In the matter of	the Resource Management Act 1991
	And a Notice of Requirement to Selwyn District Council and Applications to Canterbury Regional Council for resource consents.
By	Central Plains Water Trust
And	Central Plains Water Ltd

EVIDENCE OF HUGH MAXWELL BLAKE-MANSON
ON BEHALF OF THE SELWYN DISTRICT COUNCIL

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1 INTRODUCTION

1.1 My name is Hugh Maxwell Blake-Manson. I am the Asset Manager Utilities for Selwyn District Council. I have held this position for approximately 4 years. I hold a Bachelor of Engineering degree conferred in 1995 by Canterbury University. I also hold the professional qualification of Chartered Professional Engineer, MIPENZ (Civil, Environmental). I have had held various positions dealing with Asset Management and Operations-Maintenance of rivers, stock waterraces, water, wastewater, land drainage and stormwater infrastructure. These roles included Southland Dairy Company, in the United Kingdom as a civil works site engineer, Connell Wagner Limited as an engineer for the Kaikoura District Council. From 2001-2003 I was employed by Selwyn District Council in the capacity of Roading Asset Assistant. From 2003-2004, I was employed as a Rivers and Roading Asset Engineer with Tasman District Council. I then commenced my employment with Selwyn District Council as the Asset Manager Water in 2004 (now Asset Manager Utilities). My current role entails strategic asset management for Council's targeted funded water, wastewater, stock waterrace, land drainage and storm water assets.

1.2 This brief of evidence has been prepared to support the Selwyn District Council (SDC) submission regarding the Central Plains Water (CPW) consent applications. It discusses the SDC interest in the following community activities, which are listed as strategic assets in the Long Term Council Community Plan:

- Wastewater Schemes – particularly Rolleston and Leeston;
- Community Drinking and Stock Water Supplies;
- Waterrace Schemes – particularly the Malvern, Ellesmere and part Paparua;
- Land Drainage networks;
- Urban stormwater collection and treatment systems

and how these activities might be affected by the proposed CPW activities. I will also briefly discuss potential effects on Council's, and hence the communities roading assets.

1.3 I will conclude that it is essential that the ability of the assets, which Council manages on behalf of the community, to continue to perform in the manner they were designed for is safeguarded because they:

- Are vital to the health, well-being and sustainability of the District;

- Are vital for the long term growth and development of the district;
- Make a valuable contribution to the Region's biodiversity

1.4 The information provided by the applicant, including that on changes to groundwater and ground surface levels, water quality and interactions with potential climate changes, is not sufficient.

1.5 Increased groundwater levels have been predicted but not interpreted in terms of their effects on community and individual assets and properties. Groundwater quality and potential long term changes to it will be strongly dependent on land use, including irrigation and farming practices. Information on predicting and managing those long term effects is insufficient. There is still a need to confirm that the effects of the proposal on the community activities that I have listed above, on individual properties within those communities and on roading assets will be no more than minor, or alternatively that they can be satisfactorily mitigated.

1.6 The proposal includes draft conditions based on going ahead with the proposal, monitoring effects and mitigating them if necessary. In my opinion, the scope of potential effects and the ability to mitigate them have not been satisfactorily demonstrated by the applicant. I therefore ask that this hearing be adjourned until further information is provided. I also ask that the "wait and see and fix if necessary " approach promoted by the applicant be improved with additional conditions based on that additional information.

1.7 A summary table is provided in Appendix 5

2 Community Growth

2.1 SDC, along with its partners is part of the Greater Christchurch Urban Development Strategy (UDS) that includes the SDC communities of West Melton, Rolleston, Lincoln, Springston, Tai Tapu and Prebbleton. Assuming no constraints to inhibit growth, then the projected population of SDC to 2041 will be 64,100 or 24,600 households. It is predicted that 90% of SDC population will reside in the UDS area, – that is the population in the UDS area will rise by 36,500 persons.[1]

2.2 The major current constraints to growth are provision of consented wastewater and water services. Where additional constraints are encountered eg. inability to obtain sustainable effluent disposal options, the high cost of wastewater treatment and disposal, the difficulty in draining land, and handling stormwater runoff, then this is will be reflected in reduced uptake of land for dwellings, and impact on Council's ability to meet its communities' outcomes and commitments. Some constraints arise from current high water table conditions, and the risk of contamination of water supply wells.

[1] BERL Model of Selwyn District Growth, April 2008

3 Community Wastewater Schemes

3.1 The council is responsible for 12 reticulated wastewater systems that service 4,875 properties within the district – refer Appendix 1 (Figure 1.1 – SDC Wastewater Schemes). The wastewater schemes have a replacement value of approximately $41.4m (excluding land value). Overall there are 26 pump stations and 7 wastewater treatment and disposal plants. Total length of the reticulation is 140km, varying in diameter from DN50 to DN400. . The systems that are in the area of influence of the proposal CPW are detailed in the Table 1 below.

Table 1 – Wastewater Schemes in proposed CPW area

Community	Treatment and Disposal		Population (Year)	
	Existing – affected by CPW	Future	2008	2019
Doyleston	Via Leeston WWTP	Remain the same	208	324
Leeston	Multi staged maturation ponds followed by border dyked irrigation or	Remain the same	1599	2,660
Lincoln	Aeration followed by oxidation pond with wastewater pumped to Christchurch	Pines	2703	13,350
Prebbleton	Wastewater pumped to Christchurch City	Pines	1612	
Rolleston	Helpet WWTP - Extended aeration with nitrogen removal with spray irrigation Pines WWTP- Activated sludge plant with nitrogen removal with spray irrigation	Pines WWTP- Activated sludge plant with nitrogen removal with spray irrigation	5274	13,424
Upper Selwyn Huts	Septic tank followed by oxidation pond with border dyke irrigation	Remain the same	36	60
Southbridge	Via Leeston WWTP	Remain the same	562	1050
Springston	Wastewater pumped to Christchurch City	Pines	384	See Lincoln / Prebbleton
Tai Tapu	Wastewater pumped to Christchurch City	Remain the same	343	745

3.2 The wastewater supply activity goal is stated in the 2004 Selwyn Community Plan as being:

"To ensure the protection of the public health and property of the District by providing cost effective sewage systems relevant to the needs of District townships in an environmentally sensitive manner"

3.3 The strategic approach with respect to wastewater for the Selwyn District Council is to ensure wastewater treatment and disposal for all communities proceed in a manner that does not impede development within the district. This will include the following:

- Development of a centralised Eastern Selwyn treatment and disposal area at the Pines site, Rolleston, to meet the Greater Christchurch Urban Development agreement
- Maintenance and extension of the Leeston treatment and disposal systems, which services Doyleston and Southbridge.
- Additional onsite treatment and disposal systems for those communities and stand – alone properties not served by community reticulated systems. Those onsite systems will continue to rely on groundwater levels and ability to achieve appropriate water quality in the treatment zone.

CPW Groundwater Modeling

3.4 URS Consultants provided a response to GHD (17 March 2008 – Central Plains response to SDC submissions), relating to an assessment of groundwater mounding effects on SDC's wastewater network. This stated that:

"We used the groundwater model results from Aqualinc to assess the likely extent of CPW effects on the urban wastewater systems. Although the model limitations prohibit site specific predictions it still gives some indications on areas with very shallow GW levls. *A GIS overlay of the wastewater systems in the lower plains and the modeled increased area of existing shallow GW levels (1m depth contour) and increased area due to CPW for a wet period (October 1978) –Appendix 1-Figure 1"*

In our opinion the groundwater levels, after implementation of CPW, will not be significantly different from their historic patterns and magnitudes in the past, and these will continue to be dominated by climatic variables and natural recharges, which will not be altered significantly by CPW. Therefore SDC's wastewater needs in relation to groundwater (or other groundwater related infrastructure concerns) will be similar to what has occurred in the recent past and is reasonably well known. But it is also clear that CPW will raise groundwater levels and cause some adverse effects, even if these will be small.

Figure 1 indicates that the area with very shallow GW will expand and will cover the reticulated system in Rolleston due to CPW. However the model results do not show GW within 1m from ground in the area around Leeston. On the other hand this area is known to have very shallow GW and SDC stated that GW inflow into the pipe system was observed in wet periods.

The CPW predictions of groundwater level rise for this wet period are attached to my evidence, Appendix 1 - Figure 1.2 and Figure 1.3

The implications of the above are further discussed in the following wastewater and land drainage sections.

ROLLESTON WASTEWATER TREATMENT AND DISPOSAL – PINES and HELPET

3.5 Rolleston is serviced by two biological wastewater treatment plants "WWTP". Effluent from them is disposed of to land. Land disposal is essential for the wastewater system to operate and hence to support maintenance of community health.

3.6 The original Rolleston scheme, known as the "Helpet" plant, is consented to 4400 population equivalents "PE". A second scheme is located at the "Pines". This has been operational for 12 months, with a consented treatment and disposal capacity of 22,000 PE. The current built treatment capacity is 6000 PE.

3.7 The Helpet and Pines plants as consented today will provide sufficient capacity to accommodate only the Rolleston and environs predicted growth identified in the UDS zone. The current environs extend to West Melton, Rolleston Prison and the Rolleston Industrial Zone land.

Pines - Current Consent Matters

3.8 With reference to information from the MWH report 2003 for Pines - *(Resource Consent Application & Assessment of Environmental Effects Rolleston Wastewater Project, June 2003*)

- Mean and minimum (worst-case scenario) depths to groundwater at the Pines is 6.7 and 2.1m respectively. This provides an unsaturated zone of 6.7m and 2.1m respectively.

- Microbiological modelling and hence groundwater impacts, were based on a 90% and 20% reduction in the unsaturated zone respectively.

3.9 The URS memo dated 17 March 2008 identifies that the proposed CPW scheme will extend the groundwater contour in the Rolleston area to 1m depth during wet periods and the mean groundwater level will rise by approximately 3.3m. A similar, but slightly smaller rise is predicted in the extreme/higher winter level events. Based on this information, the mean unsaturated zone would reduce from 6.7m to 3.4m, an approximately 50% reduction. The expected faecal coliform reduction within the unsaturated zone would be adversely affected by this reduction in the unsaturated thickness. This would most likely extend the predicted groundwater contamination zone, established in the Pines 1 consent application.

3.10 Based on the information provided, the proposals by CPW would have a detrimental effect on Pines – existing and the planned phase 2 extension to the consented capacity, in that it will

- It will reduce mean unsaturated thickness by approximately 50%, and;

- Adversely affect the expected faecal coliform reduction within the unsaturated zone and extend the predicted groundwater contamination zone.

Pines Future Extension - Viability

3.11 To meet all of the UDS predicted growth commitments, Council has supported extension of the existing Pines system which will treat and dispose of the additional UDS growth in the townships of Prebbleton, Lincoln and Springston. This will be based on successful consenting. Alternative options, including an Ocean outfall were considered, but were rejected for cost, environmental and cultural reasons.

3.12 Council is now rapidly progressing the consultation and consenting phases for an extended Pines disposal and treatment area to meet the additional requirements of the UDS townships of Prebbleton, Lincoln, Springston and West Melton.

3.13 On the basis of the very limited groundwater modeling presented by CPW, and the very flat contours of the land in the area, the predicted groundwater mounding from the applicant's proposal raises the following concerns:

- The inability for future compliance with the current Regional Council consent conditions for the Helpet and Pines disposal areas;

- The inability to service the UDS growth through increased effluent disposal from the Pines WWTP either on land adjacent to the current site or on any other potentially suitable similar land within reasonable distance of Rolleston.

LEESTON

3.14 Council operates a consented oxidation pond, wetland treatment and land disposal based WWTP at Leeston. This WWTP takes wastewater from neighbouring townships of Doyleston and Southbridge. The consenting process for disposal for the communities in this area took over 10 years and consideration of three different disposal area proposals (and associated consent applications) due to the ground water mounding concerns of the rural community.

3.15 The Leeston WWTP was upgraded in 2003, and was consented to treat 3,600 PE, recognising that it and the connected townships are subject to very high groundwater levels. The Leeston sewer network is known to have high inflow and infiltration rates, particularly at groundwater levels above 0.9 m below ground level. The consent reflects this and specific treatment has been built to accommodate this ephemeral situation eg discharge via infiltration basins to Tramway Reserve Drain.

3.16 The Aqualinc modelling, recognises that there are high groundwater levels in the area. However the CPW evidence does not consider what additional effects there will be of CPW

related groundwater mounding on existing consents. The CPW plan of increased drainage problem areas does not include Leeston, Doyleston and Southbridge. It is my view that these communities, which are already subject to groundwater at ground level, will be affected by CPW. . Such a conclusion is derived from the CPW contour map of raised groundwater levels which only has an outer contour of a 2 metre rise. Therefore, Leeston, Doyleston and Southbridge fall into the category of a 0 – 2 m rise, which is an unacceptable level of increase given the high water table problems that these areas already experience.

3.17 I consider that CPW will increase the frequency, duration and extent of groundwater mounding in the Leeston scheme. This will result in increased pumping costs, and requirement for alternate disposal methods as a result of greater inflows. Without improvements to the WWTP processes it would also result in a reduction in PE treatment capacity. The scheme has already been funded on the basis that 2660 connections will be available (via development contributions). Without mitigation by the applicant, any reduction in capacity (reduction in number of connections available) would require the existing ratepayers of Leeston, Southbridge and Doyleston to fund the shortfall.

3.18 Additional upgrades to cater for a reduction in existing PE treatment capacity would also result in future costs being placed on the existing users.

SPRINGSTON and LINCOLN – SEWER NETWORKS

3.19 I recognise that parts of the Springston and Lincoln networks are subject to high levels of inflow and infiltration. In line with acceptable asset management practice, it is intended to instigate strategies to reduce the levels of infiltration to a level considered appropriate for the industry. In fact, some significant remediation works have already occurred, with more required as issues are identified.

3.20 The Aqualinc modelling identifies that the Lincoln network will be subject to an average additional inundation of 42 days / year – that is where the groundwater level is 0.5m below ground level.

3.21 I have witnessed springwater flows in the winter of 2005/2006 in parts of Springston's built township eg Ford subdivision. . Removal of this springflow is managed by provision of a classified and targeted rate land drainage scheme around the township – refer to the Land Drainage section.

3.22 I have not sighted any specific data from CPW Ltd which identifies the predicted extension of Springston sewer network inundation periods. However, it is reasonable to conclude from the CPW presented Lincoln information and local knowledge that an increase in the extent of inundation periods will also occur.

3.23 I consider that exacerbation of groundwater flows will increase the failure rate of services in Lincoln and Springston. In the short term this will be seen in footpaths and roading, where the saturated sub-base fails and top surface also fails. In the longer term as existing pipes age they can normally be expected to have increased groundwater water ingress. The effect of the predicted elevation in groundwater levels would be to extend the periods of infiltration and bring forward the asset replacement at an earlier stage than planed in their lifecycle.

3.24 International and national studies have shown that the majority of infiltration is via the private property lateral (from the property boundary to the house). Any increase in the ground water level above what is normally experienced will require additional funding requirements on the private properties to replace the property laterals. Potential effects on private landowners from the proposal have not been adequately considered by the applicant, and additional information is required.

3.25 The costs associated with mitigating increased groundwater levels resulting from an increasing frequency of inundation should not be borne by the targeted scheme rated users.

4 Water

4.1 The water supply activity goal is stated in the 2004 Selwyn Community Plan as being:

"To provide a safe and sufficient network of potable water supplies that comply with public health standards and water systems that meet the present and likely future needs of the district."

4.2 The council is responsible for 30 community water supplies - 27 reticulated water schemes and 3 rural water supplies that supply water to 24,000 people within the district. All schemes are funded via targeted rates – that is, each scheme pays only for the operation, maintenance and renewal of the assets.

4.3 The water schemes have a replacement value of approximately $49.6m[2] (excluding land value). The reticulated supplies source water from both surface and groundwater. Those schemes located from Darfield to Arthurs Pass are surface water takes, and those from Kirwee to Te Waihora / Lake Ellesemere being groundwater - refer Appendix 2 – Figure 2.1 SDC Water Supplies

4.4 The reticulated urban water schemes provide water for domestic and industrial use with the majority of schemes having fire fighting code of practice capabilities. Restricted schemes (in rural areas or adjacent to the main townships) provide stock and domestic water on a regulated basis without normal fire fighting capabilities.

[2] Figures are expressed in dollar values as at 30th June 2005 and exclude GST, unless stated to the contrary.

4.5 The groundwater sources from within the plains area receive a significant proportion of their recharge from the area of land where CPW intend to carry out their irrigation activities. Typical hydraulic gradients for the groundwater in this area of the plains are vertically downwards and laterally to the south-east. There are no significant low permeability layers that would retard the movement of this leachate water and prevent it from entering the aquifers where the SDC water supply wells are screened.

4.6 CPW indicates that drainage of water down into groundwater from beneath the irrigation area would increase from 29 cumecs to 33.1 cumecs, an increase of 4.1 cumecs (from Julian Weir's evidence). Furthermore that water would carry large increases in nutrient loads, with nitrate increases from around 15 kg/ha/year (for unirrigated land) to around 50 kg/ha/year under irrigated conditions. While CPW indicate that this drainage water would be mixed with clean water from beneath their distribution races the degree to where such mixing will actually occur is uncertain – it would not necessarily be before this water reaches our communities' and private properties' water supply wells. There are also major uncertainties over the actual volumes of recharge water from the proposal that could dilute the increased nutrient loads. Those recharge volumes would depend on scheme losses and irrigation efficiencies. There would be strong economic incentives for farmers and system managers to minimise losses to groundwater. Therefore there is a concern of adverse water quality effects occurring within our wells.

Community Water Supplies - Health

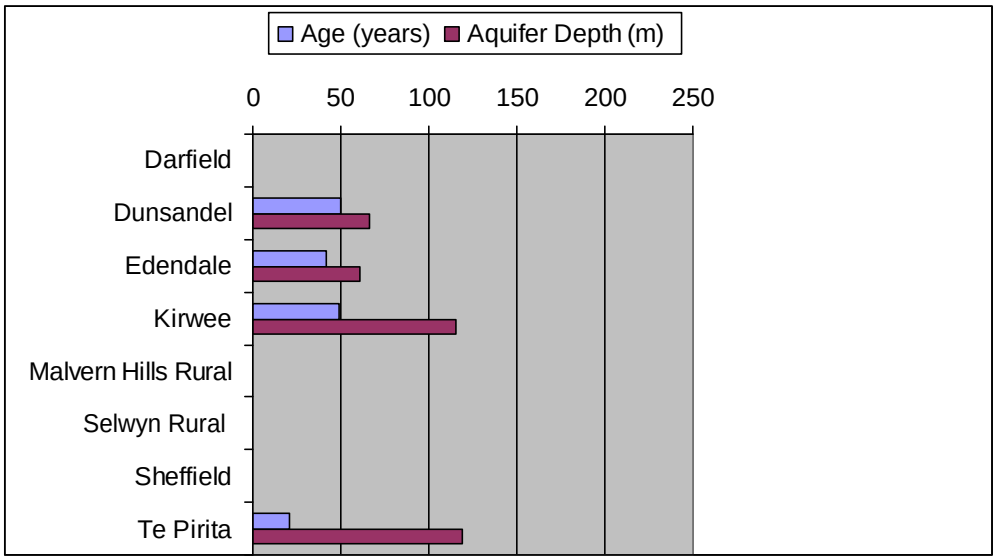
4.7 The key concern of SDC is preserving the quantity and quality of the groundwater resource that is utilised by the community schemes now and in the future. The primacy of human drinking water needs is a key matter to consider and protect for current and future generations. Sustainable communities must also have sufficient water for private gardens and for commercial, industrial and community activities.

4.8 It is the responsibility of Council to comply with legislative requirements, monitoring water quality in accordance with the New Zealand Drinking Water Standards 2005 "DWSNZ" and implement water infrastructure quality upgrades in response to legislation, community goals and needs.

Groundwater Quality – Community Schemes within proposed CPW Irrigation Area

4.9 The following community supplies are located within the proposed CPW irrigation zone. These are show as per Figure 1 and detailed in Appendix 2 - Table 2.1.

Figure 1 – Community Water Supply Schemes within the Proposed CPW service area



4.10 Figure 1 shows that in Kirwee and Te Pirita, suitable community groundwater is currently available below 100m, and it is between 20-50 years old.

4.11 It is worth noting that Darfield is consented to extract approximately 80 l/s from the Waimakiriri River bed for community water supply purposes. This Class A water is vital to the existence of this township.

4.12 CPW have indicated that they will meet irrigation demands by abstracting water on a run-of-river basis, relying primarily on the higher reliability Waimakiriri and the lower reliability Rakaia River water and then utilising their stored water as a secondary source of supply. This method of take will result in longer lower flow periods below the take point. This will increase the periods that the river is in the "Restricted period" and could significantly reduce the amount of water available to the Darfield community during the time that the community most requires it.

4.13 As with Mr Callander, I am concerned that there could be a subsequent reduction in river seepage and related drop in the quantity of water available within the SDC community supplies. These supplies include but are not limited to West Melton, Jowers Road and Johnsons Road – refer Appendix 2 - Table 2.2 and Figure 2 below. These particular supplies are already subject to tiered restrictions, which have been enforced in the past two years as "normal" groundwater levels dropped rapidly. It is clear that there is already a direct relationship between source river flow, groundwater level and water quality.

4.14 As a result I am concerned that the water allocation rules that CPW might receive for any consent to take water from the Waimakariri River appropriately allows for our ability to abstract water from aquifers that rely on Waimakariri River flow for their quantity and quality. The uncertainty and potential adverse impact relating to potential losses in the Waimakiriri recharge on SDC aquifers can be alleviated by leaving more water in the river. Furthermore it is very important

that any consent contains a clause that requires urgent review of the CPW consent should any impacts on the Darfield water supply occur.

Legislative Drivers

4.15 Council is aware that a number of these water supply sources will require some form of quality improvements in line with legislation and community needs. Potential changes to source quality resulting from the proposal, in particular nitrate concentrations, would be very difficult and costly to mitigate by additional treatment. As I noted above, there are major uncertainties with the current levels of information provided by the applicant. Applying the precautionary principle would indicate that additional information is needed before considering the proposal and any granting of consents for it.

4.16 The unsecure sourced water will require the major portion of quality upgrades. For example the Selwyn and Malvern Rural Schemes are estimated to need more than $0.5M each for quality improvements. This will place considerable financial loading on the scheme users as capital and operational works eg. treatment devices and increased ongoing maintenance costs are realised. The level of treatment and monitoring required are established against the current water quality.

4.17 I note that groundwater assessed as being secure does not require any further treatment to comply with the section of the DWSNZ on protozoa contamination. However, should a source breach the security standards, then treatment and/or new deeper bores will be required. Both options are costly eg. installation of energy intensive filtration and / or Ultra Violet treatment and/or new bore(s) lifting water from deeper aquifers. I have not sighted any assessment by CPW which identifies the risk of security standards being exceeded and consider that CPW should complete this.

4.18 Consideration also needs to be given to the Ministry for the Environment's National Environmental "MfE" Standard for Sources of Human Drinking Water (NES). This was gazetted on 20 December 2007 and comes into force on 20 June 2008. It promotes a multiple barrier approach between potential sources of contamination and the intakes for public water supplies. In particular, it requires that a regional council must not grant a water permit or a discharge permit for an activity that will occur upstream of an abstraction point if the activity is likely to introduce or increase the concentration of a contaminant that might cause the water supply to no longer meet the health criteria specified in the DWSNZ.

4.19 This NES also requires the consent authority to consider whether the activity may lead to events that create a contamination risk for a water supply and, if so, they must impose a condition requiring the consent holder to notify the water supply operator should any particular contaminating incident occur.

4.20 Furthermore the NES states that the consent authority may impose conditions on consents that are more stringent than the requirements specified in the NES.

4.21 I am unsure of the exact status of the NES because whilst the CPW consent applications were lodged prior to the NES coming into effect the decision on the application will be made after the NES has come into effect. Regardless of this I think it is important to be mindful of MfE's intentions about protecting areas that feed water supply intakes from becoming an enlarged source of contaminants and making sure that any consent that is granted has sufficient conditions that protect the water supply intakes.

Nitrate-Nitrogen

4.22 The DWSNZ identify that the Maximum Acceptable value for nitrate-nitrogen is 11.3 g/m3. Dr. A. Humphreys identifies the reasons for this limit in s4.2 of the Health Impact Assessment, noting that nitrate-nitrogen impacts on health relatively quickly.

4.23 Mr Tipler has provided evidence on the nitrate impacts on groundwater quality resulting from CPW activities. The assessment acknowledges that the mass of nitrogen entering groundwater will increase, but due to dilution effects, will result in small increased overall nitrate levels.

4.24 Whilst the effects of nitrates in some groundwater areas are lessened by dilution of river water (generally via leakage from the Waimakariri River into the Christchurch City aquifers), many of the SDC water supply wells do not receive those benefits and being located more within the Central Plains are predominately affected by groundwater derived from beneath the irrigation areas of the CPW scheme.

4.25 Council voluntarily undertakes a comprehensive chemical monitoring programme for its water supplies every three years, and this includes assessment of nitrate levels.

4.26 A selection of recorded nitrate-nitrogen levels taken in 2005 are:

- Armack Drive - 6.6 g/m3
- Darfield - 1.52 g/m3 - (taken from deep groundwater) that is being considered as an alternative supply source)
- Dunsandel - 3.3 g/m3
- Edendale - 6.55 g/m3
- Te Pirita - 1.24 g/m3

4.27 Elevated nitrate concentrations are already an issue in the Central Plains groundwater zones and indeed some Council supplies and the addition of more nitrogen sources would present an increased risk to SDC water supply wells. From the data presented above, several water supply schemes are

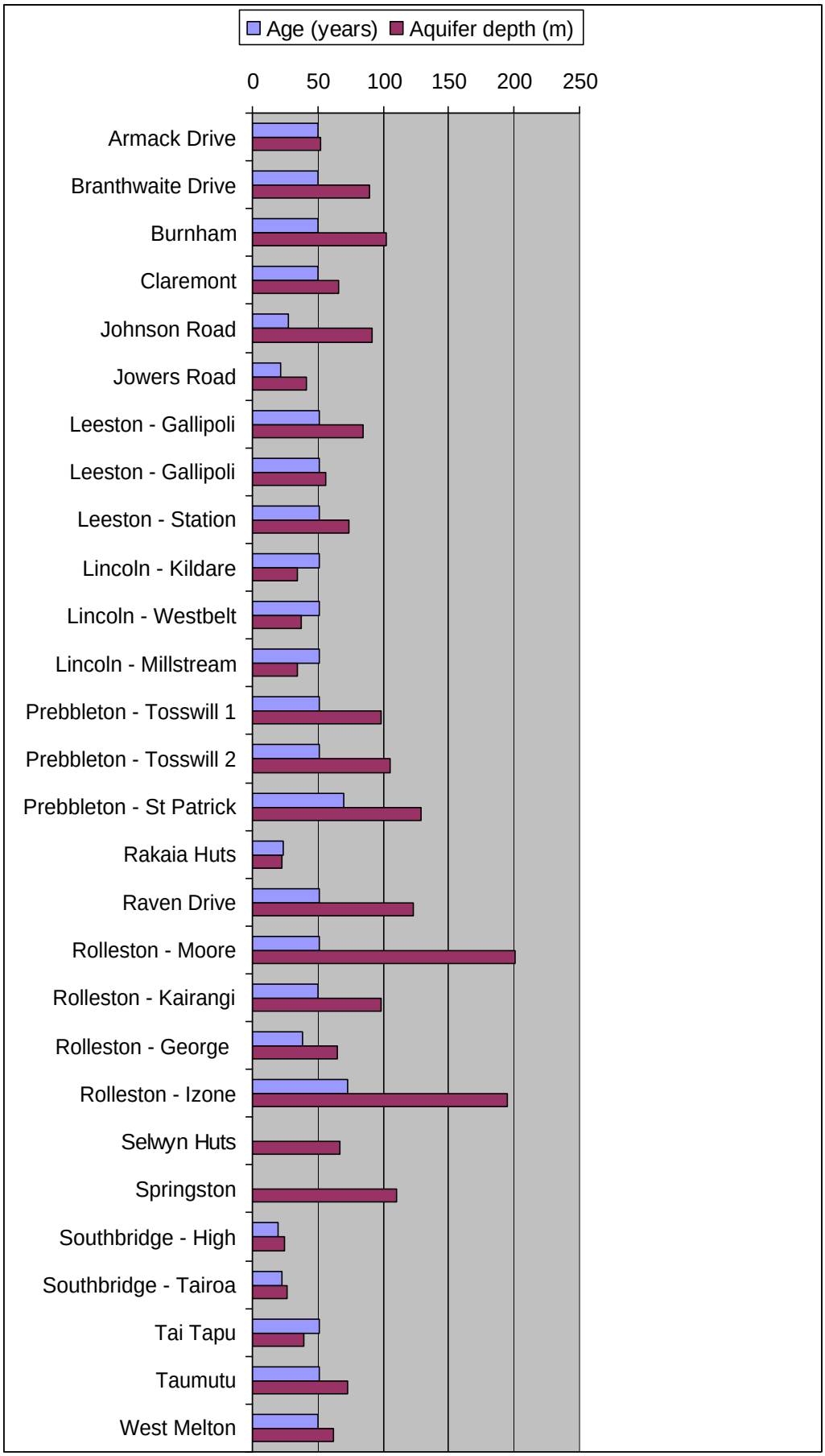
already subject to elevated nitrate levels, and it is not desirable to see further elevation in such levels.

4.28 I have read Mr Callander's evidence presented on behalf of Christchurch City Council on this matter, and concur with his views in s5.13-s5.17. I consider that there remain significant uncertainties relating to localised increases in nitrate levels in groundwater supplies i.e. spatial and seasonal variations strongly influence water quality. This requires consent conditions to ensure that CPW will mitigate any effects.

Groundwater Quality – Community Schemes below proposed CPW Irrigation Area

4.29 The following community supplies are located down gradient of the proposed CPW irrigation zone, refer Figure 2. These are shown with greater detail including population, source and well depth (aquifer) as per Appendix 2 - Table 2.2.

Figure 2– Community Water Supply Schemes down gradient of the proposed CPW service area



4.30 As identified in Figure 2, a number of wells have water ages within 10-30 years, particularly those near the West Melton special groundwater zone. These are also recognised as unconfined aquifers. While security has been proven in accordance with the DWSNZ. It is important to note that the security definition is only related to microbiological contaminants and does not in my view relate in any way to contamination risks from nitrates. I have already expressed concern at the uncertainties involved in the accuracy of Mr Tipler's modelling and therefore the potential effects on community water quality and the possible change to the secure nature of these wells.

4.31 Mr Callandar notes that in his assessment of the CPW nitrate modelling, and with increasing distance downgradient of the scheme area, the reliability of the mixing modelling becomes "more realistic". While these locations are towards Te Waihora / Lake Ellesemere, Council has recorded community water scheme water ages of 20 to 50 years.

4.32 If CPW proceeds, their land use impacts would not be observed for at least 20 years in groundwater quality reduction. This reduced quality groundwater water would still be there in a further 20 years. I do not consider it is acceptable to subject future generations with effects resulting from reduced water quality, particularly as a result of a know activity.

4.33 The adaptive management practices proposed by CPW relating to farming practices would be entirely ineffective if degradation in groundwater water quality occurred. Until additional information is provided I request that this hearing be adjourned.

4.34 I also note that Mr Callander has identified that the CCC may consider installing wells in the SDC Greenpark area, should they identify contamination of the CCC wells. Protection of the SDC groundwater aquifer quality is therefore important for both SDC and CCC future communities.

.**Mitigation Measures – Monitoring and Adverse Effects**

4.35 Given that there remain significant uncertainties even in the short to medium term (10-50 years) relating to the effects of CPW irrigation activities on groundwater water quality, future adjustments in CPW activities in combination with the effects of historic land use practices would be ineffective to secure the long term highly valued water quality. Again, once groundwater quality has reduced, one either moves to another source or waits for the 20 years or more for land use changes to reflect in groundwater quality improvement. Until additional information is provided I request that this hearing be adjourned.

4.36 I note that CPW have offered to provide replacement wells should certain circumstances occur which were are a result of their direct activities. I have covered this matter in greater detail in Section 8 – Agreements.

4.37 While replacement wells would be a mitigation measure by CPW, their installation would be but one component of the true cost, as this would only covers the immediate cost of replacement.

Assuming that a deeper well is required eg to obtain higher quality water, then the affected community would then be subject to funding increases eg increased rates and ongoing energy, operational / maintenance and renewals costs, which they would otherwise not have been subjected to at the same level. I do not consider that replacement wells are a sustainable mitigation measure as proposed. Any mitigation from CPW would need to include the full replacement costs including ongoing operational and life cycle costs.

5 Waterraces

5.1 The water race network in central Canterbury began operation over 120 years ago and was established to provide a reliable water source to sustain agriculture. The primary purpose of the water race network today is essentially the same, although it faces increased pressure from other resources users such as recreational, cultural, fisheries, large scale irrigation users and wildlife users

5.2 Selwyn District Council's existing Goal as noted in the 04/05 Annual Report is:

"*To provide a safe and sufficient network of potable water supplies, which complies with public health standards and water systems, and meets the present and likely future needs of the District".*

5.3 It is considered that the existing goal was intended for potable water supply and therefore a revised goal for the Stock Water Race system was required.

5.4 The revised current Goal of providing a Stock Water Race System is:

"To provide effectively operated and managed stock water race schemes to meet the present and likely future needs of the consumers and promote sustainability"

5.5 The water race network provides water into the SDC and CCC areas. SDC has overall responsibility for water delivery including formulation and implementation of management systems, policies and rules governing operation of the water race network.

5.6 Details of the three current schemes are detailed in Table 2. Note that Council has approved the closure of the Selwyn stock water race scheme, which served an area of 2052 ha.

Table 2 – Waterraces affected by proposed CPW scheme

Description		**Quantity**
Number of Schemes		Three
Properties Served		2785
Area Served	Ellesmere	41,847 ha
	Malvern	43,690 ha
	Paparua	22,744 ha
	Christchurch City	2,965 ha
	Total	111,246 ha

Description		Quantity
Physical Statistics	Intakes	10
	- Fish screens	2
	Tunnels	4 (1,745 m)
	Reticulation Length (km)	
	- Major races	362 km
	- Minor races	173 km
	Viaducts	4 (169 m)
	Culverts	
	- Major	35 (4,177 m)
	- Minor (under roads)	Unknown
	Divides	
	- Major	30
	- Minor	Unknown
Water Usage	Ellesmere	62.6 million m^3 (annual average)
	Malvern	36.2 million m^3 (annual average)
	Paparua	41.3 million m^3 (annual average)

5.7 The water race systems must be able to function and co–exist with other resource users. Network management and operation practices have now recognised this and reflect the values of other resource users. This has required a more structured and effective management process which is outlined in Councils Water Race Management Plan

SDC Waterrace Consents

5.8 A summary of takes for waterraces is provided in Table 3 below, noting that

- Paparua Consent - Council renewed the consent for this Waimakariri take in 2002.
- Malvern Consents - Consent conditions were provided in early 2008 and there is currently an appeal in place relating only to the Selwyn (Glentunnel) take.
- Ellesemere Scheme – Takes are via the Rakaia River and Haldon Stream. Continuation of use via s124 of the RMA has been provided and consent hearings are yet to be held for these takes.
    - Earlys / Te Pirita – Note Council has a non-consumptive diversion from the Rakaia River of 3.5 m3/s which it does not use concurrently with Glenroy Irrigation. This supports a number of irrigators and Council in their takes eg 732 l/s for SDC
    - Haldon Intake

- Lower Rakaia – diversion consent obtained in 2004 as part of the Lower Rakaia Diversion Group.

5.9 Seasonal operation of the water race network allows the water takes to be reduced in winter and spring. These are periods when the water demand and evaporative losses are decreased. Leaving more water in the rivers may be beneficial for in-stream habitat values, fisheries and recreational use of water. It also assists a fundamental philosophy that water is most appropriately left in the river.

Table 3 - SDC Water Takes for Waterraces

Scheme	Intake	Base Minimum Flow (Lts/sec)	Maximum Take (Lts/sec)
Malvern	Kowai – Upper	435	1100
	Kowai – Lower	Nil	630
	Waimakariri River Gorge	630	800
	Glentunnel	250	280
	Total	**1,315**	**2,810**
Paparua	Intake Rd – Stock water	1231	1331
	Intake Rd – Irrigation	800	800
	Total	**2,031**	**2,131**
Ellesmere	Early's – Stock	732	732
	Early's – Irrigation	1751	1751
	Haldon (Hororata River)	341	500
	Main South Rd (Lower Rakia)	466	500
	Total	**3,290**	**3,483**

All Schemes – Matters To Consider

5.10 A number of concerns are raised below.

(a) No information has been made available which provides me with any confidence that implementation of the Central Plains Water Scheme will not compromise the financial viability and underlying basis of operating and maintaining SDC's waterrace schemes. This is particularly the case with the Malvern and Ellesmere schemes. I believe CPW should undertake this work.

(b) The potential adverse effects of the proposed take from the Waimakariri River and Rakaia River on the existing Resource Consents that SDC hold for the waterrace networks have not been appropriately assessed. This includes effects of lower flows on consistency and quality of the waterrace water, and effects on active braid location and activity.

(c) SDC requires that any potential decrease in river flows from the proposed CPW Scheme do not affect SDC's ability to maintain their permitted water take and hence commitments to targeted rate users.

(d) I note that 800 l/s which has been consented for the Malvern Stock Waterrace (via the Waimakariri Gorge intake), is also included in the Class A category water. Combined with the Darfield Township take, this represents 4.5% of the smaller abstraction option identified by Mr Tipler[3] in paragraph 118 of this first brief of evidence.

(e) The effect of these two takes being disrupted by, or combined with the CPW activity eg stockwater delivered by CPW and water pipes being installed along side canals has not been adequately assessed by CPW.

(f) The applicant has failed to provide appropriate mitigation measures to address the effects of their proposed activity both during construction works and on the Selwyn District water race intakes and waterraces within the network.

(g) The applicant has not adequately addressed the potential effects on existing stock and irrigation consent that SDC hold under CRC012006 at the Paparua Intake located at Intake Road as a result of the proposal and water take from the Waimakariri River.

(h) The design of the water race crossing structures has not been supplied in the applications. Further detailed design and appropriate mitigation is required to ensure that the waterrace scheme(s) continues to operate to the high level of service they currently operate at.

(i) The information provided within the AEE stated that the canal is likely to be positioned above the waterrace crossing. No detailed information was provided by the applicant regarding the ownership of the waterrace crossing infrastructure particularly with respect to ongoing maintenance and any emergency works that may arise.

Paparua Scheme Stock Waterrace

5.11 Water is provided for SDC users and to the CCC for supplementation of its Avon and Heathcote stream flows, stockwater and utilisation in the reserves as an amenity water feature. Any reduction in flow, will in my view over time reduce the supplementation service that the waterrace provides to these streams and the cultural, social and environmental well-beings they support

[3] Mr C. Tipler CPW – Smaller abstraction is 20 m3/s and larger storage 280 Mm3, para 118 First Brief of Evidence

6 Land Drainage

6.1 The Council owns and manages ten separate land drainage systems, in the locations shown in Appendix 4 – Figure 4.1 Drainage. The purpose of land drainage is to reduce groundwater levels and in doing so make land available for arable purposes. While their secondary benefit is to minimise the effects of flooding, this is a result of but not the purpose for which they were constructed. The Council is responsible for the operation and maintenance of the main drains with all other drains being the responsibility of the owner on whose property they are located.

6.2 The drainage systems vary in size from 90 – 12,847ha. There is only one land drainage pumping station; which serves the Osbornes Land Drainage scheme. The systems are fed by a large number of secondary and tertiary private drains

6.3 Total and current predicted operating cost[4] per year varies from $171,000 to $206,000 over the period 2006/2016. The replacement value of pump station and drains was approximately $17.5m as at June 2004.

6.4 Of the ten schemes, the following would be affected by the CPW scheme:

- Taumutu Drainage
- Taumutu Culverts Drainage District
- Leeston Drainage District
- Leeston Township Drainage District
- Ellesemere Drainage District
- L11 Drainage District
- Greenpark Drainage District
- Osbornes Drainage District
- Hororata

6.5 In Mr Lewthwaites second brief of evidence on behalf of CPW, he provides interpretation of Mr Weirs (Aqualinc) general modelling. He concluded in s6.3 that:

"*…as a result in the fluctuation in (groundwater) levels, the groundwater is predicted to be at or close to the ground level i.e. areas where it is predicted there could be problems with drainage".*

6.6 Mr Lewthwaite also identified in s6.1 that

"..these areas occur particularly in the Tai Tapu-Lincoln area, and, depending on the climate, progressively westwards .."

[4] Figures are expressed in dollar values as at 30th June 2005 and exclude GST, unless stated to the contrary.

6.7 While I have covered the immediate concerns relating to this for the wastewater and water supplies, there would also be resulting impacts on Council's land drainage activities. Mr Lewthwaite considered that as a result of CPW irrigation, there would be wet weather flow increase of 1% to 20% or up to 50mm elevation above the current normal water surface levels. Again this is based on broad scale modeling, with specific modeling at local level not undertaken.

6.8 In all schemes, CPW identify that groundwater will run in drains for longer periods. This increase in flow would require the land drainage schemes to undertake more maintenance works over a larger scheme extent to ensure free transport of water. It is reasonable to expect that landowners would maintain the drainage system which services their properties, however additional works would result in main drains from the proposed CPW activities.

6.9 In the case of the pumped Osbornes Drain scheme, this predicted increase in based flow may result in additional pumping, that is outside of peak wet weather events.

6.10 Increases in Leeston Township groundwater levels would result in extension of the period of infiltration into the Leeston wastewater reticulation as detailed in paragraph 3.16

6.11 I am therefore concerned at the insufficient accuracy of the modeling for application, interpretation, predicting effects and identifying mitigation requirements at a local level. In addition, no specific data has been provided relating to the effects on flow rate and volume/cost of additional pumping that could be required in the Osbornes Drain scheme. This level of detail is required, along with clear trigger points, which would allow Council and the applicant to identify who would be responsible for additional pumping, operation and maintenance costs.

6.12 With respect to the remaining gravity based drainage schemes, it was suggested by Mr Lewthwaite that improvements in drain capacity, by widening, deepening, pumping and installation of additional drains would be reasonable.

6.13 Each of these options would however result in some adverse economic and environmental effects that the applicant has not identified and considered. Further, I do not consider that deepen drains would improve the transport of water, particularly when this activity could result in breakthrough into underlying springs.

6.14 These drains are located in very unstable, low cohesion soils, which when over-deepened would collapse. Over-deepening has been witnessed in a number of locations within the land drainage network, and these areas have now reached a stable profile. Reinstatement to appropriate bank-side profiles would be difficult or impractical and would not follow good drain management practices. A possible solution is piping through the affected sections.

6.15 I consider that installation of pumps in areas that otherwise would not have not required them would be inefficient and unsustainable. This should be considered as the last mitigation option, as it would require long term ongoing operation, maintenance and renewals funding requirements.

6.16 Overall Mr Lewthwaite recognises in s25, Second Brief of Evidence that it would be reasonable for the applicant:

"to agree to remedy adverse effects of drainage in the lower plains that result from operation of the scheme"

He qualified this in terms of the uncertainty of who or what is the cause of the "drainage difficulties" eg climatic variation and rainfall. In section 8 – Agreement I cover how I consider this matter should be attended to.

6.17 In any case, the land drainage schemes should not be subject to costs for sustainable drainage management above those they already carry.

7 Community Stormwater Collection, Treatment and Disposal

7.1 In addition to the wider district land drainage networks, the individual communities in the areas that would be affected by the proposal have their own stormwater collection, treatment and disposal systems. These systems have been developed to manage storm and groundwater flows that result not only from development, but from natural conditions including high groundwater levels and low permeability soils in the developed areas.

7.2 Additional population and community growth of the scale and in the locations I indicated earlier will require additional system development and consents. Any effects from the proposal would add to the scale and costs of that development. As I have discussed earlier, the applicant, rather than communities and individual property owners, should pay for those additional costs. The applicant's information as presented to date is insufficeent to identify actual effects or costs.

7.3 Stormwater flow rates determine network pipe sizes, storage and treatment capacities and effects on receiving waters. Stormwater volumes also determine storage and treatment capacities and effects on receiving waters.

7.4 Flow rates and volumes depend on:

- Catchment surface area including shape and contours
- Permeability, to allow infiltration rather than runoff
- Groundwater levels relative to surface levels (again, to allow infiltration rather than runoff, and also to identify base groundwater flows that must be passed though stormwater systems.)

7.5 As I have noted earlier, the proposal and accompanying evidence does not have sufficient information to allow Council to identify specific effects on community or private assets. A review of the information does however raise the following concerns relating to the predicted and potential increased groundwater levels:

- Increased groundwater base flows
- Reduced infiltration capability, resulting in increased storm runoff

7.6 Council's work in developing the Lincoln integrated stormwater management plan has included assessment of the potential effects of the proposal from the limited groundwater information that has been made available. Possible groundwater piezometric level rises of up to 5 metres at Lincoln were indicated.

7.7 Increased groundwater pressures at Lincoln and in the other at risk communities would result in increased groundwater base and storm runoff flow rates. Without additional stormwater collection capacity, those increases would increase the risk of local flooding, as base stormwater capacity and disposal eg infiltration capacity would be reduced. The proposal would therefore require some other mitigation measure, such as increasing existing network capacity.

7.8 Any increases in groundwater nutrient concentrations would also be reflected in increased discharge concentrations unless additional treatment was provided.

7.9 The applicant could be required to mitigate the predicted groundwater level rises and potential increased groundwater nutrient concentrations by providing local and wider area groundwater management. An alternative could be to require them mitigate the effects by providing and paying for additional stormwater collection, treatment and disposal system capacity.

8 Agreement – Cause, Effect and Mitigation

8.1 Mr W. Lewthwaite has provided a commitment to completion of background baseline surveying and implementation of mitigation measures which they consider appropriate. (Second brief of evidence, 31/01/08 s26-s30). I consider that Mr. Lewthwaite has provided an offer which is unacceptable as it is only to "consider" mitigation "if it can be demonstrated that there are adverse effects as a direct consequence of CPW"

8.2 I recognise that there are uncertainties in determining the cause of effects, however CPW have stated that they will cause groundwater levels to rise, land drainage flows to increase and install a scheme over significant areas already serviced by existing waterrace schemes, effecting their viability. It is not sufficient to wait 20 years or more to observe reduction in groundwater quality. Such effects are transferred to future generations, when the current ones activities are responsible.

8.3 Given this uncertainties raised, I believe it is appropriate that the burden of proof is placed entirely on CPW. Therefore, as noted earlier, I have suggested that further information should be provided by the applicant before proceeding.

8.4 If however consents are granted at this stage, any consent should be worded such that CPW is required to carry out specific monitoring and to implement mitigation measures, unless they can demonstrate prior problems existed, or the problem has not worsened or that it was due to some other explicit matter.

8.5 In the event of the proposed CPW scheme proceeding, it is vital in behalf of the community schemes that agreement is reached with CPW on:

- Clear Identification as to who and what has caused the situation to arise
- The actions required by specified parties regarding avoiding, remedying or mitigating the effects.

Construction of CPW Infrastructure

8.6 CPW have provided indicated locations of canal systems. At various points these would intercept the community schemes pipe lines, and in particular parts of the widely distributed Selwyn and Malvern Hills schemes. In rural areas, services are generally located within +/- 2.5m of as-built positions, given the standards followed at the time of installation.

8.7 CPW have identified that they will work over or under Council services during construction works. However it is my experience that pipelines are cut, and subsequently contaminated, even during minor construction works. Continuity of supply and maintenance of water quality standards are paramount to the connected community and must be maintained.

8.8 It is the responsibility of contractors to prove that they have taken all possible steps to minimise this risk, and CPW should be required to show how they would deal with the potential of widespread works to contaminate and disrupt water services.

END – APPENDICIES FOLLOW

Appendix 1 – Figure 1.1 SDC Wastewater Schemes

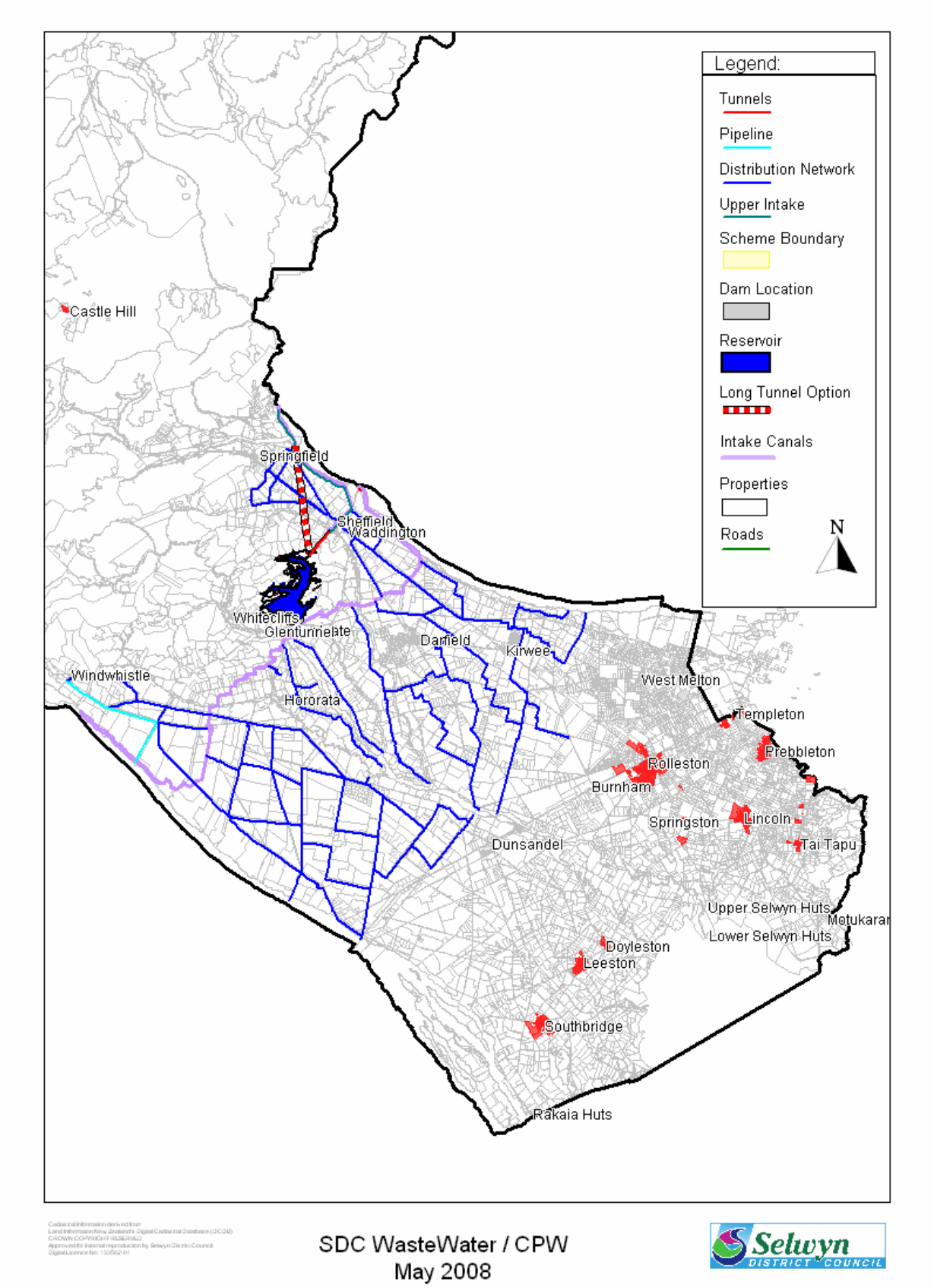


Figure 1.2 Page 109 – J. Weir Evidence

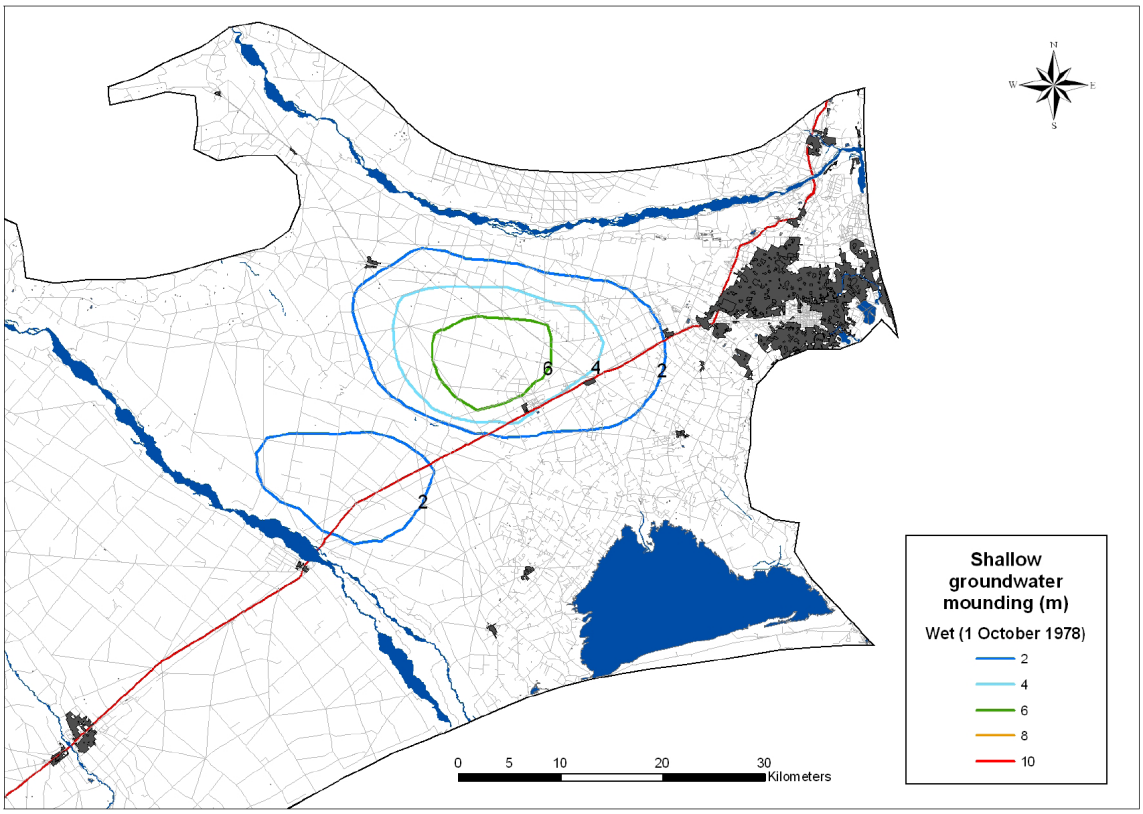
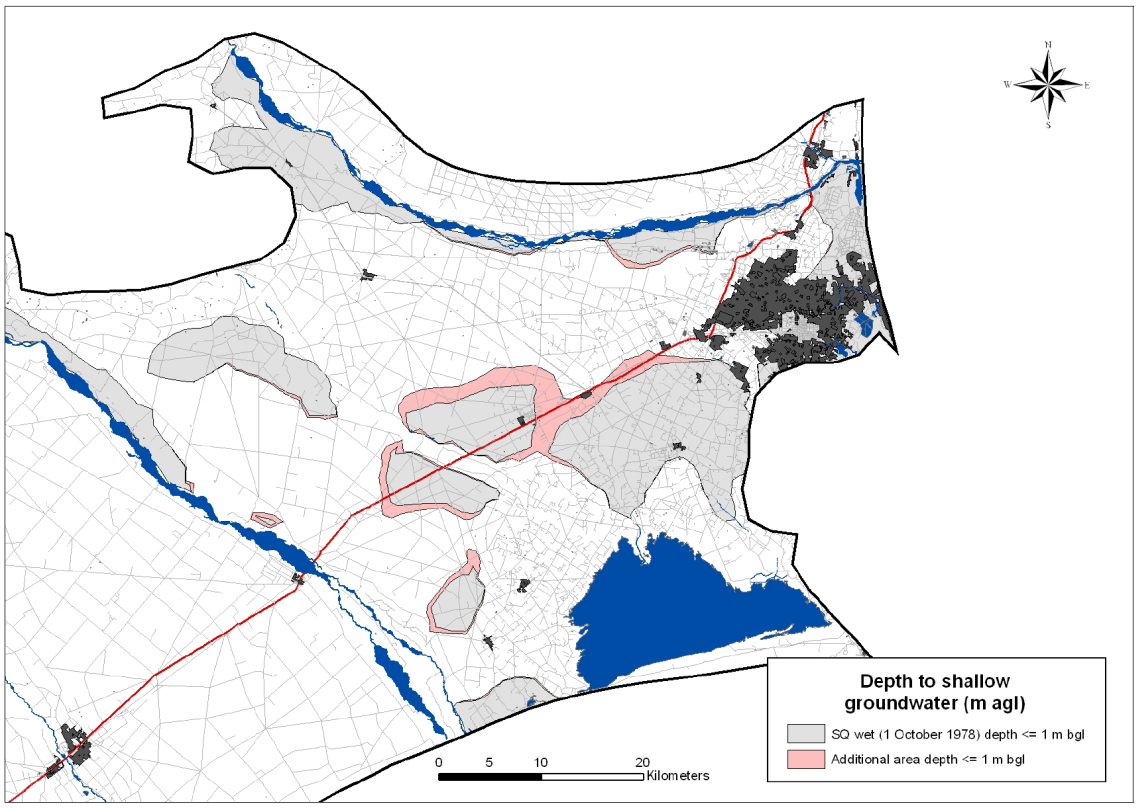
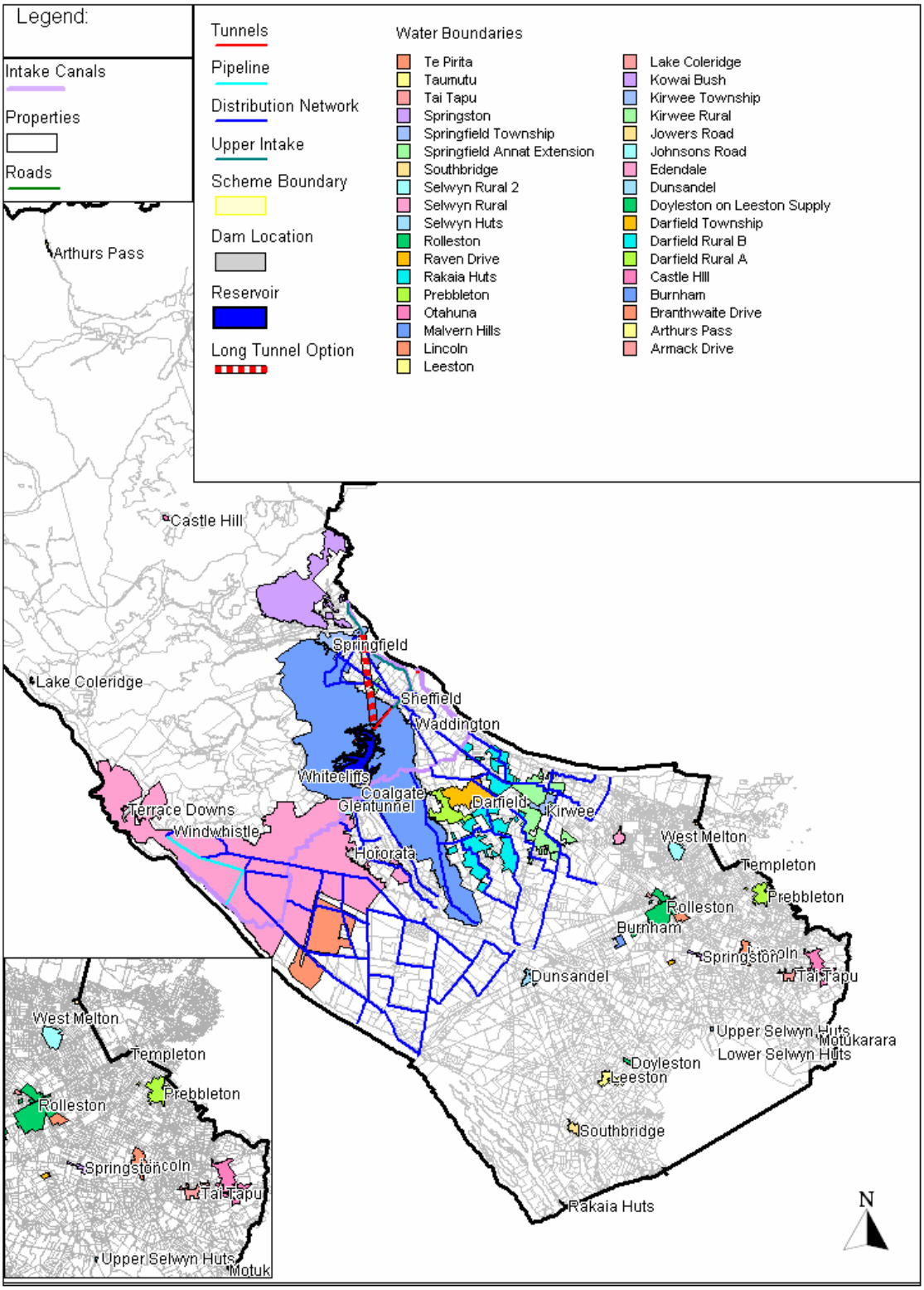


Figure 1.3 Page 120 – J. Weir Evidence



Appendix 2 – Figure 2.1 SDC Water Schemes



SDC Water Supplies / CPW
MAY 2008

Table 2.1 – Community Water Supply Schemes <u>within</u> the proposed CPW service

Scheme	Population (May 2008)	Type			Security		Age[5]	Aquifer Depth (m)	Aquifer Type	
		On Demand	Restricted	Other	Secure	Unsecure			Confined	Unconfined
Darfield	2754	✓	✓			✓		Waimakiriri River[6]		
Dunsandel	413	✓			✓		50	66		✓
Edendale	162	✓			✓		42	60.5	✓	
Kirwee	912	✓			✓		49	115.2		✓
Malvern Hills Rural	1312		✓			✓	<1	Selwyn River		
Selwyn Rural	304		✓			✓	<1	Selwyn River		
Sheffield	488	✓	✓	✓		✓	<1	Tributary Waimakiriri River		✓
Te Pirita	12			✓	✓		21	118.8	✓	

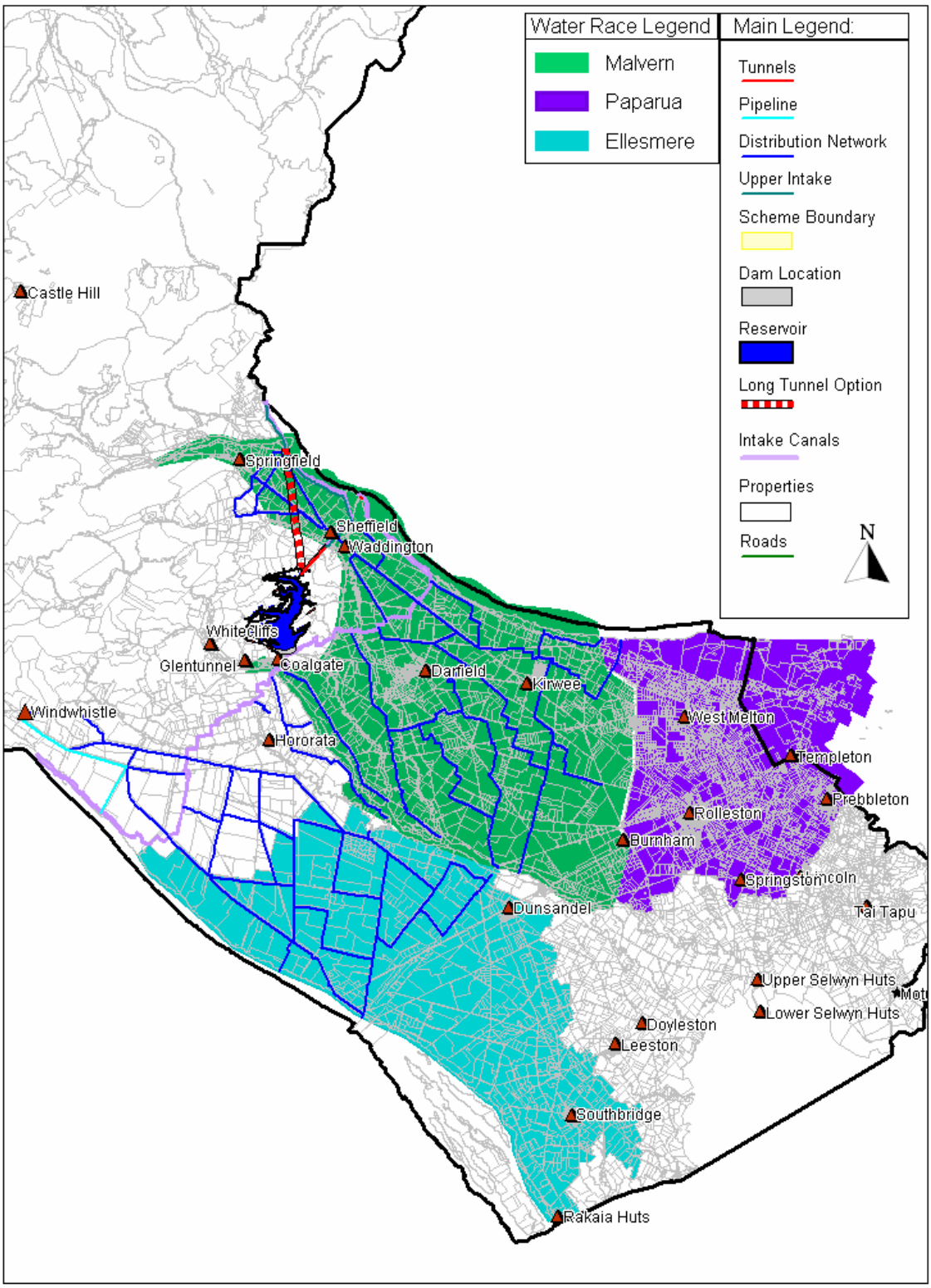
[5] Age Testing follows 2001 test results. Security as specified in the Drinking Water Standards 2001

[6] To be replaced with groundwater source

Table 2.2– Community Water Supply Schemes <u>down gradient</u> of the proposed CPW service area

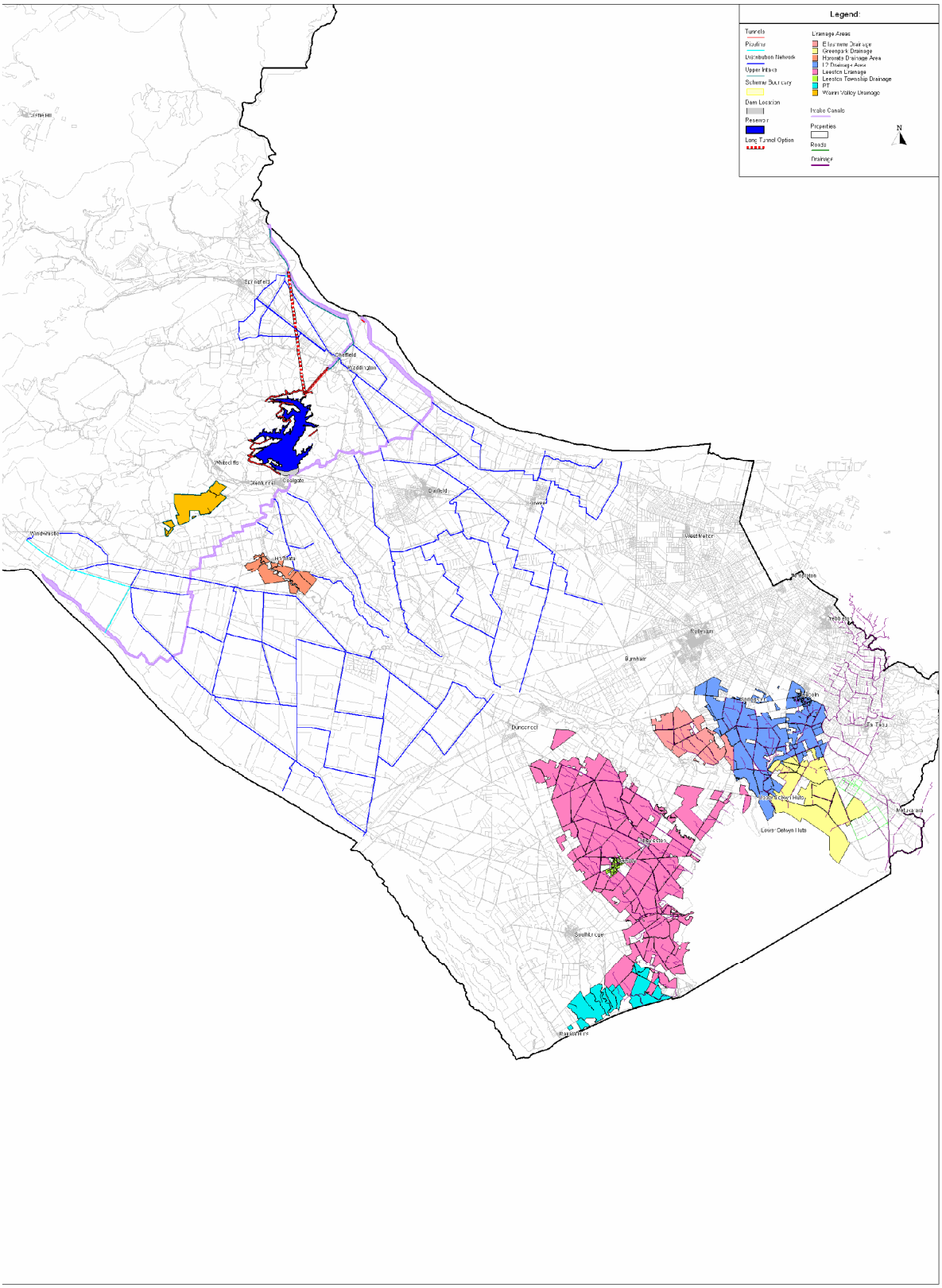
Scheme	Population (May 2008)	Type			Security		Age	Aquifer depth (m)	Aquifer Type	
		On Demand	Restricted	Other	Secure	Unsecure			Confined	Unconfined
Armack Drive	54	✓			✓		50	52 m		✓
Branthwaite Drive	65	✓			✓		50	90 m		✓
Burnham	54		✓		✓		50	102.4 m		✓
Claremont	108	✓			✓		50	66 m		✓
Johnson Road	151	✓		Tank	✓		28	91.5 m		✓
Jowers Road	49	✓		Tank	✓		22	41.6 m		✓
Leeston	1418	✓			✓		51	85 m - Gallipoli 56 m - Gallipoli 73.6m – Station	✓	
Lincoln	2729	✓			✓		51	34.3 m - Kildare 37 m – West Belt 34.3 m – Millstream	✓	
Prebbleton	1920	✓			✓		51 51 70	98.9 m – Tosswill 1 105 m – Tosswill 2 128.5m – St Patrick	✓	
Rakaia Huts	306	✓			✓		24	23 m	✓	
Raven Drive	36	✓		Tank	✓		51	123 m	✓	
Rolleston	6237	✓			✓		51 50 38 73	200.7 m Moore 98.5 m Kairangi 65.1 m George 194.5 m Izone	✓	
Selwyn Huts	32	✓					unk	67.4m	✓	
Springston	446	✓			✓			110 m	✓	
Southbridge	854	✓			✓		20 23	25 m High St. 27 m Tairoa Pl.	✓	
Tai Tapu	384	✓			✓		51	39.6 m	✓	
Taumutu	33	✓			✓		51	73 m	✓	
West Melton	157	✓			✓		50	62.2 m		✓

Appendix 3 – SDC Waterrace Schemes



SDC Water Race / CPW
May 2008

Appendix 4 – SDC Land Drainage Schemes



Appendix 5 – CPW and the Effects on SDC Water Related Utilities

To be read in conjunction with Evidence of Selwyn District Council – Asset Manager Utilities

Utility	Issue	Effect	Most Effected	Health Issues	Comments	Resolution – Procedure #
Community Water Supply	Disruption (breakages, rerouting etc) during construction	– Water outages of varying degrees and timing – Cost to community – LOS failed – Ingress of contamination into water supply	Rural water supplies or the RWS component of community water supplies	Dependant on period of outages and the extent of contamination	Experience has shown that even with the best written contracts the contractor will break mains to the detriment of the Council	Bonding during construction An agreement be made that the design team, during the detailed design phase of the project, works closely and constructively with SDC. A procedure during construction to avoid damage to and to minimise interruption of water supply mains has to be clearly defined.
	Water mains under CPW structures	Costly to repair Hard to ascertain if/when failed	Rural water supplies Critical Rising mains			All pipes to be ducted under CPW structures or durable infrastructure over. An agreement be made that the design team, during the detailed design phase of the project, works closely and constructively with SDC.
	Effect on water quality of wider community source water		Individual well users	Dependant the extent of contamination		Bonding
	SDC requires secure legal access to all water pipes which are located under or adjacent to CPW infrastructure.					An agreement between CPW and SDC in order to insure legal access to SDC assets and facilities
	SDC wells reduction in quality or quantity	No compliance with NZDWS 2005			Formal CPW's commitment to ensure appropriate drinking water quality if it reduces in quality/quantity and the appropriate lifecycle funding	Bonding CPW to provide at its own cost a potable water supply which meets Drinking water standard that is applicable to the Health Amendment Act 2007 Additional costs associated with the above to be at CPW cost for 10 years (includes additional mtce and power etc)
Wastewater	Higher GWL increases infiltration into system	– Increased pumping and mtce costs – Treatment systems capacity reduced i.e. less users can be accommodated – Higher risk of not complying with resource consents	Upper Selwyn Huts, Springston, Lincoln, Leeston and Prebbleton		Any activity which aggravates this beyond current planning will be a cost on the community of interest. LW in his evidence notes "Upgrade reticulation systems to reduce infiltration"	Bonding

Utility	Issue	Effect	Most Effected	Health Issues	Comments	Resolution – Procedure #
	Treatment disposal systems comprised	Ability for land disposal systems to continue to treat to their design requirements. The ability for towns to develop or the rate of development may be compromised	Rolleston and Leeston	Plume of influence increases along with the contamination and nitrogen levels within the plume	Over the last 18 years the Council has instigated considerable resources into obtaining resource consents for effluent disposal in the face of significant opposition.	
Land Drainage	Increased flow in drainage system by increase in GWL	Increased in flooding events as spare capacity taken by CPW. Ground water staying at higher level for longer periods. Increased cleaning requirements (as noted in WL evidence)	Farming – period that land is not usable or reduced capacity after a flood/high GWL event	Nil		
Water Races	Disruption (breakages, rerouting etc) during construction	– Water outages of varying degrees and timing – Cost to community – LOS failed	All users		Experience has shown that even with the best written contracts the contractor will cause delays to the detriment of the Council and supply of water to stock	Bonding during construction An agreement be made that the design team, during the detailed design phase of the project, works closely and constructively with SDC. A procedure during construction to avoid damage to and to minimise interruption of water supply mains has to be clearly defined. A funding mechanism that will not penalise Council or its users. Agreement to supply water to effected farms if delays are more than 4 hours per day
	Ongoing problems with the operation of a open race system in heavy irrigated and predominately dairy farming area		Those who are not using CPW and reliant on the continued operation of the water race system	Nil		Investigate single scheme – stockwater and irrigation
	The extent of funding required to installing all the new crossings both off and on farm				A water race crossing on a main race is 50m wide, siphon required i.e.2 manholes plus 1200mm Dia pipe at 5-7m deep Estimated cost	
Storm water	Increased in GWL	Reduction in ability to treat and dispose via infiltration	Lincoln, Leeston, Springston, Tai Tapu, Southbridge	Nil		