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Sent: Friday, 18 September 2020 4:35 PM
To: Plan Hearings
Cc: Ben Williams; Bianca Sullivan; Brent Walton
Subject: Rebuttal evidence on plan change 7 to the Canterbury LWRP by Waimakariri Irrigation Limited
Attachments: WIL_Neil_Thomas_rebuttal_evidence.pdf; WIL_Stuart_Ford_rebuttal.pdf; WIL_Mike_Copeland_rebuttal.pdf; WIL_David_Black_rebuttal.pdf; CHCDOC01-#1571651-v2-WIL_Bianca_Sullivan_rebuttal.pdf

Kia ora Tavisha,

Please find **attached**, on behalf of Waimakariri Irrigation Limited, rebuttal evidence on the proposed Plan Change 7 to the Canterbury Land and Water Regional Plan of:

- Neil Thomas
- Dr David Black
- Bianca Sullivan
- Stuart Ford
- Michael Copeland

Ngā mihi,
Kirsty

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Under: the Resource Management Act 1991

In the matter of: proposed Plan Change 7 to the Canterbury Land and Water Regional Plan

and: a submission (PC7-349) and further submission (FPC7-349) by Waimakariri Irrigation Limited

Statement of Rebuttal evidence of Dr David Russell Black

18 September 2020

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Statement of Rebuttal evidence of Dr David Russell Black

1. My name is Dr David Russell Black.
2. I am a medically qualified and registered specialist in occupational and environmental medicine with extensive experience in standard setting in New Zealand and internationally.
 - a. I hold the degree of BHB (Batchelor of Human Biology) and MBCHB (Batchelor of Medicine and Batchelor of Surgery) from the University of Auckland, DIH (Diploma of Industrial Health) from the University of Otago and Doctor of Medicine (MD) from the University of Auckland.
 - b. In this regard I have worked extensively with the World Health Organisation in the matter of standard setting for health effects of radiofrequency exposure. This was the topic of my postgraduate degree of Doctor of Medicine (MD).
 - c. In particular, I have undertaken this work during the time in which the precautionary principle, prudent avoidance and the like were frequently discussed as reasons for modifying established standards, and were eventually rejected resulting in standards based on proven effects with defined safety margins which are now proven and stable.
 - d. I have substantial experience in health protection regarding ground water, including in a Resource Management Act process, the establishment of land dispersal sewerage systems on the East Coast of the Coromandel Peninsula.
 - e. I was a member of Standards New Zealand from 1990 until 2008 and remain a member of Standards Australia.
 - f. I am a professional Member of the Royal Society of New Zealand (MRSNZ).
3. I have been asked by Waimakariri Irrigation Limited (WIL) to provide this statement of rebuttal evidence in response to the evidence of Dr Tim Chambers and Ms Bridget O'Brien for the Christchurch City Council.

Code of conduct

4. I confirm that I have read and am familiar with the Environment Court's Code of Conduct for Expert Witnesses, contained in the Environment Court's Practice Note 2014, and I agree to comply with it.
5. I confirm that the issues addressed in this statement of rebuttal evidence are within my area of expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed.

6. I have set out the data, information, facts and assumptions considered in forming my opinions as well as the reasons for the opinions expressed.

Context for rebuttal evidence

7. WIL runs a combined irrigation/stock water scheme in Canterbury. WIL has submitted on plan Change 7 in the Canterbury Land and Water Regional Plan (LWRP-PC7) which requires land users to not exceed nitrogen loads of 5.65 mg/L nitrate-nitrogen in ground water, which is effectively half the drinking water standard, currently set at 11.3 mg/L.
8. I have read the submission of and primary evidence for WIL and understand that WIL has not sought to challenge the proposed limit, however, Christchurch City Council has called evidence which appears to be promoting a lower limit of 1 mg/L nitrate-nitrogen. The basis of this as expressed in the evidence of Dr Tim Chambers appears to be due to putative health effects arising from ingested nitrogen to the human population. It is argued that there is an evidential basis for considering that adverse effects could occur at lower levels than the standard. This is contrary to the evidence based position adopted by WHO.
9. To provide some context to my rebuttal, the relevant standard for nitrate-nitrogen levels in drinking water is “*Drinking-Water Standards for New Zealand 2005 (Revised 2018)*” (Standards). This revision was prompted by a Government inquiry into the Havelock North drinking water outbreak. The standards are based on limiting maximum acceptable values based on determinands which could affect health. The determinands with potential to affect health are microbiological agents, inorganic chemicals, organic chemicals, and radioactivity. There is also a list of agents which could result in aesthetic degradation of water for drinking.
 - a. The issue in this case is the maximum allowable value (MAV) of nitrates which are expressed as 50 mg/L for nitrates (NO₃), there is also consideration of nitrites expressed as 0.2 mg/L as NO₂ for long-term exposure. For short-term exposure nitrites at 3 mg/L are permitted.
 - b. There is also a limiting standard for nitrate and nitrite to protect against methemoglobinemia in bottle-fed infants. In otherwise healthy individuals, the protective enzyme systems normally present in red blood cells rapidly reduce the methemoglobin back to hemoglobin and hence maintain methemoglobin levels at less than one percent of the total hemoglobin concentration. Exposure to exogenous oxidizing drugs and their metabolites (such as benzocaine, dapsone, and nitrates) may lead to an increase of up to a thousandfold of the methemoglobin formation rate, overwhelming the protective enzyme systems and acutely increasing methemoglobin levels.
 - c. Infants under 6 months of age have lower levels of a key methemoglobin reduction enzyme (NADH-cytochrome b5 reductase) in their red blood cells. This results in a possible risk of

methemoglobinemia caused by nitrates ingested in drinking water. The Standard recognises and covers this, and it is the basis for the relevant MAV's which are set. The protection level required to prevent this is expressed in the Standard as the sum of the ratio of the concentrations of nitrate and nitrite to each of their respective MAV's, and this must not exceed one.

- d. The standards do not regard nitrates and nitrites as posing a risk of cancer for which there is only regulation of arsenic, bromate and a number of organic determinands. These standards published by the Director General of Health in 2018 are consistent with international approaches; in particular, the regulation of nitrates is consistent with the approach recommended by the World Health Organisation.

Response to evidence of Christchurch City Council

10. I have read the evidence submitted by Christchurch City Council.
11. Dr Chambers from the University of Otago acknowledged that the basis of the current WHO recommendation of 11.3 mg/L nitrate-nitrogen (NO₃N) is based on the short-term risk of infantile methemoglobinemia. I agree with that.
12. Dr Chambers goes on to say that the International Agency for Research on Cancer (IARC) has recently classified nitrate or nitrite in Category 2A of their system for identification of carcinogenic chemicals. That is a category in which substances regarded as probably carcinogenic are categorised.
13. The substantial work by IARC in this area was published in 2010.¹
14. IARC maintain a system of classification which rates the potential and proven cancer-causing properties of a wide range of agents.² I will only discuss the Agency's position on oxides of nitrogen (nitrates and nitrites).
 - a. Nitrate or nitrite (ingested) under conditions that result in endogenous nitrosation is included in Category 2A, the definition of which is;
 - i. Limited evidence of carcinogenicity in humans and sufficient evidence of carcinogenicity in experimental animals **OR**
 - ii. Inadequate evidence of carcinogenicity in humans and sufficient evidence of carcinogenicity in experimental animals and strong evidence that the carcinogenesis is mediated by a mechanism that also operates in humans **OR**

¹ <https://monographs.iarc.fr/wp-content/uploads/2018/06/mono94.pdf>

² https://wiki.cancer.org.au/policy/IARC_classifications#cite_note-Citation:The_International_Agency_for_Research_on_Cancer-1

- iii. Limited evidence of carcinogenicity in humans, but belongs, based on mechanistic considerations, to a class of agents for which one or more members have been classified in Group 1 or Group 2A.
 - b. Dr Chambers argues that the process of endogenous nitrosation is the mechanism by which he considers that ingested nitrate is linked to cancer. He says that nitrite is precursor to the formation of nitroso compounds (NOC) which are carcinogenic. He also acknowledged that vegetables are the major source of ingested nitrate in the diet of New Zealanders but that because they are typically introduced with NOC inhibitor factors such as vitamin C and polyphenols this hazardous effect is prevented. His opinion is that nitrate introduced into water, because it does not contain NOC inhibiting features, is carcinogenic. That view is no more than speculative, not widely accepted and has not influenced WHO in setting drinking water standards.
 - c. Dr Chambers goes on to say that there is a *“growing body of epidemiology (sic) evidence demonstrating a positive association between nitrate introduced into drinking water and colorectal cancer”*. He discusses a number of studies which appear to show an association between nitrate in drinking water and colorectal cancer suggesting such ingestion has a linear or threshold effect on cancer. That is effectively saying that the risk he is proposing is deterministic. He does not use that term but that is the effect of what he is saying and he is inferring that there is no threshold or safe limit and that the cancer risk increases with both dose and time of exposure. He does acknowledge that he *“cannot say for certain that there is no threshold effect”*.
 - d. Essentially, Dr Chambers’ opinion is that there is emerging evidence providing a convincing case for a relationship between nitrate and colorectal cancer and that there is a *“strong case to adopt a precautionary approach to nitrate management”*. On that basis Dr Chambers recommends overturning the approach recommended by WHO and international best practise and reducing the target threshold for nitrate-nitrogen to 1 mg/L which appears to have become the basis of the submission by Christchurch City Council. This view has also been supported by the Council’s Environmental Engineer Bridget O’Brien who is the programme manager-water supply.
15. The application of epidemiological information to the setting of health-related standards is a specialised and intricate task, in which I have considerable professional experience. The use of the IARC tables are helpful in establishing a direction for investigation however it is always necessary to return to the original research which is very readily available in the monograph. IARC intends to provide a schedule of early warnings for substances which are suspected of causing cancer and it does include categories (Category 1) for those which are proven or seriously suspected.

16. Epidemiology generally does no more than provide evidence of a statistical association. That can be weak or powerful and on its own may not in itself provide compelling evidence for a causal relationship. More than fifty years ago, the British epidemiologist Sir Austin Bradford Hill wrote about this and suggested a number of viewpoints from which apparent epidemiological associations should be assessed for the likelihood of true causation. These viewpoints are regarded as the appropriate framework for undertaking epidemiological assessments.³
17. It is beyond the scope of this discussion to go into the Bradford Hill assessment methodology in further detail except to say that the suggestions of cause and effect provided in the evidence submitted by Christchurch City Council do not meet the Bradford Hill tests and in my view that is a powerful reason for not accepting any causal relationship, particularly as it is also known that exposure to nitrates from common foodstuffs such as leafy vegetables is ubiquitous and the idea that this exposure is only saved from cancer causation by the coincidental absorption of other substances is only speculation.
18. The suggestion of a “*precautionary approach*” is an area which has received extensive analysis in both scientific and I understand legal circles. The idea that a precautionary approach can be achieved by simply lowering standard thresholds is in my opinion fraught with danger and in the context of epidemiology has been rejected many times. That is particularly obvious in this case where the Standard’s MAV was deliberately set at a very low level to cover something else (here, that is methemoglobinemia in bottle-fed infants).
19. From my experience, the idea of the precautionary principle has regularly been misunderstood. It arose originally in the context of (for example) oil spills from damaged oil tankers and a recommendation for constructing these ships with double hulls. In that context it was reasoned that if there is an inevitable risk (that is, carrying oil in tankers on the sea) and this will be expressed occasionally in inevitable accidents then the impact of those accidents could logically be reduced by reducing the likelihood and magnitude of leakage. That is the basis of the precautionary principle and it remains valid. A later concept advanced by Professor Granger Morgan at Carnegie Mellon University was the concept of “*prudent avoidance*” which is essentially the idea that if there are two ways to do something and one appears to be, but may not be proven to be safer, then perhaps it is better to take the apparently safer course, because people will feel more comfortable with it. That idea is also fraught with the problems of unexpected consequences and the technique, especially in epidemiology has largely been abandoned.
20. Current best practise and standard setting is to rigorously base standards on established science. Proven and replicable effects are used as a starting point and then, standards usually apply a safety margin which is to take into account such factors as individual biological variation and errors in estimation. This is clearly the approach which has been taken in the

³ <https://www.who.int/bulletin/volumes/83/10/792.pdf>

establishment of drinking water standards based on the WHO approach, including the NZ 2018 Standards. However, it must be noted for nitrates, this has been based on nitrites and nitrates to prevent methemoglobinemia and not on any idea of carcinogenesis for which there is no established causal relationship.

21. It is also common practise for users of a standard to set an “*action level*” which is usually a level below the standard which is a target to improve strict compliance with the actual standard. That approach is neither precautionary nor prudent avoidance; it is an established technique for achieving compliance. I regard the approach proposed in the LWRP-PC7 of using half of the standard in this way as good practice.
22. There is a significant public health benefit from ensuring that standards are consistent and complied with and a contrary disbenefit in the suggestion of varying ‘pseudo-standards’ such as that proposed in evidence provided by Christchurch City Council.
23. If, across a population, compliance with properly set standards can be assured, and there is no evidence of unexplained disease which has been epidemiologically linked to a putative cause controlled by a standard, then there can be confidence in the standard. If ‘pseudo-standards’ are adopted and cause a false sense of public reassurance, significant resources can be wasted for no purpose and that also undermines why the public health studies which rely on public exposure having been contained to a properly set standard. In the context of public drinking water, it must be accepted and understood that the reason for concern about standards in New Zealand was microbiological contamination, as is made clear in the 2018 review.
24. On that basis, it is my strong recommendation that the properly established and internationally compliant standards for nitrates and nitrites in drinking water in New Zealand be set as the requirements for the LWRP-PC7 and that any suggestion of a separate ‘pseudo-standard’ be rejected on the basis that it has no proper basis in terms of established causation and therefore has poor scientific integrity.

18 September 2020



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Occupational & Environmental Medicine Specialist**

