BEFORE THE MANAWATU-WHANGANUI REGIONAL COUNCIL

UNDER	the Resource Management Act 1991
IN THE MATTER OF	a review of conditions 128 (1)(a)(iii) and a change of conditions under section 127 of the Act of the Horowhenua District Council's resource consents for discharges at the Levin Landfill

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Statement of Evidence – Water Quality

Kathryn Jane McArthur

On behalf of:

- **Hokio Neighbourhood Liaison Community Group**
- **Water and Environmental Care Association Incorporated**
- **Hokio Environmental and Kaitiaki Alliance**
- **Ecofest Education Charitable Trust**
- **Ngāti Pareraukawa**
- **Ngātokowaru Marae Committee**
- **Horowhenua Ratepayers Association**
- **E & D Grange**

9 September 2016

Table of Contents

A INTRODUCTION

Qualifications and Experience

1. My full name is Kathryn (Kate) Jane McArthur.

2. I hold a Bachelor of Science degree with Honours in Ecology and a Master of Applied Science with Honours in Natural Resource Management, both from Massey University. My areas of post-graduate research include the influence of land use on freshwater macroinvertebrate communities and the interaction between policy and science for improved freshwater resource management, with a particular focus on water quality objectives and limits. I have 15 years post-graduate experience working in the field of freshwater management and I joined The Catalyst Group (an environmental consultancy based in Palmerston North) as the Practice Leader - Water Quality in 2012.

3. Before joining The Catalyst Group, I held the role of Senior Scientist – Water Quality with Horizons Regional Council (Horizons). Over 6 years with Horizons I coordinated the State of the Environment and discharge monitoring programmes for water quality and aquatic biodiversity, produced expert evidence for many resource consent hearings and enforcement actions (relating mainly to takes of, and discharges to, water). During my work on the One Plan I led the identification of Sites of Significance – Aquatic work, reviewed and refined the water management zones and the river, lake and coastal water quality limits. I project managed the water quality evidence for the One Plan hearings and Environment Court proceedings.

4. I have authored and co-authored a range of reports and publications, including technical reports to support the Proposed One Plan. I have also authored and co-authored papers in peer-reviewed journals on topics such as: the relationship between flow and nutrients in rivers; nutrient limitation; methods for monitoring native fish; the calculation of in-river nutrient loads and limits, and the setting of water quality objectives and limits in resource management policy. I have provided evidence in these areas before the Environment Court, in Board of Inquiry and Independent Hearings Panel processes in recent years.

5. I have most recently provided ecological and policy advice to Nelson City Council, Northland Regional Council, Ngāti Kahungunu Iwi Incorporated, Hawkes Bay Regional Council, the National Iwi Leaders Group and the Department of Conservation.

6. On behalf of the New Zealand Planning Institute I co-lead the 2016 workshop series throughout the country on freshwater science and policy development. Participants have included: local government and industry planners, planning consultants, iwi/NGO resource managers, and the

Ministry for the Environment Water Directorate staff. I am a member of the National Objectives Framework (NOF) reference group advising the Ministry for the Environment.

7. Since 2012 I have worked with the Iwi Leaders Group and several iwi authorities in identifying iwi, hapū and whānau whenua values for water at national, rohe and catchment scales. I have a good working knowledge of Te Ao Māori, particularly with regard to the significance of water for tāngata whenua and the national discourse on Māori rights and interests in freshwater. However, I have not worked with the hapū and whānau of the Hokio area. Any evidence presented by the people of Ngāti Pareraukawa should in every case be preferred to the general comment on freshwater values that I have provided.

8. I have been a member of the New Zealand Freshwater Sciences Society since 2001 and I am currently elected onto the Society's executive committee. I have been a member of the Resource Management Law Association of New Zealand (RMLA) for seven years and RMLA scholarship recipient in 2010 for my work on water quality objectives and limits for the Manawatū River. I am a guest lecturer in environmental science and planning at Massey University and a practicing RMA hearings commissioner.

Purpose and Scope of Evidence

9. This statement of evidence was prepared for the Hokio Neighbourhood Liaison Community Group, Water and Environmental Care Association Incorporated, Hokio Environmental and Kaitiaki Alliance, EcoFest Education Charitable Trust, Ngāti Pareraukawa, Ngā Tokowaru Marae Committee, and Horowhenua Ratepayers Association in support of submissions on the review of consent for a discharge permit relating to the Levin Landfill.

10. The purpose of this evidence is to provide technical advice to the Hearing Panel in relation to ecological and water quality issues associated with the discharge of landfill leachate and any associated effects on freshwater values.

11. This evidence covers the following matters:

    a. Water quality results and monitoring;

    b. The status of the Tatana Drain; and

    c. The values affected by the discharge of leachate.

12. In preparing my evidence, I have read the following material:

    a. The National Policy Statement for Freshwater Management (2014) ("NPS-FM");

    b. Relevant provisions of the One Plan;

    c. Section 42A reports prepared by Logan Brown, Stuart Standen, and Andrew Bashford;

    d. Statements of evidence by Olivier Ausseil, Stephen Douglass and Gallo Saidy;

    e. The 2010 Horizons consent review decision for permit 6010;

    f. Numerous annual monitoring reports on the landfill discharge produced by MWH;

    g. A spreadsheet of monitoring results provided to the water quality experts;

    I have undertaken a visit to the site on 3 August 2016 and I participated in expert conferencing on surface water quality on 10 and 25 August.

Expert code of conduct

13. I have read the Code of Conduct for Expert Witnesses in the Environment Court's Practice Note (2014) and I agree to comply with that Code of Conduct. I confirm that the issues addressed in this brief of evidence are within my areas of expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions that I express. I have specified where my opinion is based on limited or partial information and identified any assumptions I have made in forming my opinions.

B WATER QUALITY RESULTS AND MONITORING

14. The joint witness statement (JWS) on water quality generally reflects my understanding of the nature of the leachate, and the water quality of the Tatana Drain and Hokio Stream receiving environments, notwithstanding the comments in the following sections.

15. Dr Ausseil and Mr Brown have outlined the contaminants of concern and analysed the water quality monitoring data with respect to relevant One Plan and National Policy Statement for Freshwater Management (NPS-FM) thresholds. I agree that the thresholds used in both analyses (the NOF, One Plan Schedule E and ANZECC toxicants contained in table 3.4.1 of the guidelines for 95% protection of aquatic species) are appropriate.

16. In examining the spreadsheet of monitoring data I note there is no information on dissolved oxygen (DO) concentration for the Hokio Stream monitoring sites, despite elevated BOD/COD[1] at both the upstream and downstream Hokio Stream sites. Dissolved oxygen is critical to aquatic life. Low levels of DO causes stress to aquatic life, some species are more sensitive than others. Animals, particularly fish, will leave a low DO environment if they can, which can cause local extinction of sensitive species or death if animals cannot migrate out.

17. Given the nature of the Hokio Stream I would expect periods of lowered dissolved oxygen to occur at both the upstream and downstream sites some of the time, particularly when organic loads are discharged from the lake (ie planktonic cyanobacteria) or when the lake weed die-off is occurring. However, upstream to downstream differences in DO as a result of the landfill leachate cannot be determined due to the influences of contaminated groundwater entering the Hokio Stream up-gradient of the monitoring sites as confirmed in the evidence of Mr Douglass. Understanding the potential influence of the leachate on DO levels in the Hokio Stream is important to assessing the effects on aquatic life, life-supporting capacity and mahinga kai. This cannot be undertaken in a meaningful way until an upstream site that is clear of the leachate affected groundwater is determined. Monitoring of DO is best undertaken using instream DO loggers to look at the diurnal profile of DO within the six-month warmer period of the year[2]. This will enable an assessment of the 1-day and 7-day minima that are set out in the NOF for point source discharges and the DO percent saturation criteria in the One Plan targets.

18. Dr Ausseil discusses the limitations associated with the upstream monitoring site in his evidence summary at paragraph 9(a). He concludes that there is a low risk of toxic effects on aquatic life within the Hokio Stream and bases this conclusion on the assumption that the key contaminants of concern in his opinion (ammonia[3] and metals) do not reach toxic effect thresholds at either the upstream or the downstream sites.

19. I note there is an error in Dr Ausseil's Appendix A which identifies the relevant targets as being those from the Lake Papaitonga West_8 Water Management Zone. The leachate is discharged to water within the Hoki_1b sub-zone of the Lake Horowhenua water management zone (Hoki_1). However, I have confirmed that the relevant targets are the same for both zones.

[1] Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD).

[2] Dissolved oxygen saturation is further reduced by warm water temperatures, placing additional stress on aquatic life.

[3] Dr Ausseil's Appendix A tables do not show 100% compliance with One Plan ammonia-N targets. However, by my own analysis he is correct in his statement that these targets are not exceeded at either the upstream or downstream monitoring sites.

20. Biochemical Oxygen Demand (BOD), soluble inorganic nitrogen (SIN) and dissolved reactive phosphorus (DRP) at both the upstream and downstream Hokio Stream sites exceed One Plan targets. COD is also elevated but there is no target to assess this contaminant against. Elevated BOD causes nuisance growths of heterotrophic slimes and reduces the dissolved oxygen available to aquatic life. According to Dr Ausseil's appendix A, BOD at the upstream (HS1) and downstream (HS2) Hokio Stream sites only complies with the One Plan targets 24 and 28% of sampling occasions, respectively. With the influence of leachate contaminated groundwater affecting site HS1, there can be little certainty that all effects on aquatic life are adequately understood or captured within the current monitoring.

21. Elevated SIN and DRP (which also exceed One Plan targets) are more likely to affect aquatic life indirectly through the stimulation of nuisance algae/plant growth in the Hokio Stream or downstream environments, including the estuary. High levels of growth can also lower dissolved oxygen concentrations, particularly during the night as algae and plant cells cease producing oxygen through photosynthesis and continue to respire, using up the available oxygen.

22. With respect to metals, Dr Ausseil's tables also show exceedance of the ANZECC trigger values for aluminium, boron, cadmium, copper, lead, nickel and zinc. Dr Ausseil discusses aluminium specifically but not the exceedance of other metals, instead relying on an assessment of the guidelines against the median values to determine that the risk is low.

23. In my opinion there is a high level of uncertainty associated with the analyses under taken by Dr Ausseil and his subsequent conclusions, as a result of the likelihood of contamination of the upstream site by leachate.

24. Assessment of the water quality of the Hokio Stream is complex because of the discharge of extremely poor quality water from Lake Horowhenua and the influences of the surrounding land use on the stream. This water management zone has been identified through the One Plan as a priority catchment for contaminant management of land use and considerable emphasis placed on cleaning up the lake. Water quality below NOF bottom lines in the Lake and associated waterways means that significant improvements are required by the NPS-FM. It is expected that over time water quality will improve in this management zone. This context is an important consideration for consent decision makers.

C STATUS OF THE TATANA DRAIN

25. An area of disagreement between the water quality experts has been whether the Tatana Drain is a modified watercourse, which constitutes a river under the RMA definition, or a farm drainage canal. Looking at the historical aerial photography, the area between the closed landfill site and the Hokio Beach Road appears to almost certainly have been a wetland, this is consistent with the nature of the groundwater table and the ecological context of the area. I do not think there is unequivocal evidence of a surface water flow path, although assessment of this from aerial photography is highly uncertain. I agree with Dr Ausseil that there are inconsistencies in the REC layer, particularly in low-lying areas like Hokio. My advice is to ask residents who have been in the area for a long period, they may be able to recollect the nature of the site prior to its development and drainage.

26. Regardless of RMA status, there is clearly leachate entering the Tatana Drain and this leachate flows into the Hokio Stream via the drain and the shallow groundwater.

27. Water quality results from the Tatana Drain are presented in Mr Brown's s42A report, Table 2. Monitoring results for ammonia-N, BOD, COD and chloride in the drain are extremely high. In some samples, ammonia-N and BOD were as much as 40 and 150 times (respectively) the levels known to cause adverse effects in surface waters. There is a high likelihood for this degree of contaminant concentration to have adverse effects on aquatic life if animals stray into the drain itself[4], and where the immediate discharge of this water enters the Hokio Stream. As this is an unconsented discharge, there is no 'zone of reasonable mixing' which applies. Thus I have considered the effects on aquatic life at the immediate point of discharge to the stream and within the plume of the drain discharge.

D EFFECTS OF THE DISCHARGE OF LEACHATE ON VALUES

Native fish and threatened species classification

28. I agree with the description of the aquatic ecological values of the Hokio Stream provided by Mr Brown in his s42A report. For the information of the Hearing Panel I provide some additional wider context on the New Zealand threat classification system below, which is used to assess species at risk, and is relevant to the consideration of the Hokio Stream environment.

[4] Smaller waterways provide refuge to aquatic life during high flow events. Water from the Hokio Stream back-flows into the Tatana Drain under these conditions, which I have seen on my initial site visit. There was also significant ponding on the land adjacent to the drain. Tuna (eels) are often highly mobile, including across wet land and ponded areas as they seek refuge during these events.

29. The NZ Threat Classification System uses nationally understood and consistent categories and criteria to assess the risk of extinction to all New Zealand species (Figure 1). Nationally, 78% of the native freshwater fish fauna has an assigned threat status. This is an increase from the last two reported threat classifications where 67% were identified as threatened or at risk in 2009 and 53% in 2005 (Allibone et al. 2010; Hitchmough et al. 2007). Increases in the proportion of threatened or at risk species can result from changes in taxonomic resolution for some species and changes in threat classification method since the 2005 and 2009 classifications. However, this does not explain the total pattern of decline and it is generally accepted by freshwater ecologists that native fish populations are continuing to decline nationally for reasons associated with resource use and habitat degradation (Joy 2009; Brown et al. 2015). More threatened species are in higher threat classification classes than in the past, meaning they are becoming more threatened with extinction over time (Goodman et al. 2014).

30. Allibone et al. (2010) suggest declines in migratory species in particular may be the result of a 'source and sink' effect whereby 'sinks' occur in relatively poor habitat that does not provide the critical requirements for successful reproduction, recruitment or long-term survival. Using īnanga[5] as an example, a 'sink' habitat may provide for juveniles and be adequate for growth of those fish into adults, but have no available spawning habitat and thus the fish in that habitat never reproduce. The risk of source and sink affected populations is that very rapid population decline (either regionally or nationally) is possible once source areas (spawning or juvenile rearing areas which allow for successful reproduction and recruitment of fish into the next generation) are depleted or destroyed. Such declines are now indicated in species that were once common, like the longfin eel and īnanga. Allibone at el. (2010) warn that:

> "*More serious effort is now required to reverse the decline in native freshwater fishes and to manage the instrumental causes of their decline that are ongoing, and in some cases increasing, if the extinction of further freshwater fish is to be prevented*."

[5] Īnanga are expected to have resident populations within this area of the Hokio Stream, as well as upstream habitats.

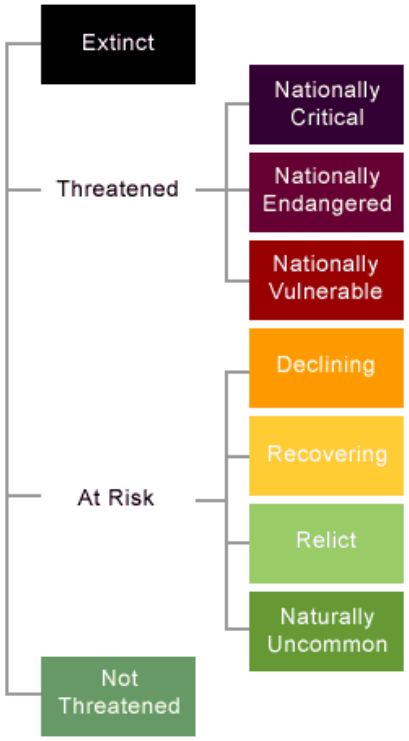

Figure 1. New Zealand Threat Classification System categories. *Source: Department of Conservation*.

31. The leading causes of decline in native fish have been identified as declining water quality, water abstraction, exotic fish species, and loss of habitat via landuse, and river modification (Allibone et al. 2010). Torrentfish, present in the Hokio Stream, are the only member of their genus (*Cheimarrichthys*) world-wide and thus they have special biodiversity value. There is mounting evidence in the freshwater fish database that they are declining in some large river systems, including the Manawatū River (*R. Allibone pers comm.*).

32. In our response to question 15 in the JWS, we have characterised the sensitivity of the Hokio Stream. I am particularly concerned about the potential for effects on juvenile migratory fish and subsequent population level effects as a result of poor juvenile recruitment into resident Hokio Stream populations, or into waters upstream of the discharge point. Fish monitoring until recently (David et al. 2010; Joy et al. 2013) is most often presence absence data only, effects on populations take time and effort to determine whether particular size classes of a species (e.g. juveniles, or mature breeding females in the case of eels) have been affected by water quality or habitat decline. Population declines in many fish species, particularly eels, can be rapid and may not be identified by monitoring until species numbers are extremely low.

33. The minimum number of eels required to reach oceanic spawning grounds for successful spawning and recruitment is unknown. If the minimum number of eels migrating is not reached in any year, eels may not encounter each other at spawning sites. There is a risk that if the number of eels

spawning declines below a critical level, then Allee effects[6] will rapidly increase the rate of decline of the species (Allibone et al. 2010).

34. Juvenile īnanga are the most common species in the whitebait catch. Reductions in the quality of habitat, adult īnanga numbers and the reproductive success of īnanga and other whitebait (galaxiid) species not only affects indigenous biodiversity values, but threatens recreational and mahinga kai values through reduced whitebait catch over time.

35. Fish monitoring, even including size class and abundance information, does not usually include assessment of the health of individuals within a population. In many cases, fish in poor condition are unavailable as a mahinga kai resource and may indicate low potential for reproductive success.

36. Īnanga and tuna are important mahinga kai species. The tangata ō Ngāti Pareraukawa can provide specific information on mahinga kai practices and species in the Hokio Stream, and what is needed to provide for this value in the local context.

Effects on Mauri

37. In the JWS response to question 17, I have commented that effects on mauri are likely as a result of the discharge. The reason I have made this comment in the JWS is because mauri is an identified value for water that applies across the whole of the Manawatū-Whanganui Region. In many cases ecological science can provide information on affects that aligns with mātauranga Māori assessments of effects on cultural health (Tipa and Teirney 2006). Based on my experience, it would be an omission for me to ignore the effects of the discharge on mauri and other tangata whenua values for water.

38. The mauri of a particular place, water or object can really only be adequately described by those who have a relationship with that place or object. There are many components to mauri, only some of which are biophysical. Effects on mauri can be wide ranging and are best determined by the tangata whenua who are affected. That said, in my experience of the effects on mauri from discharges to water is that the nature of the discharge (ie. sourced from refuse or waste) is an aspect that needs consideration, beyond a western-science monitoring paradigm. The negative connotations associated with the leachate and its source are unlikely to be assuaged by monitoring results.

[6] Allee effects are broadly defined as a decline in individual fitness at low population size or density that can result in critical thresholds below which populations crash to extinction.

39. In my recent work with Māori in different parts of the country on identifying values for water, and throughout my resource management career I have listened to many descriptions by Māori of the effects of discharges of waste on the mauri of water. The adverse effects on the wairua of the people who have a relationship with that water and/or whakapapa to that water or place are often associated with denigration of mauri by discharges of waste. These effects can be directly related to the health and wellbeing of the people[7]; and there are interrelated effects on the mana of those people, effects on the health and availability of their mahinga kai resources and the ability of the people to provide manaaki to their manuhiri (visitors). They may not be able to undertake some spiritual practices, and are essentially removed from their duties and rights to practice kaitiakitanga. Their relationship with nearby waahi taonga or waahi tapu sites may also be negatively affected.

40. As stated above, any evidence provided by mana whenua on these or any other values should be preferred over the statements above as a key principle underpinning Te Ao Māori is the recognition of rangatiratanga/self-determination/autonomy of those who are mana whenua in this place.

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9 September 2016

[7] Including spiritual and physical health and wellbeing.

E REFERENCES

Allibone RM, David BO, Hitchmough R, Jellyman DJ, Ling N, Ravenscroft P, Waters JM 2010. Conservation status of New Zealand freshwater fish, 2009. *New Zealand Journal of Marine and Freshwater Research 44*: 271–287.

Brown M, Stephens RTT, Peart R, Fedder B 2015. *Vanishing Nature: facing New Zealand's biodiversity crisis*. Environmental Defence Society, Auckland, New Zealand Pp. 196.

David, B, Hamer, M., Collier, K.J., Lake, M., Surrey, G., McArthur, K., Nicholson, C., Perrie, A., and Dale, M. 2010. A standardised sampling protocol for robust assessment of reach-scale fish community diversity in wadeable New Zealand streams. *New Zealand Journal of Marine and Freshwater Research 44(3):*177-187.

Goodman JM, Dunn NR, Ravenscroft PJ, Allibone RM, Boubee JAT, David BO, Griffiths M, Ling N, Hitchmough RA, Rolfe JR 2014. Conservation status of New Zealand freshwater fish, 2013. New Zealand Threat Classification Series 7, Department of Conservation, Wellington, 12p.

Hitchmough R, Bull L, Cromarty P, (comps) 2007: New Zealand Threat Classification System lists—2005. Department of Conservation, Wellington. 194 p.

Joy MK 2009. Temporal and land-cover trends in freshwater fish communities in New Zealand's Rivers: an analysis of data from the New Zealand Freshwater Fish Database – 1970 – 2007. Report Prepared for the Ministry for the Environment, Wellington.

Joy MK, David B, Lake M. 2013. New Zealand Freshwater Fish Sampling Protocols Part 1: Wadeable Rivers and Streams. The Ecology Group – Institute of Natural Resources, Massey University, Palmerston North. 64 p.

Tipa G. Teirney L. 2006. A Cultural Health Index for Streams and Waterways: A tool for nationwide use. A report prepared for the Ministry for the Environment, Wellington, New Zealand. 58 p.