BEFORE THE CANTERBURY REGIONAL COUNCIL
AT CHRISTCHURCH

IN THE MATTER	of the Resource Management Act 1991
SUBMITTER	**COMMUNITY AND PUBLIC HEALTH A DIVISION OF THE CANTERBURY DISTRICT HEALTH BOARD**
SUBJECT	**HEARING – VARIATION 1 TO THE LAND AND WATER REGIONAL PLAN**
SUBMITTER NO	**52266**

STATEMENT OF EVIDENCE OF DR ALISTAIR HUMPHREY

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1. INTRODUCTION

Qualifications and experience

1.1 My full name is Alistair Ross Gordon Humphrey. I am a public health physician employed by the Canterbury District Health Board. I am a Fellow of the Faculty of Public Health Medicine of the Royal Australasian College of Physicians, a Fellow of the New Zealand College of Public Health Medicine and Fellow of the Royal Australian College of General Practitioners. As well as my medical qualifications, I hold a Master of Public Health Degree. I am also a Medical Officer of Health for Canterbury designated by the Director General of Health pursuant to section 7 (a), Health Act 1956, but this submission is delivered on behalf of the Canterbury District Health Board. I have read the Code of Conduct for Expert Witnesses from Schedule 4 of the High Court Rules and have prepared my evidence accordingly. The evidence is within my area of expertise, except where I state I am relying on what I have been told by another person. I have not omitted to consider material facts known to me that might alter or detract from the opinions that I express.

2. BACKGROUND

2.1 Community and Public Health (CPH) a Division of the Canterbury District Health Board (CDHB) provides public health services to those people living in the Canterbury, South Canterbury and West Coast regions. Goals of CDHB include:

- Improve the health and wellbeing of our region, especially for children and young adults
- Reduce health inequalities especially for those of relative socio-economic deprivation
- Improve Māori and Pacific health outcomes
- Prevent illness and hospitalisation
- Work in partnership to achieve lasting change

2.2 Areas that CPH work within, and provide assistance with, include among other things:

- Drinking water
- Environmental Health Issues
- Health Information
- Recreational Water
- Waste Management
- Communicable Disease Control

2.3 **Scope of evidence**: This evidence relates to the submission of Community and Public Health (CPH) a Division of the Canterbury District Health Board (CDHB) on Variation 1 to the Land and Water Regional Plan. The submission is number 52266 and concentrated on the areas of On-site Wastewater, Nutrient Management, Fresh Water Outcomes and Water Quality Limits and Targets. The evidence will examine and expand on the points that we made in our submission.

3. On-site Wastewater

3.1 CDHB has sought input from Dr Lee Burbery, senior groundwater scientist at the Institute of Environmental Science (ESR) and technical advisor to the CDHB with regards to the following items pertaining to on-site wastewater topics related to Variation 1.

3.2 Rule 5.8 in the Decisions Version of the proposed Canterbury Land and Water Regional Plan requires that the discharge of wastewater from a new, modified or upgraded on-site domestic wastewater treatment system onto or into land in circumstances where a contaminant may enter water is a permitted activity, provided a set of seven conditions are met. Although protective of human and environmental health from microbiological parameters, none of these conditions specify a performance criterion or load limit in relation to treatment of nitrogen in wastewater effluent.

3.3 CDHB and ESR believe a holistic approach to nitrogen management is warranted in the Selwyn/Waihora zone and that setting well defined rules around nitrogen discharges permitted from on-site wastewater treatment systems which reflect Good Management Practice is deserved.

3.4 Such rules have been set in other regions where there are concerns around protecting/restoring the quality of freshwater environments, e.g. Bay of Plenty Regional Council and Waikato Regional Council have set planning requirements for total nitrogen discharges from On-site Waste Water Treatment (OSWWT) systems serving developments around the Rotorua Lakes and Lake Taupo, respectively. In the case of the Rotorua Lakes, a limit of 15 mg N/L is set.

3.5 CDHB and ESR further note that the Small Wastewater and Natural Systems Special Interest Group (SWANS-SIG), which represents the interests of Water New Zealand members involved in research, practice and administration in the small wastewater flows area, are in the process of evaluating the performance of commercially available OSWWT systems and benchmarking them against water quality parameter criteria, which includes a total nitrogen target of 15 mg N/L. The findings are yet to be published, although our understanding is that there are several conventional OSWWT systems available that can meet the performance targets. When these data become publically available they will provide guidance for what is deemed to be good practice. We anticipate that this information will be useful for implementing policy 4.39(d) in the Decisions Version of the Proposed Regional Plan and regulating any rules around nitrogen thresholds in treated effluent from OSWWT systems.

3.6 In the free-draining, aerobic subsurface soils encountered across much of the Selwyn/Waihora sub-region, effectively all nitrogen present in effluent discharged from on-site wastewater treatment (OSWWT) systems is converted to nitrate-nitrogen once it enters the subsurface environment. Furthermore, the subsurface conditions are largely non-conducive for any subsequent natural attenuation of the

leached nitrate-nitrogen, via processes such as denitrification. Nitrate concentrations of raw domestic effluent, as would discharge from a septic tank system and infiltrate to the groundwater system are commonly estimated to be 66 mg N/L (ARC, 2004; Burbery, 2014), which is significantly above any target water quality limits set for groundwater. Dilution of effluent through natural mixing with the receiving groundwater environment is a fundamental treatment process for nitrogen emissions from septic tanks operated in the Selwyn/Waihora zone.

3.7 Because groundwater in the catchment is already impacted with nitrate from agricultural land-use, the capacity of the regional groundwater system to assimilate nitrate impacts from OSWWT systems through dilution is compromised hence the overall treatment efficiency of OSWWT system is reduced. OSWWT plants that provide secondary treatment of domestic effluent before it is discharged to a drainage field and which target nitrate-nitrogen are commercially available. It is widely regarded in the waste water treatment industry to be good practice to apply an OSWWT system that provides some nitrogen treatment of the effluent, whether it is a domestic or commercial application. CDHB and ESR are of an opinion that OSWWT systems capable of reducing nitrogen loads to groundwater should form part of the overall strategy to manage water quality in the Selwyn/Waihora zone.

3.8 On a regional scale, nitrogen inputs from sewage discharges are estimated to contribute a relatively small proportion of the total nitrogen load within the catchment (Loe, 2012; 2013), although it is reported that nitrogen loads from individual properties outfitted with septic tank systems can be significant and comparable to nitrogen loads from a modern dairy farm (Wheeler et al., 2010). This is particularly the case in rural towns such as at Darfield where large clusters of septic tanks operate and annual nitrogen loads from permitted domestic wastewater practices in the town are predicted to be close to 27 kg N/ha/yr (Burbery, 2014). This is significantly more than the 15 kg N/ha/yr nitrogen loss target set for agricultural land

under the proposed nutrient management rules, which are addressed in the next section of this evidence.

On the basis of the items above, CDHB recommend the following Rule be added to Variation 1:

3.9 **11.5.3 Within the Selwyn Waihora catchment Regional Rule 5.9 shall include the following additional condition:**
1. The treatment and disposal system is designed to provide nitrogen removal from effluent and that the total nitrogen in the discharge is less than 30 mg N/L.

3.10 Loe (2012) reports that there are 8,301 OSWWT installations within the Selwyn-Waihora catchment, of which 2,966 pre-date 2006. It is presumed that many of these installations do not include any secondary treatment capability for targeting total nitrogen. The CDHB are concerned that Rule 5.7 in the Regional Plan effectively allows any OSWWT systems established lawfully prior to 1 November 2013 to keep operating irrespective of their ability to treat nitrogen.

3.11 To ensure that any old under-performing OSWWT systems are up-graded to incorporate some nitrogen treatment and meet Good Management Practice, the CDHB proposes a policy be added to Variation 1 that ensures that <u>all</u> OSWWT systems in the Selwyn-Waihora catchment conform not only to the conditions common to Regional Rules 5.8 and 5.9, but also the proposed rule 11.5.3, above, which limits total nitrogen concentrations in the discharge to less than 30 mg N/L. The year 2037 (consistent with the timeline for catchment targets of Table 11(i)) is recommended as a deadline by which all OSWWT systems should be compliant with the nitrogen discharge limit.

4. **Nutrient Management**

4.1 CDHB is supportive of a nitrogen loss calculation for a property not exceeding 15 kg N/ha/yr.

5. **Fresh Water Outcomes**

5.1 Tables 11 (a) & (b) of Variation 1 refer to the freshwater outcomes for Selwyn/Waihora Catchment for rivers and lakes in the zone.

5.2 The CDHB recommend that the terms “good/fair” or “improvement on current status” replace the term “no set value” for the microbiological indicator of suitability for contact recreation for Selwyn Waihora rivers and lakes in Tables 11(a) and 11 (b).

5.3 The CDHB recommend that Table 11(a) is amended to include values for % cyanobacteria mat coverage at values which are equivalent or better than the Land and Water Regional Plan.

5.4 **National Policy Statement for Freshwater Management** (NPS) 2014 – Objective A2 states where waterbodies do not meet the freshwater objectives, every regional council is to specify targets and implement methods to assist “with improvement of water quality”. By not setting a value, Variation 1 is inconsistent with the National Policy Statement for Freshwater Management 2014. The replacement of the term ‘no set value’ and the inclusion of a % mat cover provides an incentive to improve recreational water quality within the Selwyn/Waihora catchment and to be in line with the NPS.

5.5 **Recreational microbiological water quality**

Our submission expressed concern regarding the “no set value” in relation to some of the microbiological indicators for *suitability for contact recreation*. The CDHB acknowledge that given the current state of water quality in the Selwyn/Waihora catchment that recreational water quality may be poor in some areas; however this does not justify not setting any recreational water quality values.

5.6 Of the four recreational water sampling (microbiological) sites on the Waikirkiri/Selwyn River two of the sites – Upper Huts and Coes Ford have for the past four sampling seasons remained the same grade – Upper Hutts as very poor and Coes Ford as poor. Glentunnel is graded fair and Chamberlains Ford as good, both have held this grade for the last four sampling seasons. The Te Waihora/Lake Ellesmere Domain sampling site has deteriorated from the 2011/12 sampling season (and previous sampling seasons) when the grade was good, to being graded poor in the 2013/14 season. For some sites there is considerable information from which to develop a value, and hence the "not set value" cannot be justified. For the sites which are graded poorly targets should be developed in line with the NPS to gain improvements at these sites.

5.7 **Cyanobacteria (blue-green algae)**

CDHB recommends that a value for % cyanobacteria coverage should be included under periphyton indicators. Cyanobacteria coverage is very important for public health in terms of a river being suitable for contact recreation and its suitability as a drinking water source. Lower values should be set for rivers that are utilised for sources of human drinking water or are deemed by the community to be important recreational water locations.

5.8 Cyanobacteria (blue-green algae) generally only become problematic when their cell density is (or has been) high in water we wish to use for recreation or for human or animal drinking-water. The problem is because some species of cyanobacteria sporadically and seasonally produce toxins that contaminate water. These toxins can be difficult to remove by most conventional treatments and if consumed can cause severe adverse health effects.

5.9 From a health perspective (human or animal) the greatest problems associated with algal blooms is through drinking water, consumption of mahinga kai and direct recreational contact with the toxins that some cyanobacteria genera produce (cyanotoxins).

5.10 Recent research by the Cawthron Institute has identified a number of physical and chemical factors that are important in explaining these blooms. The relative importance of these factors may vary between rivers and temporally and spatially within a river.

5.11 **Cyanobacteria blooms in the Selwyn Waihora Zone**

There has been a regularity of cyanobacterial blooms in both the Waikirikiri/Selwyn River and Te Waihora in recent years and Variation 1 should seek to address this by setting limits.

5.12 Over the past four sampling seasons (November – March) cyanobacteria blooms requiring health warnings to be notified to the public have occurred on the Waikirikiri/Selwyn River on 3 occasions, in 2010/11, 2012/13 and 2013/14. Two sites, Glentunnel and Whitecliff have both been affected on each occasion. Te Waihora/Lake Ellesmere has had cyanobacteria blooms requiring health warnings on consecutive years since 2009.

5.13 **Cyanobacteria blooms and Drinking-water**

The ideal protection of drinking-water supplies from cyanobacteria and their toxins is to prevent bloom formation. Bloom formation can be positively influenced by catchment management to reduce the input of nutrients and by maintaining rapid river flow.

5.14 In the area of the Selwyn/Waikirikiri River and its tributaries there are several intakes for drinking water for the communties of Hororata, Glenntunnel, Coalgate, Whitecliffs and Sheffield/Waddington. These are shallow bores or infiltration galleries where the abstracted water quality is directly influenced by the river water quality. The intakes will achieve some (unknown) reduction in the number of cyanobacteria from entering the treatment plant, and the longer the travel time through the fine gravels from the river at the treatment plant the better the removal of cells (and other particulate matter) will be. However, if the gravels are open (low proportion of small gravel and sand), then the natural filtration process will be limited.

5.15 Treatment to remove cyanotoxins from drinking water is difficult and expensive. Usually it involves the use of powdered or granular activated carbon which involves considerable capital and on-going cost.

5.16 Boiling water does not remove or eliminate the toxicity of cyanotoxins. This can be problematic for drinking-water supplies that source water from surface water supplies, particularly when a bacterial transgression occurs (for example E.Coli) at the same time as a cyanobacterial bloom.

6. Water Quality Limits and Targets - nitrate-nitrogen in groundwater

6.1 Once again, I am reliant on expert advice provided to me by Dr Lee Burbery on the following items relating to water quality limits.

6.2 Table 11(m) of Variation 1 sets a Water Quality target of 8.5mg/L nitrate-nitrogen in shallow groundwater where the term “shallow” is defined as: “groundwater <50 m below the groundwater level”. Depending on how a well is screened, a groundwater level measure might reflect a piezometric level rather than the level of the phreatic surface (i.e. water table). More significantly, towards the top end of the Central Canterbury Plains aquifer (e.g. Darfield-Kirwee area), steep vertical downward pressure gradients are known to exist. In this case, interpretation of 50 m measured below the groundwater level determined from the level measured in a deep-screened well, such as the Darfield Community Water Supply wells and the supply bores for the Fonterra milk factory, which tap the aquifer more than 190 m below ground level would not provide the same water quality outcome as if the nitrate target limit were applied to a depth below the water table. Furthermore, deep wells in the sub-region are generally susceptible to large drawdown effects which might bias any water level measure.

6.3 To avoid any confusion over the interpretation of the term groundwater level and provide a more conservative protection of the groundwater resource, it is recommended that the definition of shallow groundwater referred to in subscript (1) of Table 11(m) be revised to read:

(1) In shallow groundwater <50 metres below the static level of the local water table

6.4 The CDHB recommend that table 11(m) for nitrate-N in groundwater is amended to require the limit of 5.6mg/L nitrate-N to be met in the longer term in line with the drinking water targets for 2040 in relation to ground water wells in Canterbury under the CWMS.

6.5 As our submission said, the value 8.5mg/L nitrate nitrogen exceeds half the maximum acceptable value (MAV). The drinking water target in the Canterbury Water Management Strategy is to have average annual nitrate levels for all ground water wells in Canterbury below 50% MAV by 2040.

6.6 Should the aforementioned recommendation for any reason not be considered a viable suggestion (and the Council upholds the shallow groundwater nitrate-nitrogen limit of 8.5 mg/L currently proposed in Variation 1) then as an alternative and compromise between the Council's and CDHB's differing preferred outcomes, at the least we would expect that Table 11(m) in Variation 1 include a limit of 5.6 mg N/L for nitrate-nitrogen in deep groundwater (that being deeper than 50 m below the static level of the water table). Without direct knowledge of the exact value the baseline nitrate level in deep groundwater would be at this stage, we adopt also the outcomes for Canterbury aquifers specified in the proposed Regional Plan as a conditional measure. We suggest such limits could be incorporated in Table 11(m) as:

Contaminant	Measurement	Target
Nitrate-N	3-year annual average concentration(*)	Either 5.6 mg/L or concentration is maintained at in the state recorded or reasonably reduced in the three years prior to November 2010, which ever target is lower.
Nitrate-N	Maximum concentration, not to exceed(*)	11.3 mg/L

(*) In deep groundwater >50 metres below the static level of the water table.

6.7 Specification of only a shallow groundwater limit in Table 11(m) of Variation 1 fails to restrict the depth to which nitrate impacts might penetrate and in doing so fails to limit the mass of nitrogen potentially stored in the aquifer system. The outcomes for water quality in the Selwyn/Waihora sub-region, in particular the outcomes for nitrate-nitrogen levels in Te Waihora/Lake Ellesmere to which groundwater discharges, are predicated on some acceptance that land-use impacts on the receiving groundwater environment will invoke some vertical stratification and that at the regional scale deep groundwater is recharged by river recharge which is devoid of nitrate impacts and hence acts as a diluent of nitrate derived from land-based activities. Since there are some areas of the catchment (e.g. about Darfield) where the aquifer is not influenced by river recharge processes any underlying presumption of distinct separation between shallow and deep groundwater impacts is flawed. Recent evidence collated by Hanson (2014) and Burbery (2014) confirms that nitrate-nitrogen impacts above 5.6 mg/L penetrate deeply in groundwater under Darfield and affect deep water supply bores of the area. There is potential that impacts currently observed in these deep wells will eventually be transmitted across the rest of the aquifer as gravitational flow occurs towards the coast. We consider that by explicitly specifying a more conservative nitrate-nitrogen target for deep groundwater than for shallow groundwater some provision is

given to protecting the deep aquifer system as a drinking water resource. In particular, limiting deep groundwater impacts observed in the upper parts of the Central Canterbury Plains aquifer (e.g. around Darfield) provides a degree of protection for potential impacts in deep groundwater down-gradient.

6.8 **Nitrate in Drinking water supplies**

Council have regularly(approximately 5 yearly) monitored their supplies for a range of chemical parameters including nitrate, these had been undertaken in 2010, but wary of land use changes samples were taken again in 2012. The results of these samples showed that 4 community water supplies (previously with low nitrate levels) had nitrate levels which were now above 50%of the MAV (maximum allowable level). This triggers the requirement in the Drinking water Standards (DWSNZ05/08) to assign nitrate as a 'priority 2' and for those supplies to sample monthly for nitrate. This will track whether the nitrate is continuing to climb towards the MAV and so requires further intervention to maintain chemical compliance with the DWSNZ05/08. Each year drinking water assessor staff at CPH complete a survey for the Ministry of sampling undertaken to demonstrate compliance with the DWSNZ05/08 by registered drinking water supplies, this has just been completed so the last years worth of nitrate monitoring is available.

6.9 The Section 32 report in section 5.7.3 comments that elevated nitrate levels are "usually temporary". The results we have do not support this. Results show that three of these four supplies have reasonably consistent results above 50% of the MAV and 1 supply (Dunsandel) was below 50% of the MAV but remained consistently elevated above expected background levels. The presence of nitrate is an indication that contamination is taking place.

6.10 Equally, as alluded to earlier in this evidence, elevated nitrate-nitrogen have consistently been detected in deep community supply wells at Darfield, which draw water from deeper than 190 m below ground level. Although no time-series data are presently available from which to monitor any seasonal variations, expectations are that

no significant variation will be observed owing to attenuation of any variable input signal due to the significant depth from the recharge surface/contaminant source. Thus, we remain apprehensive of broad sub-regional planning decisions made on the notion that “elevated nitrate levels are temporary”.

7 Water Quality Limits and Targets - Indicator Organism Limit

7.1	The CDHB are supportive of a median concentration limit < 1 Organism/100ml E.coli for ground water in table 11(m)

7.2 **Drinking Water Supplies** The Section 32 report states that reticulated water supplies are generally of good quality as they are either treated or sourced from secure wells.

Community supplies within the Variation 1 area are mainly owned and managed by Selwyn District Council (SDC). Approximately twenty of their supplies in this area are covered by the Variation. The supplies are a mixture of surface and groundwater sourced supplies. Surface waters don’t meet full drinking water compliance; in general they sometimes fail Escherichia coli (E. Coli) compliance because of transgressions (the presence of E. coli) and lack treatment to meet protozoa compliance. The following council supplies originating from surface water fall into this non compliance category – Malvern Hills, Selwyn Rural, Sheffield/ Waddington and Springfield, In general the larger towns Lincoln, Prebbleton, Rolleston and Leeston are provided by groundwater which is acknowledged as being generally secure and not requiring treatment. Across the SDC district 73% of the residential properties are provided with drinking water by Council, this leaves 27% of properties not receiving water from the Council. In general this drinking-water is likely to be from surface or shallower groundwater sources and will not meet the required standard of being “potable” without treatment. These sources are also generally more vulnerable to contamination with intensification of land use as mentioned in the Section 32 Report.

7.3 CDHB have noted over the last few years a deterioration in four community drinking water supplies which either were secure (being supplies not affected by surface influences and of good microbiological quality) or testing (eg age dating) had indicated they were likely to be secure and therefore compliant with the requirements of the Drinking Water Standards for New Zealand 2005 (revised 2008)(DWSNZ05/08). These supplies are now faced with having to provide treatment to meet compliance with the DWSNZ05/08, this is expensive for the communities, both initially and also ongoing with maintenance of treatment and greater ongoing monitoring required. These supplies are Dunsandel, Johnsons Rd, West Melton, Southbridge and Edendale.

7.4 This indicates a non compliance of the drinking water targets for 2010 as set out in the Canterbury Water Management Strategy. The importance of water management decisions to public health can also be illustrated in terms of health costs. Poor water management decisions shift the costs of health from water users to the health system and the public. This is most effectively illustrated when there is a reduction in drinking water quality and a consequent increase in the incidence of waterborne disease outbreaks. The worst such outbreak in New Zealand occurred in Queenstown in 1984 when 3,500 people experienced gastrointestinal symptoms. A similar, though smaller scale, problem occurred in Canterbury in 2008 when the Springston bore became contaminated, causing 40 disease cases (from a population of 500), and requiring ratepayers to bear the cost of a new well. More recently in 2012 the Darfield outbreak with 138 confirmed or probable cases of campylobacter illness and an economic cost of at least $714 527 or as high as $1.26 million depending on estimates of unreported cases. (Sheerin, Bartholomew, Brunton)

Figure 1: Average Annual Rates of Campylobacteriosis, Salmonellosis and Cryptosporosis in Selwyn and New Zealand: 2009 - 2013

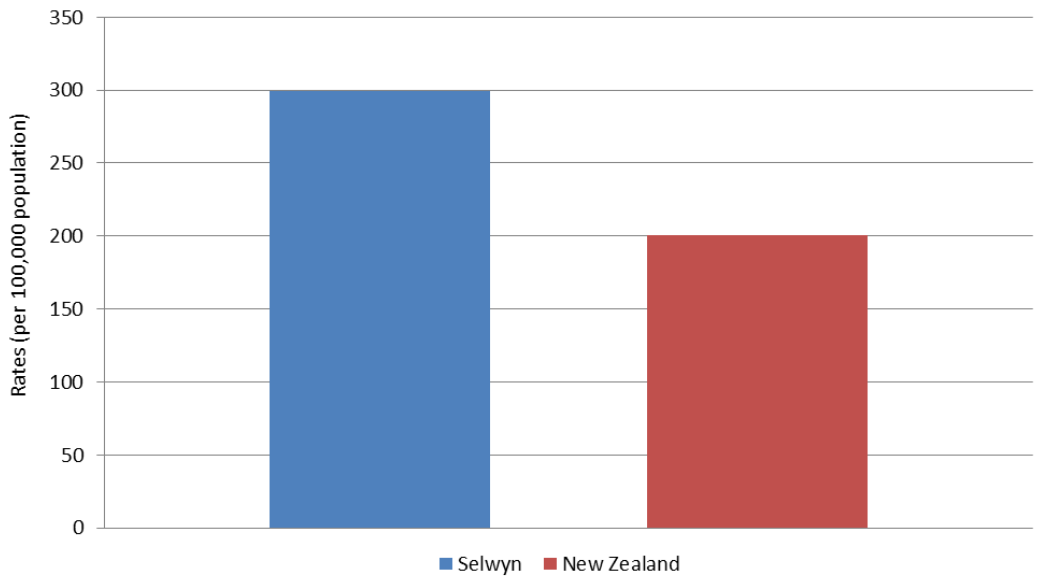
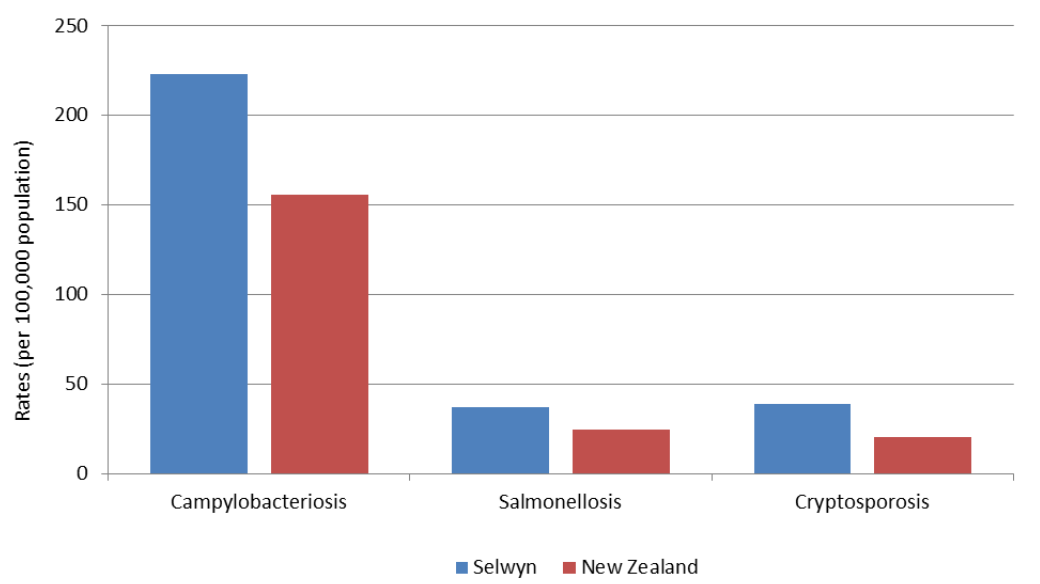


Figure 2: Average Annual Rates of Campylobacteriosis, Salmonellosis and Cryptosporosis in Selwyn District and New Zealand: 2009 - 2013



7.5 Analysis of enteric disease data from 2009-2013 comparing disease rates per 100,000 people between Selwyn District area units and New Zealand area units shows that disease rates for *Campylobacter sp*., *Salmonella sp.,Cryptosporidium sp* are significantly above the New Zealand average. Whilst drinking-water cannot be directly attributed to all of these cases, and there are other potential risk factors; drinking-water is a potential source for these cases.

7.6 The Section 32 Report acknowledges that for individual wells there are increased risks of illness from *Campylobacter sp*., *Salmonella sp.,Cryptosporidium sp* and gastro enteritis in areas of dairy and major irrigation schemes.

8 CONCLUSION

8.1 The Canterbury District Health Board has an obligation under the Health and disability Act 2000 to improve, promote and protect the health of people and communities (section 22a) and to promote the reduction of adverse social and environmental effects on the health of people and communities (section 23h). Specifically, the purpose of part 2A of the Health Act 1956 is to protect the health and safety of people and communites by promoting adequate supplies of safe drinking water from all drinking water supplies

8.2 CDHB is supportive of Variation 1 to the Land and Water Regional Plan, however submission points made are focused on specific aspects where amendments will assist in ensuring Variation 1 supports (is in line) with the CWMS, and Freshwater NPS.

8.3 **Key recommendations are**:

- That on-site treatment and disposal system are required to provide nitrogen removal from effluent and that the total nitrogen in the discharge is less than 30 mg N/L.
- that guidelines are included in Variation 1 as to freshwater outcomes for contact recreation in relation to microbiological indicators and % cyanobacteria coverage
- that an amendment lowers the limit for nitrate-nitrogen in ground water in the longer term

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