BEFORE CANTERBURY REGIONAL COUNCIL

IN THE MATTER	of the Resource Management Act 1991
AND	
IN THE MATTER	of Proposed Variation 6 to the Proposed Canterbury Natural Resources Regional Plan

STATEMENT OF EVIDENCE OF IAN RONALD FRASER

Introduction

1. My full name is Ian Ronald Fraser.
2. I have been a hydrogeologist with URS New Zealand Limited (formerly Woodward-Clyde (NZ) Ltd) since 1990.
3. My consulting career with URS has been based in Auckland from 1990 to 1993 and in the United States from 1993 to 1997, before returning to the Auckland office of URS. While working in Auckland I lectured a Masters Paper in Hydrogeology at Auckland University on a part time basis. Since 2004 I have been based in Christchurch, where I am a Principal Hydrogeologist and Regional Manager of our local business.
4. At URS, I have undertaken numerous hydrogeological investigations and assessments of environmental effects associated with town and city water supplies, irrigation schemes and discharges to groundwater associated with treated multiple sewage, mine drainage, saline waters and hydrocarbon contaminated waters. As part of this work, I have constructed and utilised a variety of groundwater models for catchment management, groundwater resource evaluation and contaminant transfer applications.
5. I have the following qualifications:

   — Bachelor of Science;
   — Masters of Science in Geology; and
   — Post Graduate Diploma in Business from Auckland University.

6. I have read and agree to comply with the code of conduct for expert witnesses set out in the Environment Court Consolidated Practice Note 2006. This evidence is within my area of expertise, except where I state that I am relying on facts or information provided 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.

Scope of Evidence

7. I have been requested by Memorial Avenue Investment Limited (MAIL) to present evidence in relation to the Christchurch groundwater system, and its vulnerability to contamination from certain land uses. The particular focus of my evidence is the groundwater system in the vicinity of the MAIL site (as shown in Attachment A of my evidence) and the implications of MAIL's proposed relief with respect to Variation 6 Chapter 4 ("V6").
8. In my evidence I will:

   — Provide background to the MAIL site
   — Describe the regional (Christchurch wide) and local (in the vicinity of MAIL land) groundwater environment;
   — Describe the groundwater quality of the Christchurch aquifer system;
   — Address the potential impacts on groundwater quality from discharges of stormwater and temporary discharges of treated wastewater to land on the MAIL site; and
   — Comment on the V6 rules; and
   — Comment on the Officer Report.

Background

9. The MAIL site is currently categorised as Groundwater Protection Zone 1, which is subject to more stringent rules (particularly rule WQL64 in the Variation 6 as notified) than Zones 1A – 1D. Zones 1 and 1A-1D have the same characteristics (they are both part of the unconfined

aquifer) so this is not determinative of the classification. Rather categorisation of groundwater recharge areas accords to the Regional Council's interpretation of current or indicated future land use. However the effects of land use change from urban activity in Zone 1 (Rural) or Zone 1A (current or future Urban) on groundwater quality will be the same.

10. To demonstrate how I have come to this conclusion I have provided the following detail on the groundwater system (both regional and local) and the effectiveness of current Best Management Practices (BMPs) in addressing groundwater quality risks.

REGIONAL HYDROGEOLOGY

11. The hydrogeological setting of the Christchurch aquifer system has been described in detail in various reports (Environment Canterbury technical reports U97/28/01, U07/24, U07/38, U02/13, Brown and Weeber, 1992, Brown, 2001). In general terms, the Christchurch aquifer system comprises layers of permeable gravels and sands that were deposited during glacial periods. The aquifers are interspersed by layers of lower permeable silts and clays that were deposited during interglacial periods which form the aquitards. The successive layering of sediments of varying permeability has created an aquifer system that is reasonably well defined in terms of aquifers and aquitards.

12. The general sequencing and approximate age and climatic event of the geological deposits for the Christchurch aquifer system is provided in the Table 1 of my evidence below and shown schematically in Attachment B.

Table 1: Sequence of Geological Desposits in the Christchurch Aquifer System

Depth (m) (Approx.)	Geological Unit	Hydrogeological Significance	Age ('000 years)	Climatic Event (Stage)
0-40	Christchurch Formation-Springston Formation	Confining material	0-10	Aranuian (Marine progradation, Marine transgression, Sea level rise, Glacial retreat
40-55	Riccarton Gravels (Burnham Formation)	1st Aquifer (confined)	10-70	Otiran (Glacial advance, Interstadial warming, Glacial advance)
55-70	Bromley Formation	Confining material	70-120	Kaihinuan (Glacial retreat)
70-100	Linwood Gravels (Woodlands Formation)	2nd Aquifer (confined)	120-200	Waimean (Glacial Advance)
100-120	Heathcote Formation	Confining material	200-250	Karoroan (Glacial retreat)
120-130	Burwood Gravels (Hororata Formation)	3rd Aquifer (confined)	250-310	Waimaungan (Glacial advance)

130-140	Shirley Formation	Confining material	310-350	Scandinavian (Glacial Retreat)
140-155	Wainoni Gravels	4th Aquifer (semi-confined)	350-380	Nemonan (Glacial Advance)
175-240	Unnamed Gravels	5th/6th Aquifer (semi-confined)	380+	Unnamed Glacial
240-433	Deeper Quaternary Units		380+	Unnamed Glacial

Source: Brown and Weeber, 1992

13. Whilst all the aquifer units could potentially receive recharge from land infiltration in the recharge zone, it is considered that the first aquifer (i.e. the Riccarton Gravel aquifer) has the greatest potential for contamination associated with land use activities. Therefore, understanding the extent of the confining materials and the nature of the unconfined system is important in terms of addressing the issue of potential risks.

14. I have provided a brief summary of the stratigraphy of the first aquifer and overlying sediments in the following sections. Much of this description is taken from recent ECan reports that have focused on the extent of the Christchurch and Springston formations (ECan Reports U07/24 and U07/38). I have not provided further detail on deep aquifers given the relative low risk to these aquifer units associated with the location and type of land use activities that are proposed by MAIL.

15. The Riccarton Gravel aquifer is the upper most gravel aquifer unit which underlies the fine sediments of the postglacial marine Christchurch Formation (ECan Report U97/28/1). This aquifer unit is considered to be the most susceptible to contamination from land use practices given its proximity to land surface. The Riccarton Gravel aquifer is present in the stratigraphic sequence across the majority of the City, however where the Christchurch Formation (surface confining sediments) is missing, it becomes indistinguishable from the overlying postglacial Springston Formation gravels (ECan Report U97/28/1). The Springston Formation includes postglacial fluvial channel and overbank deposits that have accumulated at the inland extent of the Christchurch Formation and forms the water table aquifer (ECan Report U97/28/1).

16. The spatial extent of the Christchurch formation is commonly shown using the 3m isopach of surface confining sediments, as provided in Attachment C. The formation contains extensive areas where the surface materials comprise of low permeable silt and clays. The depth of these sediments is greatest at the coast, where coastal estuarine deposits also prevail, and thins towards the western limits of the city. Where post-glacial flood channels of the Waimakariri are evident, higher permeable gravels and sands are present near the surface. These flood channels have generated a preferential vertical pathway for land infiltration into the aquifer system as well as preferential horizontal pathways for the water table aquifer which flows to the spring discharge zone at the edge of the confining sediments. In places these paleochannels have eroded some of the Christchurch Formation (U07/38). The main flood deposits are the Islington, Russley and Harewood paleochannels, with the margins of the Russley channel found at the north-west corner of the MAIL site.

17. The proposed classification of the recharge boundaries as identified in Attachment D (source: ECan Variation 6), is understood to be based on the extent of the 1m and 3m isopach of surface confining material, and the relative hydraulic head (ie, is the hydraulic head above or below ground level). Using this approach, Environment Canterbury has classified the

Christchurch groundwater system into risk areas associated with the potential for contamination of the aquifer system from surface sources.

LOCAL SETTING

18. Within the vicinity of the MAIL land at Memorial Drive and Russley Road, the groundwater system has been generally characterised by Environment Canterbury as 'unconfined' with a downward vertical hydraulic gradient. In terms of risk category, Environment Canterbury considers this type of aquifer environment the most susceptible to contamination from land use practices.

19. Geologic logs obtained from ECan wells database indicate that, within the immediate area of the MAIL site, wells do not report the existence of a layer of low permeable sediments such as clays and silts within the upper 5m of the profile. There are a few wells (M36/1492, M36/8526, and M36/9923) that are located within the Airport area that show a layer of clay and silt starting at or about 8m to 9m below ground level. I interpret this layer is the demarcation between the Riccarton Gravels and the overlying Springston Formation which I do not expect to be laterally continuous.

20. While the geologic logs obtained from wells near the site do not appear to support the presence of surface confining sediment, it is noted that the logging of the upper 2-3m of the core can be unreliable, especially when rotary percussion rigs have been utilised. In many of the logs, the upper profile is given a description of 'soil', which I consider to be an inaccurate description for the subsoil strata (soil is typically less than 0.5m deep, particularly in the western margins of the city). Therefore, I believe that caution should be applied when using well logs to determine the presence of confining layers.

21. I have provided copies of well logs and Cone Penetrometer Testing (CPT) logs, which I use in the following discussion, as Attachment E to my evidence. The investigations of the MAIL site using CPT indicated that the underlying sediments varied in terms of lithology and thickness of the deposits across the site. None of the test logs indicated the presence of a thick (>3m) layer of clay present at the site. However, in all cases the sediments near the surface are characterised as comprising silty sand with lenses of silt of varying thickness (generally <2m), overlying sands and gravels (and occasionally a thin lens of clay). This is generally consistent with the demarcation of the 1m isopach of surface fine sediments which is shown in ECan report 05/12 for the MAIL site.

22. The site testing indicated that silt and sand was typically present in the upper 2m of the log, and whilst this may not act as a true confining layer, it will act as a highly effective filter. I will return to this point later in my evidence when I discuss the relative risks to groundwater quality from development on the MAIL site.

23. The depth to groundwater in the vicinity of the MAIL site is more than 4m below ground level (monitoring wells in the vicinity of the MAIL site exhibit water levels between 6m and 9m bgl. However, some shallow monitoring wells have also encountered perched water at 2-3m bgl), with groundwater flowing approximately to the southeast. The MAIL site is considered to be within a transitional area where the hydraulic head in the Riccarton Gravels begins to show an upward trend (as determined from hydraulic heads reported in U02/13).

POTABLE SUPPLY

24. Given the number of potable supply wells that draw their water from the Riccarton Gravels, consideration of the risks of contamination of this aquifer unit from land use is important.

25. The aquifer units that are described in Table 1 of my evidence provide the source of potable supply to Christchurch City. The City Council utilises all aquifers within its network of potable supply wells across the city. However, there is a heavy reliance on the first confined aquifer (namely the Riccarton Gravels), with approximately 30% of the potable supply wells located in this formation (based on ECan database of consented potable supply wells - 25 of 83 potable supply wells located in the Riccarton Gravel aquifer).

26. The nearest public supply well field is located approximately 1,000m downgradient from the eastern boundary of the MAIL site. The Burnside public supply wells are all installed in the Riccarton Gravel Aquifer, at depths of 16.4m to 20.5m below ground level. Pump test results of the wells at this site indicate a very high yielding aquifer unit, with well specific capacities in the order of 22 l/s/m to 125 l/s/m. This indicates an aquifer unit that has a high capacity to transmit water.

GROUNDWATER QUALITY OF THE CHRISTCHURCH AQUIFER SYSTEM

27. The aquifer system that underlies Christchurch provides the City's residents with a high quality, high yielding, potable water supply which does not require treatment for contaminants. Therefore, the protection of this resource from contamination and overuse is of paramount importance to both the City Council and the Regional Council for obvious reasons. However, the restriction of land use from any/all development within the recharge zone may not be warranted given the nature of the land use and associated discharge. In the following section I will provide a brief background into the current state of the groundwater quality within the Christchurch aquifer system, focusing again on the Springston and Riccarton Gravel aquifer units.

28. Environment Canterbury technical report U02/47 "Christchurch - West Melton Groundwater Quality" provides a comprehensive assessment of the status of groundwater quality in the Christchurch aquifer system as of 2002. In addition, ECan report U05/12 provides a discussion on the contaminants of concern to the Christchurch aquifer system associated with a proposed residential development in Recharge Zone 1. There are a number of important messages that are contained within the two reports that pertain to the overall water quality of the aquifer system, the contamination risks to the Christchurch aquifer system, and the water quality in the vicinity of the MAIL site.

29. Groundwater sampled from wells located in the Springston and Riccarton Gravels generally showed a high standard of water quality, with levels of contamination generally well below maximum allowable values and/or detection limits. There are, however, areas that exhibit lower quality groundwater. These areas are located in the north-west near Harewood, and in the south and south-west near the industrial areas of Islington to Hillmorton. The main sources of contamination identified in the ECan report (U02/47) are nitrate from land use and private wastewater disposal systems, bacterial contamination from wastewater disposal systems and poorly constructed well head works, heavy metal contamination from timber treatment plants and industry, and saline intrusion in the Woolston - Heathcote area. The report notes that:

> *".. trace elements are rarely detected in the groundwater and in most cases where detected, concentrations are most likely to be well below relevant drinking water standards"*

30. Investigations undertaken by Pattle Delamore Partners on leachate plumes associated with landfills in the Canterbury Region indicate that the leachate is quickly dispersed and diluted by the rapidly moving water flowing through the aquifer unit (Callander, 2006). In addition, natural attenuation of metals by sorption to particles in the subsurface soil profile prior to

entering the saturated zone provides a high level of treatment to stormwater discharges in addition to the treatment provided by stormwater infiltration basins/swales. This is particularly important where the subsurface sediments are comprised predominately of sands and silts rather than gravels, as it provides a higher surface area for sorption and a lower vertical hydraulic conductivity, allowing additional filtering of the contaminants. As mentioned earlier, this is a common feature of the subsurface lithology found at the MAIL site.

31. Overall, I consider that the quality of groundwater within the Christchurch potable aquifer system is very high, and largely unaffected by urbanisation. The exceptions are typically associated with specific areas of known high risk contaminant discharge sources. However, even in these areas, the lateral extent of the contamination is limited.

32. It is against this background that I have considered the revised planning approach as articulated by Mr McLeod. As outlined in paragraph 4.3 of his evidence Mr McLeod suggests that the more appropriate approach is to un-couple the land use issues and focus more specifically on the use of discharge permit conditions to control effects. I support this approach and have considered below how it might work to ensure appropriate environmental outcomes on the MAIL site.

POTENTIAL IMPACTS ON GROUNDWATER QUALITY FROM LAND USE OF THE MAIL SITE

33. The current rural zoning of the MAIL site may already result in some contaminants from the site entering shallow groundwater. Although the nature and scale of the contamination from the rural use of the site is likely to be considerably less than from intensive use of rural land, the grazing of stock and use of fertilisers on the site may contribute contaminants to the shallow aquifer, albeit at negligible levels.

34. Altering the land use at the MAIL site to commercial/retail will result in a change of potential contaminant type, from primarily nitrate and bacterial contaminants to metals and hydrocarbons (generated as a result of vehicle movements). It will also alter the pathway of contaminant transport/discharge, from diffuse (non-point source) to more point source type discharges.

35. In this instance I consider that the proposed change in land use of the MAIL site is unlikely to result in any measurable change in groundwater quality at the down-gradient end of the site. My assessment is based on a number of factors, including the following:

    — The general nature of stormwater contaminants from urban areas, which primarily have metals and low levels of hydrocarbons present (the risk of hydrocarbon contamination is further reduced if no fuel on-site storage is present);
    — The high level of stormwater treatment available using swales, infiltration basins, and sediment grit traps to filter and adsorb metals and hydrocarbons before they infiltrate the substrate;
    — The level of treatment of wastewater that can currently be achieved via 'off-the-shelf' plants e.g. Membrane Bioreactors and Packed Bed Reactors.
    — The significant area available at the MAIL site providing flexibility in the size and distribution of any stormwater and treated wastewater disposal systems.
    — The nature of the substrate materials present at the MAIL site (sands and silts), which will further act to filter microbial contaminants and adsorb metals and hydrocarbons in the unsaturated zone;
    — The nature of the receiving aquifer unit, which is characterised by high hydraulic conductivities and high quality water sourced from the Waimakariri River, which will dilute and disperse contaminants very effectively.

36. I note that the impacts of stormwater disposal in Recharge Zone 1 from residential land use and from airport discharges have been addressed in two recent Environment Court cases:

    — National Investment Trust v Canterbury Regional Council and Christchurch International Airport Limited (Decision No C162/2006);
    — Canterbury Regional Council and Apple Fields Limited v Christchurch City Council (Decision No. C105/2006).

37. I consider that some of the evidence given in these cases by groundwater and stormwater experts provides relevant background and supports my evidence to you today.

38. In both cases the Court found that discharges of stormwater from residential and airport areas are likely to have a no more than minor effect on groundwater quality. I have read the evidence presented in the CIAL case by Mr Callander, and was involved in reviewing the evidence presented by Mr Evans of URS on behalf of the CCC in the Apple Fields case. In both instances I agree that discharges from the respective sites may result in changes in groundwater quality. I also agree with the Court's findings that the potential adverse effects of these discharges on groundwater quality can be considered to be minor.

39. Using these cases as a point of reference of what can be considered as 'minor' contamination, I consider that the nature and scale of a potential future stormwater discharge from the MAIL site will have negligible effects on the groundwater system.

40. In addition to stormwater discharges from the MAIL site there is expected to be a requirement in the short term to discharge wastewater to land. I understand that this will occur until such time as the CCC develops the wastewater reticulation in this area, which is forecast to occur over the next five to six years.

41. It is important to note that discharging wastewater does not automatically result in significant adverse effects on the groundwater quality. The science and technology that is associated with wastewater treatment and disposal has progressed significantly in recent years. It is now possible to acquire and install wastewater treatment systems that can remove pathogens, nutrients, and metals prior to being discharged by methods such as subsurface drip irrigation systems. Furthermore, I would expect that through conditions of consent that any risk of uncontrolled discharge e.g. system failure or spill would be mitigated through secondary containment and adherence to agreed management plans.

42. Overall, I consider that the proposed land use change on the MAIL site is expected to have no more than a minor effect on groundwater quality. However, I recognise that this will need to be demonstrated through the appropriate resource consent process. The issue here is that the approach of adopting a non-complying activity status for any new activity carried out over Zone 1 (as proposed by Rule WQL64 in V6 as notified) equates to a very restrictive approach to managing land use/development in the City. Furthermore, the variance between the MUL as notified under the PC1 decision and the V6 zonation means that MAIL may have to provide a much greater level of proof that than other areas identified for future development which have a V6 zone classification of Zone 1A. In my view there is no general difference in risk to groundwater quality between the two zones, and depending on the proposed landuse both zones require some level of assessment of the associated discharges, site conditions and if necessary mitigation to be undertaken.

OBJECTIVES AND POLICIES

43. Variation 6 proposes a number of objectives and policies, and a number of these are further amended through the Officers' Report. Many of the policies put forward under V6 contain valid and useful guidance to ensure that urban development occurs in a sustainable manner

utilising BMP's and standards as required. The comments in the remainder of my evidence relate to areas where I consider further amendment is required.

Identification of different subzones

44. Different policies apply to different subzones, which are classified according to the Regional Council's interpretation of their current or indicated future land use. I consider that the differentiation between the subzones and the Zone 1 is not required. The risks to groundwater quality from land use in these areas are the same. That is, there is no continuous surface confining sediments and therefore there is a pathway for contaminants to enter the groundwater system. However, this does not mean that the discharge of contaminants to land will automatically result in significant adverse effects on groundwater quality. In these areas the important thing to consider is the control and treatment of the discharge source to ensure that the potential for contamination of the groundwater system is mitigated to such an extent that the effects on the system as a whole are no more than minor. The policy framework provided under WQ19 provides useful guidance for development in Zone 1A and 2. In my opinion this guidance is equally applicable to development over the unconfined aquifer (including Zone 1).

45. I do not see how the zones will in themselves avoid or mitigate any further deterioration as there are areas which will be developed in Zone 1A that have the same risk to groundwater quality as the land currently within Zone 1. The issue of avoidance or mitigation of the effects of land use intensification/change on groundwater quality is one that is best dealt with via a case by case assessment of actual and potential risks associated with the development of the land, with the use of appropriate methods of source control and treatment of discharges to reduce the risk to groundwater quality to an acceptable level.

"No risk" approach

46. The objectives and policies seek to avoid further contamination by restricting development of land to areas the Regional Council considers are already provided for. The basis for this approach is that the risk of contamination should further urbanisation be allowed is too great. The explanation and principle reasons to Policies WQL13-19 (as proposed by the Officers' Report) state *"the purpose of the policies is to not allow any increase in extent or intensity of activities that will adversely affect groundwater quality, either directly or indirectly, beyond that currently anticipated in local authority statutory plans."*

47. With regard to the picture that is painted of the risks to the Christchurch aquifer system by Mr Talbot in para 14 of his report I consider that the risks are overstated giving an impression that any development of land in Zone 1 has the potential to contaminate the entire groundwater system that supplies drinking water to Christchurch City.

48. Mr Talbot in para 22 states that some submitters seek a management approach which allow activities subject to good practice to minimise risk, and replaces the avoidance approach even in circumstances where the consequences of contamination are high. Mr Talbot responds to this approach in para 23, stating that this approach is "*not accepted for a groundwater resource which provides drinking water (and all other uses) to the people of Christchurch*". Mr Talbot further states that "*the value of this resource is so high and consequences of pollution so great that even very low risk activities should not be allowed*". I consider that this approach is inconsistent with the purpose of the RMA and overstates the risk to groundwater quality of the Christchurch Aquifer system.

49. In para 25 Mr Talbot further states that for "*new proposed activities in low vulnerability zones, the requirement for best management practice measures is to ensure that the groundwater quality is not degraded*". I am supportive of this approach. However, I consider that limiting it to low vulnerability zones is short sighted. Mr Talbot states that where there are differences between the MUL outlined in PC1 and V6 zones that the "*hydrogeological vulnerability must remain the key criteria to determine the groundwater management approach*" and that "*further expansion of Zone 1A (urban) into Zone 1 (rural) would not be in accordance with the recommended approach of avoiding unnecessary risk*". I consider the relative risk of the discharge to groundwater quality needs to be assessed on a site by site basis, and in most cases the development of urban/business activities in Zone 1 would, in my opinion, have a less than minor effect on groundwater quality.

50. Again, in para 28 Mr Talbot states that the "*highly vulnerable Christchurch groundwater recharge zone requires a highly protective management approach*" and that "*the risk of pollution and consequences for all Christchurch's drinking water supply leads to a policy approach of avoiding unnecessary risk*". In my opinion Mr Talbot has overstated the risks to groundwater quality from land use change and development. I consider that the redevelopment of the MAIL site as proposed would not result in any significant adverse effect on groundwater quality downgradient of the site let alone have any significant consequences for all of Christchurch's drinking water supply. Clearly, the effects of the development of the MAIL site as proposed will need to be addressed at the time that resource consents are required.

51. I have also read the supporting technical documents provided in Parts 7 and 8 of the Regional Council documents. In particular, I reference paragraph 39 of Mr Hanson's evidence which provides a list of good management practices that greatly reduce the risks of groundwater contamination. I consider that the list is consistent with my view of best management practices, and I favour this approach ahead of the approach that is detailed by Mr Talbot which is a policy approach of avoidance. I also note that Mr Hanson states that "*modern practices are already greatly improved over historic practices, and this probably accounts for the decreases in the concentrations of hydrocarbons found in groundwater in southern Christchurch*".

52. Mr Hanson (Part 8) in para 12 of his supporting evidence states that "*the concentrations of dissolved salts and other contaminants in the groundwater are generally very low, and the water is generally free of microbiological contaminants, so it can be used as a source of drinking water without treatment*".

53. Where contamination of the groundwater system has been identified Mr Hanson in para 22 states that "*for the most part, the concentrations of the contaminants discussed above have either been below drinking water standards, or they have been found in locations where they do not threaten any existing water supply wells*". Mr Hansen is referring to the most severe cases of groundwater contamination that have been found in the Christchurch aquifer system. Those instances are associated with closed landfills, heavily industrialised areas, effluent disposal from meat processing plants (former), and timber treatment sites. With regard to the landfill leachate plume at Sawyers Arms Road and the Paparua landfill, Mr Hanson notes that the extent of the contamination is limited to several hundred meters down gradient of the landfill site. The plume has not resulted in the widespread degradation of the groundwater system and has not resulted in the loss of a high quality potable source of water for the city.

54. Mr Hanson does state that there have been two instances where contamination of the groundwater system has resulted in potable supply wells having to be abandoned. The first case of contamination was associated with chlorinated solvents. The industries that use

these solvents are not widespread in Christchurch and are not associated with the development plans on the MAIL site. The second was likely to be associated with contamination of the groundwater well from the Paparua landfill leachate plume. Both of these contaminant sources are associated with high risk and difficult to control contaminants. Again, the development of the MAIL site for business purposes is unlikely to result in any significant adverse effects on groundwater quality. Further, I am of the opinion that assessment of discharge consent applications for all sites over Zones 1 and 1A-1D on a case by case basis would result in appropriate protection of the groundwater resource.

55. In consider the Regional Council has complicated the issue of ensuring the groundwater supply to the Christchurch City maintains a high level of quality via V6 policies and rules. The Regional Council has not demonstrated that the development of land in Zone 1 will result in any significant adverse effects on the Christchurch City potable supply. Instead, the Regional Council has taken the position in V6 that it does not matter what development is planned in Zone 1, if it results in a discharge of contaminates then it is not supported.

RULES

56. I have previously commented that the approach of adopting a non-complying activity status for any new activity carried out over Zone 1 (as proposed by Rule WQL64 in V6 as notified) equates to a very restrictive approach to managing land use/development in the City.

57. The Officers' Report recommends the deletion of this rule and amendments to the "parent rules" which control discharges. I agree that this is an appropriate approach as it enables the effects of any discharge to be considered on its merits through the discharge consent process.

Summary

58. I consider that the development of the MAIL site will not result in significant adverse effects on groundwater quality. In my opinion, provided that the appropriate best management practices are employed, the development of other site in Zone 1 will not result in the widespread deterioration in groundwater quality which provides potable water for the City.

59. The effects of the proposed development on the MAIL site on groundwater quality will be minor due to the following factors:

    i. The general nature of stormwater contaminants from urban areas, which primarily have metals and low levels of hydrocarbons present (the risk of hydrocarbon contamination is further reduced if no on-site fuel storage is present);
    ii. The high level of stormwater treatment available using swales, infiltration basins, and sediment grit traps to filter and adsorb metals and hydrocarbons before they infiltrate the substrate, as would be required under the discharge consent.;
    iii. The level of treatment of wastewater that can currently be achieved via 'off-the-shelf' plants e.g. Membrane Bioreactors and Packed Bed Reactors.
    iv. The significant area available at the MAIL site providing flexibility in the size and distribution of any stormwater and treated wastewater disposal systems.
    v. The nature of the substrate materials present at the MAIL site, which will further act to filter for microbial contaminants and adsorb metals and hydrocarbons in the unsaturated zone;

vi. The nature of the receiving aquifer unit, which is characterised by high hydraulic conductivities, high quality water sourced from the Waimakariri River, which will dilute and disperse contaminants very effectively.

60. In conclusion, the Regional Council has taken the position in V6 that it does not matter what development is planned in Zone 1, if it results in a discharge of contaminates then it is not supported. While I support the objective of maintaining water quality with the aquifers beneath Christchurch, I consider this can still be achieved through site specific discharge consent assessments for new developments addressing the type of landuse and discharges, the nature of the groundwater system in the vicinity of the site and the management practices being proposed. This approach is consistent with the amendments to V6 as discussed in the evidence of Mr MacLeod.

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ATTACHMENTS

A**:** Location Map
B: Geological Cross Section of Christchurch
C: Approximate Location of 3m Isopach (Surface Confining Layer)
D: Proposed Groundwater Protection Zones
E: Copies Well Logs and CPT Logs for the MAIL Site