top of Schedules 4-6 in the conditions that refer the reader to the EMP for details of the methodology to be used when assessing data against the Attribute Target Levels (Paragraph 46 in Ms Stevenson's report). No changes are required to the EMP;

88.3 That a specific purpose description is added to all sections of the EMP, so that it is clear how each component is related to the stormwater discharge activities that fall under the CSNDC (Paragraph 90 in Ms Stevenson's report and Paragraph 92 of Dr Bolton-Ritchie's report). No changes to the conditions are required;

88.4 Addition in the EMP (Section 6.5) that annual reporting to be based on three-year dataset, with the attributes relating to the responses to monitoring condition (TSS, copper, lead and zinc in surface water) also analysed using the last year of data for compliance assessment purposes (Paragraph 46 in Ms Stevenson's report). No changes to the conditions are required;

88.5 A specific requirement in the EMP to assess all aspects of monitoring (i.e. surface water monitoring, wet weather water quality monitoring, instream sediment quality, aquatic ecology and Mana Whenua monitoring) collectively to determine relationships and trends (Paragraph 501(h)(iii) in

the s42A report and Paragraph 107 in Ms Stevenson's report). I recommend this change within Section 10 of the EMP. No changes to the conditions are required;

88.6 Amendment to the annual reporting condition (Condition 53) to ensure that the monitoring data is presented in such a way as to assess compliance with the resource consent conditions and trigger the responses required (Paragraph 230 in the s42A report). I note that specific details on how the monitoring data will be assessed is set out in the reporting sections for each monitoring aspect in the EMP, including comparison to ATL. However, I realise that the annual report will have to cover more than just these aspects on a holistic level. I have therefore recommended proposed wording to this condition to address this issue. No changes to the EMP are required;

88.7 Identification of tidal waterway sites in Table 3 of the EMP, as the freshwater guidelines for metals in surface water are impacted by salinity and are not always appropriate for these sites (Paragraph 501(e)(ii) of the s42A report and Paragraph 42 of Ms Stevenson's report). I recommend amending the EMP (Section 6.4) to require site-specific metal guidelines for these sites to be determined during the general metal guidelines review. No changes to the conditions are required;

88.8 Use of a separate ATL for metals in surface water for the Cashmere Stream catchment (Paragraph 472 in the s42A report and Paragraph 55 in Ms Stevenson's report). I note that this aligns with the LWRP (as this stream has a different classification of 'Banks Peninsula') and is the approach currently taken with monitoring, so was merely an oversight in the conditions. I recommend amending Schedule 4 of the Conditions. The EMP does not require updating, as this Cashmere Stream specific guideline level was already included;

88.9 A greater number of monthly fine sediment sites (a total of at least four in each catchment) is monitored to assess fine sediment deposition (Paragraph 501(g)(ii) in the s42A report and Paragraph 104 in Ms Stevenson's report). However, I have only recommended seven additional

sites within the catchments of the Ōtākaro/Avon River (two sites), Ōpāwaho/Heathcote River (three sites) and Pūharakekenui/Styx River (two sites). This is because there are few monitoring sites in the other remaining catchments of Huritini/Halswell River, Ōtūkaikino River and Banks Peninsula, and therefore I consider two sites in each of these is sufficient. The sites chosen are wadeable sites, align with other related monitoring (such as monthly water quality and sediment quality), are related to areas of known stormwater influences or ecological value, and give a spatial spread of sites. I recommend amending the EMP at Figure 9, Figure 10, Figure 12 and Appendix B to reflect these proposed changes. No changes to the conditions are required;

88.10 The discontinued Heathcote River at Templetons Road monitoring site is relocated downstream to a suitable location with permanent flow that is upstream of Paparua/Haytons Stream (Paragraph 501(e)(i) in the s42A report and Paragraph 92 in Ms Stevenson's report). I agree this is an important location as an upstream psuedo-control for the inputs from Haytons and Curletts Streams. I have proposed a change to the EMP in Figure 10 and Appendix B to specify a location at the footbridge off Warren Crescent within Nga Puna Wai. The community often feed the resident eels at this location and it is easily accessed. There are not many stormwater outfalls in this reach of the river. The nearest upstream outfall from this proposed site is approximately 200 m and Haytons Stream is the first contributor of stormwater inputs downstream. I consider this site is better used as an upstream pseudo-control than to be located directly by a stormwater outfall. I propose this site is monitored for monthly fine sediment, five-yearly aquatic ecology, five-yearly instream sediment quality, five-yearly wet weather surface water quality and monthly surface water quality. No changes to the conditions are required;

88.11 Collection of a minimum of three composite instream sediment samples per site on each sampling occasion, to improve statistical power to assess trends (Paragraph 501(d) in the s42A report and Paragraph 96 in Dr Bolton-Ritchie's report). I note that this will result in an estimated extra five-yearly cost of $39,000 in lab costs alone, not considering extra field time or

reporting costs. However, as mentioned previously, and in the evidence of other Council staff and in the Environment Canterbury s42A report, sediment quality is an effective way to understand accumulation of stormwater contaminants and changes in inputs over time. Therefore, I am comfortable prioritising and recommending the extra costs for this additional monitoring to the Council, to ensure the most robust comparisons possible over time. I recommend a change to the EMP at Section 7.4. No changes to the conditions are required;

88.12 Sieving of instream sediment samples through a sieve less than 2 µm in size (Paragraph 505(e) in the s42A report and Paragraph 97 in Dr Bolton-Ritchie's report). I recommend changing the EMP at Section 7.4. No changes to the conditions are required;

88.13 Updating of the ATL for Total PAHs in instream sediment within Schedule 4 to 10 mg/kg dry weight, to align with the latest guidelines (Paragraph 474 of the S42A report and Paragraph 86 of Dr Bolton-Ritchie's report). I note that this is in response to a previous query I had to Environment Canterbury in this regard. No changes to the EMP are required.

88.14 Removal of the monitoring of nitrogen and phosphorus at coastal sites within the EMP (Paragraph 547(f) of s42A report and Paragraph 52 of Dr Lesley Bolton-Ritchie's report). I recommend changing the EMP at Section 6.4 (including Table 3). No changes are required to the conditions;

88.15 Additional monitoring of faecal coliforms in surface water at the Akaroa coastal site and comparison to the Ministry for the Environment & Ministry of Health (2003) guidelines in relation to shellfish consumption (Paragraph 547(g), 547(k), 573 and 574 of the s42A report, and Paragraph 53, 57 and 58 of Dr Lesley Bolton-Ritchie's report). I recommend updating the EMP at Section 6.4 (including Table 3). No changes are required to the conditions;

88.16 Sampling at the Beachville Road Ihutai/Avon-Heathcote Estuary site is undertaken around the time of high tide (Paragraph 547(e) of the s42A report and Paragraph 51 of Dr Bolton-Ritchie's report). Dr Bolton-Ritchie

further states that the time of sampling does not need to be determined by the state of the tide for the three other coastal waters sites. However, as with the tidal waterway sites, I consider it best practice to keep the time of sampling consistent, to avoid differences in basic water chemistry due to sampling different points in the tide. I recommend changing the EMP at Section 6.4. No changes are required to the conditions; and

88.17 Amendment of the guideline value for enterococci at the Ihutai/Avon-Heathcote Estuary Beachville Road monitoring site to be the same as that for Cass Bay and Akaroa Harbour - ≤200 CFU/100 ml (Paragraph 547(j) of the s42A report and Paragraph 56 of Dr Bolton-Ritchie's report). I recommend changing the EMP at Table 3 of Section 6.4. No changes are required to the conditions.

89. Ms Stevenson raised concerns about the appropriateness of the proposed wet weather TSS target level, and how the dry versus wet weather ATL will be assessed for compliance (Paragraph 471, 501(e)(v) and 501(f) of the s42A report, and Paragraph 51, 52 and 99 in Ms Stevenson's report). As an alternative, Ms Stevenson suggests the use of an 80th percentile approach for the ATL, determined from analysis of Council baseflow and wet weather data.

89.1 I note that this 80th percentile guideline approach is not based on effects, but comparison to reference levels – which is the basis of some of the other guidelines as discussed earlier. Council have assessed the monitoring data (using the Hazen method recommended by Environment Canterbury) and this showed that the 80th percentile for baseflow data for each individual catchment was well below the 25 mg/L guideline. For the wet weather data for all catchments combined, the 80th percentile was 91 mg/L;

89.2 I also note that Council has proposed an additional ATL of no statistically significant increase in concentrations, to ensure that even if levels are below the 25 mg/L ATL, levels do not increase. I consider this is a very conservative proposal that will ensure that any additional effects on the receiving environment will be identified early.

89.3 I have also clarified earlier in this evidence that the ATL are only proposed to pertain to the monthly monitoring and not the wet weather monitoring, due to the lack of acute wet weather guidelines. I also consider it would be complex and onerous to partition the monthly monitoring data to assess against a baseflow versus wet weather ATL.

89.4 I therefore recommend that the currently proposed wet weather ATL of 100 mg/L is removed. The monthly surface water monitoring data will then be assessed against the two remaining ATL: 25 mg/L and no statistical increase in concentrations. No change to the EMP is required. I have recommended the change to Schedule 4 of the conditions.

90. Dr Lesley Bolton-Ritchie recommends the use of ANZECC (2000) 95% species protection values for the ATL for metals in surface water in coastal waters, instead of the RCEP standards (Paragraph 539(b) and 547(h) of the s42A report, and Paragraphs 39, 42 and 54 of Dr Lesley Bolton-Ritchie's report). I agree it is appropriate to adopt these more relevant guideline levels, and recommend updating the conditions at Schedule 5 and the EMP at Section 6.4 (including Table 3). Council has assessed the consequence to this change in ATL for the coastal waters pilot study mentioned in Appendix A and I note this results in non-compliance for almost all copper samples. However, whilst I agree that the Lyttelton Port site should be monitored for metals and compared to these same 95% species protection values, I do not consider it is appropriate for this site to be included in the ATL and therefore the responses to monitoring condition. Mr Norton has highlighted in his evidence in response to the Lyttelton Port Company's submission that there are numerous discharges into this coastal area from many private stormwater discharges, from sites of varying land use, not just the Council's stormwater network. As such, the effects of stormwater on the receiving environment is not in the total control of the Council. I do support the investigations into the contribution of stormwater discharged into the Port as recommended by Dr Bolton-Ritchie (Paragraph 539(c) of the s42A report and Paragraph 43 of Dr Bolton-Ritchie's report). I consider this investigation is best undertaken during the SMP development for this area.

91. A recommendation for additional wet weather monitoring was also raised for both waterway and coastal waters (Paragraph 501(c), 501(f) and 547(d) of the s42A report, Paragraph 101 Ms Stevenson's report, and Paragraph 49 of Dr Lesley Bolton-Ritchie's report).

91.1 I agree with the statements that wet weather monitoring is more appropriate for assessing the effects of stormwater discharges. For clarity, I also note that baseflow monitoring is still useful (for example, in identifying contaminants of concerns and the worst catchments, using the most cost-effective way of sampling widespread areas).

91.2 I disagree with the statements that wet weather monitoring is more appropriate for compliance, including comparisons to the ATLs. As discussed previously, there are no acute wet weather guidelines to give an indication of the risk of effects and the tolerance of biota to acute events may be higher than that for chronic events. I note that there is the potential for the development of acute guidelines in the future, and these could be incorporated into the consent and the EMP under Condition 46.

91.3 Whilst I agree with the appropriateness of wet weather monitoring, there are technical and logistical, and therefore financial, issues with undertaking this type of sampling using the current technique of grab sampling. As outlined in the EMP in more detail, rainfall events need to be forecasted correctly to meet the sampling criteria, such as sufficient rainfall depth and the number of dry days prior. Samplers are then required to get to several sites within the time of 'First Flush'. These criteria are important, to achieve representative results of stormwater effects. However, invariably events are never as forecasted, and often occur outside the time of reasonable health and safety expectations (e.g. at night), during times samplers are already busy undertaking other fieldwork, or when the lab is not open to receive the samples within the appropriate time period (e.g. on the weekend). As an example, for this calendar year, Council is required to sample the Styx River at four sites over two rainfall events and only one sampling event has been achieved to date. Often what sampling does occur, not surprisingly does not meet the sampling criteria and sometimes misses the 'First Flush'. Given

the large geographical area to be covered under this consent, from coastal areas to Banks Peninsula, this would exacerbate the issue if more than one catchment is to be sampled during a monitoring year. Hence the proposal to maintain the approach of Council's current stormwater consents to monitor catchments five-yearly.

91.4 I have had many discussions previously with Environment Canterbury staff about these difficulties and it is encouraging to see the acknowledgement of this in Ms Stevenson's report. In particular, the statement 'more intensive routine monitoring during wet weather would require significant resources and I would not support a greater level of this monitoring on a routine basis due to the opportunity cost in terms of actual stormwater mitigation and retrofitting'. I agree that the current NIWA study on monitoring techniques will be useful in providing guidance in this area, although it is likely the relative financial costs of this type of monitoring will still be high, especially if sampling is to be undertaken routinely over large geographical areas.

91.5 I support the balance recommended by Ms Stevenson of undertaking targeted investigations, which could include not only new stormwater developments and retrofits as suggested, but known existing hotspots of contaminants. I agree it would be far better to focus on targeted, more detailed and accurate sampling, using auto-samplers or similar, than having more widespread grab sampling (even though the cost for this targeted approach is likely greater on a per site and event basis).

91.6 I consider that this targeted monitoring would already potentially be carried out as part of (1) SMP development, (2) responses to monitoring or/and (3) the Stormwater Quality Investigation Actions under Table 3 of the conditions. However, I acknowledge that the Council is not bound to this as the conditions are currently drafted (July version), and therefore Council has proposed a study in this regard to Table 3 of the conditions. No update to the EMP is required.

91.7 I do not support the slightly different approach for coastal waters recommended by Dr Lesley Bolton-Ritchie which is effectively increasing

the number of grab sampling events above the proposed five-yearly schedule, with no specific link to targeted catchments of concern. Although as noted earlier, on average the monthly monitoring achieves the three days of rainfall recommended by Dr Bolton-Ritchie. I do not support the added complexity of partitioning the monthly monitoring data into dry and wet weather samples. Given the large resource requirement to analyse the large dataset as it stands, let alone with the additional monitoring proposed under this consent, this would be overly onerous and may also limit the robustness of analyses, due to limiting sample sizes. This partitioning could be done on an on-need basis to further understand exceedances, as occurs currently (e.g., to see if exceedances align with rainfall).

92. With regard to the objective to improve instream sediment quality (Schedule 4), Dr Bolton-Ritchie states that the objective should be to maintain sediment quality, to ensure that stormwater discharges do not result in a decrease in sediment quality in the future (Paragraph 474 of the S42A report and Paragraph 88 of Dr Bolton-Ritchie's report). I have recommended proposed changes to the objectives to give more clarity on their purpose, as discussed previously, and I do not suggest further changes to these. However, I agree with the concern of not making sites worse, and to be in line with the ATL for TSS, copper, lead and zinc in surface water, I recommend that an additional ATL is added of 'no statistically significant increase in copper, lead, zinc and Total PAHs'. I have recommended a change to the conditions at Schedule 4 and a change to the EMP is not required. I do note that the statistical robustness of comparisons over time for this five-yearly instream sediment monitoring will not be as great as that for the monthly surface water quality monitoring and this needs to be assessed at the time of analysis. This was also raised in Dr Bolton-Ritchie's report (Paragraph 98) and has already been addressed in the Areas of Agreement section.

93. I also note that the s42A report and the associated technical reports mention several times the concern that the current proposed consent conditions, including the EMP, do not provide enough certainty that contaminants from high-risk sites will be monitored and therefore mitigated effectively (e.g. the s42A report, Ms Stevenson's report, Dr Bolton-Ritchie's report and Mr Freeman's report). I consider that ensuring adequate monitoring of those sites is a valid concern, as

atypical contaminants from these sites may be having proportionally large effects on the receiving environment and may not be addressed by the general monitoring of the EMP. However, I consider the ATL in the conditions and the EMP is not the right place to address this type of monitoring. The contaminants will likely be site and contaminant-specific, so it would be overly onerous to monitor all potential contaminants in the wide-spread manner of the EMP. Environment Canterbury has also not yet shared with Council the required information to understand the type, location and scale of these contaminants from high-risk sites, so it is not possible to design an effective monitoring programme at this stage. Instead, I recommend that a specific condition is drafted that states that Council or the landowner will carry-out site-specific monitoring where required, in line with that required by the existing consents from Environment Canterbury, which will give the same environmental outcomes. No update to the EMP is required.

Points of Clarification

94. Mr Reuther states that there is no clarity as to what the subsequent investigations and actions under the responses to monitoring and modelling are required to include, giving uncertainty as to whether adequate remedial actions will be implemented prior to elevating any issues to the Water Issues Management Group (Paragraph 236 of the s42A report).

94.1 With respect to the responses to monitoring, I understand these concerns, but the difficulty is that there is currently not enough experience in this area to predict what the best approach and methodology will be. It would be counterproductive to guess what this approach might be and to detail this in the conditions. Further investigations will also be dependent on the contaminants of concern, their scale of effects, and what is within the Council ability to control, so what is an appropriate approach for one issue, will not necessarily be appropriate for another.

94.2 Investigations could include identifying the source and contaminants (e.g. through assessing site management practices, and monitoring stormwater and surface water), researching appropriate ways to reduce contaminant inputs (e.g. treatment or control at source), understanding the effects on the

discharge on the receiving environment (e.g. toxicity testing of biota) and determining if remedial actions are required and how these will be most effectively carried out (e.g. sediment removal). External specialist advice will be sought if the skills to undertake these assessments are not available within Council.

95. In the s42A report, it is also stated that no target values for TSS have been set yet, as there is insufficient information about TSS levels in the coastal environment (Paragraph 255). I would like to clarify that there are no guidelines available to use for the ATL, not that there is no target. The proposed ATL is 'no statistically significant increase in TSS concentrations'. This was discussed in the 'Appropriateness of the ATL' section of my evidence.

96. Dr Bolton-Ritchie recommends that the ATL for TSS and metals in surface water of coastal waters should be amended to also have a target of a statistically significant decrease in concentrations, not just a target for no statistically significant increase in concentrations, to align better with the objectives of Schedule 5 (Paragraph of 540, 593(a)(i) and 593(a)(ii) of the s42A report, and Paragraph 37 and 38 of Dr Lesley Bolton-Ritchie's report). This is because the objectives refer to a decrease or reduction in inputs. I consider this is a misinterpretation of the objectives, due to the wording not being specific enough. The intent of these objectives was never to have blanket reductions/improvements, as there will be some sites that are currently meeting standards and are therefore showing no indication of effects (and there may be no contaminants present, so these cannot be reduced further). As mentioned in the 'Appropriateness of the ATL' section, having an ATL of no statistical increase is already conservative in my opinion. As also mentioned in this section, not meeting the ATL does not indicate that effects are occurring, but that there is a risk they are, and further investigations should be carried out to confirm this. To address this confusion, the objectives have been re-worded in both the conditions and the EMP to state that adverse effects do not occur (as measured by the meeting of the ATL), rather than inputs will be reduced.

97. The s42A report questions whether early warning triggers should be used regarding the ATL in Schedules 4 to 6 of the proposed conditions and the

subsequent responses to monitoring, to prevent a failure to meet the proposed targets (Paragraph 239 and 240). I do not consider this is appropriate for the reasons outlined in the 'Appropriateness of the ATL' section – the targets do not indicate that effects are occurring, only that there is a risk. These current targets could in effect be the early warning triggers suggested. I also note that some of the ATL relate to no statistical increase in levels, therefore, this achieves the intent of Mr Reuther's recommendation.

98. Ms Stevenson recommends in her report (Paragraph 110) for the monthly surface water quality monitoring that as Christchurch experiences on average 84 days of rainfall per year, at least two out of twelve monthly samples should include a rainfall day, to give an appropriate indication of the state of the environment. Council has analysed the last three years of this data and this requirement is typically achieved. For example, the Heathcote River had an average of three rainfall days per year over the three years;

99. Ms Stevenson recommends that Dissolved Organic Carbon (DOC) in surface water is monitored for at least the first year, as it is likely the update of the ANZECC (2000) guidelines will include this parameter as a modifier; she considers this parameter should be added to the list in Table 3 of the EMP (Paragraph 501(e)(vii) in the s42A report and paragraph 97 in Ms Stevenson's report). I note that Council has already initiated monitoring of this parameter at the current monitoring sites for this very reason. I also note that Table 3 in the EMP already includes DOC. The five-yearly hardness review section of the EMP also already includes a requirement to include monitoring and calculation of additional guideline modifiers should these change. Therefore, I do not consider that changes to the conditions or EMP are warranted;

100. Ms Stevenson recommends that the review of the water hardness modified guidelines for metals in surface water occur in 2019 (Paragraph 501(e)(vi) in the s42A report and Paragraph 96 in Ms Stevenson's report). I understand Ms Stevenson's concerns about this review being undertaken as soon as possible. However, the draft EMP does not propose that hardness is typically sampled (and is not under the current monitoring programme) and before the review can be undertaken this parameter is required to be monitored during the given monitoring

year. Because of the timeframe for the potential granting of this consent (and potential appeal timeframes), I consider it would be more pragmatic for this review to be undertaken during the 2020 monitoring year. This would also give time for the calculations from the collected data to be carried out. It may also be that the new guidelines are released by this point and the review can include this new methodology in its entirety. This would mean results are presented in the 2021 annual report, instead of the 2020 report if Ms Stevenson's recommendations are adopted. As such, I recommend changing the conditions (Condition 45) and EMP (Section 6.4) to refer to 2020;

101. It is also recommended in the s42A report that further targeted sediment quality monitoring in sub-catchments with elevated contaminant levels is undertaken, to aid with deducing contaminant sources and treatment options (Paragraph 501(f) of the s42A report and Paragraph 102 of Ms Stevenson's report). I note that this will be carried out as part of the SMPs and the sediment study (Condition 37, Items 7-8 of Table 3) if required. Therefore, I do not recommend any changes to the conditions or EMP.

102. Dr Bolton-Ritchie also recommends that if the water quality monitoring results indicate that dissolved metal concentrations at the Akaroa site are above guideline values, the flesh of the shellfish species that occur in proximity to the sampling site should be assessed for cadmium and lead concentrations (Paragraph 575 of the s42A report, and Paragraph 59 of Dr Lesley Bolton-Ritchie's report). She considers that the results should be compared to food safety guidelines and follow-up actions undertaken. I note that the approach taken for investigation will be determined through the process related to the responses to monitoring condition. Therefore, I do not recommend amendment to the conditions or EMP in response to Dr Bolton-Ritchie's comments. These recommendations can be taken on board should investigations be warranted. I note that careful consideration needs to be taken with monitoring cadmium as a surrogate for copper and zinc, as Council monitoring data shows that cadmium is not typically recorded in stormwater within Christchurch.

Areas of Disagreement

103. Dr Bolton-Ritchie recommends that the reporting for the data for metals in surface water at coastal sites for the calendar year should include the (1) number of samples below the laboratory limit of detection, (2) number of samples above the guideline levels, and (3) by how much the guidelines were exceeded (Paragraph 62 of her report). This is because she considers that many values under the limit of detection will not allow an assessment of trends. However, I note that the proposed EMP outlines the correct method of assessing against guideline levels, based on assessing the 95th percentiles, rather than individual events. I am also reluctant to add additional levels of analysis and complexity to the monitoring report, given the substantial workload already required to collate the data. This additional assessment would also not relate back to compliance of the ATL. If a site has the majority of values below the limit of detection, this suggests that contaminants are not an issue at this site. Should levels increase significantly, this will be identified in the trends assessment.

104. It is recommended by Dr Bolton-Ritchie that if the faecal coliforms monitored at the Akaroa coastal site exceed the guidelines for water over lying shellfish that (1) signage warning against collecting and eating shellfish from the area must be erected, and (2) Council will need to undertake investigations and actions to reduce faecal coliform concentrations in stormwater (Paragraph 547(k), 573 and 574 of the s42A report, and Paragraph 53, 57 and 58 of Dr Lesley Bolton-Ritchie's report). I note that this contaminant is present from many sources, not just stormwater, such as waterfowl and wastewater discharges (as highlighted in Paragraph 12(c) of Dr Lesley Bolton-Ritchie's report). Therefore, I consider this request is outside the control of this Application and do not recommend that this approach is adopted. I also note that the Council will come under significant community pressure in response to this issue and signage, which further exacerbates the consequences of this request not being solely within the scope of this stormwater consent or Council's control.

105. The s42A report recommends adding additional monitoring at two sites to the EMP: Horseshoe Lake (Paragraph 501(i)(i) of the s42A report and Paragraph 108 of Ms Stevenson's report), and the Ihutai/Avon-Heathcote Estuary at the mouth of either Charlesworth Drain or Linwood Canal (Paragraph 547(a) of the s42A report and Paragraph 46 of Dr Bolton-Ritchie's report). Dr Bolton-Ritchie also

recommends that more instream sediment monitoring sites are added over time as urban areas grow (Paragraph 93 of Dr Bolton-Ritchie's report).

105.1 Ms Stevenson recommends that additional monitoring of water quality and ecological health should be undertaken within Horseshoe Lake, as no monitoring of lake water quality is proposed in the EMP, and to better assess the condition of the lake. She considers that appropriate lake criteria should be established to assess the impact of stormwater, as standards for waterways are not appropriate.

105.2 However, I consider that Horseshoe Lake is a lake in name only, not in form. The Christchurch black map, which outlines the form of receiving bodies prior to drainage of the land, refers to the lake as a lagoon. I note that this area is not functioning as a normal lake and was/is a natural extension to the Avon River (an oxbow). Water levels in the lake are highly regulated, with tide gates and pumping for flood management. Without this pumping, it is likely that Horseshoe Lake would have tidal influence. Ecological monitoring at this site would be influenced by this regulation of water levels, the dense population of waterfowl and choking of the water column by willows, not just the influence of stormwater. I also note that the cultural monitoring will already have some ecological components that will be presented in the annual reporting, and that a monthly surface water quality monitoring site (at the outlet to the Avon River) is proposed in the EMP and has already been monitored for many years. I consider the continuation of using waterway standards for this water quality site is appropriate.

105.3 With respect to the recommendation for an additional Ihutai/Avon-Heathcote Estuary site, I agree that the condition of the Ihutai/Avon-Heathcote Estuary is impacted by the discharge of waterways influenced by stormwater. However, the purpose of the coastal waters sites was to locate them in direct proximity to stormwater outfalls into the estuary, to allow direct assessment of stormwater effects, rather than monitoring downstream receiving environments. I also note that the EMP includes a site within Linwood Canal/City Outfall Drain itself and has been monitored already for many years. I also note that additional investigations may be

carried out as part of the SMP development to inform contaminant sources and treatment options.

105.4 I consider that the adding of more instream sediment monitoring sites (or replacement of current sites) could occur through the EMP amendment condition as required (Condition 43). I do not recommend proposing further amendments to the conditions or EMP, as I consider that there are already sufficient widespread representative sites, and the addition of more sites would become costly and onerous. It would also add an extra level of complexity to design a condition around this when the areas at this stage are unknown.

105.5 Whilst monitoring all areas receiving stormwater contaminants would be ideal, I note that this is not an efficient and cost-effective approach. I have instead proposed to adopt the s42a report recommendations that I consider are either not high in cost or are higher monitoring priorities. I also note that the purpose of the EMP is to provide a representation of the receiving environments, not to monitor all areas.

106. Dr Bolton-Ritchie also recommended aligning of the instream sediment and aquatic ecology monitoring at the Kilmore Street and Manchester Street Avon River sites, the two Mona Vale Avon River sites, and the four Kā Pūtahi Creek sites (Paragraph 501(c) in the s42A report and Paragraph 94 in Dr Bolton-Ritchie's report). I carefully considered the aligning of these sites when recommending the EMP to the Council as I agree this is important. Unfortunately, there is a lot of historical data that would be lost if these sites were aligned and I considered it more important to keep this baseline information. The benefit of adding the sampling of additional parameters to these eight sites to allow alignment was in my opinion outweighed by the cost. Therefore, I have not recommended any changes to the conditions or the EMP.

107. Dr Lesley Bolton-Ritchie recommends that there are responses to monitoring if the instream sediment ATL are not met (Paragraph 513 of the s42A report and Paragraph 99 of Dr Bolton-Ritchie's report). I have discussed the issues with this in the 'Responses of the Receiving Environment within the Scope of the

Stormwater Consent' section of my evidence. Having this attribute included in the responses to monitoring condition is onerous, due to the remediation required likely extending into large reaches of waterways and the effects being largely legacy issues. It is not as 'simple' as reducing contaminant loads, as is the case with surface water contaminants. I consider that the investigation and remediation programme proposed to mitigate these effects (Condition 37, Items 7-8 of Table 3) is more appropriate. This programme could consider Dr Bolton-Ritchie's suggestion of a weight of evidence approach.

108. Dr Bolton-Ritchie recommends a five-yearly review of which Semi-Volatile Organic Compounds (SVOCs) are to be sampled in the instream sediment quality monitoring (Paragraph 505(b) of the s42A report and Paragraph 95 of Dr Bolton-Ritchie's report). The Council's current monitoring of SVOCs is very detailed, including over 75 constituents covering haloethers, nitrogen compounds, organochlorine pesticides, PAHs, phenols, plasticisers and halogenated compounds. This is what is currently proposed to continue under this Application. Typically these constituents are recorded below the limit of detection. The testing of these compounds are in one bulk suite, so removal or addition of constituents would not be cost-effective. Currently the cost for testing of SVOCs is $255 + GST per sample (quote from Hills Laboratories). I discussed this issue with Hills Laboratories and they confirmed that (1) they consider all possible SVOCs are included in this testing, and (2) it is unlikely any new constituents will be available in the future, due to the comprehensive testing currently. I note if this does occur, changes can be incorporated into the EMP as an amendment. Therefore, I do not support the inclusion of a five-yearly review.

Mana whenua values monitoring

109. The s42A report states that there is insufficient information to determine whether the proposed monitoring of mana whenua values is appropriate, as there has been no feedback from Ngā Rūnanga on this issue. Ngā Rūnanga have also not confirmed that they will undertake the required monitoring with Council.

110. The ATL and some of the site locations in the EMP for the mana whenua values monitoring is yet to be confirmed. No mana whenua values guideline levels were

available to be automatically adopted as ATL. Therefore, the Application includes a condition for the development of this outstanding information in consultation with papatipu rūnanga (Condition 47), and Council has now proposed the inclusion of a timeframe for completion of this condition.

111. This monitoring has previously been discussed with papatipu rūnanga during initial hui regarding the Application. It is my understanding that they were supportive of the proposal. When I investigated finalising the targets and sites, Mahaanui advised that this would be best carried out by the Water Quality Specialist and Mahinga Kai Specialist roles being established as part of the Deed with papatipu rūnanga. The job descriptions for these roles include the task of carrying out the mana whenua values monitoring.

112. I note that what is proposed already appears to be a lot more comprehensive than that of other stormwater consents within New Zealand. Some consents do not have mana whenua values monitoring at all (e.g., Dunedin City Council stormwater consent) and others have conditions to develop monitoring post granting of the consent (e.g., Invercargill and Tauranga City Council stormwater consents).

113. I consider that not having the complete information at this stage is not an issue. Sufficient time is required to ensure that Council continue to engage with papatipu rūnanga and that the overall objective of the monitoring will be realised. The proposed condition (Condition 47) gives sufficient certainty that the targets and sites will be developed within the required timeframe.

ADDITIONAL CHANGES TO THE CONDITIONS AND EMP

114. Additional proposed changes to the conditions and EMP that I recommend, arising from my ongoing review of the aspects of the Application within my area of expertise, are detailed below. The condition numbers are from the version filed originally with the Application. Exact wording of original conditions are detailed in italics.

Item	Proposed Change	Reasoning

Condition 37 (Table 3, Items 4 and 5)	Item 4 Action Start Date: ~~*Dec-18*~~ *Jun-19* Item 4 Action Completion Date: ~~*Jun-20*~~ *Jun-21* Item 5 Action Start Date: ~~*Jul-20*~~ *Jul-21*	The current start date for this study is not realistic to achieve when the current consenting outcome has not been confirmed
Condition 37 (Table 3, Items 7 and 8)	Item 7 Action Start Date: ~~*Sep-18*~~ *Jun-19* Item 7 Action Completion Date: ~~*Oct-19*~~ *Jun-20* Item 8 Action Start Date: ~~*Nov-19*~~ *Jul-20*	The current start date for this study is not realistic to achieve when the current consenting outcome has not been confirmed
Schedules 4 and 5 of the conditions	Add information throughout the schedules in the 'Basis for Target' column	To provide better certainty around the source of the target levels
Section 5.3 of the EMP	Update the information on TSS standards and guidelines	To update with the correct information
Section 6.3 of the EMP	Clarify that PAH should be normalised by Total Organic Carbon	To be clear around the correct method that aligns with the guidelines, following discussions with Environment Canterbury scientists
Table 4 of Section 6.3 of the EMP	Change mg/L to mg/kg dry weight	To refer to the correct unit of measurement
Conditions and EMP	Addition of the word 'values' after 'mana whenua'	To more accurately reflect what is being considered
Figure 12 and Appendix B of EMP	Addition of wet weather monitoring at the Kā Pūtahi Creek at Blakes Road monitoring site	Due to this site being influenced by stormwater and other inputs from upstream
Appendix D	Monitoring of Banks Peninsula waterways in 2020 instead of 2019	Monitoring of these sites does not currently occur, so I consider it is better to await the

		outcome of the consent before monitoring is carried out

DURATION

115. I consider that, with regard to matters that are within my area of expertise, the proposed consent duration of 25 years is appropriate. As highlighted in the 'Recovery of the Receiving Environment' section of this evidence, recovery could take some time to occur, so a shorter consent duration may not glean sufficiently more information. Important to a 25-year consent duration is the responses to monitoring condition, which requires investigations and remediation if the ATL for the key stormwater contaminants are not being met. I also consider that the proposed 'mitigation toolbox' is appropriate to address the effects of stormwater discharges, which further supports a 25 year consent.

Dr Belinda Margetts

15 October 2018

REFERENCES

Anzecc. (2000a) Australian and New Zealand guidelines for fresh and marine water quality. Aquatic ecosystems - rationale and background information. pp. 1-678.

Anzecc. (2000b) Australian and New Zealand guidelines for fresh and marine water quality. The guidelines. pp. 1-103.

Blakely T. (2014) Ecological values of the Avon River catchment: an ecological survey of the Avon SMP catchment. Boffa Miskell Limited, Christchurch, New Zealand.

Blakely T. (2015) Aquatic ecology of sites within the Heathcote, Estuary & Coastal, and Avon SMP catchments: informing the Comprehensive Discharge Consent. p. 76. Boffa Miskell Limited, Christchurch, New Zealand.

Blakely T. (2016) Halswell River sediment and aquatic ecology survey. p. 55. Boffa Miskell Limited, Christchurch, New Zealand.

Blakely T., Harding J., Mcintosh A. & Winterbourn M. (2006) Barriers to the recovery of aquatic insect communities in urban streams. *Freshwater Biology,* **51,** 12.

Bolton-Ritchie L. (2016) The sediments and biota of the estuary of the Heathcote and Avon Rivers/Ihutai and tidal reaches of the Avon/Ōtākaro and Heathcote/Ōpawaho Rivers. Summary on data collected in 2015. p. 19. Environment Canterbury, Christchurch, New Zealand.

Bolton-Ritchie L. (2017) Healthy estuary and rivers of the city; water quality of the estuary of the Heathcote and Avon Rivers/Ihutai. Summary report on data collected in 2016. In: *Water quality and ecosystem health monitoring programme of Ihutai*, p. 20. Environment Canterbury, Christchurch, New Zealand.

Bolton-Ritchie L. & Lees P. (2012) Sediment quality at muddy intertidal sites in Canterbury. Environment Canterbury, Christchurch, New Zealand.

Burrell G. (2018) Styx River catchment ecology 2018. p. 65. Prepared by Instream Consulting Limited for Christchurch City Council, Christchurch, New Zealand.

Crowe A. & Hay J. (2004) Effects of fine sediment on river biota. p. 35. Prepared by Cawthron Institute for Motueka Integrated Catchment Management Programme, Nelson, New Zealand.

Dunn N., Allibone R., Closs G., Crow S., David B., Goodman J., Griffiths M., Jack D., Ling N., Waters J. & Rolfe J. (2018) Conservation status of New Zealand freshwater fishes, 2017. In: *New Zealand Threat Classification Series*, p. 11. Department of Conservation, Wellington, New Zealand.

Elliot S., Jowett I., Suren A. & Richardson J. (2004) A guide for assessing effects of urbanisation on flow-related stream habitat. In: *NIWA Science & Technology Series*, p. 59. National Institute of Water and Atmospheric Research Limited, Wellington, New Zealand.

Environment Canterbury. (2005) Regional Coastal Environment Plan for the Canterbury region. p. 268. Environment Canterbury.

Environment Canterbury. (2017) Waimakariri River Regional Plan. p. 123. Environment Canterbury.

Environment Canterbury. (2018) Canterbury Land and Water Regional Plan. Environment Canterbury, Christchurch, New Zealand.

Franklin P., Gee E., Baker C. & Bowie S. (2018) New Zealand fish passage guidelines for structures up to 4 metres. p. 226. National Institute of Water and Atmospheric Research Limited, Hamilton, New Zealand.

Gadd J. (2015) Sediment quality survey for Heathcote River catchment, City Outfall Drain and Estuary Drain. p. 77. National Institute of Water and Atmospheric Research Limited, Auckland, New Zealand.
Gadd J., Milne J. & Hickey C. (2017) Copper and zinc aquatic toxicity. Frequently asked questions., p. 32. National Institute of Water and Atmospheric Research Limited, Auckland, New Zealand.
Gadd J. & Sykes J. (2014) Avon River sediment survey. p. 98, Vol. AKL2014-004. National Institute of Water and Atmospheric Research Limited, Auckland, New Zealand.
Grainger N., Collier K.J., Hitchmough R., Harding J.S., Smith B.J. & Sutherland D.L. (2014) Conservation status of New Zealand freshwater invertebrates, 2013. Department of Conservation, Wellington, New Zealand.
Harding J.S. (2005) Impacts of metals and mining on stream communities. In: *Metal contaminants in New Zealand.* (Eds T.A. Moore & A. Black & J.A. Centeno & J.S. Harding & D.A. Trumm), pp. 343-357. Resolutionz press, Christchurch, New Zealand.
Hayward S., Meredith A. & Stevenson M. (2009) Review of proposed NRRP water quality objectives and standards for rivers and lakes in the Canterbury region. p. 129. Environment Canterbury.
Lemly A.D. (1997) Ecosystem recovery following selenium contamination in a freshwater reservoir. *Ecotoxicology and Environmental Safety,* **36,** 275-281.
Margetts B. (2014) Interim Global Stormwater Consent. Wet weather monitoring report for the period May 2013- April 2014. p. 52. Christchurch City Council, Christchurch, New Zealand.
Margetts B. & Marshall W. (2015) Interim Global Stormwater Consent. Wet weather monitoring report for the period May 2014- April 2015. p. 30. Christchurch City Council, Christchurch, New Zealand.
Margetts B. & Marshall W. (2016) Surface water quality monitoring report for Christchurch City waterways: January – December 2015. p. 144. Christchurch City Council, Christchurch, New Zealand.
Margetts B. & Marshall W. (2018) Surface water quality monitoring report for Christchurch City waterways: January – December 2017. p. 102. Christchurch City Council, Christchurch, New Zealand.
Marshall W. & Burrell G. (2017) Surface water quality monitoring report for Christchurch City waterways: January – December 2016. p. 144. Christchurch City Council, Christchurch, New Zealand.
Ministry for the Environment & Ministry of Health. (2003) Microbiological water quality guidelines for marine and freshwater recreational areas. p. 159, Wellington, New Zealand.
Moriarty E. & Gilpin B. (2015) Faecal sources in the Avon River/Ōtākaro, Heathcote River/Ōpāwaho and the Estuary of the Heathcote and Avon Rivers/Ihutai. p. 65. The Institute of Environmental Science and Research Limited, Christchurch, New Zealand.
Munro B. (2015) CCC instream spring water quality project - Waimairi and Wairarapa Stream. Pattle Delamore Partners Limited, Christchurch, New Zealand.
Noakes K. (2017) Ōtūkaikino River catchment aquatic ecology. p. 65. Boffa Miskell Limited, Christchurch, New Zealand.
Packman A. (2014) Pathogens in Urban Stormwater Systems. p. 267.
Poff N.L., Bledsoe B.P. & Cuhaciyan C.O. (2006) Hydrologic variation with land use across the contiguous United States: geomorphic and ecological consequences for stream ecosystems. *Geomorphology,* **79,** 264-285.

Poff N.L. & Zimmerman J.K. (2010) Ecological responses to altered flow regimes: a literature review to inform the science and management of environmental flows. *Freshwater Biology,* **55,** 194-205.

Quinn J.M., Williamson R.B., Smith R.K. & Vickers M.L. (1992) Effects of riparian grazing and channelisation on streams in Southland, New Zealand. 2. Benthic invertebrates. *New Zealand journal of marine and freshwater research,* **26,** 259-273.

Ryan P.A. (1991) Environmental effects of sediment on New Zealand streams: a review. *New Zealand Journal of Marine and Freshwater Research,* **25,** 207-221.

Sansalone J.J. & Buchberger S.G. (1997) Partitioning and first flush of metals in urban roadway storm water. *Journal of Environmental engineering,* **123,** 134-143.

Stark J. & Maxted J.R. (2007) A user guide for the Macroinvertebrate Community Index. p. 58. Cawthron Institute, Nelson, New Zealand.

Stevenson M., Wilks T. & Hayward S. (2010) An overview of the state and trends in water quality of Canterbury's rivers and streams. p. 80. Environment Canterbury, Christchurch, New Zealand.

Suren A.M. (2000) Effects of urbanisation. In: *New Zealand stream invertebrates: ecology and implications for management.* (Eds K.J. Collier & M.J. Winterbourne), pp. 260-288. New Zealand Limnological Society, Hamilton, New Zealand.

Vaze J. & Chiew F. (2002) Experimental study of pollutant accumulation on an urban road surface. *Urban Water,* **4,** 11.

Walsh C.J., Roy A.H., Feminella J.W., Cottingham P.D., Groffman P.M. & Morgan R.P. (2005) The urban stream syndrome: current knowledge and the search for a cure. *Journal of the North American Benthological Society,* **24,** 706-723.

Woods C., Hawke L., Unwin M., Sykes J., Kelly G. & Greenwood M. (2016) Assessment of fish populations in the Estuary of the Heathcote and Avon Rivers/Ihutai: 2015., p. 66. National Institute of Water and Atmospheric Research Limited, Christchurch, New Zealand.

Appendix A
Updated Information on the Receiving Environment

WATER QUALITY

Ōtautahi/Christchurch Waterways

1. The Council has monitored surface water quality within the five major river catchments of Ōtautahi/Christchurch (the Ōtākaro/Avon, Ōpāwaho/Heathcote, Huritini/Halswell, Pūharakekenui/Styx and Ōtūkaikino Rivers) and Linwood Canal for many years. Irregular sampling has occurred for decades, but regular monthly monitoring at 42 sites has typically occurred since 2007.

2. Sites are sampled monthly for a range of different parameters including dissolved metals (copper, lead and zinc), pH, conductivity, Total Suspended Solids (TSS), turbidity, dissolved oxygen (DO), water temperature, biochemical oxygen demand (BOD_5), ammonia, nitrate, Nitrate Nitrite Nitrogen (NNN), Dissolved Inorganic Nitrogen (DIN), Dissolved Reactive Phosphorus (DRP) and *Escherichia coli*.

3. The latest report for the 2017 monitoring year concluded the following (Margetts & Marshall, 2018):

    3.1 The contaminants of most concern were nitrogen, phosphorus and *E. coli*, as well as dissolved copper, zinc, TSS, turbidity, DO and BOD_5 at certain sites;

    3.2 98% of sites did not meet the guideline level for at least one parameter;

    3.3 The LWRP Schedule 8 nitrate limit for rivers was achieved at all monitoring sites;

    3.4 The majority of individual parameters did not change in concentration over time;

3.5 The majority of waterways recorded a Water Quality Index (**WQI**) of 'poor' or 'fair'. This is the first year this index has been used;

3.6 The Ōpāwaho/Heathcote River catchment recorded the poorest water quality, and the worst site was Haytons Stream, followed by Curletts Road Stream. The Ōtūkaikino River catchment recorded the best water quality, and the best site was tied between the Ōtūkaikino River at Groynes Inlet and Waimairi Stream;

3.7 The results of this monitoring year are similar to that recorded in previous years. Although development of the new WQI showed that the Ōtākaro/Avon River and Pūharakekenui/Styx River catchments recorded significant improvements in WQI over time, the other catchments showed limited change;

3.8 The monitoring supports the Urban Stream Syndrome (Walsh *et al.*, 2005), whereby lower water quality is recorded in urban areas (e.g., Ōtākaro/Avon and Ōpāwaho/Heathcote catchments) and generally better water quality is recorded in rural areas (e.g., Ōtūkaikino catchment); and

3.9 In relation to the key stormwater contaminants identified in this consent application (TSS, copper, lead and zinc):

- 7% of TSS samples exceeded their respective guideline level (the 9th most frequent guideline exceeder out of the 15 parameters reported)

- 4% of copper samples exceeded their respective guideline level (the 10th most frequent guideline exceeder out of the 15 parameters reported)

- 0% of lead samples exceeded their respective guideline level

- 13% of zinc samples exceeded their respective guideline level (the 7th most frequent guideline exceeder out of the 15 parameters reported)

4. The majority of this water quality sampling has been undertaken during baseline conditions. For stormwater contaminants this may not give the worst-case scenario during wet weather events. The council has monitored stormwater itself within manholes in the past and has a five-yearly in river wet weather monitoring programme. This monitoring showed that:

4.1 Very high levels of dissolved copper, dissolved zinc and TSS are present in stormwater, as high as 20, 18 and 44 times greater than instream guideline levels, respectively (Margetts, 2014; Margetts & Marshall, 2015);

4.2 One-off grab sampling within waterways during wet weather shows that approximately 20%, 60% and 30% of samples recorded dissolved copper, dissolved zinc and TSS values above the guidelines, respectively (Margetts, 2014; Margetts & Marshall, 2015; Margetts & Marshall, 2016; Margetts & Marshall, 2018; Marshall & Burrell, 2017). As an example of the level of exceedance, one site in the Ōtākaro/Avon River (at Carlton Mill Corner) recorded dissolved copper and dissolved zinc values approximately ten and five times higher than their guideline level, respectively; and

4.3 Stormwater does not appear to be a major contributor of nitrogen within waterways:

- All nitrogen parameters (nitrate, NNN, DIN) in stormwater have been recorded in low concentrations below the respective guidelines (Margetts, 2014; Margetts & Marshall, 2015)

- Monitoring of instream springs also suggests that vents and groundwater seepage contribute a significant proportion of nitrogen within Ōtautahi/Christchurch waterways (Munro, 2015)

5. An additional study also investigated the sources of *E. coli* within the Ōtākaro/Avon and Ōpāwaho/Heathcote River, and the Ihutai/Avon-Heathcote Estuary (Moriarty & Gilpin, 2015). This study concluded:

    5.1 Wildfowl were the primary source of faecal contamination during baseflow, with human sources also detected on occasion at some sites. Following rainfall, contamination from waterfowl was still present, with contamination from human sources more abundant, and additional ruminant (sheep and cows) and canine contamination; and

    5.2 *E. coli* levels exceeded contact recreation guideline levels on a number of occasions during baseflow conditions and almost always after rainfall.

Te Pātaka o Rākaihautū/Banks Peninsula/Bank Peninsula Waterways

6. Environment Canterbury collects regular (quarterly or monthly) monitoring data from waterways within BP at fourteen sites (Environment Canterbury, *unpublished data*[2]). These sites are generally located within rural or urban catchments, with one site located within a forested catchment. Of particular relevance is the monitoring of turbidity, ammonia, *E. coli* and DRP.

7. Most sites did not comply with either the DRP (0.025 mg/L) or *E. coli* (550 CFU/100 ml) LWRP guidelines in 2016 (Environment Canterbury, 2018). The only site to comply with both was Zephyr Stream, which showed much less variation in concentrations than the other sites and was the site located within a forested catchment. All sites complied with the ammonia guideline (tested at seven rural sites only), and almost all sites complied with the turbidity guideline.

8. Council carried out a comparison of this Environment Canterbury BP data with the 42 Council water quality sites, using the data from the 2016 calendar year. Of the four contaminants that overlap with the Council monitoring (turbidity, ammonia, *E. coli* and DRP), *E. coli* was the only one that was markedly different, with the median value 135 CFU/100ml higher for BP.

[2] Sourced from Land, Air, Water Aotearoa website

Coastal Waters

9. Environment Canterbury collects monthly water quality data from six sites within the Ihutai/Avon-Heathcote Estuary and two sites just outside the estuary in the coastal waters of Pegasus Bay. A WQI was developed for these sites based on ammonia, NNN, DRP, TSS and enterococci. However, this index only gives a relative indication of water quality (Bolton-Ritchie, 2017). For some parameters in this index, specific national guideline levels were not available and a value was chosen instead that was considered to be appropriate based on other monitoring worldwide (Bolton-Ritchie, 2017). WQI for these sites in 2016 ranged from 'very poor' to 'very good'. Three of these sites are located within the vicinity of stormwater outfalls (Cave Rock, Beachville Road Jetty and Penguin Street). These sites recorded a WQI of 'fair', 'very good' and 'poor', respectively. Overall, the main contaminants of concern at the sites were TSS/turbidity, NNN/DIN, DRP and copper.

10. Council carried out a pilot study of the water quality of coastal waters for the four sites proposed in the EMP (these are all located in proximity to stormwater discharges) in May 2015 (Christchurch City Council, *unpublished data*). Monitoring of the Ihutai/Avon-Heathcote Estuary site showed that dissolved copper, lead and zinc were all below their respective ATL during both dry and wet weather (one event each). Dry weather sampling (one event) at the Lyttelton Port, Cass Bay and Akaroa Harbour sites also recorded all three dissolved metals below the ATL. TSS was also monitored at the four sites. No guideline is available for coastal waters and the ATL proposed is therefore for no statistical increase in concentrations, so there is no trigger value for guidance on acceptable levels. However, based on my knowledge of monitoring, levels (26 – 43 mg/L) were low for these dynamic, soft-bottomed environments, where you would expect naturally high turbulence. This pilot study suggests that the ATL at these monitoring sites will be met, but additional monitoring over the long-term is required to confirm this.

INSTREAM SEDIMENT QUALITY

Ōtautahi/Christchurch Waterways

11. Council has monitored instream sediment quality at 73 sites in the five major river catchments of Ōtautahi/Christchurch City and Linwood Canal in recent years (Blakely, 2016; Gadd & Sykes, 2014; Gadd, 2015; Noakes, 2017; Burrell, 2018). This monitoring showed:

    11.1 The main contaminants of concern were zinc, lead and PAHs, with 36%, 29% and 30% of sites exceeding the relevant guidelines, respectively;

    11.2 Sediment Quality was generally worst in the Ōtākaro/Avon River catchment, with 33% of samples not meeting the 'guidelines for copper, zinc, lead or PAH. Sediment quality was best in the Huritini/Halswell and Ōtūkaikino catchments, with none and 6% of samples not meeting the guidelines, respectively; and

    11.3 This monitoring highlighted that copper and zinc levels in particular are patchy, and highly correlated with the type of urban land use in the catchment.

    11.4 Cadmium, chromium, arsenic and nickel have also been monitored in the Ōtākaro/Avon and Ōpāwaho/Heathcote catchments, with levels typically below the respective guideline levels.

Coastal Waters

12. Council monitors sediment within the Ihutai/Avon-Heathcote Estuary at seven sites every five years, with the most recent survey being carried out in 2016 (Christchurch City Council, *unpublished data 2016*). Metal concentrations (arsenic, cadmium, chromium, copper, nickel, lead and zinc) at all sites were below the respective guideline levels.

13. Sediment samples taken by Environment Canterbury in 2010 within the estuary (City Outfall Drain, Mount Pleasant Yacht Club and Causeway) exceeded the PAH guidelines at three sites (Bolton-Ritchie & Lees, 2012).

ECOLOGY

Ōtautahi/Christchurch Waterways

14. Based on the Council five-yearly surveys, the Ōpāwaho/Heathcote and Huritini/Halswell River catchments generally recorded degraded ecological habitat, often with high proportions of fine sediment cover, modified channels, and little shading and in-stream habitat heterogeneity (Blakely, 2015; Blakely, 2016). The Ōtākaro/Avon River catchment was similar, being typical of waterways in moderately urbanised catchments, although there were areas of greater ecological value (Blakely, 2014). Habitat in the Pūharakekenui/Styx River catchment was variable, with some natural areas and others highly modified areas (Burrell, 2018). The Ōtūkaikino River catchment was generally in good condition, with good substrate, shading and in-stream habitat, and little channel modification (Noakes, 2017).

15. According to the QMCI (Stark & Maxted, 2007), the majority of monitoring sites in Ōtautahi/Christchurch are indicative of 'poor' quality (QMCI of <4.00) according to the QMCI (Blakely, 2014; Blakely, 2015; Blakely, 2016; Noakes, 2017; Burrell, 2018). However, a small number of sites within more rural catchments, such as the Ōtūkaikino River, record an index of 'good' (QMCI of <5.00-5.90) and 'excellent' (QMCI of >5.99).

16. There are a number of biota present within Ōtautahi/Christchurch waterways that fall within the 'Threatened' (lamprey) or 'At Risk' (freshwater mussel/kākahi, longfin eel, bluegill bully, giant bully and inanga) categories of the Threat Classification System (Dunn *et al.*, 2018; Grainger *et al.*, 2014), or are locally uncommon (e.g., redfin bully; Aquatic Ecology Limited, *unpublished data, 2018*).

Coastal Waters

17. An ecological survey of the Ihutai/Avon-Heathcote Estuary by the Council during 2015 recorded variable invertebrate species diversity, with the number of species ranging from 16 - 35 per site (Bolton-Ritchie, 2016). Species present were snails/shellfish, worms, crustacea, anemones, sea spiders and ribbon worms. An additional fish survey in 2015 by the Council recorded the most abundant fish in

the estuary as yellow-eyed mullet, common smelt, yellow-belly flounder and sand flounder, collectively making up 97% of the catch (Woods *et al.*, 2016).